# 96 Common Challenges in Power Query

Practical Solutions for Mastering Data Transformation in Excel and Power BI

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Omid Motamedisedeh

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*May your life's queries always fetch the most favorable outcomes!*

# Introduction

## The Story Behind This Book and How to Use It

The idea for this book was born on February 3, 2024, when I posted my first Power Query challenge on LinkedIn. That initial challenge sparked a wave of engagement, with experts providing solutions using Excel, Python, R, Power Query, DAX, and more. Encouraged by the response, I continued posting new challenges every other day. Over time, participation grew significantly. By the time I posted Challenge #52, more than 100 comments flooded in within just 10 hours.

Since that day, I have continued sharing challenges regularly, and as of today, the 224th challenge has been posted. Seeing the enthusiasm of professionals eager to tackle these problems, propose their own solutions, and learn from others, I realized the impact of a book built around a challenge-based structure. So, I started to write this book. This book is designed not only to teach Power Query but also to sharpen your problem-solving skills by exposing you to a variety of real-world scenarios and solutions.

## How This Book Is Structured

In this book, each chapter begins with an introduction to key concepts, followed by a series of carefully selected challenges related to the chapter's topic. For each challenge, I provide step-by-step solutions, along with tips, tricks, and best practices to help you better understand Power Query's functionality.

Whenever multiple logics are possible, I compare them, evaluating performance for larger datasets so that you can choose the most efficient approach for your own use case. Most solutions begin with the Power Query UI, after which you'll manually modify the generated formula to tailor it for specific needs and uncover hidden features of Power Query's M language.

While basic familiarity with M will make it easier to follow this book, I have carefully explained each modification, making it accessible even to those who are not fully comfortable with M yet. However, if you are completely new to Power Query, I recommend starting with an introductory book before diving into this one.

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## How to Get the Most Out of This Book

This book is organized into 12 chapters, and I recommend reading them in order. However, if you struggle with Chapters 2 and 3, particularly when working with custom functions, I suggest jumping to Chapter 12, reading its introduction, and then returning to continue. This will help make the logic clearer.

When reading each chapter, I highly recommend taking a moment to think through each challenge before looking at the solution. Try to solve it yourself first, then compare your approach with the provided solutions. This will sharpen your problem-solving mindset and prepare you for real-world challenges you might encounter in your work.

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## Chapter Overview

1. **Data Extraction from Sources**: Learn how to load data from various sources, handle unstructured data (e.g., Excel, CSV), and deal with challenges like inconsistent column names, multi-row headers, and Merging cells. You'll also learn how to import data from the web and combine Power Query results with Excel tables while maintaining order after refresh.
2. **Referencing**: Understand how to reference specific columns, rows, or cells inside a Power Query table. Explore techniques such as searching rows dynamically, referencing previous rows, and performing approximate lookups similar to `VLOOKUP`.
3. **Sorting and Filtering**: Master Power Query's filtering and sorting capabilities, including dynamic filtering across multiple columns. Learn how to overcome Power Query's unexpected sorting behaviors by using `Table.Buffer` for stability.
4. **Column Splitting and Merging:** Learn how to dynamically split columns using multiple delimiters or custom criteria. Explore advanced techniques for merging columns using different operators.
5. **Pivoting and Unpivoting Tables:** Understand how to transform messy data into an analysis-ready structure by pivoting and unpivoting tables.
6. **Grouping Rows with Table.Group:** Discover advanced grouping techniques using `Table.Group()`, including custom grouping logic, modifying aggregation behavior, and optimizing performance.
7. **Merging and Appending Tables:** Learn how to combine multiple datasets, whether by appending (stacking) tables or merging (joining) them side by side. This chapter also covers fuzzy merging and recursive self-merging techniques.
8. **Handling Missing Values:** Explore methods for identifying and replacing missing values, including linear interpolation and

replacing missing values, including linear interpolation and machine learning approaches like KNN.

9. **Looping in Power Query:** Master four key functions that enable looping in Power Query:

   - `List.Transform()`
   - `List.TransformMany()`
   - `List.Accumulate()`
   - `List.Generate()`

You learn how to use them for complex scenarios and repetitive tasks across different tables and columns.

10. **Leveraging Scripting and External Integrations in Power Query:** Discover how to integrate Power Query with JavaScript, R, and Python for enhanced functionality. Learn how to export CSV files mid-query and use regular expressions (Regex) in Power Query.
11. **Error-Handling Strategies:** Understand Power Query's different error types and learn best practices for creating robust, error-resistant queries.
12. **Custom Functions:** Learn how to build custom functions in Power Query and share them across multiple workbooks. This chapter also covers adding documentation to your functions. If you find Chapter 2 challenging, reading Chapter 12's introduction first will help clarify key concepts.
13. **The Appendix: A Challenge Hub:** Unlike most books, your learning doesn't stop after Chapter 12. The appendix includes an index of challenges related to each chapter from my LinkedIn page, where you can test what you've learned by solving real-world problems. These challenges provide a great opportunity to reinforce your knowledge while also seeing alternative solutions from other experts.

## A Note on Efficiency and Performance

Throughout this book, I have included efficiency tips to help you optimize Power Query performance. When comparing solution runtimes, keep in mind that execution speed depends on multiple factors, including your dataset size and system specifications. While your results may vary, these comparisons will help you understand performance tradeoffs and choose the best solution for your case.

Additionally, all examples (files are available at `www.OmidBI.com`) assume that data is imported from Excel into the Excel version of Power Query using the From Table command. In many cases, I have removed the Changed Type step to better demonstrate function behavior. However, in real-world scenarios, defining correct column types is highly recommended, as it affects both performance and accuracy.

## Final Thoughts

Like any book, this one isn't flawless—and I truly welcome your feedback! If you find any mistakes, no matter how small, please let me know. You can easily reach me on LinkedIn or by sending me an email at `Omid_Motamedi@Outlook.com`. I would love to hear from you.

Now, let's dive in and start solving some Power Query challenges!

# Acknowledgments

I would like to express my heartfelt gratitude to my family, and everyone who has played an invaluable role in supporting me throughout the journey of writing this book. My appreciation extends to those within my professional circle and those who have personally impacted my life.

A special thank you to Pavel Adam and Zoran Milokanović, the esteemed technical reviewers, whose insightful feedback and encouragement have greatly enriched the quality of this work. Your expertise and meticulous attention to detail have been instrumental in refining the content.

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Lastly, I want to acknowledge the incredible LinkedIn community. Over time, I have posted challenges on my LinkedIn page —many of which are included in this book—where numerous professionals have actively participated by sharing their solutions. Their diverse approaches and creative insights have inspired me to view problems from different perspectives. My profound appreciation goes to all those who have contributed their solutions and engaged in these discussions. This includes but is not limited to:

Brian Julius, Abdallah Ally, Aditya Kumar, Alejandro Simón, Alex Popoff, Alexis Olson, Amit Ahuja, Amit Patel, An Nguyen, Andy Heybruch, Anil Kumar Goyal, Ankur Sharma, Arden Nguyen, Asheesh Pahwa, Ashutosh Sharma, Bhavya Gupta, Bilal Mahmoud, Bilal Mahmoud Kh, Bo Rydobon, Burhan Cesur Dinesh, Ca Raghunath Gundi, Ca Raghunath Gundi, Charles Roldan, Cindy C, Craig Hatmaker, Crispo Mwangi, Cristobal Salcedo Beltran, Daniel Madhadha, Darak IN, Diarmuid Early, Eric Laforce, Ernesto Vega Castillo, Ferhat Ck, Gabriel

Raigosa, Gerson Pineda, Glyn Willis, Gowthaman V, Harsha Vijayantha, Henk-Jan Van Well, Hussein Satour Leonard Ochea, Ibrahim Sadiq, Iván Cortinas Rodríguez, Jan Willem Van Holst, John Jairo, Josh Brodrick, Julian Poeltl, Konrad Gryczan, Kris Jaganah, Krzysztof Nowak, Kumar Bhatia, Luan Rodrigues, Luis Florentino Couto Cortegoso, Mahmood Shaban, Mahmoud Bani Asadi, Masoto Lazarus Kanyane, Masoud Karami, Md Ismail Hosen, Md. Zohurul Islam, Murat Bayraktar, Navid Esmaeilzadeh, Ned Navarrete, Nelson Mwangi, Nicolas Micot, Oscar Javier, Oscar Mendez, Owen Price, Pankaj Sharma, Peter Compton, Peter Krkos, Peter Tholstrup, Pieter De B, Pieter De Bruijn, Rahim Zulfiqar Ali, Ramiro Ayala Chávez, Raphael Okoye, Rayan Saud, Rick Rothstein, Roca Farell, Rosero Jiménez, Saikrishnaa R, Seema Dabas, Sunny Baggu, Surendra Reddy, Taeyong Shin, Talha Parkar, Tamer Salem, Thang Van, Theerapun Maneethap, Tyler Cameron, Vergara Domínguez, and Ziad Ahmed.

# Table of Contents

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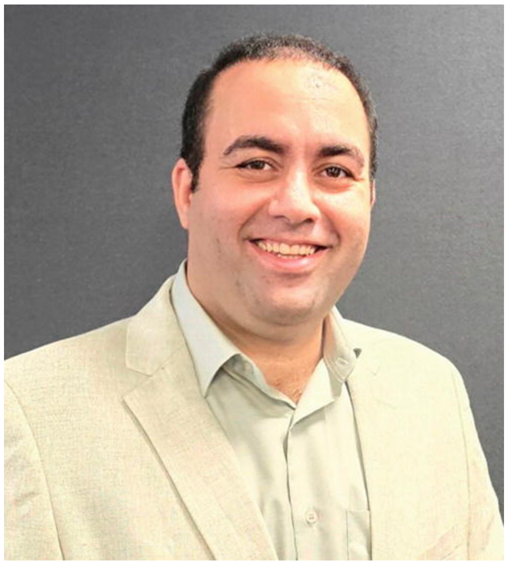

is a data analyst, author, and educator specializing in Power BI, Power Query, and Excel. A Microsoft Super User with a Ph.D. in industrial engineering, he shares his expertise through books, blog articles (Omid BI), and his YouTube channel, OmidBI, where he provides in-depth insights on data transformation and analytics.

Passionate about knowledge sharing, Omid has authored several books on Microsoft technologies. He is a speaker at various data-related boot camps, communities, and user group meetings. Through his blog and YouTube channel, he provides in-depth tutorials, problem-solving techniques, and practical applications of Power Query and Power BI, helping users at all levels master data transformation efficiently.

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## About the Technical Reviewers

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# 1. Data Extraction from Sources

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The Power Query journey, as a powerful ETL (Extract, Transform, Load) tool, begins with its primary function of extracting data from various sources. It allows users to load data from a wide range of sources, ranging from simple file formats like CSV, TXT, Excel, and PDF, to more complex sources such as entire folders of files or databases like SQL Server. Additionally, Power Query supports data extraction from online sources, including websites, APIs, and cloud-based services, making it a versatile solution for handling both structured and unstructured data.

Data extraction in Power Query refers to the process of connecting to a data source and retrieving the necessary data. The main functions for extracting data from different sources are shown in Table 1-1.

***Table 1-1*** Functions for Extracting Data

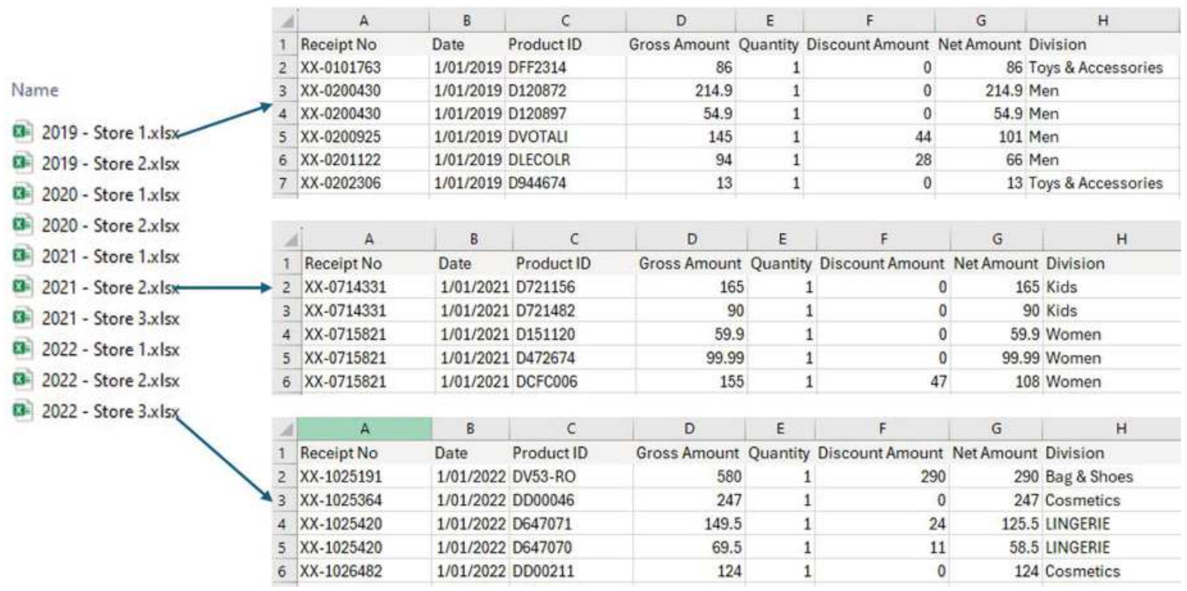
| Function | Description |
|---|---|
| `Csv.Document()` | Reads data from a CSV file. |
| `Excel.Workbook()` | Loads data from an Excel workbook, allowing you to select specific sheets or tables. |
| `Text.Csv()` | Loads data from a text source. |
| `Pdf.Tables()` | Extracts tables from a PDF file. |
| `Folder.Files()` | Returns a table of all the files in a specified folder. |
| `Web.Contents()` | Retrieves data from a web URL, useful for loading data from websites or APIs. |
| `Odbc.DataSource()` | Connects to ODBC-compatible databases. |
| `OData.Feed()` | Connects to an OData feed, typically used for accessing web services. |
| `Sql.Database()` | Connects to an SQL Server database to extract data. |
| `Access.Database()` | Extracts data from a Microsoft Access database. |
| `SharePoint.Files()` | Loads files from a SharePoint site. |
| `Json.Document()` | Extracts data from a JSON document, typically used for APIs or web services. |
| `Xml.Tables()` | Retrieves data from XML files, often used in web services or data exchanges. |
| `BinaryFile.Contents()` | Loads data from binary files, often used for non-standard file formats. |
| `Exchange.Contents()` | Connects to Microsoft Exchange to retrieve data such as emails, contacts, and calendar entries. |
| `ActiveDirectory.Domains()` | Retrieves data from Active Directory domains, useful for organizational data. |
| `Salesforce.Data()` | Extracts data from Salesforce, commonly used in customer relationship management. |

In most cases, the journey of using Power Query begins with one of the functions listed in Table 1-1. Despite the importance of these functions, they are less known since the extraction process in Power Query is typically managed through the user-friendly interface of this tool, rather than direct use of functions. However, there are scenarios where modifying these functions becomes necessary to achieve more advanced or customized transformations.

This chapter presents the process of loading data using the Power Query user interface (UI), providing a step-by-step guide for connecting to and importing data with ease. Following this, the chapter delves into the hidden features of some of the functions in Power Query. These functions, though often managed behind the scenes by the UI, hold powerful capabilities that can significantly enhance data extraction and transformation when utilized directly. This combination of UI-based guidance and advanced function insights equips users with a comprehensive understanding of both basic and advanced Power Query workflows.

## Combining Data from Excel Files with Consistent Column Names

Historical yearly sales data from different stores is stored in several Excel files in a folder. Consider the case that the column names are identical across all files, as shown in Figure 1-1. Combine all the data into a single table, ensuring that store numbers are included (store numbers should be extracted from the filenames).



| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 1 | Receipt No | Date | Product ID | Gross Amount | Quantity | Discount Amount | Net Amount | Division |
| 2 | XX-0101763 | 1/01/2019 | DFF2314 | 86 | 1 | 0 | 86 | Toys & Accessories |
| 3 | XX-0200430 | 1/01/2019 | D120872 | 214.9 | 1 | 0 | 214.9 | Men |
| 4 | XX-0200430 | 1/01/2019 | D120897 | 54.9 | 1 | 0 | 54.9 | Men |
| 5 | XX-0200925 | 1/01/2019 | DVOTALI | 145 | 1 | 44 | 101 | Men |
| 6 | XX-0201122 | 1/01/2019 | DLECOLR | 94 | 1 | 28 | 66 | Men |
| 7 | XX-0202306 | 1/01/2019 | D944674 | 13 | 1 | 0 | 13 | Toys & Accessories |

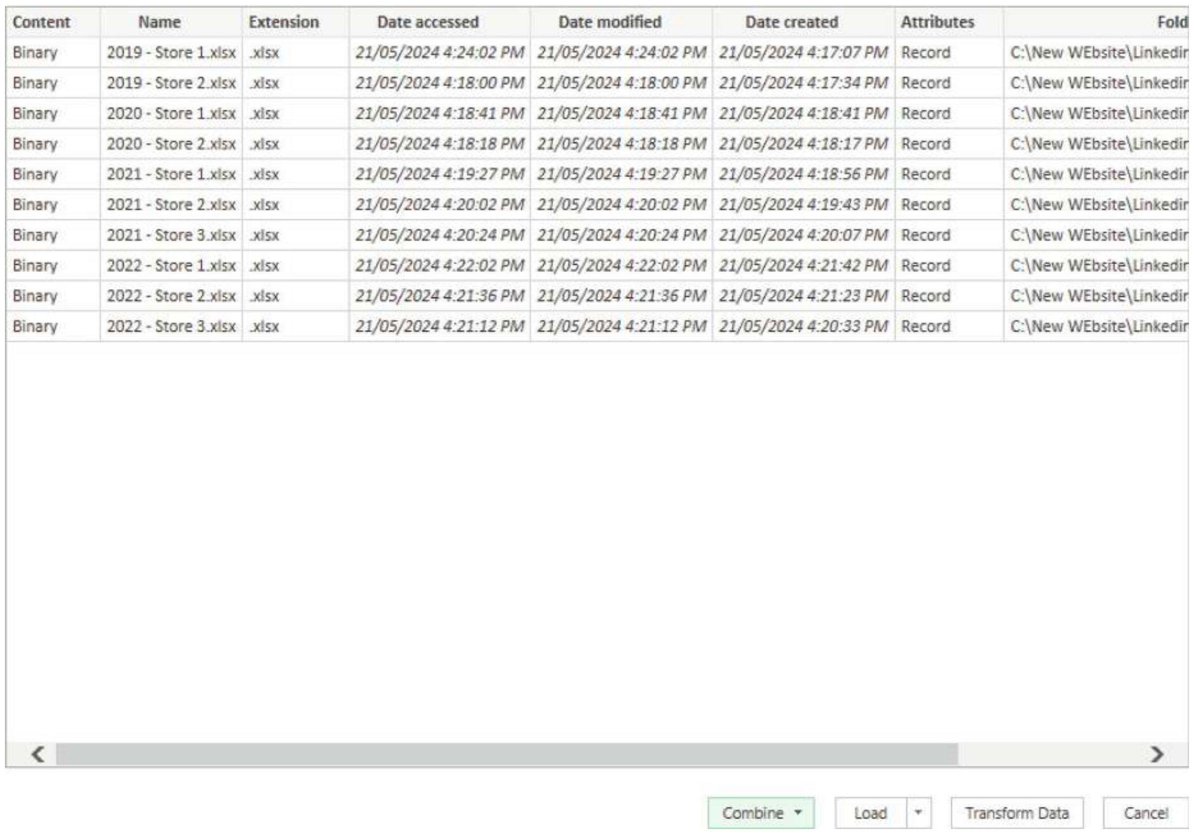
| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 1 | Receipt No | Date | Product ID | Gross Amount | Quantity | Discount Amount | Net Amount | Division |
| 2 | XX-0714331 | 1/01/2021 | D721156 | 165 | 1 | 0 | 165 | Kids |
| 3 | XX-0714331 | 1/01/2021 | D721482 | 90 | 1 | 0 | 90 | Kids |
| 4 | XX-0715821 | 1/01/2021 | D151120 | 59.9 | 1 | 0 | 59.9 | Women |
| 5 | XX-0715821 | 1/01/2021 | D472674 | 99.99 | 1 | 0 | 99.99 | Women |
| 6 | XX-0715821 | 1/01/2021 | DCFC006 | 155 | 1 | 47 | 108 | Women |

| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 1 | Receipt No | Date | Product ID | Gross Amount | Quantity | Discount Amount | Net Amount | Division |
| 2 | XX-1025191 | 1/01/2022 | DV53-RO | 580 | 1 | 290 | 290 | Bag & Shoes |
| 3 | XX-1025364 | 1/01/2022 | DD00046 | 247 | 1 | 0 | 247 | Cosmetics |
| 4 | XX-1025420 | 1/01/2022 | D647071 | 149.5 | 1 | 24 | 125.5 | LINGERIE |
| 5 | XX-1025420 | 1/01/2022 | D647070 | 69.5 | 1 | 11 | 58.5 | LINGERIE |
| 6 | XX-1026482 | 1/01/2022 | DD00211 | 124 | 1 | 0 | 124 | Cosmetics |

***Figure 1-1*** Excel files

**Note** The Excel files used in this example are provided in the folder titled `01`.

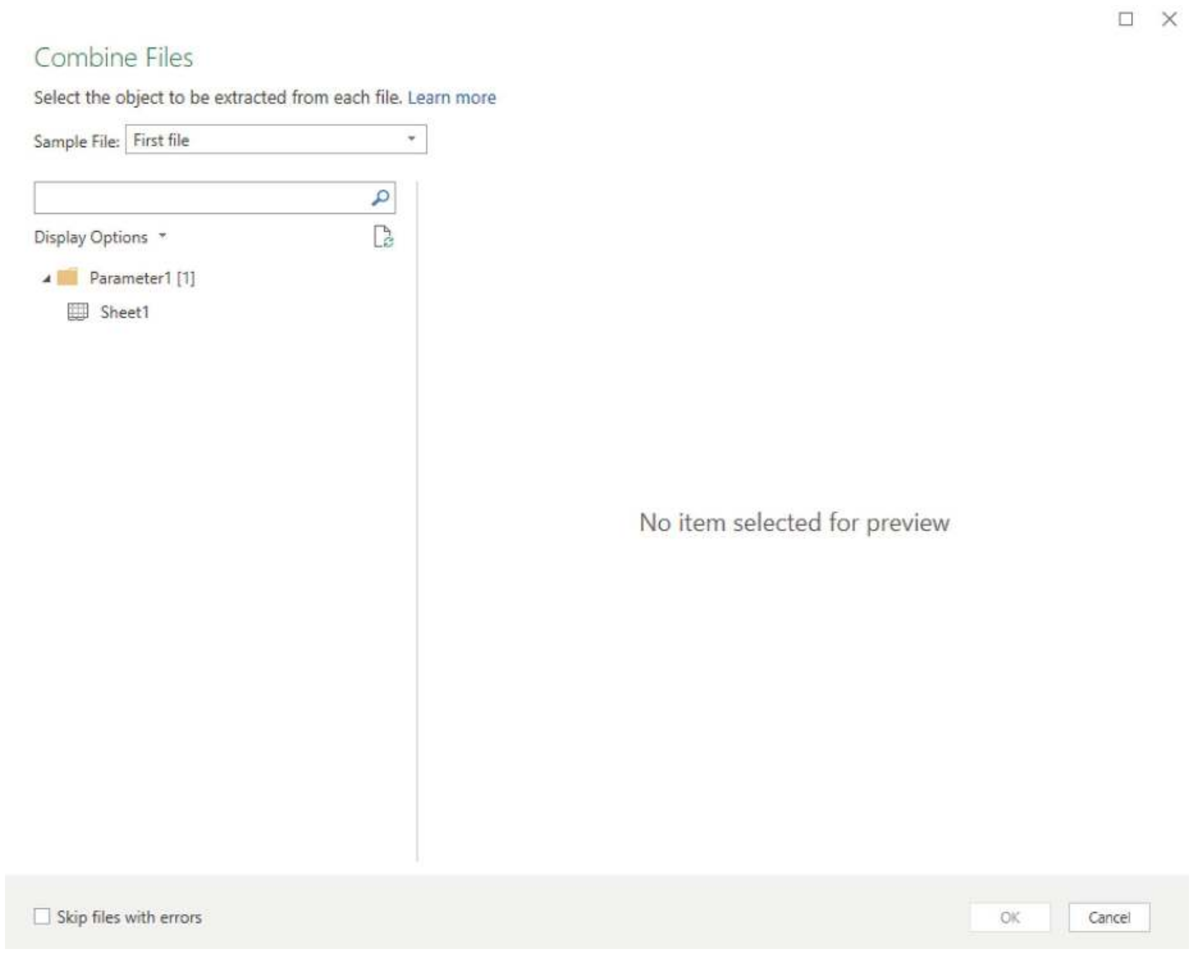
To solve this problem using Excel (or Power BI), open a new Excel (Power BI) file, from the Data (Home) tab, use the Get Data command, then select From File, and among the options, choose From Folder. Provide the folder path containing the Excel files and then click OK. You'll access the new window shown in Figure 1-2.



| Content | Name | Extension | Date accessed | Date modified | Date created | Attributes | Fold |
|---|---|---|---|---|---|---|---|
| Binary | 2019 - Store 1.xlsx | .xlsx | 21/05/2024 4:24:02 PM | 21/05/2024 4:24:02 PM | 21/05/2024 4:17:07 PM | Record | C:\New WEbsite\Linkedir |
| Binary | 2019 - Store 2.xlsx | .xlsx | 21/05/2024 4:18:00 PM | 21/05/2024 4:18:00 PM | 21/05/2024 4:17:34 PM | Record | C:\New WEbsite\Linkedir |
| Binary | 2020 - Store 1.xlsx | .xlsx | 21/05/2024 4:18:41 PM | 21/05/2024 4:18:41 PM | 21/05/2024 4:18:41 PM | Record | C:\New WEbsite\Linkedir |
| Binary | 2020 - Store 2.xlsx | .xlsx | 21/05/2024 4:18:18 PM | 21/05/2024 4:18:18 PM | 21/05/2024 4:18:17 PM | Record | C:\New WEbsite\Linkedir |
| Binary | 2021 - Store 1.xlsx | .xlsx | 21/05/2024 4:19:27 PM | 21/05/2024 4:19:27 PM | 21/05/2024 4:18:56 PM | Record | C:\New WEbsite\Linkedir |
| Binary | 2021 - Store 2.xlsx | .xlsx | 21/05/2024 4:20:02 PM | 21/05/2024 4:20:02 PM | 21/05/2024 4:19:43 PM | Record | C:\New WEbsite\Linkedir |
| Binary | 2021 - Store 3.xlsx | .xlsx | 21/05/2024 4:20:24 PM | 21/05/2024 4:20:24 PM | 21/05/2024 4:20:07 PM | Record | C:\New WEbsite\Linkedir |
| Binary | 2022 - Store 1.xlsx | .xlsx | 21/05/2024 4:22:02 PM | 21/05/2024 4:22:02 PM | 21/05/2024 4:21:42 PM | Record | C:\New WEbsite\Linkedir |
| Binary | 2022 - Store 2.xlsx | .xlsx | 21/05/2024 4:21:36 PM | 21/05/2024 4:21:36 PM | 21/05/2024 4:21:23 PM | Record | C:\New WEbsite\Linkedir |
| Binary | 2022 - Store 3.xlsx | .xlsx | 21/05/2024 4:21:12 PM | 21/05/2024 4:21:12 PM | 21/05/2024 4:20:33 PM | Record | C:\New WEbsite\Linkedir |

***Figure 1-2*** Choosing From Folder

If you select Combine and Load, the Combine Files window will appear as shown in Figure 1-3.

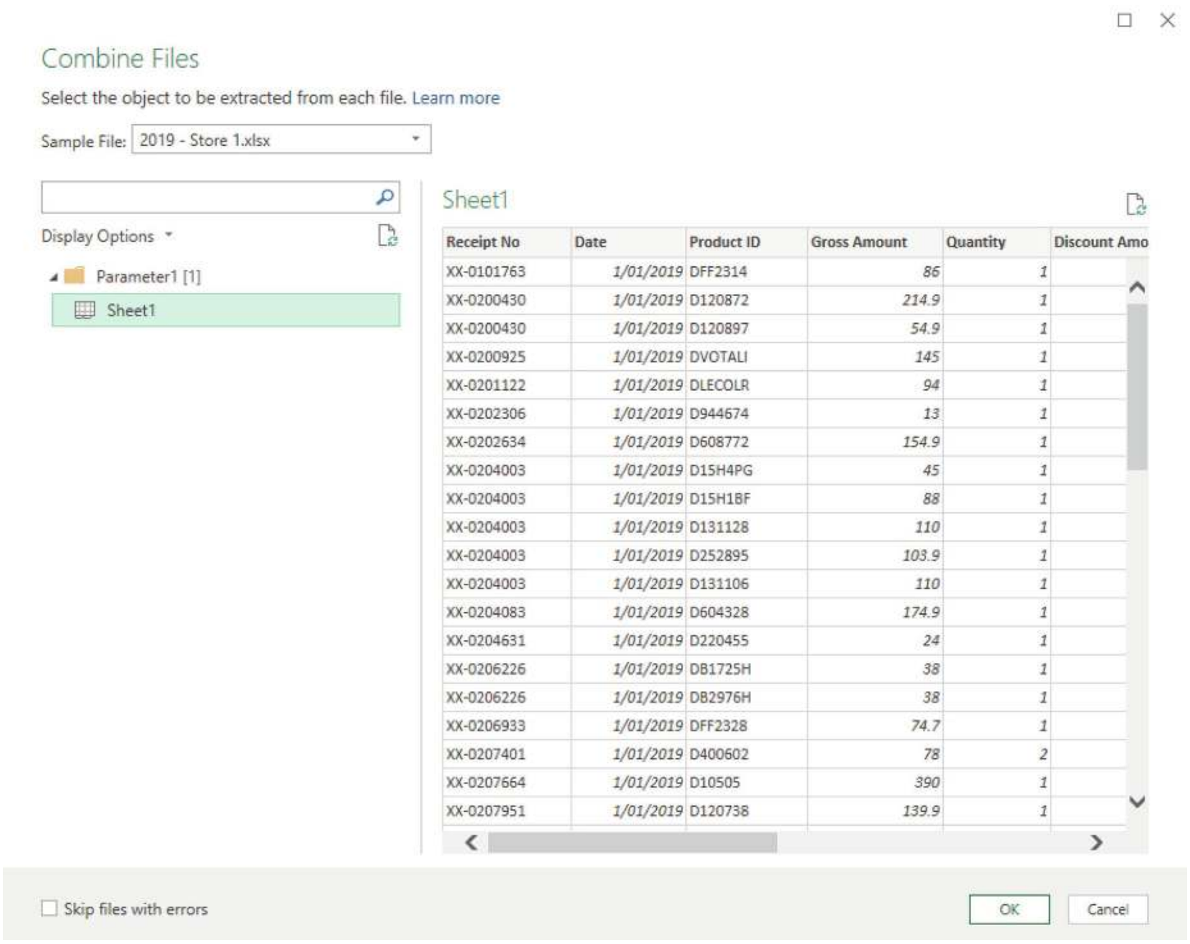

Combine Files

Select the object to be extracted from each file. Learn more

Sample File: First file

***Figure 1-3*** Combining files

Adjust the settings, as shown in Figure 1-4, by selecting `2019 Store 1.xlsx` as the sample file and choosing Sheet 1 as the sample sheet (as long as the data structure in all files is the same, no matter which workbook and sheet is selected). By clicking OK, the combined table will be generated as shown in Figure 1-5.



Combine Files

Select the object to be extracted from each file. Learn more

Sample File: 2019 - Store 1.xlsx

Display Options

Parameter1 [1]

Sheet1

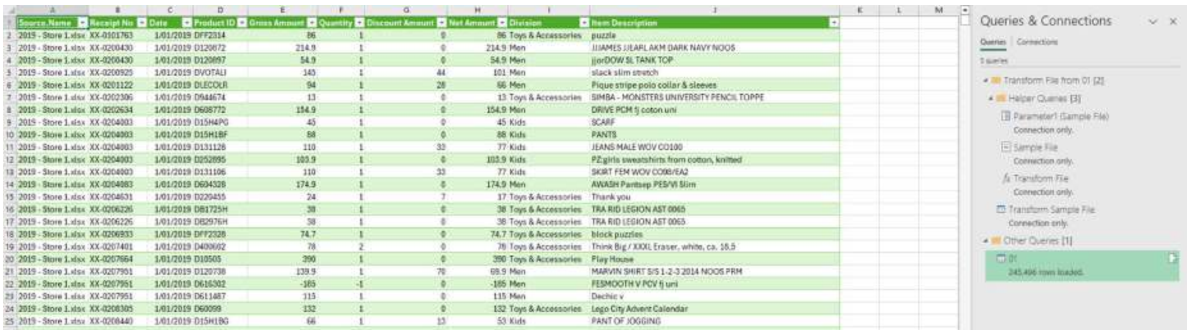
Sheet1

| Receipt No | Date | Product ID | Gross Amount | Quantity | Discount Amo |
|---|---|---|---|---|---|
| XX-0101763 | 1/01/2019 | DFF2314 | 86 | 1 | |
| XX-0200430 | 1/01/2019 | D120872 | 214.9 | 1 | |
| XX-0200430 | 1/01/2019 | D120897 | 54.9 | 1 | |
| XX-0200925 | 1/01/2019 | DVOTALI | 145 | 1 | |
| XX-0201122 | 1/01/2019 | DLECOLR | 94 | 1 | |
| XX-0202306 | 1/01/2019 | D944674 | 13 | 1 | |
| XX-0202634 | 1/01/2019 | D608772 | 154.9 | 1 | |
| XX-0204003 | 1/01/2019 | D15H4PG | 45 | 1 | |
| XX-0204003 | 1/01/2019 | D15H1BF | 88 | 1 | |
| XX-0204003 | 1/01/2019 | D131128 | 110 | 1 | |
| XX-0204003 | 1/01/2019 | D252895 | 103.9 | 1 | |
| XX-0204003 | 1/01/2019 | D131106 | 110 | 1 | |
| XX-0204083 | 1/01/2019 | D604328 | 174.9 | 1 | |
| XX-0204631 | 1/01/2019 | D220455 | 24 | 1 | |
| XX-0206226 | 1/01/2019 | DB1725H | 38 | 1 | |
| XX-0206226 | 1/01/2019 | DB2976H | 38 | 1 | |
| XX-0206933 | 1/01/2019 | DFF2328 | 74.7 | 1 | |
| XX-0207401 | 1/01/2019 | D400602 | 78 | 2 | |
| XX-0207664 | 1/01/2019 | D10505 | 390 | 1 | |
| XX-0207951 | 1/01/2019 | D120738 | 139.9 | 1 | |

Skip files with errors

OK Cancel

*Figure 1-4* Selecting a sample file



| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Source.Name | Receipt No | Date | Product ID | Gross Amount | Quantity | Discount Amount | Net Amount | Division | Item Description |
| 2 | 2019 - Store 1.xlsx | XX-0101763 | 1/01/2019 | DFF2314 | 86 | 1 | 0 | 86 | Toys & Accessories | puzzle |
| 3 | 2019 - Store 1.xlsx | XX-0200430 | 1/01/2019 | D120872 | 214.9 | 1 | 0 | 214.9 | Men | JJJAMES JJEARL AKM DARK NAVY NOOS |
| 4 | 2019 - Store 1.xlsx | XX-0200430 | 1/01/2019 | D120897 | 54.9 | 1 | 0 | 54.9 | Men | jjorDOW SL TANK TOP |
| 5 | 2019 - Store 1.xlsx | XX-0200925 | 1/01/2019 | DVOTALI | 145 | 1 | 44 | 101 | Men | slack slim stretch |
| 6 | 2019 - Store 1.xlsx | XX-0201122 | 1/01/2019 | DLECOLR | 94 | 1 | 28 | 66 | Men | Pique stripe polo collar & sleeves |
| 7 | 2019 - Store 1.xlsx | XX-0202306 | 1/01/2019 | D944674 | 13 | 1 | 0 | 13 | Toys & Accessories | SIMBA - MONSTERS UNIVERSITY PENCIL TOPPE |
| 8 | 2019 - Store 1.xlsx | XX-0202634 | 1/01/2019 | D608772 | 154.9 | 1 | 0 | 154.9 | Men | DRIVE PCM fj coton uni |
| 9 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D15H4PG | 45 | 1 | 0 | 45 | Kids | SCARF |
| 10 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D15H1BF | 88 | 1 | 0 | 88 | Kids | PANTS |
| 11 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D131128 | 110 | 1 | 33 | 77 | Kids | JEANS MALE WOV CO100 |
| 12 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D252895 | 103.9 | 1 | 0 | 103.9 | Kids | PZ:girls sweatshirts from cotton, knitted |
| 13 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D131106 | 110 | 1 | 33 | 77 | Kids | SKIRT FEM WOV CO98/EA2 |
| 14 | 2019 - Store 1.xlsx | XX-0204083 | 1/01/2019 | D604328 | 174.9 | 1 | 0 | 174.9 | Men | AWASH Pantsep PES/VI Slim |
| 15 | 2019 - Store 1.xlsx | XX-0204631 | 1/01/2019 | D220455 | 24 | 1 | 7 | 17 | Toys & Accessories | Thank you |
| 16 | 2019 - Store 1.xlsx | XX-0206226 | 1/01/2019 | DB1725H | 38 | 1 | 0 | 38 | Toys & Accessories | TRA RID LEGION AST 0065 |
| 17 | 2019 - Store 1.xlsx | XX-0206226 | 1/01/2019 | DB2976H | 38 | 1 | 0 | 38 | Toys & Accessories | TRA RID LEGION AST 0065 |
| 18 | 2019 - Store 1.xlsx | XX-0206933 | 1/01/2019 | DFF2328 | 74.7 | 1 | 0 | 74.7 | Toys & Accessories | block puzzles |
| 19 | 2019 - Store 1.xlsx | XX-0207401 | 1/01/2019 | D400602 | 78 | 2 | 0 | 78 | Toys & Accessories | Think Big / XXXL Eraser, white, ca. 18.5 |
| 20 | 2019 - Store 1.xlsx | XX-0207664 | 1/01/2019 | D10505 | 390 | 1 | 0 | 390 | Toys & Accessories | Play House |
| 21 | 2019 - Store 1.xlsx | XX-0207951 | 1/01/2019 | D120738 | 139.9 | 1 | 70 | 69.9 | Men | MARVIN SHIRT S/S 1-2-3 2014 NOOS PRM |
| 22 | 2019 - Store 1.xlsx | XX-0207951 | 1/01/2019 | D616302 | -165 | -1 | 0 | -165 | Men | FESMOOTH V PCV fj uni |
| 23 | 2019 - Store 1.xlsx | XX-0207951 | 1/01/2019 | D611487 | 115 | 1 | 0 | 115 | Men | Dechic v |
| 24 | 2019 - Store 1.xlsx | XX-0208305 | 1/01/2019 | D60099 | 132 | 1 | 0 | 132 | Toys & Accessories | Lego City Advent Calendar |
| 25 | 2019 - Store 1.xlsx | XX-0208440 | 1/01/2019 | D15H1BG | 66 | 1 | 13 | 53 | Kids | PANT OF JOGGING |

Queries & Connections

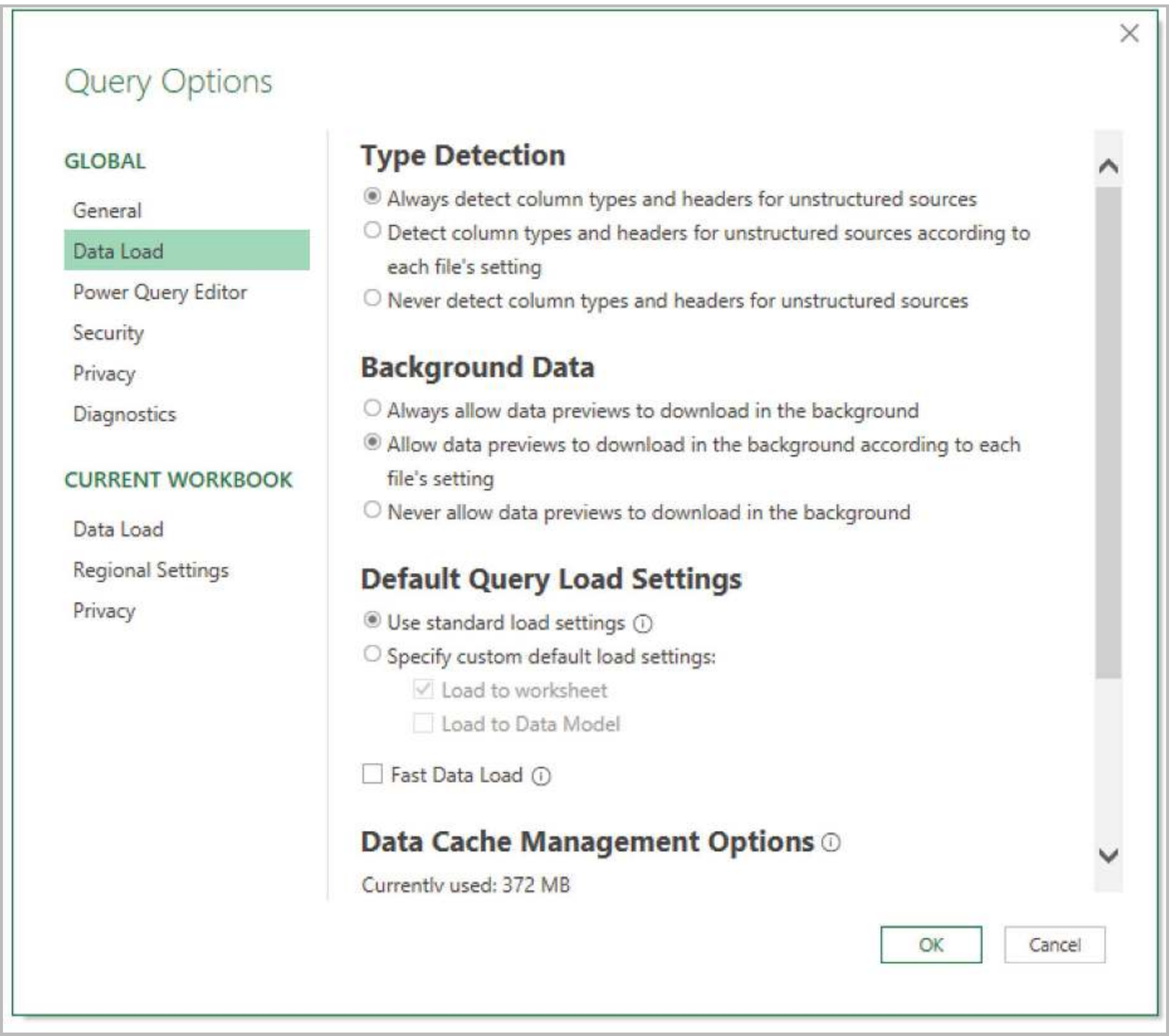
Queries | Connections

5 queries

- Transform File from 01 [2]
  - Helper Queries [3]
    - Parameter1 (Sample File)
      Connection only.
    - Sample File
      Connection only.
    - Transform File
      Connection only.
  - Transform Sample File
    Connection only.
- Other Queries [1]
  - 01
    245,496 rows loaded.

*Figure 1-5* Combined table

**Note** Data sources such as Excel, CSV, and Text are considered unstructured data sources. Power Query provides a setting to automatically detect headers and column types before loading the data. This setting is defined in the Power Query Editor. To access it, in the Power Query Editor, go to the File tab, then select Options and Settings, and choose Query Options. In the window that opens, navigate to the Data Load section, to see the setting, as shown in Figure 1-6 in the Type Detection part.



Query Options

GLOBAL

- General
- Data Load
- Power Query Editor
- Security
- Privacy
- Diagnostics

CURRENT WORKBOOK

- Data Load
- Regional Settings
- Privacy

**Type Detection**

[✓ Always detect column types and headers for unstructured sources]

Detect column types and headers for unstructured sources according to each file's setting

Never detect column types and headers for unstructured sources

**Background Data**

Always allow data previews to download in the background

[✓ Allow data previews to download in the background according to each file's setting]

Never allow data previews to download in the background

**Default Query Load Settings**

[✓ Use standard load settings]

Specify custom default load settings:

☑ Load to worksheet

☐ Load to Data Model

☐ Fast Data Load

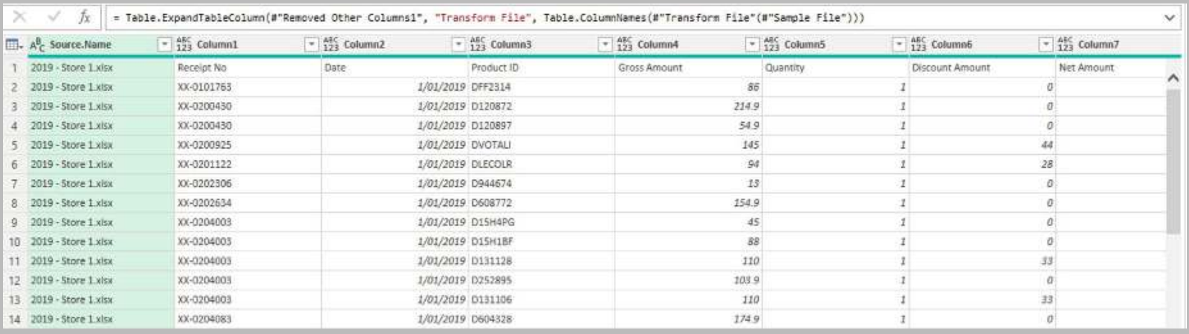
**Data Cache Management Options**

Currently used: 372 MB

OK Cancel

*Figure 1-6* Setting for type detection

The predefined setting has the “Always Detect Column Types and Headers for Unstructured Data” option selected by default, but you can change it to another setting. If you choose the “Never Detect Column Types and Headers for Unstructured Sources” option and then do the process shown in this section, the result of the previous step would be different, as shown in Figure 1-7.



```
= Table.ExpandTableColumn(#"Removed Other Columns1", "Transform File", Table.ColumnNames(#"Transform File"(#"Sample File")))
```

| | Source.Name | Column1 | Column2 | Column3 | Column4 | Column5 | Column6 | Column7 |
|---|---|---|---|---|---|---|---|---|
| 1 | 2019 - Store 1.xlsx | Receipt No | Date | Product ID | Gross Amount | Quantity | Discount Amount | Net Amount |
| 2 | 2019 - Store 1.xlsx | XX-0101763 | 1/01/2019 | DFF2314 | 86 | 1 | 0 | |
| 3 | 2019 - Store 1.xlsx | XX-0200430 | 1/01/2019 | D120872 | 214.9 | 1 | 0 | |
| 4 | 2019 - Store 1.xlsx | XX-0200430 | 1/01/2019 | D120897 | 54.9 | 1 | 0 | |
| 5 | 2019 - Store 1.xlsx | XX-0200925 | 1/01/2019 | DVOTALI | 145 | 1 | 44 | |
| 6 | 2019 - Store 1.xlsx | XX-0201122 | 1/01/2019 | DLECOLR | 94 | 1 | 28 | |
| 7 | 2019 - Store 1.xlsx | XX-0202306 | 1/01/2019 | D944674 | 13 | 1 | 0 | |
| 8 | 2019 - Store 1.xlsx | XX-0202634 | 1/01/2019 | D608772 | 154.9 | 1 | 0 | |
| 9 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D15H4PG | 45 | 1 | 0 | |
| 10 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D15H1BF | 88 | 1 | 0 | |
| 11 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D131128 | 110 | 1 | 33 | |
| 12 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D252895 | 103.9 | 1 | 0 | |
| 13 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D131106 | 110 | 1 | 33 | |
| 14 | 2019 - Store 1.xlsx | XX-0204083 | 1/01/2019 | D604328 | 174.9 | 1 | 0 | |

*Figure 1-7* The result of the query using the Never Detect Column Types option

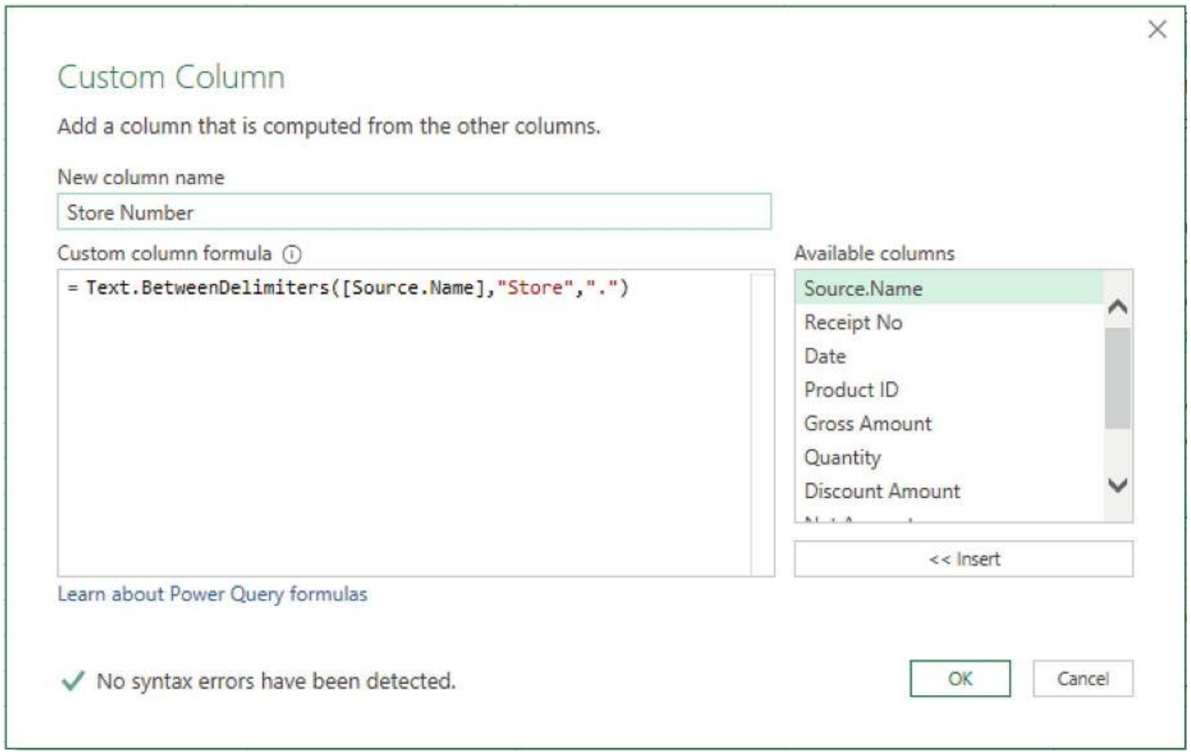
As shown, in the new result, instead of using the data headers as column names in the new combined table, the columns are labeled Column 1, Column 2, and so on, and the headers of each file are considered rows of data.

The resultant table includes all the historical data, as well as the whole name of the source files (first column). To extract the store number from the `Source.Name` column, right-click the query named `01` (this is the same name as the folder containing the Excel files) and select Edit to open the Power Query Editor. (If you cannot find the queries in Excel, activate the Queries & Connections toggle button located in the Data tab. This will display the list of queries on the right side of the worksheet.)

The store numbers are listed in the `Source.Name` column, located between the text "Store" and the period (.). In Power Query, the `Text.BetweenDelimiters()` function can be used to extract values located between two specified text delimiters, as in this case. The function takes the text as its first input, followed by the delimiters as the second and third inputs.

So, to extract the store numbers into a new column, select the Custom Column command from the Add Column tab. As shown in Figure 1-8, enter **Store Number** as the name of the new column and use `Text.BetweenDelimiters()` as the following formula in the Custom Column window. This extracts the values between "Store" and the period as the delimiters, resulting in Figure 1-9.

```
= Text.BetweenDelimiters([Source.Name],"Store",".")
```


Custom Column

Add a column that is computed from the other columns.

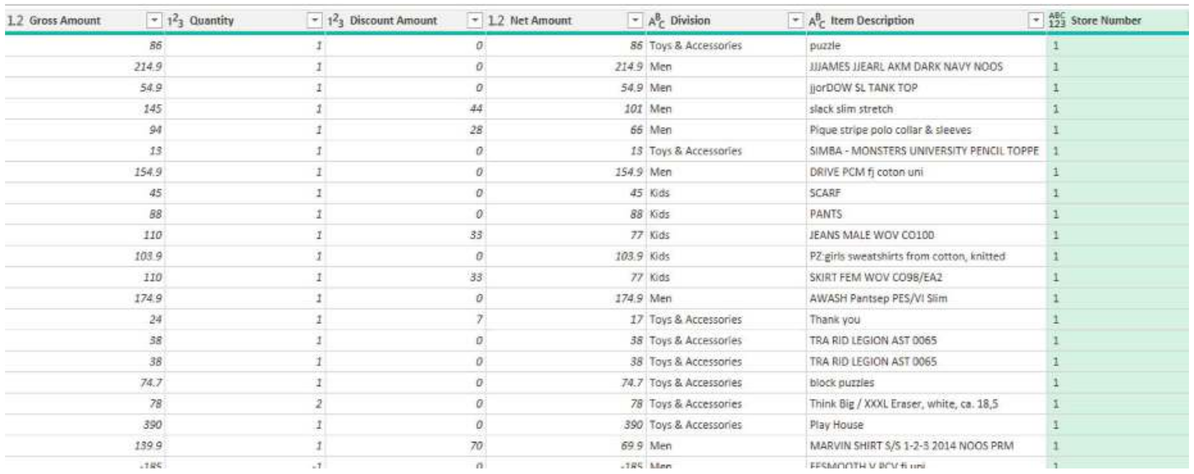
New column name: Store Number

Custom column formula:

```
= Text.BetweenDelimiters([Source.Name],"Store",".")
```

No syntax errors have been detected.

*Figure 1-8* Adding a custom column to extract the store numbers



| Gross Amount | Quantity | Discount Amount | Net Amount | Division | Item Description | Store Number |
|---|---|---|---|---|---|---|
| 86 | 1 | 0 | 86 | Toys & Accessories | puzzle | 1 |
| 214.9 | 1 | 0 | 214.9 | Men | JJJAMES JJEARL AKM DARK NAVY NOOS | 1 |
| 54.9 | 1 | 0 | 54.9 | Men | jjorDOW SL TANK TOP | 1 |
| 145 | 1 | 44 | 101 | Men | slack slim stretch | 1 |
| 94 | 1 | 28 | 66 | Men | Pique stripe polo collar & sleeves | 1 |
| 13 | 1 | 0 | 13 | Toys & Accessories | SIMBA - MONSTERS UNIVERSITY PENCIL TOPPE | 1 |
| 154.9 | 1 | 0 | 154.9 | Men | DRIVE PCM fj coton uni | 1 |
| 45 | 1 | 0 | 45 | Kids | SCARF | 1 |
| 88 | 1 | 0 | 88 | Kids | PANTS | 1 |
| 110 | 1 | 33 | 77 | Kids | JEANS MALE WOV CO100 | 1 |
| 103.9 | 1 | 0 | 103.9 | Kids | PZ girls sweatshirts from cotton, knitted | 1 |
| 110 | 1 | 33 | 77 | Kids | SKIRT FEM WOV CO98/EA2 | 1 |
| 174.9 | 1 | 0 | 174.9 | Men | AWASH Pantsep PES/VI Slim | 1 |
| 24 | 1 | 7 | 17 | Toys & Accessories | Thank you | 1 |
| 38 | 1 | 0 | 38 | Toys & Accessories | TRA RID LEGION AST 0065 | 1 |
| 38 | 1 | 0 | 38 | Toys & Accessories | TRA RID LEGION AST 0065 | 1 |
| 74.7 | 1 | 0 | 74.7 | Toys & Accessories | block puzzles | 1 |
| 78 | 2 | 0 | 78 | Toys & Accessories | Think Big / XXXL Eraser, white, ca. 18,5 | 1 |
| 390 | 1 | 0 | 390 | Toys & Accessories | Play House | 1 |
| 139.9 | 1 | 70 | 69.9 | Men | MARVIN SHIRT S/S 1-2-3 2014 NOOS PRM | 1 |
| -185 | -1 | 0 | -185 | Men | EESMOOTH V PCV fj uni | 1 |

*Figure 1-9* Resultant table

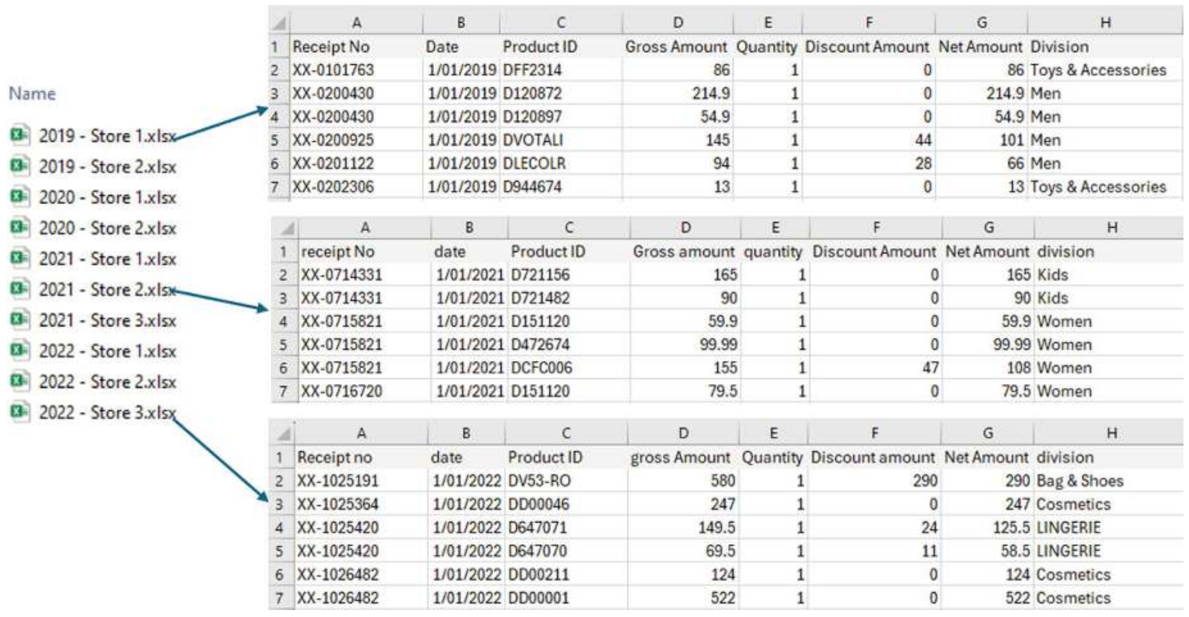
**Note** Power Query is case-sensitive in all cases. So, in the previous example, if the file is named `2019 - store 1.xlsx`, the previous formula will return nothing for this file. To address this, it is recommended to use the following formula, which is not case-sensitive. This formula first converts all the text to lowercase before attempting to extract the store number.`=Text.BetweenDelimiters(Text.Lower([Source.Name]),"store",".")`

In the next step, finalize the solution by right-clicking the `Source.Name` column and selecting the Remove command. This will delete this column.

**Performance Tips** The speed of loading data from sources depends on several factors, including the system being used, the type of file, and the number of sheets in an Excel workbook. However, in general, the process of loading data from an Excel file is relatively fast. For a case with 100 Excel files in a folder, each containing approximately 16,000 rows, it takes 27 seconds to load and combine them. Loading data from CSV files follows a similar process, but is significantly faster. For the same case of 100 files with around 16,000 rows each, it takes 3 seconds to load and combine them.

## Combining Data from Excel Files with Different Column Names: Case Sensitivity

Consider the previous example, but the column names in some of the files are uppercase, and in others, they are lowercase, as shown in Figure 1-10. Combine all the data and provide a unique table.



| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 1 | Receipt No | Date | Product ID | Gross Amount | Quantity | Discount Amount | Net Amount | Division |
| 2 | XX-0101763 | 1/01/2019 | DFF2314 | 86 | 1 | 0 | 86 | Toys & Accessories |
| 3 | XX-0200430 | 1/01/2019 | D120872 | 214.9 | 1 | 0 | 214.9 | Men |
| 4 | XX-0200430 | 1/01/2019 | D120897 | 54.9 | 1 | 0 | 54.9 | Men |
| 5 | XX-0200925 | 1/01/2019 | DVOTALI | 145 | 1 | 44 | 101 | Men |
| 6 | XX-0201122 | 1/01/2019 | DLECOLR | 94 | 1 | 28 | 66 | Men |
| 7 | XX-0202306 | 1/01/2019 | D944674 | 13 | 1 | 0 | 13 | Toys & Accessories |

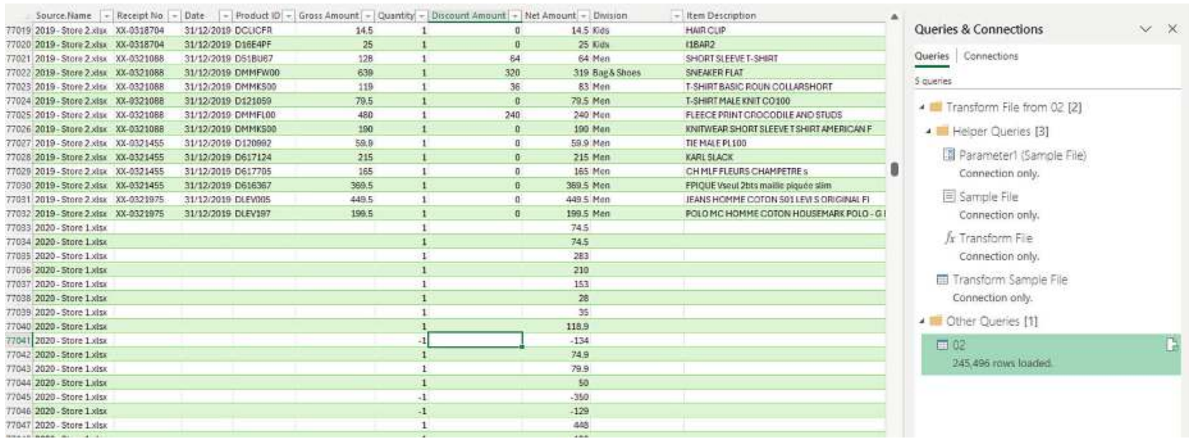
| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 1 | receipt No | date | Product ID | Gross amount | quantity | Discount Amount | Net Amount | division |
| 2 | XX-0714331 | 1/01/2021 | D721156 | 165 | 1 | 0 | 165 | Kids |
| 3 | XX-0714331 | 1/01/2021 | D721482 | 90 | 1 | 0 | 90 | Kids |
| 4 | XX-0715821 | 1/01/2021 | D151120 | 59.9 | 1 | 0 | 59.9 | Women |
| 5 | XX-0715821 | 1/01/2021 | D472674 | 99.99 | 1 | 0 | 99.99 | Women |
| 6 | XX-0715821 | 1/01/2021 | DCFC006 | 155 | 1 | 47 | 108 | Women |
| 7 | XX-0716720 | 1/01/2021 | D151120 | 79.5 | 1 | 0 | 79.5 | Women |

| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 1 | Receipt no | date | Product ID | gross Amount | Quantity | Discount amount | Net Amount | division |
| 2 | XX-1025191 | 1/01/2022 | DV53-RO | 580 | 1 | 290 | 290 | Bag & Shoes |
| 3 | XX-1025364 | 1/01/2022 | DD00046 | 247 | 1 | 0 | 247 | Cosmetics |
| 4 | XX-1025420 | 1/01/2022 | D647071 | 149.5 | 1 | 24 | 125.5 | LINGERIE |
| 5 | XX-1025420 | 1/01/2022 | D647070 | 69.5 | 1 | 11 | 58.5 | LINGERIE |
| 6 | XX-1026482 | 1/01/2022 | DD00211 | 124 | 1 | 0 | 124 | Cosmetics |
| 7 | XX-1026482 | 1/01/2022 | DD00001 | 522 | 1 | 0 | 522 | Cosmetics |

***Figure 1-10*** Source tables with different column names

> **Note** The Excel files used in this example are provided in the folder titled `02`.

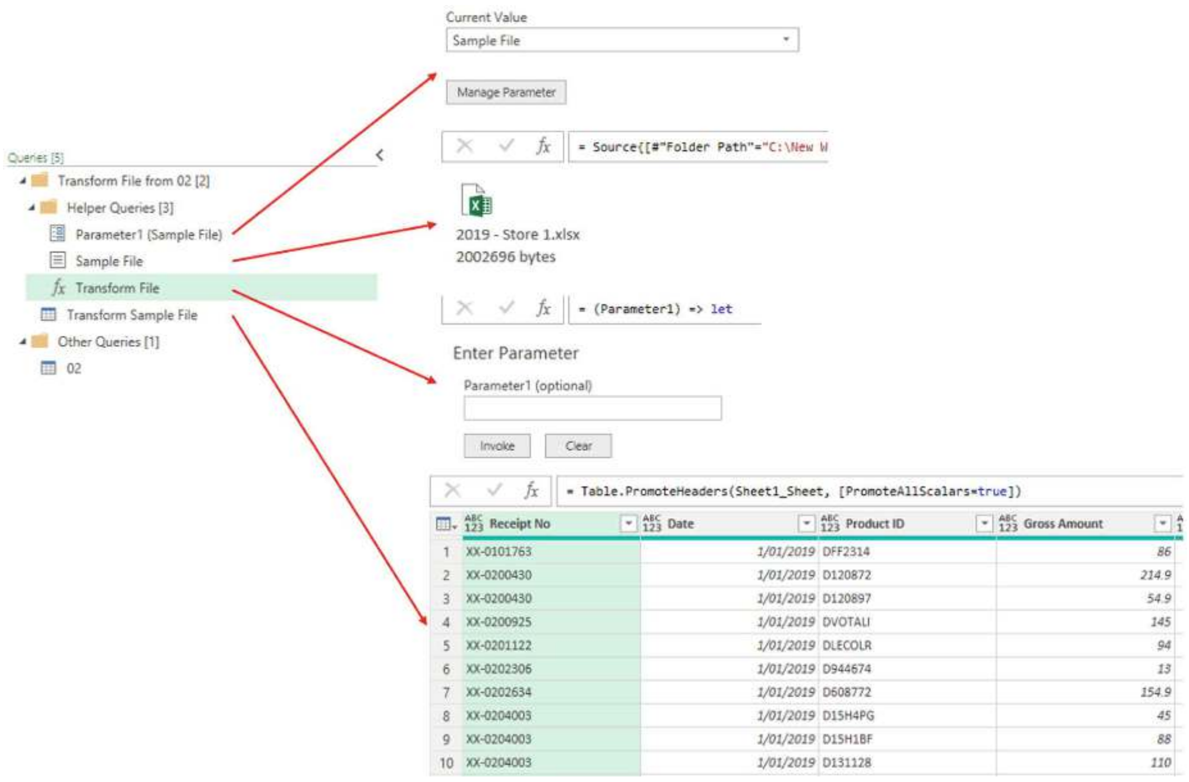
To solve this problem, follow the process shown in the previous example, which is leading the result. This is shown in Figure 1-11, where blank values are provided for columns with names that differ by case across the files.



| | Source.Name | Receipt No | Date | Product ID | Gross Amount | Quantity | Discount Amount | Net Amount | Division | Item Description |
|---|---|---|---|---|---|---|---|---|---|---|
| 77019 | 2019 - Store 2.xlsx | XX-0318704 | 31/12/2019 | DCLICFR | 14.5 | 1 | 0 | 14.5 | Kids | HAIR CLIP |
| 77020 | 2019 - Store 2.xlsx | XX-0318704 | 31/12/2019 | D16E4PF | 25 | 1 | 0 | 25 | Kids | I1BAR2 |
| 77021 | 2019 - Store 2.xlsx | XX-0321088 | 31/12/2019 | D51BU67 | 128 | 1 | 64 | 64 | Men | SHORT SLEEVE T-SHIRT |
| 77022 | 2019 - Store 2.xlsx | XX-0321088 | 31/12/2019 | DMMFW00 | 639 | 1 | 320 | 319 | Bag & Shoes | SNEAKER FLAT |
| 77023 | 2019 - Store 2.xlsx | XX-0321088 | 31/12/2019 | DMMKS00 | 119 | 1 | 36 | 83 | Men | T-SHIRT BASIC ROUN COLLARSHORT |
| 77024 | 2019 - Store 2.xlsx | XX-0321088 | 31/12/2019 | D121059 | 79.5 | 1 | 0 | 79.5 | Men | T-SHIRT MALE KNIT CO100 |
| 77025 | 2019 - Store 2.xlsx | XX-0321088 | 31/12/2019 | DMMFL00 | 480 | 1 | 240 | 240 | Men | FLEECE PRINT CROCODILE AND STUDS |
| 77026 | 2019 - Store 2.xlsx | XX-0321088 | 31/12/2019 | DMMKS00 | 190 | 1 | 0 | 190 | Men | KNITWEAR SHORT SLEEVE T SHIRT AMERICAN F |
| 77027 | 2019 - Store 2.xlsx | XX-0321455 | 31/12/2019 | D120892 | 59.9 | 1 | 0 | 59.9 | Men | TIE MALE PL100 |
| 77028 | 2019 - Store 2.xlsx | XX-0321455 | 31/12/2019 | D617124 | 215 | 1 | 0 | 215 | Men | KARL SLACK |
| 77029 | 2019 - Store 2.xlsx | XX-0321455 | 31/12/2019 | D617705 | 165 | 1 | 0 | 165 | Men | CH MLF FLEURS CHAMPETRE s |
| 77030 | 2019 - Store 2.xlsx | XX-0321455 | 31/12/2019 | D616367 | 369.5 | 1 | 0 | 369.5 | Men | FPIQUE Vseul 2bts maille piquée slim |
| 77031 | 2019 - Store 2.xlsx | XX-0321975 | 31/12/2019 | DLEV005 | 449.5 | 1 | 0 | 449.5 | Men | JEANS HOMME COTON 501 LEVI S ORIGINAL FI |
| 77032 | 2019 - Store 2.xlsx | XX-0321975 | 31/12/2019 | DLEV197 | 199.5 | 1 | 0 | 199.5 | Men | POLO MC HOMME COTON HOUSEMARK POLO - G I |
| 77033 | 2020 - Store 1.xlsx | | | | | 1 | | 74.5 | | |
| 77034 | 2020 - Store 1.xlsx | | | | | 1 | | 74.5 | | |
| 77035 | 2020 - Store 1.xlsx | | | | | 1 | | 283 | | |
| 77036 | 2020 - Store 1.xlsx | | | | | 1 | | 210 | | |
| 77037 | 2020 - Store 1.xlsx | | | | | 1 | | 153 | | |
| 77038 | 2020 - Store 1.xlsx | | | | | 1 | | 28 | | |
| 77039 | 2020 - Store 1.xlsx | | | | | 1 | | 35 | | |
| 77040 | 2020 - Store 1.xlsx | | | | | 1 | | 118.9 | | |
| 77041 | 2020 - Store 1.xlsx | | | | | -1 | | -134 | | |
| 77042 | 2020 - Store 1.xlsx | | | | | 1 | | 74.9 | | |
| 77043 | 2020 - Store 1.xlsx | | | | | 1 | | 79.9 | | |
| 77044 | 2020 - Store 1.xlsx | | | | | 1 | | 50 | | |
| 77045 | 2020 - Store 1.xlsx | | | | | -1 | | -350 | | |
| 77046 | 2020 - Store 1.xlsx | | | | | -1 | | -129 | | |
| 77047 | 2020 - Store 1.xlsx | | | | | 1 | | 448 | | |

***Figure 1-11*** Result of combined tables

As shown in the resultant table, the column names of the combined table match those in the selected sample file (`2019 Store 1.xlsx`). For other files, if the column title differs (Power Query is a case-sensitive language, so Division is different from division), a null value is provided. To address this issue, let's take a closer look at the generated queries (shown on the right side of the Excel window), which are named Parameter1 (Sample File), Sample File, Transform File, Transform Sample File, and 02. Right-click any of these queries and select Edit to view the queries in the Power Query Editor, as shown in Figure 1-12.



```
= Source{[#"Folder Path"="C:\New W
```

```
= (Parameter1) => let
```

```
= Table.PromoteHeaders(Sheet1_Sheet, [PromoteAllScalars=true])
```

| | Receipt No | Date | Product ID | Gross Amount |
|---|---|---|---|---|
| 1 | XX-0101763 | 1/01/2019 | DFF2314 | 86 |
| 2 | XX-0200430 | 1/01/2019 | D120872 | 214.9 |
| 3 | XX-0200430 | 1/01/2019 | D120897 | 54.9 |
| 4 | XX-0200925 | 1/01/2019 | DVOTALI | 145 |
| 5 | XX-0201122 | 1/01/2019 | DLECOLR | 94 |
| 6 | XX-0202306 | 1/01/2019 | D944674 | 13 |
| 7 | XX-0202634 | 1/01/2019 | D608772 | 154.9 |
| 8 | XX-0204003 | 1/01/2019 | D15H4PG | 45 |
| 9 | XX-0204003 | 1/01/2019 | D15H1BF | 88 |
| 10 | XX-0204003 | 1/01/2019 | D131128 | 110 |

***Figure 1-12*** Automatically generated queries

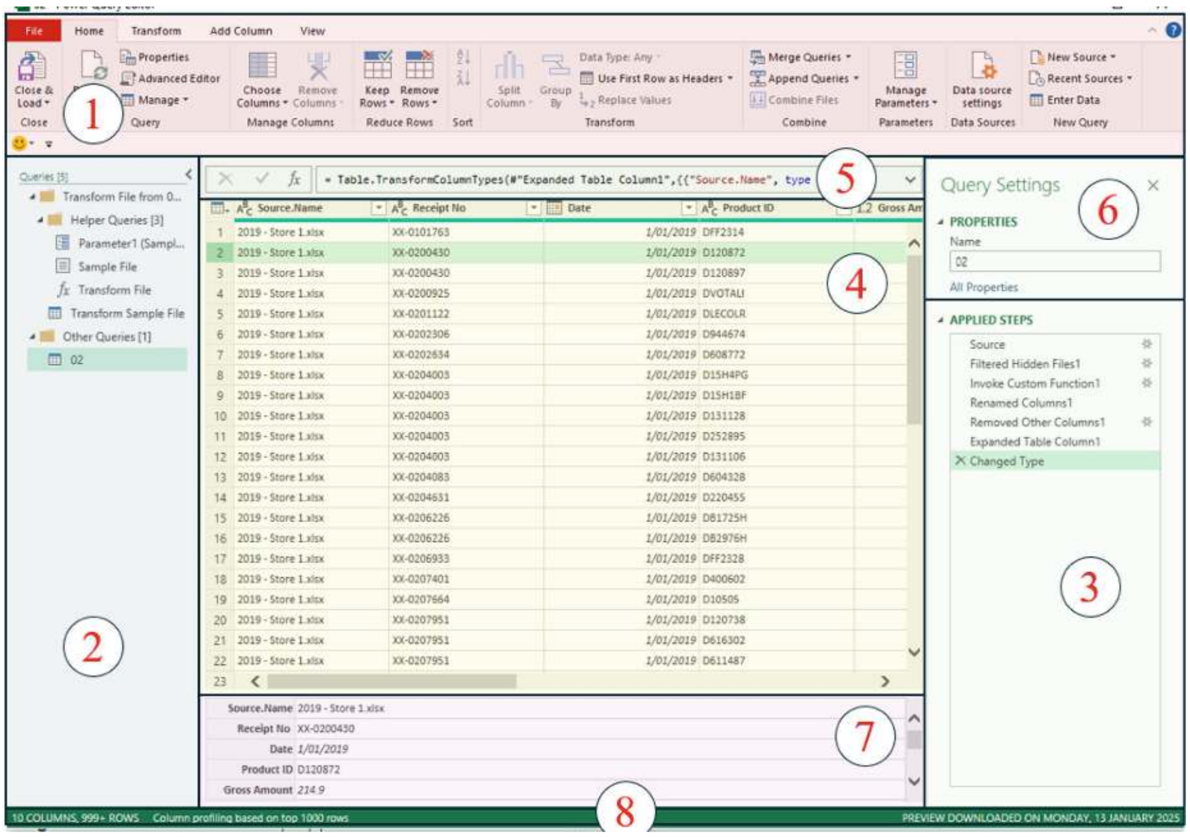
**Note** As shown in Figure 1-13, the Power Query Editor includes eight sections:

1. **Ribbon:** The Ribbon contains all the commands you need to manipulate data, transform columns, apply filters, and work with queries. It is similar to the Ribbon in Excel, with tabs like Home, Transform, Add Column, View, and so on.
2. **Query Pane (Left Section):** This pane shows the list of all the queries currently in your workbook. You can manage queries here by right-clicking them to edit, delete, rename, or refresh them. You can also reorder the queries or create new queries, or group them.
3. **Applied Steps (Right Section):** The Applied Steps pane lists all the transformations applied to the data, step-by-step. Each time you perform an action (like changing a column's data type or removing rows), a new step is added here. You can delete, reorder, and edit steps by clicking the gear icon next to each step. This section allows you to track your transformations and undo any steps if necessary.
4. **Data Preview (Middle Section):** This is where you can see a preview of your data in tabular form as you apply transformations. The data preview is updated as you apply each step in the Applied Steps pane. You can scroll through the data, select rows, and observe how your transformations affect the dataset. You can also filter or search the data directly in this section.
5. **Formula Bar (Top of the Data Preview Section):** The formula bar displays the formula for the current step, providing a detailed view of the applied M code. If the formula bar is not visible, you can enable it from the View tab in the Ribbon. The formula bar is especially useful for writing custom M code or adjusting existing transformations manually.
6. **Query Settings (Right Section):** Under the Query Settings pane, you can see the properties of the query, such as its name and data source information. You can rename the query, and access additional settings related to the query's behavior.

additional settings related to the query's behavior.

7.
This section provides a detailed preview of the selected row or cell when you click a specific value in the data preview table. It is helpful for inspecting individual cell contents or rows, especially when working with complex data transformations or large datasets.

8.
This section shows a summary of the dataset that's currently loaded into the Power Query Editor. It includes key information such as the total number of rows (how many rows are currently loaded in the dataset) or total number of columns (the total number of columns in the dataset). This is a quick reference for understanding the size and structure of your data.



```
= Table.TransformColumnTypes(#"Expanded Table Column1",{{"Source.Name", type
```

| | Source.Name | Receipt No | Date | Product ID | Gross Am |
|---|---|---|---|---|---|
| 1 | 2019 - Store 1.xlsx | XX-0101763 | 1/01/2019 | DFF2314 | |
| 2 | 2019 - Store 1.xlsx | XX-0200430 | 1/01/2019 | D120872 | |
| 3 | 2019 - Store 1.xlsx | XX-0200430 | 1/01/2019 | D120897 | |
| 4 | 2019 - Store 1.xlsx | XX-0200925 | 1/01/2019 | DVOTALI | |
| 5 | 2019 - Store 1.xlsx | XX-0201122 | 1/01/2019 | DLECOLR | |
| 6 | 2019 - Store 1.xlsx | XX-0202306 | 1/01/2019 | D944674 | |
| 7 | 2019 - Store 1.xlsx | XX-0202634 | 1/01/2019 | D608772 | |
| 8 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D15H4PG | |
| 9 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D15H1BF | |
| 10 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D131128 | |
| 11 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D252895 | |
| 12 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D131106 | |
| 13 | 2019 - Store 1.xlsx | XX-0204083 | 1/01/2019 | D604328 | |
| 14 | 2019 - Store 1.xlsx | XX-0204631 | 1/01/2019 | D220455 | |
| 15 | 2019 - Store 1.xlsx | XX-0206226 | 1/01/2019 | D81725H | |
| 16 | 2019 - Store 1.xlsx | XX-0206226 | 1/01/2019 | D82976H | |
| 17 | 2019 - Store 1.xlsx | XX-0206933 | 1/01/2019 | DFF2328 | |
| 18 | 2019 - Store 1.xlsx | XX-0207401 | 1/01/2019 | D400602 | |
| 19 | 2019 - Store 1.xlsx | XX-0207664 | 1/01/2019 | D10505 | |
| 20 | 2019 - Store 1.xlsx | XX-0207951 | 1/01/2019 | D120738 | |
| 21 | 2019 - Store 1.xlsx | XX-0207951 | 1/01/2019 | D616302 | |
| 22 | 2019 - Store 1.xlsx | XX-0207951 | 1/01/2019 | D611487 | |
| 23 | | | | | |

Name: 02

Source
Filtered Hidden Files1
Invoke Custom Function1
Renamed Columns1
Removed Other Columns1
Expanded Table Column1
Changed Type

| | |
|---|---|
| Source.Name | 2019 - Store 1.xlsx |
| Receipt No | XX-0200430 |
| Date | 1/01/2019 |
| Product ID | D120872 |
| Gross Amount | 214.9 |

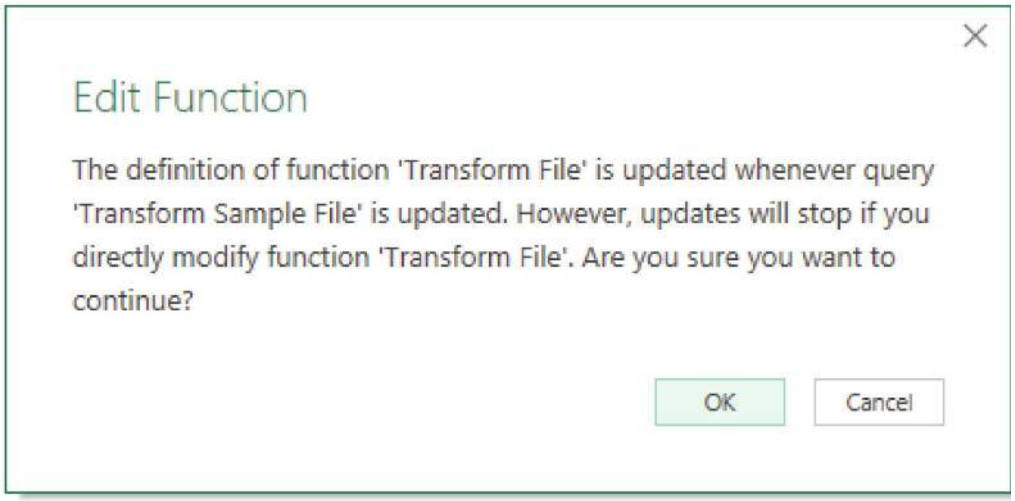
10 COLUMNS, 999+ ROWS Column profiling based on top 1000 rows PREVIEW DOWNLOADED ON MONDAY, 13 JANUARY 2025

*Figure 1-13* Sections of the Power Query Editor

When you load data from a folder using Power Query, it automatically generates these queries to handle the files within that folder. These queries are:

**Parameter1 (Sample File)**: This query likely represents a sample file chosen from the folder. Power Query uses a sample file to infer the structure of the data and the transformations needed. It may act as a placeholder or template for applying transformations to the other files in the folder.
**Sample File**: This query is based on the sample file selected in the process of loading data. It could be the initial query that loads and previews the data from the sample file.
**Transform File**: This function is created based on the Transform Sample File query and plays a key role in fetching data from the files. It converts all the steps of the Transform Sample File query into a reusable function. During the process of combining data from the files, this function is first applied to each file individually, and then the results from all the files are combined into a single dataset.
If you select this query and, from the Home tab, choose the Advanced Editor command, the message displayed in Figure 1-14 will show that this query is connected to Transform Sample File. Therefore,

any changes made to the Transform Sample File query also affect this function, and the same change will be added as a step of this function. As a result, any updates to the Transform Sample File query will automatically be applied to the data-loading process for all files in the folder.

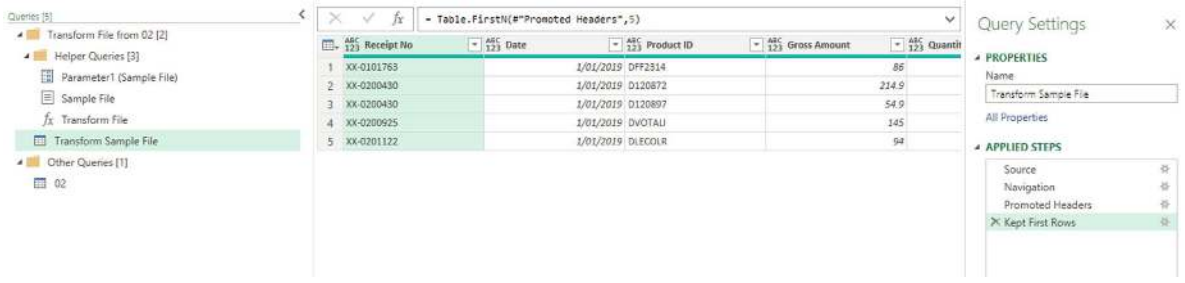


Edit Function

The definition of function 'Transform File' is updated whenever query 'Transform Sample File' is updated. However, updates will stop if you directly modify function 'Transform File'. Are you sure you want to continue?

***Figure 1-14*** Edit Function massage

**Transform Sample File**: In the process of combining data from files using the UI, this query plays a crucial role. This query serves as a sample and allows you to modify the cleaning process. Any changes made to this query will impact the loaded data from other files in the selected folder. For example, if you select this query, go to the Home tab, and in the Reduce Rows section, choose Keep Rows and then Keep Top Rows, entering 5 in the dialog box, it will keep only the top five rows of the table. This results in Figure 1-15, but its impact is not limited to this query, as this change will also add to the Transform File query automatically and will apply it to all the files on the selected folder. This means that during the data-loading process from the files in the selected folder, only the top five rows of each file are loaded. If you select the `02` query, its result will be updated to Figure 1-16.

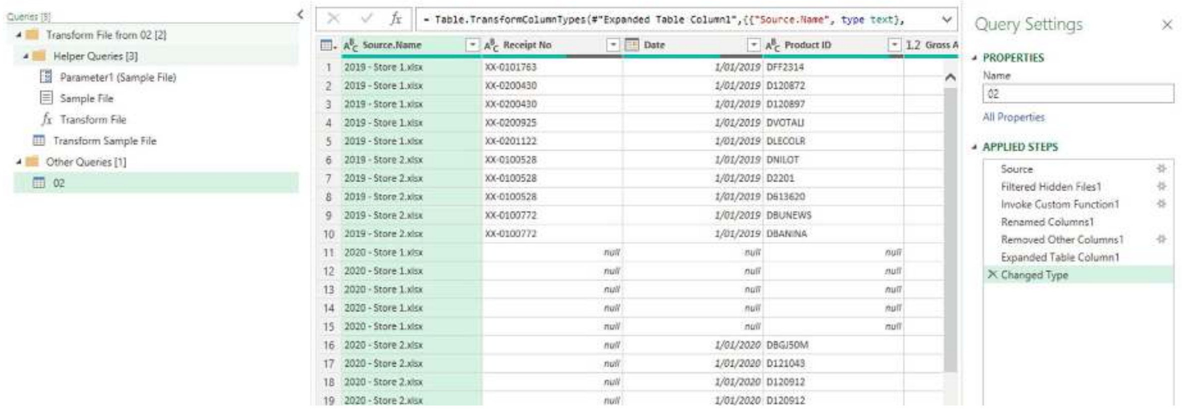


```
= Table.FirstN(#"Promoted Headers",5)
```

| | Receipt No | Date | Product ID | Gross Amount | Quantit |
|---|---|---|---|---|---|
| 1 | XX-0101763 | 1/01/2019 | DFF2314 | 86 | |
| 2 | XX-0200430 | 1/01/2019 | D120872 | 214.9 | |
| 3 | XX-0200430 | 1/01/2019 | D120897 | 54.9 | |
| 4 | XX-0200925 | 1/01/2019 | DVOTALI | 145 | |
| 5 | XX-0201122 | 1/01/2019 | DLECOLR | 94 | |

Name: Transform Sample File

***Figure 1-15*** Keep the top five rows of the Transform Sample File


Queries [3]
- Transform File from 02 [2]
  - Helper Queries [3]
    - Parameter1 (Sample File)
    - Sample File
    - Transform File
    - Transform Sample File
- Other Queries [1]
  - 02

```
= Table.TransformColumnTypes(#"Expanded Table Column1",{{"Source.Name", type text},
```

| | Source.Name | Receipt No | Date | Product ID | Gross A |
|---|---|---|---|---|---|
| 1 | 2019 - Store 1.xlsx | XX-0101763 | 1/01/2019 | DFF2314 | |
| 2 | 2019 - Store 1.xlsx | XX-0200430 | 1/01/2019 | D120872 | |
| 3 | 2019 - Store 1.xlsx | XX-0200430 | 1/01/2019 | D120897 | |
| 4 | 2019 - Store 1.xlsx | XX-0200925 | 1/01/2019 | DVOTALI | |
| 5 | 2019 - Store 1.xlsx | XX-0201122 | 1/01/2019 | DLECOLR | |
| 6 | 2019 - Store 2.xlsx | XX-0100528 | 1/01/2019 | DNILOT | |
| 7 | 2019 - Store 2.xlsx | XX-0100528 | 1/01/2019 | D2201 | |
| 8 | 2019 - Store 2.xlsx | XX-0100528 | 1/01/2019 | D613620 | |
| 9 | 2019 - Store 2.xlsx | XX-0100772 | 1/01/2019 | DBUNEWS | |
| 10 | 2019 - Store 2.xlsx | XX-0100772 | 1/01/2019 | DBANINA | |
| 11 | 2020 - Store 1.xlsx | null | null | null | |
| 12 | 2020 - Store 1.xlsx | null | null | null | |
| 13 | 2020 - Store 1.xlsx | null | null | null | |
| 14 | 2020 - Store 1.xlsx | null | null | null | |
| 15 | 2020 - Store 1.xlsx | null | null | null | |
| 16 | 2020 - Store 2.xlsx | null | 1/01/2020 | DBGJ50M | |
| 17 | 2020 - Store 2.xlsx | null | 1/01/2020 | D121043 | |
| 18 | 2020 - Store 2.xlsx | null | 1/01/2020 | D120912 | |
| 19 | 2020 - Store 2.xlsx | null | 1/01/2020 | D120912 | |

Query Settings
PROPERTIES
Name
02
All Properties
APPLIED STEPS
- Source
- Filtered Hidden Files1
- Invoke Custom Function1
- Renamed Columns1
- Removed Other Columns1
- Expanded Table Column1
- Changed Type

*Figure 1-16* Impact of the Transform Sample File over the general result

**02**: Among all the automatically generated queries, this is what you see as the final result, including the combination of files, and its name is generated based on the folder from which the data was loaded.

Based on this explanation, to solve this problem and combine the data from all the files in the correct format, you can modify the Transform Sample File query. Any changes made to this query will automatically be applied to all files in the folder, in the process of data loading. For instance, if you convert all column headers in this query to lowercase (or uppercase), during the data-loading process from the selected folder, the column headers in each file will first be converted to lowercase (or uppercase) before the data is combined. So, all the column names become the same over the files.

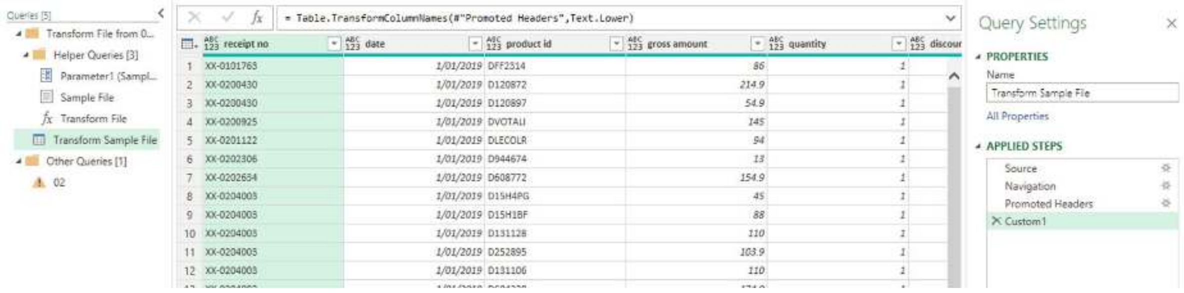
To ensure consistent column headers, select this query and convert all column names to lowercase. However, renaming column headers manually does not work, as it generates hard-coded names in the formula bar as presented in follow. For example, if in Transform Sample File query you rename the Date column to date, it produces a hard-coded formula, which only works for files where the column name is exactly Date. If another file uses the DATE column name, this change will not apply for that column.

```
= Table.RenameColumns(#"Promoted Headers",{{"Date", "date"}})
```

To handle this issue dynamically, you should use a formula that converts all column headers dynamically. The `Table.TransformColumnNames()` function is an excellent tool for handling such situations. It takes two arguments: the table name as the first argument and the transformation function to be applied as the second argument.

To proceed, select the Transform Sample File query and click the *fx* button next to the formula bar. This will create a new step, with the formula = `#"Promoted Headers"` (referring to the previous step) displayed in the formula bar. Replace this formula with the following one in the formula bar, which converts all the column headers of `#"Promoted Headers"` to lowercase. The result is shown in Figure 1-17.

```
= Table.TransformColumnNames(#"Promoted Headers",Text.Lower)
```


Queries [5]
- Transform File from 0...
  - Helper Queries [3]
    - Parameter1 (Sampl...
    - Sample File
    - Transform File
    - Transform Sample File
- Other Queries [1]
  - 02

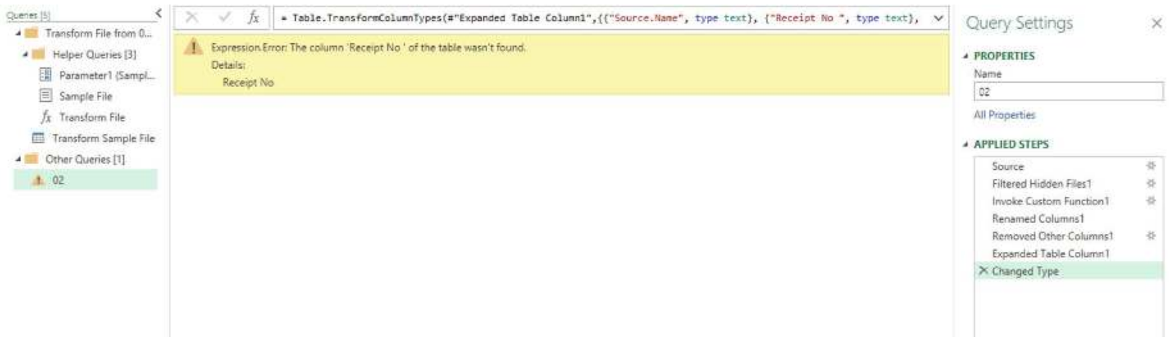
```
= Table.TransformColumnNames(#"Promoted Headers",Text.Lower)
```

| | receipt no | date | product id | gross amount | quantity | discour |
|---|---|---|---|---|---|---|
| 1 | XX-0101763 | 1/01/2019 | DFF2314 | 86 | 1 | |
| 2 | XX-0200430 | 1/01/2019 | D120872 | 214.9 | 1 | |
| 3 | XX-0200430 | 1/01/2019 | D120897 | 54.9 | 1 | |
| 4 | XX-0200925 | 1/01/2019 | DVOTALI | 145 | 1 | |
| 5 | XX-0201122 | 1/01/2019 | DLECOLR | 94 | 1 | |
| 6 | XX-0202306 | 1/01/2019 | D944674 | 13 | 1 | |
| 7 | XX-0202654 | 1/01/2019 | D608772 | 154.9 | 1 | |
| 8 | XX-0204003 | 1/01/2019 | D15H4PG | 45 | 1 | |
| 9 | XX-0204003 | 1/01/2019 | D15H1BF | 88 | 1 | |
| 10 | XX-0204003 | 1/01/2019 | D131128 | 110 | 1 | |
| 11 | XX-0204003 | 1/01/2019 | D252895 | 103.9 | 1 | |
| 12 | XX-0204003 | 1/01/2019 | D131106 | 110 | 1 | |

Query Settings
PROPERTIES
Name
Transform Sample File
All Properties
APPLIED STEPS
- Source
- Navigation
- Promoted Headers
- Custom1

*Figure 1-17* Converting the column names to the lowercase

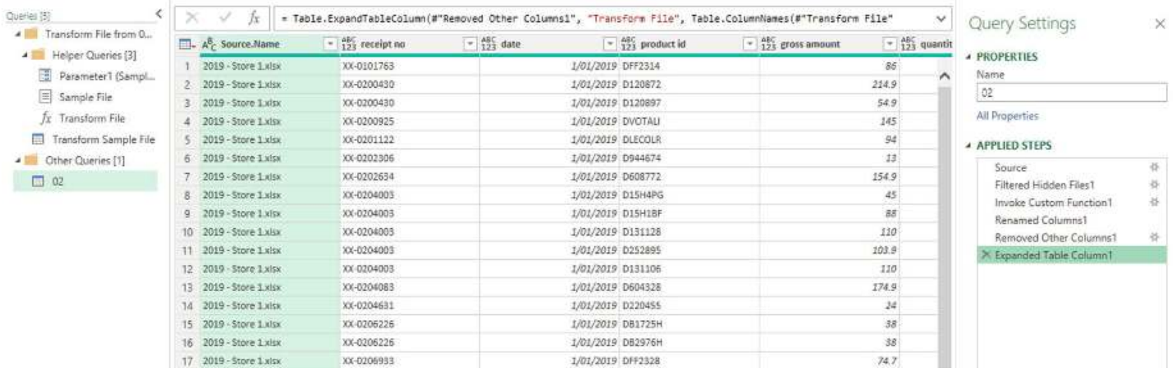
As shown in Figure 1-18, this change causes the 02 query to return an error, stating that the Receipt No column does not exist. This issue occurs because the last step of the query, Changed Type, relies on the previous column names, which have now been modified. To resolve this issue, simply remove the Changed Type step, which will eliminate the error and produce the correct result, shown in Figure 1-19.



```
= Table.TransformColumnTypes(#"Expanded Table Column1",{{"Source.Name", type text}, {"Receipt No ", type text},
```

```
Expression.Error: The column 'Receipt No ' of the table wasn't found.
Details:
    Receipt No
```

*Figure 1-18* Result of query 02



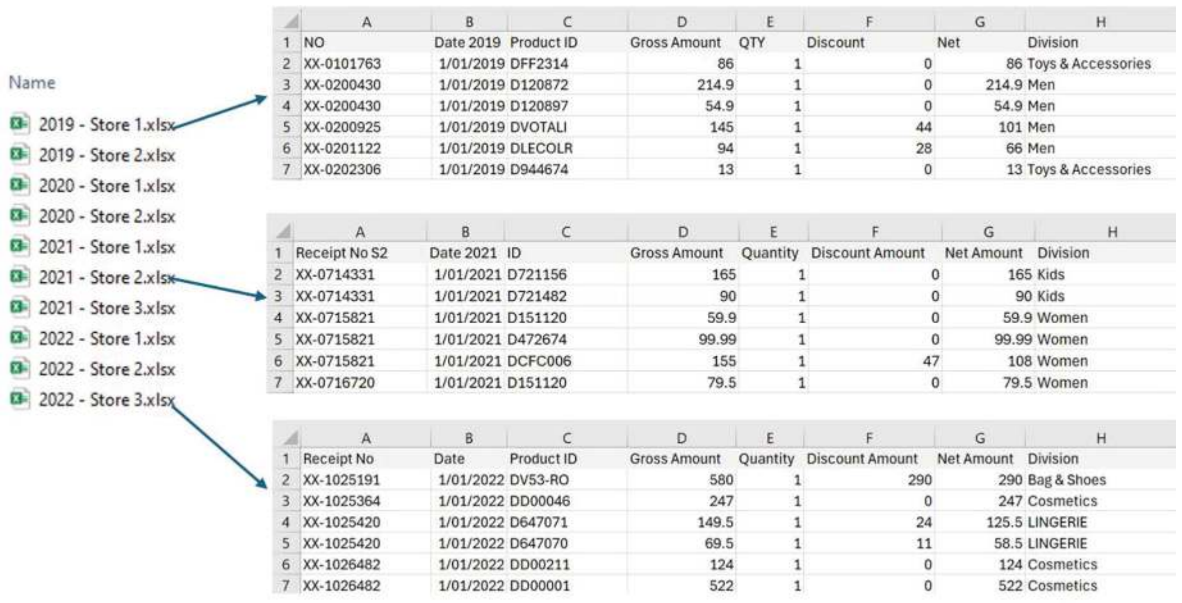
```
= Table.ExpandTableColumn(#"Removed Other Columns1", "Transform File", Table.ColumnNames(#"Transform File"
```

| | Source.Name | receipt no | date | product id | gross amount | quantit |
|---|---|---|---|---|---|---|
| 1 | 2019 - Store 1.xlsx | XX-0101763 | 1/01/2019 | DFF2314 | 86 | |
| 2 | 2019 - Store 1.xlsx | XX-0200430 | 1/01/2019 | D120872 | 214.9 | |
| 3 | 2019 - Store 1.xlsx | XX-0200430 | 1/01/2019 | D120897 | 54.9 | |
| 4 | 2019 - Store 1.xlsx | XX-0200925 | 1/01/2019 | DVOTALI | 145 | |
| 5 | 2019 - Store 1.xlsx | XX-0201122 | 1/01/2019 | DLECOLR | 94 | |
| 6 | 2019 - Store 1.xlsx | XX-0202306 | 1/01/2019 | D944674 | 13 | |
| 7 | 2019 - Store 1.xlsx | XX-0202634 | 1/01/2019 | D608772 | 154.9 | |
| 8 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D15H4PG | 45 | |
| 9 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D15H1BF | 88 | |
| 10 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D131128 | 110 | |
| 11 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D252895 | 103.9 | |
| 12 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D131106 | 110 | |
| 13 | 2019 - Store 1.xlsx | XX-0204083 | 1/01/2019 | D604328 | 174.9 | |
| 14 | 2019 - Store 1.xlsx | XX-0204631 | 1/01/2019 | D220455 | 24 | |
| 15 | 2019 - Store 1.xlsx | XX-0206226 | 1/01/2019 | DB1725H | 38 | |
| 16 | 2019 - Store 1.xlsx | XX-0206226 | 1/01/2019 | DB2976H | 38 | |
| 17 | 2019 - Store 1.xlsx | XX-0206933 | 1/01/2019 | DFF2328 | 74.7 | |

*Figure 1-19* Final table

## Combining Data from Excel Files with Different Column Names: Comprehensive Solution

Consider the previous example, but in this case, the column names in some files are completely different, as shown in Figure 1-20. For example, a column might be called Quantity in some files and QTY in others. Combine all the data and provide a unique table.



| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 1 | NO | Date 2019 | Product ID | Gross Amount | QTY | Discount | Net | Division |
| 2 | XX-0101763 | 1/01/2019 | DFF2314 | 86 | 1 | 0 | 86 | Toys & Accessories |
| 3 | XX-0200430 | 1/01/2019 | D120872 | 214.9 | 1 | 0 | 214.9 | Men |
| 4 | XX-0200430 | 1/01/2019 | D120897 | 54.9 | 1 | 0 | 54.9 | Men |
| 5 | XX-0200925 | 1/01/2019 | DVOTALI | 145 | 1 | 44 | 101 | Men |
| 6 | XX-0201122 | 1/01/2019 | DLECOLR | 94 | 1 | 28 | 66 | Men |
| 7 | XX-0202306 | 1/01/2019 | D944674 | 13 | 1 | 0 | 13 | Toys & Accessories |

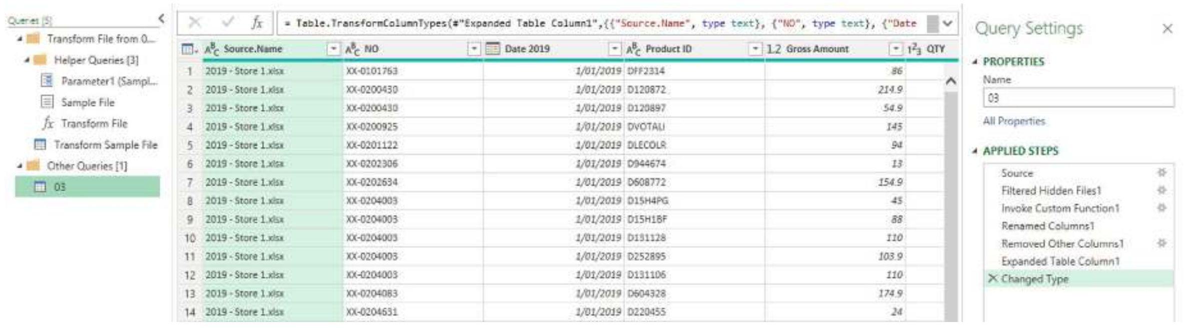
| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 1 | Receipt No S2 | Date 2021 | ID | Gross Amount | Quantity | Discount Amount | Net Amount | Division |
| 2 | XX-0714331 | 1/01/2021 | D721156 | 165 | 1 | 0 | 165 | Kids |
| 3 | XX-0714331 | 1/01/2021 | D721482 | 90 | 1 | 0 | 90 | Kids |
| 4 | XX-0715821 | 1/01/2021 | D151120 | 59.9 | 1 | 0 | 59.9 | Women |
| 5 | XX-0715821 | 1/01/2021 | D472674 | 99.99 | 1 | 0 | 99.99 | Women |
| 6 | XX-0715821 | 1/01/2021 | DCFC006 | 155 | 1 | 47 | 108 | Women |
| 7 | XX-0716720 | 1/01/2021 | D151120 | 79.5 | 1 | 0 | 79.5 | Women |

| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 1 | Receipt No | Date | Product ID | Gross Amount | Quantity | Discount Amount | Net Amount | Division |
| 2 | XX-1025191 | 1/01/2022 | DV53-RO | 580 | 1 | 290 | 290 | Bag & Shoes |
| 3 | XX-1025364 | 1/01/2022 | DD00046 | 247 | 1 | 0 | 247 | Cosmetics |
| 4 | XX-1025420 | 1/01/2022 | D647071 | 149.5 | 1 | 24 | 125.5 | LINGERIE |
| 5 | XX-1025420 | 1/01/2022 | D647070 | 69.5 | 1 | 11 | 58.5 | LINGERIE |
| 6 | XX-1026482 | 1/01/2022 | DD00211 | 124 | 1 | 0 | 124 | Cosmetics |
| 7 | XX-1026482 | 1/01/2022 | DD00001 | 522 | 1 | 0 | 522 | Cosmetics |

***Figure 1-20*** Source files

> **Note** The Excel files used in this example are provided in the folder titled `03`.

To solve this problem, as in the previous example, you use the From Folder command, navigate to the folder, and then choose Combine & Transform Data, by selecting any sample file. You'll get the result shown in Figure 1-21.



```
= Table.TransformColumnTypes(#"Expanded Table Column1",{{"Source.Name", type text}, {"NO", type text}, {"Date
```

| | Source.Name | NO | Date 2019 | Product ID | Gross Amount | QTY |
|---|---|---|---|---|---|---|
| 1 | 2019 - Store 1.xlsx | XX-0101763 | 1/01/2019 | DFF2314 | 86 | |
| 2 | 2019 - Store 1.xlsx | XX-0200430 | 1/01/2019 | D120872 | 214.9 | |
| 3 | 2019 - Store 1.xlsx | XX-0200430 | 1/01/2019 | D120897 | 54.9 | |
| 4 | 2019 - Store 1.xlsx | XX-0200925 | 1/01/2019 | DVOTALI | 145 | |
| 5 | 2019 - Store 1.xlsx | XX-0201122 | 1/01/2019 | DLECOLR | 94 | |
| 6 | 2019 - Store 1.xlsx | XX-0202306 | 1/01/2019 | D944674 | 13 | |
| 7 | 2019 - Store 1.xlsx | XX-0202634 | 1/01/2019 | D608772 | 154.9 | |
| 8 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D15H4PG | 45 | |
| 9 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D15H1BF | 88 | |
| 10 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D131128 | 110 | |
| 11 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D252895 | 103.9 | |
| 12 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D131106 | 110 | |
| 13 | 2019 - Store 1.xlsx | XX-0204083 | 1/01/2019 | D604328 | 174.9 | |
| 14 | 2019 - Store 1.xlsx | XX-0204631 | 1/01/2019 | D220455 | 24 | |

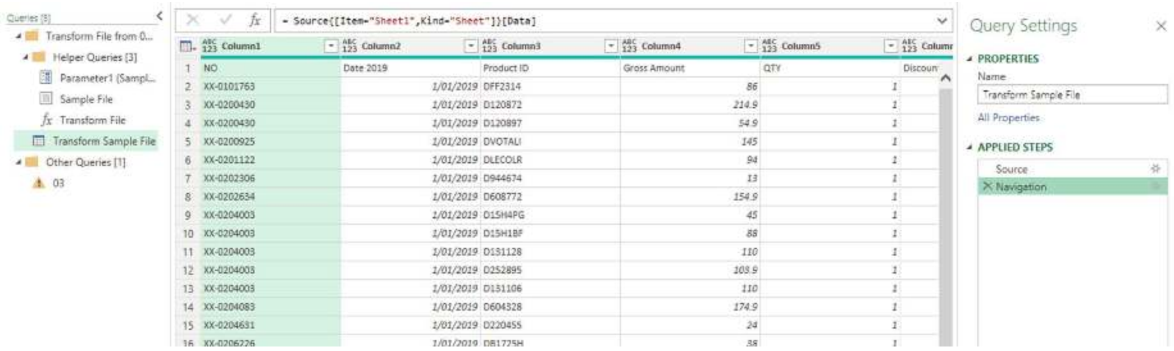
***Figure 1-21*** Combining and loading data into the Power Query Editor

In this example, you will see how to solve this problem using two different scenarios.

## Scenario 1: Different Column Headers but the Same Number and Order of Columns Across All Files

If the column headers differ between files but the number and order of columns are the same, you can standardize the process by using generic headers like Column1, Column2, and so on, instead of relying on the headers from the files themselves.

So, select the Transform Sample File query in the Power Query Editor, locate the last step in the Applied Steps pane, which is named Promoted Headers, and remove this step to revert to the default headers (Column1, Column2, etc.). See Figure 1-22.



Queries [5]
- Transform File from 0...
  - Helper Queries [3]
    - Parameter1 (Sampl...
    - Sample File
    - Transform File
    - Transform Sample File
- Other Queries [1]
  - 03

```
= Source{[Item="Sheet1",Kind="Sheet"]}[Data]
```

| | Column1 | Column2 | Column3 | Column4 | Column5 | Colum |
|---|---|---|---|---|---|---|
| 1 | NO | Date 2019 | Product ID | Gross Amount | QTY | Discoun |
| 2 | XX-0101763 | 1/01/2019 | DFF2314 | 86 | 1 | |
| 3 | XX-0200430 | 1/01/2019 | D120872 | 214.9 | 1 | |
| 4 | XX-0200430 | 1/01/2019 | D120897 | 54.9 | 1 | |
| 5 | XX-0200925 | 1/01/2019 | DVOTALI | 145 | 1 | |
| 6 | XX-0201122 | 1/01/2019 | DLECOLR | 94 | 1 | |
| 7 | XX-0202306 | 1/01/2019 | D944674 | 13 | 1 | |
| 8 | XX-0202634 | 1/01/2019 | D608772 | 154.9 | 1 | |
| 9 | XX-0204003 | 1/01/2019 | D15H4PG | 45 | 1 | |
| 10 | XX-0204003 | 1/01/2019 | D15H1BF | 88 | 1 | |
| 11 | XX-0204003 | 1/01/2019 | D131128 | 110 | 1 | |
| 12 | XX-0204003 | 1/01/2019 | D252895 | 103.9 | 1 | |
| 13 | XX-0204003 | 1/01/2019 | D131106 | 110 | 1 | |
| 14 | XX-0204083 | 1/01/2019 | D604328 | 174.9 | 1 | |
| 15 | XX-0204631 | 1/01/2019 | D220455 | 24 | 1 | |
| 16 | XX-0206226 | 1/01/2019 | DB1725H | 38 | 1 | |

Query Settings

PROPERTIES

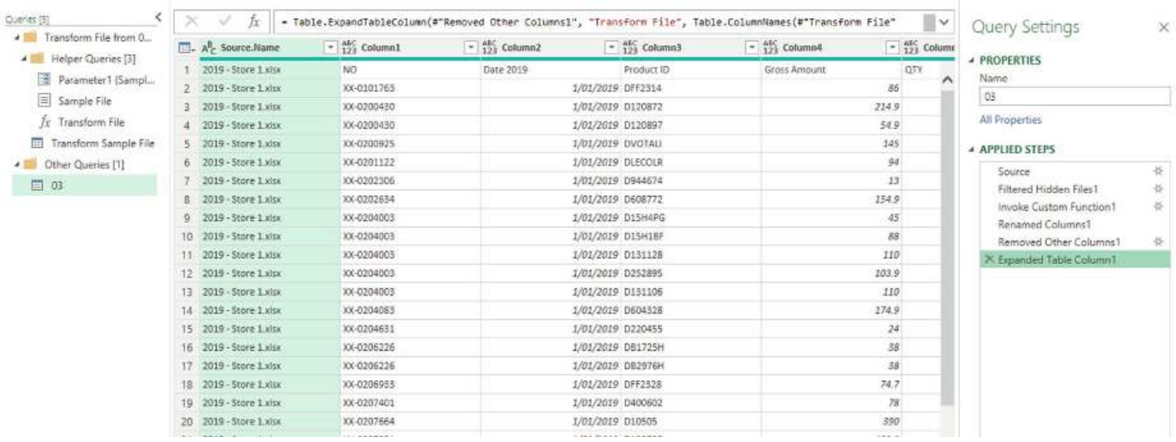
Name: Transform Sample File

All Properties

APPLIED STEPS
- Source
- Navigation

*Figure 1-22* Result of removing the Promote Header step

Now, go to the 03 query, which currently results in an error. The error occurs because the column names from the files do not match. To fix this, remove the last step, Changed Type, from the Applied Steps pane. Now you'll see the result shown in Figure 1-23.



Queries [5]
- Transform File from 0...
  - Helper Queries [3]
    - Parameter1 (Sampl...
    - Sample File
    - Transform File
    - Transform Sample File
- Other Queries [1]
  - 03

```
= Table.ExpandTableColumn(#"Removed Other Columns1", "Transform File", Table.ColumnNames(#"Transform File"
```

| | Source.Name | Column1 | Column2 | Column3 | Column4 | Colum |
|---|---|---|---|---|---|---|
| 1 | 2019 - Store 1.xlsx | NO | Date 2019 | Product ID | Gross Amount | QTY |
| 2 | 2019 - Store 1.xlsx | XX-0101763 | 1/01/2019 | DFF2314 | 86 | |
| 3 | 2019 - Store 1.xlsx | XX-0200430 | 1/01/2019 | D120872 | 214.9 | |
| 4 | 2019 - Store 1.xlsx | XX-0200430 | 1/01/2019 | D120897 | 54.9 | |
| 5 | 2019 - Store 1.xlsx | XX-0200925 | 1/01/2019 | DVOTALI | 145 | |
| 6 | 2019 - Store 1.xlsx | XX-0201122 | 1/01/2019 | DLECOLR | 94 | |
| 7 | 2019 - Store 1.xlsx | XX-0202306 | 1/01/2019 | D944674 | 13 | |
| 8 | 2019 - Store 1.xlsx | XX-0202634 | 1/01/2019 | D608772 | 154.9 | |
| 9 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D15H4PG | 45 | |
| 10 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D15H1BF | 88 | |
| 11 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D131128 | 110 | |
| 12 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D252895 | 103.9 | |
| 13 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D131106 | 110 | |
| 14 | 2019 - Store 1.xlsx | XX-0204083 | 1/01/2019 | D604328 | 174.9 | |
| 15 | 2019 - Store 1.xlsx | XX-0204631 | 1/01/2019 | D220455 | 24 | |
| 16 | 2019 - Store 1.xlsx | XX-0206226 | 1/01/2019 | DB1725H | 38 | |
| 17 | 2019 - Store 1.xlsx | XX-0206226 | 1/01/2019 | DB2976H | 38 | |
| 18 | 2019 - Store 1.xlsx | XX-0206933 | 1/01/2019 | DFF2328 | 74.7 | |
| 19 | 2019 - Store 1.xlsx | XX-0207401 | 1/01/2019 | D400602 | 78 | |
| 20 | 2019 - Store 1.xlsx | XX-0207664 | 1/01/2019 | D10505 | 390 | |

Query Settings

PROPERTIES

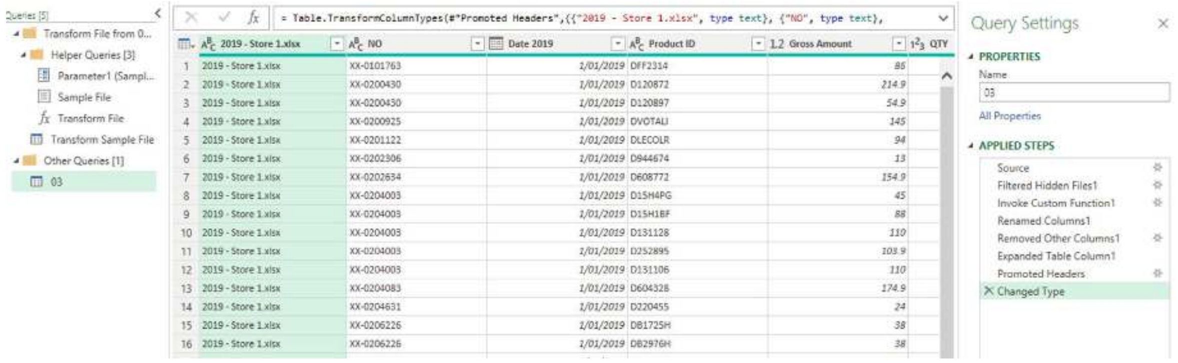
Name: 03

All Properties

APPLIED STEPS
- Source
- Filtered Hidden Files1
- Invoke Custom Function1
- Renamed Columns1
- Removed Other Columns1
- Expanded Table Column1

*Figure 1-23* Result of removing the Changed Type step

As shown, the column headers of the tables in the loaded files have been neglected. You need to promote the first row to be used as the column headers and remove any rows that are not relevant (rows related to the header of files in the selected folder). So, from the Transform tab, click Use First Row as Headers to promote the first row to column headers; see Figure 1-24.



Queries [5]
- Transform File from 0...
  - Helper Queries [3]
    - Parameter1 (Sampl...
    - Sample File
    - Transform File
    - Transform Sample File
- Other Queries [1]
  - 03

```
= Table.TransformColumnTypes(#"Promoted Headers",{{"2019 - Store 1.xlsx", type text}, {"NO", type text},
```

| | 2019 - Store 1.xlsx | NO | Date 2019 | Product ID | 1.2 Gross Amount | 1²₃ QTY |
|---|---|---|---|---|---|---|
| 1 | 2019 - Store 1.xlsx | XX-0101763 | 1/01/2019 | DFF2314 | 86 | |
| 2 | 2019 - Store 1.xlsx | XX-0200430 | 1/01/2019 | D120872 | 214.9 | |
| 3 | 2019 - Store 1.xlsx | XX-0200430 | 1/01/2019 | D120897 | 54.9 | |
| 4 | 2019 - Store 1.xlsx | XX-0200925 | 1/01/2019 | DVOTALI | 145 | |
| 5 | 2019 - Store 1.xlsx | XX-0201122 | 1/01/2019 | DLECOLR | 94 | |
| 6 | 2019 - Store 1.xlsx | XX-0202306 | 1/01/2019 | D944674 | 13 | |
| 7 | 2019 - Store 1.xlsx | XX-0202634 | 1/01/2019 | D608772 | 154.9 | |
| 8 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D15H4PG | 45 | |
| 9 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D15H1BF | 88 | |
| 10 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D131128 | 110 | |
| 11 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D252895 | 103.9 | |
| 12 | 2019 - Store 1.xlsx | XX-0204003 | 1/01/2019 | D131106 | 110 | |
| 13 | 2019 - Store 1.xlsx | XX-0204083 | 1/01/2019 | D604328 | 174.9 | |
| 14 | 2019 - Store 1.xlsx | XX-0204631 | 1/01/2019 | D220455 | 24 | |
| 15 | 2019 - Store 1.xlsx | XX-0206226 | 1/01/2019 | DB1725H | 38 | |
| 16 | 2019 - Store 1.xlsx | XX-0206226 | 1/01/2019 | DB2976H | 38 | |

Query Settings

PROPERTIES

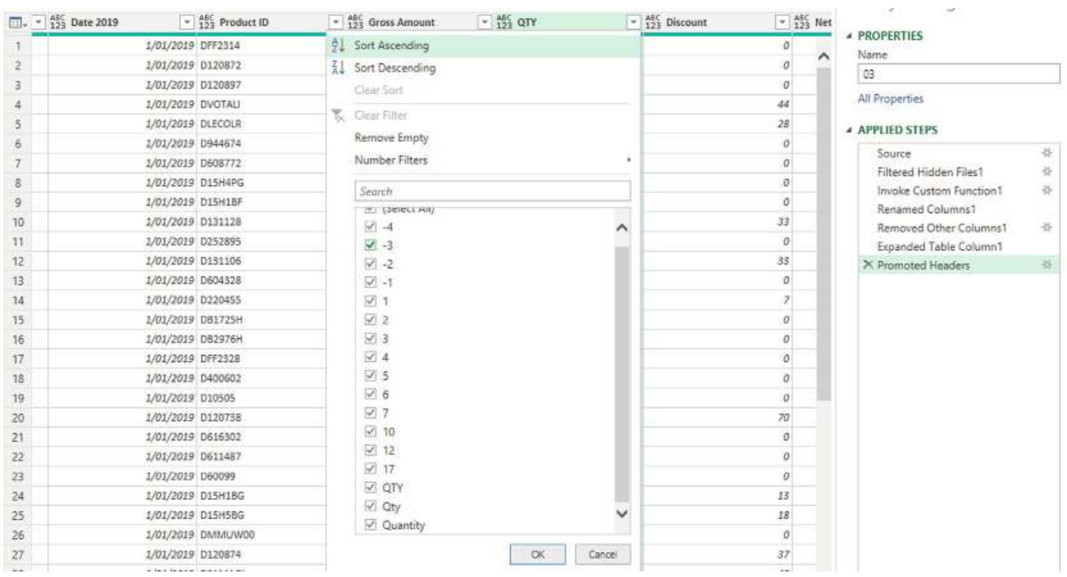
Name: 03

All Properties

APPLIED STEPS
- Source
- Filtered Hidden Files1
- Invoke Custom Function1
- Renamed Columns1
- Removed Other Columns1
- Expanded Table Column1
- Promoted Headers
- Changed Type

*Figure 1-24* Result of promoting the headers

After making this change, two steps—Promoted Headers and Changed Type—will be added to the list of applied steps. To proceed, remove the Changed Type step from the Applied Steps pane, and, for a column that contains numeric values, such as QTY, click the filter icon next to the column name. Then select Load More to view all the values in that column, as shown in Figure 1-25. Deselect the values that are related to the titles of other files and click OK.



| | Date 2019 | Product ID | Gross Amount | QTY | Discount | Net |
|---|---|---|---|---|---|---|
| 1 | 1/01/2019 | DFF2314 | | | 0 | |
| 2 | 1/01/2019 | D120872 | | | 0 | |
| 3 | 1/01/2019 | D120897 | | | 0 | |
| 4 | 1/01/2019 | DVOTALI | | | 44 | |
| 5 | 1/01/2019 | DLECOLR | | | 28 | |
| 6 | 1/01/2019 | D944674 | | | 0 | |
| 7 | 1/01/2019 | D608772 | | | 0 | |
| 8 | 1/01/2019 | D15H4PG | | | 0 | |
| 9 | 1/01/2019 | D15H1BF | | | 0 | |
| 10 | 1/01/2019 | D131128 | | | 33 | |
| 11 | 1/01/2019 | D252895 | | | 0 | |
| 12 | 1/01/2019 | D131106 | | | 35 | |
| 13 | 1/01/2019 | D604328 | | | 0 | |
| 14 | 1/01/2019 | D220455 | | | 7 | |
| 15 | 1/01/2019 | D81725H | | | 0 | |
| 16 | 1/01/2019 | D82976H | | | 0 | |
| 17 | 1/01/2019 | DFF2328 | | | 0 | |
| 18 | 1/01/2019 | D400602 | | | 0 | |
| 19 | 1/01/2019 | D10505 | | | 0 | |
| 20 | 1/01/2019 | D120738 | | | 70 | |
| 21 | 1/01/2019 | D616302 | | | 0 | |
| 22 | 1/01/2019 | D611487 | | | 0 | |
| 23 | 1/01/2019 | D60099 | | | 0 | |
| 24 | 1/01/2019 | D15H1BG | | | 13 | |
| 25 | 1/01/2019 | D15H5BG | | | 18 | |
| 26 | 1/01/2019 | DMMUW00 | | | 0 | |
| 27 | 1/01/2019 | D120874 | | | 37 | |

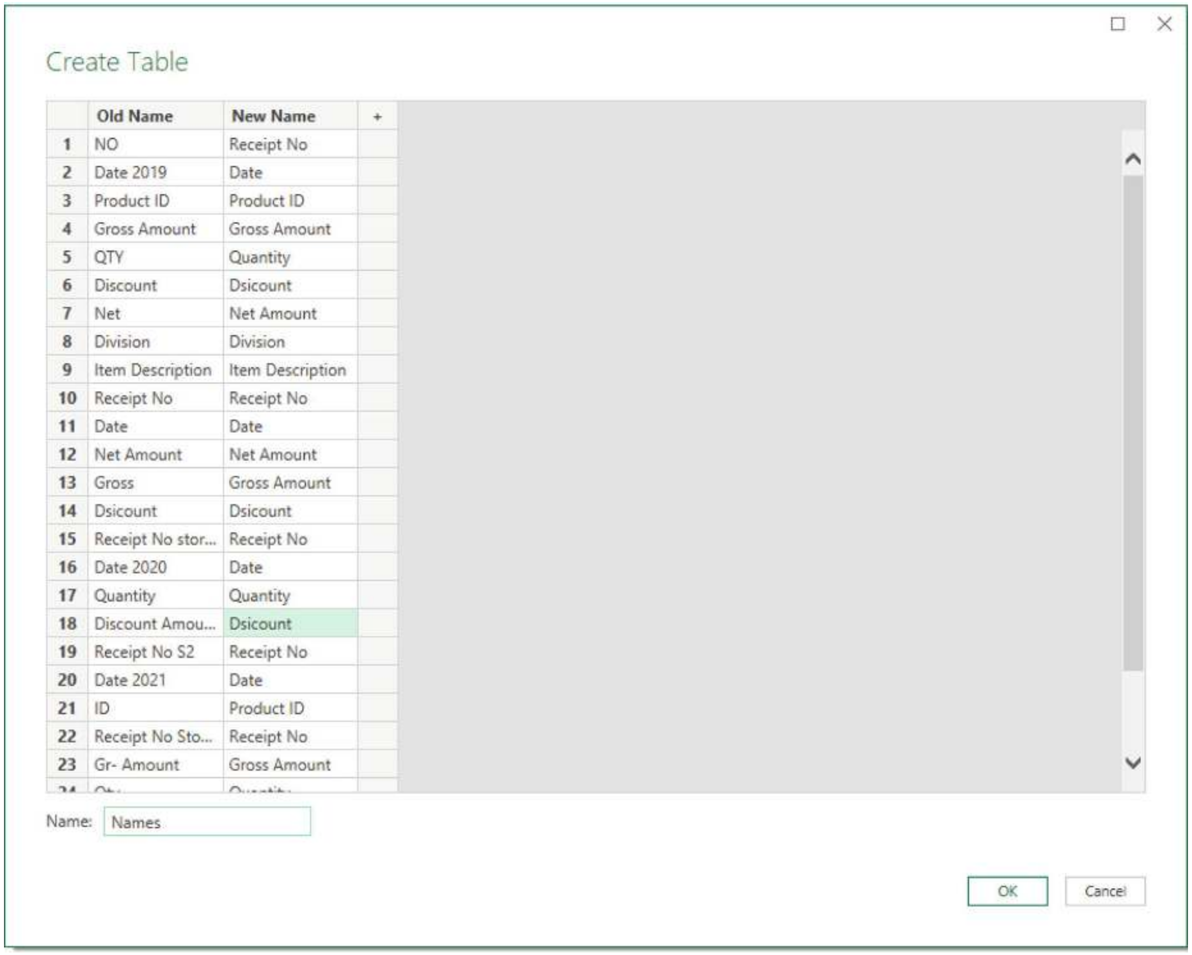
*Figure 1-25* Setting for filtering

This will resolve the issue and ensure that only the relevant data is included in the query.

## Scenario 2: The Number and Order of Columns Varies Across Different Files

In this scenario, since the order of columns varies across different files, you need to extract all the column name variations and define a generic name for each similar column. Then, you will replace the original column names with the new generic names across the tables in the files.

To address this issue, first assume that you know all the variations of column names. (At the end of this chapter, I explain how to extract the column names.) From the Home tab in the Power Query Editor, go to the New Query section and select Enter Data. As shown in Figure 1-26, create a table called Names with two columns: one for the old names and another for the new generic names. (Alternatively, if you're using Excel, you can create this table directly in Excel and then load it into the Power Query Editor.)



Create Table

| | Old Name | New Name |
|---|---|---|
| 1 | NO | Receipt No |
| 2 | Date 2019 | Date |
| 3 | Product ID | Product ID |
| 4 | Gross Amount | Gross Amount |
| 5 | QTY | Quantity |
| 6 | Discount | Dsicount |
| 7 | Net | Net Amount |
| 8 | Division | Division |
| 9 | Item Description | Item Description |
| 10 | Receipt No | Receipt No |
| 11 | Date | Date |
| 12 | Net Amount | Net Amount |
| 13 | Gross | Gross Amount |
| 14 | Dsicount | Dsicount |
| 15 | Receipt No stor... | Receipt No |
| 16 | Date 2020 | Date |
| 17 | Quantity | Quantity |
| 18 | Discount Amou... | Dsicount |
| 19 | Receipt No S2 | Receipt No |
| 20 | Date 2021 | Date |
| 21 | ID | Product ID |
| 22 | Receipt No Sto... | Receipt No |
| 23 | Gr- Amount | Gross Amount |

Name: Names

***Figure 1-26*** Creating a new query

In this case, you need to replace the old column names with new generic names across all the files using the Transform Sample File query. To understand the process for changing column names in Power Query, let's first explore the logic. So, select the Transform Sample File query and manually rename the NO column to Receipt No. This will generate the following formula in the formula bar:

```
= Table.RenameColumns(#"Promoted Headers",{{"NO", "Receipt No"}})
```

If you also change the column name from Date 2019 to Date, the formula will be updated to:

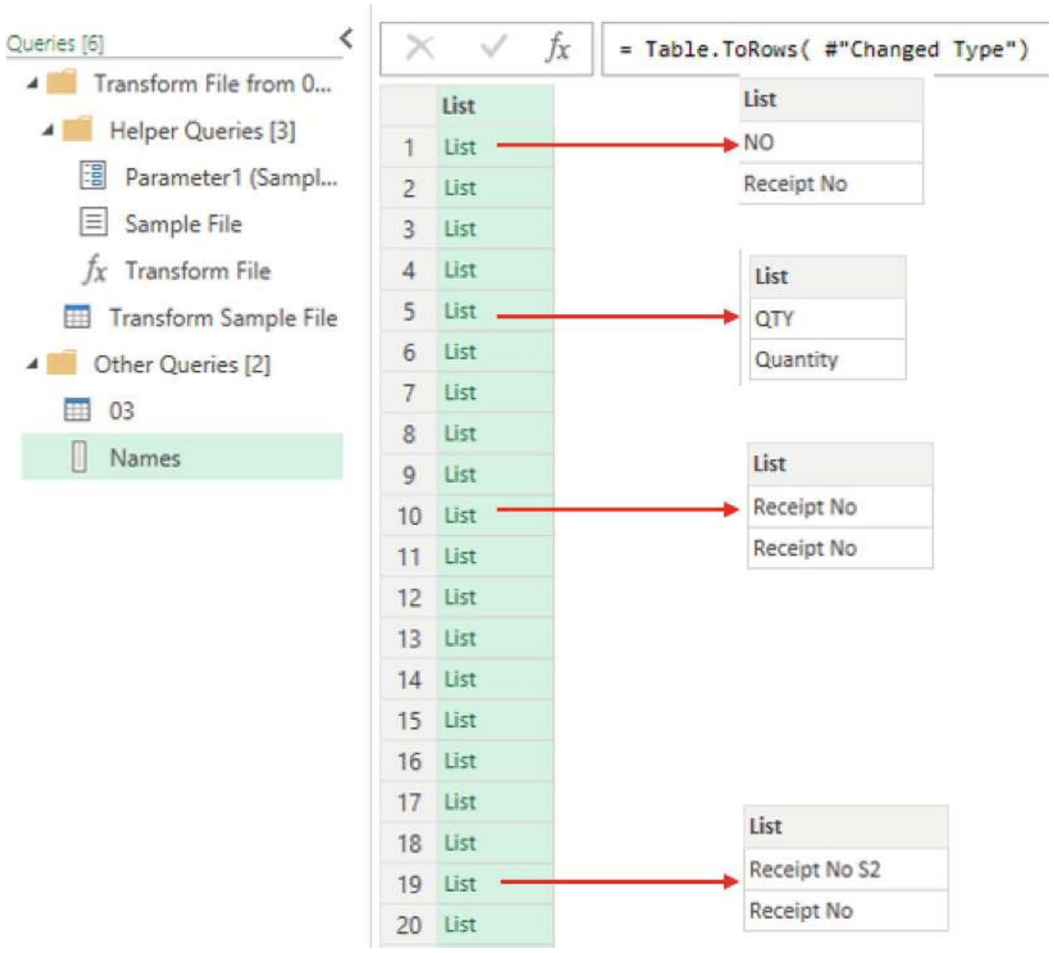
```
= Table.RenameColumns(#"Promoted Headers",{{"NO", "Receipt No"}, {"Date
2019", "Date"}})
```

From these examples, it becomes clear that, in order to change column names in a table (like #"Promoted Headers"), you need to input the table name as the first argument of the `Table.RenameColumns()` function. The second argument is a list of sub-lists, each containing the old and new column names.

Now, to apply this logic to all files, you need to change the format of the Names query from a table to a list. So, select the Names query and, next to the formula bar, click *fx* next to the formula bar, which generates `= #"Changed Type"` (where `#"Changed Type"` is the name of the previous step) in the formula bar.

Replace this formula with the following one to convert the table into a list. See Figure 1-27 (the `Table.ToRows()` function converts a table into a list, with each row represented as a sublist).

```
= Table.ToRows( #"Changed Type")
```



```
= Table.ToRows( #"Changed Type")
```

|  | List |
|---|---|
| 1 | List |
| 2 | List |
| 3 | List |
| 4 | List |
| 5 | List |
| 6 | List |
| 7 | List |
| 8 | List |
| 9 | List |
| 10 | List |
| 11 | List |
| 12 | List |
| 13 | List |
| 14 | List |
| 15 | List |
| 16 | List |
| 17 | List |
| 18 | List |
| 19 | List |
| 20 | List |

| List |
|---|
| NO |
| Receipt No |

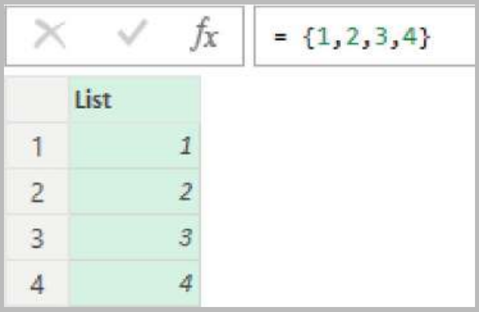
| List |
|---|
| QTY |
| Quantity |

| List |
|---|
| Receipt No |
| Receipt No |

| List |
|---|
| Receipt No S2 |
| Receipt No |

*Figure 1-27* Result of using Table.ToRows()

**Note** In Power Query, a list is a simple, ordered collection of values. It is a fundamental data type used to represent a sequence of items, similar to an array in programming. Lists are versatile and play an essential role in many Power Query operations, such as filtering, aggregating, and performing iterative calculations. A list maintains the order of its items, like `={1,2,3,4}`, as shown in Figure 1-28.

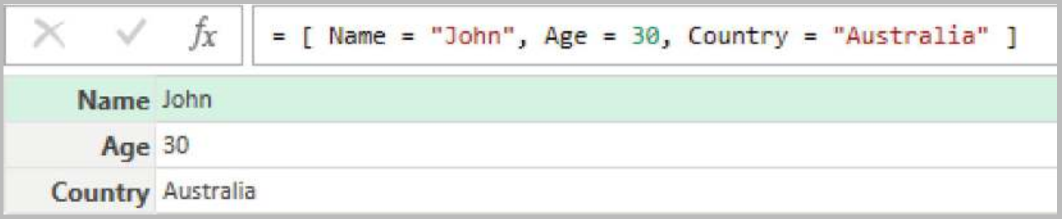


```
= {1,2,3,4}
```

|  | List |
|---|---|
| 1 | 1 |
| 2 | 2 |
| 3 | 3 |
| 4 | 4 |

*Figure 1-28* Defining a list in Power Query

Additionally, a record is a data type that represents a single structured entity, similar to a row in a table or a key-value pair in a dictionary. A record consists of one or more fields, each of which has a field name (key) and an associated value. Records are often used to store and process structured data with a fixed set of attributes. Each field in a record has a unique name (the key) and a corresponding value. For example, a record might look like `[ Name = "John", Age = 30, Country = "Australia" ]`, as shown in Figure 1-29.



```
= [ Name = "John", Age = 30, Country = "Australia" ]
```

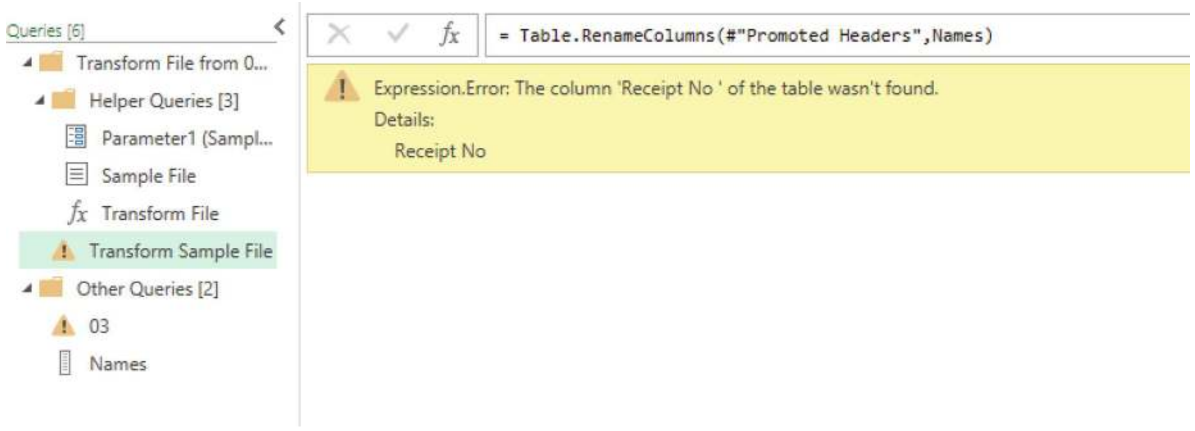
|  |  |
|---|---|
| Name | John |
| Age | 30 |
| Country | Australia |

***Figure 1-29*** Defining a record in Power Query

Now that the result of the Names query is ready, you can use it in the second argument of the `Table.RenameColumns()` function. To proceed, go to the Transform Sample File query and click *fx* next to the formula bar, which will display `= #"Promoted Headers"` in the formula bar. Replace this formula with the following:

```
= Table.RenameColumns(#"Promoted Headers",Names)
```

However, this will result in an error for query 03, as shown in Figure 1-30, because some of the old column names listed in the Names query do not exist in the table. This error occurs because Power Query is unable to find certain column names that are specified in the Names query within the current table.



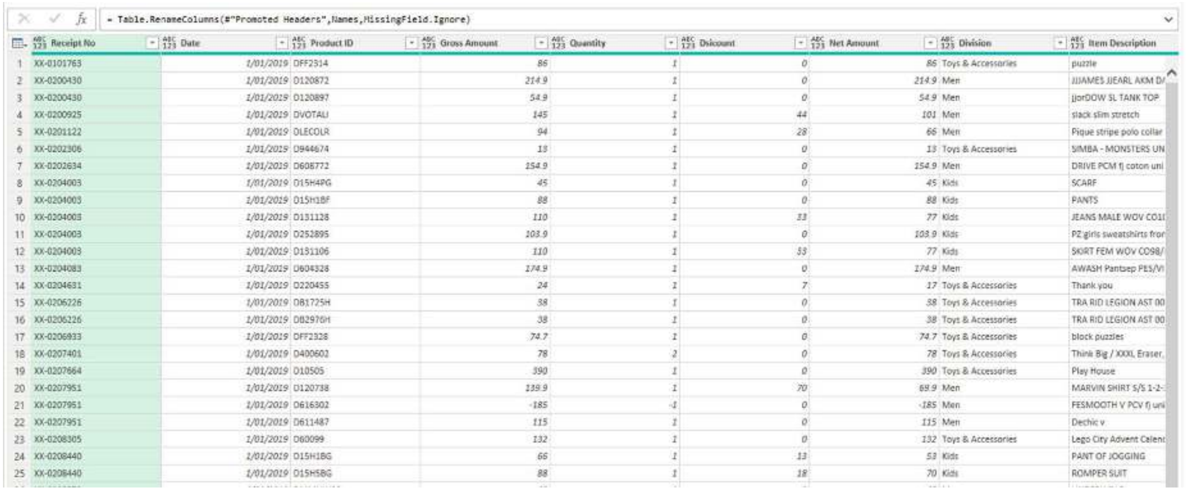
```
= Table.RenameColumns(#"Promoted Headers",Names)
```

Expression.Error: The column 'Receipt No ' of the table wasn't found.
Details:
Receipt No

***Figure 1-30*** Result of renaming the column headers

To address this issue and ignore nonexistent columns in the renaming process, rewrite the formula as shown here. Adding `MissingField.Ignore` (or 1) as the third argument in the `Table.RenameColumns()` will cause nonexistent column headers to be ignored, thus preventing errors. The updated formula will result in the table shown in Figure 1-31.

```
Table.RenameColumns([Custom.Data],Names,MissingField.Ignore)
```



```
= Table.RenameColumns(#"Promoted Headers",Names,MissingField.Ignore)
```

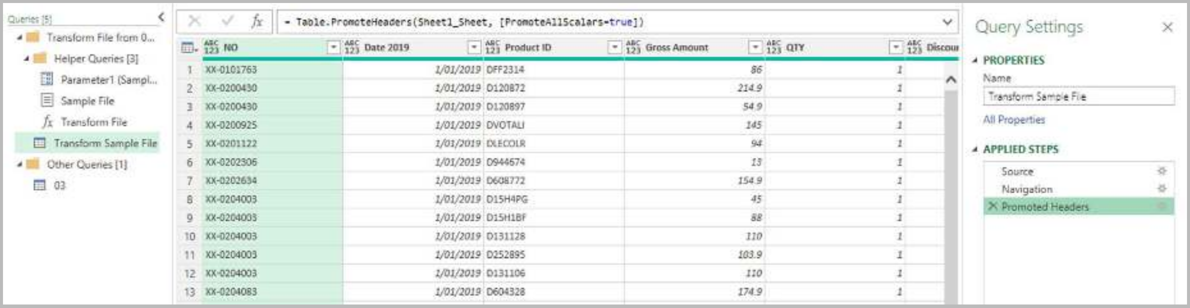
| | Receipt No | Date | Product ID | Gross Amount | Quantity | Dsicount | Net Amount | Division | Item Description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | XX-0101763 | 1/01/2019 | DFF2314 | 86 | 1 | 0 | 86 | Toys & Accessories | puzzle |
| 2 | XX-0200430 | 1/01/2019 | D120872 | 214.9 | 1 | 0 | 214.9 | Men | JJJAMES JJEARL AKM D/ |
| 3 | XX-0200430 | 1/01/2019 | D120897 | 54.9 | 1 | 0 | 54.9 | Men | JJorDOW SL TANK TOP |
| 4 | XX-0200925 | 1/01/2019 | DVOTALI | 145 | 1 | 44 | 101 | Men | slack slim stretch |
| 5 | XX-0201122 | 1/01/2019 | DLECOLR | 94 | 1 | 28 | 66 | Men | Pique stripe polo collar |
| 6 | XX-0202306 | 1/01/2019 | D944674 | 13 | 1 | 0 | 13 | Toys & Accessories | SIMBA - MONSTERS UN |
| 7 | XX-0202634 | 1/01/2019 | D608772 | 154.9 | 1 | 0 | 154.9 | Men | DRIVE PCM fj coton uni |
| 8 | XX-0204003 | 1/01/2019 | D15H4PG | 45 | 1 | 0 | 45 | Kids | SCARF |
| 9 | XX-0204003 | 1/01/2019 | D15H1BF | 88 | 1 | 0 | 88 | Kids | PANTS |
| 10 | XX-0204003 | 1/01/2019 | D131128 | 110 | 1 | 33 | 77 | Kids | JEANS MALE WOV CO1 |
| 11 | XX-0204003 | 1/01/2019 | D252895 | 103.9 | 1 | 0 | 103.9 | Kids | PZ girls sweatshirts fror |
| 12 | XX-0204003 | 1/01/2019 | D131106 | 110 | 1 | 33 | 77 | Kids | SKIRT FEM WOV CO98/ |
| 13 | XX-0204083 | 1/01/2019 | D604328 | 174.9 | 1 | 0 | 174.9 | Men | AWASH Pantsep PES/VI |
| 14 | XX-0204631 | 1/01/2019 | D220455 | 24 | 1 | 7 | 17 | Toys & Accessories | Thank you |
| 15 | XX-0206226 | 1/01/2019 | D81725H | 38 | 1 | 0 | 38 | Toys & Accessories | TRA RID LEGION AST 00 |
| 16 | XX-0206226 | 1/01/2019 | D82976H | 38 | 1 | 0 | 38 | Toys & Accessories | TRA RID LEGION AST 00 |
| 17 | XX-0206933 | 1/01/2019 | DFF2328 | 74.7 | 1 | 0 | 74.7 | Toys & Accessories | block puzzles |
| 18 | XX-0207401 | 1/01/2019 | D400602 | 78 | 2 | 0 | 78 | Toys & Accessories | Think Big / XXXL Eraser, |
| 19 | XX-0207664 | 1/01/2019 | D10505 | 390 | 1 | 0 | 390 | Toys & Accessories | Play House |
| 20 | XX-0207951 | 1/01/2019 | D120738 | 139.9 | 1 | 70 | 69.9 | Men | MARVIN SHIRT S/S 1-2- |
| 21 | XX-0207951 | 1/01/2019 | D616302 | -185 | -1 | 0 | -185 | Men | FESMOOTH V PCV fj uni |
| 22 | XX-0207951 | 1/01/2019 | D611487 | 115 | 1 | 0 | 115 | Men | Dechic v |
| 23 | XX-0208305 | 1/01/2019 | D60099 | 132 | 1 | 0 | 132 | Toys & Accessories | Lego City Advent Calen |
| 24 | XX-0208440 | 1/01/2019 | D15H1BG | 66 | 1 | 13 | 53 | Kids | PANT OF JOGGING |
| 25 | XX-0208440 | 1/01/2019 | D15H5BG | 88 | 1 | 18 | 70 | Kids | ROMPER SUIT |

*Figure 1-31* Solving the problem by adding MissingField.Ignore

As in the previous scenario, to complete the solution, go to query 03 and remove the last step (related to changing the type) to solve the problem.

**Note** To solve the problem in the second scenario, it is assumed that you already know all the variations of column names across the files in a folder. This note explains how to extract this data.

To extract the column names from the files in a folder, open an Excel file. Then use the From Folder command to navigate to the folder containing the files, select Combine & Transform Data, and choose any sample file to proceed. This will lead to the result shown in Figure 1-32.



```
= Table.PromoteHeaders(Sheet1_Sheet, [PromoteAllScalars=true])
```

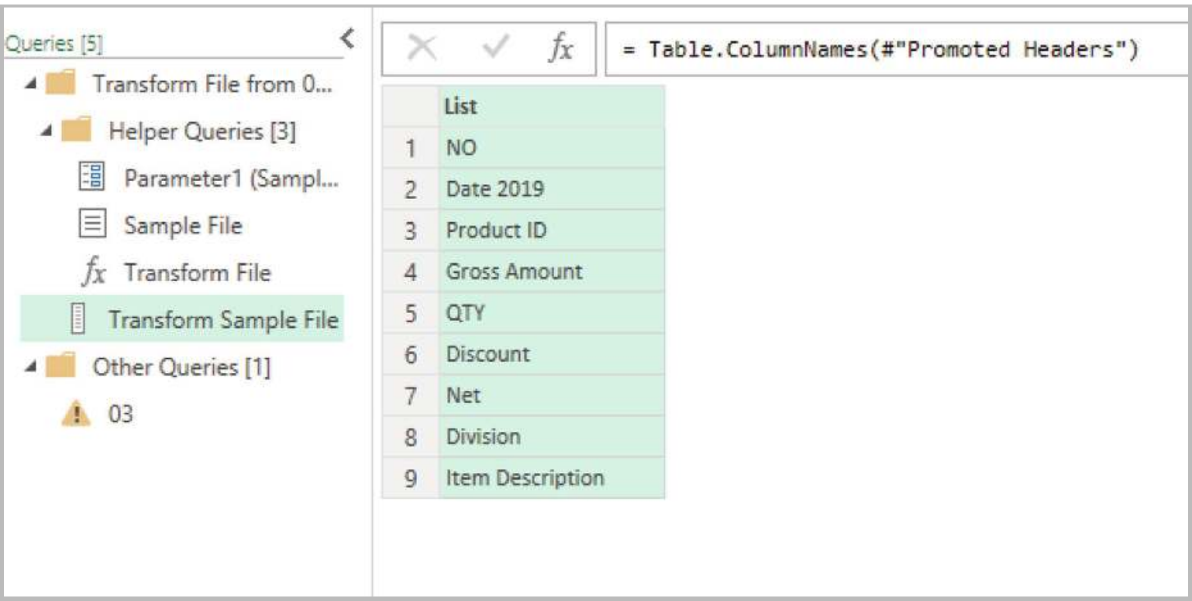
| | NO | Date 2019 | Product ID | Gross Amount | QTY | Discou |
|---|---|---|---|---|---|---|
| 1 | XX-0101763 | 1/01/2019 | DFF2314 | 86 | 1 | |
| 2 | XX-0200430 | 1/01/2019 | D120872 | 214.9 | 1 | |
| 3 | XX-0200430 | 1/01/2019 | D120897 | 54.9 | 1 | |
| 4 | XX-0200925 | 1/01/2019 | DVOTALI | 145 | 1 | |
| 5 | XX-0201122 | 1/01/2019 | DLECOLR | 94 | 1 | |
| 6 | XX-0202306 | 1/01/2019 | D944674 | 13 | 1 | |
| 7 | XX-0202634 | 1/01/2019 | D608772 | 154.9 | 1 | |
| 8 | XX-0204003 | 1/01/2019 | D15H4PG | 45 | 1 | |
| 9 | XX-0204003 | 1/01/2019 | D15H1BF | 88 | 1 | |
| 10 | XX-0204003 | 1/01/2019 | D131128 | 110 | 1 | |
| 11 | XX-0204003 | 1/01/2019 | D252895 | 103.9 | 1 | |
| 12 | XX-0204003 | 1/01/2019 | D131106 | 110 | 1 | |
| 13 | XX-0204083 | 1/01/2019 | D604328 | 174.9 | 1 | |

*Figure 1-32* Result of loading the data

Then, go to the Transform Sample File query, click *fx* to add a new step, and replace the generated formula with the following:

```
= Table.ColumnNames(#"Promoted Headers")
```

This will result in a list that includes all the column names from the selected sample file, as shown in Figure 1-33.

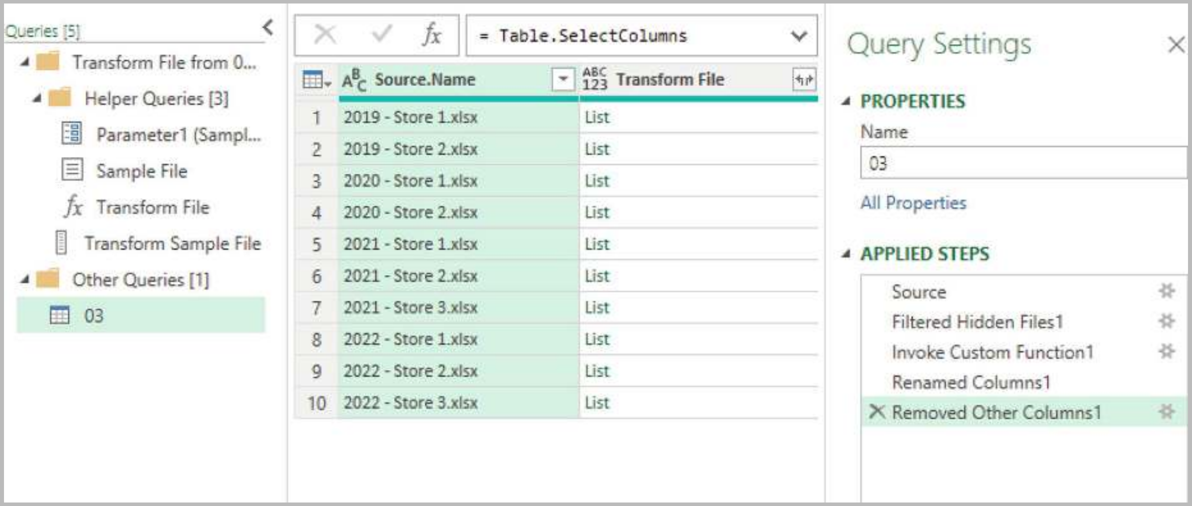


```
= Table.ColumnNames(#"Promoted Headers")
```

| | List |
|---|---|
| 1 | NO |
| 2 | Date 2019 |
| 3 | Product ID |
| 4 | Gross Amount |
| 5 | QTY |
| 6 | Discount |
| 7 | Net |
| 8 | Division |
| 9 | Item Description |

***Figure 1-33*** Result of using the Table.ColumnNames() function

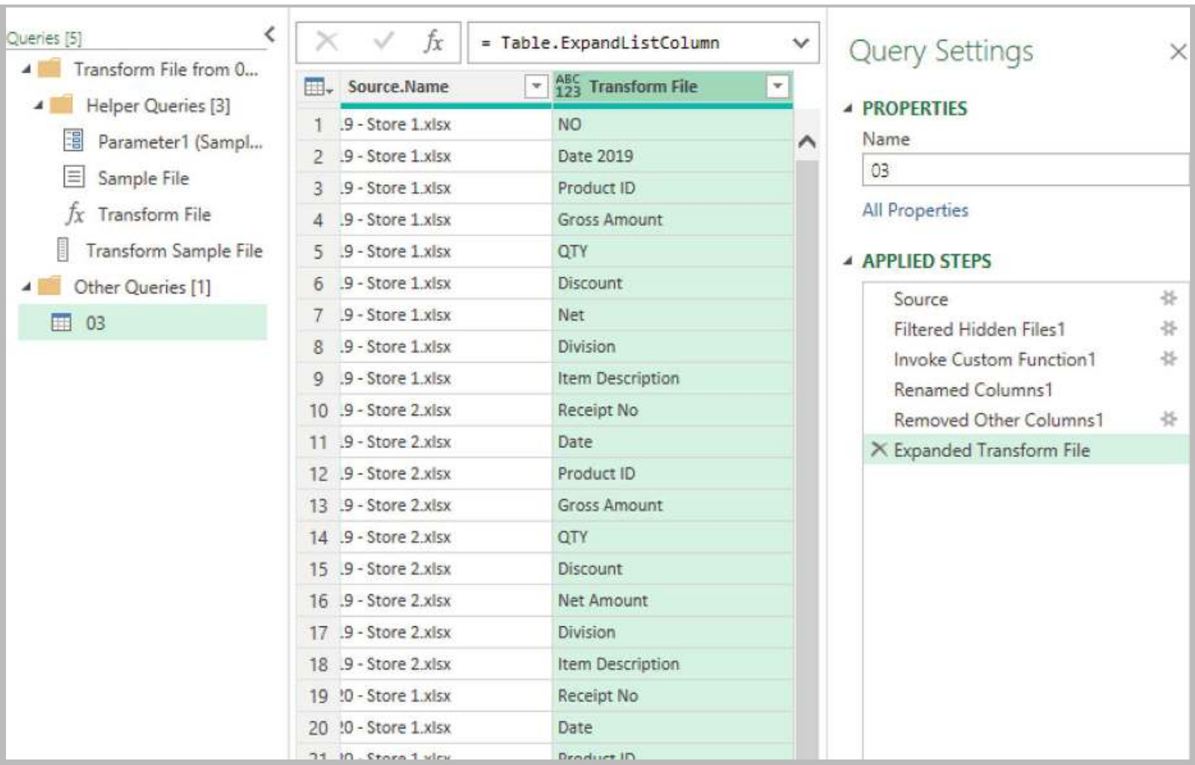
By doing this, the result of query 03 will change to an error. To fix this, remove the last two steps of this query (Changed Type and Expanded Table Column1), and you'll reach the result shown in the Figure 1-34. Next, use the Expand icon next to the column Transform File to expand its values. You'll see the result in Figure 1-35.



```
= Table.SelectColumns
```

| | Source.Name | Transform File |
|---|---|---|
| 1 | 2019 - Store 1.xlsx | List |
| 2 | 2019 - Store 2.xlsx | List |
| 3 | 2020 - Store 1.xlsx | List |
| 4 | 2020 - Store 2.xlsx | List |
| 5 | 2021 - Store 1.xlsx | List |
| 6 | 2021 - Store 2.xlsx | List |
| 7 | 2021 - Store 3.xlsx | List |
| 8 | 2022 - Store 1.xlsx | List |
| 9 | 2022 - Store 2.xlsx | List |
| 10 | 2022 - Store 3.xlsx | List |

***Figure 1-34*** Result of removing the steps



```
= Table.ExpandListColumn
```

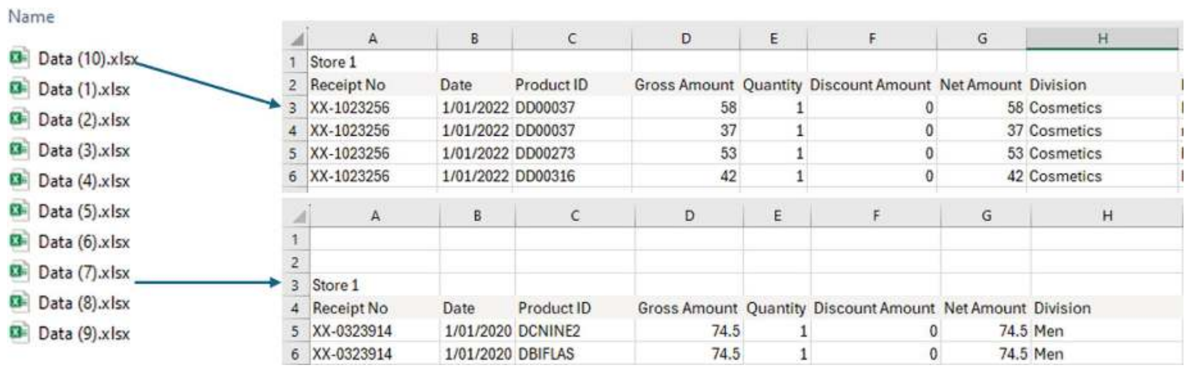
| | Source.Name | Transform File |
|---|---|---|
| 1 | .9 - Store 1.xlsx | NO |
| 2 | .9 - Store 1.xlsx | Date 2019 |
| 3 | .9 - Store 1.xlsx | Product ID |
| 4 | .9 - Store 1.xlsx | Gross Amount |
| 5 | .9 - Store 1.xlsx | QTY |
| 6 | .9 - Store 1.xlsx | Discount |
| 7 | .9 - Store 1.xlsx | Net |
| 8 | .9 - Store 1.xlsx | Division |
| 9 | .9 - Store 1.xlsx | Item Description |
| 10 | .9 - Store 2.xlsx | Receipt No |
| 11 | .9 - Store 2.xlsx | Date |
| 12 | .9 - Store 2.xlsx | Product ID |
| 13 | .9 - Store 2.xlsx | Gross Amount |
| 14 | .9 - Store 2.xlsx | QTY |
| 15 | .9 - Store 2.xlsx | Discount |
| 16 | .9 - Store 2.xlsx | Net Amount |
| 17 | .9 - Store 2.xlsx | Division |
| 18 | .9 - Store 2.xlsx | Item Description |
| 19 | !0 - Store 1.xlsx | Receipt No |
| 20 | !0 - Store 1.xlsx | Date |

*Figure 1-35* Result of expanding the column

Now, all the column names from the different files, along with their source files, will be displayed. As you do not need the `Source.Name` column, remove it. Then right-click the Transform File column and select the Remove Duplicates command to get a unique list of column header variations across all the files.

## Extracting Values Outside of Tables

Consider Example 1 in this chapter, but in this case, the store numbers are not mentioned in the names of the files and are instead provided in a cell above the table; see Figure 1-36. Combine the files by keeping the values of the store name.



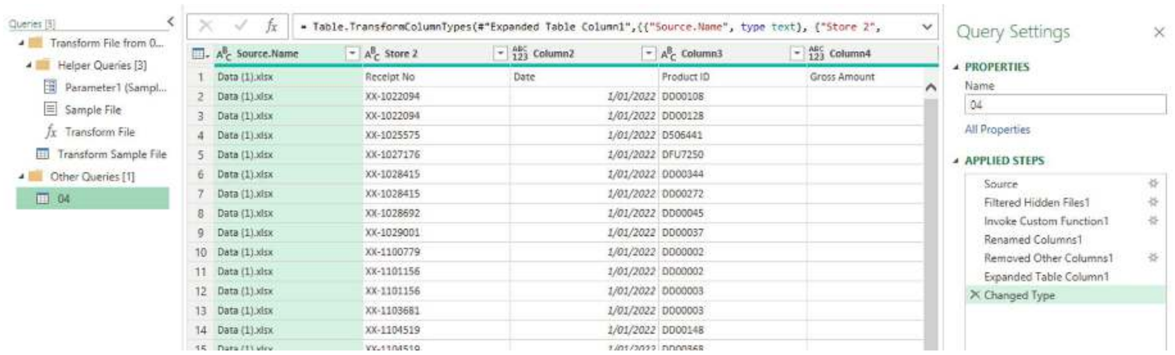
| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 1 | Store 1 | | | | | | | |
| 2 | Receipt No | Date | Product ID | Gross Amount | Quantity | Discount Amount | Net Amount | Division |
| 3 | XX-1023256 | 1/01/2022 | DD00037 | 58 | 1 | 0 | 58 | Cosmetics |
| 4 | XX-1023256 | 1/01/2022 | DD00037 | 37 | 1 | 0 | 37 | Cosmetics |
| 5 | XX-1023256 | 1/01/2022 | DD00273 | 53 | 1 | 0 | 53 | Cosmetics |
| 6 | XX-1023256 | 1/01/2022 | DD00316 | 42 | 1 | 0 | 42 | Cosmetics |

| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| 2 | | | | | | | | |
| 3 | Store 1 | | | | | | | |
| 4 | Receipt No | Date | Product ID | Gross Amount | Quantity | Discount Amount | Net Amount | Division |
| 5 | XX-0323914 | 1/01/2020 | DCNINE2 | 74.5 | 1 | 0 | 74.5 | Men |
| 6 | XX-0323914 | 1/01/2020 | DBIFLAS | 74.5 | 1 | 0 | 74.5 | Men |

*Figure 1-36* Source files

**Note** The Excel files used in this example are provided in the folder titled `04`.

To solve this problem, as in the previous example, use the From Folder command, navigate to the folder, and then choose Combine & Transform Data, by selecting any sample file. You'll see the result in Figure



```
= Table.TransformColumnTypes(#"Expanded Table Column1",{{"Source.Name", type text}, {"Store 2",
```

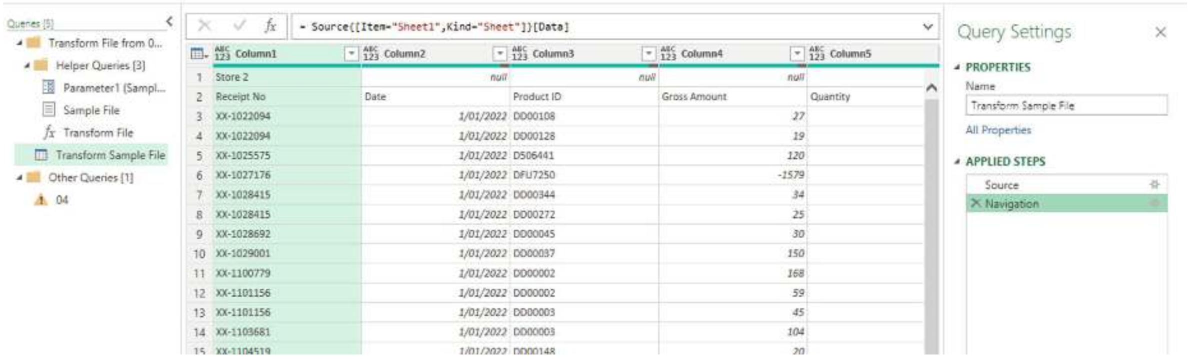
| | Source.Name | Store 2 | Column2 | Column3 | Column4 |
|---|---|---|---|---|---|
| 1 | Data (1).xlsx | Receipt No | Date | Product ID | Gross Amount |
| 2 | Data (1).xlsx | XX-1022094 | 1/01/2022 | DD00108 | |
| 3 | Data (1).xlsx | XX-1022094 | 1/01/2022 | DD00128 | |
| 4 | Data (1).xlsx | XX-1025575 | 1/01/2022 | D506441 | |
| 5 | Data (1).xlsx | XX-1027176 | 1/01/2022 | DFU7250 | |
| 6 | Data (1).xlsx | XX-1028415 | 1/01/2022 | DD00344 | |
| 7 | Data (1).xlsx | XX-1028415 | 1/01/2022 | DD00272 | |
| 8 | Data (1).xlsx | XX-1028692 | 1/01/2022 | DD00045 | |
| 9 | Data (1).xlsx | XX-1029001 | 1/01/2022 | DD00037 | |
| 10 | Data (1).xlsx | XX-1100779 | 1/01/2022 | DD00002 | |
| 11 | Data (1).xlsx | XX-1101156 | 1/01/2022 | DD00002 | |
| 12 | Data (1).xlsx | XX-1101156 | 1/01/2022 | DD00003 | |
| 13 | Data (1).xlsx | XX-1103681 | 1/01/2022 | DD00003 | |
| 14 | Data (1).xlsx | XX-1104519 | 1/01/2022 | DD00148 | |

Query Settings
PROPERTIES
Name: 04
APPLIED STEPS: Source; Filtered Hidden Files1; Invoke Custom Function1; Renamed Columns1; Removed Other Columns1; Expanded Table Column1; Changed Type

*Figure 1-37* Combining and loading data into the Power Query Editor

1-21.

As shown in this example, the store name is shown one row above the main table, causing the rows to be treated as header rows (as seen in the name of the second column). To solve this issue, you need to first extract the store name and then promote the first row as the header. To do this, select the Transform Sample File query and remove its last step (Promoted Headers) to access the previous steps; see Figure 1-38.



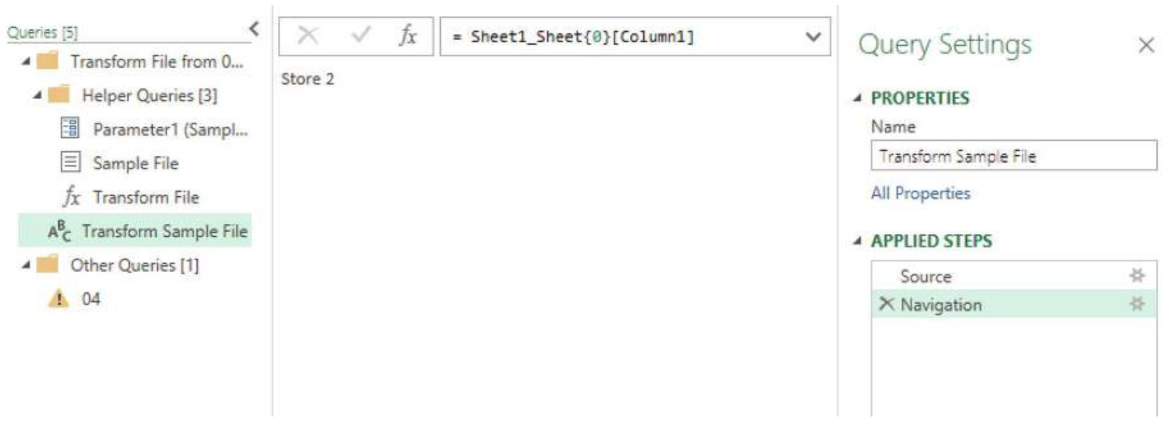
```
= Source{[Item="Sheet1",Kind="Sheet"]}[Data]
```

| | Column1 | Column2 | Column3 | Column4 | Column5 |
|---|---|---|---|---|---|
| 1 | Store 2 | null | null | null | |
| 2 | Receipt No | Date | Product ID | Gross Amount | Quantity |
| 3 | XX-1022094 | 1/01/2022 | DD00108 | 27 | |
| 4 | XX-1022094 | 1/01/2022 | DD00128 | 19 | |
| 5 | XX-1025575 | 1/01/2022 | D506441 | 120 | |
| 6 | XX-1027176 | 1/01/2022 | DFU7250 | -1579 | |
| 7 | XX-1028415 | 1/01/2022 | DD00344 | 34 | |
| 8 | XX-1028415 | 1/01/2022 | DD00272 | 25 | |
| 9 | XX-1028692 | 1/01/2022 | DD00045 | 30 | |
| 10 | XX-1029001 | 1/01/2022 | DD00037 | 150 | |
| 11 | XX-1100779 | 1/01/2022 | DD00002 | 168 | |
| 12 | XX-1101156 | 1/01/2022 | DD00002 | 59 | |
| 13 | XX-1101156 | 1/01/2022 | DD00003 | 45 | |
| 14 | XX-1103681 | 1/01/2022 | DD00003 | 104 | |

Query Settings
PROPERTIES
Name: Transform Sample File
APPLIED STEPS: Source; Navigation

*Figure 1-38* Removing the promote headers

Then, right-click the first cell in Column1 (where Store 2 is located) and select Drill Down to access the store name; see Figure 1-39.

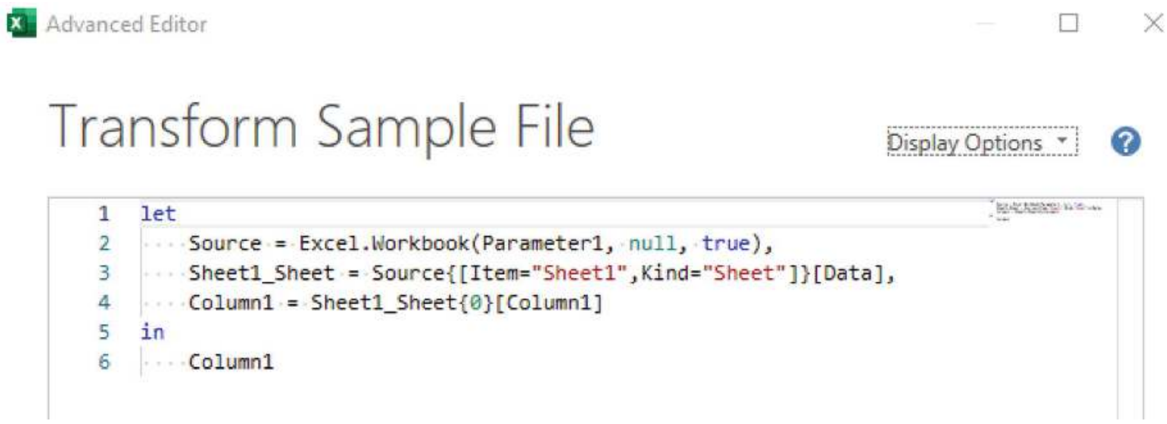


```
= Sheet1_Sheet{0}[Column1]
```

Name: Transform Sample File

*Figure 1-39* Result of drilling down

Before continuing with the rest of the solution, there is a strange behavior after performing the Drill Down action in the previous step that you need to investigate. The program does not add a new step in the Applied Steps section, and in the formula bar, the name of the previous step is shown as Sheet1_Sheet, which does not appear in the list of steps in the Applied Steps section. To investigate the issue, go to the Home tab and click the Advanced Editor. In the window that opens, shown in Figure 1-40, you'll see three steps, whereas in the Applied Steps section, only two steps are shown—Sheet1_Sheet and Column1—both listed under the Navigation step.



```
let
    Source = Excel.Workbook(Parameter1, null, true),
    Sheet1_Sheet = Source{[Item="Sheet1",Kind="Sheet"]}[Data],
    Column1 = Sheet1_Sheet{0}[Column1]
in
    Column1
```

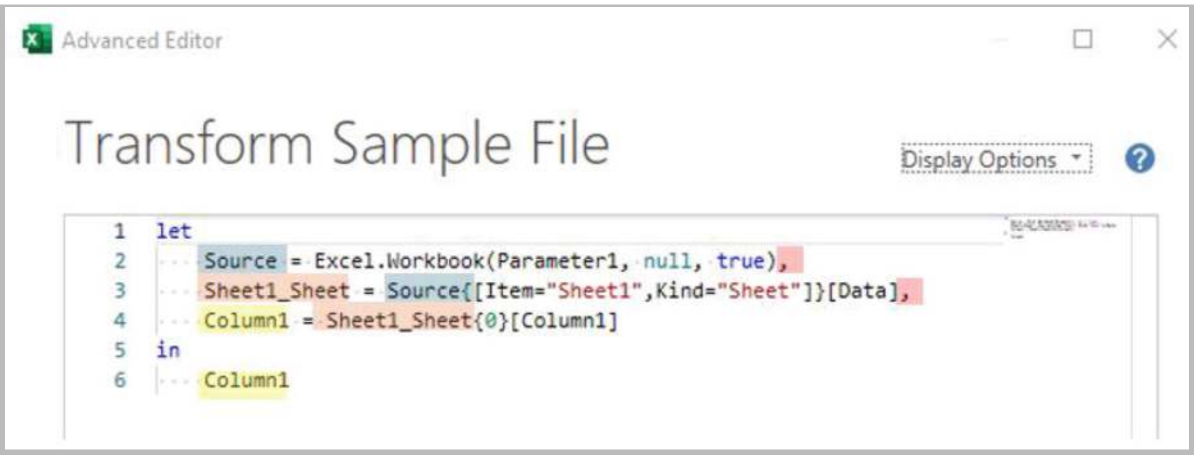
*Figure 1-40* Advanced Editor

**Note** The Advanced Editor in Power Query allows you to view and edit the M code behind your queries. While the Power Query Editor provides a user-friendly interface with options like transformations, filters, and other data manipulation features, the Advanced Editor provides a deeper level of control by exposing the underlying code that defines the sequence of operations applied to your data.

In the Advanced Editor, as shown in Figure 1-41, all the steps are defined between the `let` and `in` keywords. Each step begins with a step name (except for the navigation task, which is exactly as shown in the Applied Steps window) and ends with a comma (`,`). The only exception is the last step, which does not require a comma.

If a step name contains spaces, it should be enclosed in `#"` and `"`. For example, if the step name is `Promoted Headers`, it should be written as `#"Promoted Headers"`. This ensures that Power Query correctly recognizes the step name.

The `in` keyword is used to define the result of the query. It usually refers to the final expression or the last step to be executed, which will return the result of the entire query.



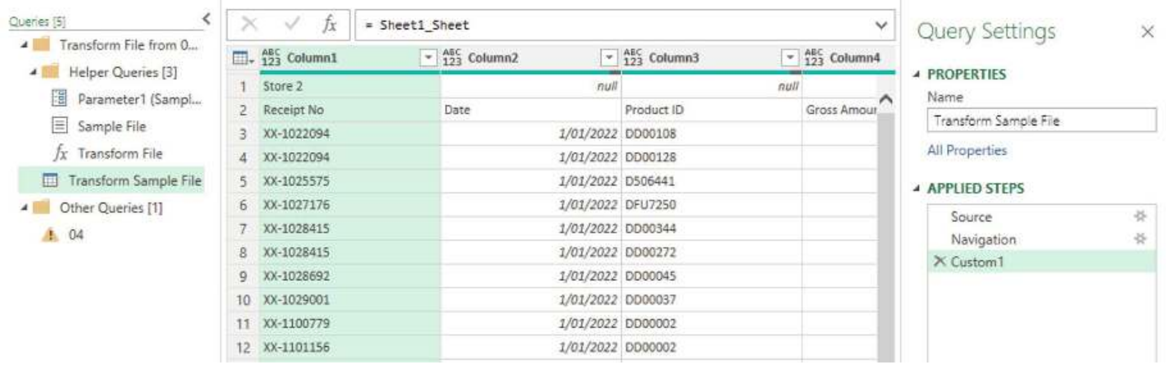
```
let
    Source = Excel.Workbook(Parameter1, null, true),
    Sheet1_Sheet = Source{[Item="Sheet1",Kind="Sheet"]}[Data],
    Column1 = Sheet1_Sheet{0}[Column1]
in
    Column1
```

***Figure 1-41*** View of the Advanced Editor

This behavior occurs due to Power Query's logic of grouping steps related to navigation across tables, columns, and rows under the name Navigation. However, be cautious, as you cannot refer to Navigation directly in the formula; instead, you should use the names shown in the Advanced Editor.

So based on this explanation, to refer to the table before the Drill Down, use the name `Sheet1_Sheet`, and to refer to the store name that was extracted, use the step named `Column1`.

For the rest of the solution, click the *fx* next to the formula bar, and in the formula bar, enter `=Sheet1_Sheet` to access the table before the Drill Down, as shown in Figure 1-42.



```
= Sheet1_Sheet
```

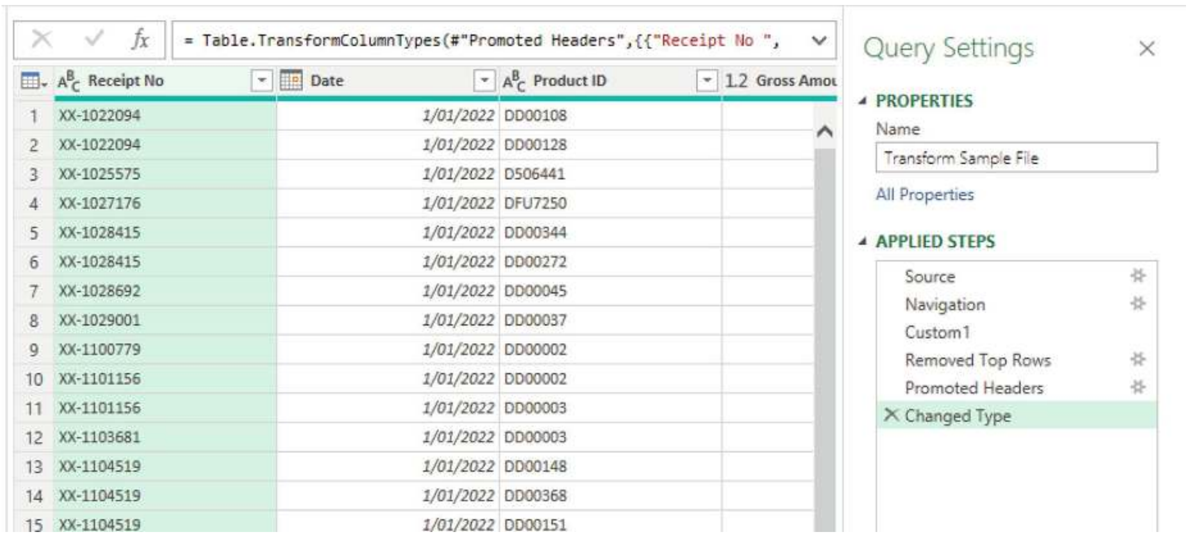
| | Column1 | Column2 | Column3 | Column4 |
|---|---|---|---|---|
| 1 | Store 2 | null | null | |
| 2 | Receipt No | Date | Product ID | Gross Amour |
| 3 | XX-1022094 | 1/01/2022 | DD00108 | |
| 4 | XX-1022094 | 1/01/2022 | DD00128 | |
| 5 | XX-1025575 | 1/01/2022 | D506441 | |
| 6 | XX-1027176 | 1/01/2022 | DFU7250 | |
| 7 | XX-1028415 | 1/01/2022 | DD00344 | |
| 8 | XX-1028415 | 1/01/2022 | DD00272 | |
| 9 | XX-1028692 | 1/01/2022 | DD00045 | |
| 10 | XX-1029001 | 1/01/2022 | DD00037 | |
| 11 | XX-1100779 | 1/01/2022 | DD00002 | |
| 12 | XX-1101156 | 1/01/2022 | DD00002 | |

Name: Transform Sample File

Applied Steps: Source, Navigation, Custom1

***Figure 1-42*** Referring to the previous step

In this table, since the store number has been extracted, you no longer need the first row. To remove it, go to the Home tab, and under the Reduce Rows section, select Remove Rows, then choose Remove Top Rows. In the dialog that appears, enter 1 to remove the first row. Next, go to the Transform tab and choose the Use First Row as Headers command to reach the result shown in Figure 1-43.



```
= Table.TransformColumnTypes(#"Promoted Headers",{{"Receipt No ",
```

| | Receipt No | Date | Product ID | Gross Amou |
|---|---|---|---|---|
| 1 | XX-1022094 | 1/01/2022 | DD00108 | |
| 2 | XX-1022094 | 1/01/2022 | DD00128 | |
| 3 | XX-1025575 | 1/01/2022 | D506441 | |
| 4 | XX-1027176 | 1/01/2022 | DFU7250 | |
| 5 | XX-1028415 | 1/01/2022 | DD00344 | |
| 6 | XX-1028415 | 1/01/2022 | DD00272 | |
| 7 | XX-1028692 | 1/01/2022 | DD00045 | |
| 8 | XX-1029001 | 1/01/2022 | DD00037 | |
| 9 | XX-1100779 | 1/01/2022 | DD00002 | |
| 10 | XX-1101156 | 1/01/2022 | DD00002 | |
| 11 | XX-1101156 | 1/01/2022 | DD00003 | |
| 12 | XX-1103681 | 1/01/2022 | DD00003 | |
| 13 | XX-1104519 | 1/01/2022 | DD00148 | |
| 14 | XX-1104519 | 1/01/2022 | DD00368 | |
| 15 | XX-1104519 | 1/01/2022 | DD00151 | |

Query Settings

PROPERTIES

Name: Transform Sample File

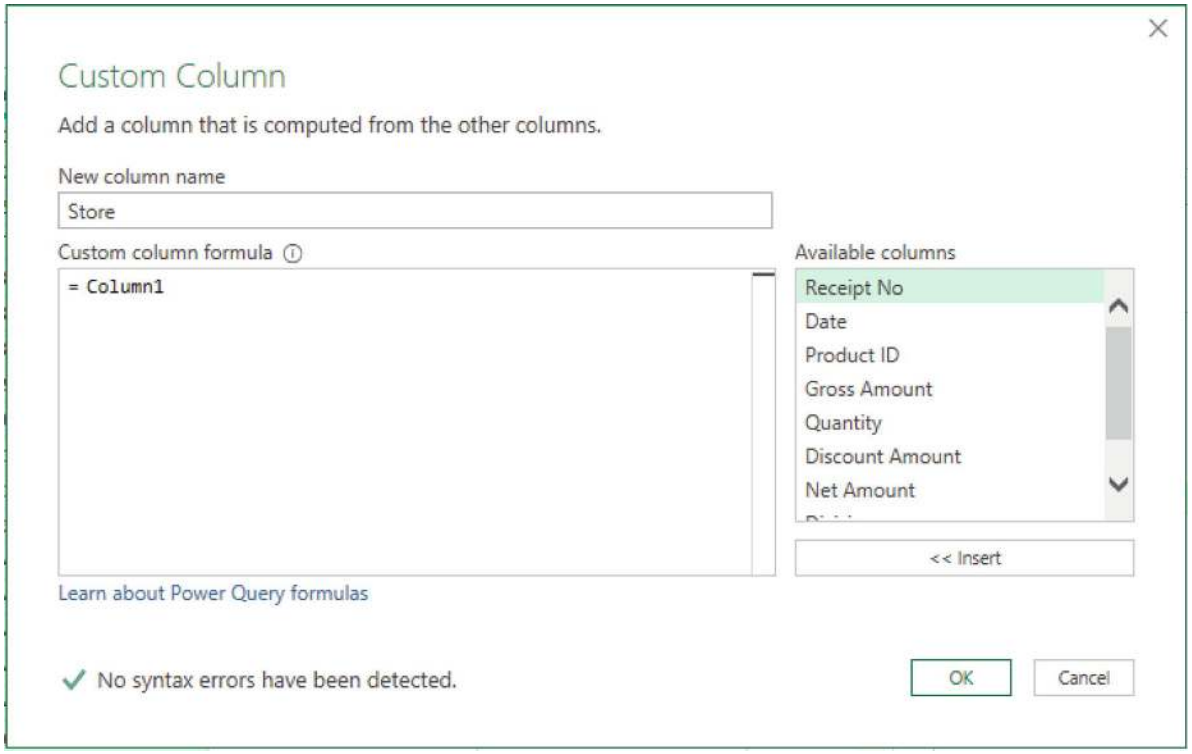
All Properties

APPLIED STEPS

- Source
- Navigation
- Custom1
- Removed Top Rows
- Promoted Headers
- Changed Type

***Figure 1-43*** Result of promoting the headers

In the next step, go to the Add Column tab and click the Custom Column command. In the open window, shown in Figure 1-44, name the column Store and enter the `=Column1` formula (which extracts the store name from the two steps previously). This will result in the table shown in Figure 1-45, creating a new column that includes the store number for all the rows.



Custom Column

Add a column that is computed from the other columns.

New column name: Store

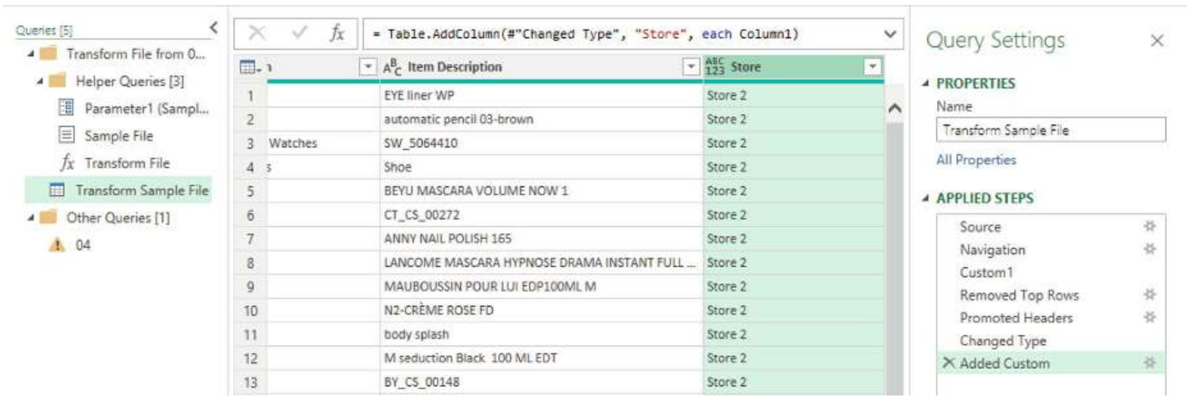
Custom column formula:

```
= Column1
```

Available columns: Receipt No, Date, Product ID, Gross Amount, Quantity, Discount Amount, Net Amount

<< Insert
Learn about Power Query formulas
No syntax errors have been detected.
OK
Cancel

***Figure 1-44*** Custom column window



```
= Table.AddColumn(#"Changed Type", "Store", each Column1)
```

| | 1 | Item Description | Store |
|---|---|---|---|
| 1 | | EYE liner WP | Store 2 |
| 2 | | automatic pencil 03-brown | Store 2 |
| 3 | Watches | SW_5064410 | Store 2 |
| 4 | s | Shoe | Store 2 |
| 5 | | BEYU MASCARA VOLUME NOW 1 | Store 2 |
| 6 | | CT_CS_00272 | Store 2 |
| 7 | | ANNY NAIL POLISH 165 | Store 2 |
| 8 | | LANCOME MASCARA HYPNOSE DRAMA INSTANT FULL ... | Store 2 |
| 9 | | MAUBOUSSIN POUR LUI EDP100ML M | Store 2 |
| 10 | | N2-CRÈME ROSE FD | Store 2 |
| 11 | | body splash | Store 2 |
| 12 | | M seduction Black 100 ML EDT | Store 2 |
| 13 | | BY_CS_00148 | Store 2 |

Query Settings

PROPERTIES

Name: Transform Sample File

All Properties

APPLIED STEPS

- Source
- Navigation
- Custom1
- Removed Top Rows
- Promoted Headers
- Changed Type
- Added Custom

***Figure 1-45*** Adding a custom column

By following these steps, the result of Query 04 will return an error. To finalize the solution, go to this query and simply remove the last step (Change Type).

## Handling Multi-Row Headers in Excel Tables

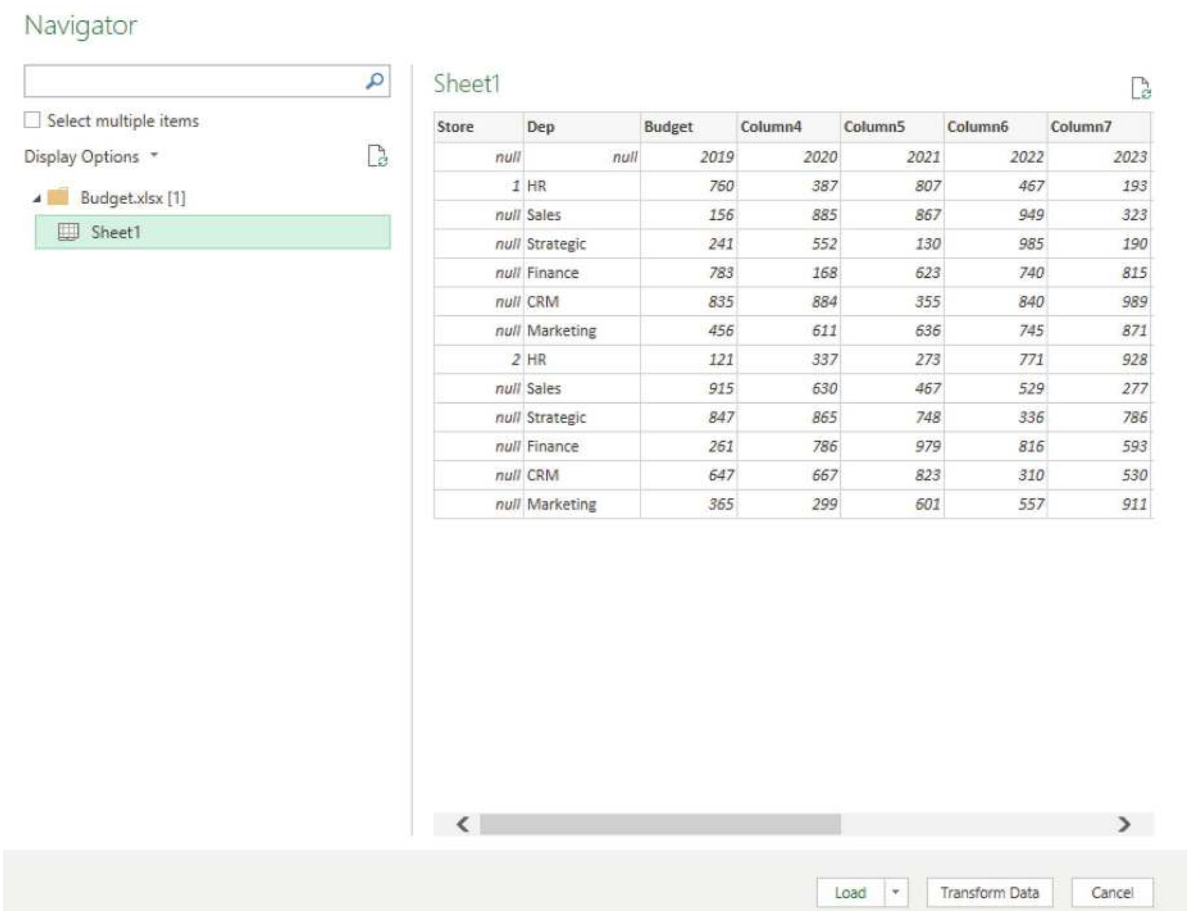
The budget/cost data for two different stores of a company over different years is saved in Excel file as the Source table (see Table 1-2). Since you cannot use merged cells in Power Query, combine the first two rows and treat their combination as headers, such as Budget:2019, Budget:2020, Budget:2021, and so on.

***Table 1-2*** Source Table

| **Store** | **Dept** | **Budget** | | | | | **Actual** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **2019** | **2020** | **2021** | **2022** | **2023** | **2019** | **2020** | **2021** | **2022** | **2023** |
| 1 | HR | 760 | 387 | 807 | 467 | 193 | 914 | 298 | 1065 | 505 | 254 |
| | Sales | 156 | 885 | 867 | 949 | 323 | 151 | 1191 | 1188 | 1153 | 270 |
| | Strategic | 241 | 552 | 130 | 985 | 190 | 296 | 516 | 99 | 1141 | 177 |
| | Finance | 783 | 168 | 623 | 740 | 815 | 823 | 178 | 519 | 718 | 726 |
| | CRM | 835 | 884 | 355 | 840 | 989 | 686 | 602 | 249 | 738 | 874 |
| | Marketing | 456 | 611 | 636 | 745 | 871 | 449 | 767 | 534 | 854 | 638 |
| 2 | HR | 121 | 337 | 273 | 771 | 928 | 89 | 341 | 285 | 494 | 1031 |
| | Sales | 915 | 630 | 467 | 529 | 277 | 1361 | 480 | 498 | 511 | 363 |
| | Strategic | 847 | 865 | 748 | 336 | 786 | 747 | 614 | 769 | 323 | 811 |
| | Finance | 261 | 786 | 979 | 816 | 593 | 313 | 945 | 986 | 453 | 586 |
| | CRM | 647 | 667 | 823 | 310 | 530 | 845 | 525 | 754 | 260 | 667 |
| | Marketing | 365 | 299 | 601 | 557 | 911 | 314 | 401 | 460 | 699 | 796 |

**Note** The data in this example is provided in an Excel file titled `Budget.xlsx`.

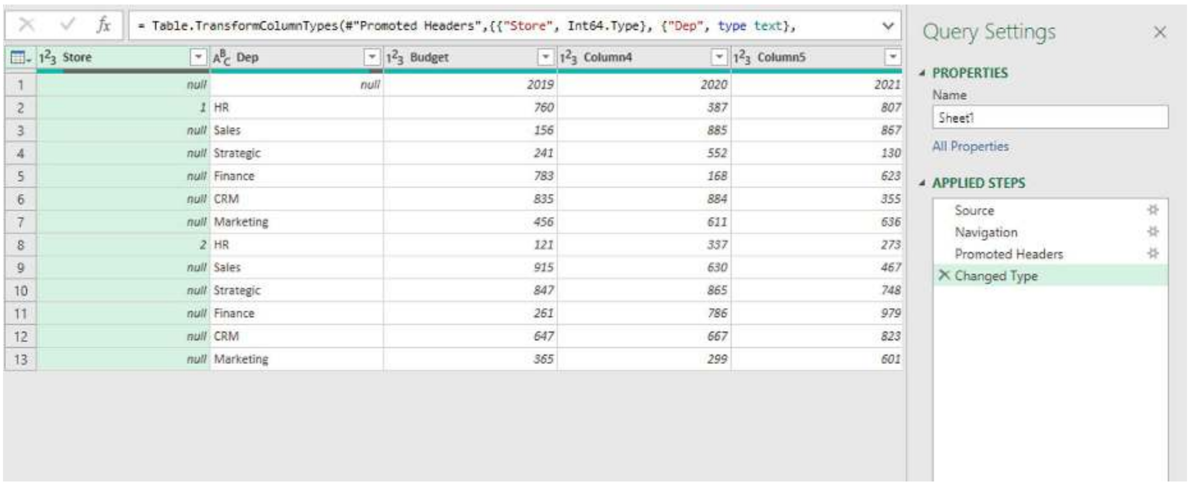
To solve this problem, open a blank Excel file, and from the Data tab, in the Get Data section, select From File, then From Excel Workbook (see Figure 1-46). In the open window, navigate to the Excel file (`Budget.xlsx`), and in the Navigator window, select Sheet 1. Then, click the Transform Data button to load the data into the Power Query Editor, as shown in Figure 1-47.



Sheet1

| Store | Dep | Budget | Column4 | Column5 | Column6 | Column7 |
|---|---|---|---|---|---|---|
| null | null | 2019 | 2020 | 2021 | 2022 | 2023 |
| 1 | HR | 760 | 387 | 807 | 467 | 193 |
| null | Sales | 156 | 885 | 867 | 949 | 323 |
| null | Strategic | 241 | 552 | 130 | 985 | 190 |
| null | Finance | 783 | 168 | 623 | 740 | 815 |
| null | CRM | 835 | 884 | 355 | 840 | 989 |
| null | Marketing | 456 | 611 | 636 | 745 | 871 |
| 2 | HR | 121 | 337 | 273 | 771 | 928 |
| null | Sales | 915 | 630 | 467 | 529 | 277 |
| null | Strategic | 847 | 865 | 748 | 336 | 786 |
| null | Finance | 261 | 786 | 979 | 816 | 593 |
| null | CRM | 647 | 667 | 823 | 310 | 530 |
| null | Marketing | 365 | 299 | 601 | 557 | 911 |

*Figure 1-46* Navigation Excel file



```
= Table.TransformColumnTypes(#"Promoted Headers",{{"Store", Int64.Type}, {"Dep", type text},
```

| | Store | Dep | Budget | Column4 | Column5 |
|---|---|---|---|---|---|
| 1 | null | null | 2019 | 2020 | 2021 |
| 2 | 1 | HR | 760 | 387 | 807 |
| 3 | null | Sales | 156 | 885 | 867 |
| 4 | null | Strategic | 241 | 552 | 130 |
| 5 | null | Finance | 783 | 168 | 623 |
| 6 | null | CRM | 835 | 884 | 355 |
| 7 | null | Marketing | 456 | 611 | 636 |
| 8 | 2 | HR | 121 | 337 | 273 |
| 9 | null | Sales | 915 | 630 | 467 |
| 10 | null | Strategic | 847 | 865 | 748 |
| 11 | null | Finance | 261 | 786 | 979 |
| 12 | null | CRM | 647 | 667 | 823 |
| 13 | null | Marketing | 365 | 299 | 601 |

Query Settings

PROPERTIES

Name: Sheet1

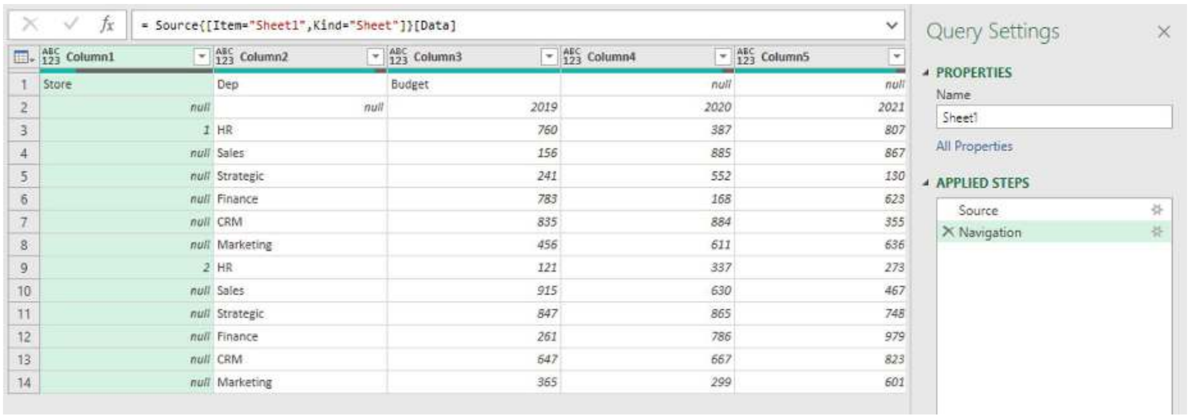
All Properties

APPLIED STEPS

- Source
- Navigation
- Promoted Headers
- Changed Type

*Figure 1-47* The Power Query Editor

If you follow this process, a query named Sheet1 with four steps—Source, Navigation, Promoted Headers, and Changed Type—will be generated. Remove the last two steps (Promoted Headers and Changed Type) to reach Figure 1-48, where null values are provided for any merged cell. (As in the source table, cells C1:C8 are merged, and the word "Budget" is written in them. If you unmerge the cells, the text "Budget" will remain in cell C1, while the other cells will become blank.)

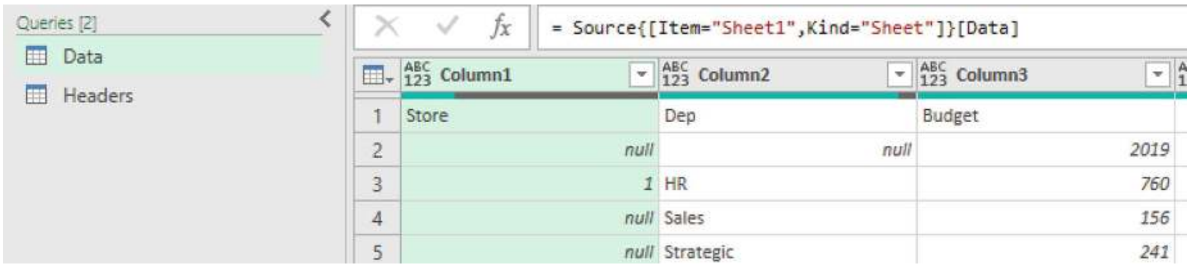


```
= Source{[Item="Sheet1",Kind="Sheet"]}[Data]
```

| | Column1 | Column2 | Column3 | Column4 | Column5 |
|---|---|---|---|---|---|
| 1 | Store | Dep | Budget | null | null |
| 2 | null | null | 2019 | 2020 | 2021 |
| 3 | 1 | HR | 760 | 387 | 807 |
| 4 | null | Sales | 156 | 885 | 867 |
| 5 | null | Strategic | 241 | 552 | 130 |
| 6 | null | Finance | 783 | 168 | 623 |
| 7 | null | CRM | 835 | 884 | 355 |
| 8 | null | Marketing | 456 | 611 | 636 |
| 9 | 2 | HR | 121 | 337 | 273 |
| 10 | null | Sales | 915 | 630 | 467 |
| 11 | null | Strategic | 847 | 865 | 748 |
| 12 | null | Finance | 261 | 786 | 979 |
| 13 | null | CRM | 647 | 667 | 823 |
| 14 | null | Marketing | 365 | 299 | 601 |

*Figure 1-48* Navigation step

To solve the rest of this problem, you need to extract the first two rows and merge them to create the correct column names, which you will then use as the header. While this can be done within the same query, to make the process clearer, you can perform these steps in a separate query. From the query pane, right-click the query name and choose the Duplicate command to copy the query. Rename one of the queries Data and another one Headers. See Figure 1-49.

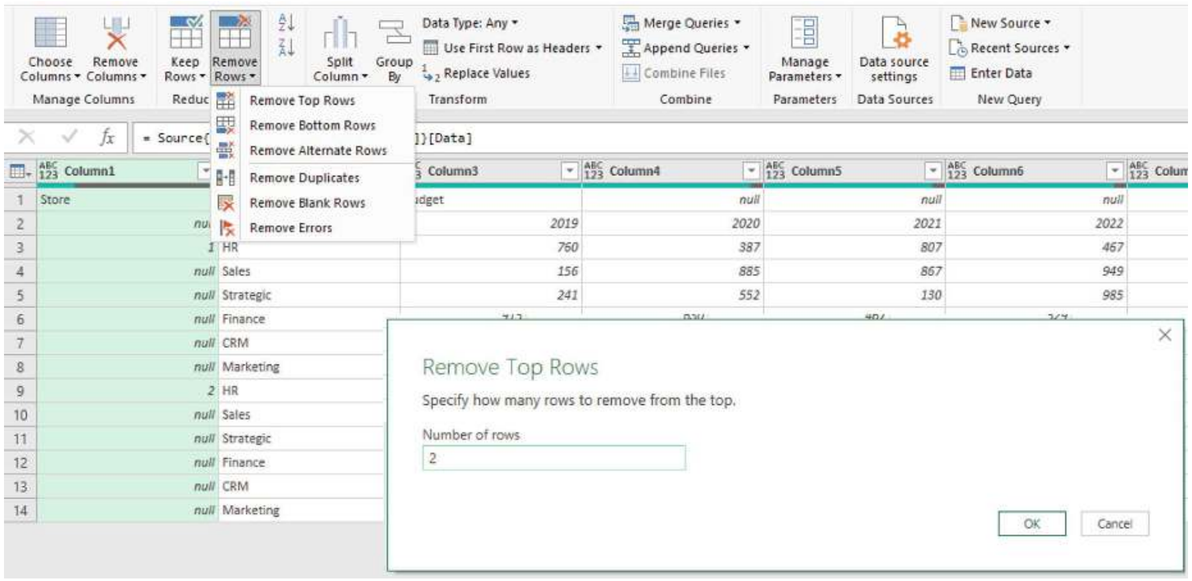


```
= Source{[Item="Sheet1",Kind="Sheet"]}[Data]
```

| | Column1 | Column2 | Column3 |
|---|---|---|---|
| 1 | Store | Dep | Budget |
| 2 | null | null | 2019 |
| 3 | 1 | HR | 760 |
| 4 | null | Sales | 156 |
| 5 | null | Strategic | 241 |

*Figure 1-49* Duplicating a query

On the Data query, from the Home tab, in the Reduce Rows section, select the Remove Rows command, then choose the Remove Top Rows option. Then enter 2 in the open window, as shown in Figure 1-50. Click OK to remove the top rows; see Figure 1-51.



```
= Source{
]}[Data]
```

| | Column1 | | Column3 | Column4 | Column5 | Column6 |
|---|---|---|---|---|---|---|
| 1 | Store | | dget | null | null | null |
| 2 | nu | | 2019 | 2020 | 2021 | 2022 |
| 3 | 1 | HR | 760 | 387 | 807 | 467 |
| 4 | null | Sales | 156 | 885 | 867 | 949 |
| 5 | null | Strategic | 241 | 552 | 130 | 985 |
| 6 | null | Finance | | | | |
| 7 | null | CRM | | | | |
| 8 | null | Marketing | | | | |
| 9 | 2 | HR | | | | |
| 10 | null | Sales | | | | |
| 11 | null | Strategic | | | | |
| 12 | null | Finance | | | | |
| 13 | null | CRM | | | | |
| 14 | null | Marketing | | | | |

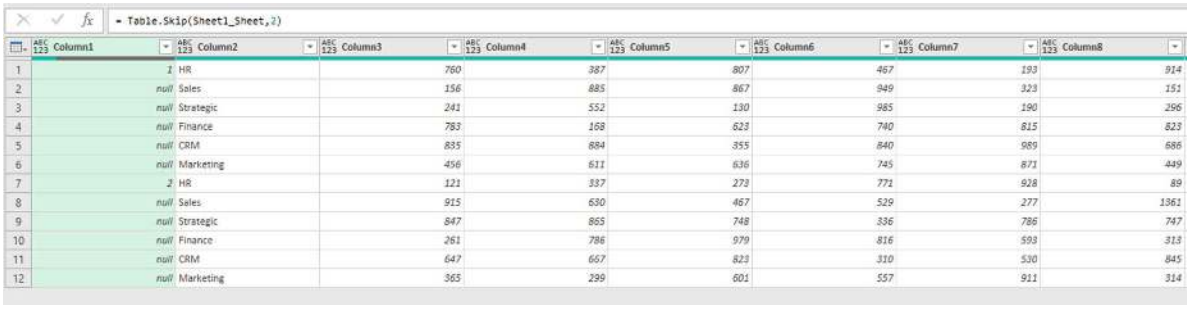
Remove Top Rows

Specify how many rows to remove from the top.

Number of rows

2

*Figure 1-50* Remove top rows

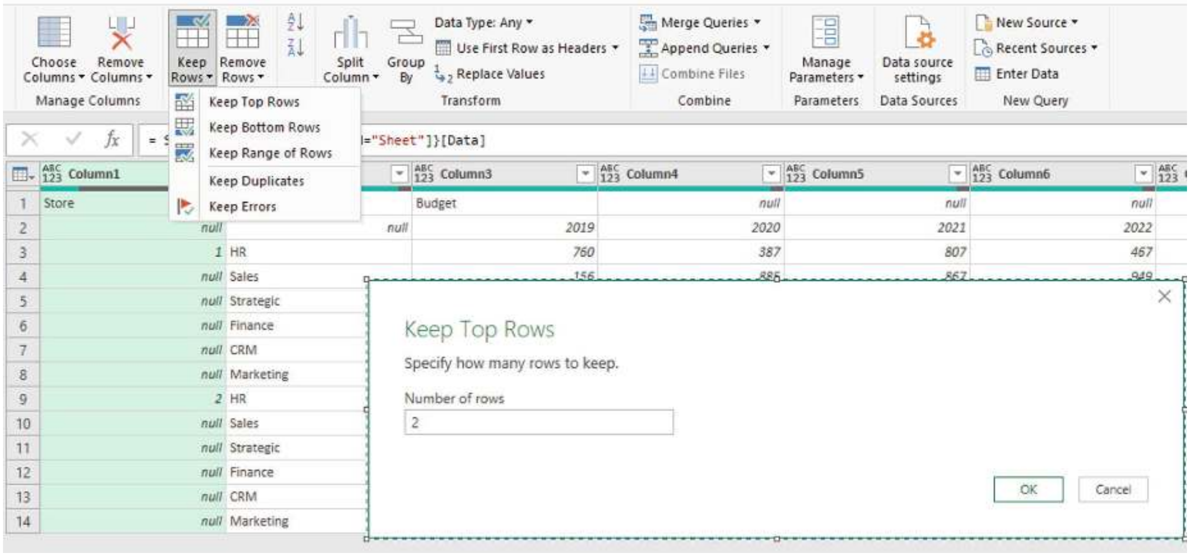


```
= Table.Skip(Sheet1_Sheet,2)
```

|  | Column1 | Column2 | Column3 | Column4 | Column5 | Column6 | Column7 | Column8 |
|---|---|---|---|---|---|---|---|---|
| 1 | 1 | HR | 760 | 387 | 807 | 467 | 193 | 914 |
| 2 | null | Sales | 156 | 885 | 867 | 949 | 323 | 151 |
| 3 | null | Strategic | 241 | 552 | 130 | 985 | 190 | 296 |
| 4 | null | Finance | 783 | 168 | 623 | 740 | 815 | 823 |
| 5 | null | CRM | 835 | 884 | 355 | 840 | 989 | 686 |
| 6 | null | Marketing | 456 | 611 | 636 | 745 | 871 | 449 |
| 7 | 2 | HR | 121 | 337 | 273 | 771 | 928 | 89 |
| 8 | null | Sales | 915 | 630 | 467 | 529 | 277 | 1361 |
| 9 | null | Strategic | 847 | 865 | 748 | 336 | 786 | 747 |
| 10 | null | Finance | 261 | 786 | 979 | 816 | 593 | 313 |
| 11 | null | CRM | 647 | 667 | 823 | 310 | 530 | 845 |
| 12 | null | Marketing | 365 | 299 | 601 | 557 | 911 | 314 |

*Figure 1-51* The result of removing the top rows

In the Headers query, from the Home tab, in the Reduce Rows section, select Keep Rows and then Keep Top Rows. Enter 2 in the open window, as shown in Figure 1-52. This process results in Figure 1-53.



```
= S ... ="Sheet"]}[Data]
```

|  | Column1 |  | Column3 | Column4 | Column5 | Column6 |
|---|---|---|---|---|---|---|
| 1 | Store |  | Budget | null | null | null |
| 2 | null | null | 2019 | 2020 | 2021 | 2022 |
| 3 | 1 | HR | 760 | 387 | 807 | 467 |
| 4 | null | Sales | 156 | 885 | 867 | 949 |
| 5 | null | Strategic |  |  |  |  |
| 6 | null | Finance |  |  |  |  |
| 7 | null | CRM |  |  |  |  |
| 8 | null | Marketing |  |  |  |  |
| 9 | 2 | HR |  |  |  |  |
| 10 | null | Sales |  |  |  |  |
| 11 | null | Strategic |  |  |  |  |
| 12 | null | Finance |  |  |  |  |
| 13 | null | CRM |  |  |  |  |
| 14 | null | Marketing |  |  |  |  |

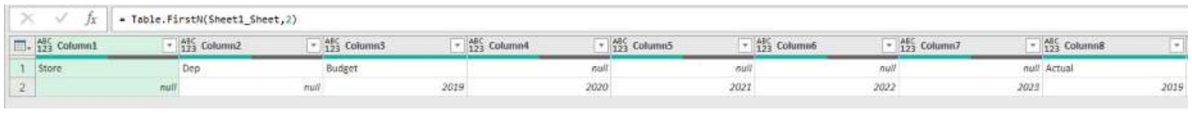
Keep Top Rows

Specify how many rows to keep.

Number of rows: 2

OK Cancel

*Figure 1-52* Keep the top rows

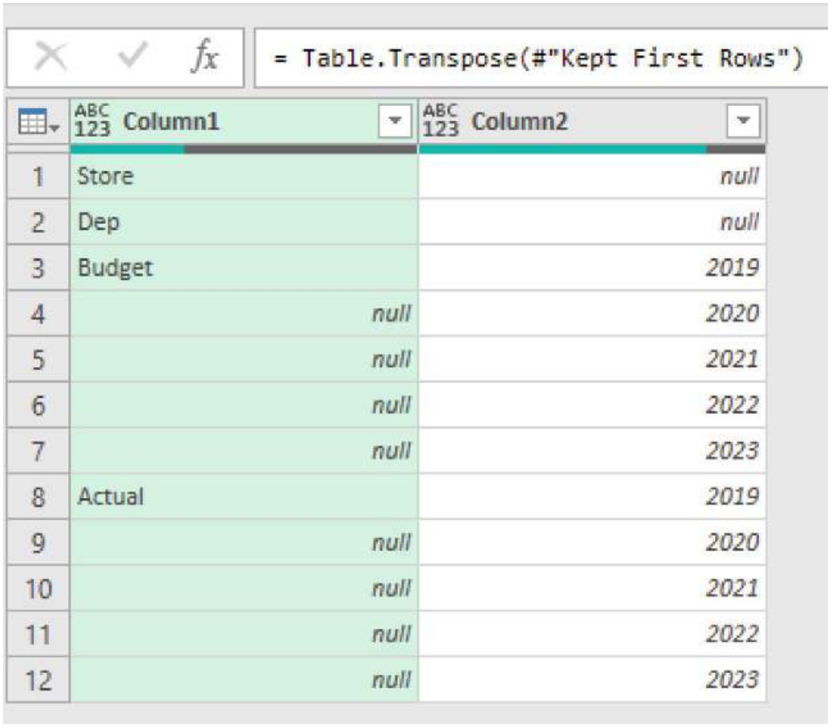


```
= Table.FirstN(Sheet1_Sheet,2)
```

|  | Column1 | Column2 | Column3 | Column4 | Column5 | Column6 | Column7 | Column8 |
|---|---|---|---|---|---|---|---|---|
| 1 | Store | Dep | Budget | null | null | null | null | Actual |
| 2 | null | null | 2019 | 2020 | 2021 | 2022 | 2023 | 2019 |

*Figure 1-53* The result of keeping the top rows

Then, in the Headers query, from the Transform tab, select Transpose to achieve the transpose version of the data, as shown in Figure 1-54.

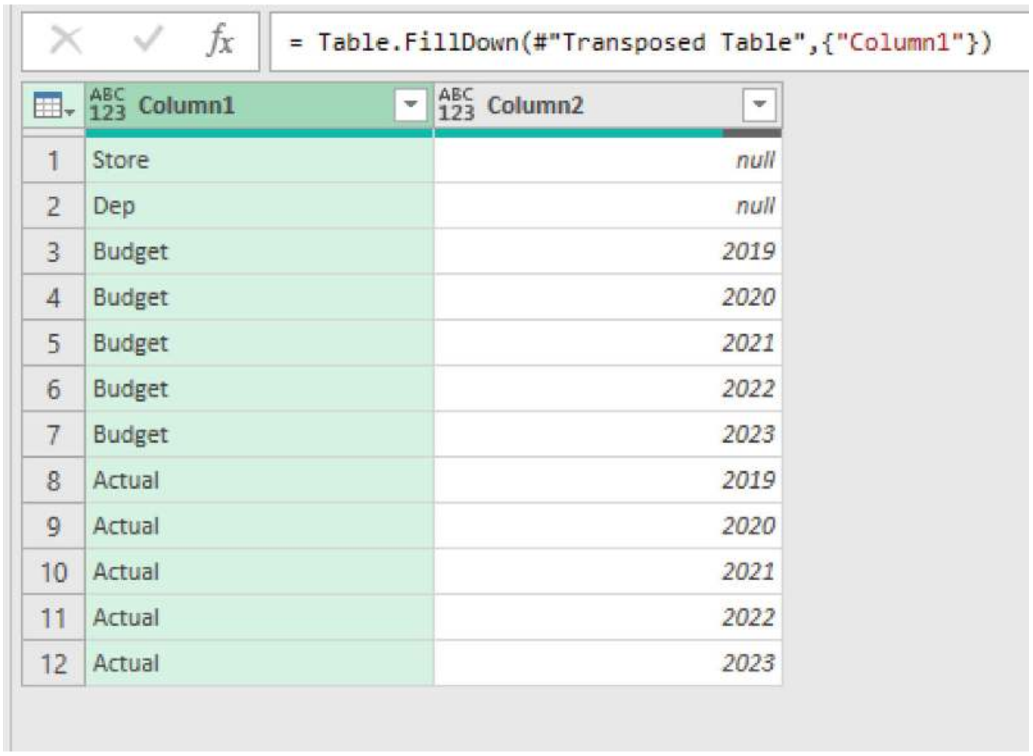


```
= Table.Transpose(#"Kept First Rows")
```

| | Column1 | Column2 |
|---|---|---|
| 1 | Store | null |
| 2 | Dep | null |
| 3 | Budget | 2019 |
| 4 | null | 2020 |
| 5 | null | 2021 |
| 6 | null | 2022 |
| 7 | null | 2023 |
| 8 | Actual | 2019 |
| 9 | null | 2020 |
| 10 | null | 2021 |
| 11 | null | 2022 |
| 12 | null | 2023 |

***Figure 1-54*** Transposing the table

At this step, you need to replace any null values in Column1 with the previous non-null value in this column. Select the Column1 column, and from the Transform tab, choose Fill Down to replace the null cells with the value from the upper cells, resulting in Figure 1-55.

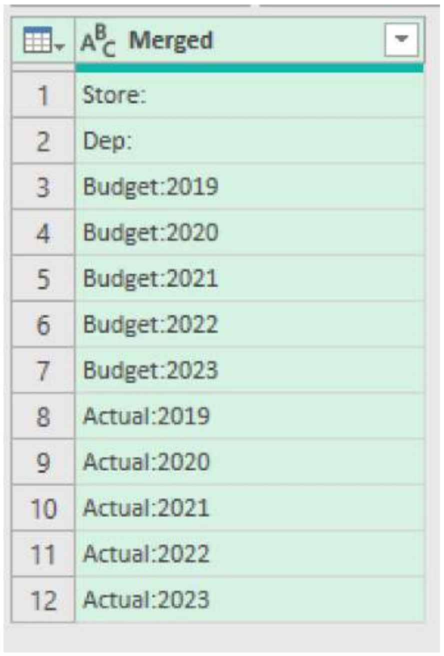


```
= Table.FillDown(#"Transposed Table",{"Column1"})
```

| | Column1 | Column2 |
|---|---|---|
| 1 | Store | null |
| 2 | Dep | null |
| 3 | Budget | 2019 |
| 4 | Budget | 2020 |
| 5 | Budget | 2021 |
| 6 | Budget | 2022 |
| 7 | Budget | 2023 |
| 8 | Actual | 2019 |
| 9 | Actual | 2020 |
| 10 | Actual | 2021 |
| 11 | Actual | 2022 |
| 12 | Actual | 2023 |

***Figure 1-55*** Using Fill Down

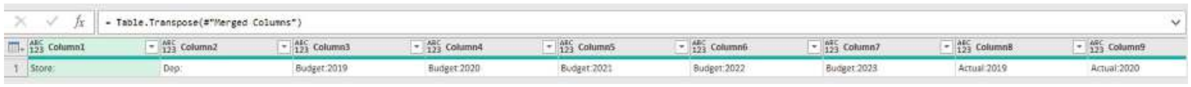
Next, select the Column1 column, hold Ctrl, and then select the Column2 column. Right-click one of them, choose Merge Columns, and select Colon as the separator in the open window. Figure 1-56 shows the right column names.



| | Merged |
|---|---|
| 1 | Store: |
| 2 | Dep: |
| 3 | Budget:2019 |
| 4 | Budget:2020 |
| 5 | Budget:2021 |
| 6 | Budget:2022 |
| 7 | Budget:2023 |
| 8 | Actual:2019 |
| 9 | Actual:2020 |
| 10 | Actual:2021 |
| 11 | Actual:2022 |
| 12 | Actual:2023 |

***Figure 1-56*** Merging columns

To use this column name, from the Transform tab, select the Transpose command to achieve Figure 1-57.

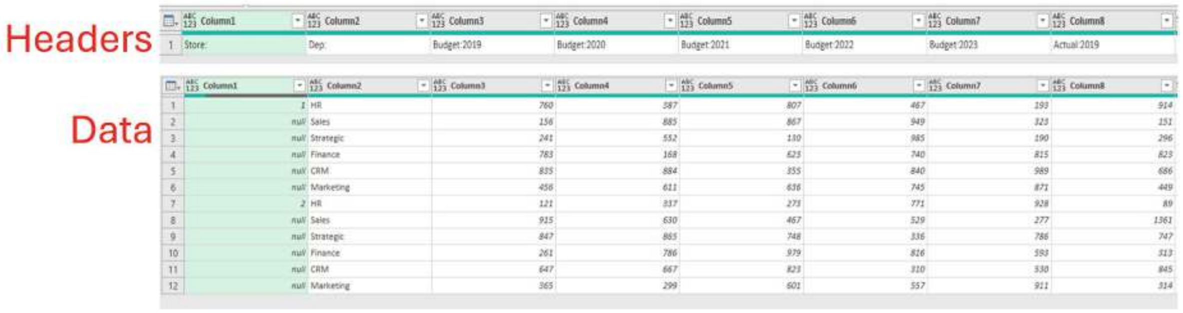


```
= Table.Transpose(#"Merged Columns")
```

| | Column1 | Column2 | Column3 | Column4 | Column5 | Column6 | Column7 | Column8 | Column9 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Store: | Dep: | Budget:2019 | Budget:2020 | Budget:2021 | Budget:2022 | Budget:2023 | Actual:2019 | Actual:2020 |

***Figure 1-57*** Transposing

By following these steps, two queries—Headers and Data—are created, as shown in Figure 1-58. In the next step, you simply need to combine these two queries by placing one under the other, a process referred to as *appending* in Power Query.



| | Column1 | Column2 | Column3 | Column4 | Column5 | Column6 | Column7 | Column8 |
|---|---|---|---|---|---|---|---|---|
| 1 | Store: | Dep: | Budget:2019 | Budget:2020 | Budget:2021 | Budget:2022 | Budget:2023 | Actual:2019 |

| | Column1 | Column2 | Column3 | Column4 | Column5 | Column6 | Column7 | Column8 |
|---|---|---|---|---|---|---|---|---|
| 1 | 1 | HR | 760 | 587 | 807 | 467 | 193 | 914 |
| 2 | null | Sales | 156 | 885 | 867 | 949 | 323 | 151 |
| 3 | null | Strategic | 241 | 552 | 130 | 985 | 190 | 296 |
| 4 | null | Finance | 783 | 168 | 625 | 740 | 815 | 823 |
| 5 | null | CRM | 835 | 884 | 355 | 840 | 989 | 686 |
| 6 | null | Marketing | 456 | 611 | 636 | 745 | 871 | 449 |
| 7 | 2 | HR | 121 | 337 | 273 | 771 | 928 | 89 |
| 8 | null | Sales | 915 | 630 | 467 | 529 | 277 | 1361 |
| 9 | null | Strategic | 847 | 865 | 748 | 336 | 786 | 747 |
| 10 | null | Finance | 261 | 786 | 979 | 816 | 593 | 313 |
| 11 | null | CRM | 647 | 667 | 823 | 310 | 330 | 845 |
| 12 | null | Marketing | 365 | 299 | 601 | 557 | 911 | 314 |

***Figure 1-58*** The two results tables

In the next step, while the Header query is still selected, from the Home tab, select the Append Queries command. In the open window, choose the Data query as the table to append (see Figure 1-59). Click OK, which results in Figure 1-60.

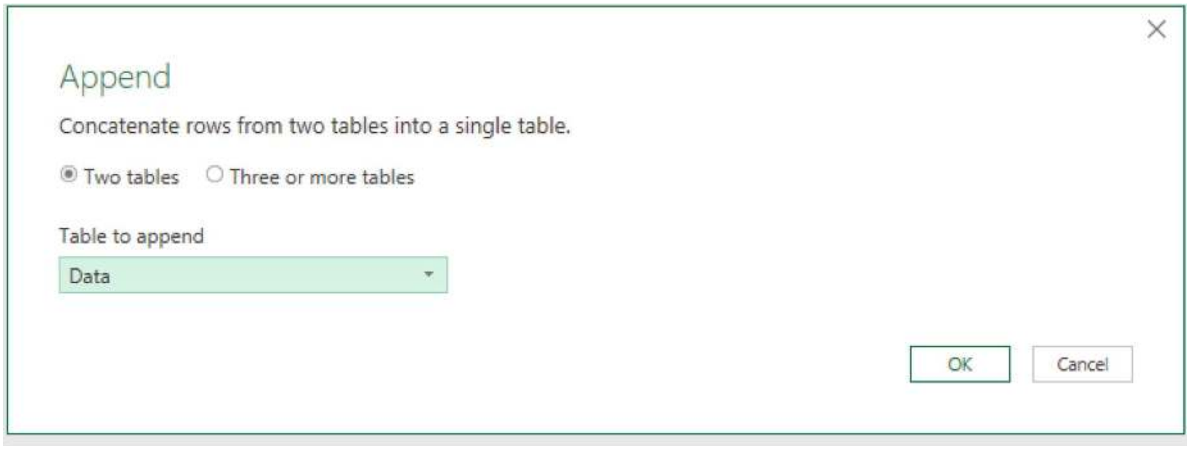
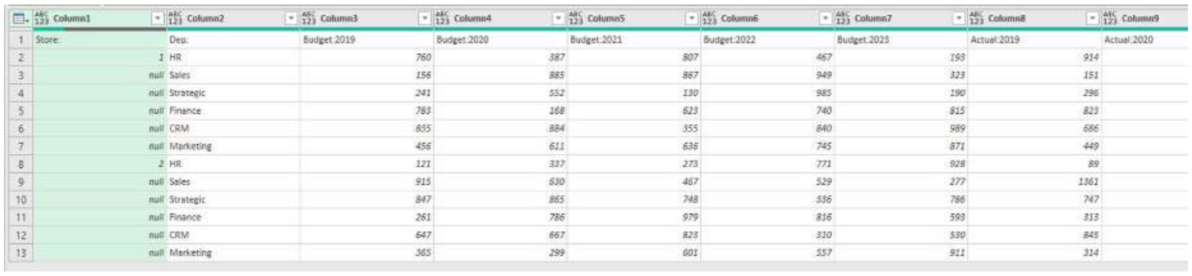


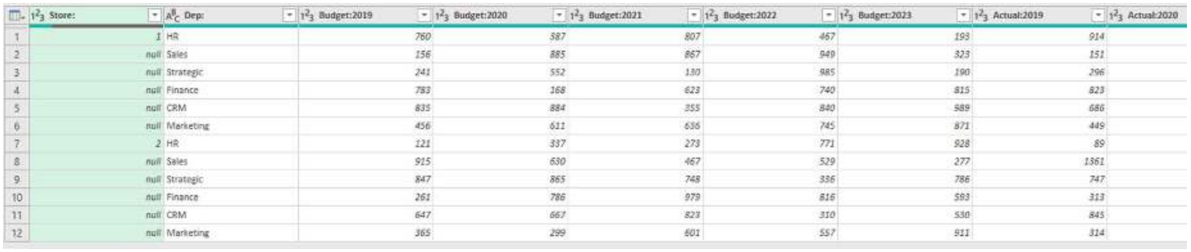
*Figure 1-59* Appending queries



| | Column1 | Column2 | Column3 | Column4 | Column5 | Column6 | Column7 | Column8 | Column9 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Store: | Dep: | Budget:2019 | Budget:2020 | Budget:2021 | Budget:2022 | Budget:2023 | Actual:2019 | Actual:2020 |
| 2 | 1 | HR | 760 | 387 | 807 | 467 | 193 | 914 | |
| 3 | null | Sales | 156 | 885 | 867 | 949 | 323 | 151 | |
| 4 | null | Strategic | 241 | 552 | 130 | 985 | 190 | 296 | |
| 5 | null | Finance | 783 | 168 | 623 | 740 | 815 | 823 | |
| 6 | null | CRM | 835 | 884 | 355 | 840 | 989 | 686 | |
| 7 | null | Marketing | 456 | 611 | 636 | 745 | 871 | 449 | |
| 8 | 2 | HR | 121 | 337 | 273 | 771 | 928 | 89 | |
| 9 | null | Sales | 915 | 630 | 467 | 529 | 277 | 1361 | |
| 10 | null | Strategic | 847 | 865 | 748 | 336 | 786 | 747 | |
| 11 | null | Finance | 261 | 786 | 979 | 816 | 593 | 313 | |
| 12 | null | CRM | 647 | 667 | 823 | 310 | 530 | 845 | |
| 13 | null | Marketing | 365 | 299 | 601 | 557 | 911 | 314 | |

*Figure 1-60* The result of appending queries

In the final step, from the Transform tab, select the Use First Row as Headers command; see Figure 1-61.



| | Store: | Dep: | Budget:2019 | Budget:2020 | Budget:2021 | Budget:2022 | Budget:2023 | Actual:2019 | Actual:2020 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | HR | 760 | 387 | 807 | 467 | 193 | 914 | |
| 2 | null | Sales | 156 | 885 | 867 | 949 | 323 | 151 | |
| 3 | null | Strategic | 241 | 552 | 130 | 985 | 190 | 296 | |
| 4 | null | Finance | 783 | 168 | 623 | 740 | 815 | 823 | |
| 5 | null | CRM | 835 | 884 | 355 | 840 | 989 | 686 | |
| 6 | null | Marketing | 456 | 611 | 636 | 745 | 871 | 449 | |
| 7 | 2 | HR | 121 | 337 | 273 | 771 | 928 | 89 | |
| 8 | null | Sales | 915 | 630 | 467 | 529 | 277 | 1361 | |
| 9 | null | Strategic | 847 | 865 | 748 | 336 | 786 | 747 | |
| 10 | null | Finance | 261 | 786 | 979 | 816 | 593 | 313 | |
| 11 | null | CRM | 647 | 667 | 823 | 310 | 530 | 845 | |
| 12 | null | Marketing | 365 | 299 | 601 | 557 | 911 | 314 | |

*Figure 1-61* The result of using the first row as headers

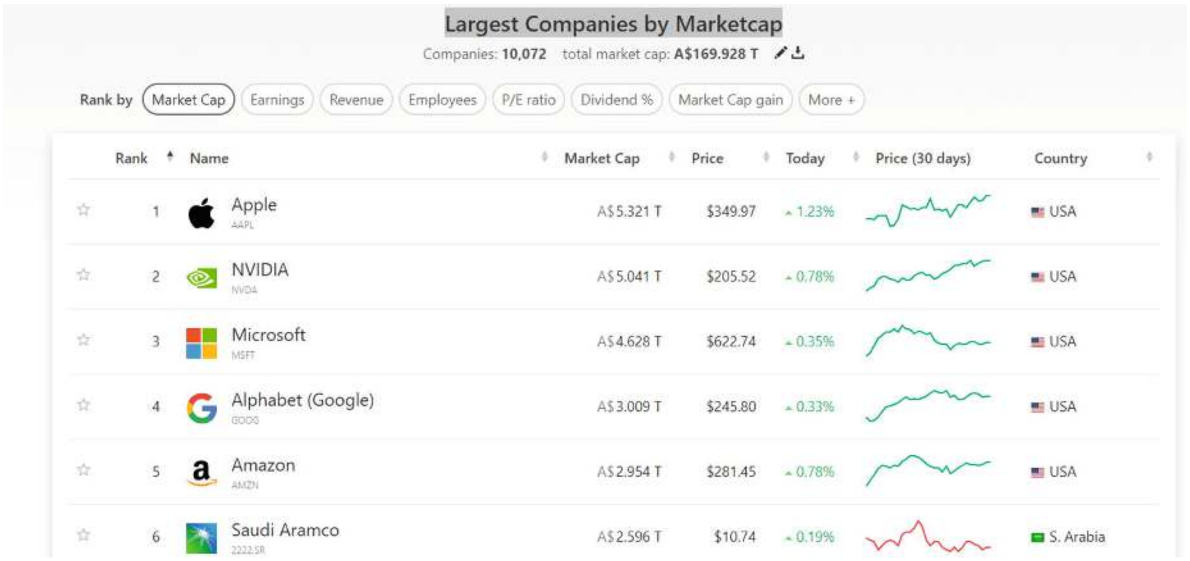
Now that the problem is almost resolved, rename the first two columns, removing the **:** (colon) from the end of their names. Additionally, use the Fill Down command for the Store column to replace null cells with the values from the upper cells.

**Note** To solve this problem, you initially duplicated the query, extracted the first two rows as headers, and applied several steps to format the column headers appropriately. While it would have been possible to apply all these steps (transposing, filling down, and merging the column) directly to the main query, there isn't a significant difference between the solutions in this example. However, when dealing with large datasets, applying these transformations to the entire dataset is confusing. Therefore, it is better to follow the approach presented here, by separating the first two rows and applying the transformations on them, rather than applying all the steps to the entire dataset.

## Loading Data from a Webpage

This example explores how to load data from a webpage. Consider the following URL, which contains information about 10,072 companies, sorted based on their market cap, as shown in Figure 1-62. Each page provides information on 100 companies. Try to load the data for the first 100 largest companies, shown in the first page.

`https://companiesmarketcap.com/aud/`



Largest Companies by Marketcap

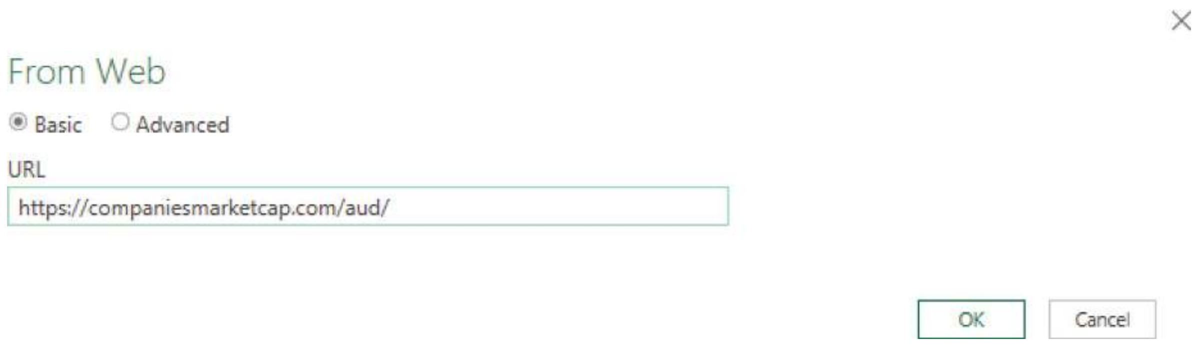
Companies: 10,072 total market cap: A$169.928 T

Rank by: Market Cap | Earnings | Revenue | Employees | P/E ratio | Dividend % | Market Cap gain | More +

| Rank | Name | Market Cap | Price | Today | Price (30 days) | Country |
|---|---|---|---|---|---|---|
| 1 | Apple AAPL | A$5.321 T | $349.97 | 1.23% | | USA |
| 2 | NVIDIA NVDA | A$5.041 T | $205.52 | 0.78% | | USA |
| 3 | Microsoft MSFT | A$4.628 T | $622.74 | 0.35% | | USA |
| 4 | Alphabet (Google) GOOG | A$3.009 T | $245.80 | 0.33% | | USA |
| 5 | Amazon AMZN | A$2.954 T | $281.45 | 0.78% | | USA |
| 6 | Saudi Aramco 2222.SR | A$2.596 T | $10.74 | 0.19% | | S. Arabia |

*Figure 1-62* Appearance of website

On the first page, information about the first 100 companies is provided, so you only need to load the data from this page. In Excel, go to the Data tab, and in the Get & Transform section, select From Web. Then, paste the URL in the open window, as shown in Figure 1-63.



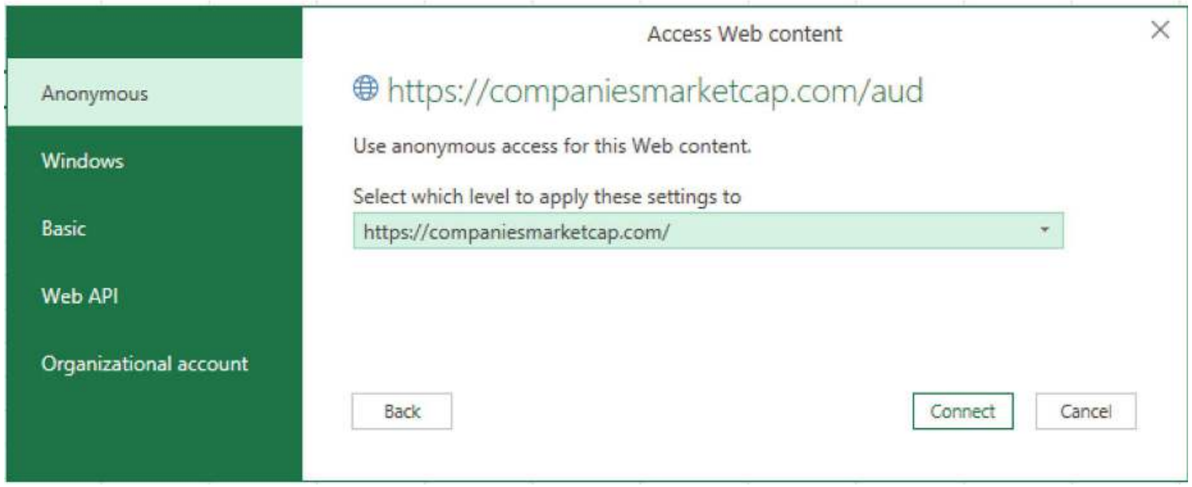
From Web

[✓ Basic] Advanced

URL: https://companiesmarketcap.com/aud/

*Figure 1-63* Choosing From Web

Clicking OK will open a new window related to Access Web Content, as shown in Figure 1-64. In this window, click Connect to reach the Navigation window.



https://companiesmarketcap.com/aud

Use anonymous access for this Web content.

Select which level to apply these settings to

https://companiesmarketcap.com/

***Figure 1-64*** Accessing web content

**Note** When loading data from the web, be aware of company-specific limitations on accessing data sources in Anonymous mode. Ensure compliance with data security policies and verify whether authentication is required for the intended source.

Next, in the Navigator window, select your desired table, as shown in Figure 1-65. In this example, it appears that the information shown in Table 5 is appropriate. Select this table and click Load to import the data into Excel.

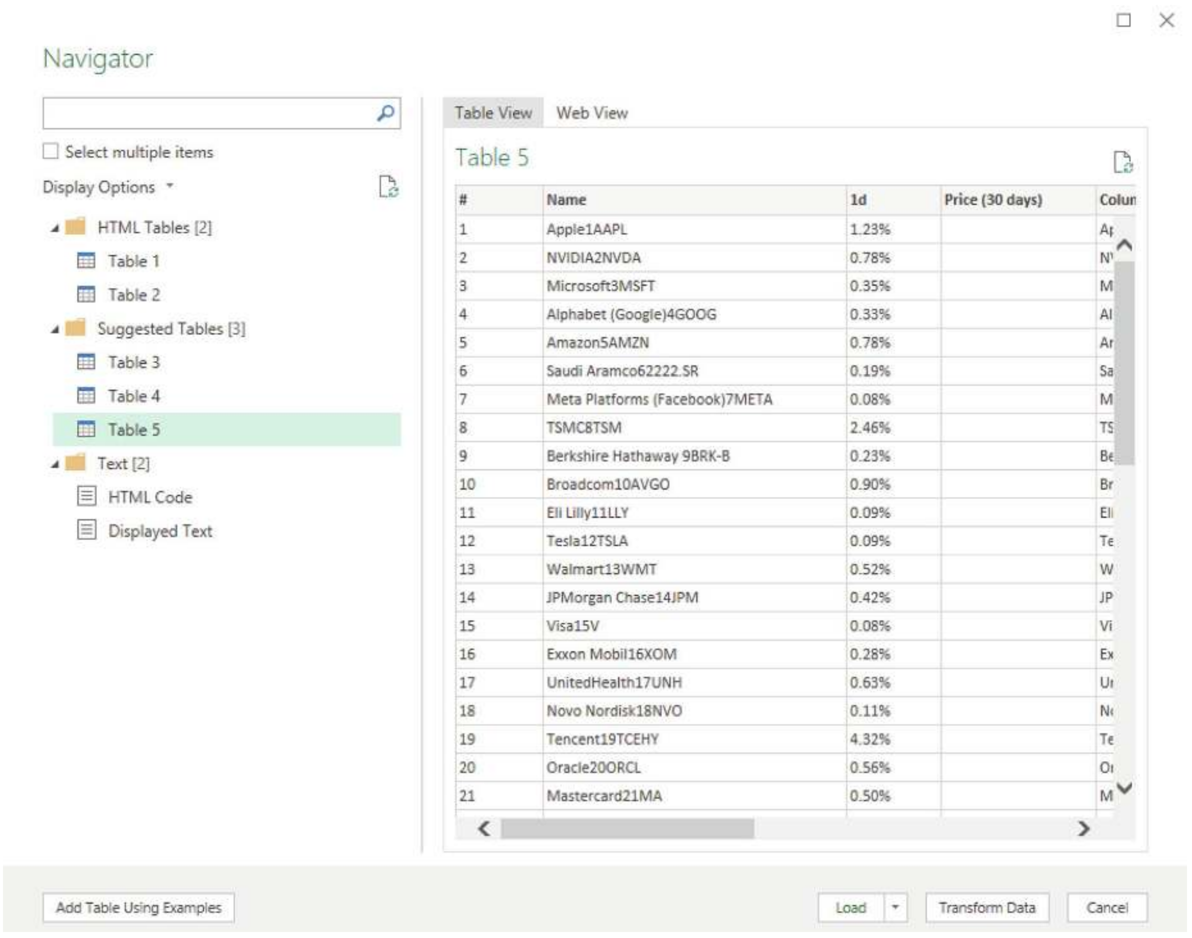
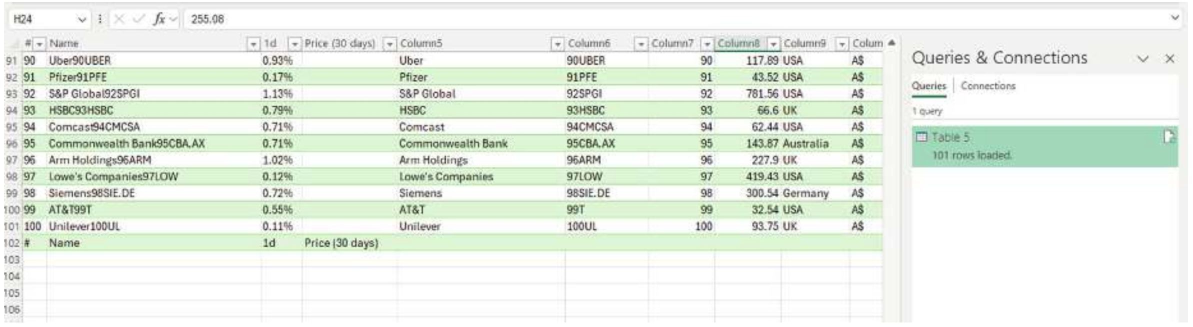


Table 5

| # | Name | 1d | Price (30 days) | Colun |
|---|---|---|---|---|
| 1 | Apple1AAPL | 1.23% | | Ap |
| 2 | NVIDIA2NVDA | 0.78% | | N' |
| 3 | Microsoft3MSFT | 0.35% | | M |
| 4 | Alphabet (Google)4GOOG | 0.33% | | Al |
| 5 | Amazon5AMZN | 0.78% | | Ar |
| 6 | Saudi Aramco62222.SR | 0.19% | | Sa |
| 7 | Meta Platforms (Facebook)7META | 0.08% | | M |
| 8 | TSMC8TSM | 2.46% | | TS |
| 9 | Berkshire Hathaway 9BRK-B | 0.23% | | Be |
| 10 | Broadcom10AVGO | 0.90% | | Br |
| 11 | Eli Lilly11LLY | 0.09% | | Eli |
| 12 | Tesla12TSLA | 0.09% | | Te |
| 13 | Walmart13WMT | 0.52% | | W |
| 14 | JPMorgan Chase14JPM | 0.42% | | JP |
| 15 | Visa15V | 0.08% | | Vi |
| 16 | Exxon Mobil16XOM | 0.28% | | Ex |
| 17 | UnitedHealth17UNH | 0.63% | | Ur |
| 18 | Novo Nordisk18NVO | 0.11% | | No |
| 19 | Tencent19TCEHY | 4.32% | | Te |
| 20 | Oracle20ORCL | 0.56% | | Or |
| 21 | Mastercard21MA | 0.50% | | M |

***Figure 1-65*** Navigator pane

After loading the data into Excel, it indicates that 101 rows have been loaded, as shown in Figure 1-66. This is due to the last row, which is not required, presenting some different information. To remove this row, right-click the query and select Edit. In the Power Query Editor, go to the Home tab, and in the Reduce Rows section, select Remove Bottom Rows. Enter 1 to remove the last row.



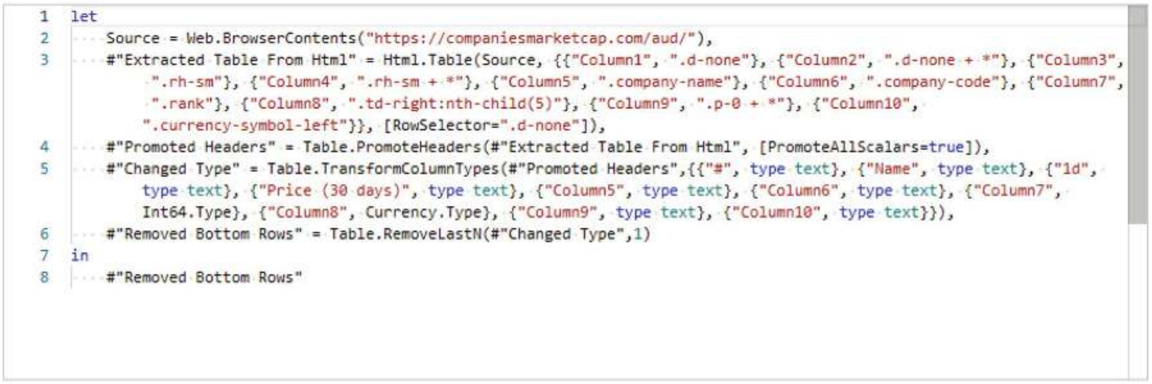
| | # | Name | 1d | Price (30 days) | Column5 | Column6 | Column7 | Column8 | Column9 | Colum |
|---|---|---|---|---|---|---|---|---|---|---|
| 91 | 90 | Uber90UBER | 0.93% | | Uber | 90UBER | 90 | 117.89 | USA | A$ |
| 92 | 91 | Pfizer91PFE | 0.17% | | Pfizer | 91PFE | 91 | 43.52 | USA | A$ |
| 93 | 92 | S&P Global92SPGI | 1.13% | | S&P Global | 92SPGI | 92 | 781.56 | USA | A$ |
| 94 | 93 | HSBC93HSBC | 0.79% | | HSBC | 93HSBC | 93 | 66.6 | UK | A$ |
| 95 | 94 | Comcast94CMCSA | 0.71% | | Comcast | 94CMCSA | 94 | 62.44 | USA | A$ |
| 96 | 95 | Commonwealth Bank95CBA.AX | 0.71% | | Commonwealth Bank | 95CBA.AX | 95 | 143.87 | Australia | A$ |
| 97 | 96 | Arm Holdings96ARM | 1.02% | | Arm Holdings | 96ARM | 96 | 227.9 | UK | A$ |
| 98 | 97 | Lowe's Companies97LOW | 0.12% | | Lowe's Companies | 97LOW | 97 | 419.43 | USA | A$ |
| 99 | 98 | Siemens98SIE.DE | 0.72% | | Siemens | 98SIE.DE | 98 | 300.54 | Germany | A$ |
| 100 | 99 | AT&T99T | 0.55% | | AT&T | 99T | 99 | 32.54 | USA | A$ |
| 101 | 100 | Unilever100UL | 0.11% | | Unilever | 100UL | 100 | 93.75 | UK | A$ |
| 102 | # | Name | 1d | Price (30 days) | | | | | | |
| 103 | | | | | | | | | | |
| 104 | | | | | | | | | | |
| 105 | | | | | | | | | | |
| 106 | | | | | | | | | | |

***Figure 1-66*** Resultant table

## Loading Data from a Webpage, Part 2

Consider the previous example and try to load the information for all the companies listed on the webpage.

Before attempting to load data from all the pages in the provided link, let's first review the code used in the previous example, for loading the information on the first page. To do this, open the final file related to the previous example, go to the Power Query Editor, and from the Home tab, click Advanced Editor to view the complete steps for solving the problem, as shown in Figure 1-67.

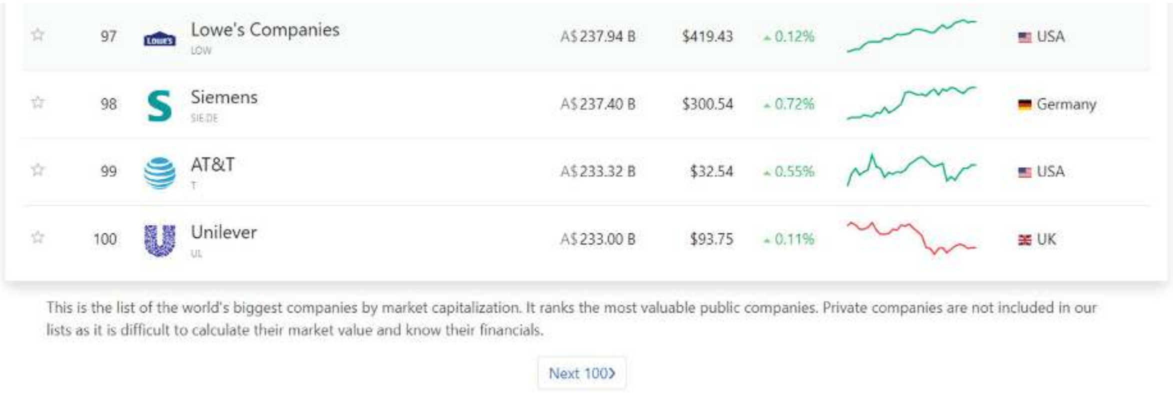


```
let
    Source = Web.BrowserContents("https://companiesmarketcap.com/aud/"),
    #"Extracted Table From Html" = Html.Table(Source, {{"Column1", ".d-none"}, {"Column2", ".d-none + *"}, {"Column3",
        ".rh-sm"}, {"Column4", ".rh-sm + *"}, {"Column5", ".company-name"}, {"Column6", ".company-code"}, {"Column7",
        ".rank"}, {"Column8", ".td-right:nth-child(5)"}, {"Column9", ".p-0 + *"}, {"Column10",
        ".currency-symbol-left"}}, [RowSelector=".d-none"]),
    #"Promoted Headers" = Table.PromoteHeaders(#"Extracted Table From Html", [PromoteAllScalars=true]),
    #"Changed Type" = Table.TransformColumnTypes(#"Promoted Headers",{{"#", type text}, {"Name", type text}, {"1d",
        type text}, {"Price (30 days)", type text}, {"Column5", type text}, {"Column6", type text}, {"Column7",
        Int64.Type}, {"Column8", Currency.Type}, {"Column9", type text}, {"Column10", type text}}),
    #"Removed Bottom Rows" = Table.RemoveLastN(#"Changed Type",1)
in
    #"Removed Bottom Rows"
```

*Figure 1-67* The Advanced Editor

As presented, the data is extracted in five steps—Source, #"Extracted Table From Html", #"Promoted Headers", #"Changed Type", and #"Removed Bottom Rows". The URL for loading data is defined in the first step. If you change this URL and replace it with the URL of the second page, you can retrieve the data from the second page.

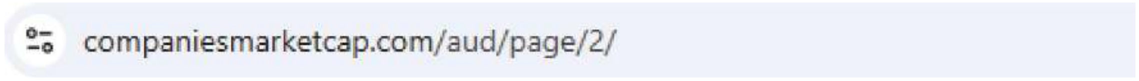
As shown in Figure 1-68, go to your browser, scroll to the end of the table, and click Next 100. The URL will be displayed, as shown in Figure 1-69.



| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ☆ | 97 | Lowe's Companies<br>LOW | A$237.94 B | $419.43 | ▲0.12% | | USA |
| ☆ | 98 | Siemens<br>SIE.DE | A$237.40 B | $300.54 | ▲0.72% | | Germany |
| ☆ | 99 | AT&T<br>T | A$233.32 B | $32.54 | ▲0.55% | | USA |
| ☆ | 100 | Unilever<br>UL | A$233.00 B | $93.75 | ▲0.11% | | UK |

This is the list of the world's biggest companies by market capitalization. It ranks the most valuable public companies. Private companies are not included in our lists as it is difficult to calculate their market value and know their financials.

*Figure 1-68* Going to the next page

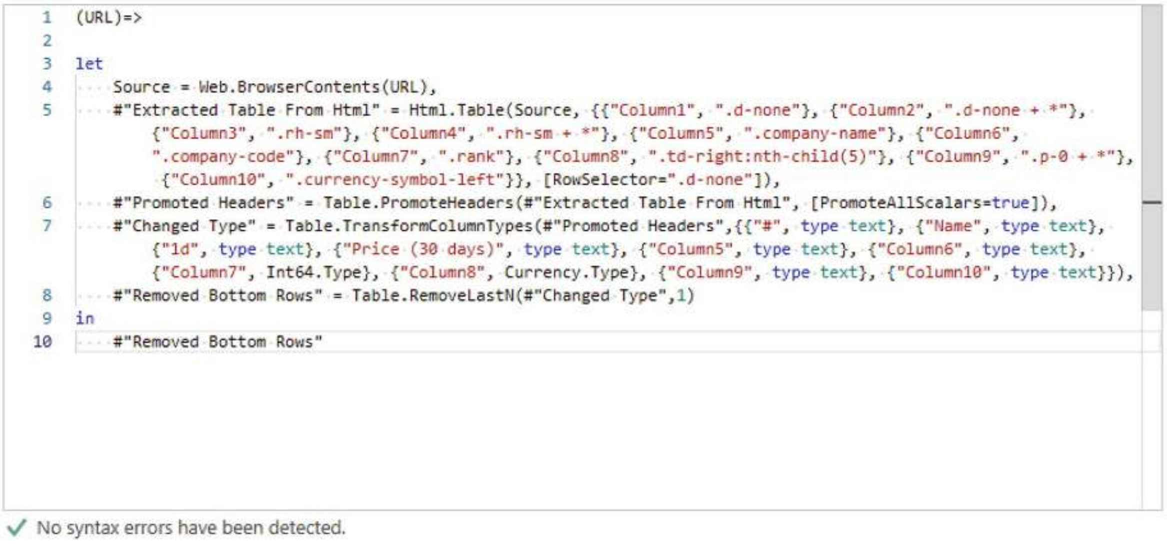


companiesmarketcap.com/aud/page/2/

*Figure 1-69* The URL for the second page

Copy this URL and use it instead of the previous URL in Advance Editor, This will update the result of the query and will show the information related to the next page. So, in the advanced editor by replacing the URL with the URL of any page, you can retrieve the data from that specific page. Based on this, you can convert the query into a function that accepts an URL for a page of the website. The function will apply all five steps—Source, #"Extracted Table From Html", #"Promoted Headers", #"Changed Type", and #"Removed Bottom Rows"—to extract and return the company information from that page.

Converting this query into a function is an easy step. Simply go to the Advanced Editor, add (URL) => at the beginning of the query, and replace the used URL with the variable URL, as shown in Figure 1-70. Then, click OK to create the function. Rename this query `LoadTopCompanies`. The result is shown in Figure 1-71.



```
(URL)=>

let
    Source = Web.BrowserContents(URL),
    #"Extracted Table From Html" = Html.Table(Source, {{"Column1", ".d-none"}, {"Column2", ".d-none + *"},
        {"Column3", ".rh-sm"}, {"Column4", ".rh-sm + *"}, {"Column5", ".company-name"}, {"Column6",
        ".company-code"}, {"Column7", ".rank"}, {"Column8", ".td-right:nth-child(5)"}, {"Column9", ".p-0 + *"},
         {"Column10", ".currency-symbol-left"}}, [RowSelector=".d-none"]),
    #"Promoted Headers" = Table.PromoteHeaders(#"Extracted Table From Html", [PromoteAllScalars=true]),
    #"Changed Type" = Table.TransformColumnTypes(#"Promoted Headers",{{"#", type text}, {"Name", type text},
        {"1d", type text}, {"Price (30 days)", type text}, {"Column5", type text}, {"Column6", type text},
        {"Column7", Int64.Type}, {"Column8", Currency.Type}, {"Column9", type text}, {"Column10", type text}}),
    #"Removed Bottom Rows" = Table.RemoveLastN(#"Changed Type",1)
in
    #"Removed Bottom Rows"
```

✓ No syntax errors have been detected.

*Figure 1-70* Converting the query to a function

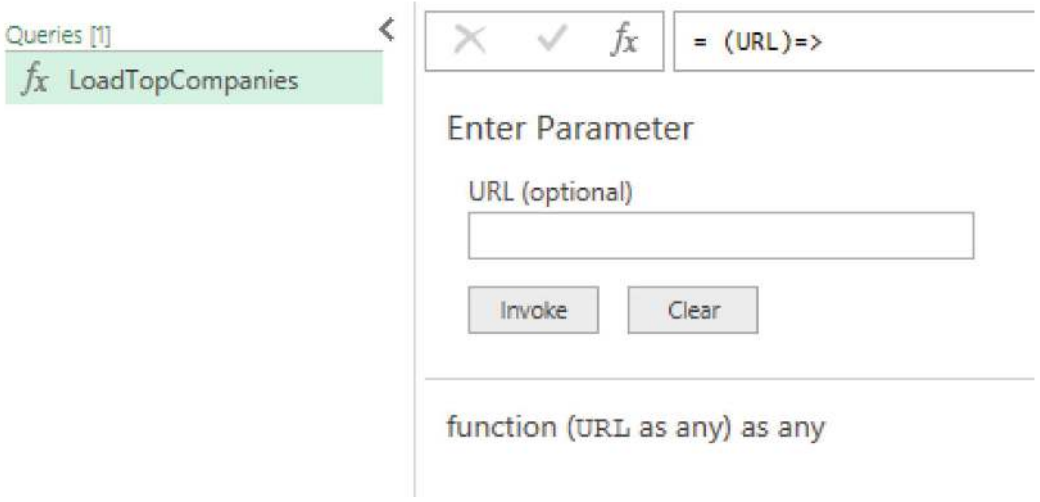


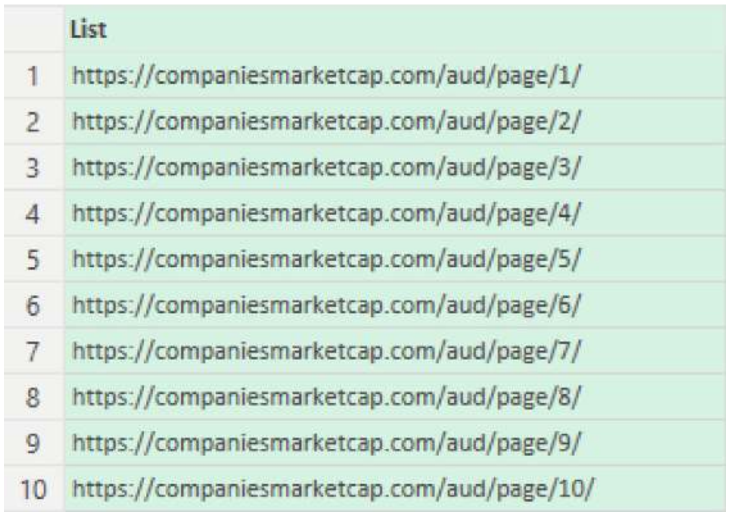
*Figure 1-71* Result of the function

In this function, if you put the URL of any page as its input and click Invoke, the information of that page will be extracted. Based on this, you need to create the list of URLs and then use this function for any URL.

As presented, the URLs (even for the first page) are in the `https://companiesmarketcap.com/aud/page/2/` format, where the page number is specified at the end.

To start, let's assume the number of pages is known and predefined as 10. So, the `List.Transform()` function can used to create the URL for the first ten pages using the following formula, which generates the links for the first ten pages, as shown in Figure 1-72.

```
= List.Transform({1..10}, each "https://companiesmarketcap.com/aud/page/"
& Text.From(_)&"/")
```



| | List |
|---|---|
| 1 | https://companiesmarketcap.com/aud/page/1/ |
| 2 | https://companiesmarketcap.com/aud/page/2/ |
| 3 | https://companiesmarketcap.com/aud/page/3/ |
| 4 | https://companiesmarketcap.com/aud/page/4/ |
| 5 | https://companiesmarketcap.com/aud/page/5/ |
| 6 | https://companiesmarketcap.com/aud/page/6/ |
| 7 | https://companiesmarketcap.com/aud/page/7/ |
| 8 | https://companiesmarketcap.com/aud/page/8/ |
| 9 | https://companiesmarketcap.com/aud/page/9/ |
| 10 | https://companiesmarketcap.com/aud/page/10/ |

***Figure 1-72*** Result of List.Transform

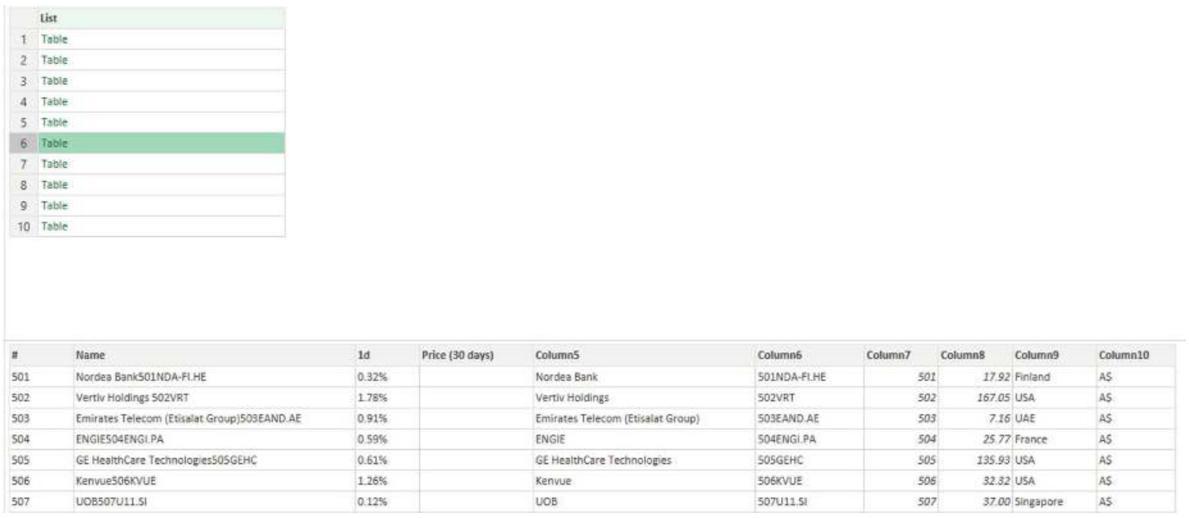
**Note** `List.Transform()` is a powerful function in Power Query that takes two inputs: the first is a list, and the second is the transformation function.

For example, the `=List.Transform({1,2}, each _ * 10)` formula means that for each item in the main list `{1, 2}`, represented by `_`, it multiplies the item by 10. So, the result will be `{10, 20}`.

Additionally, the `=List.Transform({1,2}, each "X" & Text.From(_))` formula works as follows: for each item in the list `{1, 2}`, it first converts the item into text using `Text.From(_)`, then concatenates `"X"` to the item. The result is `{"X1", "X2"}`.

Simultaneously, you can apply the `LoadTopCompanies()` function over the generated URLs, by rewriting the previous formula as shown here (this results in the table in Figure 1-73):

```
= List.Transform({1..10}, each
LoadTopCompanies("https://companiesmarketcap.com/aud/page/" &
Text.From(_)&"/"))
```

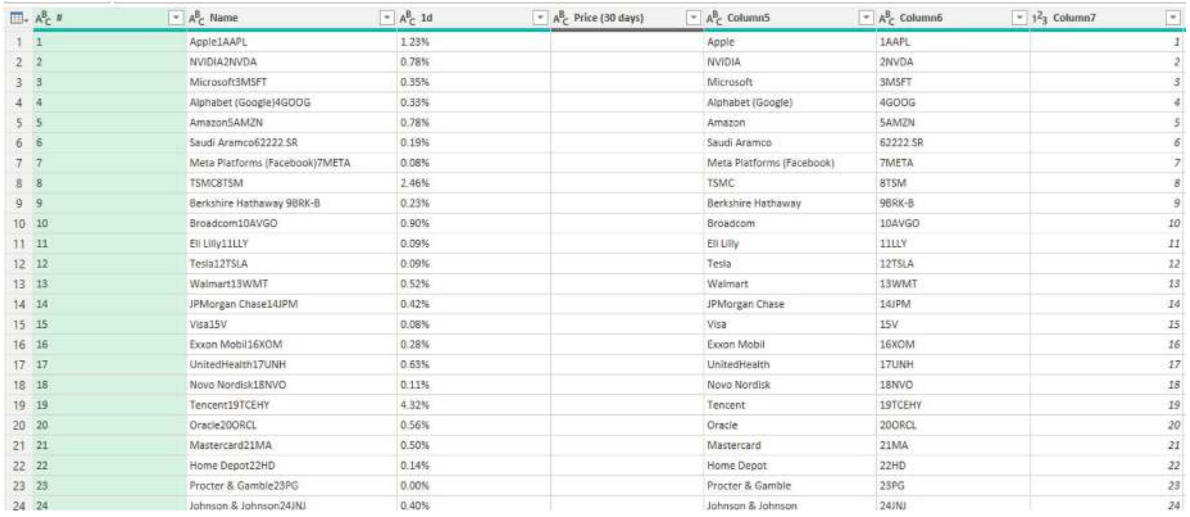


| | List |
|---|---|
| 1 | Table |
| 2 | Table |
| 3 | Table |
| 4 | Table |
| 5 | Table |
| 6 | Table |
| 7 | Table |
| 8 | Table |
| 9 | Table |
| 10 | Table |

| # | Name | 1d | Price (30 days) | Column5 | Column6 | Column7 | Column8 | Column9 | Column10 |
|---|---|---|---|---|---|---|---|---|---|
| 501 | Nordea Bank501NDA-FI.HE | 0.32% | | Nordea Bank | 501NDA-FI.HE | 501 | 17.92 | Finland | A$ |
| 502 | Vertiv Holdings 502VRT | 1.78% | | Vertiv Holdings | 502VRT | 502 | 167.05 | USA | A$ |
| 503 | Emirates Telecom (Etisalat Group)503EAND.AE | 0.91% | | Emirates Telecom (Etisalat Group) | 503EAND.AE | 503 | 7.16 | UAE | A$ |
| 504 | ENGIE504ENGI.PA | 0.59% | | ENGIE | 504ENGI.PA | 504 | 25.77 | France | A$ |
| 505 | GE HealthCare Technologies505GEHC | 0.61% | | GE HealthCare Technologies | 505GEHC | 505 | 135.93 | USA | A$ |
| 506 | Kenvue506KVUE | 1.26% | | Kenvue | 506KVUE | 506 | 32.32 | USA | A$ |
| 507 | UOB507U11.SI | 0.12% | | UOB | 507U11.SI | 507 | 37.00 | Singapore | A$ |

***Figure 1-73*** Using a custom function in List.Transform

Now, to finalize, go to the Transform tab, select the To Table command, and then click the Expand icon next to the column to extract the information from the first 10 pages into a table, as shown in Figure 1-74.



| | # | Name | 1d | Price (30 days) | Column5 | Column6 | Column7 |
|---|---|---|---|---|---|---|---|
| 1 | 1 | Apple1AAPL | 1.23% | | Apple | 1AAPL | 1 |
| 2 | 2 | NVIDIA2NVDA | 0.78% | | NVIDIA | 2NVDA | 2 |
| 3 | 3 | Microsoft3MSFT | 0.35% | | Microsoft | 3MSFT | 3 |
| 4 | 4 | Alphabet (Google)4GOOG | 0.33% | | Alphabet (Google) | 4GOOG | 4 |
| 5 | 5 | Amazon5AMZN | 0.78% | | Amazon | 5AMZN | 5 |
| 6 | 6 | Saudi Aramco62222.SR | 0.19% | | Saudi Aramco | 62222.SR | 6 |
| 7 | 7 | Meta Platforms (Facebook)7META | 0.08% | | Meta Platforms (Facebook) | 7META | 7 |
| 8 | 8 | TSMC8TSM | 2.46% | | TSMC | 8TSM | 8 |
| 9 | 9 | Berkshire Hathaway 9BRK-B | 0.23% | | Berkshire Hathaway | 9BRK-B | 9 |
| 10 | 10 | Broadcom10AVGO | 0.90% | | Broadcom | 10AVGO | 10 |
| 11 | 11 | Eli Lilly11LLY | 0.09% | | Eli Lilly | 11LLY | 11 |
| 12 | 12 | Tesla12TSLA | 0.09% | | Tesla | 12TSLA | 12 |
| 13 | 13 | Walmart13WMT | 0.52% | | Walmart | 13WMT | 13 |
| 14 | 14 | JPMorgan Chase14JPM | 0.42% | | JPMorgan Chase | 14JPM | 14 |
| 15 | 15 | Visa15V | 0.08% | | Visa | 15V | 15 |
| 16 | 16 | Exxon Mobil16XOM | 0.28% | | Exxon Mobil | 16XOM | 16 |
| 17 | 17 | UnitedHealth17UNH | 0.63% | | UnitedHealth | 17UNH | 17 |
| 18 | 18 | Novo Nordisk18NVO | 0.11% | | Novo Nordisk | 18NVO | 18 |
| 19 | 19 | Tencent19TCEHY | 4.32% | | Tencent | 19TCEHY | 19 |
| 20 | 20 | Oracle20ORCL | 0.56% | | Oracle | 20ORCL | 20 |
| 21 | 21 | Mastercard21MA | 0.50% | | Mastercard | 21MA | 21 |
| 22 | 22 | Home Depot22HD | 0.14% | | Home Depot | 22HD | 22 |
| 23 | 23 | Procter & Gamble23PG | 0.00% | | Procter & Gamble | 23PG | 23 |
| 24 | 24 | Johnson & Johnson24JNJ | 0.40% | | Johnson & Johnson | 24JNJ | 24 |

***Figure 1-74*** Resultand table

The previous step was enough to extract the info from the pages if the number of pages are predefined. But if you do not know the total number of pages in the URL, it's better to start from the first page, and then continue the process of loading data page by page until you reach the last page (a page without a table). To accomplish this, you can use the `List.Generate()` function as follows.

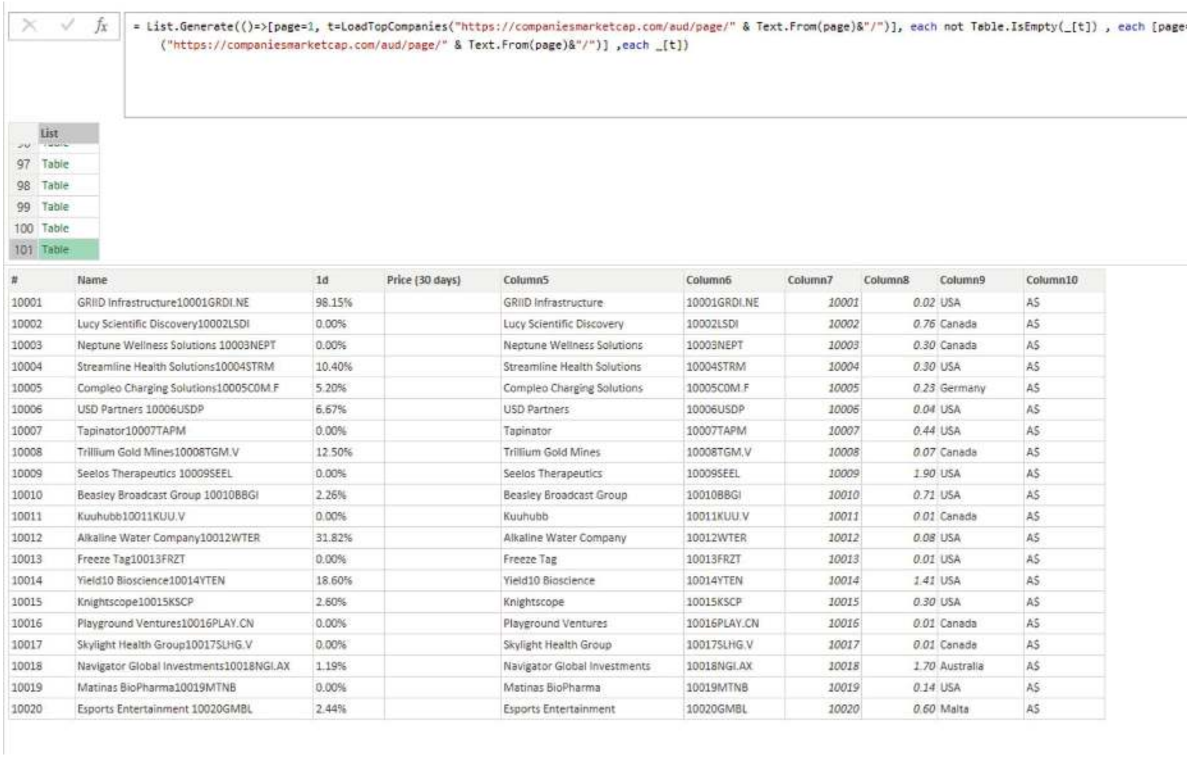
```
= List.Generate(
      ()=>[page=1,
t=LoadTopCompanies("https://companiesmarketcap.com/aud/page/" &
Text.From(page)&"/")],
      each not Table.IsEmpty([t]) ,
      each [page=_[page]+1,
t=LoadTopCompanies("https://companiesmarketcap.com/aud/page/" &
Text.From(page)&"/")] ,
        each _[t])
```

**Note** The `List.Generate` function is an advanced function and is covered in Chapter 9. If you find this formula challenging, feel free to skip it for now. After reading Chapter 9, come back and review it.

In this formula, a loop is created by the `List.Generate()` function. In each iteration of `List.Generate()`, a record containing the fields page, which represents the page numbers in the URL, and `t`, which contains the information about the companies on that page, will be created. Initially, the page is set to 1, and `t` includes the information from the first page (`https://companiesmarketcap.com/aud/page/1/`).

As the process continues, the page value is updated to 2, and `t` reflects the information from the second page. This continues until the condition in the second argument of `List.Generate()` evaluates to `false`, indicating that you have encountered an empty table. In other words, the process continues until `t` becomes a blank table.

The result of this formula is a list containing 101 items, with each item representing a table that includes the company information for a specific page of the website, as shown in Figure 1-75.



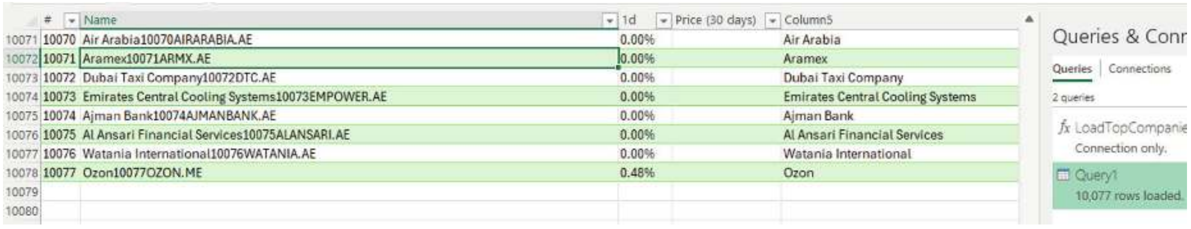
```
= List.Generate(()=>[page=1, t=LoadTopCompanies("https://companiesmarketcap.com/aud/page/" & Text.From(page)&"/")], each not Table.IsEmpty(_[t]) , each [page=
    ("https://companiesmarketcap.com/aud/page/" & Text.From(page)&"/")] ,each _[t])
```

| | List |
|---|---|
| 97 | Table |
| 98 | Table |
| 99 | Table |
| 100 | Table |
| 101 | Table |

| # | Name | 1d | Price (30 days) | Column5 | Column6 | Column7 | Column8 | Column9 | Column10 |
|---|---|---|---|---|---|---|---|---|---|
| 10001 | GRIID Infrastructure10001GRDI.NE | 98.15% | | GRIID Infrastructure | 10001GRDI.NE | 10001 | 0.02 | USA | A$ |
| 10002 | Lucy Scientific Discovery10002LSDI | 0.00% | | Lucy Scientific Discovery | 10002LSDI | 10002 | 0.76 | Canada | A$ |
| 10003 | Neptune Wellness Solutions 10003NEPT | 0.00% | | Neptune Wellness Solutions | 10003NEPT | 10003 | 0.30 | Canada | A$ |
| 10004 | Streamline Health Solutions10004STRM | 10.40% | | Streamline Health Solutions | 10004STRM | 10004 | 0.30 | USA | A$ |
| 10005 | Compleo Charging Solutions10005COM.F | 5.20% | | Compleo Charging Solutions | 10005COM.F | 10005 | 0.23 | Germany | A$ |
| 10006 | USD Partners 10006USDP | 6.67% | | USD Partners | 10006USDP | 10006 | 0.04 | USA | A$ |
| 10007 | Tapinator10007TAPM | 0.00% | | Tapinator | 10007TAPM | 10007 | 0.44 | USA | A$ |
| 10008 | Trillium Gold Mines10008TGM.V | 12.50% | | Trillium Gold Mines | 10008TGM.V | 10008 | 0.07 | Canada | A$ |
| 10009 | Seelos Therapeutics 10009SEEL | 0.00% | | Seelos Therapeutics | 10009SEEL | 10009 | 1.90 | USA | A$ |
| 10010 | Beasley Broadcast Group 10010BBGI | 2.26% | | Beasley Broadcast Group | 10010BBGI | 10010 | 0.71 | USA | A$ |
| 10011 | Kuuhubb10011KUU.V | 0.00% | | Kuuhubb | 10011KUU.V | 10011 | 0.01 | Canada | A$ |
| 10012 | Alkaline Water Company10012WTER | 31.82% | | Alkaline Water Company | 10012WTER | 10012 | 0.08 | USA | A$ |
| 10013 | Freeze Tag10013FRZT | 0.00% | | Freeze Tag | 10013FRZT | 10013 | 0.01 | USA | A$ |
| 10014 | Yield10 Bioscience10014YTEN | 18.60% | | Yield10 Bioscience | 10014YTEN | 10014 | 1.41 | USA | A$ |
| 10015 | Knightscope10015KSCP | 2.60% | | Knightscope | 10015KSCP | 10015 | 0.30 | USA | A$ |
| 10016 | Playground Ventures10016PLAY.CN | 0.00% | | Playground Ventures | 10016PLAY.CN | 10016 | 0.01 | Canada | A$ |
| 10017 | Skylight Health Group10017SLHG.V | 0.00% | | Skylight Health Group | 10017SLHG.V | 10017 | 0.01 | Canada | A$ |
| 10018 | Navigator Global Investments10018NGI.AX | 1.19% | | Navigator Global Investments | 10018NGI.AX | 10018 | 1.70 | Australia | A$ |
| 10019 | Matinas BioPharma10019MTNB | 0.00% | | Matinas BioPharma | 10019MTNB | 10019 | 0.14 | USA | A$ |
| 10020 | Esports Entertainment 10020GMBL | 2.44% | | Esports Entertainment | 10020GMBL | 10020 | 0.60 | Malta | A$ |

***Figure 1-75*** Result of List.Generate

To combine the tables in the resulting list, go to the Transform tab, select the To Table command, and then click the Expand icon next to the column to extract the information from all the pages into a table, as shown in Figure 1-76.

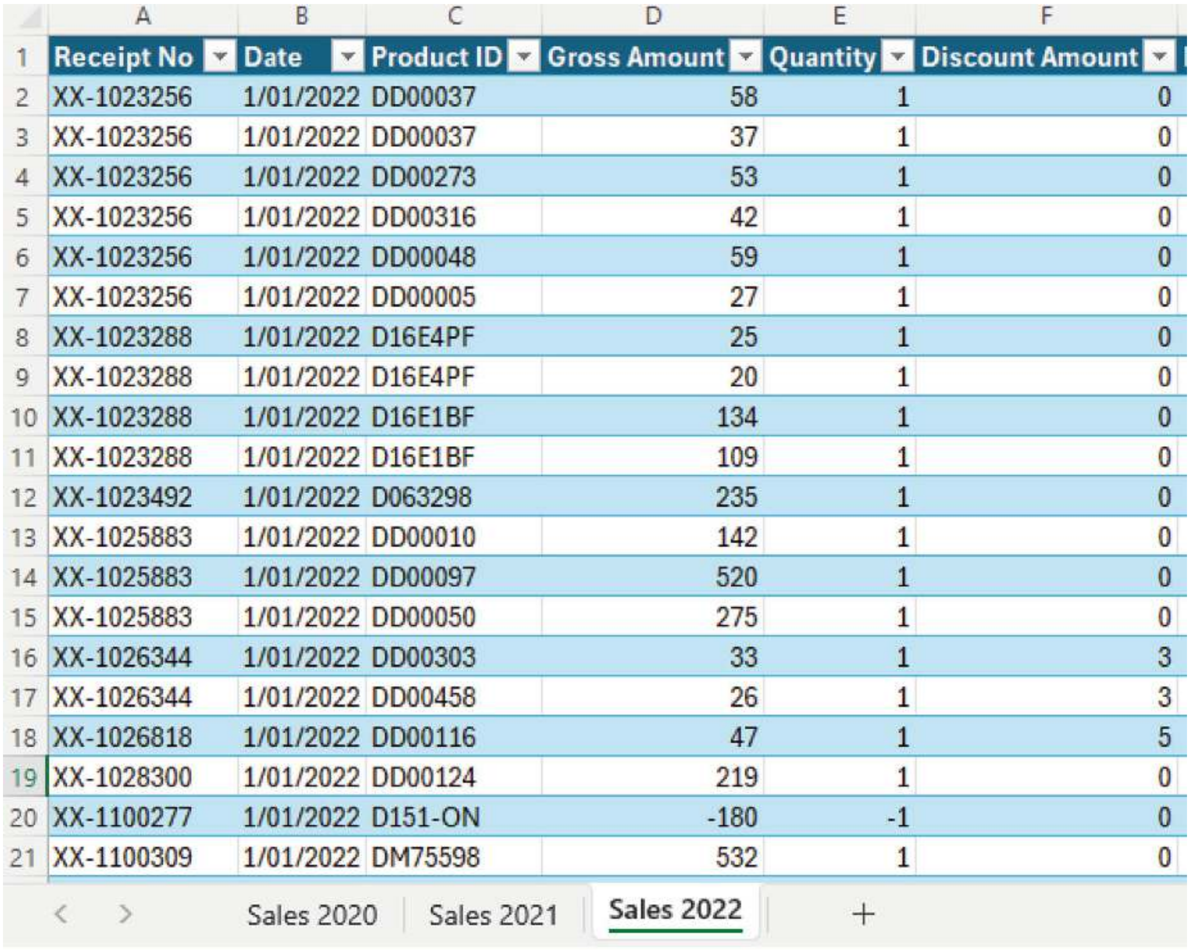


| | # | Name | 1d | Price (30 days) | Column5 |
|---|---|---|---|---|---|
| 10071 | 10070 | Air Arabia10070AIRARABIA.AE | 0.00% | | Air Arabia |
| 10072 | 10071 | Aramex10071ARMX.AE | 0.00% | | Aramex |
| 10073 | 10072 | Dubai Taxi Company10072DTC.AE | 0.00% | | Dubai Taxi Company |
| 10074 | 10073 | Emirates Central Cooling Systems10073EMPOWER.AE | 0.00% | | Emirates Central Cooling Systems |
| 10075 | 10074 | Ajman Bank10074AJMANBANK.AE | 0.00% | | Ajman Bank |
| 10076 | 10075 | Al Ansari Financial Services10075ALANSARI.AE | 0.00% | | Al Ansari Financial Services |
| 10077 | 10076 | Watania International10076WATANIA.AE | 0.00% | | Watania International |
| 10078 | 10077 | Ozon10077OZON.ME | 0.48% | | Ozon |
| 10079 | | | | | |
| 10080 | | | | | |

*Figure 1-76* Result of all the companies

## Loading Tables from an Excel File

Consider an Excel file that contains three tables (with the potential for additional tables in the future), each in one sheet, as shown in Figure 1-77, and each containing sales information for different years. Load all these tables into Power Query and stack them vertically.



| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | Receipt No | Date | Product ID | Gross Amount | Quantity | Discount Amount |
| 2 | XX-1023256 | 1/01/2022 | DD00037 | 58 | 1 | 0 |
| 3 | XX-1023256 | 1/01/2022 | DD00037 | 37 | 1 | 0 |
| 4 | XX-1023256 | 1/01/2022 | DD00273 | 53 | 1 | 0 |
| 5 | XX-1023256 | 1/01/2022 | DD00316 | 42 | 1 | 0 |
| 6 | XX-1023256 | 1/01/2022 | DD00048 | 59 | 1 | 0 |
| 7 | XX-1023256 | 1/01/2022 | DD00005 | 27 | 1 | 0 |
| 8 | XX-1023288 | 1/01/2022 | D16E4PF | 25 | 1 | 0 |
| 9 | XX-1023288 | 1/01/2022 | D16E4PF | 20 | 1 | 0 |
| 10 | XX-1023288 | 1/01/2022 | D16E1BF | 134 | 1 | 0 |
| 11 | XX-1023288 | 1/01/2022 | D16E1BF | 109 | 1 | 0 |
| 12 | XX-1023492 | 1/01/2022 | D063298 | 235 | 1 | 0 |
| 13 | XX-1025883 | 1/01/2022 | DD00010 | 142 | 1 | 0 |
| 14 | XX-1025883 | 1/01/2022 | DD00097 | 520 | 1 | 0 |
| 15 | XX-1025883 | 1/01/2022 | DD00050 | 275 | 1 | 0 |
| 16 | XX-1026344 | 1/01/2022 | DD00303 | 33 | 1 | 3 |
| 17 | XX-1026344 | 1/01/2022 | DD00458 | 26 | 1 | 3 |
| 18 | XX-1026818 | 1/01/2022 | DD00116 | 47 | 1 | 5 |
| 19 | XX-1028300 | 1/01/2022 | DD00124 | 219 | 1 | 0 |
| 20 | XX-1100277 | 1/01/2022 | D151-ON | -180 | -1 | 0 |
| 21 | XX-1100309 | 1/01/2022 | DM75598 | 532 | 1 | 0 |

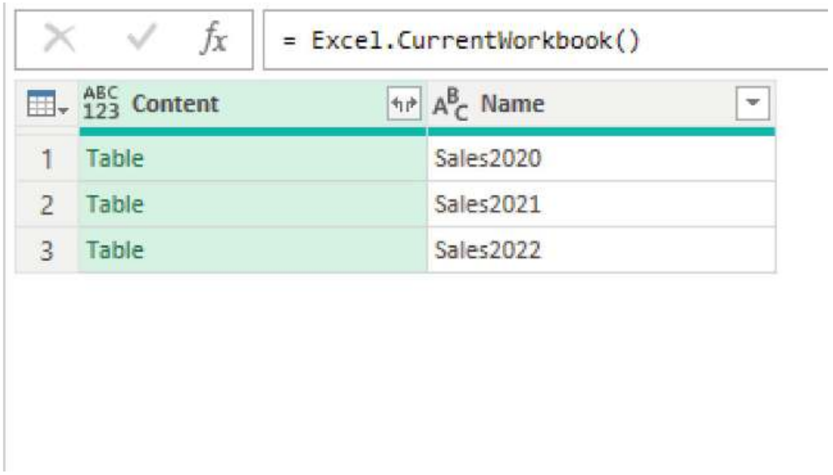
*Figure 1-77* An Excel file including three sheets

**Note** The data in this example is provided in an Excel file titled `08 Excel.CurrentWorkbook.Xlsx`.

A useful function in the Excel version of Power Query is the `Excel.CurrentWorkbook()` function, which can help load all the tables in a workbook. The syntax of this function is as follows (this function comes with no argument):

```
Excel.CurrentWorkbook() as table
```

To solve this problem, go to the Power Query Editor by pressing Alt+F12 and create a blank query (it is named `Query1`). Click *fx* next to the formula bar to add a new step and enter the `=Excel.CurrentWorkbook()` formula in the formula bar. This will load all tables and named ranges from the Excel file into the Power Query Editor, as shown in Figure 1-78.

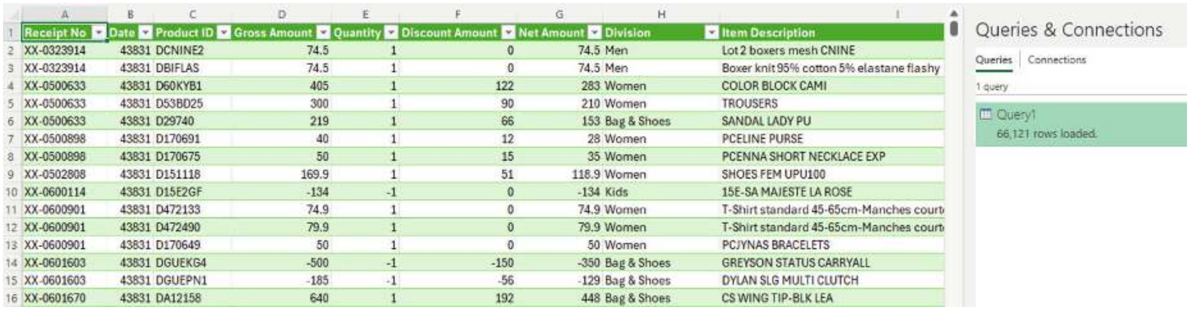


```
= Excel.CurrentWorkbook()
```

|  | Content | Name |
|---|---|---|
| 1 | Table | Sales2020 |
| 2 | Table | Sales2021 |
| 3 | Table | Sales2022 |

***Figure 1-78*** Result of Excel.CurrentWorkbook()

By expanding the Content column, you can combine all the tables. After this step, use Close & Load to load the resulting table into Excel, as shown in Figure 1-79, which includes 66121 rows.

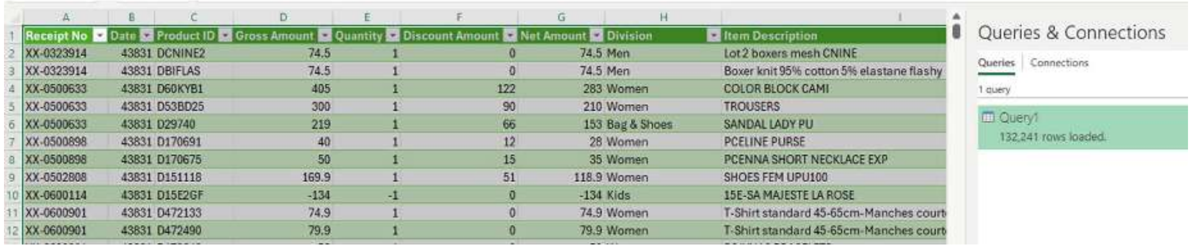


|  | Receipt No | Date | Product ID | Gross Amount | Quantity | Discount Amount | Net Amount | Division | Item Description |
|---|---|---|---|---|---|---|---|---|---|
| 2 | XX-0323914 | 43831 | DCNINE2 | 74.5 | 1 | 0 | 74.5 | Men | Lot 2 boxers mesh CNINE |
| 3 | XX-0323914 | 43831 | DBIFLAS | 74.5 | 1 | 0 | 74.5 | Men | Boxer knit 95% cotton 5% elastane flashy |
| 4 | XX-0500633 | 43831 | D60KYB1 | 405 | 1 | 122 | 283 | Women | COLOR BLOCK CAMI |
| 5 | XX-0500633 | 43831 | D53BD25 | 300 | 1 | 90 | 210 | Women | TROUSERS |
| 6 | XX-0500633 | 43831 | D29740 | 219 | 1 | 66 | 153 | Bag & Shoes | SANDAL LADY PU |
| 7 | XX-0500898 | 43831 | D170691 | 40 | 1 | 12 | 28 | Women | PCELINE PURSE |
| 8 | XX-0500898 | 43831 | D170675 | 50 | 1 | 15 | 35 | Women | PCENNA SHORT NECKLACE EXP |
| 9 | XX-0502808 | 43831 | D151118 | 169.9 | 1 | 51 | 118.9 | Women | SHOES FEM UPU100 |
| 10 | XX-0600114 | 43831 | D15E2GF | -134 | -1 | 0 | -134 | Kids | 15E-SA MAJESTE LA ROSE |
| 11 | XX-0600901 | 43831 | D472133 | 74.9 | 1 | 0 | 74.9 | Women | T-Shirt standard 45-65cm-Manches court |
| 12 | XX-0600901 | 43831 | D472490 | 79.9 | 1 | 0 | 79.9 | Women | T-Shirt standard 45-65cm-Manches court |
| 13 | XX-0600901 | 43831 | D170649 | 50 | 1 | 0 | 50 | Women | PCJYNAS BRACELETS |
| 14 | XX-0601603 | 43831 | DGUEKG4 | -500 | -1 | -150 | -350 | Bag & Shoes | GREYSON STATUS CARRYALL |
| 15 | XX-0601603 | 43831 | DGUEPN1 | -185 | -1 | -56 | -129 | Bag & Shoes | DYLAN SLG MULTI CLUTCH |
| 16 | XX-0601670 | 43831 | DA12158 | 640 | 1 | 192 | 448 | Bag & Shoes | CS WING TIP-BLK LEA |

Queries & Connections
Queries | Connections
1 query
Query1
66,121 rows loaded.

***Figure 1-79*** Loading the result in Excel

While it may seem like the problem is resolved at this point, right-clicking the resulting table and selecting Refresh will reveal that new rows are added to the result table, and with the next refresh, the number of rows will increase to 132241 rows, as shown in Figure 1-80.

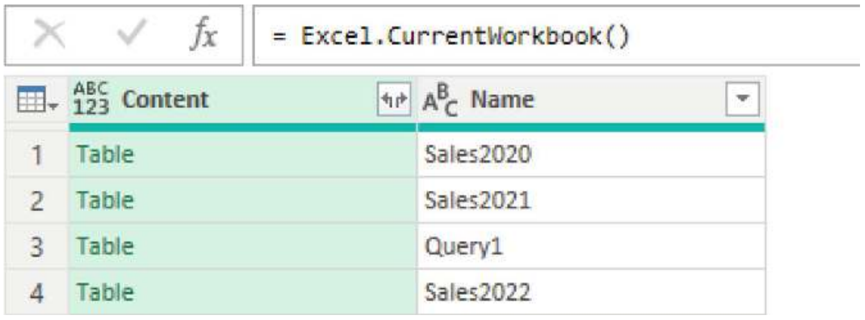


|  | Receipt No | Date | Product ID | Gross Amount | Quantity | Discount Amount | Net Amount | Division | Item Description |
|---|---|---|---|---|---|---|---|---|---|
| 2 | XX-0323914 | 43831 | DCNINE2 | 74.5 | 1 | 0 | 74.5 | Men | Lot 2 boxers mesh CNINE |
| 3 | XX-0323914 | 43831 | DBIFLAS | 74.5 | 1 | 0 | 74.5 | Men | Boxer knit 95% cotton 5% elastane flashy |
| 4 | XX-0500633 | 43831 | D60KYB1 | 405 | 1 | 122 | 283 | Women | COLOR BLOCK CAMI |
| 5 | XX-0500633 | 43831 | D53BD25 | 300 | 1 | 90 | 210 | Women | TROUSERS |
| 6 | XX-0500633 | 43831 | D29740 | 219 | 1 | 66 | 153 | Bag & Shoes | SANDAL LADY PU |
| 7 | XX-0500898 | 43831 | D170691 | 40 | 1 | 12 | 28 | Women | PCELINE PURSE |
| 8 | XX-0500898 | 43831 | D170675 | 50 | 1 | 15 | 35 | Women | PCENNA SHORT NECKLACE EXP |
| 9 | XX-0502808 | 43831 | D151118 | 169.9 | 1 | 51 | 118.9 | Women | SHOES FEM UPU100 |
| 10 | XX-0600114 | 43831 | D15E2GF | -134 | -1 | 0 | -134 | Kids | 15E-SA MAJESTE LA ROSE |
| 11 | XX-0600901 | 43831 | D472133 | 74.9 | 1 | 0 | 74.9 | Women | T-Shirt standard 45-65cm-Manches court |
| 12 | XX-0600901 | 43831 | D472490 | 79.9 | 1 | 0 | 79.9 | Women | T-Shirt standard 45-65cm-Manches court |

Queries & Connections
Queries | Connections
1 query
Query1
132,241 rows loaded.

***Figure 1-80*** Increasing the row number by each refresh

To investigate the cause of this issue, let's edit the query and check the first step. You do this by right-clicking the query name and selecting Edit Query. If you select the first step in the Applied Step section, shown in Figure 1-81, you'll see that four tables are now loaded into the query, while at the time of creating the query, it initially included only three tables. It appears that the result of the query is also included in the list of tables and considered as the input of itself. Consequently, each Refresh adds all the data from the result query to the rows of the other tables, causing the problem.

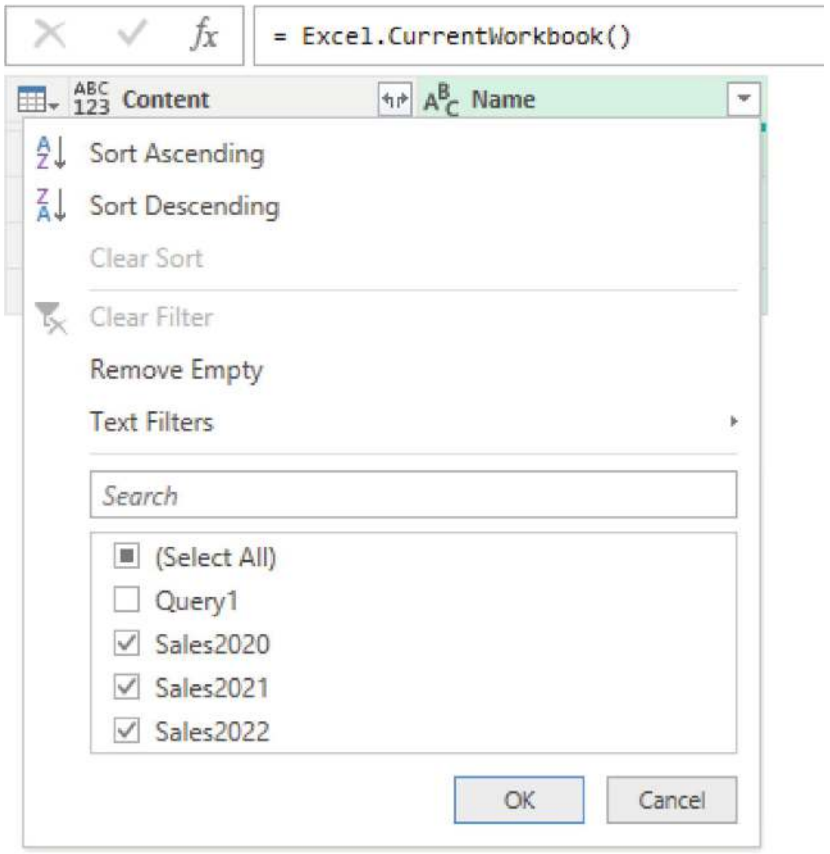


```
= Excel.CurrentWorkbook()
```

|  | Content | Name |
|---|---|---|
| 1 | Table | Sales2020 |
| 2 | Table | Sales2021 |
| 3 | Table | Query1 |
| 4 | Table | Sales2022 |

*Figure 1-81* Four tables in the query

To resolve this issue and solve the problem, simply filter the table names to exclude the table associated with the query, as shown in Figure 1-82. In the filtering step, you can also exclude other tables that you do not want to include in the result table.



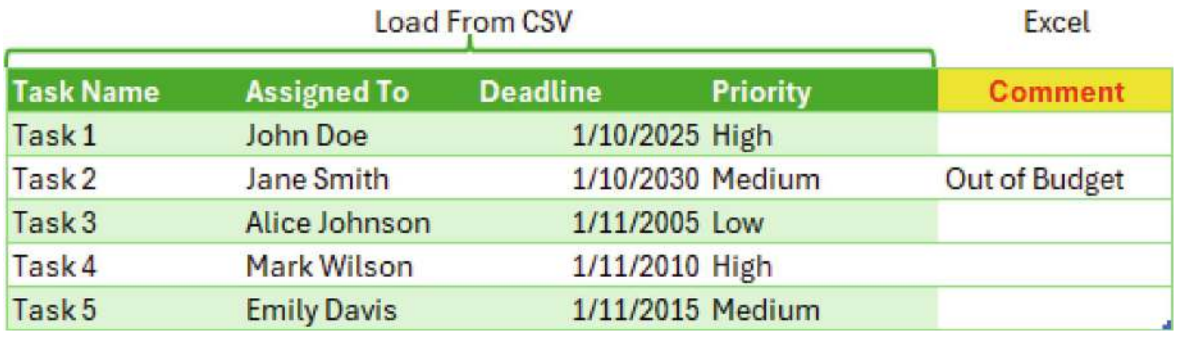
```
= Excel.CurrentWorkbook()
```

Filter settings: Query1 unchecked; Sales2020, Sales2021, Sales2022 checked.

*Figure 1-82* Filtering the query result table

## Manually Adding Columns to the Query

Consider the task assignments table shown in Figure 1-83, which is imported from a CSV file into an Excel file using the Load From CSV query. In the Excel worksheet, an additional column is manually added (highlighted in yellow) to write comments about the tasks. However, when the query is refreshed, the order of the task rows in Power Query may change, causing a mismatch between the tasks and the comments. How can this issue be resolved?

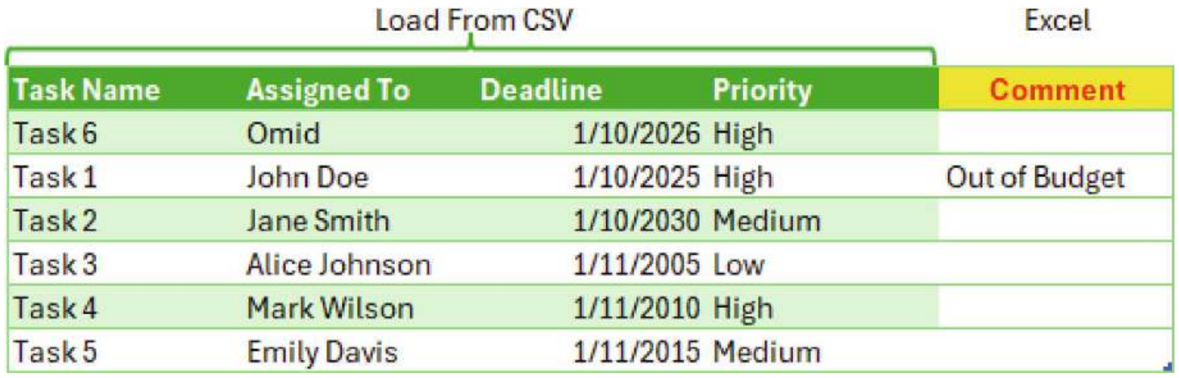

Load From CSV
Excel

| Task Name | Assigned To | Deadline | Priority | Comment |
|---|---|---|---|---|
| Task 1 | John Doe | 1/10/2025 | High | |
| Task 2 | Jane Smith | 1/10/2030 | Medium | Out of Budget |
| Task 3 | Alice Johnson | 1/11/2005 | Low | |
| Task 4 | Mark Wilson | 1/11/2010 | High | |
| Task 5 | Emily Davis | 1/11/2015 | Medium | |

***Figure 1-83*** Combination of Query and Excel column

**Note** The data in this example is provided in an Excel file titled `09 Manually adding column into the Query.CSV`.

In this example, if a new task is added to the top of the CSV file and the query is refreshed, the row order in the Power Query will change, as shown in Figure 1-84. However, the order of the comments remains unchanged, as this column is not linked to the query columns. As a result, the comments no longer correspond to the original tasks.


Load From CSV
Excel

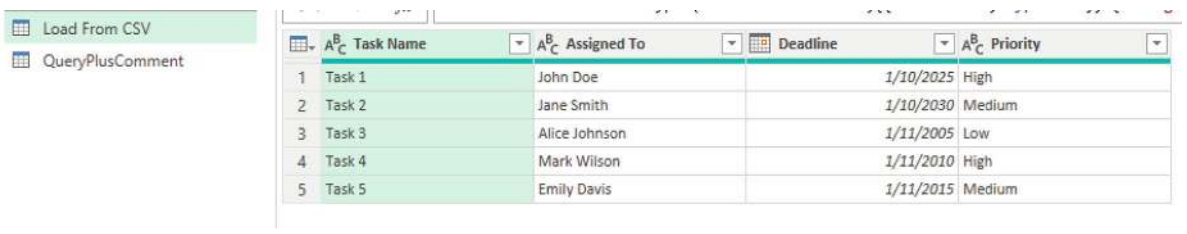
| Task Name | Assigned To | Deadline | Priority | Comment |
|---|---|---|---|---|
| Task 6 | Omid | 1/10/2026 | High | |
| Task 1 | John Doe | 1/10/2025 | High | Out of Budget |
| Task 2 | Jane Smith | 1/10/2030 | Medium | |
| Task 3 | Alice Johnson | 1/11/2005 | Low | |
| Task 4 | Mark Wilson | 1/11/2010 | High | |
| Task 5 | Emily Davis | 1/11/2015 | Medium | |

***Figure 1-84*** Result of adding a new task in the CSV file

Before starting to solve this problem, it is worth mentioning that, since the result of the query is saved as a table in Excel when a comment column is added, it becomes part of that table. So you have a table with some columns that came from the query and others that came from Excel.

To solve this problem, you need to link each comment to its corresponding task. This requires loading the latest version of the Excel table with comments into Power Query, as well as the most recent list of tasks from the CSV files. Then, you will transfer the comments from the first query to the second query based on the Task Name.

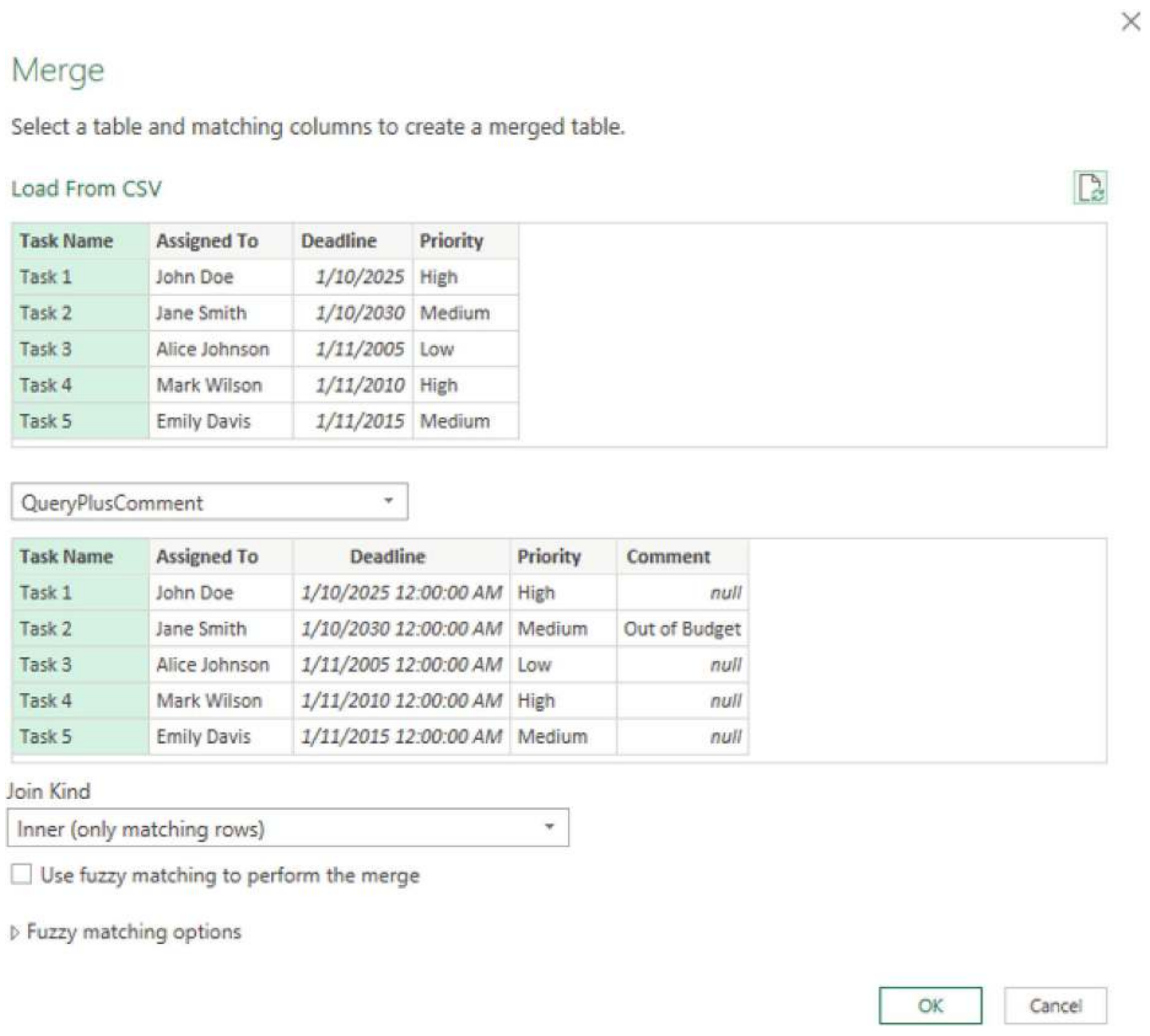
In Excel, select the entire table (including both the query result and the comment column) and load it into Power Query by going to the Data tab and choosing From Table/Range in the Get & Transform Data section. Name this query `QueryPlusComment`. At this point, as shown in Figure 1-85, the Power Query Editor contains two queries, one for loading tasks from the CSV file (Load From CSV) and one for loading the table from Excel, including the result of the previous query and the Comment column.



| | Task Name | Assigned To | Deadline | Priority |
|---|---|---|---|---|
| 1 | Task 1 | John Doe | 1/10/2025 | High |
| 2 | Task 2 | Jane Smith | 1/10/2030 | Medium |
| 3 | Task 3 | Alice Johnson | 1/11/2005 | Low |
| 4 | Task 4 | Mark Wilson | 1/11/2010 | High |
| 5 | Task 5 | Emily Davis | 1/11/2015 | Medium |

***Figure 1-85*** Loading data in Power Query

After loading both queries, you need to combine them. Select the Load From CSV query, and from the Home tab, select the Merge Queries command (this command is fully explained in Chapter 7). Make the setting provided in Figure 1-86. (In the Merge settings, choose the Task Name column from both queries and set the join kind to Inner Join.)


Merge

Select a table and matching columns to create a merged table.

Load From CSV

| Task Name | Assigned To | Deadline | Priority |
|---|---|---|---|
| Task 1 | John Doe | 1/10/2025 | High |
| Task 2 | Jane Smith | 1/10/2030 | Medium |
| Task 3 | Alice Johnson | 1/11/2005 | Low |
| Task 4 | Mark Wilson | 1/11/2010 | High |
| Task 5 | Emily Davis | 1/11/2015 | Medium |

QueryPlusComment

| Task Name | Assigned To | Deadline | Priority | Comment |
|---|---|---|---|---|
| Task 1 | John Doe | 1/10/2025 12:00:00 AM | High | null |
| Task 2 | Jane Smith | 1/10/2030 12:00:00 AM | Medium | Out of Budget |
| Task 3 | Alice Johnson | 1/11/2005 12:00:00 AM | Low | null |
| Task 4 | Mark Wilson | 1/11/2010 12:00:00 AM | High | null |
| Task 5 | Emily Davis | 1/11/2015 12:00:00 AM | Medium | null |

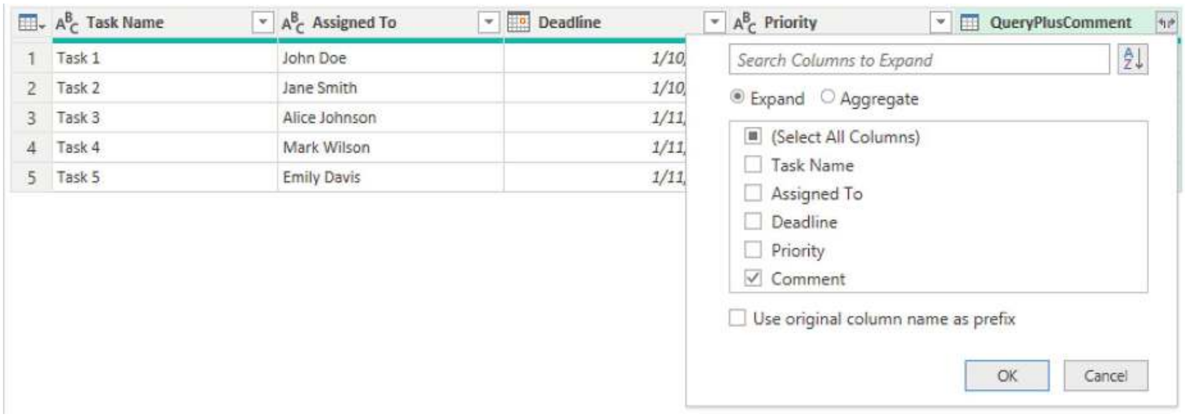
Join Kind: Inner (only matching rows)

☐ Use fuzzy matching to perform the merge

***Figure 1-86*** Merging tables

**Note** In the previous step, Task Name was selected as the common column between the tables. In this case, this column must contain unique values, without any duplicates.

After the previous step, you may encounter a Privacy Level message. If this happens, simply confirm it. Next, expand the newly added column, as shown in Figure 1-87, and click OK to proceed to Figure 1-88.



| | Task Name | Assigned To | Deadline | Priority | QueryPlusComment |
|---|---|---|---|---|---|
| 1 | Task 1 | John Doe | 1/10, | | |
| 2 | Task 2 | Jane Smith | 1/10, | | |
| 3 | Task 3 | Alice Johnson | 1/11, | | |
| 4 | Task 4 | Mark Wilson | 1/11, | | |
| 5 | Task 5 | Emily Davis | 1/11, | | |

Search Columns to Expand

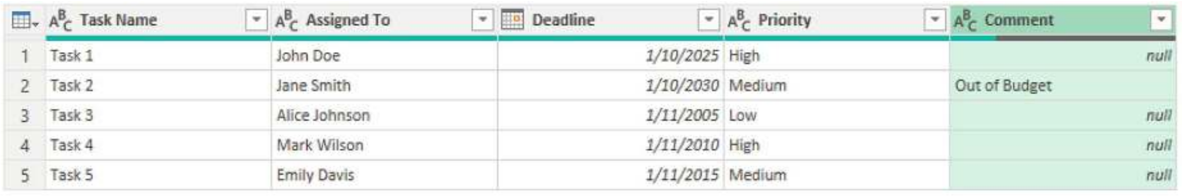
[✓ Expand] Aggregate

- ☐ (Select All Columns)
- ☐ Task Name
- ☐ Assigned To
- ☐ Deadline
- ☐ Priority
- ☑ Comment

☐ Use original column name as prefix

OK Cancel

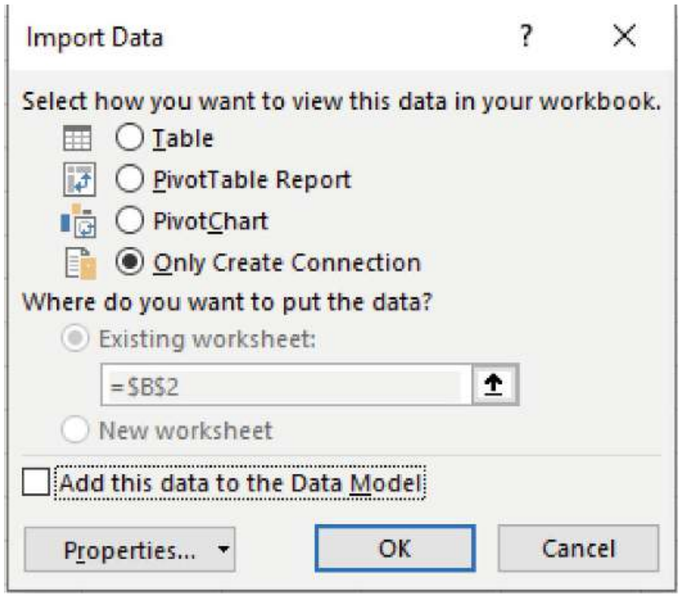
*Figure 1-87* Setting for expanding the comment column



| | Task Name | Assigned To | Deadline | Priority | Comment |
|---|---|---|---|---|---|
| 1 | Task 1 | John Doe | 1/10/2025 | High | null |
| 2 | Task 2 | Jane Smith | 1/10/2030 | Medium | Out of Budget |
| 3 | Task 3 | Alice Johnson | 1/11/2005 | Low | null |
| 4 | Task 4 | Mark Wilson | 1/11/2010 | High | null |
| 5 | Task 5 | Emily Davis | 1/11/2015 | Medium | null |

*Figure 1-88* Expanding the comment column

At this step, from the Close & Load dropdown, select Close & Load To. In the open window, choose Only Create Connection, as shown in Figure 1-89.



Import Data

Select how you want to view this data in your workbook.

- ○ Table
- ○ PivotTable Report
- ○ PivotChart
- ◉ Only Create Connection

Where do you want to put the data?

- ○ Existing worksheet:

=$B$2

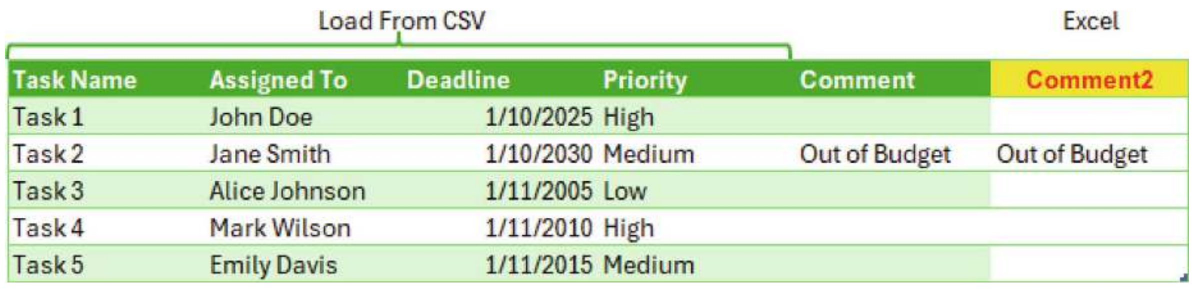
- ○ New worksheet

☐ Add this data to the Data Model

Properties... OK Cancel

*Figure 1-89* Loading as a connected table

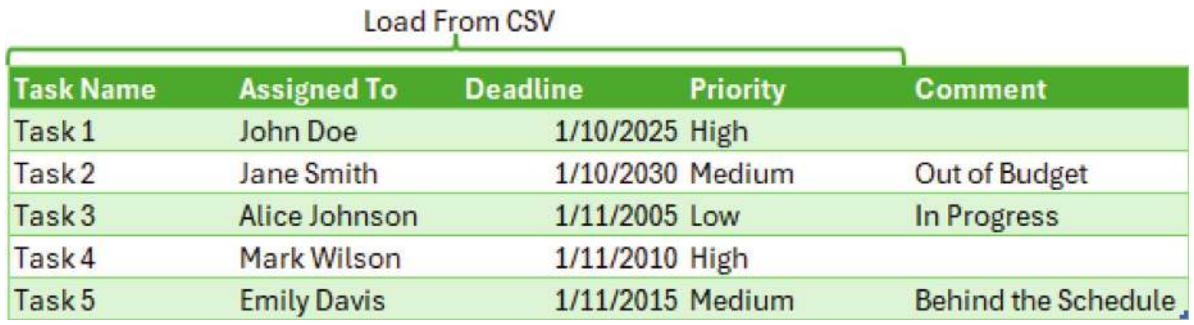
After you do this, the table in Figure 1-90 will appear with the Comment column, which is integrated as part of the query, and another column called Comment2 (showing the columns that were added manually).


Load From CSV
Excel

| Task Name | Assigned To | Deadline | Priority | Comment | Comment2 |
|---|---|---|---|---|---|
| Task 1 | John Doe | 1/10/2025 | High | | |
| Task 2 | Jane Smith | 1/10/2030 | Medium | Out of Budget | Out of Budget |
| Task 3 | Alice Johnson | 1/11/2005 | Low | | |
| Task 4 | Mark Wilson | 1/11/2010 | High | | |
| Task 5 | Emily Davis | 1/11/2015 | Medium | | |

***Figure 1-90*** Result of the loaded table

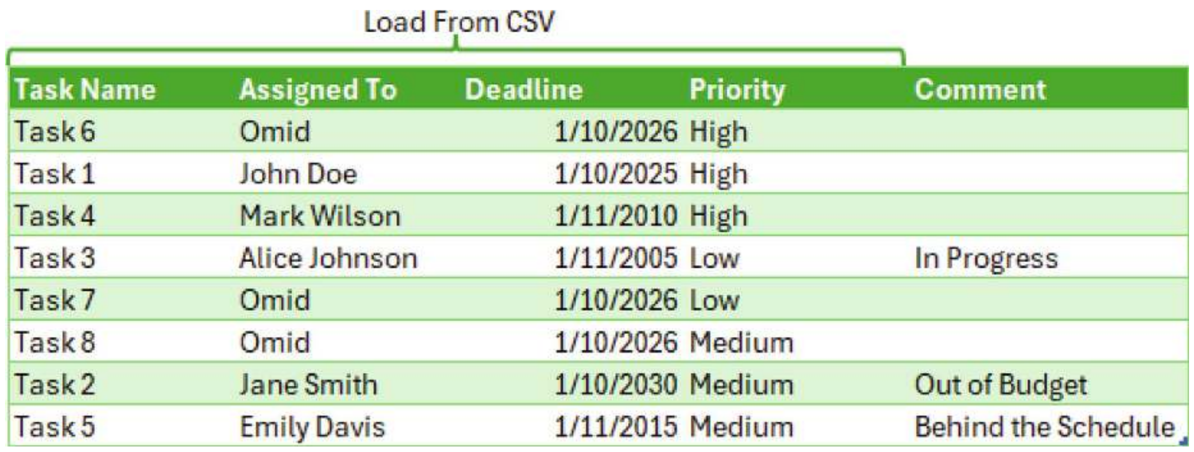
The problem is solved. You can now remove the Comment2 column and add your comments in the Comment column, as shown in Figure 1-91.


Load From CSV

| Task Name | Assigned To | Deadline | Priority | Comment |
|---|---|---|---|---|
| Task 1 | John Doe | 1/10/2025 | High | |
| Task 2 | Jane Smith | 1/10/2030 | Medium | Out of Budget |
| Task 3 | Alice Johnson | 1/11/2005 | Low | In Progress |
| Task 4 | Mark Wilson | 1/11/2010 | High | |
| Task 5 | Emily Davis | 1/11/2015 | Medium | Behind the Schedule |

***Figure 1-91*** Adding new comments

By adding new tasks to the CSV file, rearranging the previous tasks, and refreshing the query, you will see that the comments are correctly aligned with their respective tasks; see Figure 1-92.


Load From CSV

| Task Name | Assigned To | Deadline | Priority | Comment |
|---|---|---|---|---|
| Task 6 | Omid | 1/10/2026 | High | |
| Task 1 | John Doe | 1/10/2025 | High | |
| Task 4 | Mark Wilson | 1/11/2010 | High | |
| Task 3 | Alice Johnson | 1/11/2005 | Low | In Progress |
| Task 7 | Omid | 1/10/2026 | Low | |
| Task 8 | Omid | 1/10/2026 | Medium | |
| Task 2 | Jane Smith | 1/10/2030 | Medium | Out of Budget |
| Task 5 | Emily Davis | 1/11/2015 | Medium | Behind the Schedule |

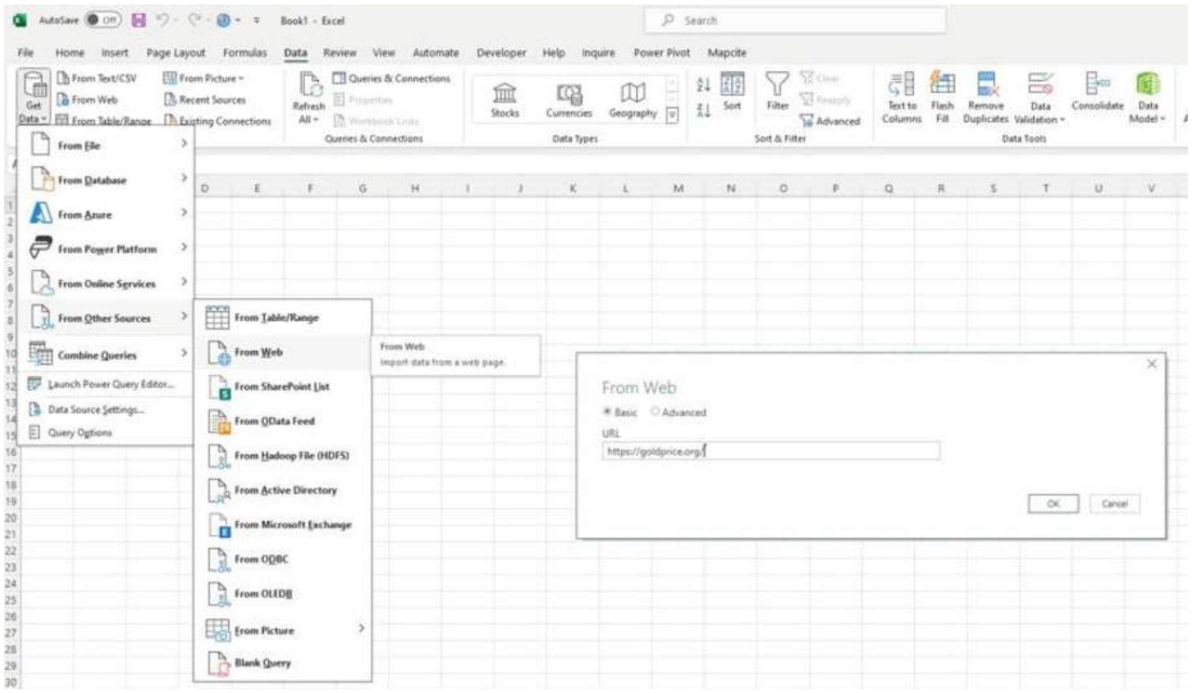
***Figure 1-92*** Result of refreshing the query after adding some tasks

## Using a Data Load Tracker (Log)

Extract the price of gold from the `GoldPrice.org` website. Ensure that each time the data is refreshed, the historical data is preserved.

**Note** The idea of this solution came from the TheBICCOUNTANT website, written by Microsoft MVP Imke Feldmann: `https://www.thebiccountant.com/2016/02/09/how-to-create-a-load-history-or-load-log-in-power-query-or-power-bi/`.

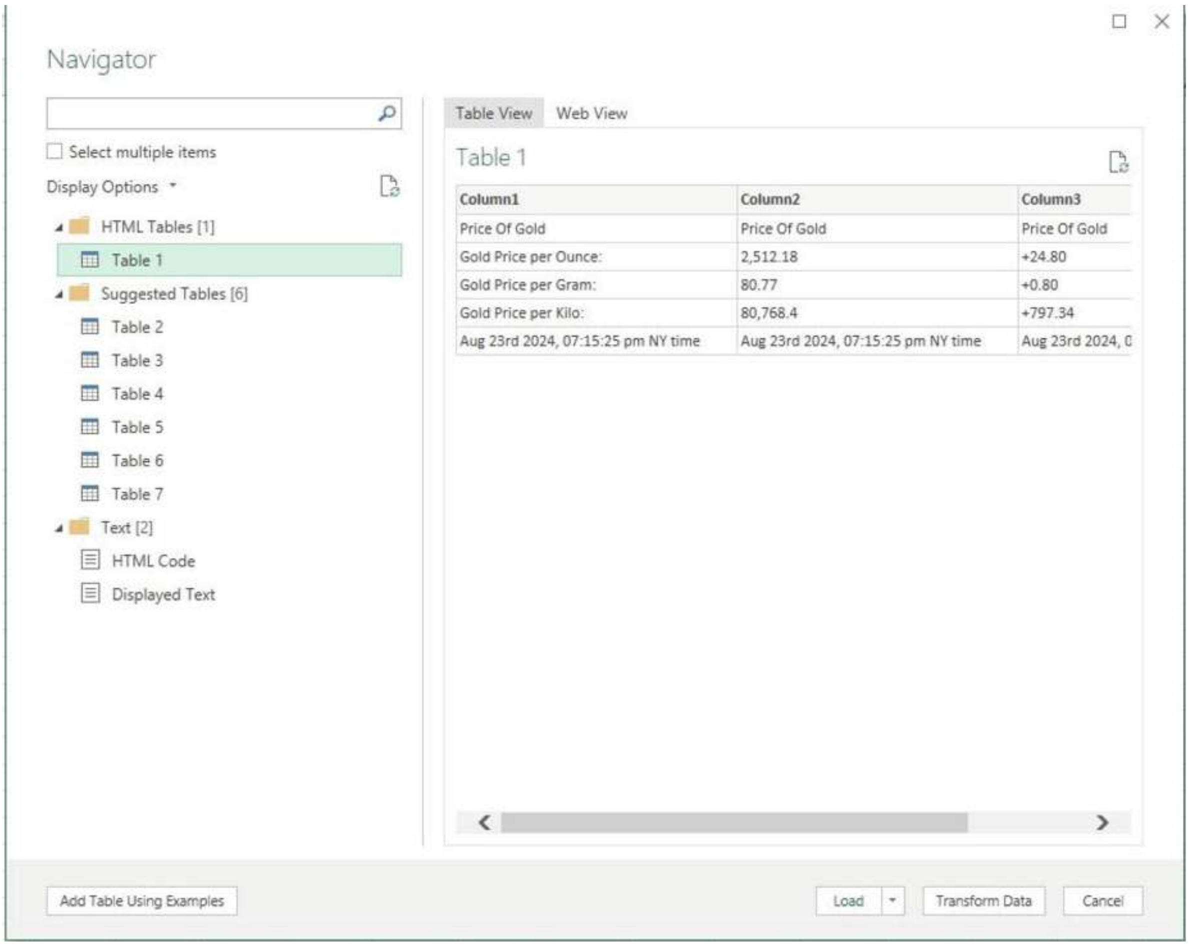
To extract the price of gold from the `GoldPrice.org` website, in Excel, go to the Data tab and select Get Data. Then, choose From Other Sources and From Web. Then, enter the URL of the gold price page in the URL box, as shown in Figure 1-93. Click OK to access the data shown in Figure 1-94.



[✓ Basic] Advanced

URL: https://goldprice.org/

*Figure 1-93* Using From Web

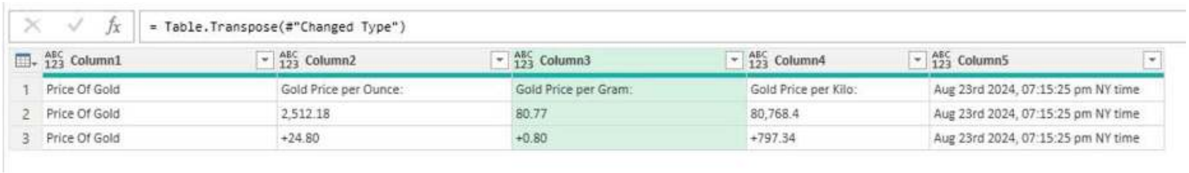


| Column1 | Column2 | Column3 |
|---|---|---|
| Price Of Gold | Price Of Gold | Price Of Gold |
| Gold Price per Ounce: | 2,512.18 | +24.80 |
| Gold Price per Gram: | 80.77 | +0.80 |
| Gold Price per Kilo: | 80,768.4 | +797.34 |
| Aug 23rd 2024, 07:15:25 pm NY time | Aug 23rd 2024, 07:15:25 pm NY time | Aug 23rd 2024, 0 |

***Figure 1-94*** The Navigator pane

In the Navigator pane, select Table 1 (which includes the desired info) and click Transform Data to load the data into the Power Query Editor. This will initiate the steps: Source, Extracted Table From HTML, and Change Type.

Out of all the provided data, you are searching for the values of Gold Price per Ounce, Gold Price per Gram, and Gold Price per Kilo in different columns, as well as the date and time of collecting the data. To extract the desired info, in the Power Query Editor, go to the Transform tab and select Transpose. This rearranges the table, as shown in Figure 1-95.

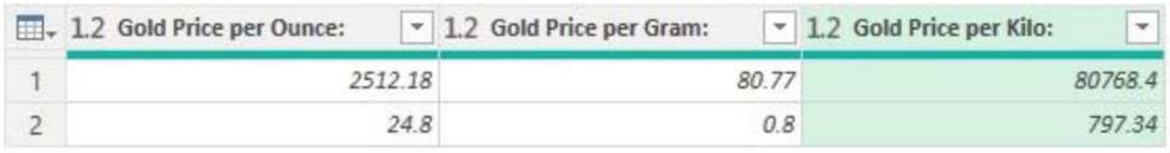


```
= Table.Transpose(#"Changed Type")
```

|  | Column1 | Column2 | Column3 | Column4 | Column5 |
|---|---|---|---|---|---|
| 1 | Price Of Gold | Gold Price per Ounce: | Gold Price per Gram: | Gold Price per Kilo: | Aug 23rd 2024, 07:15:25 pm NY time |
| 2 | Price Of Gold | 2,512.18 | 80.77 | 80,768.4 | Aug 23rd 2024, 07:15:25 pm NY time |
| 3 | Price Of Gold | +24.80 | +0.80 | +797.34 | Aug 23rd 2024, 07:15:25 pm NY time |

***Figure 1-95*** Transposed table

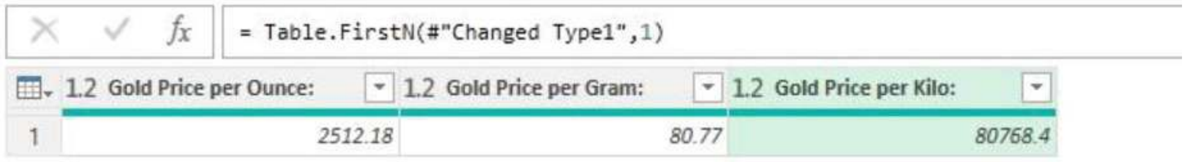
Remove Column1 and Column5, and from the Transform tab, choose the Use First Row as Headers command to set the first row as the headers, resulting in Figure 1-96.



| | 1.2 Gold Price per Ounce: | 1.2 Gold Price per Gram: | 1.2 Gold Price per Kilo: |
|---|---|---|---|
| 1 | 2512.18 | 80.77 | 80768.4 |
| 2 | 24.8 | 0.8 | 797.34 |

*Figure 1-96* The result of promoting the headers

To remove the unnecessary second row, go to the Home tab, select Keep Rows, then Keep Top Rows, and enter 1 in the empty box. This will result in Figure 1-97.



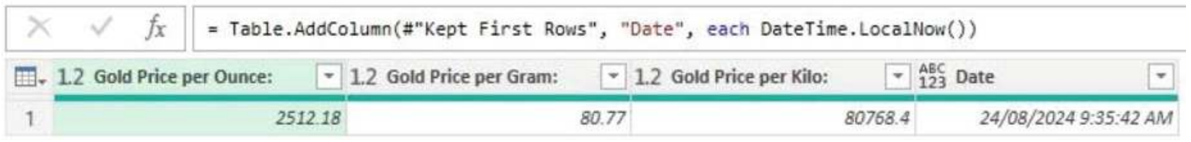
```
= Table.FirstN(#"Changed Type1",1)
```

| | 1.2 Gold Price per Ounce: | 1.2 Gold Price per Gram: | 1.2 Gold Price per Kilo: |
|---|---|---|---|
| 1 | 2512.18 | 80.77 | 80768.4 |

*Figure 1-97* The result of removing extra columns

To record the refreshing time and date, add a new column named Date with the following formula in the Custom Column window, resulting in Figure 1-98:

```
=DateTime.LocalNow()
```



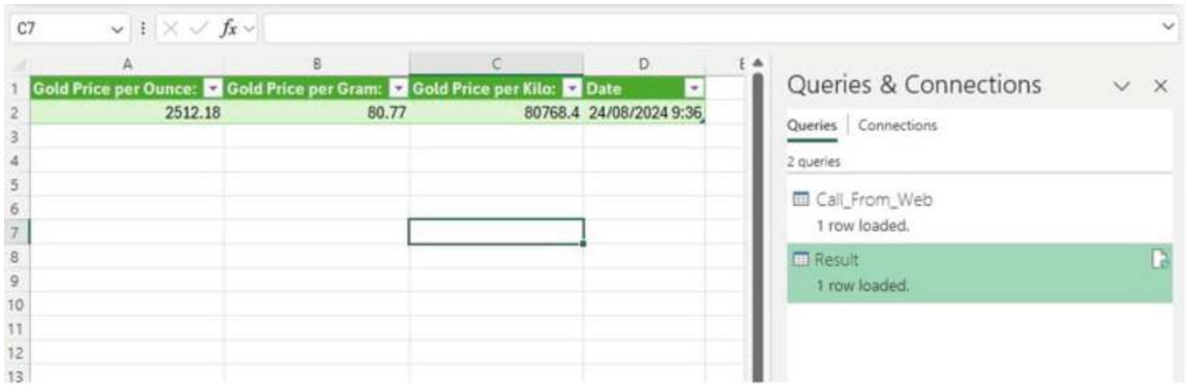
```
= Table.AddColumn(#"Kept First Rows", "Date", each DateTime.LocalNow())
```

| | 1.2 Gold Price per Ounce: | 1.2 Gold Price per Gram: | 1.2 Gold Price per Kilo: | ABC 123 Date |
|---|---|---|---|---|
| 1 | 2512.18 | 80.77 | 80768.4 | 24/08/2024 9:35:42 AM |

*Figure 1-98* Adding a date column

Using the previous steps, the last price of the gold is extracted, but in each refresh, it just includes the last price. To create a load tracker and preserve the historically loaded prices after each refresh, you need two queries: one to load the latest price and another to retain the previously loaded prices. Finally, you'll append these two queries together.

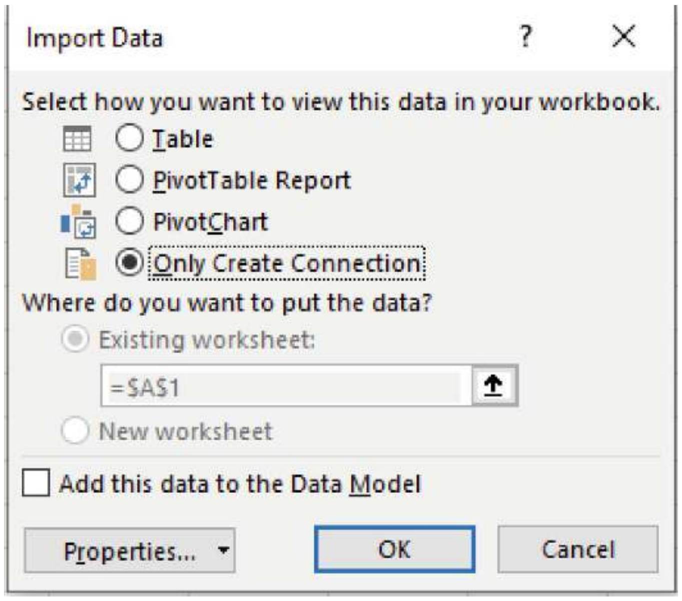
So, in the Query Pane, right-click the query name and select Duplicate to create a copy of the query. Rename one query `Call_From_Web` and the other `Result`. Then, click Close & Load to load both queries into Excel and achieve the result shown in Figure 1-99.



| | A | B | C | D |
|---|---|---|---|---|
| 1 | Gold Price per Ounce: | Gold Price per Gram: | Gold Price per Kilo: | Date |
| 2 | 2512.18 | 80.77 | 80768.4 | 24/08/2024 9:36 |

*Figure 1-99* Queries and connection

The task of the `Call_From_Web` query is to load the latest price, which will later be appended to the historically loaded prices in the `Result` query. Since you don't need to display it as a table, right-click it in the Queries & Connections section, and as shown in Figure 1-100, select Only Create Connection.


Import Data

Select how you want to view this data in your workbook.

( ) Table
( ) PivotTable Report
( ) PivotChart
[✓ Only Create Connection]

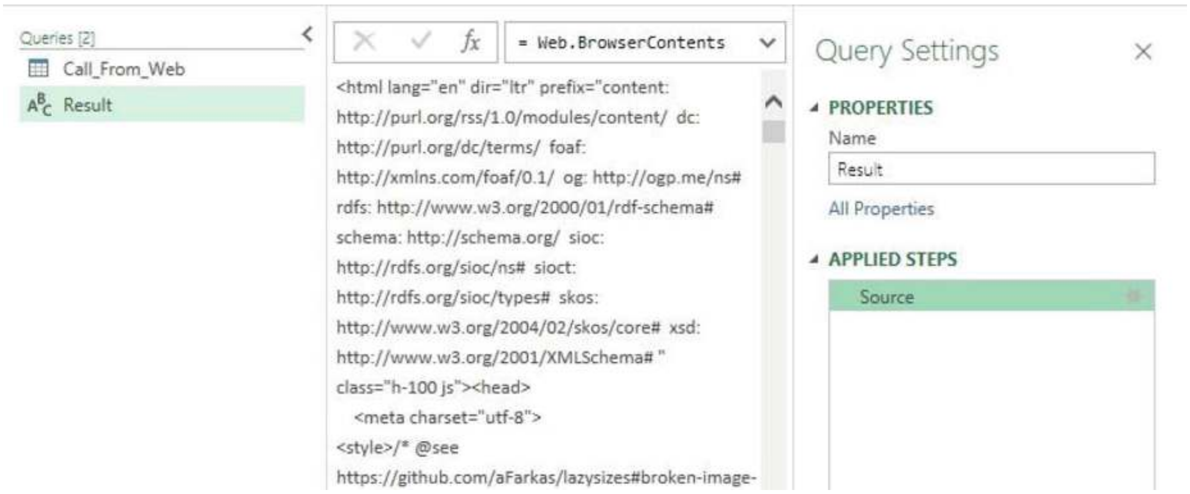
Where do you want to put the data?

( ) Existing worksheet:
=$A$1
( ) New worksheet

[ ] Add this data to the Data Model

*Figure 1-100* Setting for Load To

Then, right-click the query named `Result` and select Edit. In the Power Query Editor, as shown in Figure 1-101, remove all the steps except for the Source step.



= Web.BrowserContents

```
<html lang="en" dir="ltr" prefix="content:
http://purl.org/rss/1.0/modules/content/  dc:
http://purl.org/dc/terms/  foaf:
http://xmlns.com/foaf/0.1/  og: http://ogp.me/ns#
rdfs: http://www.w3.org/2000/01/rdf-schema#
schema: http://schema.org/  sioc:
http://rdfs.org/sioc/ns#  sioct:
http://rdfs.org/sioc/types#  skos:
http://www.w3.org/2004/02/skos/core#  xsd:
http://www.w3.org/2001/XMLSchema# "
class="h-100 js"><head>
  <meta charset="utf-8">
<style>/* @see
https://github.com/aFarkas/lazysizes#broken-image-
```

Query Settings

PROPERTIES

Name: Result

All Properties

APPLIED STEPS

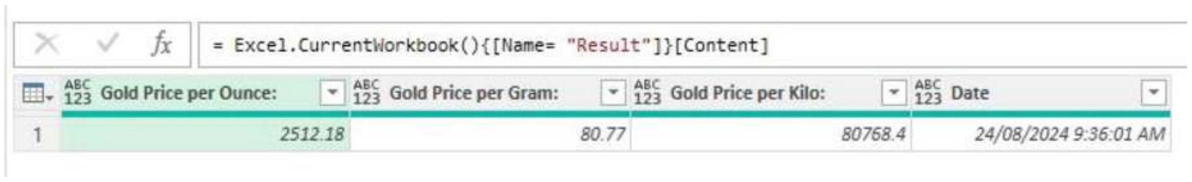
Source

*Figure 1-101* The Power Query Editor

Replace the formula for the Source step with the following formula:

```
= Excel.CurrentWorkbook(){[Name= "Result"]}[Content]
```

This will refer to the Result table, which includes historical values, as shown in Figure 1-102.



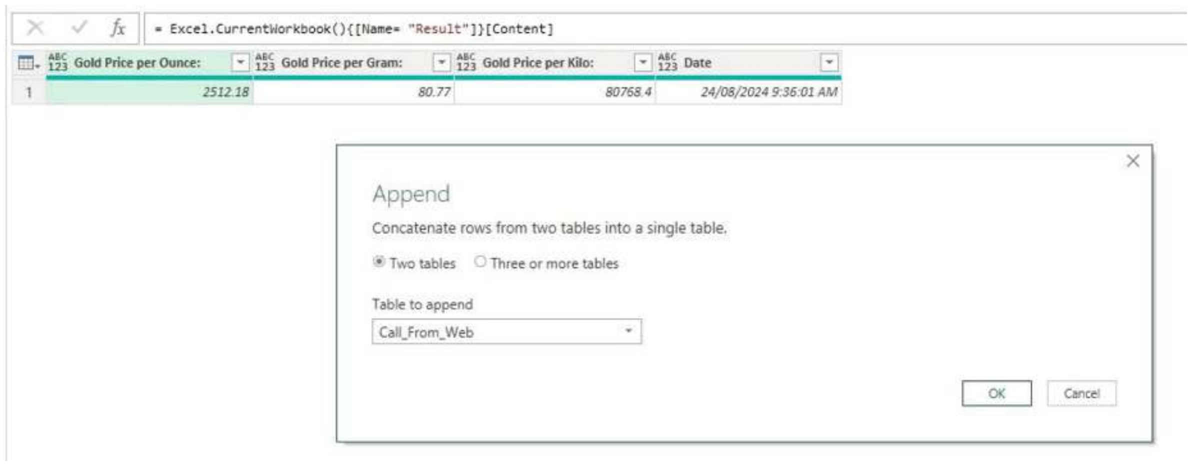
```
= Excel.CurrentWorkbook(){[Name= "Result"]}[Content]
```

| | Gold Price per Ounce: | Gold Price per Gram: | Gold Price per Kilo: | Date |
|---|---|---|---|---|
| 1 | 2512.18 | 80.77 | 80768.4 | 24/08/2024 9:36:01 AM |

*Figure 1-102* Historical values are shown

This step is crucial for maintaining historical data. This query results were loaded into an Excel table, also named Result. The first step of this query refers to this table, ensuring that historical values are initially loaded into the query. Subsequently, the new gold price extracted by the `Call_From_Web` query will be appended to the bottom of this historical data and then the appended table (including the historical and new prices) will be loaded into the Result table.

So, select the `Result` query and, from the Home tab, choose the Append Queries command. Configure the settings as shown in Figure 1-103, then click OK to add the new price to the bottom of historically loaded price, as shown in Figure 1-104.



```
= Excel.CurrentWorkbook(){[Name= "Result"]}[Content]
```

| | Gold Price per Ounce: | Gold Price per Gram: | Gold Price per Kilo: | Date |
|---|---|---|---|---|
| 1 | 2512.18 | 80.77 | 80768.4 | 24/08/2024 9:36:01 AM |

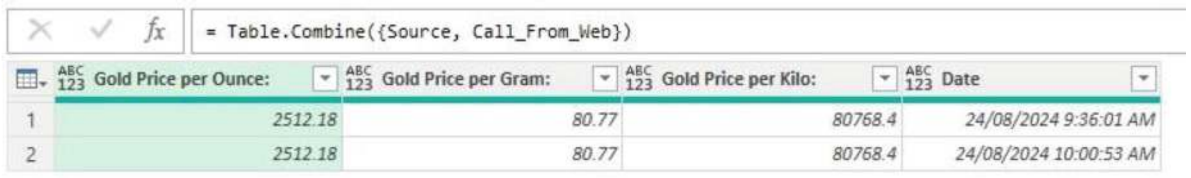
Append

Concatenate rows from two tables into a single table.

[✓ Two tables] Three or more tables

Table to append: Call_From_Web

*Figure 1-103* Setting for Append

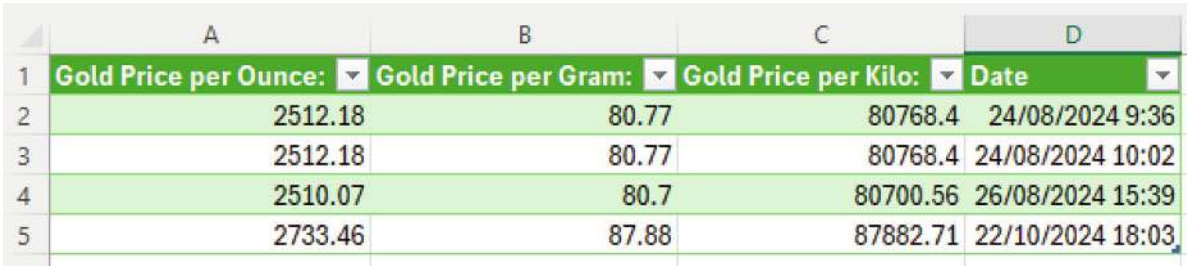


```
= Table.Combine({Source, Call_From_Web})
```

| | Gold Price per Ounce: | Gold Price per Gram: | Gold Price per Kilo: | Date |
|---|---|---|---|---|
| 1 | 2512.18 | 80.77 | 80768.4 | 24/08/2024 9:36:01 AM |
| 2 | 2512.18 | 80.77 | 80768.4 | 24/08/2024 10:00:53 AM |

*Figure 1-104* Result of Append

After the last step, the new gold price will be added as a new row to the end of the existing historical data. Click Close & Load from the Home tab to update the Excel table. With each refresh, new values will be appended to the historical data, as depicted in Figure 1-105.



| | A | B | C | D |
|---|---|---|---|---|
| 1 | Gold Price per Ounce: | Gold Price per Gram: | Gold Price per Kilo: | Date |
| 2 | 2512.18 | 80.77 | 80768.4 | 24/08/2024 9:36 |
| 3 | 2512.18 | 80.77 | 80768.4 | 24/08/2024 10:02 |
| 4 | 2510.07 | 80.7 | 80700.56 | 26/08/2024 15:39 |
| 5 | 2733.46 | 87.88 | 87882.71 | 22/10/2024 18:03 |

*Figure 1-105* Adding new value to the historical values

## Creating a Date Table

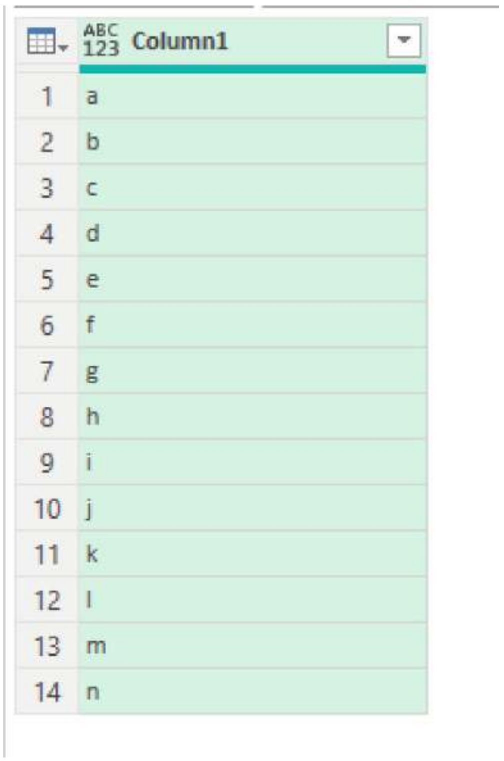
Create a data table including all the dates in 2023 and 2024 and the following columns:

- Data in the format of d/m/yyyy
- Year
- Month as a number and as text
- Day (as a number)
- Weekday as a number and as text
- Week of month and week of the year
- Quarter as a number and as text
- Starting and ending date of that month

This problem can be solved in several ways, but thanks to the `Table.FromList()` function, it can be solved easily. Let's check this function first and then try to solve this problem. The syntax of `Table.FromList()` is as follows:

```
Table.FromList(
      list as list,
      optional splitter as nullable function,
      optional columns as any,
      optional default as any,
      optional extraValues as nullable number) as table
```

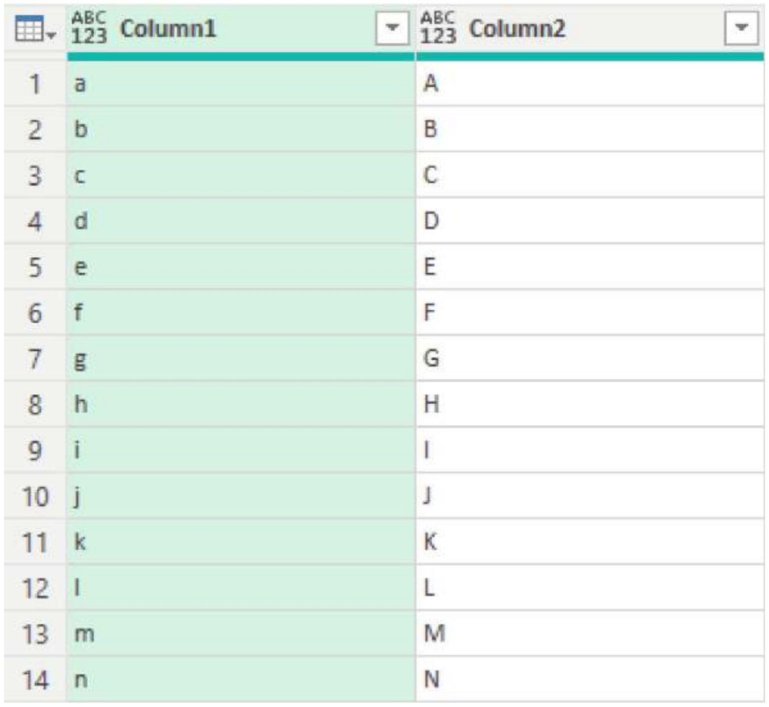
It includes five arguments, the first being mandatory and the others being optional. As the name suggests, it converts the list in its first argument into a table. For example, the result of `=Table.FromList({"a".."n"})` is the table displayed in Figure 1-106.



| | Column1 |
|---|---|
| 1 | a |
| 2 | b |
| 3 | c |
| 4 | d |
| 5 | e |
| 6 | f |
| 7 | g |
| 8 | h |
| 9 | i |
| 10 | j |
| 11 | k |
| 12 | l |
| 13 | m |
| 14 | n |

*Figure 1-106* The result of Table.FromList

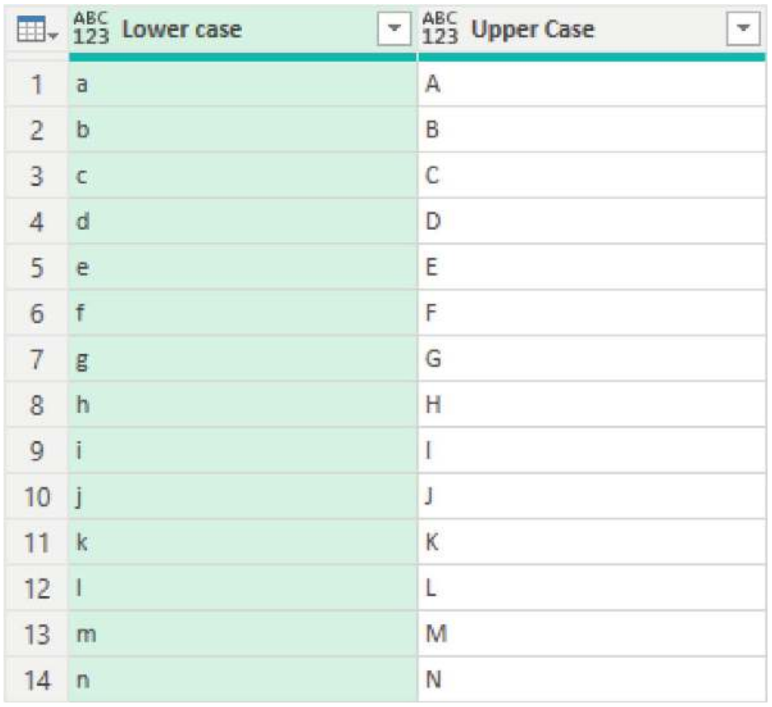
Using the second argument, new columns can be added to the created table by defining a transformation function based on the generated list. For example, the result of `=Table.FromList({"a".."n"}, each {_})` is the same as the previous formula. However, the result of `=Table.FromList({"a".."n"}, each {_, Text.Upper(_)})` produces a table with two columns: the first containing lowercase letters and the second containing the corresponding uppercase letters. See Figure 1-107.



|  | Column1 | Column2 |
|---|---|---|
| 1 | a | A |
| 2 | b | B |
| 3 | c | C |
| 4 | d | D |
| 5 | e | E |
| 6 | f | F |
| 7 | g | G |
| 8 | h | H |
| 9 | i | I |
| 10 | j | J |
| 11 | k | K |
| 12 | l | L |
| 13 | m | M |
| 14 | n | N |

***Figure 1-107*** Using the second argument of Table.FromList

The column names can be modified using the third argument. For example, rewriting the previous formula as `=Table.FromList({"a".."n"}, each {_, Text.Upper(_)}, {"Lowercase", "Uppercase"})` will result in Figure 1-108.



| | Lower case | Upper Case |
|---|---|---|
| 1 | a | A |
| 2 | b | B |
| 3 | c | C |
| 4 | d | D |
| 5 | e | E |
| 6 | f | F |
| 7 | g | G |
| 8 | h | H |
| 9 | i | I |
| 10 | j | J |
| 11 | k | K |
| 12 | l | L |
| 13 | m | M |
| 14 | n | N |

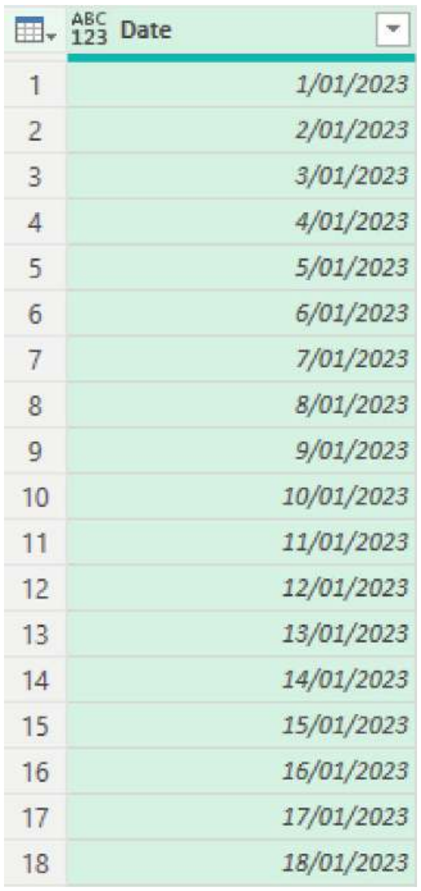
***Figure 1-108*** Using the third argument of Table.FromList

Based on the explanation, try creating a Date table. To do this, you need a list containing all the dates from 2023 and 2024, which can be achieved using the following formula:

```
=List.Dates(Date.From("1/1/2023"), 2*365, #duration(1,0,0,0)).
```

To convert this list into a table, use `Table.FromList()` as shown here, which results in Figure 1-109:

```
=
Table.FromList(List.Dates(Date.From("1/1/2023"),2*365,#duration(1,0,0,0)),
each {_},{"Date"})
```

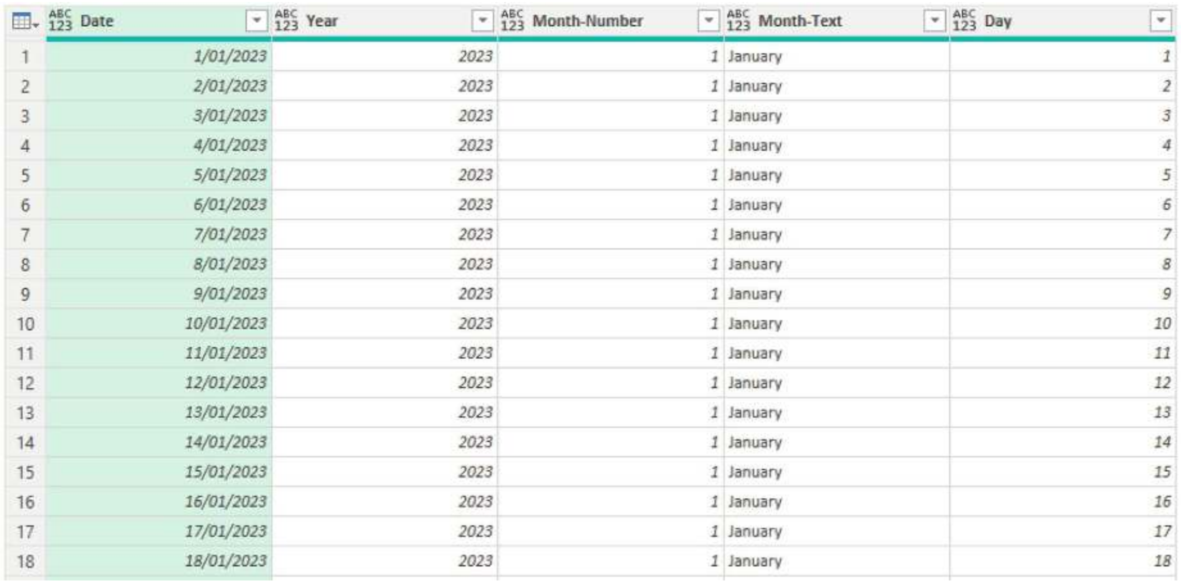


| | Date |
|---|---|
| 1 | 1/01/2023 |
| 2 | 2/01/2023 |
| 3 | 3/01/2023 |
| 4 | 4/01/2023 |
| 5 | 5/01/2023 |
| 6 | 6/01/2023 |
| 7 | 7/01/2023 |
| 8 | 8/01/2023 |
| 9 | 9/01/2023 |
| 10 | 10/01/2023 |
| 11 | 11/01/2023 |
| 12 | 12/01/2023 |
| 13 | 13/01/2023 |
| 14 | 14/01/2023 |
| 15 | 15/01/2023 |
| 16 | 16/01/2023 |
| 17 | 17/01/2023 |
| 18 | 18/01/2023 |

***Figure 1-109*** The result of Table.FromList

To add columns for the year, month (both as a number and as text), and day, rewrite the formula as follows, which results in Figure 1-110:

```
Table.FromList(
  =List.Dates(Date.From("1/1/2023"), 2 * 365, #duration(1, 0, 0, 0)),
      each {_, Date.Year(_), Date.Month(_), Date.MonthName(_),
Date.Day(_)},
      {"Date", "Year", "Month-Number", "Month-Text", "Day"})
```



| | Date | Year | Month-Number | Month-Text | Day |
|---|---|---|---|---|---|
| 1 | 1/01/2023 | 2023 | 1 | January | 1 |
| 2 | 2/01/2023 | 2023 | 1 | January | 2 |
| 3 | 3/01/2023 | 2023 | 1 | January | 3 |
| 4 | 4/01/2023 | 2023 | 1 | January | 4 |
| 5 | 5/01/2023 | 2023 | 1 | January | 5 |
| 6 | 6/01/2023 | 2023 | 1 | January | 6 |
| 7 | 7/01/2023 | 2023 | 1 | January | 7 |
| 8 | 8/01/2023 | 2023 | 1 | January | 8 |
| 9 | 9/01/2023 | 2023 | 1 | January | 9 |
| 10 | 10/01/2023 | 2023 | 1 | January | 10 |
| 11 | 11/01/2023 | 2023 | 1 | January | 11 |
| 12 | 12/01/2023 | 2023 | 1 | January | 12 |
| 13 | 13/01/2023 | 2023 | 1 | January | 13 |
| 14 | 14/01/2023 | 2023 | 1 | January | 14 |
| 15 | 15/01/2023 | 2023 | 1 | January | 15 |
| 16 | 16/01/2023 | 2023 | 1 | January | 16 |
| 17 | 17/01/2023 | 2023 | 1 | January | 17 |
| 18 | 18/01/2023 | 2023 | 1 | January | 18 |

***Figure 1-110*** Using the second and third arguments in Table.FromList

The complete solution is provided by the following formula:

```
=Table.FromList(
      List.Dates(Date.From("1/1/2023"), 2 * 365, #duration(1, 0, 0, 0)),
      each {
            _,
            Date.Year(_),
            Date.Month(_),
            Date.MonthName(_),
            Date.Day(_),
            Date.DayOfWeek(_),
            Date.DayOfWeekName(_),
            Date.WeekOfMonth(_),
            Date.WeekOfYear(_),
            Date.QuarterOfYear(_),
            Date.StartOfMonth(_),
            Date.EndOfMonth(_)
      },
      {
            "Date",
            "Year",
            "Month-Number",
            "Month-Text",
            "Day",
            "WeekDay-Number",
            "WeekDay-Text",
            "WeekMonth",
            "WeekYear",
            "Quarter",
            "Start Date of Month",
            "End Date of Month"
      }
)
```

## Summary

The journey into Power Query as an ETL (Extract, Transform, Load) tool begins with data extraction from multiple sources. This chapter explored techniques for loading data with varying structures, discussed ways to handle and combine tables with inconsistent column names, manage complex multi-row headers, and extract information outside the table boundaries. It also covered creating a loading log in Excel to monitor data processing and merging query results, with manually entered data for added flexibility. The chapter also included a solid foundation in establishing data connectivity and overcoming structural challenges, setting the stage for advanced transformations presented in this chapter.

In the next chapter, you continue this journey by learning the functions and operators used to refer to a specific item inside tables, lists, and records.

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# 2. Referencing

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In various real-world scenarios, you may need to extract values of a specific column, row, or even a cell in a table or search for a specific field in a record or item in a list. There are several methods and different functions to reference specific values in a table, list, or record. This chapter explores various Power Query functions for referencing data, including extracting the first or last *N* items or rows, retrieving middle items or rows, and extracting values based on specific conditions in real-word problems. Before starting the problems in this section, let's review some tips for referencing.

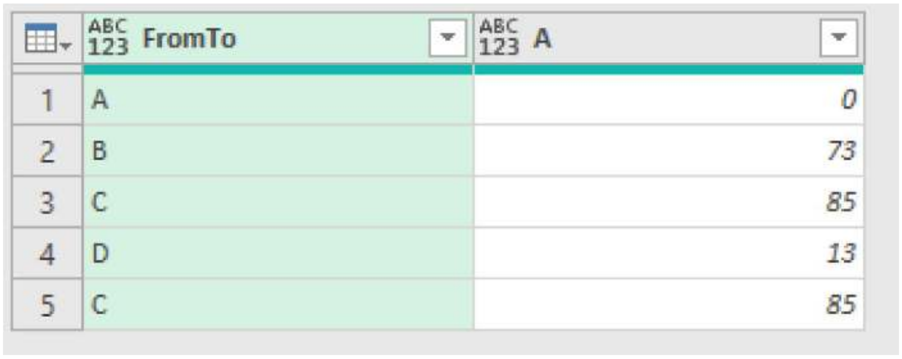
Consider the table named Source, shown in Table 2-1. It shows the distances between cities.

***Table 2-1*** Source: Distances Between Cities

| FromTo | A | B | C | D |
|---|---|---|---|---|
| A | 0 | 73 | 85 | 13 |
| B | 73 | 0 | 91 | 41 |
| C | 85 | 91 | 0 | 31 |
| D | 13 | 41 | 31 | 0 |
| C | 85 | 91 | 0 | 31 |

To reference one or multiple columns in this table, you can use the `Table.SelectColumns()` function by entering two inputs for it—the first parameter is the name of the table, and the second is a list of column names to be selected. The following formula results in a table with only the specified columns, whose names are mentioned in the second argument. The result is shown in Figure 2-1. (If you select both the columns—FromTo and A—right-click one of them, and then choose the Remove Other Columns command, the same formula will generated in the formula bar.)

```
= Table.SelectColumns(Source,{"FromTo","A"})
```



| | FromTo | A |
|---|---|---|
| 1 | A | 0 |
| 2 | B | 73 |
| 3 | C | 85 |
| 4 | D | 13 |
| 5 | C | 85 |

***Figure 2-1*** Using Table.SelectColumns

Alternatively, you can achieve the same result using the following formula, where the column names are listed in the `[ ]`:

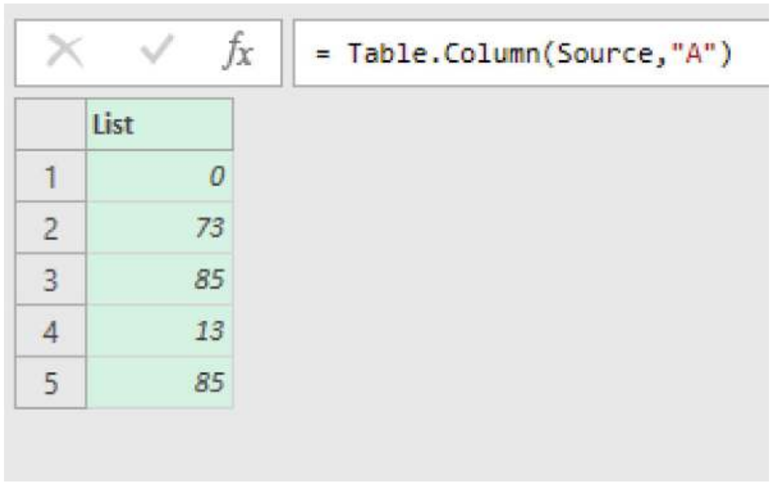
```
= Source[[FromTo],[A]]
```

The same result can be achieved by removing unwanted columns using the `Table.RemoveColumns()` function, as shown in the following formula. In this formula, the name of the columns that you want to remove should be provided in the second argument. (The same formula will be generated if you select the B, C, and D columns, right-click one of them, and choose the Remove Columns command.)

```
= Table.RemoveColumns(Distance,{"B", "C", "D"})
```

In another case, to address a specific column (just one column) in a table, you can use the `Table.Column()` function. The following formula returns the values of the specified column in the second argument as a list (not a table), as shown in Figure 2-2.

```
= Table.Column(Source,"A")
```



```
= Table.Column(Source,"A")
```

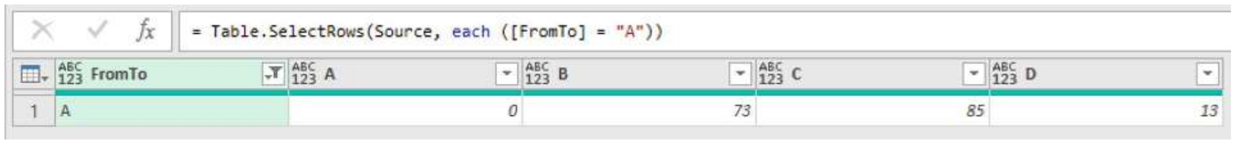
| | List |
|---|---|
| 1 | 0 |
| 2 | 73 |
| 3 | 85 |
| 4 | 13 |
| 5 | 85 |

***Figure 2-2*** Using Table.Column

The =`Source[A]` formula also returns a list, like the previous formula. (However, be careful with the syntax used for referencing. The result of `Source[A]` and `Table.Column(Source,"A")` is a list, whereas `Source[[A]]` and =`Table.SelectColumns(Source,{"A"})` returns a table with just one column.)

Just as you can select specific columns in a table, there are functions available in Power Query to select the desired rows. To extract specific rows from a table based on its value on a specific column, you can use the `Table.SelectRows()` function. (This function is explained in depth in Chapter 3.) To use this function by UI, select the filter icon next to the FromTo column name and choose the desired city, like A, from the list. It results in the table shown in Figure 2-3 based on the following formula, which is shown in the formula bar.

```
= Table.SelectRows(Source, each ([FromTo] = "A"))
```



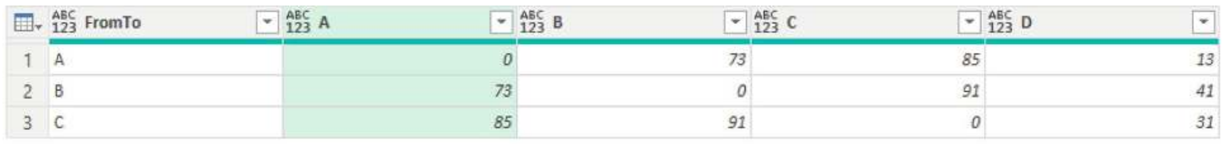
```
= Table.SelectRows(Source, each ([FromTo] = "A"))
```

| | FromTo | A | B | C | D |
|---|---|---|---|---|---|
| 1 | A | 0 | 73 | 85 | 13 |

***Figure 2-3*** Using Table.SelectRows

To select the top or bottom *N* rows of a table, use the `Table.FirstN()` and `Table.LastN()` functions. To remove the top or bottom *N* rows of a table, use the `Table.RemoveFirstN()` and `Table.RemoveLastN()` functions. You can specify *N* as a number or a condition in the second argument. For example, the following formula shows the first three rows in the Source table, as shown in Figure 2-4.

```
= Table.FirstN(Source,3)
```

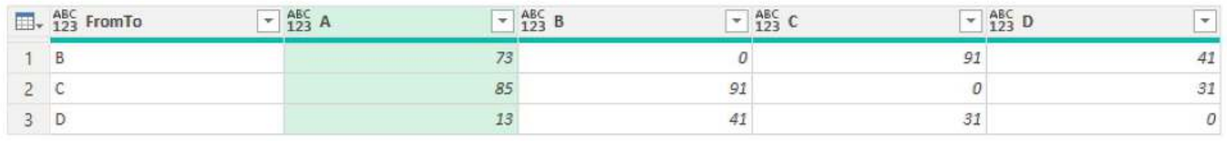


| | FromTo | A | B | C | D |
|---|---|---|---|---|---|
| 1 | A | 0 | 73 | 85 | 13 |
| 2 | B | 73 | 0 | 91 | 41 |
| 3 | C | 85 | 91 | 0 | 31 |

***Figure 2-4*** Using Table.FirstN

Similarly, you can use the `Table.Range()` function to extract rows based on their position from the middle rows of a table and `Table.AlternateRows()` to remove the table rows based on a specific pattern. For example, the following formula returns three rows from the source table, starting from the second row (as indexing in Power Query starts from 0) of the table shown in Figure 2-5.

```
= Table.Range(Source,1,3)
```



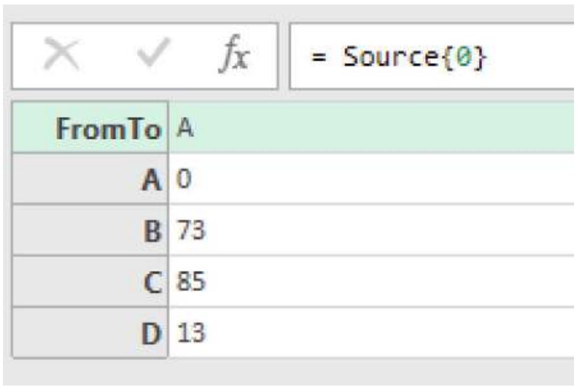
| | FromTo | A | B | C | D |
|---|---|---|---|---|---|
| 1 | B | 73 | 0 | 91 | 41 |
| 2 | C | 85 | 91 | 0 | 31 |
| 3 | D | 13 | 41 | 31 | 0 |

***Figure 2-5*** Using Table.Range

**Note** To select or remove the top or bottom rows in Power Query using the UI, navigate to the Home tab and choose the desired command from the Reduce Rows section. Using the Keep Rows options will generate functions like `Table.FirstN()`, `Table.LastN()`, or `Table.Range()`. In contrast, using the Remove Rows options will result in functions such as `Table.RemoveFirstN()`, `Table.RemoveLastN()`, or `Table.AlternateRows()`.

In addition to using the previously mentioned functions, you can also extract a row of a table by using the indexing sign after the table name. Since indexing starts at 0 in Power Query, the following formula refers to the first row of the Source table, as shown in Figure 2-6.

```
= Source{0}
```



```
= Source{0}
```

| FromTo | A |
|---|---|
| A | 0 |
| B | 73 |
| C | 85 |
| D | 13 |

***Figure 2-6*** Using Source{0}

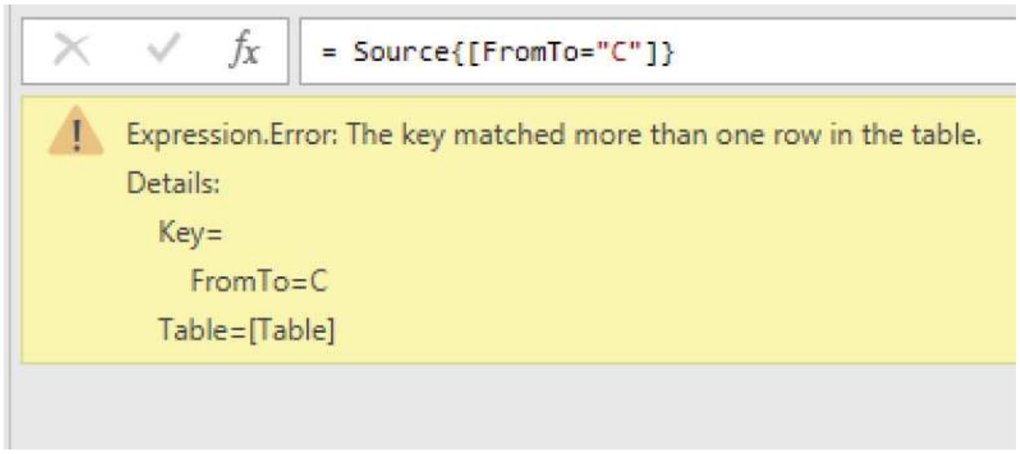
**Note** Using the list sign to reference a row returns a record, whereas `Table.SelectRows()` always returns a table. To extract the first row of a table not using `Source{0}`, you can use `Table.First(Source)` to reach the same result as the record. Similarly, you can use `Table.Last()` to reach the last row of a table, which will also return the result in a record type.

Besides referencing a row by mentioning the row number in the index sign, you can use the index sign to apply the filter on a table, based on the cell values like the following formula:

```
=Source{[FromTo="A"]}
```

The previous formula will result in a record as long as the A value is just entered once in the FromTo column. Otherwise, it results in an error. The result of the following formula is the error shown in Figure 2-7.

```
= Source{[FromTo="C"]}
```



```
= Source{[FromTo="C"]}
```

Expression.Error: The key matched more than one row in the table.
Details:
    Key=
        FromTo=C
    Table=[Table]

***Figure 2-7*** Using Source {[FromTo="C"]}

In addition to tables, records and lists are other commonly used data types in Power Query. When working with records, the field values can be extracted by using the `Record.Field()` function or by using the field name directly after the record sign. For example, if the source record is represented as `[A=13, B=41, C=31, D=0]`, both `Record.Field(Source, "A")` and `Source[A]` will return the same result, which is `13`.

In the case of lists, you can extract the value at a specific index by placing the desired index in curly braces `{}` after the list name. For instance, if the source list is `{1, 2, 4, 6, 8}`, then `Source{2}` will return `4` (since indexing starts at 0).

In addition to the methods for extracting specific values from a table, record, or list, there are other functions, summarized in Table 2-2. These functions are explained further with examples in this chapter.

***Table 2-2*** Referencing and Removing Functions

| **Function** | **Description** |
|---|---|
| `List.FirstN()` | Returns the first *N* items from a list. |
| `List.LastN()` | Returns the last *N* items from a list. |
| `List.Range()` | Extracts a range of items from a list based on their positions. |
| `List.RemoveFirstN()` | Removes the first *N* items from a list. |
| `List.RemoveItems()` | Removes specified items from a list. |
| `List.RemoveLastN()` | Removes the last *N* items from a list. |
| `List.RemoveNull()` | Removes null values from a list. |
| `List.RemoveRange()` | Removes a range of items from a list based on their positions. |
| `List.Select()` | Selects items from a list based on a specified condition. |
| `Record.Field()` | Retrieves the value of a specified field from a record. |
| `Record.FieldOrDefault()` | Retrieves the value of a specified field from a record or returns a default value if the field does not exist. |
| `Record.RemoveFields()` | Removes specified fields from a record. |
| `Record.SelectFields()` | Selects specified fields from a record. |
| `Table.AlternateRows()` | Selects alternate rows from a table. |

| Function | Description |
|---|---|
| `Table.FirstN()` | Returns the first *N* rows from a table. *N* can be a specific number or a condition. |
| `Table.FirstValue()` | Retrieves the first value from a specified column in a table. |
| `Table.LastN()` | Returns the last *N* rows from a table. *N* can be a specific number or a condition. |
| `Table.Max()` | Returns the maximum value from a specified column in a table. |
| `Table.MaxN()` | Returns the maximum *N* rows from a specified column in a table. |
| `Table.Min()` | Returns the minimum value from a specified column in a table. |
| `Table.MinN()` | Returns the minimum *N* rows from a specified column in a table. |
| `Table.Range()` | Extracts a range of rows from a table based on their positions. |
| `Table.RemoveBottomRows()` | Removes a specified number of rows from the bottom of a table. |
| `Table.RemoveFirstN()` | Removes the first *N* rows from a table. |
| `Table.RemoveLastN()` | Removes the last *N* rows from a table. |
| `Table.RemoveMatchingRows()` | Removes rows from a table that match specified criteria. |
| `Table.RemoveRows()` | Removes specified rows from a table based on their position or condition. |
| `Table.RemoveRowsWithErrors()` | Removes rows that contain errors from a table. |
| `Table.RemoveTopRows()` | Removes a specified number of rows from the top of a table. |
| `Table.SelectRows()` | Selects rows from a table based on a condition or criteria. |
| `Table.SelectRowsWithErrors()` | Selects rows that contain errors from a table. |
| `Table.Skip()` | Skips the first *N* rows of a table and returns the remaining rows. |

## Referencing Cells in Power Query

Consider the Distance table shown in Table 2-3, which presents the distances between cities, and consider the Source table shown in Table 2-4. Both tables are loaded into Power Query as separate queries with the names Distance and Source.

***Table 2-3*** Distance: Distances Between Cities

| FromTo | A | B | C | D |
|---|---|---|---|---|
| A | 0 | 73 | 85 | 13 |
| B | 73 | 0 | 91 | 41 |
| C | 85 | 91 | 0 | 31 |
| D | 13 | 41 | 31 | 0 |

***Table 2-4*** Source Table

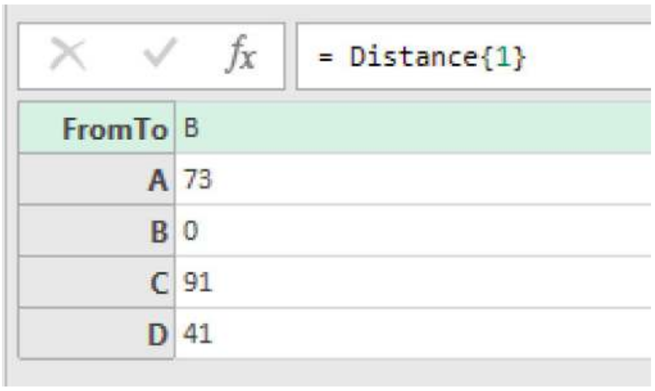
| From | To |
|---|---|
| A | B |
| A | A |
| B | D |
| A | D |

Add a new column to the Source table that calculates the distance between the cities specified in the From and To columns.

To solve this problem, initially try to calculate the distance from city B to city C on the Distance table, then modify the formula for all the cases. To calculate the distance from B to C, right-click the value 91 (the distance from B to C) in the Distance table and select the Drill Down command. This action will generate the following formula in the formula bar:

```
= Distance{1}[C]
```

In the formula generated from the Drill Down operation, `Distance{1}` returns a record containing five fields—FromTo, A, B, C, and D—each with different values (see Figure 2-8). By using `[C]` after this record, the value for the C field, which is 91, is extracted.



```
= Distance{1}
```

| FromTo | B |
|---|---|
| A | 73 |
| B | 0 |
| C | 91 |
| D | 41 |

***Figure 2-8*** Using Distance {[FromTo="C"]}

The previous formula works correctly for the distance from B to C. To make the previous formula dynamic, it can be rewritten as follows (instead of using 1 as hard code):

```
= Distance {[FromTo="B"]}[C]
```

In the formula, B (the source city) is still hardcoded but can be replaced with a variable like *x* as it is in type text. However, C (the destination city) cannot be replaced directly by a variable as it is not in type text and the whole `[C]` comes together as the record operator. To make the formula more flexible, instead of extracting the field value for the city C using `[C]`, you can use the `Record.Field()` function, thus allowing both cities' names to be dynamic. So, the revised formula is:

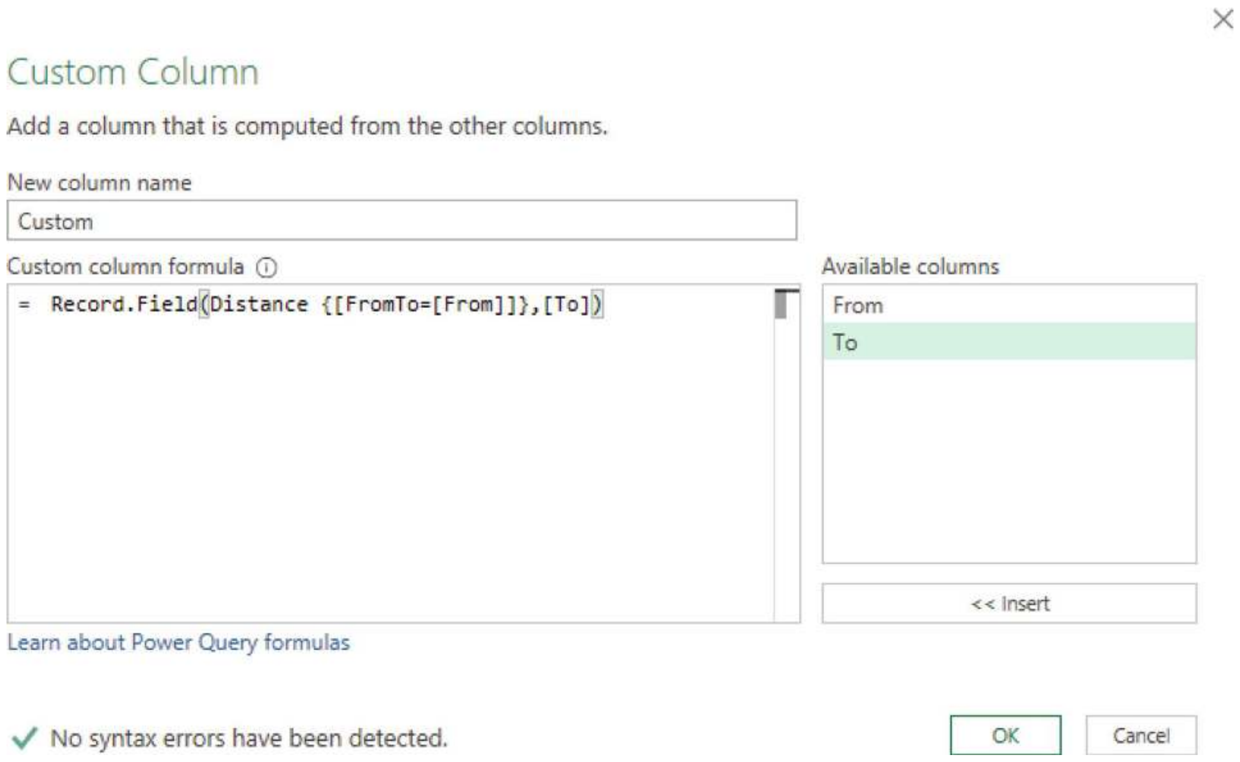
```
= Record.Field(Distance {[FromTo="B"]},"C")
```

This approach enables both cities (B and C) in type text, which can be replaced with variables or values from other columns. Using this formula, let's back to the question and try to solve the problem.

To add a distance column to the Source table, select the Source table, go to the Add Column tab, and choose Custom Column. Using the following formula in the Custom Column window will result in the distance from B to C for all the rows:

```
= Record.Field(Distance {[FromTo="B"]},"C")
```

To use the formula to calculate the distance of cities in each row, rewrite the previous formula by replacing B with `[From]` (the values of the From column in the Source table) and C with `[To]` (equal to values of the To column in the Source table), as shown in Figure 2-9.



New column name: Custom

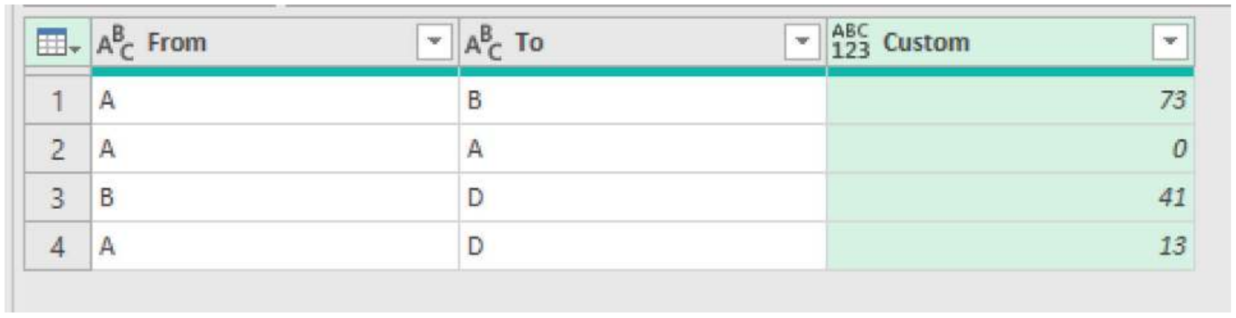
```
= Record.Field(Distance {[FromTo=[From]]},[To])
```

✓ No syntax errors have been detected.

***Figure 2-9*** Adding a new column

```
= Record.Field(Distance {[FromTo=[From]]}, [To])
```

The result of the previous formula is shown in Figure 2-10.



|  | From | To | Custom |
|---|---|---|---|
| 1 | A | B | 73 |
| 2 | A | A | 0 |
| 3 | B | D | 41 |
| 4 | A | D | 13 |

***Figure 2-10*** Result of adding a column

By following the previous steps, you can resolve the problem. To view the entire set of query steps, select the Source query and click the Advanced Editor command in the Home tab. The whole code for solving this problem is as follows:

```
let
```

```
    Source = Excel.CurrentWorkbook(){[Name="Table4"]}[Content],
    #"Added Custom" = Table.AddColumn(Source, "Custom", each
Record.Field(Distance{[FromTo=[From]]},[To]))
in
    #"Added Custom"
```

**Efficiency Tips** Let's examine the execution time of this problem in two scenarios: a small distance table with ten rows and columns, and a larger distance table with 1,000 rows and columns (though this scenario is uncommon in practice).

In the small distance table scenario, with a source table of 1,000 rows, the execution time without buffering the distance table is 1.16 seconds, and with buffering, it is reduced to 0.08 seconds. For a source table with 1 million rows, the execution time is 50 seconds (for more information about buffering, read this post https://learn.microsoft.com/en-us/powerquery-m/table-buffer).

In the large distance table scenario, if the source table has nine rows, the execution time is about four to six seconds. However, with 1,000 rows in the source table, the execution time increases to around 500 seconds without `Table.Buffer`. Even using `Table.Buffer`, the execution time only reduces to 350 seconds. By replacing the `X{[FromTo=[From]]}` part of the formula with `Table.SelectRows(X, (x) => x[FromTo] = _[From]){0}`, the execution time decreases to 140 seconds, though this is still quite high.

In this example, you are searching for values in the From column of the source table over the FromTo column of the Distance table, but all 999 other columns are also being considered. To improve execution time, it is better to separate the FromTo column from the Distance table and use it in a different variable for buffering. Then, you can find the position the value in the From column over this list.

The revised formula, which solves the problem in 0.87 seconds, is provided here. In the small distance table scenario, with a source table of 1 million rows, the execution time using this revised formula is eight seconds.

```
let
    Source = Excel.CurrentWorkbook(){[Name="Table4"]}[Content],
    X=Table.Buffer(Distance),
    Y=List.Buffer(Table.Column(X,"FromTo")),
    #"Added Custom" = Table.AddColumn(Source, "Custom", each
Record.Field(Table.Range(X, List.PositionOf(Y,[From]),1){0},
[To]))
in
    #"Added Custom"
```

## Referencing the Previous Row

In the Source table, as shown in Table 2-5, the monthly sales data is provided (the table is sorted based on month). Calculate the growth rate for each month compared to the previous month.

*Table 2-5* Source: Monthly Sales

| Month | Sales |
|---|---|
| 1 | 69 |
| 2 | 81 |
| 3 | 39 |
| 4 | 15 |
| 5 | 68 |
| 6 | 77 |
| 7 | 75 |
| 8 | 29 |
| 9 | 81 |
| 10 | 52 |
| 11 | 97 |
| 12 | 80 |

Four different solutions are provided to solve this problem. In all the solutions, to extract the information from the previous row in Power Query, an index column with consecutive values (numbers or dates) is helpful. If no such column exists, you can add one by selecting the Add Index Column command under the Add Column tab. However, in this example, the Month column can serve as the index column. So, don't bother to add an index column for this problem.

## Solution 1: Based on Filtering the Rows

To solve this problem, from the Add Column tab, choose Custom Column. This adds a new column to the table. Name this new column Monthly Growth Rate and enter the following formula into the Custom Column window (Source is the name of the previous step). Click OK.

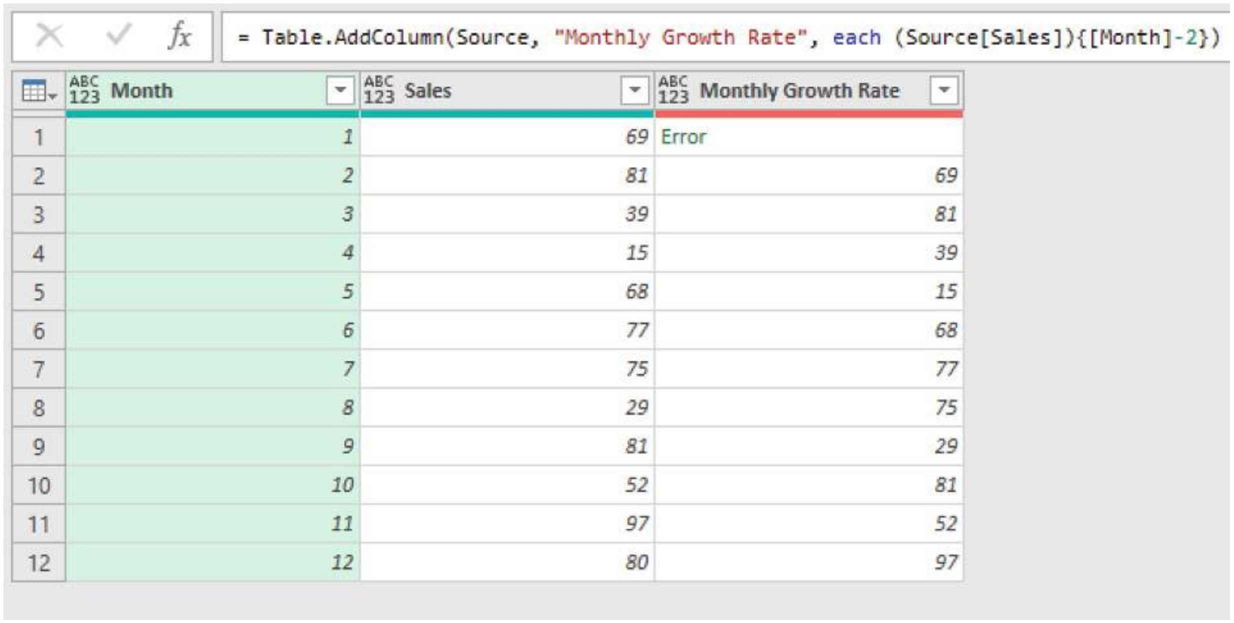
```
=Source
```

Using this formula will result in the same values being repeated for all rows, with every cell in this column containing all the rows and columns of the Source table. To calculate the monthly growth rate, only the values in the Sales column are needed. Replace the previous formula with the following one to generate a list of all the sales values for every row:

```
=Source[Sales]
```

To calculate the growth rate, you need the sales value from the previous month for each row. For example, out of all the values in this list, for `Month = 2`, you need to extract the value for `Month=1`, which is presented as the first item in the list. As Power Query indexing starts from 0, for this month, the value with index 0 should be extracted. Similarly, for `Month=3`, the item in index 1 should be extracted. So, for each month, the value in index `[Month]-2` should be extracted. To reach the values of the previous month, the previous formula should be replaced with the following formula, which results in Figure 2-11.

```
=(Source[Sales]){[Month]-2}
```



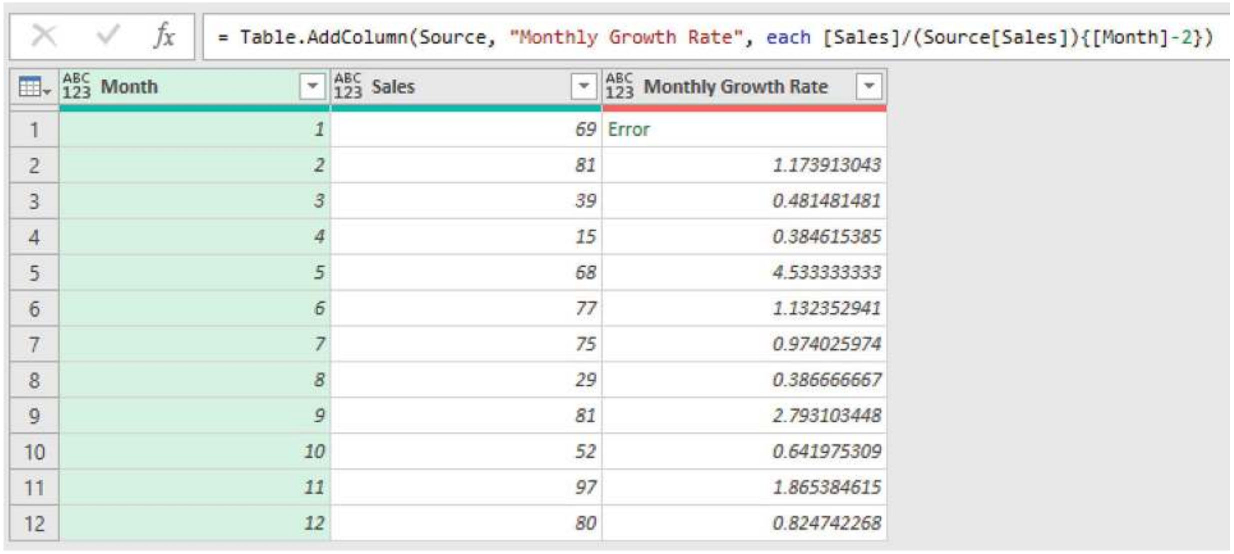
```
= Table.AddColumn(Source, "Monthly Growth Rate", each (Source[Sales]){[Month]-2})
```

| | Month | Sales | Monthly Growth Rate |
|---|---|---|---|
| 1 | 1 | 69 | Error |
| 2 | 2 | 81 | 69 |
| 3 | 3 | 39 | 81 |
| 4 | 4 | 15 | 39 |
| 5 | 5 | 68 | 15 |
| 6 | 6 | 77 | 68 |
| 7 | 7 | 75 | 77 |
| 8 | 8 | 29 | 75 |
| 9 | 9 | 81 | 29 |
| 10 | 10 | 52 | 81 |
| 11 | 11 | 97 | 52 |
| 12 | 12 | 80 | 97 |

***Figure 2-11*** Referring to the previous value in the same column

The previous formula results in the sales value of the previous month. To calculate the growth rate, the formula can be rewritten as follows, resulting in Figure 2-12:

```
=[Sales]/(Source[Sales]){[Month]-2}
```



```
= Table.AddColumn(Source, "Monthly Growth Rate", each [Sales]/(Source[Sales]){[Month]-2})
```

| | Month | Sales | Monthly Growth Rate |
|---|---|---|---|
| 1 | 1 | 69 | Error |
| 2 | 2 | 81 | 1.173913043 |
| 3 | 3 | 39 | 0.481481481 |
| 4 | 4 | 15 | 0.384615385 |
| 5 | 5 | 68 | 4.533333333 |
| 6 | 6 | 77 | 1.132352941 |
| 7 | 7 | 75 | 0.974025974 |
| 8 | 8 | 29 | 0.386666667 |
| 9 | 9 | 81 | 2.793103448 |
| 10 | 10 | 52 | 0.641975309 |
| 11 | 11 | 97 | 1.865384615 |
| 12 | 12 | 80 | 0.824742268 |

***Figure 2-12*** Result of growth rate

To handle potential error values in the first row, you can use the `try-otherwise` expression by replacing the previous formula with the following formula. This new formula calculates `[Sales]/(Source[Sales]){[Month]-2}` for all the rows. If it results in an error, it replaces the error with the value presented after `otherwise`, which is `"-"` in this example.

```
=try [Sales]/(Source[Sales]){[Month]-2} otherwise "-"
```

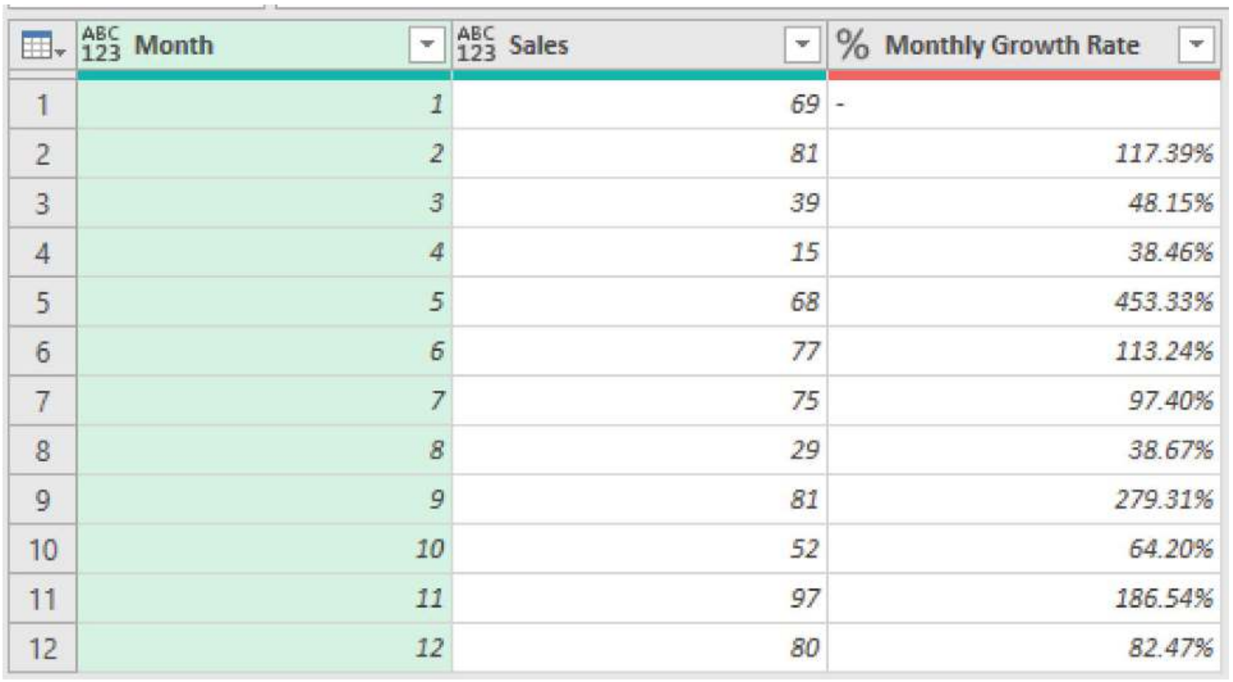
Applying the previous steps results in the following formula using the `Table.AddColumn()` function in the formula bar:

```
= Table.AddColumn(
      Source,
      "Monthly Growth Rate",
      each try [Sales]/(Source[Sales]){[Month]-2} otherwise "-")
```

To improve the readability of results and convert the values in this column into percentages, you can use the fourth argument of this function, shown here:

```
= Table.AddColumn(
      Source,
      "Monthly Growth Rate",
      each try [Sales]/(Source[Sales]){[Month]-2} otherwise "-",
      Percentage.Type)
```

This results in Figure 2-13.



| | Month | Sales | Monthly Growth Rate |
|---|---|---|---|
| 1 | 1 | 69 | - |
| 2 | 2 | 81 | 117.39% |
| 3 | 3 | 39 | 48.15% |
| 4 | 4 | 15 | 38.46% |
| 5 | 5 | 68 | 453.33% |
| 6 | 6 | 77 | 113.24% |
| 7 | 7 | 75 | 97.40% |
| 8 | 8 | 29 | 38.67% |
| 9 | 9 | 81 | 279.31% |
| 10 | 10 | 52 | 64.20% |
| 11 | 11 | 97 | 186.54% |
| 12 | 12 | 80 | 82.47% |

***Figure 2-13*** Changing the value type

Using the previous steps, the problem is solved. In the proposed solution, the `(Source[Sales]){[Month]-2}` formula is used. This formula first extracts the values of the Sales column as a list and, from that list, it retrieves the value with an index equal to `[Month]-2`. However, this logic can be revised by extracting the ([Month]-2)th row of the table first, which is in type of record, and then retrieving the value of the Sales field using the following formula:

```
=Source{[Month]-2}[Sales]
```

Similarly, the previous formula can be replaced by any of the following formulas with the same result, and each is equal to the value in the Sales column for the previous row (the last two formulas are useable even if the rows are not sorted based on the month).

```
=Record.Field(Source{[Month]-2},"Sales")
```

```
=Source{[Month=[Month]-1]}[Sales]
```

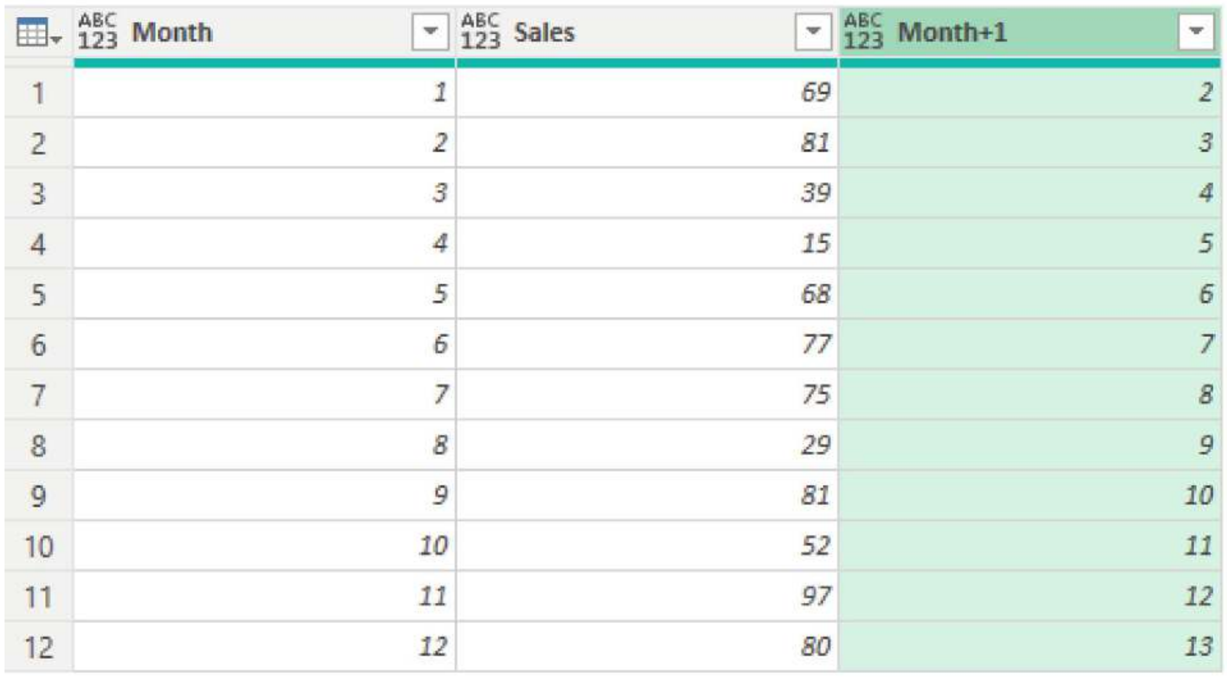
```
=Table.SelectRows(Source, (x)=> x[Month]=[Month]-1)[Sales]{0}
```

## Solution 2: Based on Merging

Consider the Source table. Go to the Add Column tab and select Custom Column. Name the new column Month +1 and enter the following formula:

```
=[Month]+1
```

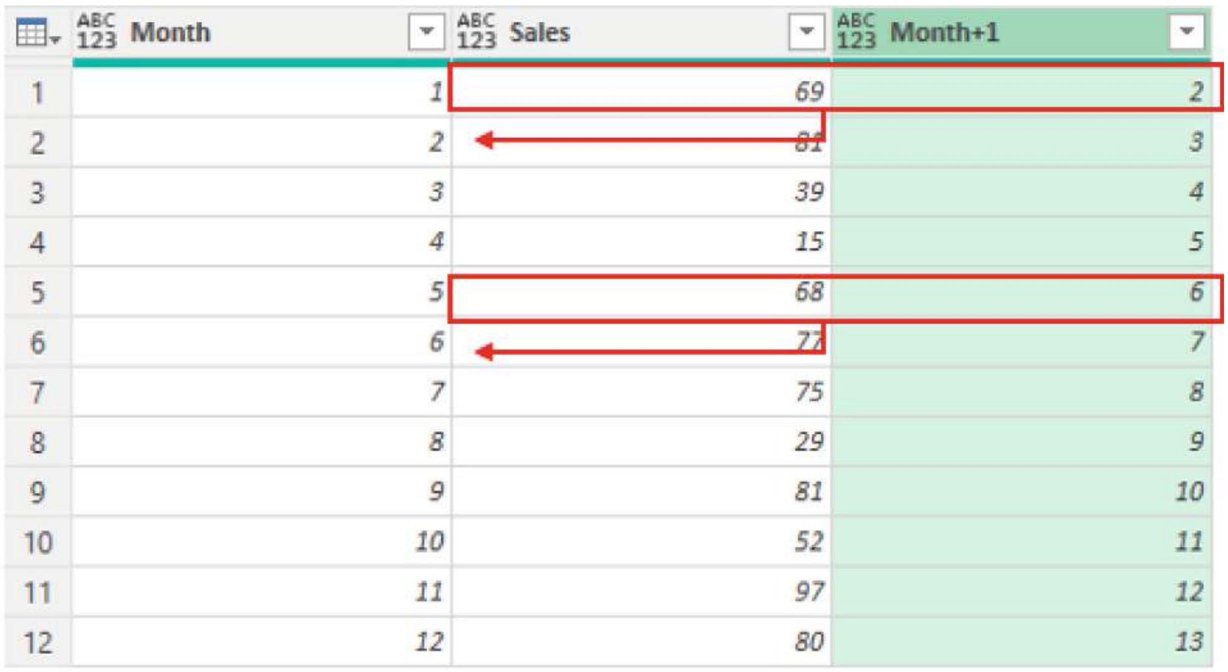
This formula adds one to the values in the Month column, resulting in the Figure 2-14.



| | Month | Sales | Month+1 |
|---|---|---|---|
| 1 | 1 | 69 | 2 |
| 2 | 2 | 81 | 3 |
| 3 | 3 | 39 | 4 |
| 4 | 4 | 15 | 5 |
| 5 | 5 | 68 | 6 |
| 6 | 6 | 77 | 7 |
| 7 | 7 | 75 | 8 |
| 8 | 8 | 29 | 9 |
| 9 | 9 | 81 | 10 |
| 10 | 10 | 52 | 11 |
| 11 | 11 | 97 | 12 |
| 12 | 12 | 80 | 13 |

***Figure 2-14*** Result of [Month]+1

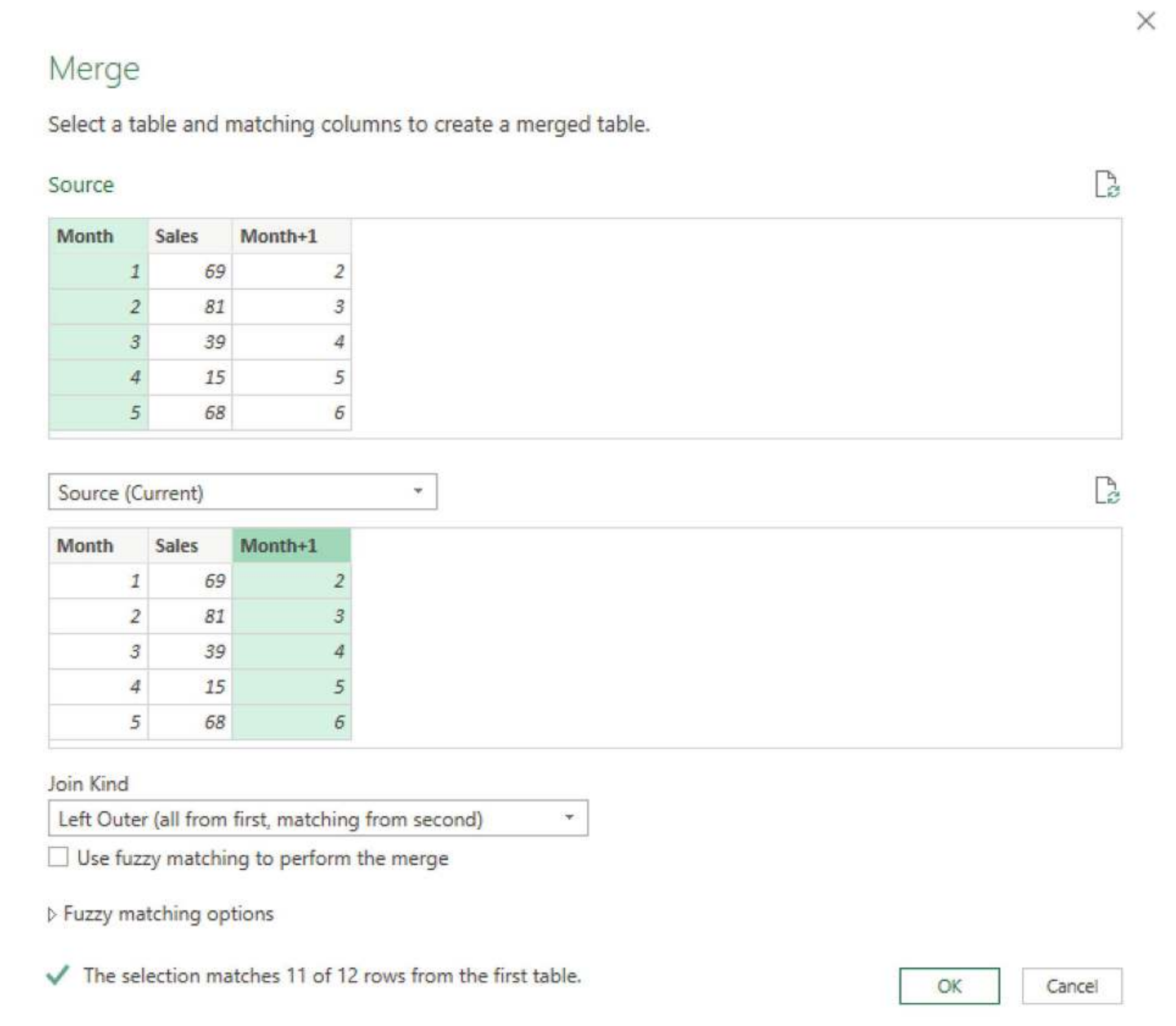
In the next step, to solve this problem, as shown in Figure 2-15, you just need to search for the values in the Month column in the Month+1 column and select that row. The selected row presents the values related to the previous month.



| | Month | Sales | Month+1 |
|---|---|---|---|
| 1 | 1 | 69 | 2 |
| 2 | 2 | 81 | 3 |
| 3 | 3 | 39 | 4 |
| 4 | 4 | 15 | 5 |
| 5 | 5 | 68 | 6 |
| 6 | 6 | 77 | 7 |
| 7 | 7 | 75 | 8 |
| 8 | 8 | 29 | 9 |
| 9 | 9 | 81 | 10 |
| 10 | 10 | 52 | 11 |
| 11 | 11 | 97 | 12 |
| 12 | 12 | 80 | 13 |

***Figure 2-15*** Value of the next month

From the Home tab, select the Merge Queries command (explained in detail in Chapter 7). Then, as shown in Figure 2-16, select the Source table for both parts of the Merge window. Choose the Month column in the top table and the Month +1 column in the bottom table as the common columns.


Merge

Select a table and matching columns to create a merged table.

Source

| Month | Sales | Month+1 |
|---|---|---|
| 1 | 69 | 2 |
| 2 | 81 | 3 |
| 3 | 39 | 4 |
| 4 | 15 | 5 |
| 5 | 68 | 6 |

Source (Current)

| Month | Sales | Month+1 |
|---|---|---|
| 1 | 69 | 2 |
| 2 | 81 | 3 |
| 3 | 39 | 4 |
| 4 | 15 | 5 |
| 5 | 68 | 6 |

Join Kind

Left Outer (all from first, matching from second)

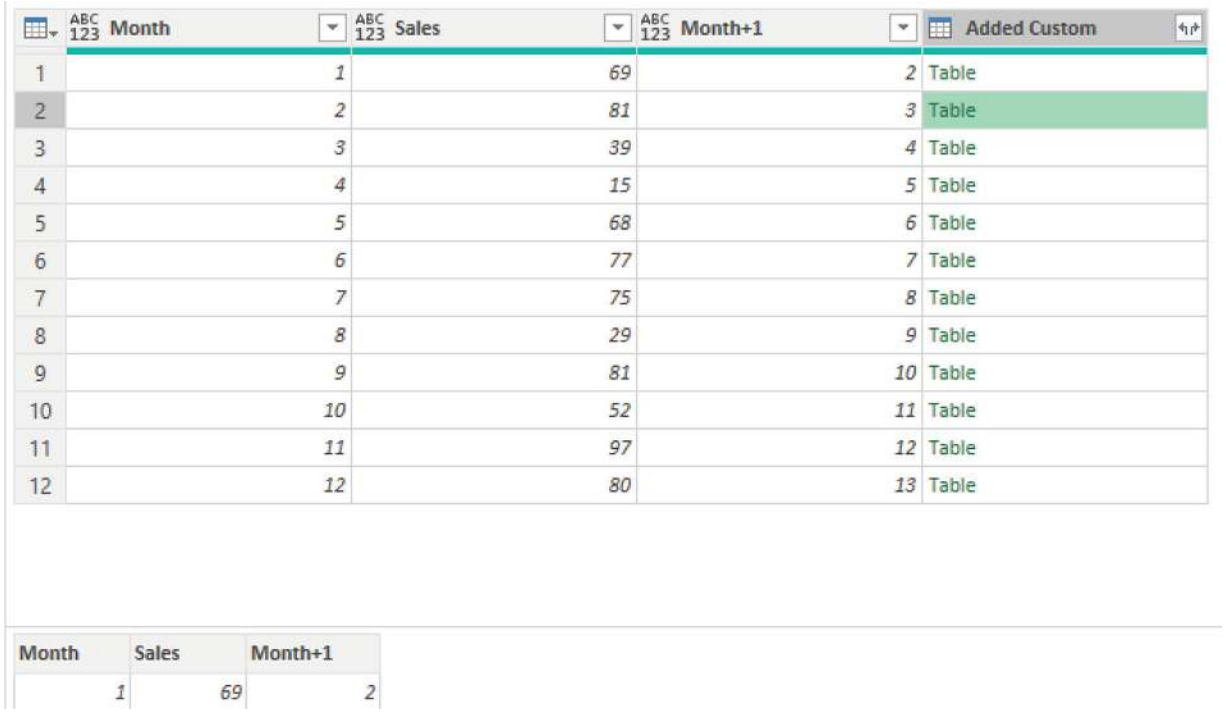
☐ Use fuzzy matching to perform the merge

▷ Fuzzy matching options

✓ The selection matches 11 of 12 rows from the first table.

***Figure 2-16*** Setting for merging

Clicking OK will create a new column named Added Custom, as shown in Figure 2-17. It contains values in the form of a table that correspond to the previous month.

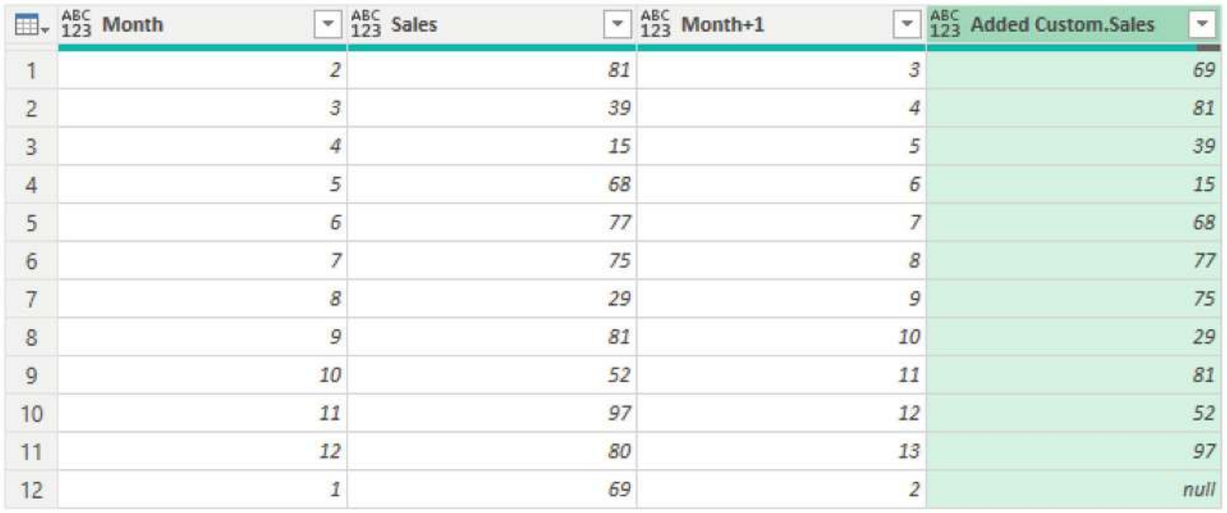


| | Month | Sales | Month+1 | Added Custom |
|---|---|---|---|---|
| 1 | 1 | 69 | 2 | Table |
| 2 | 2 | 81 | 3 | Table |
| 3 | 3 | 39 | 4 | Table |
| 4 | 4 | 15 | 5 | Table |
| 5 | 5 | 68 | 6 | Table |
| 6 | 6 | 77 | 7 | Table |
| 7 | 7 | 75 | 8 | Table |
| 8 | 8 | 29 | 9 | Table |
| 9 | 9 | 81 | 10 | Table |
| 10 | 10 | 52 | 11 | Table |
| 11 | 11 | 97 | 12 | Table |
| 12 | 12 | 80 | 13 | Table |

| Month | Sales | Month+1 |
|---|---|---|
| 1 | 69 | 2 |

***Figure 2-17*** Result of merging

To extract the sales values for the previous month, click the expand icon (⇆) next to the Added Custom column. From the available options, select Sales and click OK to get the result, as shown in Figure 2-18.



| | Month | Sales | Month+1 | Added Custom.Sales |
|---|---|---|---|---|
| 1 | 2 | 81 | 3 | 69 |
| 2 | 3 | 39 | 4 | 81 |
| 3 | 4 | 15 | 5 | 39 |
| 4 | 5 | 68 | 6 | 15 |
| 5 | 6 | 77 | 7 | 68 |
| 6 | 7 | 75 | 8 | 77 |
| 7 | 8 | 29 | 9 | 75 |
| 8 | 9 | 81 | 10 | 29 |
| 9 | 10 | 52 | 11 | 81 |
| 10 | 11 | 97 | 12 | 52 |
| 11 | 12 | 80 | 13 | 97 |
| 12 | 1 | 69 | 2 | null |

***Figure 2-18*** Result of expanding

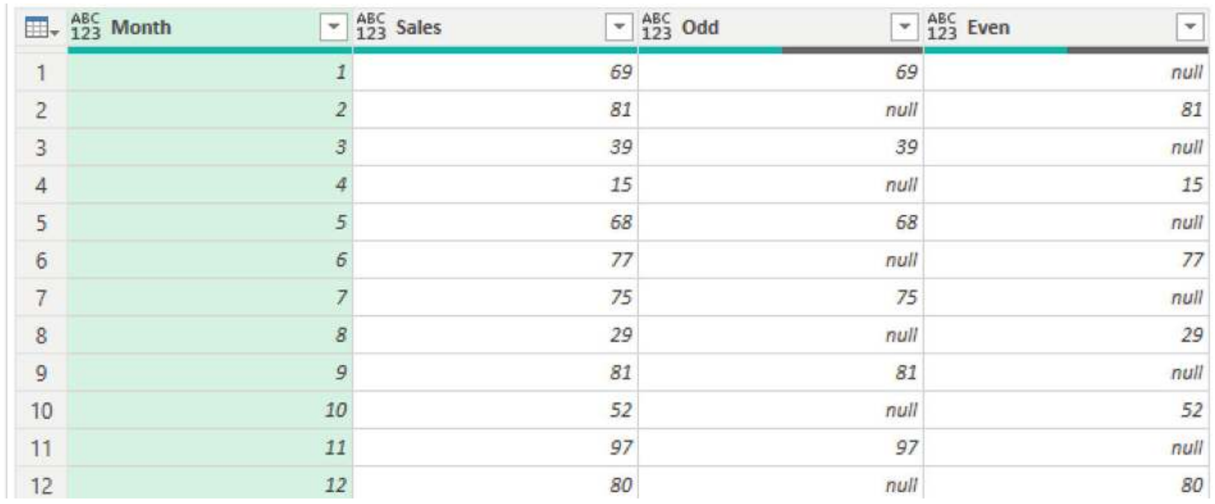
Following the previous steps, you can extract the sales values for the previous month. To calculate the growth rate, simply add another Custom Column named Growth Rate and use the following formula in this column:

```
=[Sales]/[Added Custom.Sales]
```

### Solution 3: Based on the Fill Down Function

Consider the Source table. In the first step, you will add two new columns, named Odd and Even, using the following formulas (enter the formulas separately in the Custom Column window), which will result in Figure 2-19.

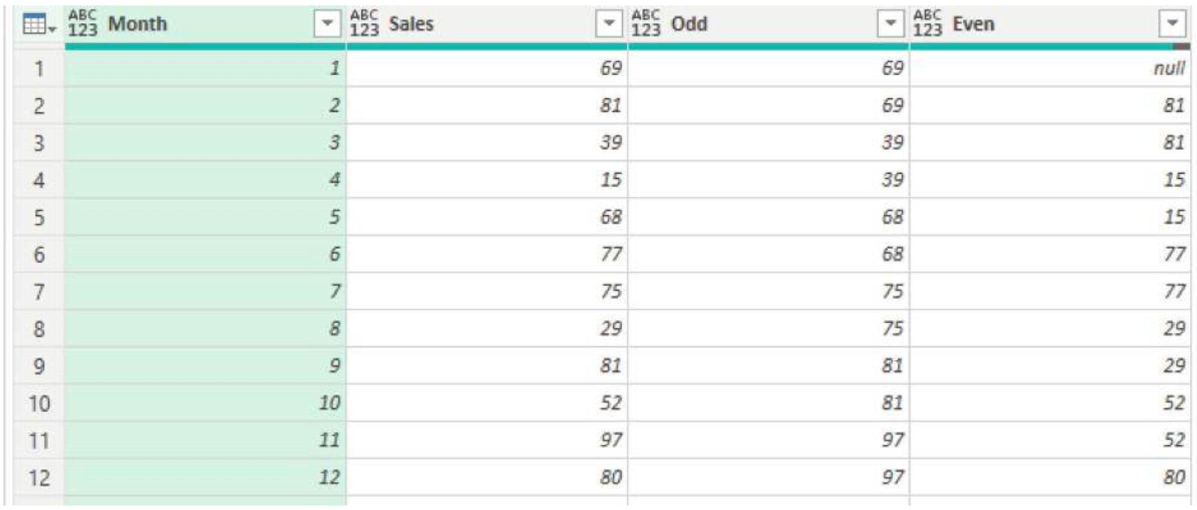
```
=if Number.IsOdd([Month]) then [Sales] else null
=if Number.IsEven([Month]) then [Sales] else null
```



| | Month | Sales | Odd | Even |
|---|---|---|---|---|
| 1 | 1 | 69 | 69 | null |
| 2 | 2 | 81 | null | 81 |
| 3 | 3 | 39 | 39 | null |
| 4 | 4 | 15 | null | 15 |
| 5 | 5 | 68 | 68 | null |
| 6 | 6 | 77 | null | 77 |
| 7 | 7 | 75 | 75 | null |
| 8 | 8 | 29 | null | 29 |
| 9 | 9 | 81 | 81 | null |
| 10 | 10 | 52 | null | 52 |
| 11 | 11 | 97 | 97 | null |
| 12 | 12 | 80 | null | 80 |

***Figure 2-19*** Adding new columns

Using the Fill Down feature for both columns will result in Figure 2-20. As shown in the resultant table, for rows with months like 2, 4, 6, and 8, the values from the previous month are filled in the Odd column in the same row. Similarly, for rows with months like 3, 5, and 7, the sales from their previous month are provided in the Even column in the same row.

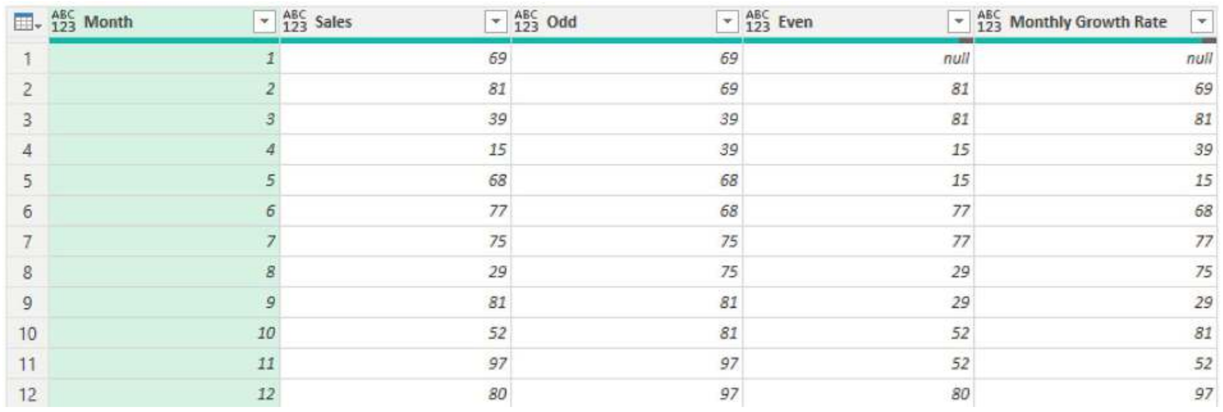


| | Month | Sales | Odd | Even |
|---|---|---|---|---|
| 1 | 1 | 69 | 69 | null |
| 2 | 2 | 81 | 69 | 81 |
| 3 | 3 | 39 | 39 | 81 |
| 4 | 4 | 15 | 39 | 15 |
| 5 | 5 | 68 | 68 | 15 |
| 6 | 6 | 77 | 68 | 77 |
| 7 | 7 | 75 | 75 | 77 |
| 8 | 8 | 29 | 75 | 29 |
| 9 | 9 | 81 | 81 | 29 |
| 10 | 10 | 52 | 81 | 52 |
| 11 | 11 | 97 | 97 | 52 |
| 12 | 12 | 80 | 97 | 80 |

***Figure 2-20*** Using Fill Down

Adding another custom column and using the following formula for it results in the value from the previous month, as shown in Figure 2-21.

```
=if Number.IsOdd([Month]) then [Even] else [Odd]
```



| | Month | Sales | Odd | Even | Monthly Growth Rate |
|---|---|---|---|---|---|
| 1 | 1 | 69 | 69 | null | null |
| 2 | 2 | 81 | 69 | 81 | 69 |
| 3 | 3 | 39 | 39 | 81 | 81 |
| 4 | 4 | 15 | 39 | 15 | 39 |
| 5 | 5 | 68 | 68 | 15 | 15 |
| 6 | 6 | 77 | 68 | 77 | 68 |
| 7 | 7 | 75 | 75 | 77 | 77 |
| 8 | 8 | 29 | 75 | 29 | 75 |
| 9 | 9 | 81 | 81 | 29 | 29 |
| 10 | 10 | 52 | 81 | 52 | 81 |
| 11 | 11 | 97 | 97 | 52 | 52 |
| 12 | 12 | 80 | 97 | 80 | 97 |

***Figure 2-21*** Extracting the value of the previous month

Revising the previous formula and rewriting it as follows provides the growth rate:

```
try  [Sales]/(if Number.IsOdd([Month]) then [Even] else [Odd])
otherwise "-"
```

This formula solves the problem, but when using this method, you must sort the source table by month.

## Solution 4: Based on the List of Functions

Consider the Source table. At first glance, it may seem like a good idea to separate the Sales column, add a new row at the top with a null value, shift all the existing values down by one row, and then reconnect it to the table. This would allow you to create a new column containing the values from the previous row. Unfortunately, this operation cannot be performed directly on a table. However, it is possible to achieve this by working with the values as a list.

In this solution, you will:

1. Convert the table into a list of column values.
2. Shift the Sales values down by one row (pushing the values down with a null at the top).
3. Reconnect the shifted list to the origin list.
4. Convert the list back into a table.

To begin, select the Source table and click the *fx* button on the left side of the formula bar to add a new step named Custom1. Enter the following formula in the formula bar:

```
= Table.ToColumns(Source)
```

As shown in Figure 2-22, this formula will convert the Source table into a list, including one sublist for any column in the Source table.

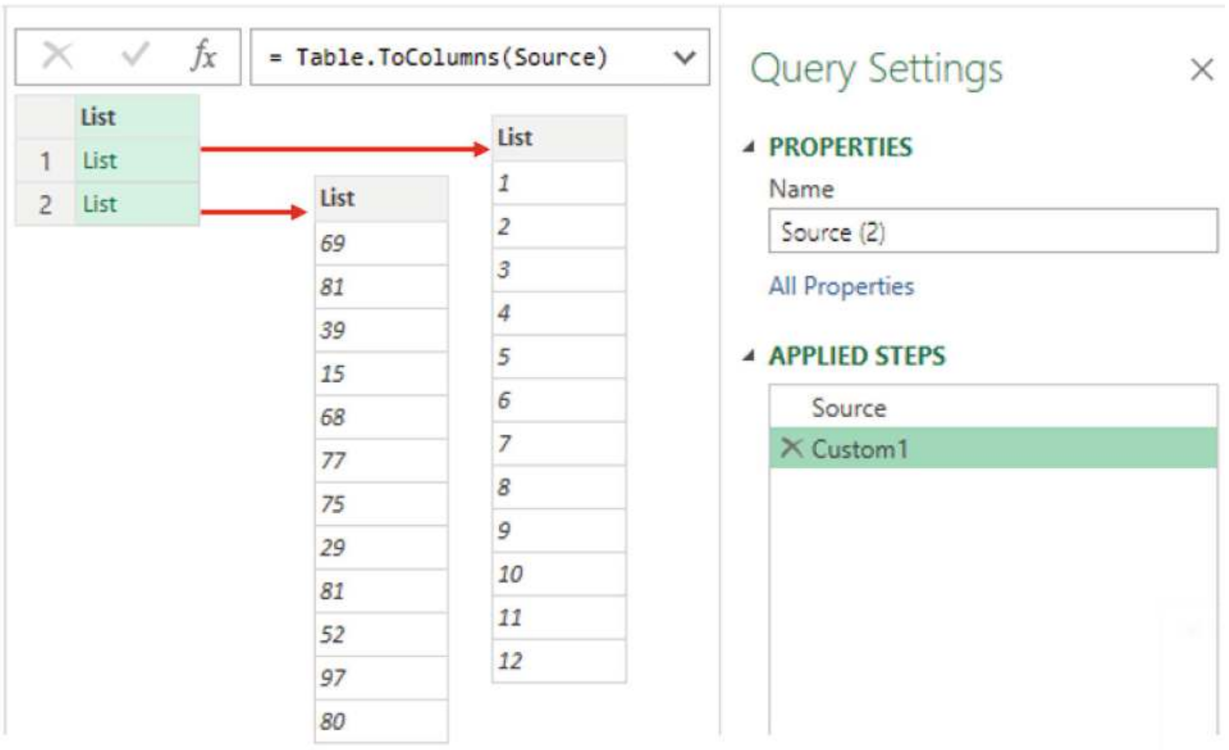


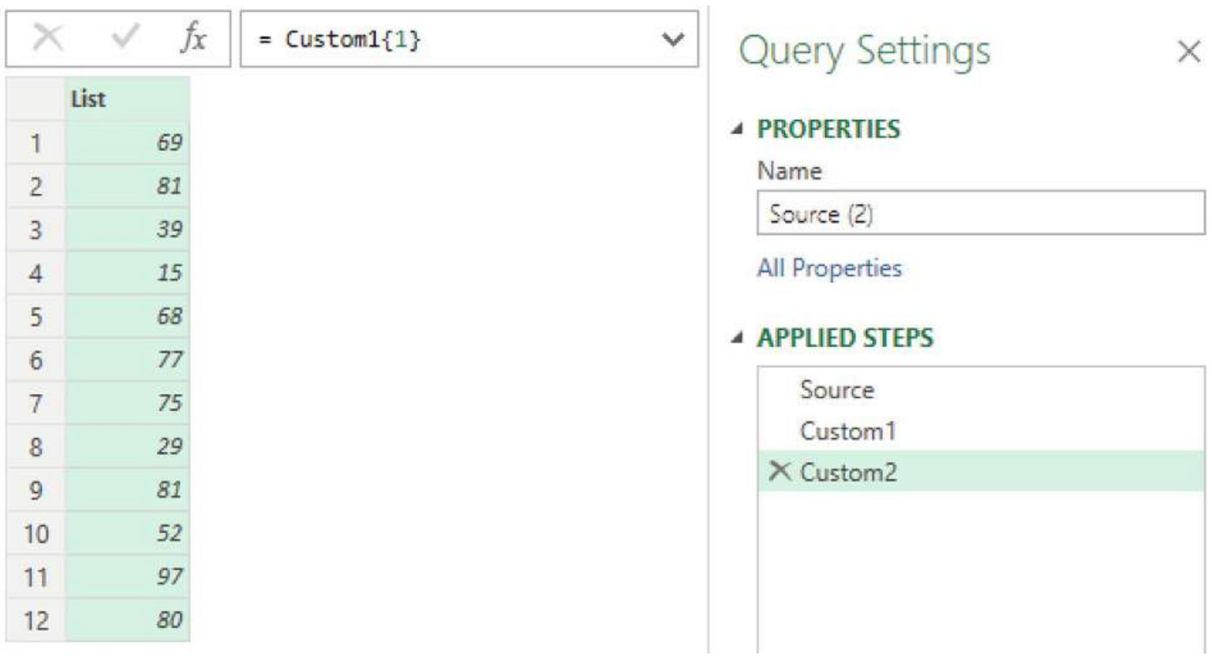
***Figure 2-22*** The result of using Table.ToColumns()

As shown on the right side of the window, the name of this list is Custom1. In this list, you need to extract the second sublist and shift its values down by one row, then reconnect the result to the list.

To do this, click the *fx* button to add another step named Custom2. Then enter the following formula in the formula bar, which results in Figure 2-23:

```
=Custom1{1}
```

Since indexing in Power Query starts from 0, this formula will return the second sublist from the Custom1 list.



```
= Custom1{1}
```

| | List |
|---|---|
| 1 | 69 |
| 2 | 81 |
| 3 | 39 |
| 4 | 15 |
| 5 | 68 |
| 6 | 77 |
| 7 | 75 |
| 8 | 29 |
| 9 | 81 |
| 10 | 52 |
| 11 | 97 |
| 12 | 80 |

Query Settings

PROPERTIES

Name: Source (2)

All Properties

APPLIED STEPS

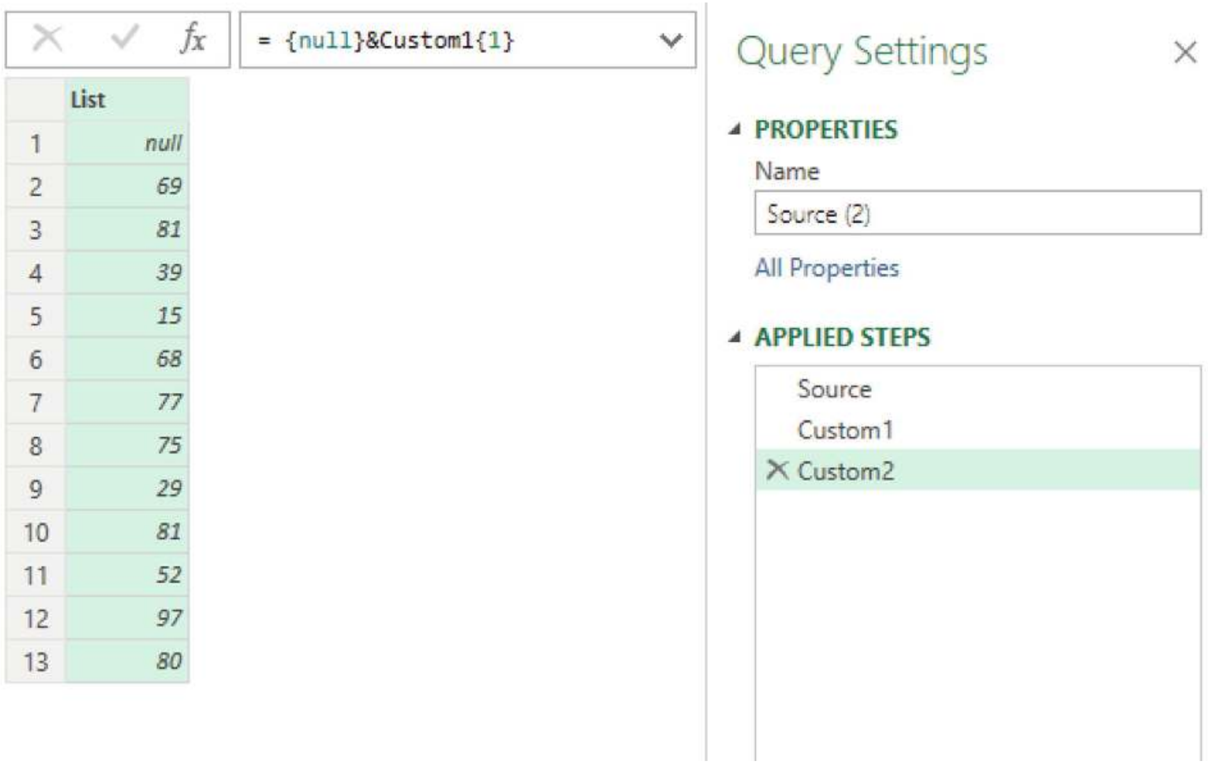
- Source
- Custom1
- Custom2

***Figure 2-23*** The result of Custom1{1}

To shift the values in the list down by one row and add a null value at the beginning, rewrite the previous formula as follows:

```
= {null}&Custom1{1}
```

This formula inserts a null value at the beginning of the second sublist (`Custom1{1}`), shifting all existing values down by one row, as shown in Figure 2-24.



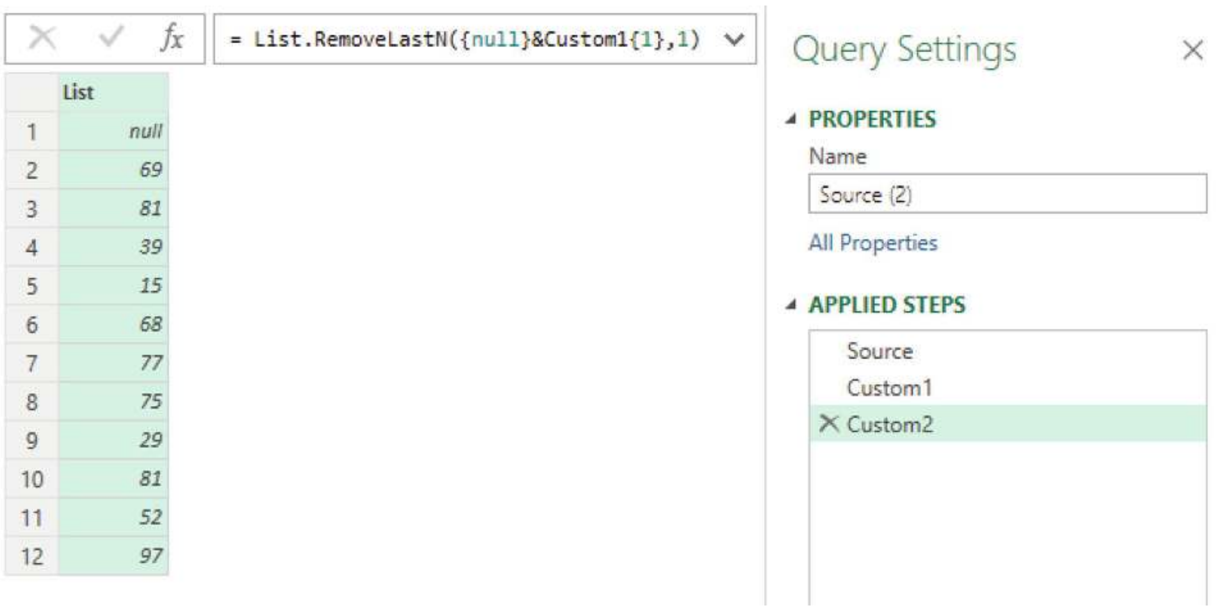
| | List |
|---|---|
| 1 | null |
| 2 | 69 |
| 3 | 81 |
| 4 | 39 |
| 5 | 15 |
| 6 | 68 |
| 7 | 77 |
| 8 | 75 |
| 9 | 29 |
| 10 | 81 |
| 11 | 52 |
| 12 | 97 |
| 13 | 80 |

***Figure 2-24*** Adding a null

By adding a null to the beginning of this list, the length of this list increases by one compared to the other sublists in Custom1. To correct this, you need to remove the last item from this list. To do this, rewrite the previous formula as follows:

```
= List.RemoveLastN({null}&Custom1{1},1)
```

This formula first inserts the null value at the beginning of the second sublist (`Custom1{1}`), then removes the last item from the list, resulting in Figure 2-25.



```
= List.RemoveLastN({null}&Custom1{1},1)
```

|  | List |
|---|---|
| 1 | null |
| 2 | 69 |
| 3 | 81 |
| 4 | 39 |
| 5 | 15 |
| 6 | 68 |
| 7 | 77 |
| 8 | 75 |
| 9 | 29 |
| 10 | 81 |
| 11 | 52 |
| 12 | 97 |

Query Settings

PROPERTIES

Name: Source (2)

All Properties

APPLIED STEPS

Source

Custom1

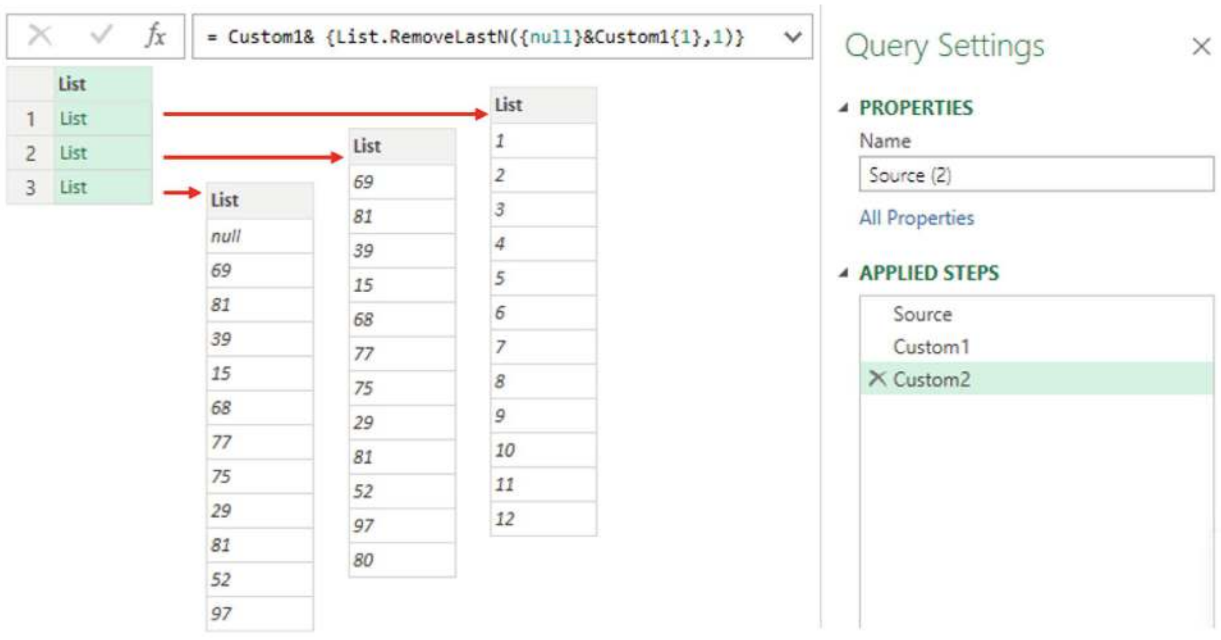
Custom2

*Figure 2-25* Removing the last item

To add this modified list (with the null at the beginning and the last item removed) to the other sublists in the Custom1 list, revise the formula as follows:

```
= Custom1& {List.RemoveLastN({null}&Custom1{1},1)}
```

This formula inserts the modified list (with the null added and the last item removed) back into the Custom1 list at the third position (index 2), resulting in Figure 2-26.



```
= Custom1& {List.RemoveLastN({null}&Custom1{1},1)}
```

|  | List |
|---|---|
| 1 | List |
| 2 | List |
| 3 | List |

| List |
|---|
| 1 |
| 2 |
| 3 |
| 4 |
| 5 |
| 6 |
| 7 |
| 8 |
| 9 |
| 10 |
| 11 |
| 12 |

| List |
|---|
| 69 |
| 81 |
| 39 |
| 15 |
| 68 |
| 77 |
| 75 |
| 29 |
| 81 |
| 52 |
| 97 |
| 80 |

| List |
|---|
| null |
| 69 |
| 81 |
| 39 |
| 15 |
| 68 |
| 77 |
| 75 |
| 29 |
| 81 |
| 52 |
| 97 |

Query Settings

PROPERTIES

Name: Source (2)

All Properties

APPLIED STEPS

Source

Custom1

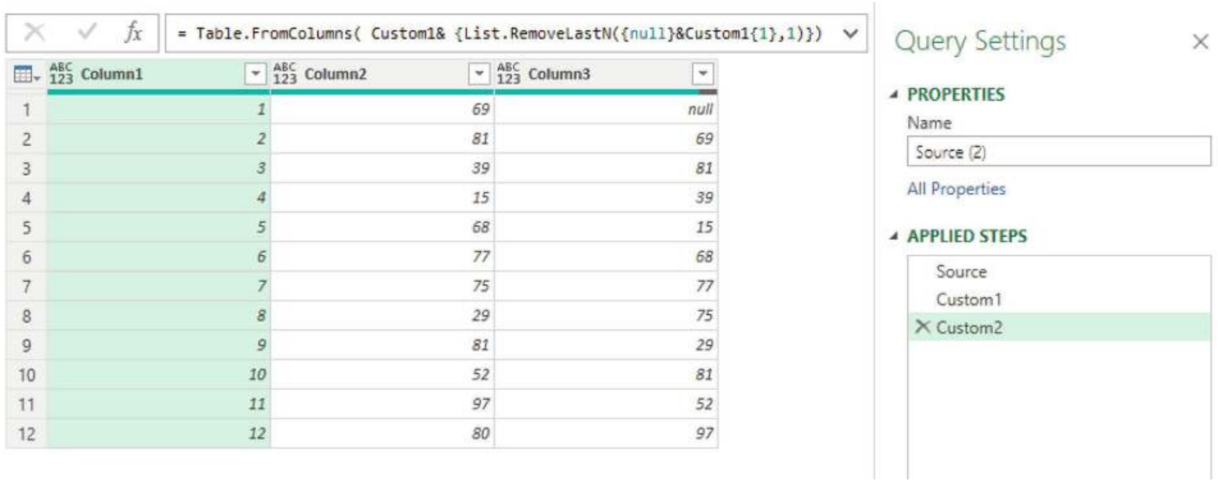
Custom2

*Figure 2-26* Combining the lists

To convert the result into a table, rewrite the previous formula as follows:

```
=Table.FromColumns( Custom1&
{List.RemoveLastN({null}&Custom1{1},1)})
```

This formula converts the result into a table, with the list modified as described, resulting in Figure 2-27.



```
= Table.FromColumns( Custom1& {List.RemoveLastN({null}&Custom1{1},1)})
```

| | Column1 | Column2 | Column3 |
|---|---|---|---|
| 1 | 1 | 69 | null |
| 2 | 2 | 81 | 69 |
| 3 | 3 | 39 | 81 |
| 4 | 4 | 15 | 39 |
| 5 | 5 | 68 | 15 |
| 6 | 6 | 77 | 68 |
| 7 | 7 | 75 | 77 |
| 8 | 8 | 29 | 75 |
| 9 | 9 | 81 | 29 |
| 10 | 10 | 52 | 81 |
| 11 | 11 | 97 | 52 |
| 12 | 12 | 80 | 97 |

Query Settings

PROPERTIES

Name: Source (2)

All Properties

APPLIED STEPS

- Source
- Custom1
- Custom2

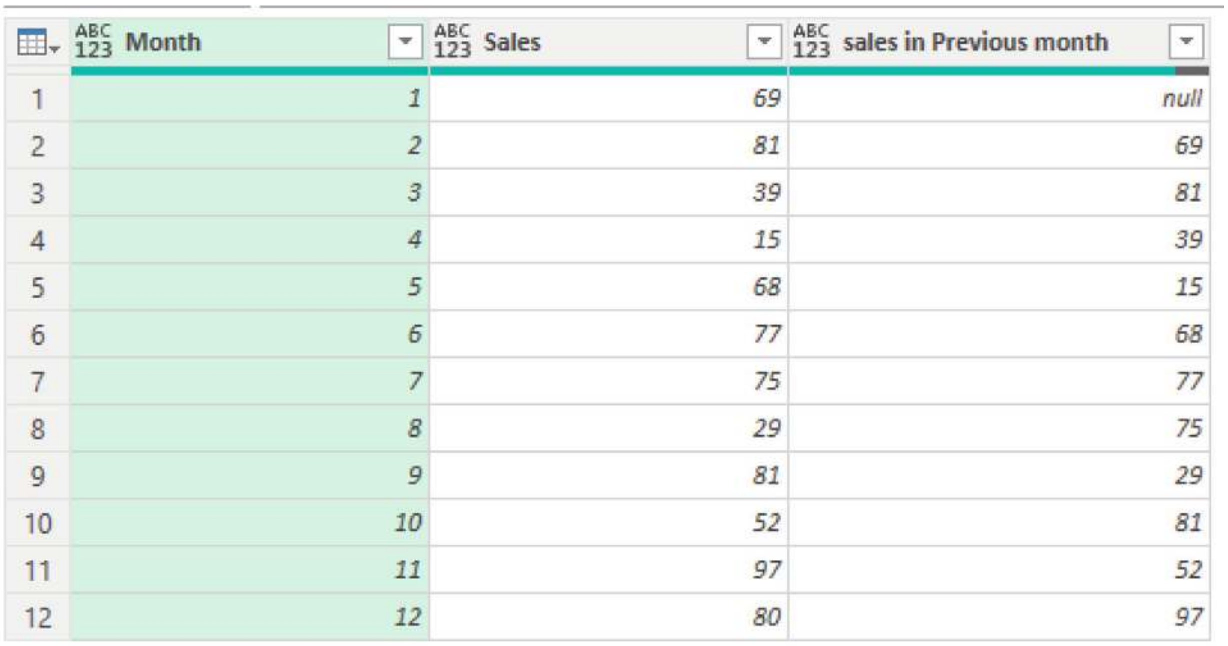
*Figure 2-27* Converting the list into a table

In this case, because there are two columns, you can manually rename them. However, in real-world scenarios, where you may face numerous columns, you can use the second argument of the `Table.FromColumns()` function to rename all columns at once.

To achieve this, rewrite the formula as follows:

```
= Table.FromColumns( Custom1&
{List.RemoveLastN({null}&Custom1{1},1)},Table.ColumnNames(Source)&
{"sales in Previous month"})
```

This formula renames all columns based on the column names in the Source table, resulting in Figure 2-28.



| Month | Sales | sales in Previous month |
|---|---|---|
| 1 | 69 | null |
| 2 | 81 | 69 |
| 3 | 39 | 81 |
| 4 | 15 | 39 |
| 5 | 68 | 15 |
| 6 | 77 | 68 |
| 7 | 75 | 77 |
| 8 | 29 | 75 |
| 9 | 81 | 29 |
| 10 | 52 | 81 |
| 11 | 97 | 52 |
| 12 | 80 | 97 |

***Figure 2-28*** Final result

In the next step, add another column named Growth Rate using the following formula in the Custom Column window to solve the problem:

```
=[Sales]/[sales in Previous month]
```

**Efficiency Tips** This example presents four different types of solutions. Among them, the first solution is the least efficient in terms of execution time, taking over 30 seconds even for a small table containing just 10,000 rows. Additionally, applying the `Table.Buffer()` or `List.Buffer()` functions does not significantly improve its efficiency compared to the other solutions.

The remaining three solutions perform well, even with larger datasets. These solutions were tested across four different scenarios, with table sizes of 1,000, 10,000, 100,000, and 500,000 rows. Based on the results, the solution using the Fill Down logic demonstrates the highest efficiency.

| Number of Rows | Solution 2: Merge | Solution 3: Fill Down | Solution 4: Convert to List |
|---|---|---|---|
| 1000 | 0.031337 | 0.046659 | 0.08671 |
| 10000 | 0.097672 | 0.079737 | 0.123611 |
| 100000 | 0.786016 | 0.266608 | 0.928861 |
| 500000 | 4.335289 | 0.941159 | 5.201284 |

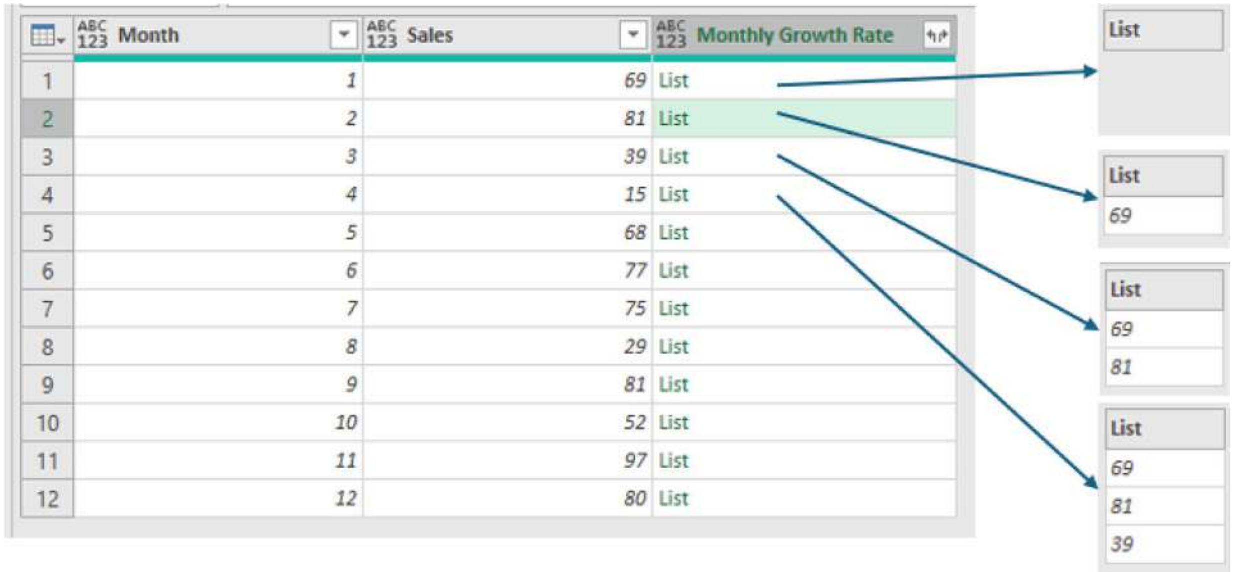
## Referencing Multiple Previous Rows

Consider the table provided in the previous question and calculate the sales growth rate for each month in comparison to the average sales values of all the preceding months.

In the previous example, the =(Source[Sales]){[Month]-2} formula was used to reference the value in the Sales column in the previous row. However, in this example, for month *N*, it must calculate the average of the sales values in the previous *N-1* months.

To extract the first N values from a list, you can use the List.FirstN() function. Therefore, you can use the following formula for a new custom column to extract the sales values of the previous *N-1* months for the row with the month equal to *N*, which results in Figure 2-29:

```
=List.FirstN(Source[Sales],[Month]-1)
```



|  | Month | Sales | Monthly Growth Rate |
|---|---|---|---|
| 1 | 1 | 69 | List |
| 2 | 2 | 81 | List |
| 3 | 3 | 39 | List |
| 4 | 4 | 15 | List |
| 5 | 5 | 68 | List |
| 6 | 6 | 77 | List |
| 7 | 7 | 75 | List |
| 8 | 8 | 29 | List |
| 9 | 9 | 81 | List |
| 10 | 10 | 52 | List |
| 11 | 11 | 97 | List |
| 12 | 12 | 80 | List |

| List |
|---|

| List |
|---|
| 69 |

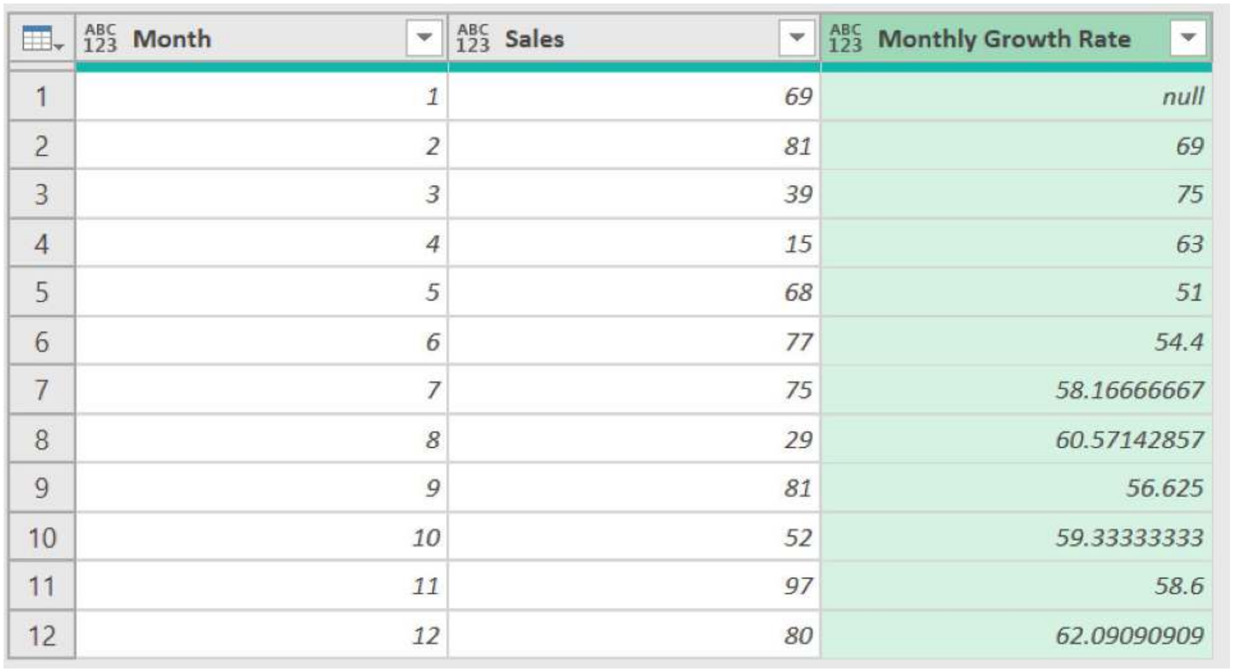
| List |
|---|
| 69 |
| 81 |

| List |
|---|
| 69 |
| 81 |
| 39 |

***Figure 2-29*** Changing the value type

Since the result of the previous formula is a list, you can use the List.Average() function to calculate the average of its items. You can update the formula as follows, which results in the average of sales values in the previous months for each row, as shown in Figure 2-30:

```
=List.Average(List.FirstN(Source[Sales],[Month]-1))
```

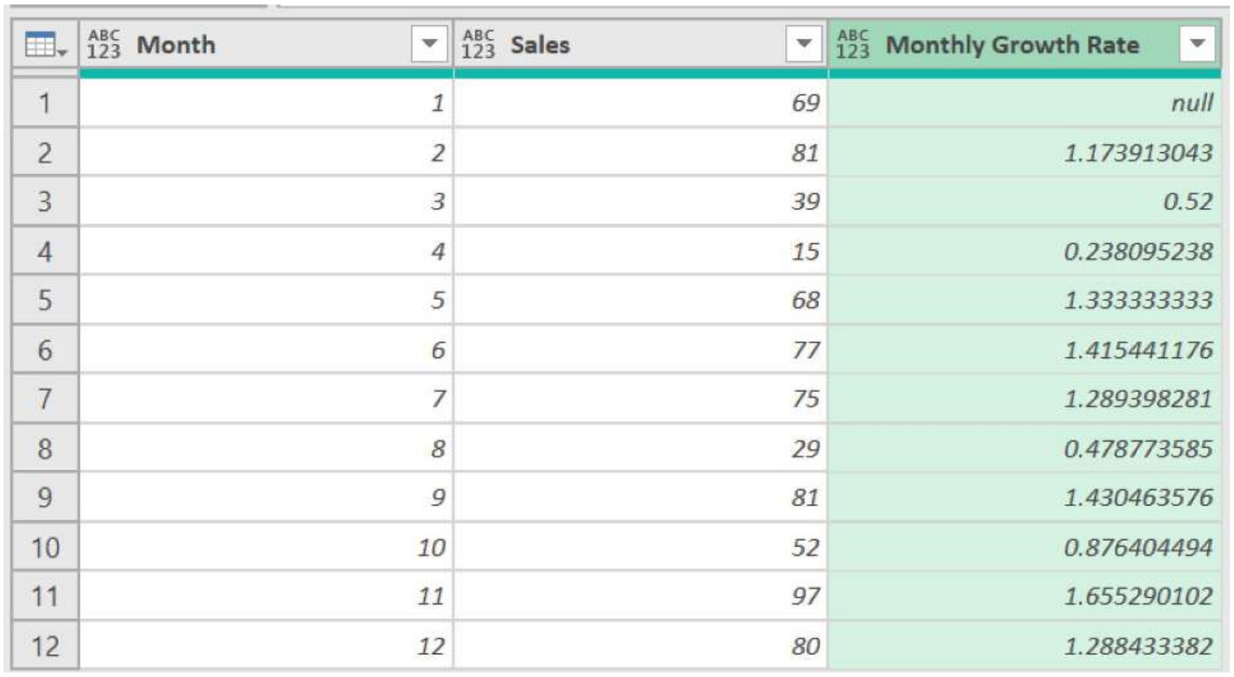


| | Month | Sales | Monthly Growth Rate |
|---|---|---|---|
| 1 | 1 | 69 | null |
| 2 | 2 | 81 | 69 |
| 3 | 3 | 39 | 75 |
| 4 | 4 | 15 | 63 |
| 5 | 5 | 68 | 51 |
| 6 | 6 | 77 | 54.4 |
| 7 | 7 | 75 | 58.16666667 |
| 8 | 8 | 29 | 60.57142857 |
| 9 | 9 | 81 | 56.625 |
| 10 | 10 | 52 | 59.33333333 |
| 11 | 11 | 97 | 58.6 |
| 12 | 12 | 80 | 62.09090909 |

***Figure 2-30*** Result of List.Average

Similar to the previous example, to calculate the growth rate, you can use the following formula, which results in Figure 2-31.

```
=[Sales]/List.Average(List.FirstN(Source[Sales],[Month]-1))
```



| | Month | Sales | Monthly Growth Rate |
|---|---|---|---|
| 1 | 1 | 69 | null |
| 2 | 2 | 81 | 1.173913043 |
| 3 | 3 | 39 | 0.52 |
| 4 | 4 | 15 | 0.238095238 |
| 5 | 5 | 68 | 1.333333333 |
| 6 | 6 | 77 | 1.415441176 |
| 7 | 7 | 75 | 1.289398281 |
| 8 | 8 | 29 | 0.478773585 |
| 9 | 9 | 81 | 1.430463576 |
| 10 | 10 | 52 | 0.876404494 |
| 11 | 11 | 97 | 1.655290102 |
| 12 | 12 | 80 | 1.288433382 |

***Figure 2-31*** Result of List.Average

To handle null results and replace them with a dash ("-") for the first row, modify the formula by adding ?? to the end of the formula:

```
=[Sales]/List.Average(List.FirstN(Source[Sales],[Month]-1)) ??"-"
```

**Note** To explain further, you can use the ? operator to handle null values. Suppose x and y are two different formulas. The expression x? checks the result of x and compares it to a null value. It evaluates to true if the result of x is null and false if the result of x is anything other than null. Additionally, the ?? operator can replace null values with an alternative. For example, x??y means: evaluate x and use its result unless the result of x is null; then evaluate y and use it as the result instead.

By using the previous formula, you can solve the problem. In this solution, `List.FirstN(Source[Sales], [Month]-1)` initially selects the sales values from the Source table and then filters the first *N* values. However, this can be replaced with `Table.FirstN(Source, [Month]-1)[Sales]`, which filters the first *N* rows of the table and then extracts the sales values as a list.

Similarly, all the following formulas will yield the same results:

```
=List.FirstN(Source[Sales],[Month]-1)

=Table.FirstN(Source,[Month]-1) [Sales]

=Table.Column(Table.FirstN(Source,[Month]-1) ,"Sales")

=List.Range(Source[Sales],0,[Month]-1))

=Table.Range(Source,0,[Month]-1) [Sales]
```

## Adding Multiple Columns at Once

Consider the Source table as Table 2-6, which provides coding information in a hierarchical format. All codes for products' names (third level) are three characters long. The products' families (level 1) are determined by the left-most character of the code, and the group (level 2) is determined by the first two characters.

For example, the product with code 111 is Compact Powder. Its family (first level) is Cosmetic (code=1), and its group (second level) is Face (code =11).

Instead of displaying all the codes in two columns, separate them into three distinct levels—family, group, and product.

***Table 2-6*** Source: Coding

| Code | Description |
|---|---|
| 1 | Cosmetics |
| 11 | Face |
| 111 | Compact Powder |
| 12 | Lip |

| Code | Description |
|---|---|
| 121 | Lipstick |
| 122 | Lip Gloss |
| 2 | Men |
| 21 | Accessories |
| 211 | Belt |
| 212 | Hat |
| 213 | Sunglasses |
| 22 | Shirt |
| 221 | Shirt Casual |
| 3 | Toys & Accessories |
| 31 | Construction Toys |
| 311 | Legos |

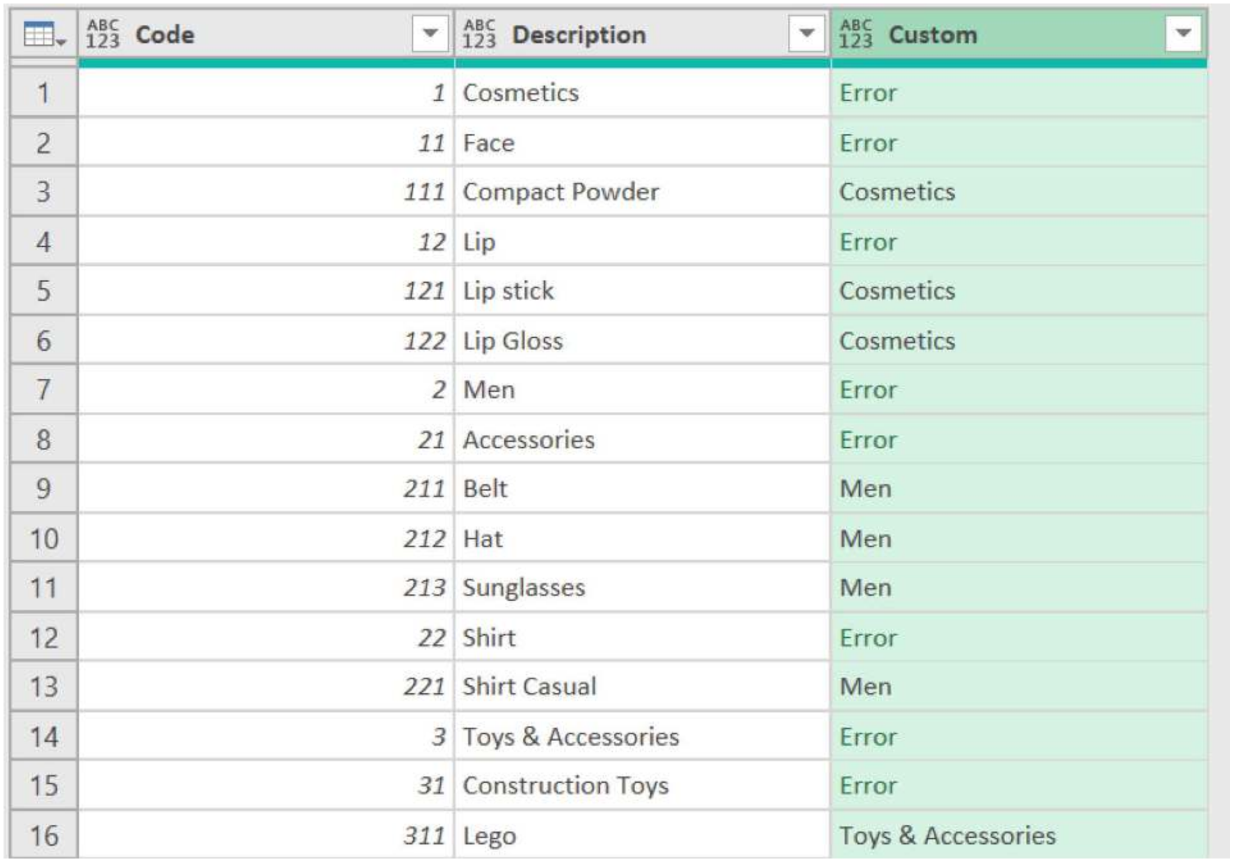
This problem can be addressed in several ways, including merging or using advanced functions, but, in this section, you'll see how to use this table and solve the problem by adding new columns, one for the product's group, another for the products' family, and then filter the desired rows. Consider the product code equal to 211. To extract the product family and group for this code, you can use the following formulas separately in the formula bar (since all values in the Code column are unique).

```
=Source{[Code=2]}[Description]
```

```
=Source{[Code=21]}[Description]
```

Writing these two formulas in the custom column window will return the product family and product group for the product with code 211 across all rows. Instead of using the value of 2, and 21 for all the cases, you can use the `Number.IntegerDivide()` function as `Number.IntegerDivide(211, 100)` and `Number.IntegerDivide(211, 10)`. Replacing the value of 211 in these two formulas will make the formula dynamic for all the rows. Add a Custom column to the Source table and use the following formula in the Custom column, resulting in Figure 2-32.

```
= Source{[Code=Number.IntegerDivide([Code],100)]}[Description]
```



|  | Code | Description | Custom |
|---|---|---|---|
| 1 | 1 | Cosmetics | Error |
| 2 | 11 | Face | Error |
| 3 | 111 | Compact Powder | Cosmetics |
| 4 | 12 | Lip | Error |
| 5 | 121 | Lip stick | Cosmetics |
| 6 | 122 | Lip Gloss | Cosmetics |
| 7 | 2 | Men | Error |
| 8 | 21 | Accessories | Error |
| 9 | 211 | Belt | Men |
| 10 | 212 | Hat | Men |
| 11 | 213 | Sunglasses | Men |
| 12 | 22 | Shirt | Error |
| 13 | 221 | Shirt Casual | Men |
| 14 | 3 | Toys & Accessories | Error |
| 15 | 31 | Construction Toys | Error |
| 16 | 311 | Lego | Toys & Accessories |

***Figure 2-32*** Adding product families

To extract the product group, add another Custom column using a similar formula:

```
= Source{[Code=Number.IntegerDivide([Code],10)]}[Description]
```

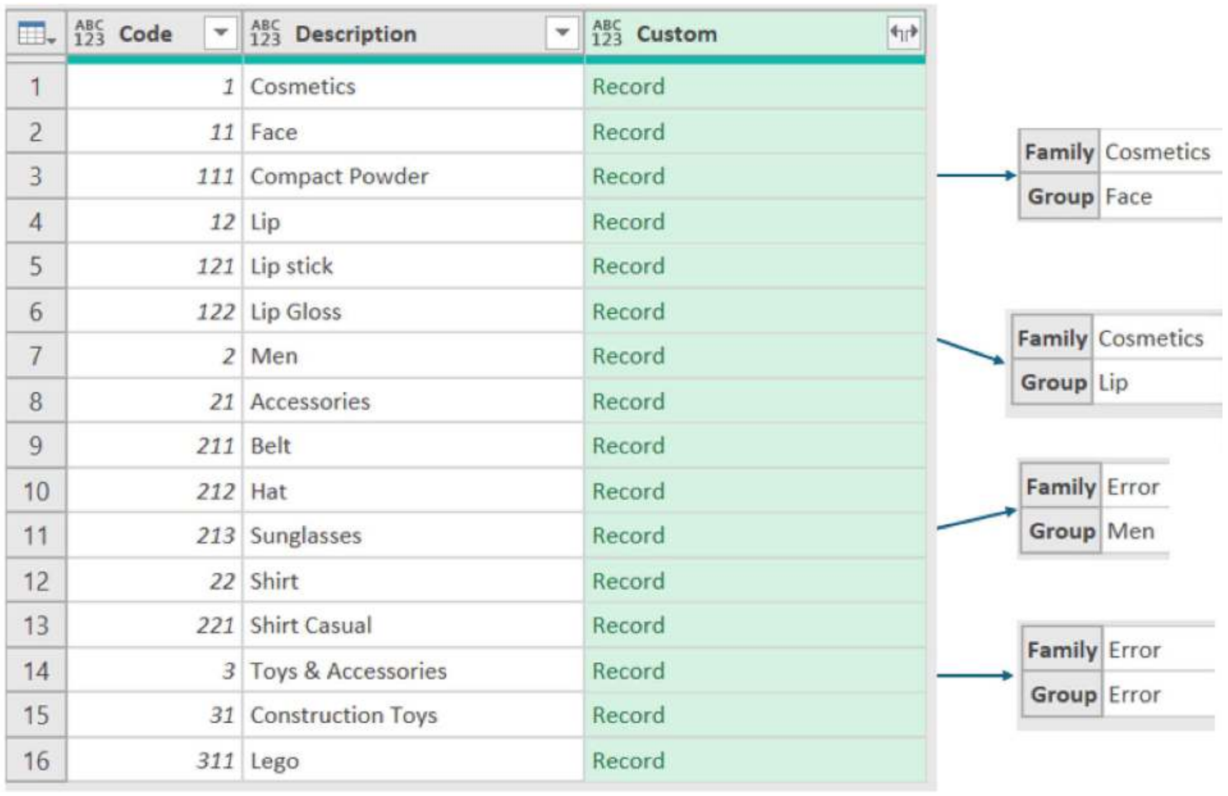
After adding these two columns, the problem will be solved by filtering the rows with code greater than 100 or removing the rows including errors on the newly added columns.

As shown, two new columns are added to the Source table, in two different steps, to solve this problem. What if you have to add more columns in a real-world case? Instead of adding the columns separately, all the columns can be added at once by using the characteristic of records in Power Query.

For example, using the Source table, from the Add Column tab, choose the Custom Column command, then use the following formula in the Custom column window:

```
=[
      Family=Source{[Code=Number.IntegerDivide([Code],100)]}
[Description],
      Group=Source{[Code=Number.IntegerDivide([Code],10)]}
[Description]
]
```

This formula results in Figure 2-33, including the value for both the columns of product's family and group, in the type of record.



| | Code | Description | Custom |
|---|---|---|---|
| 1 | 1 | Cosmetics | Record |
| 2 | 11 | Face | Record |
| 3 | 111 | Compact Powder | Record |
| 4 | 12 | Lip | Record |
| 5 | 121 | Lip stick | Record |
| 6 | 122 | Lip Gloss | Record |
| 7 | 2 | Men | Record |
| 8 | 21 | Accessories | Record |
| 9 | 211 | Belt | Record |
| 10 | 212 | Hat | Record |
| 11 | 213 | Sunglasses | Record |
| 12 | 22 | Shirt | Record |
| 13 | 221 | Shirt Casual | Record |
| 14 | 3 | Toys & Accessories | Record |
| 15 | 31 | Construction Toys | Record |
| 16 | 311 | Lego | Record |

| | |
|---|---|
| Family | Cosmetics |
| Group | Face |

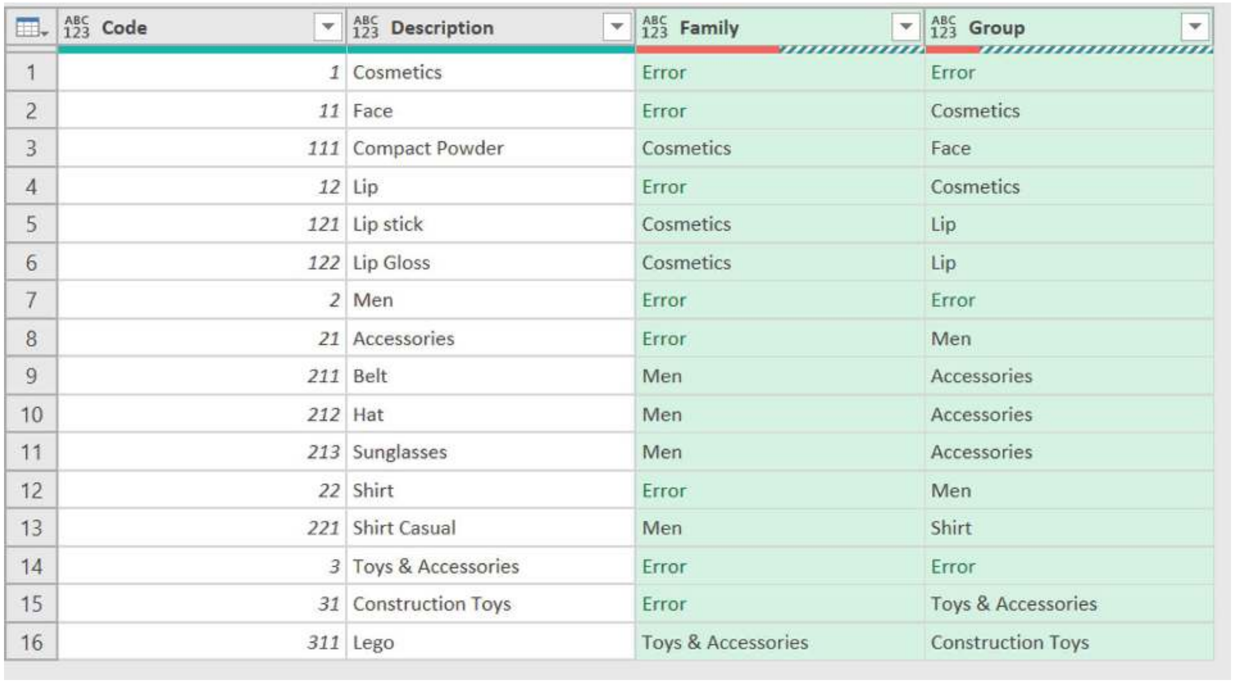
| | |
|---|---|
| Family | Cosmetics |
| Group | Lip |

| | |
|---|---|
| Family | Error |
| Group | Men |

| | |
|---|---|
| Family | Error |
| Group | Error |

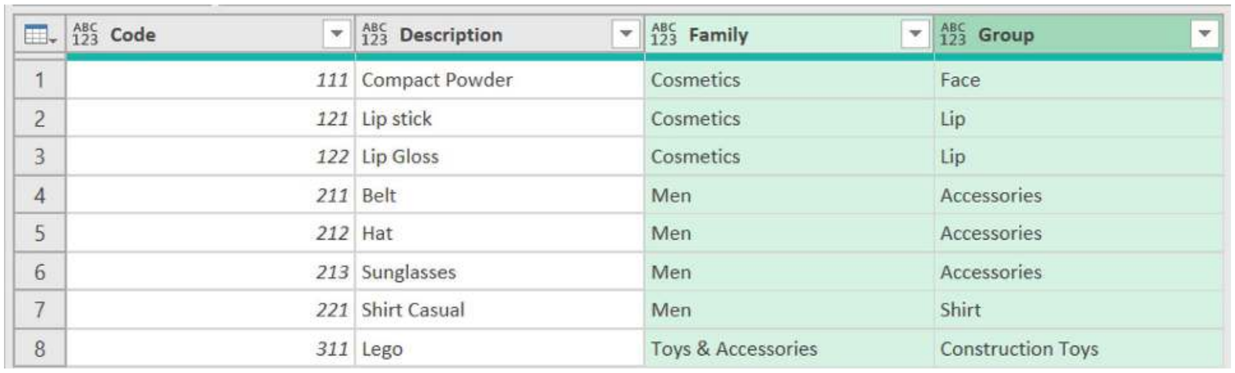
*Figure 2-33* Using a record to add columns once

Next, by expanding this new column, you will get Figure 2-34, in which both the columns are added once. (Even if you define additional fields for the record in the previous step, all of them will be added here.) Select the Remove Errors command from the Remove Rows section in the Home tab. The result is shown in Figure 2-35.



| | Code | Description | Family | Group |
|---|---|---|---|---|
| 1 | 1 | Cosmetics | Error | Error |
| 2 | 11 | Face | Error | Cosmetics |
| 3 | 111 | Compact Powder | Cosmetics | Face |
| 4 | 12 | Lip | Error | Cosmetics |
| 5 | 121 | Lip stick | Cosmetics | Lip |
| 6 | 122 | Lip Gloss | Cosmetics | Lip |
| 7 | 2 | Men | Error | Error |
| 8 | 21 | Accessories | Error | Men |
| 9 | 211 | Belt | Men | Accessories |
| 10 | 212 | Hat | Men | Accessories |
| 11 | 213 | Sunglasses | Men | Accessories |
| 12 | 22 | Shirt | Error | Men |
| 13 | 221 | Shirt Casual | Men | Shirt |
| 14 | 3 | Toys & Accessories | Error | Error |
| 15 | 31 | Construction Toys | Error | Toys & Accessories |
| 16 | 311 | Lego | Toys & Accessories | Construction Toys |

***Figure 2-34*** Result of expanding a column



| | Code | Description | Family | Group |
|---|---|---|---|---|
| 1 | 111 | Compact Powder | Cosmetics | Face |
| 2 | 121 | Lip stick | Cosmetics | Lip |
| 3 | 122 | Lip Gloss | Cosmetics | Lip |
| 4 | 211 | Belt | Men | Accessories |
| 5 | 212 | Hat | Men | Accessories |
| 6 | 213 | Sunglasses | Men | Accessories |
| 7 | 221 | Shirt Casual | Men | Shirt |
| 8 | 311 | Lego | Toys & Accessories | Construction Toys |

***Figure 2-35*** Result of removing errors

## Using VLOOKUP with Approximate Match in Power Query

Based on the tax rates provided in the TaxRates table in Table 2-7 and the income data in the People_Income table in Table 2-8, add a new column to the People_Income table to calculate each person's tax. (Both tables are loaded into Power Query, called TaxRates and People_Income.)

***Table 2-7*** TaxRates Table

| From | To | Tax Rate |
|---|---|---|
| $0 | $18,200 | 0% |
| $18,201 | $45,000 | 19% |
| $45,001 | $120,000 | 33% |
| $120,001 | $180,000 | 37% |

| From | To | Tax Rate |
|---|---|---|
| $180,001 | Over | 45% |

***Table 2-8*** People_Income table

| Person ID | Income |
|---|---|
| A | 199,920 |
| B | 26,068 |
| C | 106,439 |
| D | 28,521 |
| E | 142,566 |

To compute the tax, use the following logic: For each income value, find its related row in the TaxRates table where income falls between the numbers in the From and To columns, retrieve the tax rate on that row, and multiply it by the income.

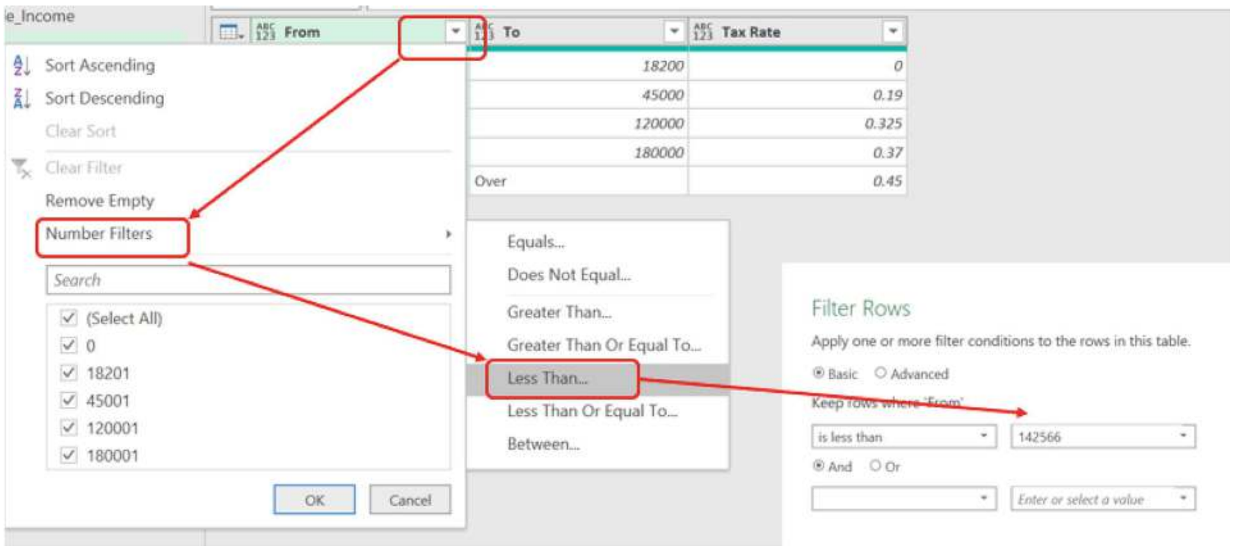
This problem can be easily solved in Excel using the `VLOOKUP` or `XLOOKUP` function with an approximate match. However, in Power Query, the `VLOOKUP` function is not available, so you need to combine several functions to achieve the same result.

Before solving this problem for all the people, let's solve it just for the `Person ID = "E"` with an income of 142,566. By examining the TaxRates table, you can see that this income falls within the range specified in the fourth row of the table, where the tax rate is 37 percent, so the tax value is 0.37*142566.

If you solve this problem using Excel's `VLOOKUP`, it searches for the value `142566` in the From column, identifies the row with the largest value that is less than or equal to `142566`, and returns the tax rate from that row as the result.

In Power Query, you apply a similar logic. First, you filter the rows in the Tax_Rate table where the value in the From column is less than or equal to `142566`. Then, you extract the row with the highest value in the From column (i.e., the last row) and use the tax rate from that row for the calculation.

To solve the problem for this person, Go to the TaxRates query, then filter the table based on the values in the From column, and filter all the values less than `142566,` as shown in Figure 2-36, to get the result in Figure 2-37.



| To | Tax Rate |
|---|---|
| 18200 | 0 |
| 45000 | 0.19 |
| 120000 | 0.325 |
| 180000 | 0.37 |
| Over | 0.45 |

Filter Rows

Apply one or more filter conditions to the rows in this table.

◉ Basic ○ Advanced

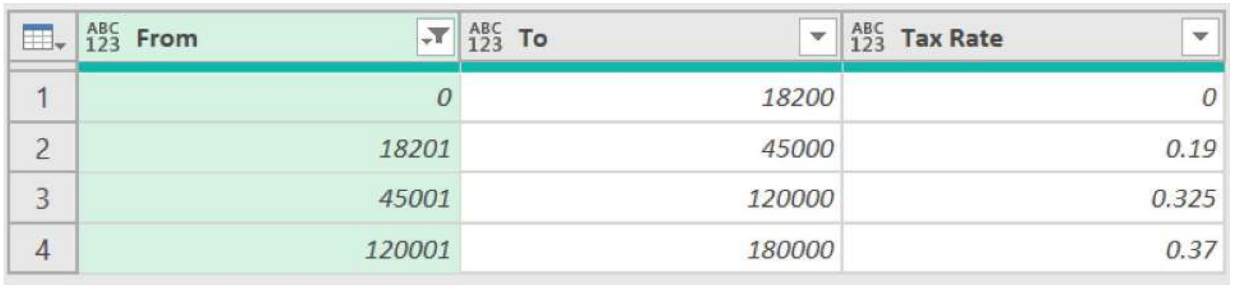
Keep rows where 'From'

is less than | 142566

◉ And ○ Or

Enter or select a value

***Figure 2-36*** Filtering the table



|  | From | To | Tax Rate |
|---|---|---|---|
| 1 | 0 | 18200 | 0 |
| 2 | 18201 | 45000 | 0.19 |
| 3 | 45001 | 120000 | 0.325 |
| 4 | 120001 | 180000 | 0.37 |

***Figure 2-37*** The result of filtering

The filtering step will lead to the following formula in the formula bar. (Source is the first step in the `Tax_Rates` query.)

```
= Table.SelectRows(Source, each [From] < 142566)
```

In the result table, the last value in the Tax Rate column represents the tax rate for this person. So, to reach tax rates, add `[Tax Rate ]` to the end of the previous formula. It results in a list of tax rates from the filtered table, equal to `{0, 0.19, 0.325, 0.37}`. To extract the last value from this list, use the `List.Last()` function. To reach the tax rate for this person, the previous formula can be rewritten as follows:

```
= List.Last(Table.SelectRows(Source, each [From] < 142566)[Tax
Rate])
```

The previous formula works like `VLOOKUP` with approximate match logic in Power Query. (If the Tax_Rates table is sorted ascending based on the From column.) This formula filters the rows in the TaxRates table where the From column values are less than 142,566 and then returns the last value on the Tax Rate column in the filtered table.

Before making this formula dynamic and using it as a custom column in the People_Income table, let's first modify the part related to the `Table.SelectRows()`

function. (The reason for this modification is explained at the end of this question and in the next chapter.)

Currently, the formula is written as `Table.SelectRows(Source, each [From] < 142566)`. In this formula, the first argument, `Source`, specifies the table to filter, and the second argument, `each [From] < 142566`, provides the filtering condition. The `each` keyword refers to each row in the table, and `[From]` accesses the From column of the current row.

Although `each` usually appears with the underscore character "_" in Power Query, like the form of "`each _[From]`", the result is the same even if "_" is omitted. In other words, the full version of the formula is `Table.SelectRows(Source, each _[From] < 142566)`.

Here, `each _` explicitly refers to every row in the Source table. In this case, since only one table (Source) is being used, the underscore can be skipped without affecting the outcome. However, when working with more complex formulas involving nested functions, it's a good idea to include the underscore to clearly indicate the reference to the row. So, let's consider the full version of the formula as: `Table.SelectRows(Source, each _[From] < 142566)` and make another change to it.

In Power Query, the `each _` expression is equivalent to writing "`(x)=> x`", "`(y)=>y`", or any placeholder name like `(variable_name) => variable_name`. (There is a small difference between `each _` and the general definition of `(variable_name) => variable_name`, which I explain in depth in Chapter 12.) Based on this understanding, the following two formulas are identical in functionality and produce the exact same result, differing only in their notation:

```
Table.SelectRows(Source, each _[From] < 142566)
Table.SelectRows(Source, (x)=>x[From] < 142566)
```

Based on this alteration of the `Table.SelectRows()` part, the formula for extracting the tax rate for person D can be rewritten as follows without changing the result.

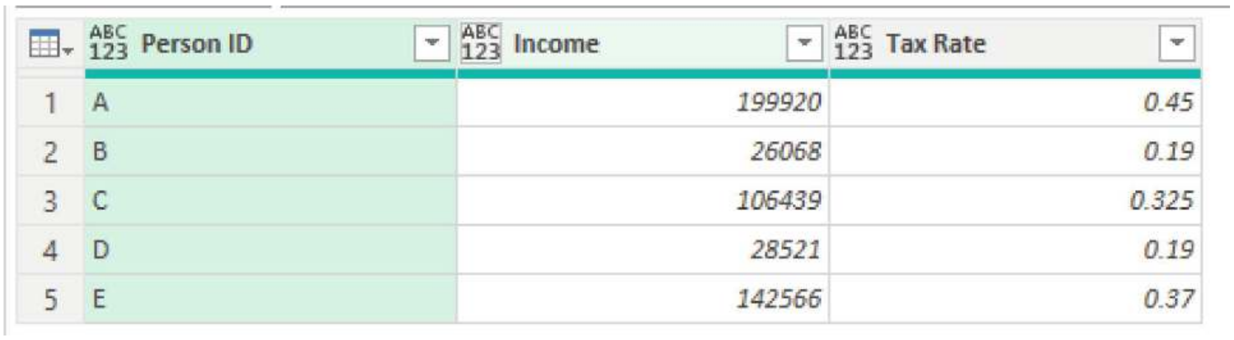
```
= List.Last(Table.SelectRows(Source, (x)=> x[From] < 142566)[Tax
Rate])
```

This formula can be applied to any person by substituting 142,566 with the income of that person. To apply this logic to the original problem, go back to the problem and consider the queries unchanged. Then, select the People_Income table, go to the Add Column tab, and select Custom Column. Then, use the following formula in the Custom column window to create a new column named Tax Rate:

```
= List.Last(Table.SelectRows(Tax_Rates, (x)=> x[From] < [Income])
[Tax Rate])
```

This is exactly like the previous formula, in which `142566` is replaced with values on the Income column and the Source query is changed to the TaxRates query, as Source is the name of a step in the TaxRates query and, from the People_Income query, you can't directly refer to the name of middle steps of another query.)

Clicking OK results in the tax rate, as shown in Figure 2-38.



| | Person ID | Income | Tax Rate |
|---|---|---|---|
| 1 | A | 199920 | 0.45 |
| 2 | B | 26068 | 0.19 |
| 3 | C | 106439 | 0.325 |
| 4 | D | 28521 | 0.19 |
| 5 | E | 142566 | 0.37 |

*Figure 2-38* The tax rate

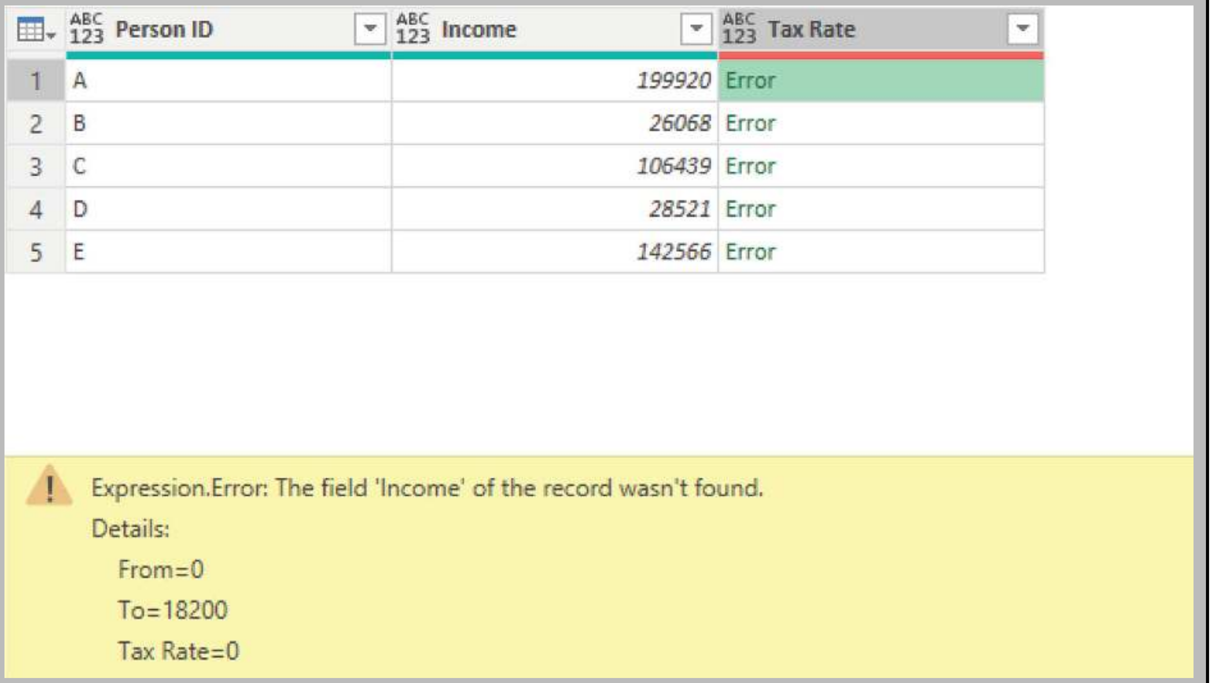
To calculate the tax, you just need to add another Custom column and multiply the values on the Income and Tax Rate columns using the following formula in the custom column window.

**Note** As shown in the steps, to solve this problem, `each [From]` is changed to `(x)=>x` and then used in the custom column for the `People_Info` query. Let's see the reason for this change.

So, considering the unchanged queries, go to the `People_Info` query, then select the Custom Column command. In the open window, write the original formula as follows:

```
= List.Last(Table.SelectRows(Tax_Rates, each [From] < [Income])
[Tax Rate])
```

Clicking OK will result in an error for the values of the newly added column, as shown in Figure 2-39.



| | Person ID | Income | Tax Rate |
|---|---|---|---|
| 1 | A | 199920 | Error |
| 2 | B | 26068 | Error |
| 3 | C | 106439 | Error |
| 4 | D | 28521 | Error |
| 5 | E | 142566 | Error |

```
Expression.Error: The field 'Income' of the record wasn't found.
Details:
    From=0
    To=18200
    Tax Rate=0
```

*Figure 2-39* The result is an error

To extract the source of error, look at the entire formula in the formula bar, as follows:

```
= Table.AddColumn(
      Source,
      "Tax",
      each List.Last(
                     Table.SelectRows(
                            Tax_Rates,
                                    each [From] < [Income]
                                               )[Tax Rate]
      ))
```

As shown, after clicking OK in the Custom Column window, the formula entered is included as part of the third argument in the `Table.AddColumn()` function. In other words, to add a new column to a table, you use the `Table.AddColumn()` function. This function typically takes three arguments: the name of the table to which the new column will be added, the name of the new column, and the formula used to calculate the values for the new column.

The formula uses two tables: Source (referring to the last step of `People_Income` query) and Tax_Rates. In the third argument of `Table.AddColumn()`, the `each _` logic is used twice—once to refer to the rows in the Source table and another time to refer to the rows in the People_Info table. However, it is not clear to Power Query that `each _` refer to rows in which table.

In Figure 2-28, the underscores are added before the name of columns. This determines which `"_"` is related to which `each`, and which `each` is related to which "table". This is clear to humans, but due to using `each _` to refer to the rows of both tables, it leads to the error in Power Query.

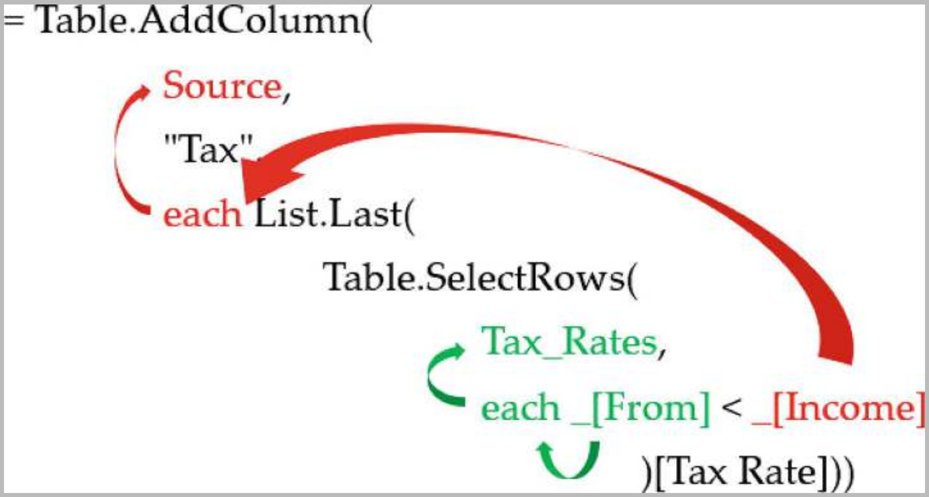


*Figure 2-40* Dependency of each and tables

To resolve this issue and clarify the reference table for `each _`, replace the `each _` logic with function definition syntax, such as `(x) =>`, in at least one of the functions. This adjustment ensures that the formula explicitly identifies the reference of `each`.

The formula can then be rewritten in one of the following forms:

```
= Table.AddColumn(
     Source,
     "Tax",
      (x)=> List.Last(
                    Table.SelectRows(
                           Tax_Rates,
                                   (y)=> y[From] < x[Income]
                                                 )[Tax Rate]
      ))

= Table.AddColumn(
     Source,
     "Tax",
      (x)=> List.Last(
                    Table.SelectRows(
                          Tax_Rates,
                                   each [From] < x[Income]
                                                 )[Tax Rate]
      ))

= Table.AddColumn(
      Source,
      "Tax",
      each List.Last(
                    Table.SelectRows(
                           Tax_Rates,
                                   (y)=> y[From] < [Income]
                                                 )[Tax Rate]
      ))
```

Considering the first variation of the formula, it is now clear that `x` refers to the Source table (the first step of the `People_Income` query) and `y` refers to the Tax_Rates table. Therefore, using `y[From] < x[Income]` clarifies that the From column comes from the Tax_Rates table and the Income column comes from the People_Income table.

## Extracting Data from the Price List Table

The price list for the two products is shown in Table 2-9, and historical sales data is shown in Table 2-10. Both tables are loaded into Power Query as separate queries, named `PriceList` and `Historical_Data`. Add a new column called Price to the Historical_Data table equal to the last recorded price on the PriceList table with the date before the transaction date. (For example, for the transaction on 22/04/2023, as the last recorded price before this date on the PriceList table is related to 17/04/2023, the price for A and B on this date are, respectively, 15 and 18.)

***Table 2-9*** The PriceList Table

| From Date | Product | Price |
|---|---|---|
| 1/01/2023 | A | 10 |
| 1/01/2023 | B | 12 |
| 17/04/2023 | A | 15 |
| 17/04/2023 | B | 18 |
| 26/07/2023 | A | 18 |
| 3/11/2023 | A | 21 |
| 3/11/2023 | B | 20 |

***Table 2-10*** The Historical_Data: Historical Sales Values

| Date | Product | Quantity |
|---|---|---|
| 21/02/2023 | B | 41 |
| 1/03/2023 | A | 10 |
| 10/03/2023 | B | 10 |
| 22/04/2023 | B | 9 |
| 26/04/2023 | B | 6 |
| 2/05/2023 | A | 39 |
| 2/05/2023 | B | 42 |
| 1/06/2023 | A | 12 |
| 19/08/2023 | A | 18 |
| 21/09/2023 | B | 13 |
| 24/10/2023 | B | 49 |
| 27/11/2023 | A | 32 |
| 5/12/2023 | B | 31 |

Before solving the problem for all rows in the Historical_Data table, let's test it by addressing it for the sixth row and extracting the price of product A on 2/05/2023. To do this, select the `PriceList` query and from the drop-down list next to the Product column, select A, as shown in Figure 2-41. Click OK, which will result in the following formula in the formula bar and lead to Figure 2-42 (Source is the name of first step in the `PriceList` query).

```
= Table.SelectRows(Source, each ([Product] = "A"))
```

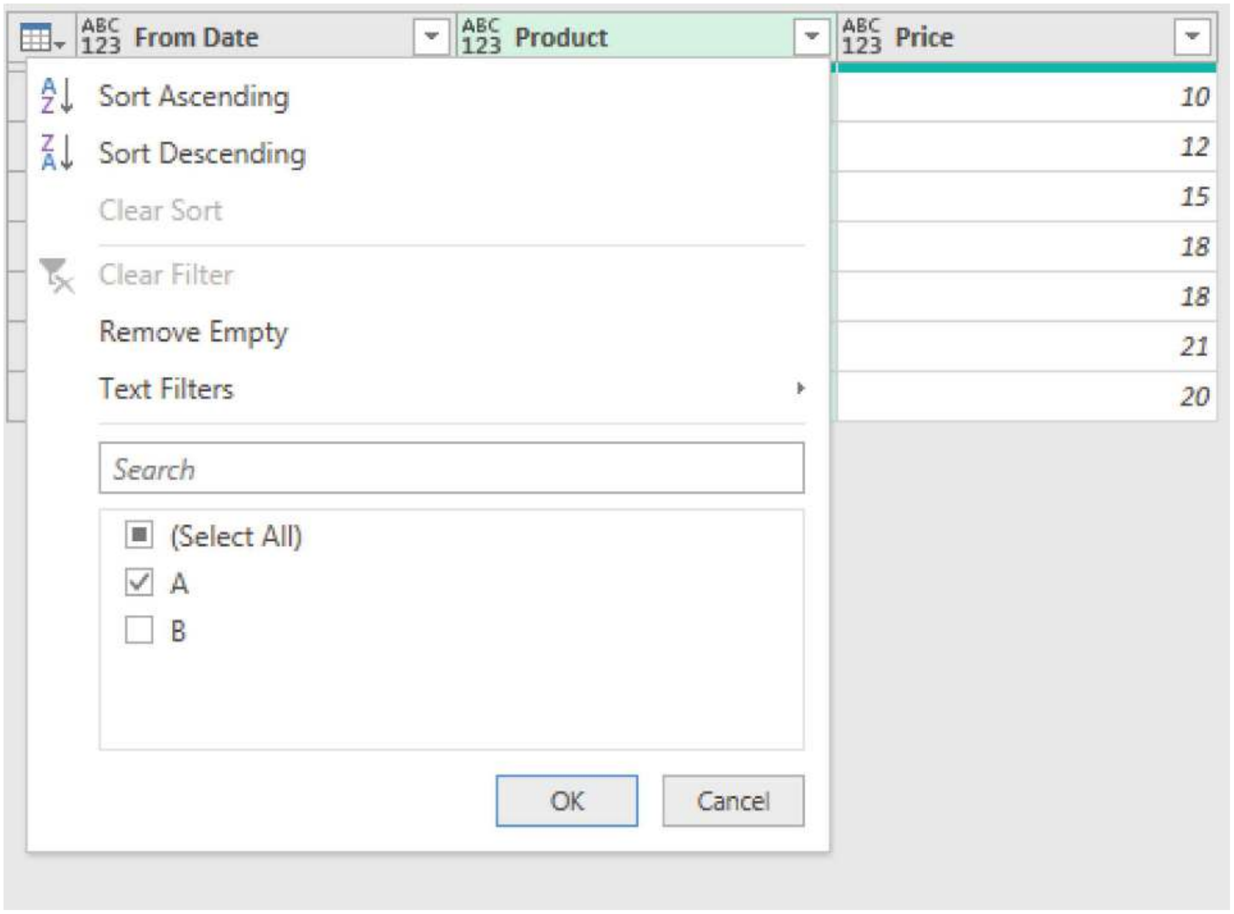
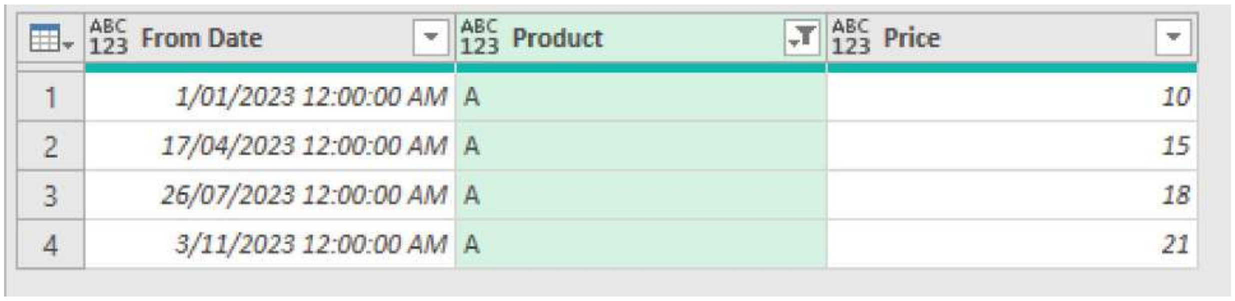


*Figure 2-41* Filtering product A



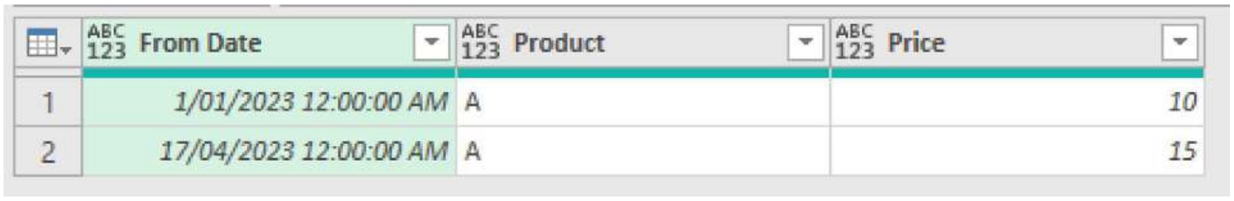
| | From Date | Product | Price |
|---|---|---|---|
| 1 | 1/01/2023 12:00:00 AM | A | 10 |
| 2 | 17/04/2023 12:00:00 AM | A | 15 |
| 3 | 26/07/2023 12:00:00 AM | A | 18 |
| 4 | 3/11/2023 12:00:00 AM | A | 21 |

*Figure 2-42* Result of filtering product A

In the result table, the row corresponding to the last date before 2/05/2023 should be extracted. Therefore, the From Date column should also be filtered. You can do this filter using UI, like in the previous step, or apply it by modifying the formula in the formula bar. To modify the previous formula, the new criteria for filtering can be added to the second argument of the `Table.SelectRows()` function by providing the filtering criteria. The formula can be rewritten as the next to apply filters on both columns once, which results in Figure 2-43. In this example, the values in the From Date column are in type `DateTime`, so `<=#datetime(2023, 5, 2, 0, 0, 0)` filters any rows with values less than

2023/05/2 00:00 on this column. If the values are in type date, `#date(2023, 5, 2)` should be used:

```
= Table.SelectRows(Source,
      each ([Product] = "A") and ([From Date] <= #datetime(2023,
5, 2, 0, 0, 0)))
```



| | From Date | Product | Price |
|---|---|---|---|
| 1 | 1/01/2023 12:00:00 AM | A | 10 |
| 2 | 17/04/2023 12:00:00 AM | A | 15 |

***Figure 2-43*** Result of filtering on Product and Date From

In the resulting table, the value in the Price column for the last row represents the value that you are searching for (as the rows are sorted ascending based on the dates). This can be extracted by first obtaining the values from the Price column, by adding `[Price]` to the end of the formula, which results in a list including all price list as `{10,15}`, and then applying the `List.Last()` formula on the resulted list to reach the value 15. So the previous formula can be rewritten as follows.

```
= List.Last(Table.SelectRows(Source, each ([Product] = "A") and
([From Date] <= #datetime(2023, 5, 2, 0, 0, 0)))[Price])
```

Alternatively, the following formula can also be used to extract the values from the last row of the table first by using the `Table.Last()` function. This function will result in a record including all the values of the last row. Then, to extract the value of the field price, `[Price]` is written at the end of the formula.

```
= Table.Last(Table.SelectRows(Source, each ([Product] = "A") and
([From Date] <= #datetime(2023, 5, 2, 0, 0, 0))))[Price]
```

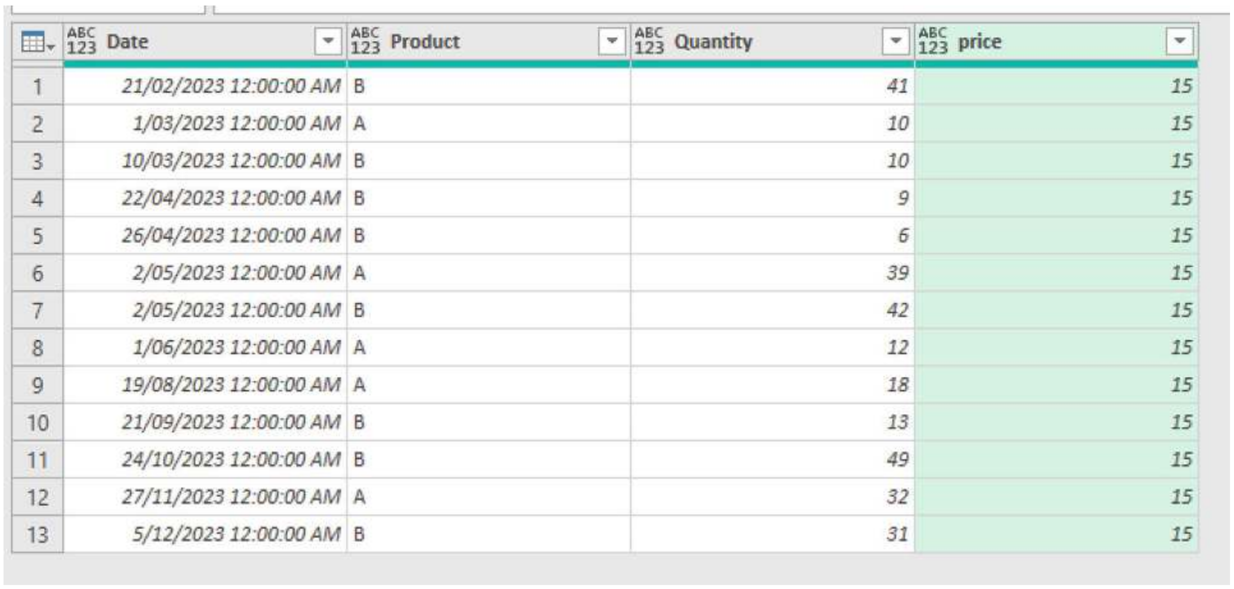
This formula results in the price for product A on the date 2023/05/02. You can now apply this formula to all rows in the Historical_Data table by replacing A and `#datetime(2023, 5, 2, 0, 0, 0)` with values from the Product and Date columns, respectively. However, to avoid the errors associated with using two `each _` expressions (the condition mentioned in "2.5. Using VLOOKUP with Approximate Match in Power Query"), the formula should be modified first by replacing `each _` logic with `(x) =>x` logic, as follows:

```
= Table.Last(Table.SelectRows(Source, (x)=> (x[Product] = "A")
and (x[From Date] <= #datetime(2023, 5, 2, 0, 0, 0))))[Price]
```

So, back to the question, considering both the queries unchanged. You select the `Historical_Data` query and add a new custom column named Price. Then use the following formula in it:

```
= Table.Last(Table.SelectRows(PriceList, (x)=> (x[Product] = "A")
and (x[From Date] <= #datetime(2023, 5, 2, 0, 0, 0))))[Price]
```

(This is the same as the previous formula, but the step name Source in the `PriceList` query is replaced with the query name, as you cannot refer to a step in another query directly.) Using this formula will result in Figure 2-44, where the value 15 is repeated for all rows.

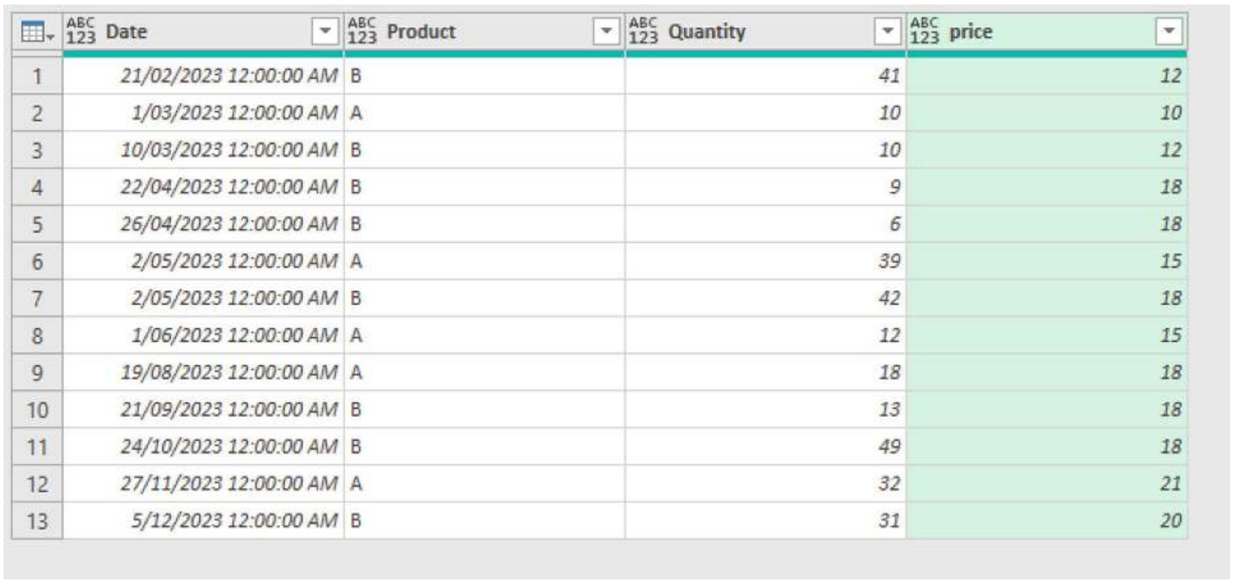


| | Date | Product | Quantity | price |
|---|---|---|---|---|
| 1 | 21/02/2023 12:00:00 AM | B | 41 | 15 |
| 2 | 1/03/2023 12:00:00 AM | A | 10 | 15 |
| 3 | 10/03/2023 12:00:00 AM | B | 10 | 15 |
| 4 | 22/04/2023 12:00:00 AM | B | 9 | 15 |
| 5 | 26/04/2023 12:00:00 AM | B | 6 | 15 |
| 6 | 2/05/2023 12:00:00 AM | A | 39 | 15 |
| 7 | 2/05/2023 12:00:00 AM | B | 42 | 15 |
| 8 | 1/06/2023 12:00:00 AM | A | 12 | 15 |
| 9 | 19/08/2023 12:00:00 AM | A | 18 | 15 |
| 10 | 21/09/2023 12:00:00 AM | B | 13 | 15 |
| 11 | 24/10/2023 12:00:00 AM | B | 49 | 15 |
| 12 | 27/11/2023 12:00:00 AM | A | 32 | 15 |
| 13 | 5/12/2023 12:00:00 AM | B | 31 | 15 |

***Figure 2-44*** Adding a new column

To make the formula dynamic for all rows, modify the formula in the Custom column window and replace A and `#datetime(2023, 5, 2, 0, 0, 0)` in the formula with `[Product]` and `[Date]`, respectively, as provided in the following formula. This modification will produce the updated formula shown in Figure 2-45.

```
= Table.Last(Table.SelectRows(PriceList, (x)=> (x[Product] =
[Product]) and (x[From Date] <= [Date])))[Price]
```



| | Date | Product | Quantity | price |
|---|---|---|---|---|
| 1 | 21/02/2023 12:00:00 AM | B | 41 | 12 |
| 2 | 1/03/2023 12:00:00 AM | A | 10 | 10 |
| 3 | 10/03/2023 12:00:00 AM | B | 10 | 12 |
| 4 | 22/04/2023 12:00:00 AM | B | 9 | 18 |
| 5 | 26/04/2023 12:00:00 AM | B | 6 | 18 |
| 6 | 2/05/2023 12:00:00 AM | A | 39 | 15 |
| 7 | 2/05/2023 12:00:00 AM | B | 42 | 18 |
| 8 | 1/06/2023 12:00:00 AM | A | 12 | 15 |
| 9 | 19/08/2023 12:00:00 AM | A | 18 | 18 |
| 10 | 21/09/2023 12:00:00 AM | B | 13 | 18 |
| 11 | 24/10/2023 12:00:00 AM | B | 49 | 18 |
| 12 | 27/11/2023 12:00:00 AM | A | 32 | 21 |
| 13 | 5/12/2023 12:00:00 AM | B | 31 | 20 |

***Figure 2-45*** Making the formula dynamic

So, by adding this column, the formula in the formula bar will be as follows:

```
= Table.AddColumn(
      Source,
      "price",
      each Table.Last(
                     Table.SelectRows(
                                        PriceList,
                                        (x)=> (x[Product] =
[Product]) and (x[From Date] <= [Date])
                                                      )
                                         )[Price]
                                     )
```

## Summary

In real-world scenarios, there are many instances where you need to search for specific values or sets of values across different tables. In this chapter, you learned how to utilize functions and operators to extract these specific values from tables, records, and lists.

While the effectiveness of these techniques can vary based on the cases, most of the time, using functions like `Table.SelectRows()` is more efficient in terms of time than using operators. Additionally, in a lengthy table, employing the `Table.Buffer()` and `List.Buffer()` functions can further optimize the performance of referencing.

The next chapter provides additional tips regarding the `Table.Sort()` and the `Table.SelectRows()` functions.

O. Motamedisedeh, *96 Common Challenges in Power Query*
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# 3. Sorting and Filtering

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Sort and Filter are essential commands for cleaning datasets and extracting the desired rows in the desired order. This chapter covers these two important tasks. But before diving into the main problems, you should be familiar with the basics of these two functions.

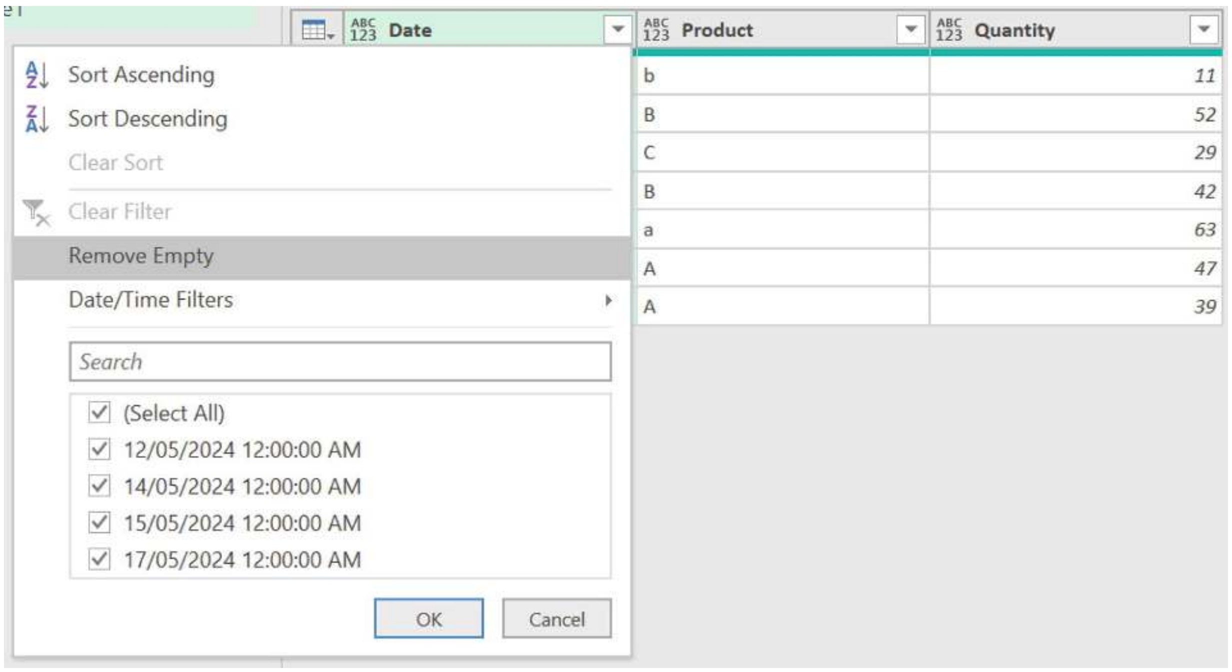
In Power Query, sorting and filtering rows is straightforward. Consider the Source table shown in Table 3-1.

***Table 3-1*** Source: Sales Data

| Date | Product | Quantity |
|---|---|---|
| 12/05/2024 | b | 11 |
| 15/05/2024 | B | 52 |
| 14/05/2024 | C | 29 |
| 15/05/2024 | B | 42 |
| 17/05/2024 | a | 63 |
| 15/05/2024 | A | 47 |
| 17/05/2024 | A | 39 |

To sort data in ascending order based on the values in the Date column, simply click the down arrow next to the column name and choose Sort Ascending, as shown in Figure 3-1. This will generate the following formula in the formula bar:

```
= Table.Sort(Source,{{"Date", Order.Ascending}})
```

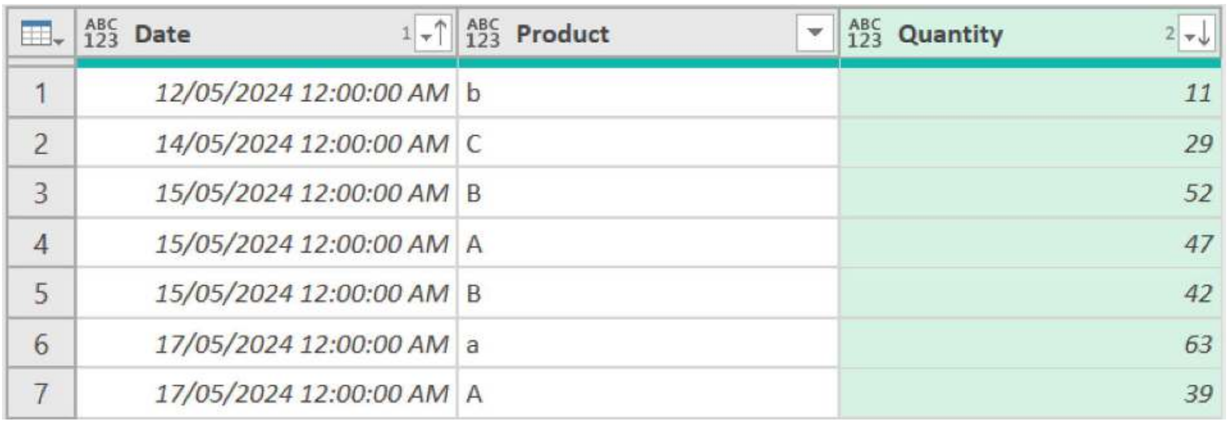


| Product | Quantity |
|---|---|
| b | 11 |
| B | 52 |
| C | 29 |
| B | 42 |
| a | 63 |
| A | 47 |
| A | 39 |

***Figure 3-1*** The Sort Ascending option

In the resulting table, rows are sorted in ascending order based on the Date column. Since 15/05/2024 12:00:00 AM appears three times in this column, you can add another sorting criterion to sort these rows. To sort rows with the same date in descending order based on the Quantity column, just click the down arrow next to this column and select Sort Descending (see Figure 3-2). Here is the formula in the formula bar:

```
= Table.Sort(Source,{{"Date", Order.Ascending},
{"Quantity", Order.Descending}})
```



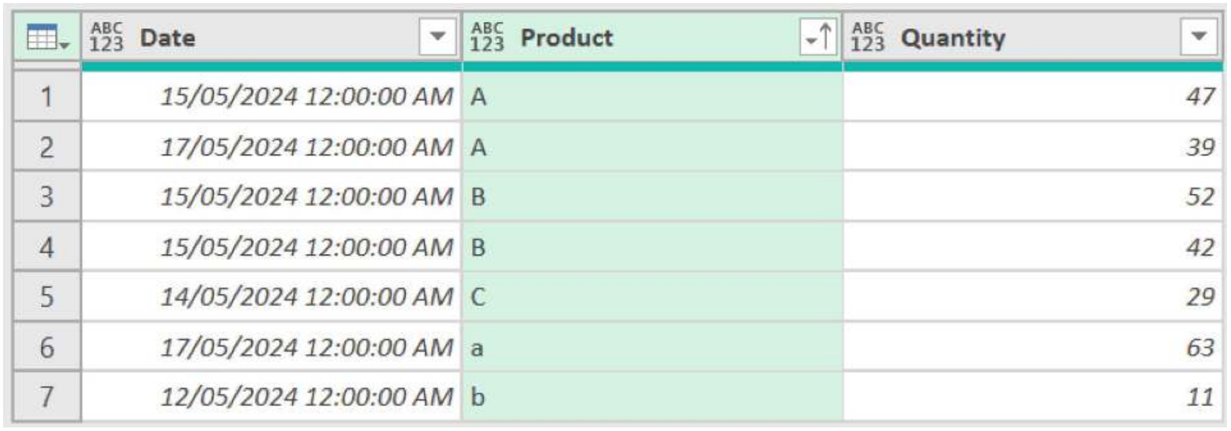
|  | Date | Product | Quantity |
|---|---|---|---|
| 1 | 12/05/2024 12:00:00 AM | b | 11 |
| 2 | 14/05/2024 12:00:00 AM | C | 29 |
| 3 | 15/05/2024 12:00:00 AM | B | 52 |
| 4 | 15/05/2024 12:00:00 AM | A | 47 |
| 5 | 15/05/2024 12:00:00 AM | B | 42 |
| 6 | 17/05/2024 12:00:00 AM | a | 63 |
| 7 | 17/05/2024 12:00:00 AM | A | 39 |

***Figure 3-2*** Two column sort

In the previous formulas, `Order.Descending` and `Order.Ascending` are enumerations that determine the sorting directions, and instead of using them, you can use the values that represent them. The value for `Order.Descending` is 1, and the value for `Order.Ascending` is 0. Therefore, without altering the result, the previous formula can be rewritten as shown here:

```
= Table.Sort(Source,{{"Date", 0}, {"Quantity", 1}})
```

Like other functions in Power Query, sorting is also case-sensitive. So, sorting the Source table in ascending order based on the Product column results in Figure 3-3. (Later in this chapter, custom logic for sorting is defined.)

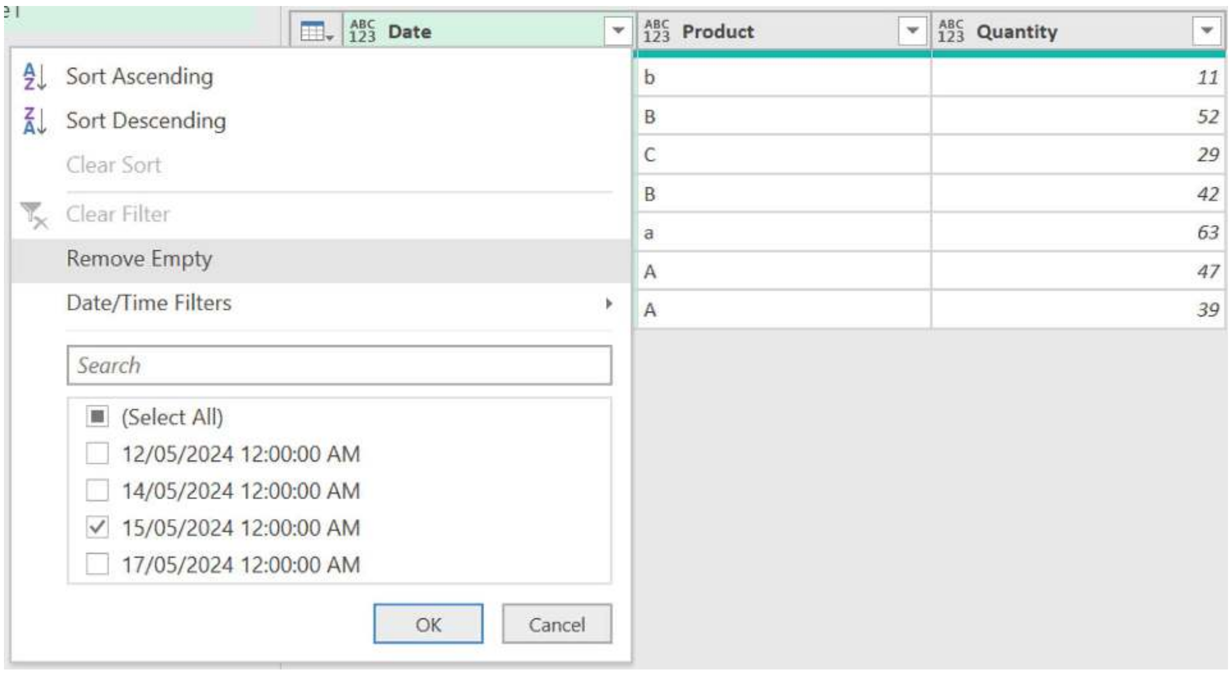


| | Date | Product | Quantity |
|---|---|---|---|
| 1 | 15/05/2024 12:00:00 AM | A | 47 |
| 2 | 17/05/2024 12:00:00 AM | A | 39 |
| 3 | 15/05/2024 12:00:00 AM | B | 52 |
| 4 | 15/05/2024 12:00:00 AM | B | 42 |
| 5 | 14/05/2024 12:00:00 AM | C | 29 |
| 6 | 17/05/2024 12:00:00 AM | a | 63 |
| 7 | 12/05/2024 12:00:00 AM | b | 11 |

***Figure 3-3*** Sort based on the Product column

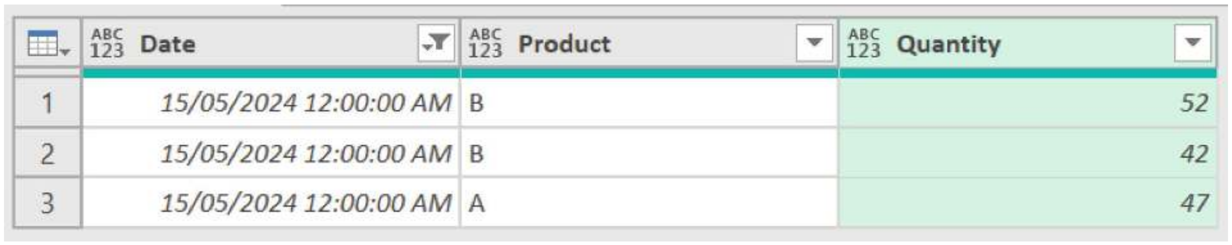
Similar to the sorting process, the filtering process is straightforward in Power Query. To filter rows where the Date is equal to 15/05/2024, as in Figure 3-4, click the down arrow next to the column name and select this date among all the available dates. This results in Figure 3-5, which is generated by the following formula:

```
= Table.SelectRows(Source, each ([Date] = #datetime(2024,
5, 15, 0, 0, 0)))
```



| Product | Quantity |
|---|---|
| b | 11 |
| B | 52 |
| C | 29 |
| B | 42 |
| a | 63 |
| A | 47 |
| A | 39 |

***Figure 3-4*** Filter date equal to 15/05/2024



| | Date | Product | Quantity |
|---|---|---|---|
| 1 | 15/05/2024 12:00:00 AM | B | 52 |
| 2 | 15/05/2024 12:00:00 AM | B | 42 |
| 3 | 15/05/2024 12:00:00 AM | A | 47 |

***Figure 3-5*** Result of the filter

If you add a filter to the Quantity column and select 52, for example, the formula changes to the following:

```
= Table.SelectRows(Source, each ([Date] = #datetime(2024,
5, 15, 0, 0, 0)) and ([Quantity] = 52))
```

The result of the previous formula is exactly the same as the following formula, with the only difference being that the "_" was removed. Since all the column names, in this example, came from the same table, the "_", which represents the table name for each column, can be removed.

```
= Table.SelectRows(Source, each (_[Date] =
#datetime(2024, 5, 15, 0, 0, 0)) and (_[Quantity] = 52))
```

In this formula, the condition will be evaluated for each row of the table. If the condition is true for a row, that row will be displayed in the result table. As shown, the function includes two arguments: the name of the table (in the type of table) and the selection criteria (in the type of function). The second argument usually starts with the word `each`, which is used in Power Query to define a custom function.

As a general rule in Power Query, when you're using `each` to create a custom function, its optional input variable is represented by an underscore ("_"). For example, when using `each _` in the second argument of `Table.SelectRows()`, for each row of the table, "_" represents a record containing the values of that row, with the field names corresponding to the column headers. For example, for the first row, `each _` is equal to `[Date="12/05/2024", Product="b", Quantity= 11]`. So `_[Date]` refers to the value in the Date field for that particular record, which is the same as the value in the Date column for that row.

Instead of using the `each` expression to define a custom function with the variable name of "_", you can use the general custom function definition with any variable (or variables) like `x`, as in `(x) =>`. In this case, the `()=>` syntax is used to define a function, and the variable name is enclosed in parentheses. So, in the previous formula, `each` can be replaced with `(x)=>`, and then "_" should be replaced with `x`. The previous formula can be rewritten as the following with the same result:

```
= Table.SelectRows(Source, (x)=> (x[Date] =
#datetime(2024, 5, 15, 0, 0, 0)) and (x[Quantity] = 52))
```

(If you're wondering why you need to replace the `each _` logic with `(x) =>` logic, just wait for Example 3-8 in this chapter.)

**Efficiency Tips** Filtering rows in Power Query is an important task for improving query execution time, and it is generally recommended to filter out unwanted rows in the early steps. But there is also another rule related to applying filtering commands over the rows.

A key factor in optimizing the consumption time of a filtering action is to simplify the condition as much as possible. For example, consider a table, called Source, with 10,000 rows including four columns, with the first row shown in Table 3-2. If you want to filter all the rows in this table, and include at least one value in the Objective columns that is greater than the value of the corresponding objective in the first row of the table, you can use the following formula, which takes 29 seconds to execute.

***Table 3-2*** The First Row

| Solution ID | Objective 1 | Objective 2 | Objective 3 |
|---|---|---|---|

| Solution ID | Objective 1 | Objective 2 | Objective 3 |
|---|---|---|---|
| **1** | 32 | 5 | 32 |

```
=Table.SelectRows(Source, each ([Objective 1] >=
Source[Objective 1]{0} or [Objective 2] >=
Source[Objective 2]{0} or [Objective 3] >=
Source[Objective 3]{0}))
```

However, directly referencing the values of the first row in the filter condition, as shown here, reduces the time to just 0.02 seconds:

```
= Table.SelectRows(Source, each ([Objective 1] >= 32 or
[Objective 2] >= 5 or [Objective 3] >= 32)
```

Based on the basic information provided at the beginning of this chapter, in the rest of this chapter, sort and filter tips are presented using several examples.

## Filtering Across Multiple Columns, Part 1

Consider the sales data provided in the Source table shown in Table 3-3 and filter the rows that include the character "*" in at least one column.

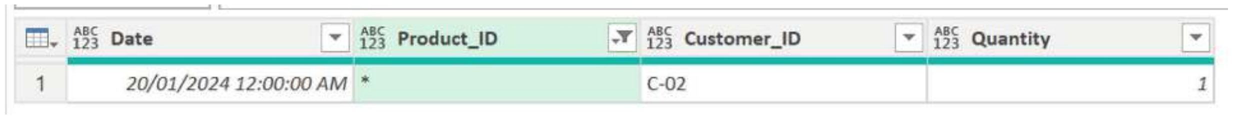
***Table 3-3*** Source: Historical Sales

| Date | Product_ID | Customer_ID | Quantity |
|---|---|---|---|
| 18/01/2024 | P-5 | C-03 | 9 |
| 19/01/2024 | P-4 | C-02 | 5 |
| 20/01/2024 | * | C-02 | 1 |
| * | P-2 | C-02 | * |
| 23/01/2024 | P-3 | C-03 | 7 |
| 24/01/2024 | P-2 | * | 8 |
| * | P-5 | C-03 | 6 |
| 30/01/2024 | P-1 | C-03 | 2 |
| 31/01/2024 | P-3 | C-02 | 7 |

> **Note** The data in this example is provided in an Excel file titled `01 Filtering Across Multiple Columns Part 1.xlsx`.

To solve this problem, filter "*" in the Product_ID column. This leads to Figure 3-6 and generates the following formula in the formula bar:

```
= Table.SelectRows(Source, each ([Product_ID] = "*"))
```



| | Date | Product_ID | Customer_ID | Quantity |
|---|---|---|---|---|
| 1 | 20/01/2024 12:00:00 AM | * | C-02 | 1 |

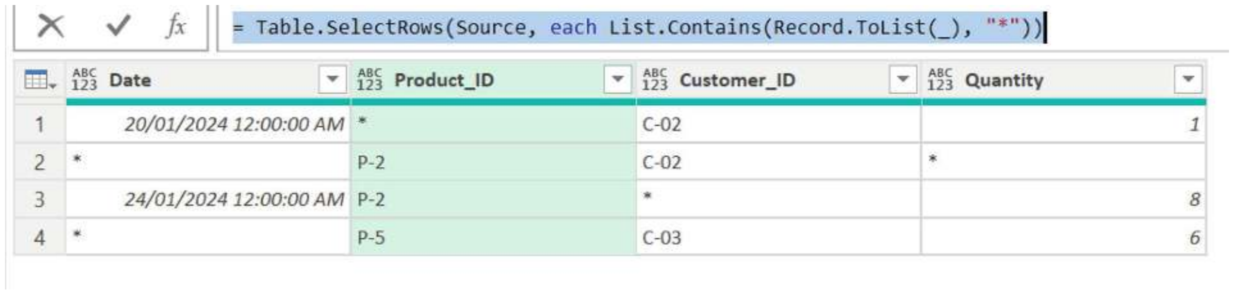
***Figure 3-6*** Result of filtering "*" on the Product_ID column

The previous formula checks for the availability of "*" in the Product_ID column. Similarly, the condition for checking the availability of "*" in other columns can be added by using `or` between the conditions. The formula can be rewritten as follows:

```
= Table.SelectRows(
      Source, each ([Product_ID] = "*" or [Quantity]="*"
or [Date]="*" or [Customer_ID]="*"))
```

The problem will be solved efficiently using the previous formula, but in cases where you have more columns, instead of using the previous formula, you can also use the following formula, which results in Figure 3-7.

```
= Table.SelectRows(Source, each
List.Contains(Record.ToList(_), "*"))
```



```
= Table.SelectRows(Source, each List.Contains(Record.ToList(_), "*"))
```

| | Date | Product_ID | Customer_ID | Quantity |
|---|---|---|---|---|
| 1 | 20/01/2024 12:00:00 AM | * | C-02 | 1 |
| 2 | * | P-2 | C-02 | * |
| 3 | 24/01/2024 12:00:00 AM | P-2 | * | 8 |
| 4 | * | P-5 | C-03 | 6 |

***Figure 3-7*** The result of filtering on all the columns

In this example, as presented in the beginning of this chapter, "_" refers to the values of each row of the Source table, and it is in the type of Record. So, using Record.ToList(_) will convert the record to the list including the values of each row. Using the List.Contains() function, it checks if the list presented in its first argument contains "*".

This formula filters rows across many columns by converting each row into a list and checking for the presence of "*". In another case, to filter the rows that do not include "*" in any column, you can rewrite the formula as follows:

```
= Table.SelectRows(Source, each not
List.Contains(Record.ToList(_), "*"))
```

## Filtering Across Multiple Columns, Part 2

Similar to the previous example, consider the sales data provided in the Source table, shown in Table 3-4, and filter the rows that contain character `"*"` in at least one cell.

***Table 3-4*** Source: Sales Info

| Date | Product_ID | Customer_ID | Quantity |
|---|---|---|---|
| 18/01/2024 | P-5 | C-03 | 9 |
| 19/01/2024 | P-4 | C-02 | 5 |
| 20/01/2024 | P-1* | C-02 | 1 |
| 21/01/2024* | P-2 | C-02 | 8* |
| 23/01/2024 | P-3 | C-03 | 7 |
| 24/01/2024 | P-2 | C-01* | 8 |
| 25/01/2024* | P-5 | C-03 | 6 |
| 30/01/2024 | P-1 | C-03 | 2 |
| 31/01/2024 | P-3 | C-02 | 7 |

**Note** The data in this example is provided in an Excel file titled `02 Filtering Across Multiple Columns Part 2 .xlsx`.

In this problem, to check whether the cells in the rows contain `"*"` using text functions, first, select all columns. From the Home tab, convert the data type of all columns to text (this step makes the process easier, as the `Text.Contains()` function can be applied on values in the type of text). Next, click the filter icon next to the Product_ID column, choose Text Filter, select Contains, and enter `*`, as shown in Figure 3-8.

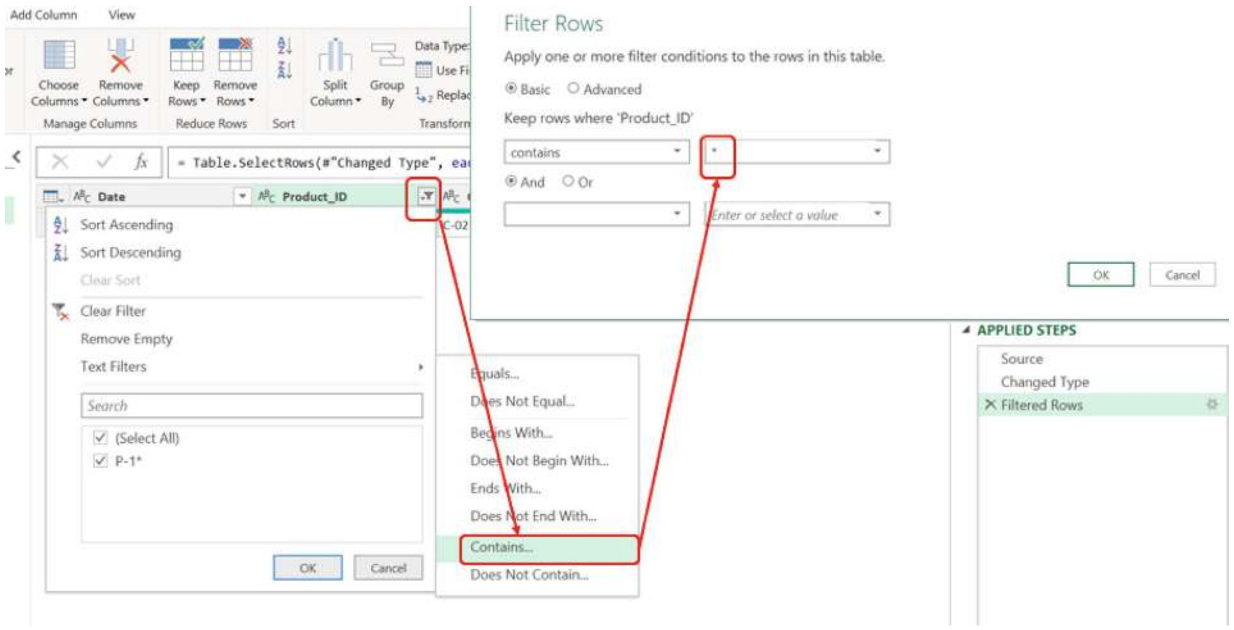


***Figure 3-8*** Setting the filter

These changes will generate the following formula in the formula bar:

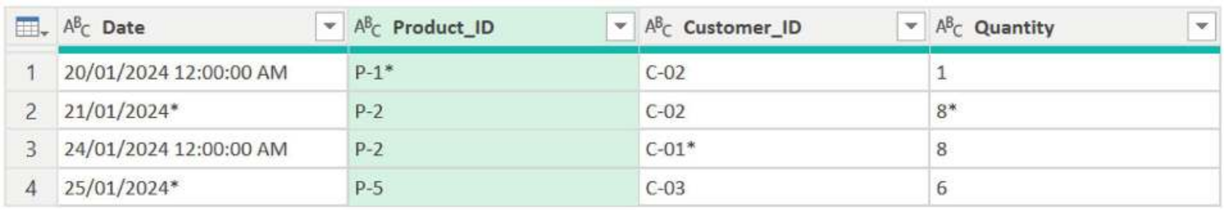
```
= Table.SelectRows(#"Changed Type", each
Text.Contains([Product_ID], "*"))
```

If the number of columns is limited, the previous formula can be rewritten to include additional columns in the filter criteria, ensuring that "*" is checked across all relevant columns.

```
= Table.SelectRows(
      #"Changed Type",
      each Text.Contains([Date], "*") or
      Text.Contains([Product_ID], "*") or
      Text.Contains([Customer_ID], "*") or
      Text.Contains([Quantity], "*"))
```

But if there are many, many columns, the formula can be simplified to filter rows based on the presence of "*" in any column. Do this using the following formula, which results in Figure 3-9:

```
= Table.SelectRows(#"Changed Type", each
Text.Contains(Text.Combine(Record.ToList(_)), "*") )
```



| | Date | Product_ID | Customer_ID | Quantity |
|---|---|---|---|---|
| 1 | 20/01/2024 12:00:00 AM | P-1* | C-02 | 1 |
| 2 | 21/01/2024* | P-2 | C-02 | 8* |
| 3 | 24/01/2024 12:00:00 AM | P-2 | C-01* | 8 |
| 4 | 25/01/2024* | P-5 | C-03 | 6 |

***Figure 3-9*** Result of the filter

In this formula, in the `Table.SelectRows()` function, the result of `each _` for each row is a record containing all the values for that row with field names matching the column names. For example, for the first row, it is equal to: `[Date="18/01/2024 12:00:00 AM", Product_ID="P-5", Customer_ID="C-03", Quantity="9"]`.

Using each `Record.ToList(_)`, the record is converted into a list of values. For the first row, this results in `{"18/01/2024 12:00:00 AM", "P-5", "C-03", "9"}`. Next, the `Text.Combine(Record.ToList(_))` concatenates all the values in this list into a single text string. So, for the first row, this results in `"18/01/2024 12:00:00 AMP-5C-039"`.

The `Text.Contains()` function is then used to check if this concatenated text contains `"*"` or not. Therefore, `Text.Contains(Text.Combine(Record.ToList(_)), "*")` will return true if at least one cell in the row contains `"*"`, and false otherwise.

**Efficiency Tips** In this example, when running a query on a dataset with 500,000 rows, the execution time is approximately 4 seconds for the second solution. Additionally, adding 12 more columns to the table increases the runtime to 12 seconds. Using the `or` function between conditions for all column names results in faster performance, reducing the runtime to around 3 seconds for the same dataset with the additional columns.

The key issue regarding the use of `or` conditions is about using hardcoded column names. The code should be modified after changing the column name or adding a new column to the table.

## Filtering Across Multiple Columns, Part 3

The information on yearly purchases by customers is provided in the Source table, as shown in Table 3-5. Extract the list of customer IDs who made seven or fewer purchases at least in two years.

***Table 3-5*** Source: the Purchase Info

| Customer ID | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|
| C-1 | 15 | 16 | 14 | 27 | 11 | 11 |
| C-2 | 12 | 27 | 3 | 11 | 4 | 7 |
| C-3 | 14 | 6 | 14 | 5 | 19 | 12 |
| C-4 | 11 | 26 | 17 | 11 | 6 | 10 |
| C-5 | 5 | 9 | 8 | 17 | 18 | 14 |
| C-6 | 19 | 18 | 5 | 19 | 2 | 10 |
| C-7 | 15 | 7 | 22 | 22 | 12 | 30 |
| C-8 | 18 | 14 | 11 | 15 | 19 | 13 |
| C-9 | 15 | 22 | 10 | 7 | 17 | 19 |
| C-10 | 28 | 20 | 26 | 18 | 13 | 9 |
| C-11 | 22 | 11 | 17 | 13 | 21 | 23 |
| C-12 | 4 | 5 | 2 | 13 | 5 | 3 |
| C-13 | 8 | 12 | 9 | 8 | 13 | 11 |
| C-14 | 14 | 4 | 13 | 10 | 10 | 24 |
| C-15 | 6 | 3 | 6 | 18 | 3 | 4 |

**Note** The data in this example is provided in an Excel file titled `03 Filtering Across Multiple Columns Part 3.xlsx`.

Two different solutions are provided for this problem as follows.

### Solution 1: Initial Filtering

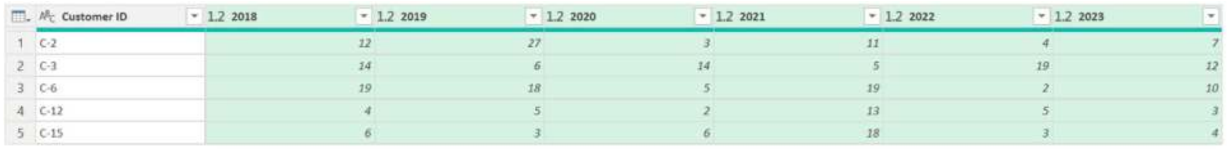
Instead of considering all the columns for filtering, you can initially filter the rows that have a value less than or equal to 7 in the 2018 column, by using the following formula:

```
= Table.SelectRows(Source, each _[2018] <= 7)
```

In this formula, using `each _ [2018] <= 7` in the second argument filters the rows where the value in the 2018 column is less than or equal to 7. But to solve the problem, you need to consider the values of all the years (all the columns except the first one).

To extend this approach and find customers with seven or fewer purchases in at least two years, the formula can be modified as follows (this results in Figure 3-10):

```
= Table.SelectRows(
      Source,
      each
List.Count(List.Select(List.Skip(Record.ToList(_)), (x)=>
x <= 7))>=2)
```



| | Customer ID | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|
| 1 | C-2 | 12 | 27 | 3 | 11 | 4 | 7 |
| 2 | C-3 | 14 | 6 | 14 | 5 | 19 | 12 |
| 3 | C-6 | 19 | 18 | 5 | 19 | 2 | 10 |
| 4 | C-12 | 4 | 5 | 2 | 13 | 5 | 3 |
| 5 | C-15 | 6 | 3 | 6 | 18 | 3 | 4 |

***Figure 3-10*** The result of the filter

As presented, the selection condition is "`each List.Count(List.Select(List.Skip(Record.ToList(_)), (x) => x <= 7)) >= 2`". Let's break down this formula step by step.

Using `each_` in the second argument results in a record for each row of the source table. For example, for the first row, this results in `[Customer ID="C-1", 2018=15, 2019=16, 2020=14, 2021=27, 2022=11, 2023=11]`.

As it is hard to apply a condition over the values in a record, the records are converted into lists by using each `Record.ToList(_)`. The result of this formula for the first row is `{ "C-1", 15, 16, 14, 27, 11, 11 }`.

The first item in the result list is the Customer ID, and it is not required for creating filtering conditions, so the `List.Skip()` function is used in `each List.Skip(Record.ToList(_))` to neglect the first items in the lists. This results in `{ 15, 16, 14, 27, 11, 11 }` for the first row.

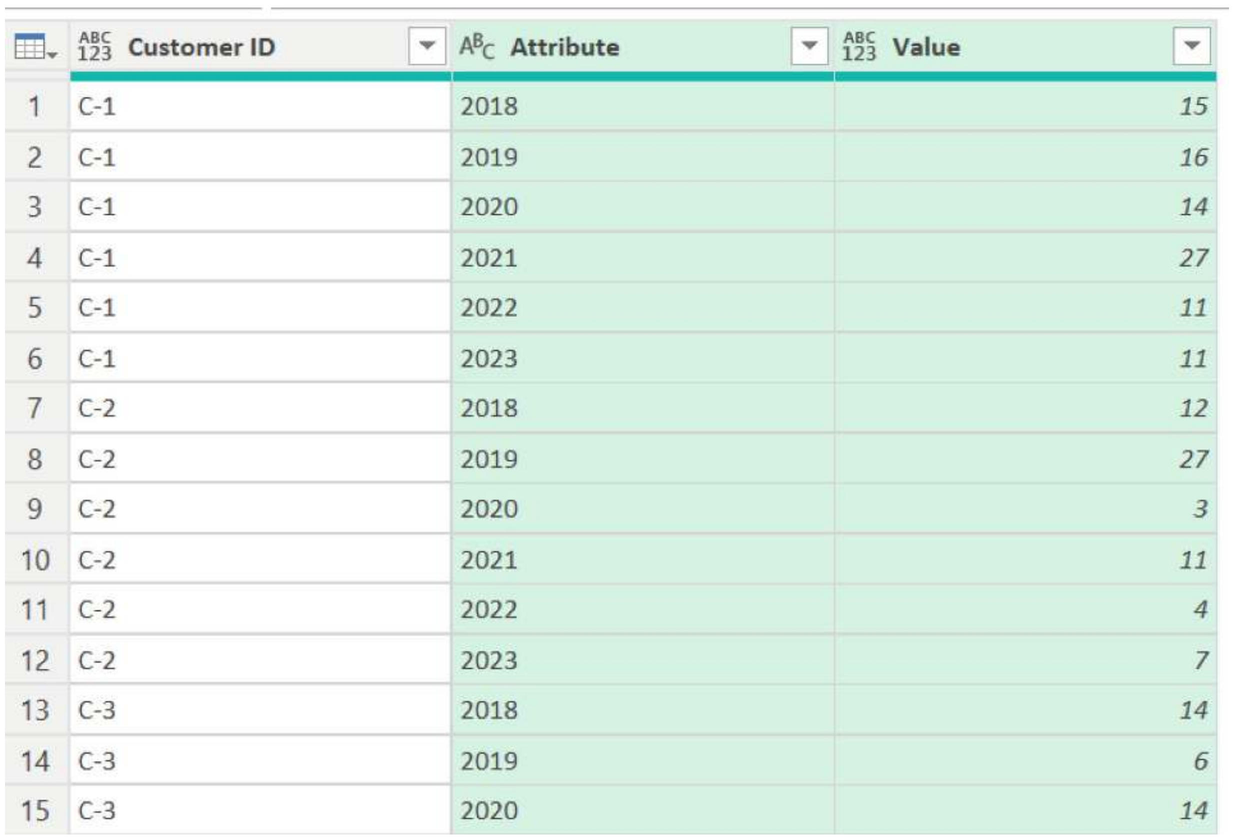
Out of all the values in the list, you are searching for those that are less than or equal to 7, so each `List.Select(List.Skip(Record.ToList(_)), (x) => x <= 7)` is used to filter the items into the list that are less than or equal to 7. For the first row, this results in `{}`, but for the second row, this results `in { 3, 4, 7 }`.

In the next step, the `List.Count()` function is used, as in `each List.Count(List.Select(List.Skip(Record.ToList(_)), (x) => x <= 7))` to count the number of values less than or equal to 7. For the first row, the result of the count is 0, and for the second row, it is 3.

In the last step, the result of the count is compared by threshold 2 and it returns `true` if the count value is greater than or equal to 2. The formula solves the problem by filtering the rows that have at least two values equal to or less than 7.

## Solution 2: Unpivoting and Using Group By

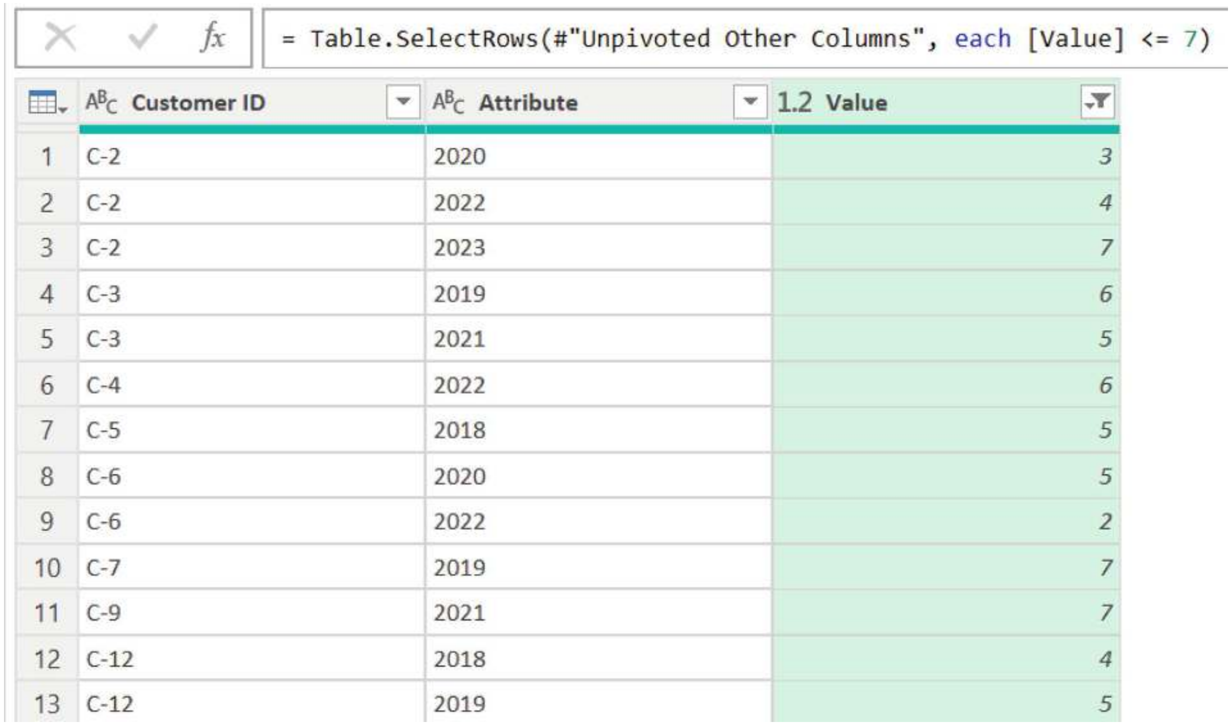
If the first solution seems complex, you can use this alternative approach. For the second solution, right-click the Customer ID column and select Unpivot Other Columns, resulting in Figure 3-11.



| | Customer ID | Attribute | Value |
|---|---|---|---|
| 1 | C-1 | 2018 | 15 |
| 2 | C-1 | 2019 | 16 |
| 3 | C-1 | 2020 | 14 |
| 4 | C-1 | 2021 | 27 |
| 5 | C-1 | 2022 | 11 |
| 6 | C-1 | 2023 | 11 |
| 7 | C-2 | 2018 | 12 |
| 8 | C-2 | 2019 | 27 |
| 9 | C-2 | 2020 | 3 |
| 10 | C-2 | 2021 | 11 |
| 11 | C-2 | 2022 | 4 |
| 12 | C-2 | 2023 | 7 |
| 13 | C-3 | 2018 | 14 |
| 14 | C-3 | 2019 | 6 |
| 15 | C-3 | 2020 | 14 |

***Figure 3-11*** The result of unpivoting

In the next step, on the Value column, filter the value less than or equal to 7, to remove the years for values greater than 7 for each customer. This results in Figure 3-12.

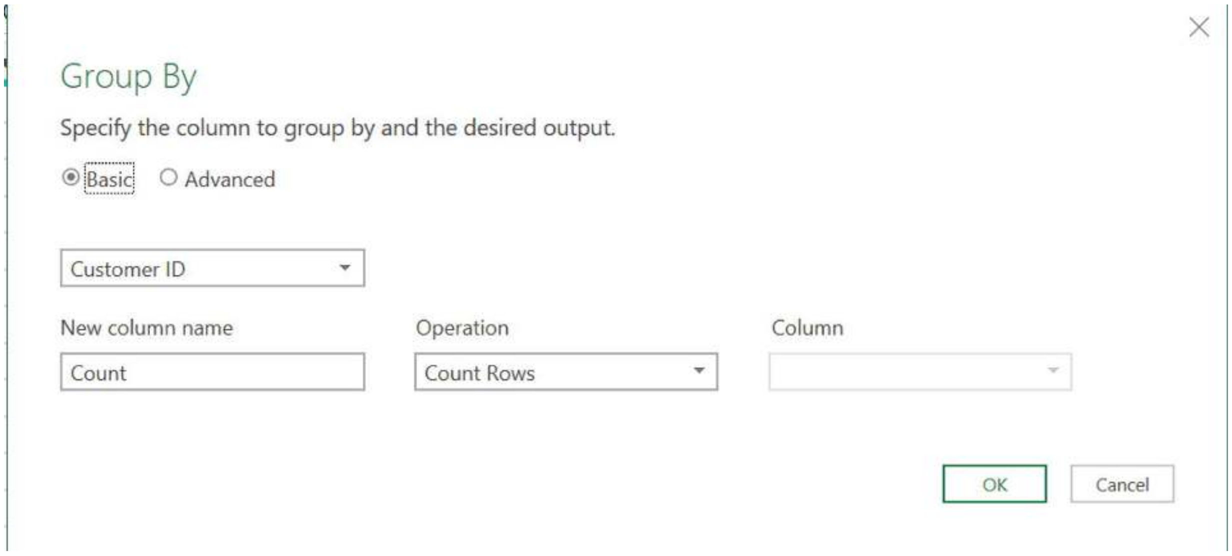


```
= Table.SelectRows(#"Unpivoted Other Columns", each [Value] <= 7)
```

| | Customer ID | Attribute | Value |
|---|---|---|---|
| 1 | C-2 | 2020 | 3 |
| 2 | C-2 | 2022 | 4 |
| 3 | C-2 | 2023 | 7 |
| 4 | C-3 | 2019 | 6 |
| 5 | C-3 | 2021 | 5 |
| 6 | C-4 | 2022 | 6 |
| 7 | C-5 | 2018 | 5 |
| 8 | C-6 | 2020 | 5 |
| 9 | C-6 | 2022 | 2 |
| 10 | C-7 | 2019 | 7 |
| 11 | C-9 | 2021 | 7 |
| 12 | C-12 | 2018 | 4 |
| 13 | C-12 | 2019 | 5 |

***Figure 3-12*** The result of filtering values less than or equal to 7

The resulting table includes only the years with values less than or equal to 7 for the customers. You now need to count the number of repetitions of each customer ID in this table. So, select the Customer ID column, and from the Home tab, choose the Group By command and configure the settings as shown in Figure 3-13. This will produce a table with two columns—the Customer ID and the number of its repetitions (the number of years with a value less than or equal to 7). See Figure 3-14.



Group By

Specify the column to group by and the desired output.

[✓ Basic] Advanced

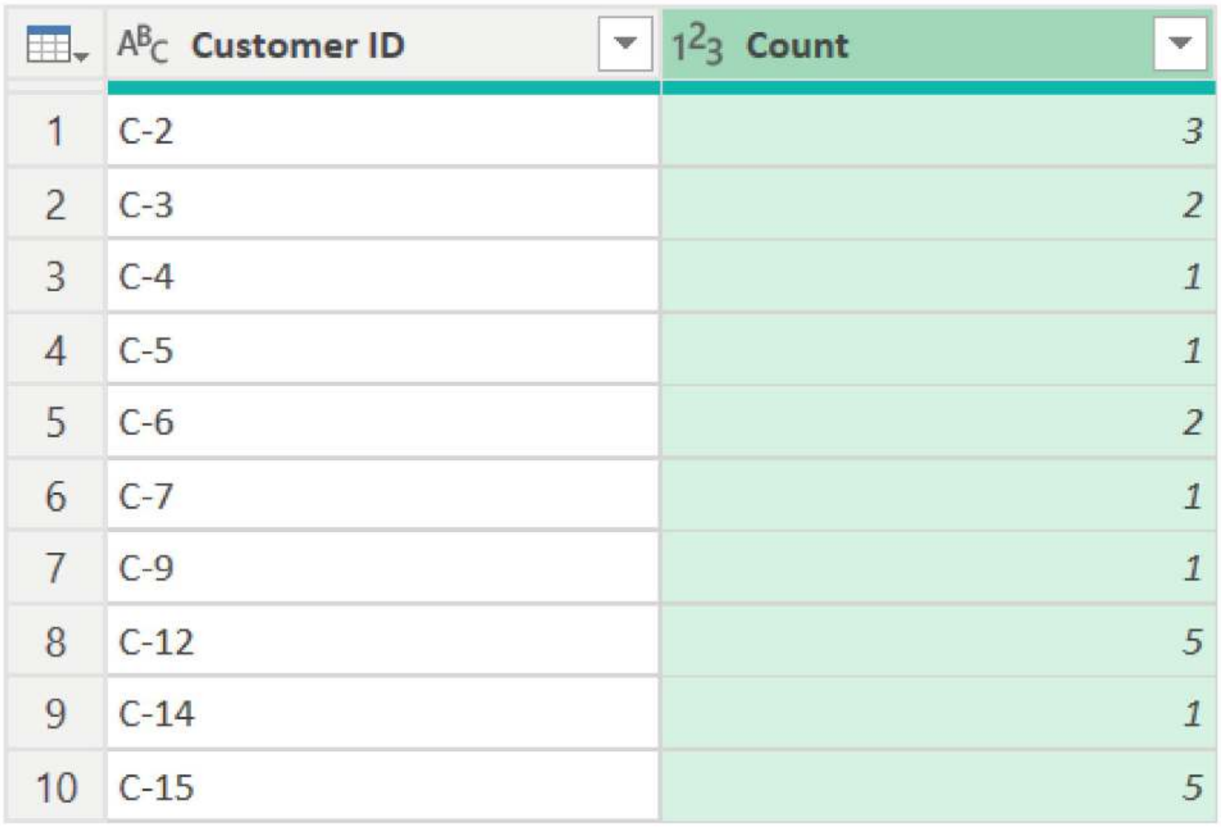
Customer ID

New column name: Count

Operation: Count Rows

Column:

*Figure 3-13* Using Group By



| | Customer ID | Count |
|---|---|---|
| 1 | C-2 | 3 |
| 2 | C-3 | 2 |
| 3 | C-4 | 1 |
| 4 | C-5 | 1 |
| 5 | C-6 | 2 |
| 6 | C-7 | 1 |
| 7 | C-9 | 1 |
| 8 | C-12 | 5 |
| 9 | C-14 | 1 |
| 10 | C-15 | 5 |

*Figure 3-14* The result of grouping

In the next step, the problem is solved, and the Customer IDs with value less than or equal to 7 in at least two years are extracted. This is done by filtering rows where their values on the Count column is greater than or equal to 2.

## Extracting a First Purchasing Date

The historical sales data for customers, sorted by the Quantity column, is provided in the Source table shown in Table 3-6. Extract the first purchase date of each customer.

*Table 3-6* Source: Student Grads

| Date | Customer_ID | Quantity |
|---|---|---|
| 20/01/2024 | C-02 | 1 |
| 30/01/2024 | C-03 | 2 |
| 19/01/2024 | C-02 | 5 |
| 25/01/2024 | C-03 | 6 |
| 23/01/2024 | C-03 | 7 |

| Date | Customer_ID | Quantity |
|---|---|---|
| 31/01/2024 | C-02 | 7 |
| 21/01/2024 | C-02 | 8 |
| 24/01/2024 | C-01 | 8 |
| 18/01/2024 | C-01 | 9 |

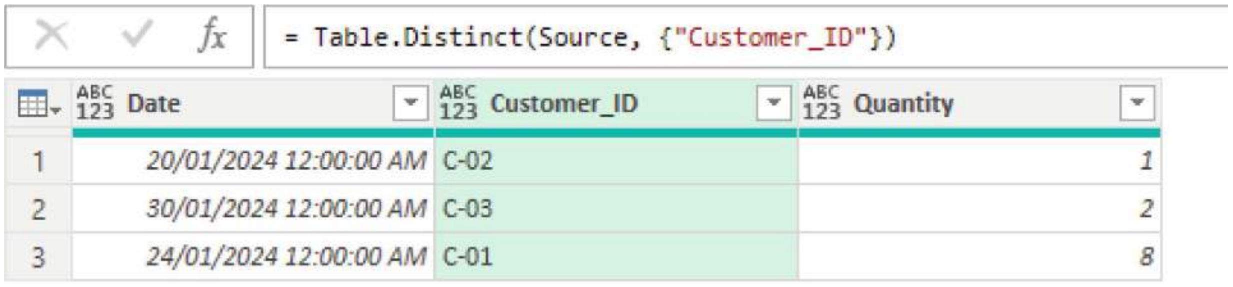
**Note** The data in this example is provided in an Excel file titled `04 First Purchasing Date.xlsx`.

Two different solutions, based on sorting and grouping, are provided as outlined in this section.

## Solution 1: Based on Sorting

Before exploring the solution, let's review the result of removing duplicate Customer_ID values using the `Table.Distinct()` function. To remove duplicate Customer_IDs, right-click this column and select the Remove Duplicates command. This generates the following formula in the formula bar and produces the table shown in Figure 3-15, which includes only the rows where each Customer_ID appears for the first time.

```
= Table.Distinct(Source,{"Customer_ID"})
```

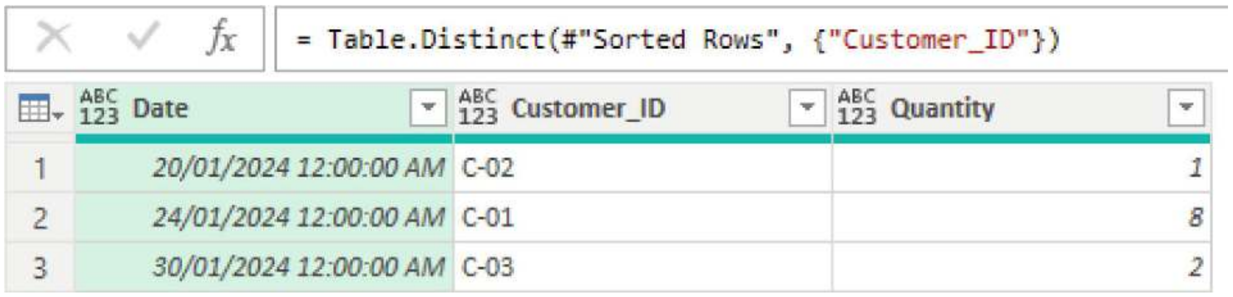


```
= Table.Distinct(Source, {"Customer_ID"})
```

|  | Date | Customer_ID | Quantity |
|---|---|---|---|
| 1 | 20/01/2024 12:00:00 AM | C-02 | 1 |
| 2 | 30/01/2024 12:00:00 AM | C-03 | 2 |
| 3 | 24/01/2024 12:00:00 AM | C-01 | 8 |

***Figure 3-15*** Removing duplicate Customer_IDs

Based on this explanation, to solve this problem, you can sort the table in ascending order based on the Date column. Then, removing duplicate values from the Customer_ID column should ideally yield the first purchase date for each Customer_ID. However, this approach produces an unexpected result, as shown in Figure 3-16.


```
= Table.Distinct(#"Sorted Rows", {"Customer_ID"})
```

| | Date | Customer_ID | Quantity |
|---|---|---|---|
| 1 | 20/01/2024 12:00:00 AM | C-02 | 1 |
| 2 | 24/01/2024 12:00:00 AM | C-01 | 8 |
| 3 | 30/01/2024 12:00:00 AM | C-03 | 2 |

***Figure 3-16*** Removing duplicate Customer_IDs

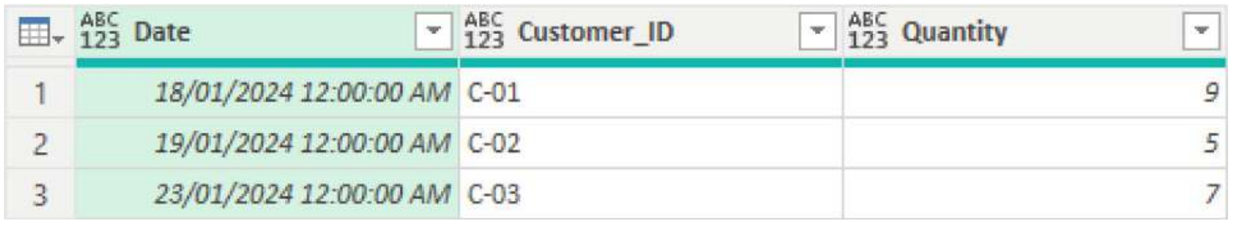
In the provided result, it appears that duplicate rows are removed first, and then the remaining rows are sorted based on the Date column. This happens because Power Query does not execute all commands in the order they are written; instead, it optimizes the execution sequence for better performance.

To address this issue, you need to force Power Query to execute the sorting command before removing duplicates. To do this, consider the following formula generated in the formula bar after executing the Remove Duplicates command:

```
= Table.Distinct(#"Sorted Rows", {"Customer_ID"})

= Table.Distinct(Table.Buffer(#"Sorted Rows"),
{"Customer_ID"})
```

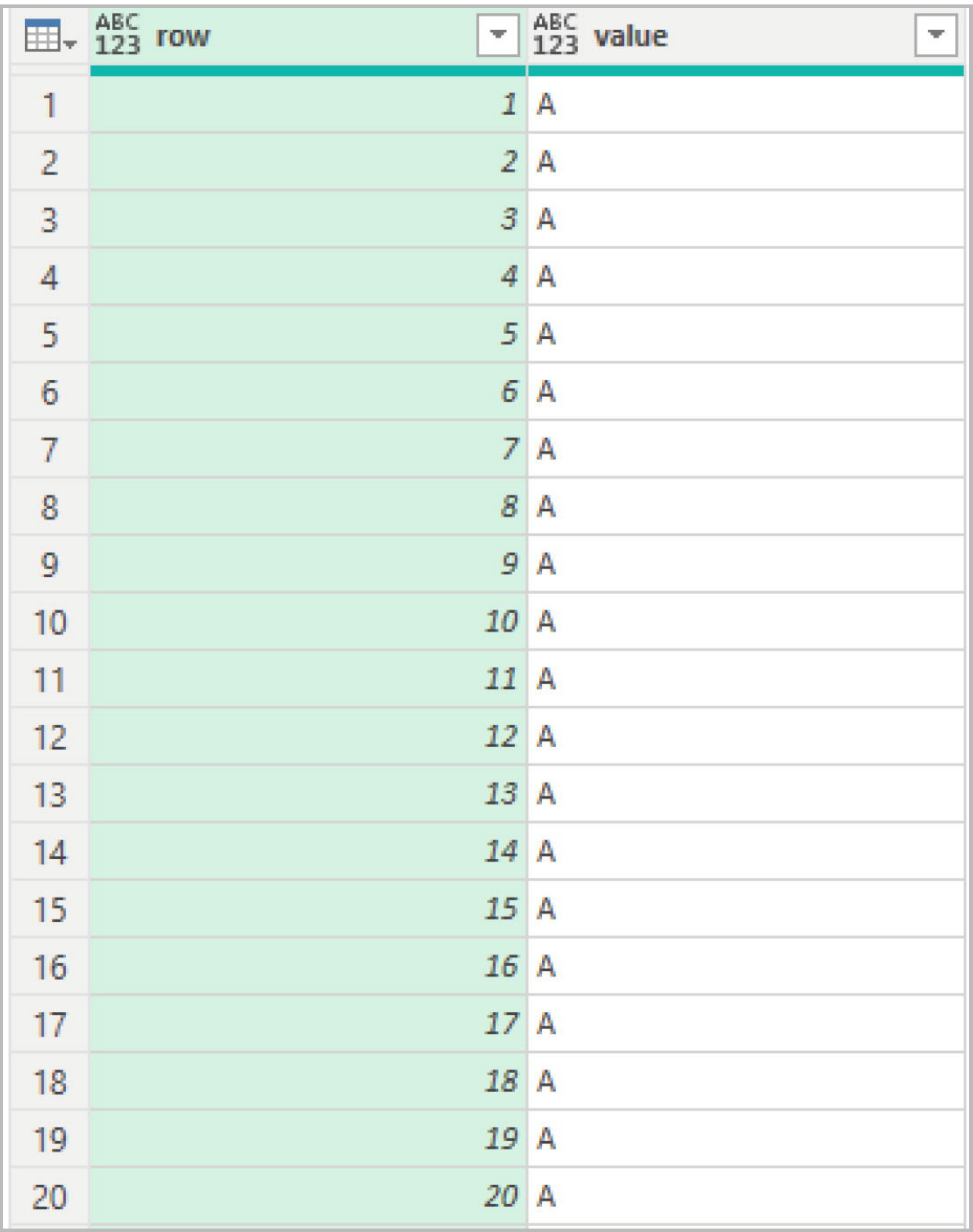
To address the issue, you simply need to add the `Table.Buffer()` function before the name of the table (the first argument), as shown here. This results in Figure 3-17.



| | Date | Customer_ID | Quantity |
|---|---|---|---|
| 1 | 18/01/2024 12:00:00 AM | C-01 | 9 |
| 2 | 19/01/2024 12:00:00 AM | C-02 | 5 |
| 3 | 23/01/2024 12:00:00 AM | C-03 | 7 |

***Figure 3-17*** The final result

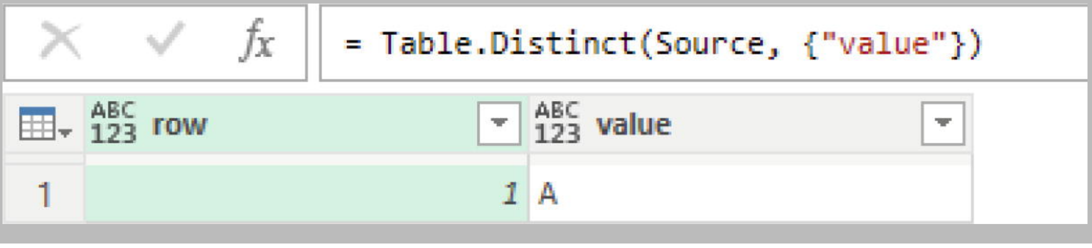
**Note** To check this weird behavior of sorting in Power Query, consider another example. Consider a source table with two columns, Row and Value, containing 1,048,575 rows. The Row column lists numbers from 1 to 1,048,575 (matching Excel's row limit) in ascending order, while the Value column contains only the value A, as shown in Figure 3-18.



| | row | value |
|---|---|---|
| 1 | 1 | A |
| 2 | 2 | A |
| 3 | 3 | A |
| 4 | 4 | A |
| 5 | 5 | A |
| 6 | 6 | A |
| 7 | 7 | A |
| 8 | 8 | A |
| 9 | 9 | A |
| 10 | 10 | A |
| 11 | 11 | A |
| 12 | 12 | A |
| 13 | 13 | A |
| 14 | 14 | A |
| 15 | 15 | A |
| 16 | 16 | A |
| 17 | 17 | A |
| 18 | 18 | A |
| 19 | 19 | A |
| 20 | 20 | A |

***Figure 3-18*** Part of the Source table

In the first scenario, right-clicking the Value column and selecting Remove Duplicates results in a single remaining row, related to the first row of the Source table, as shown in Figure 3-19.

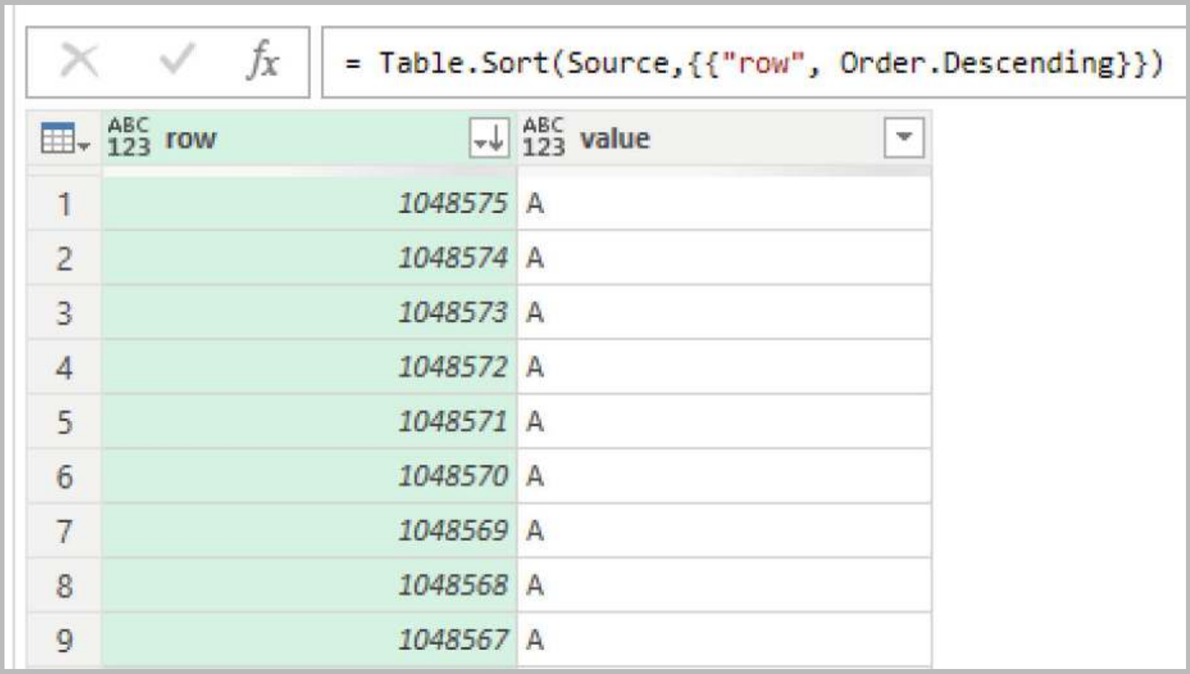


```
= Table.Distinct(Source, {"value"})
```

| | row | value |
|---|---|---|
| 1 | 1 | A |

*Figure 3-19* The result of removing duplicates

In another scenario, let's sort the Row column in descending order, which results in Figure 3-20.

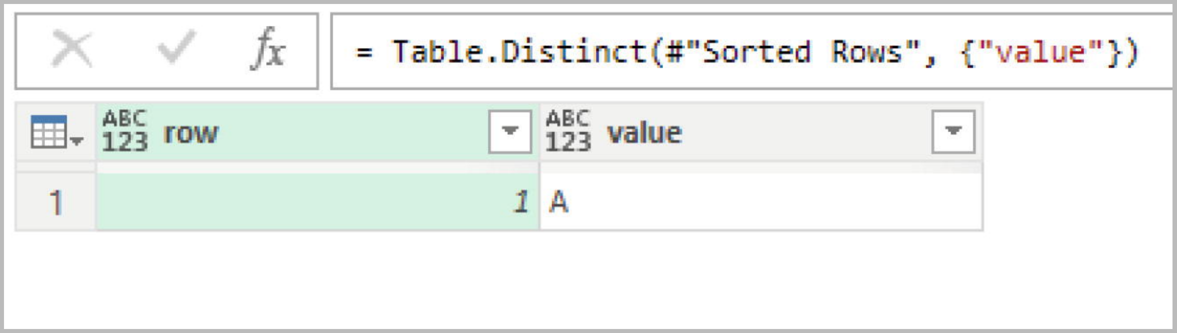


```
= Table.Sort(Source,{{"row", Order.Descending}})
```

| | row | value |
|---|---|---|
| 1 | 1048575 | A |
| 2 | 1048574 | A |
| 3 | 1048573 | A |
| 4 | 1048572 | A |
| 5 | 1048571 | A |
| 6 | 1048570 | A |
| 7 | 1048569 | A |
| 8 | 1048568 | A |
| 9 | 1048567 | A |

*Figure 3-20* The result of sorting the row column in descending order

Then, by right-clicking the Value column and selecting Remove Duplicates, again the result is unexpectedly the same as in the previous scenario, as shown in Figure 3-21.



```
= Table.Distinct(#"Sorted Rows", {"value"})
```

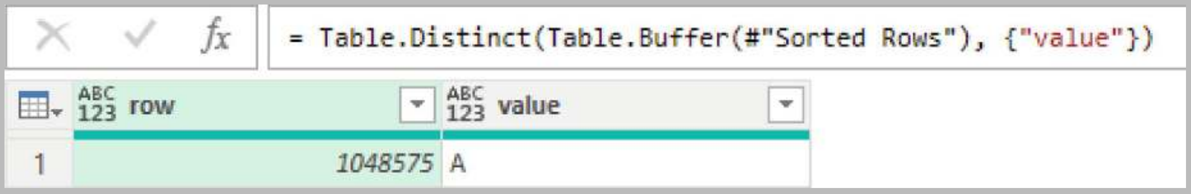
| | row | value |
|---|---|---|
| 1 | 1 | A |

*Figure 3-21* The result of removing duplicates

This is strange, as it appears that Power Query is neglecting the sorting step first and executing the Remove Duplicates step prior to sorting. To resolve this issue, the `Table.Buffer()` function can be used to ensure the sorting command will be applied before the removing duplicate command. Instead of using this usual formula to remove duplicates:

```
= Table.Distinct(#"Sorted Rows", {"value"})
```

Use this formula, which results in Figure 3-22:



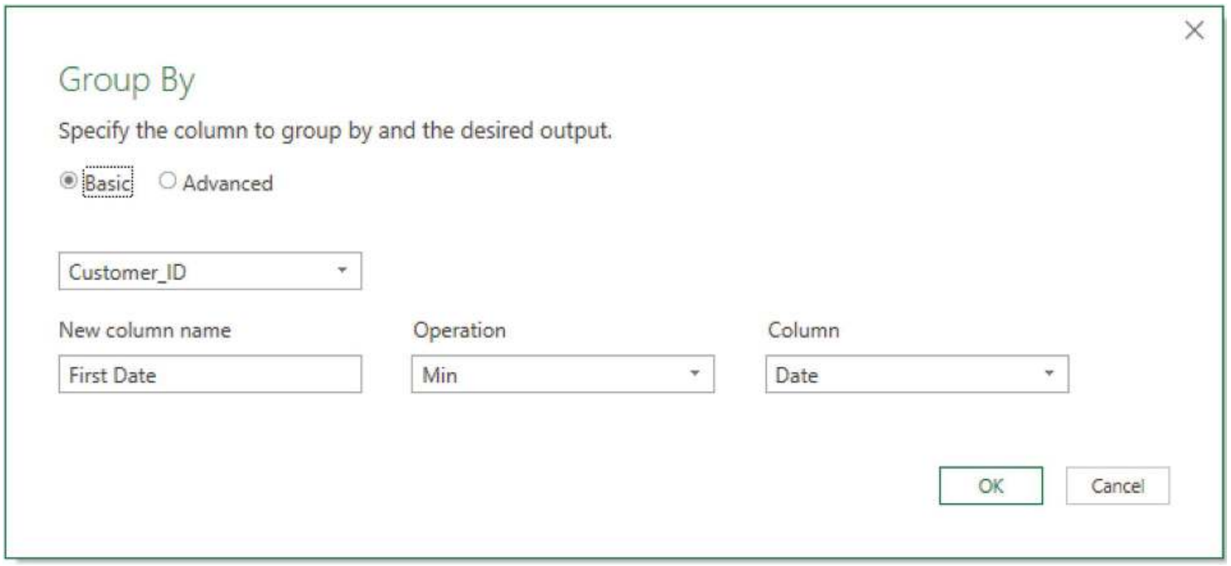
```
= Table.Distinct(Table.Buffer(#"Sorted Rows"), {"value"})
```

| | row | value |
|---|---|---|
| 1 | 1048575 | A |

*Figure 3-22* The result of removing duplicates after buffering the sorted table

## Solution 2: Grouping

This problem can be solved alternatively by grouping the rows based on Customer_IDs and selecting the minimum date. To do this, right-click the Customer_ID column and choose the Group By command. Then, configure it as shown in Figure 3-23 and click OK. This results in the final table shown in Figure 3-24.



Group By

Specify the column to group by and the desired output.

[✓ Basic] Advanced

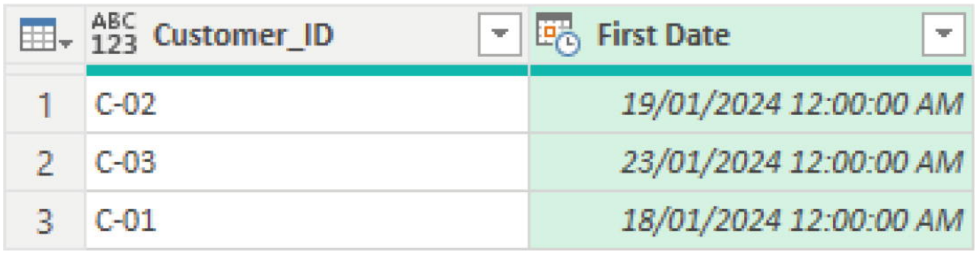
Customer_ID

New column name: First Date

Operation: Min

Column: Date

*Figure 3-23* Setting Table.Group()



| | Customer_ID | First Date |
|---|---|---|
| 1 | C-02 | 19/01/2024 12:00:00 AM |
| 2 | C-03 | 23/01/2024 12:00:00 AM |
| 3 | C-01 | 18/01/2024 12:00:00 AM |

*Figure 3-24* The result of grouping

## Filtering Based on a List of Values

The Source table, shown in Table 3-7, provides a list of patients scheduled for consultations and surgeries. Filters the historical visit and surgery information of patients who have undergone surgery at least once.

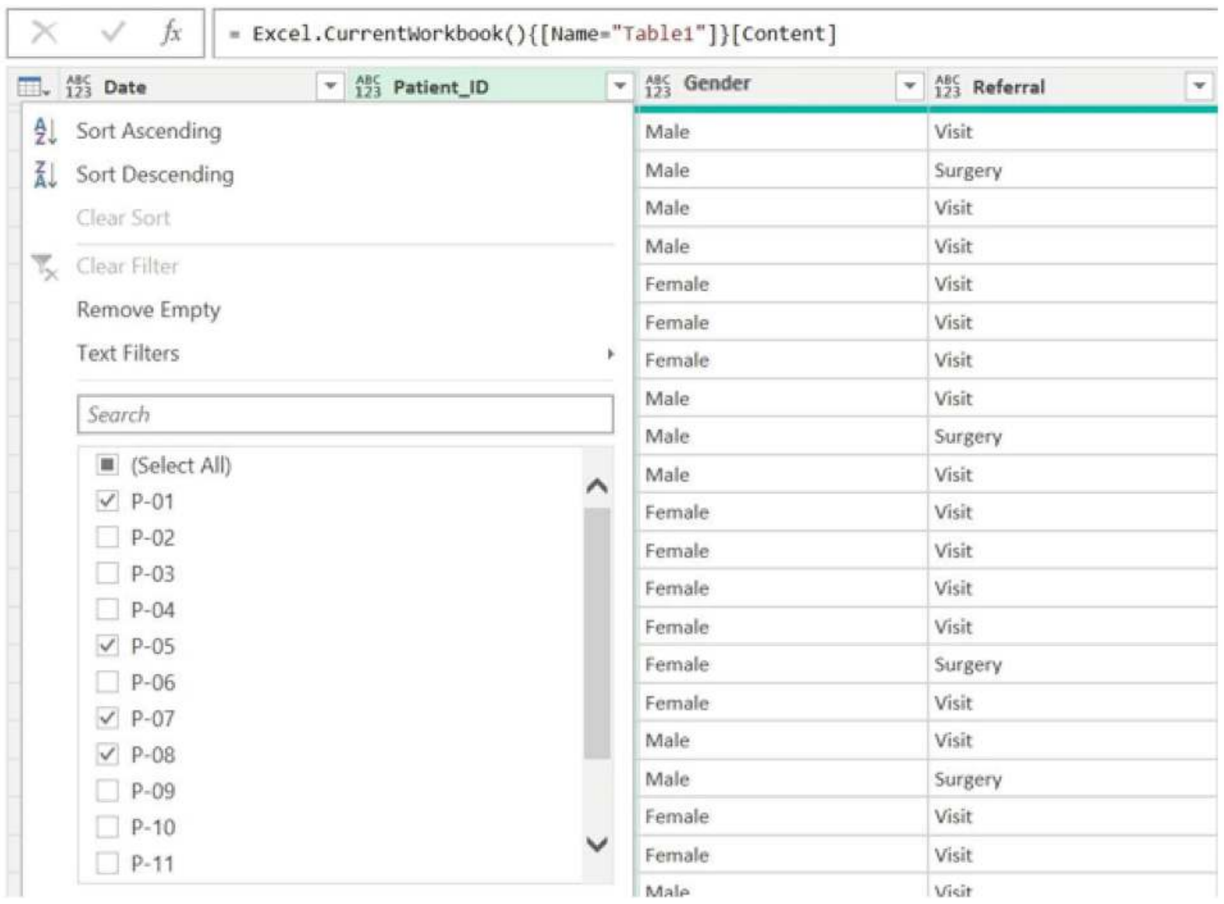
***Table 3-7*** Source: Patients

| Date | Patient_ID | Gender | Referral |
|---|---|---|---|
| 18/01/2024 | P-01 | Male | Visit |
| 23/01/2024 | P-01 | Male | Surgery |
| 8/02/2024 | P-01 | Male | Visit |
| 19/01/2024 | P-02 | Male | Visit |
| 20/01/2024 | P-03 | Female | Visit |
| 22/01/2024 | P-04 | Female | Visit |
| 24/01/2024 | P-04 | Female | Visit |
| 23/01/2024 | P-05 | Male | Visit |
| 7/02/2024 | P-05 | Male | Surgery |
| 17/02/2024 | P-05 | Male | Visit |
| 24/01/2024 | P-06 | Female | Visit |
| 3/02/2024 | P-06 | Female | Visit |
| 9/02/2024 | P-06 | Female | Visit |
| 25/01/2024 | P-07 | Female | Visit |
| 10/02/2024 | P-07 | Female | Surgery |
| 14/02/2024 | P-07 | Female | Visit |
| 25/01/2024 | P-08 | Male | Visit |
| 31/01/2024 | P-08 | Male | Surgery |
| 30/01/2024 | P-09 | Female | Visit |
| 31/01/2024 | P-10 | Female | Visit |
| 2/02/2024 | P-11 | Male | Visit |
| 23/02/2024 | P-11 | Male | Visit |
| 3/02/2024 | P-12 | Female | Visit |
| 4/02/2024 | P-12 | Female | Visit |
| 21/02/2024 | P-12 | Female | Visit |
| 4/02/2024 | P-13 | Female | Visit |
| 5/02/2024 | P-14 | Male | Surgery |
| 14/02/2024 | P-14 | Male | Surgery |
| 28/02/2024 | P-14 | Male | Visit |

**Note** The data in this example is provided in an Excel file titled `05 Filtering Based on a List of Values.xlsx`.

Before solving this challenge, assume you have a list of surgery patients identified as P-01, P-05, P-07, P-08, and P-14. Using this list, you can easily select these patients from the Filter dropdown shown in Figure 3-25, which results in the following formula in the formula bar:

```
= Table.SelectRows(Source, each
      ([Patient_ID] = "P-01" or
       [Patient_ID] = "P-05" or
       [Patient_ID] = "P-07" or
       [Patient_ID] = "P-08" or
       [Patient_ID] = "P-14"))
```



```
= Excel.CurrentWorkbook(){[Name="Table1"]}[Content]
```

| Gender | Referral |
|---|---|
| Male | Visit |
| Male | Surgery |
| Male | Visit |
| Male | Visit |
| Female | Visit |
| Female | Visit |
| Female | Visit |
| Male | Visit |
| Male | Surgery |
| Male | Visit |
| Female | Visit |
| Female | Visit |
| Female | Visit |
| Female | Visit |
| Female | Surgery |
| Female | Visit |
| Male | Visit |
| Male | Surgery |
| Female | Visit |
| Female | Visit |
| Male | Visit |

***Figure 3-25*** Filtering patient IDs

If you need to filter many patient IDs (like a hundred), instead of selecting each one manually, you can enter them in a list and use the `List.Contains()`

function to filter a row, if the Patient_ID of that row is available in the defined list. The previous formula can be rewritten as follows, without changing the result:

```
= Table.SelectRows(
      Source,
      each List.Contains({"P-01", "P-05" , "P-07", "P-
08", "P-14"},[Patient_ID]))
```

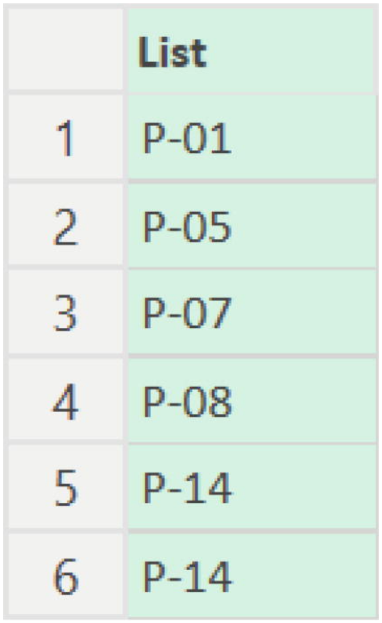
But in the question, the IDs of those who had surgery were not predefined, and you need to initially extract the list of patients who have undergone surgery and then use the previous formula to filter their historical records.

To extract the list of patients who have undergone surgery, filter the Source table by filtering the Referral column and then select the rows with the value of Surgery, using the following formula:

```
= Table.SelectRows(Source, each ([Referral] = "Surgery"))
```

The previous formula results in a table. However, you need the patient IDs as a list. Add the column name to the end of the previous formula to obtain a list of patient IDs who had a surgery in their records. Doing so results in Figure 3-26.

```
= Table.SelectRows(Source, each ([Referral] = "Surgery"))
[Patient_ID]
```

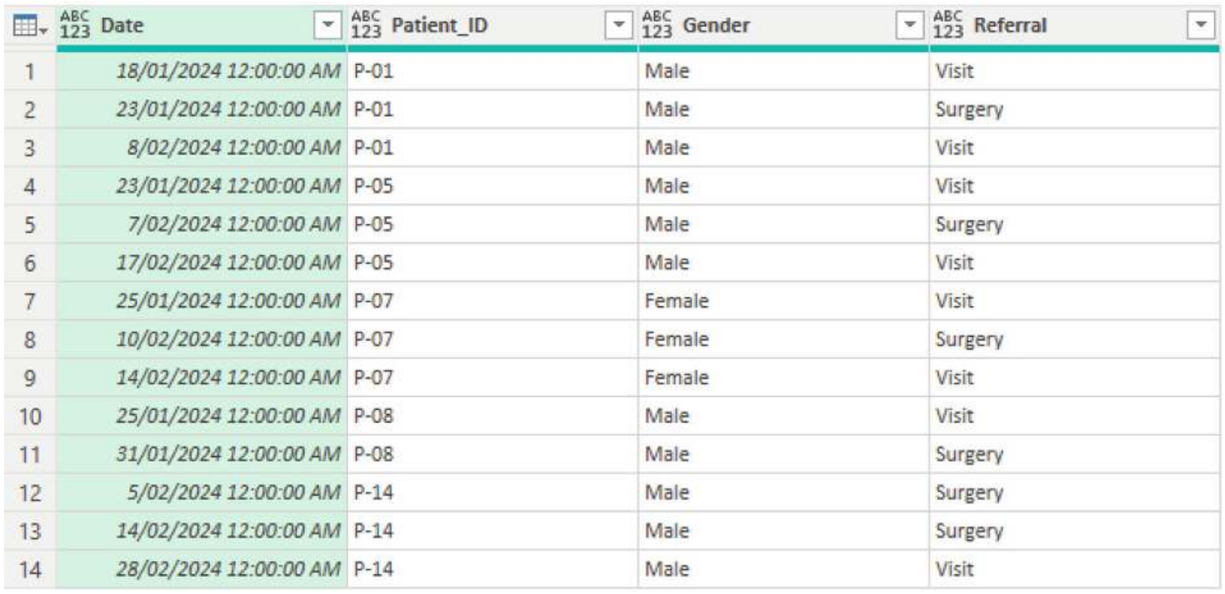


| | List |
|---|---|
| 1 | P-01 |
| 2 | P-05 |
| 3 | P-07 |
| 4 | P-08 |
| 5 | P-14 |
| 6 | P-14 |

***Figure 3-26*** Extracting the list of patient IDs

Now you can use this formula instead of using hardcoded patient IDs in the formula shown at the beginning of solving this problem. Use the following formula, which results in Figure 3-27:

```
= Table.SelectRows(
      Source,
      each List.Contains(
            Table.SelectRows(Source,
                  each ([Referral] = "Surgery"))
[Patient_ID]
                        ,[Patient_ID]))
```



|  | Date | Patient_ID | Gender | Referral |
|---|---|---|---|---|
| 1 | 18/01/2024 12:00:00 AM | P-01 | Male | Visit |
| 2 | 23/01/2024 12:00:00 AM | P-01 | Male | Surgery |
| 3 | 8/02/2024 12:00:00 AM | P-01 | Male | Visit |
| 4 | 23/01/2024 12:00:00 AM | P-05 | Male | Visit |
| 5 | 7/02/2024 12:00:00 AM | P-05 | Male | Surgery |
| 6 | 17/02/2024 12:00:00 AM | P-05 | Male | Visit |
| 7 | 25/01/2024 12:00:00 AM | P-07 | Female | Visit |
| 8 | 10/02/2024 12:00:00 AM | P-07 | Female | Surgery |
| 9 | 14/02/2024 12:00:00 AM | P-07 | Female | Visit |
| 10 | 25/01/2024 12:00:00 AM | P-08 | Male | Visit |
| 11 | 31/01/2024 12:00:00 AM | P-08 | Male | Surgery |
| 12 | 5/02/2024 12:00:00 AM | P-14 | Male | Surgery |
| 13 | 14/02/2024 12:00:00 AM | P-14 | Male | Surgery |
| 14 | 28/02/2024 12:00:00 AM | P-14 | Male | Visit |

***Figure 3-27*** Final results

**Efficiency Tips** The problem is solved. Let's call this solution Variation 1. Go to the Home tab and choose the Advanced Editor command. All the steps of the query will be shown as follows:

```
let
    Source = Excel.CurrentWorkbook(){[Name="Table1"]}
[Content],
    #"Filtered Rows" = Table.SelectRows(Source, each
List.Contains(Table.SelectRows(Source, each ([Referral] =
"Surgery"))[Patient_ID],[Patient_ID]))
in
    #"Filtered Rows"
```

In Variation 1, patients with a past surgery are extracted using the `Table.SelectRows(Source, each ([Referral] = "Surgery"))[Patient_ID]` formula, and this formula is directly applied to the `Table.SelectRows()` function within the step named `#"Filtered Rows"`. Let's separate these steps and create an intermediate step named PatientID before the `#"Filtered Rows"` step. This intermediate step will be equal to `Table.SelectRows(Source, each ([Referral] = "Surgery"))[Patient_ID]`. Then, you can use the result of this intermediate step in the `#"Filtered Rows"` step, as shown in the following formula. This code is Variation 2.

```
let
    Source = Excel.CurrentWorkbook(){[Name="Table1"]}
[Content],
    PatientID=Table.SelectRows(Source, each ([Referral]
= "Surgery"))
    [Patient_ID], #"Filtered Rows" =
Table.SelectRows(Source, each List.Contains(PatientID,
[Patient_ID]))
in
    #"Filtered Rows"
```

In another variation, called Variation 3, you could add the `List.Buffer()` function to the PatientID step, as follows.

```
let
    Source = Excel.CurrentWorkbook(){[Name="Table1"]}
[Content],
    PatientID=List.Buffer(Table.SelectRows(Source, each
([Referral] = "Surgery"))[Patient_ID]),
    #"Filtered Rows" = Table.SelectRows(Source, each
List.Contains(PatientID,[Patient_ID]))
in
    #"Filtered Rows"
```

To check the performance of these three variations, a test table with 10,000 rows is considered. The first variation, which did not use buffering, solved the problem in 237 seconds, while the second variation took 288 seconds. By simply applying `List.Buffer()` on the list of patients, as in the third variation, the runtime was drastically reduced to 0.74 seconds.

**Note** In this example, both of the following formulas can be used to extract the rows related to patients who never had surgery:

```
let
    Source = Excel.CurrentWorkbook(){[Name="Table1"]}
[Content],
    PatientID=List.Buffer(Table.SelectRows(Source, each
([Referral] = "Surgery"))[Patient_ID]),
    #"Filtered Rows" = Table.SelectRows(Source, each not
List.Contains(PatientID,[Patient_ID]))
in
    #"Filtered Rows"

let
    Source = Excel.CurrentWorkbook(){[Name="Table1"]}
[Content],
    #"Filtered Rows" = Table.RemoveMatchingRows( Source,
Table.ToRecords( Table.SelectRows(Source, each
([Referral] = "Surgery"))[[Patient_ID]]),"Patient_ID")
in
    #"Filtered Rows"
```

## Filtering Based on Sequence

Consider the previous example and extract the list of patient IDs who revisited the doctor after having surgery.

In the table, different patterns might be seen in the patient's referral. For example, if you sort the table based on the Date column in ascending order, the order of referral history for P-01 is Visit/Surgery/Visit, and for P-04, it is Visit/Visit. Among all the patients, you are searching for those who include Surgery/Visit (visiting the doctor after surgery) as part of their referral patterns. To solve this question, you initially sort the table based on the Date column, then extract the referral sequence for each patient, and finally filter those included in the desired pattern.

Initially sort the table by the Date column in ascending order. This results in the following formula in the formula bar:

```
=Table.Sort(Source,{{"Date", Order.Ascending}})
```

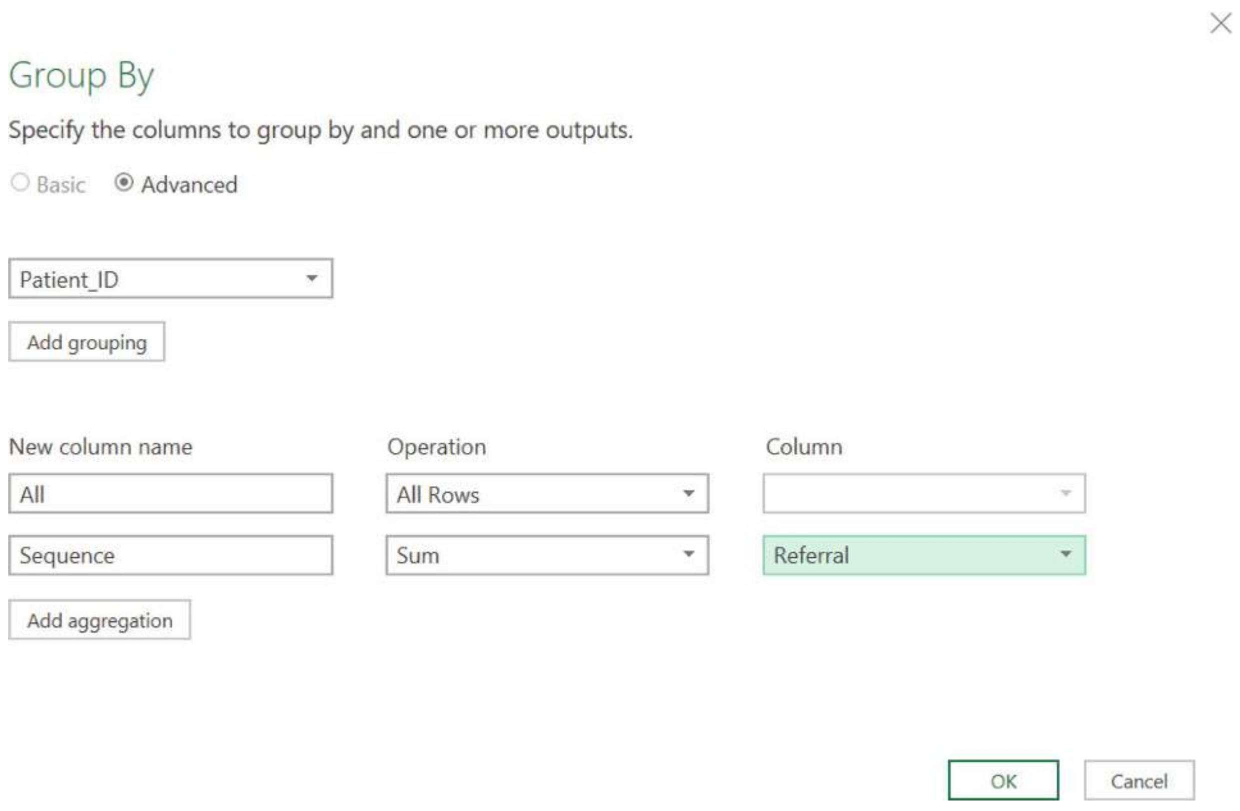
Based on the information in Section 3-4, if you use the result of this sorted table in the next step, Power Query may rearrange the execution order, causing this step not to be applied first. So rewrite the previous formula as shown here, by using the `Table.Buffer()` function:

```
=Table.Buffer(Table.Sort(Source,{{"Date",
Order.Ascending}}))
```

After sorting the table, you need to extract the sequence of referrals for each patient. To do this, you can group the rows based on the Patient IDs using the Group By command in the Home tab. So, select this command, then in the open window, switch to the Advanced settings.

The Group By window consists of two sections: the grouping section (top part) and the aggregation section (bottom part). In the grouping section, you specify which columns are used to group the rows. In the aggregation section, you define the type of calculations or summaries to be applied to the grouped data, such as counting the rows in each group.

Select Patient_ID in the grouping section. In the aggregation section, you need all the historical data; therefore, choose All Rows as the operation and name this column All. Additionally, you need to extract the sequence of referrals. To do this, add a new aggregation and name it Sequence. For this column, you need to apply a concatenation operation over the text in the Referral column. However, since there is no direct concatenation operation available, as shown in Figure 3-28, select Sum as the operation and choose Referral as the column. Clicking OK will result in Figure 3-29, where the rows are grouped based on the Patient IDs.



Group By

Specify the columns to group by and one or more outputs.

Basic [✓ Advanced]

Patient_ID

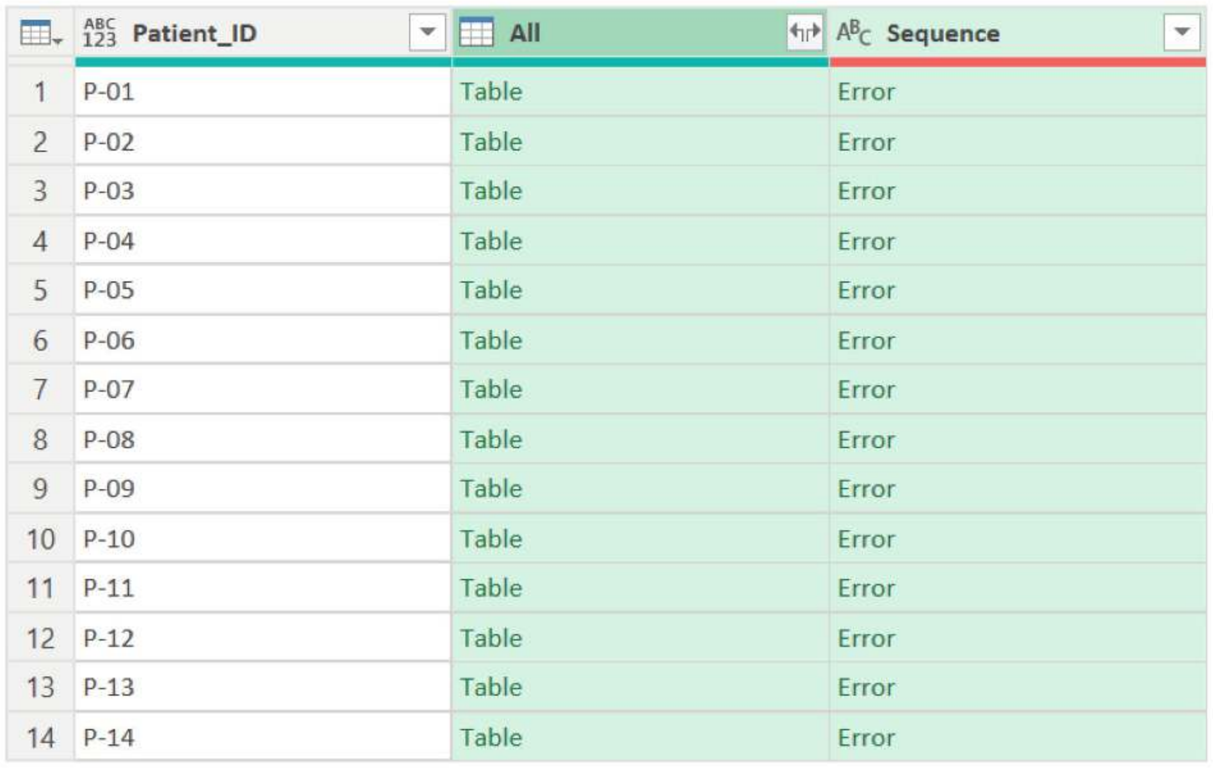
Add grouping

| New column name | Operation | Column |
|---|---|---|
| All | All Rows | |
| Sequence | Sum | Referral |

Add aggregation

OK Cancel

*Figure 3-28* The Group By setting



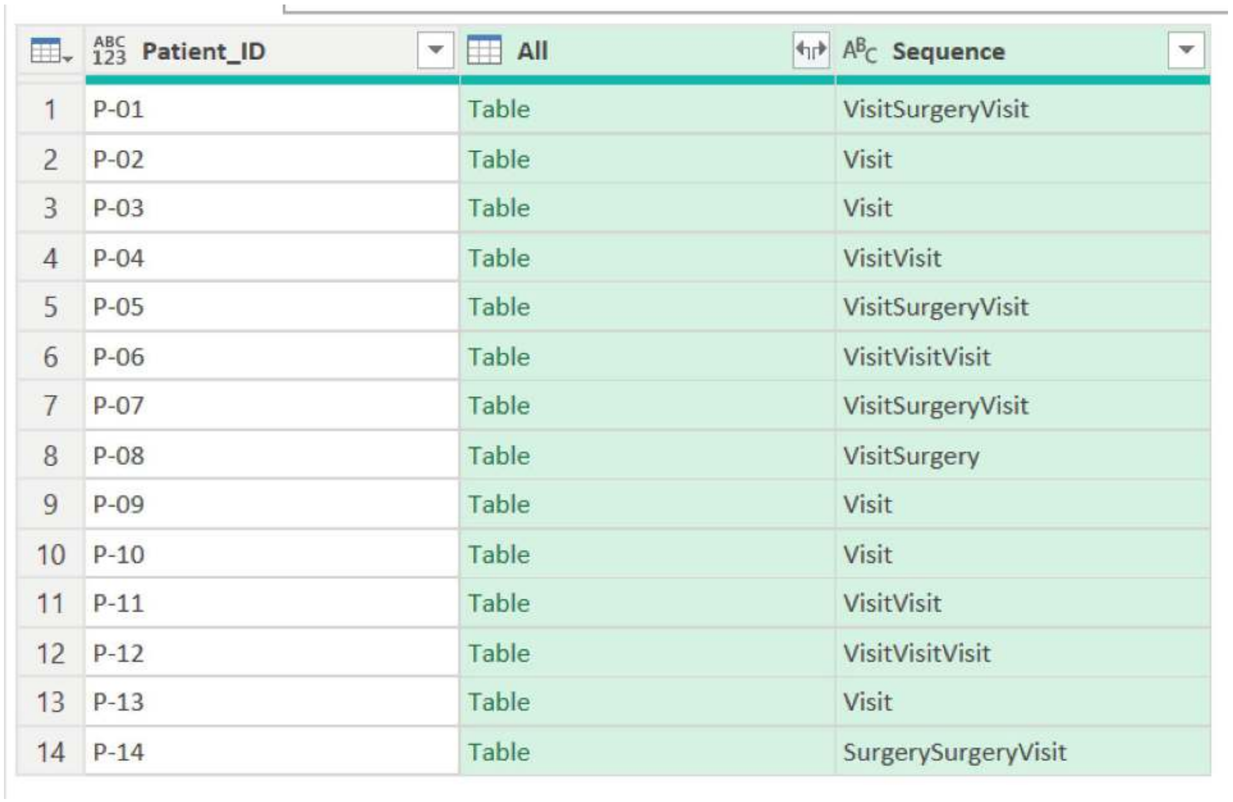
| | Patient_ID | All | Sequence |
|---|---|---|---|
| 1 | P-01 | Table | Error |
| 2 | P-02 | Table | Error |
| 3 | P-03 | Table | Error |
| 4 | P-04 | Table | Error |
| 5 | P-05 | Table | Error |
| 6 | P-06 | Table | Error |
| 7 | P-07 | Table | Error |
| 8 | P-08 | Table | Error |
| 9 | P-09 | Table | Error |
| 10 | P-10 | Table | Error |
| 11 | P-11 | Table | Error |
| 12 | P-12 | Table | Error |
| 13 | P-13 | Table | Error |
| 14 | P-14 | Table | Error |

*Figure 3-29* The result of using GroupBy()

The previous step used the Sum operation on the Referral column, which is in type text. It results in errors for all the values in the Sequence column. The errors can be addressed by modifying the formula. The previous steps lead to the following formula in the formula bar:

```
= Table.Group(
        #"Sorted Rows",
        {"Patient_ID"},
        {{"All", each _, type table [Date=datetime,
Patient_ID=text, Gander=text, Referral=text]},
{"Sequence", each List.Sum([Referral]), type text}})
```

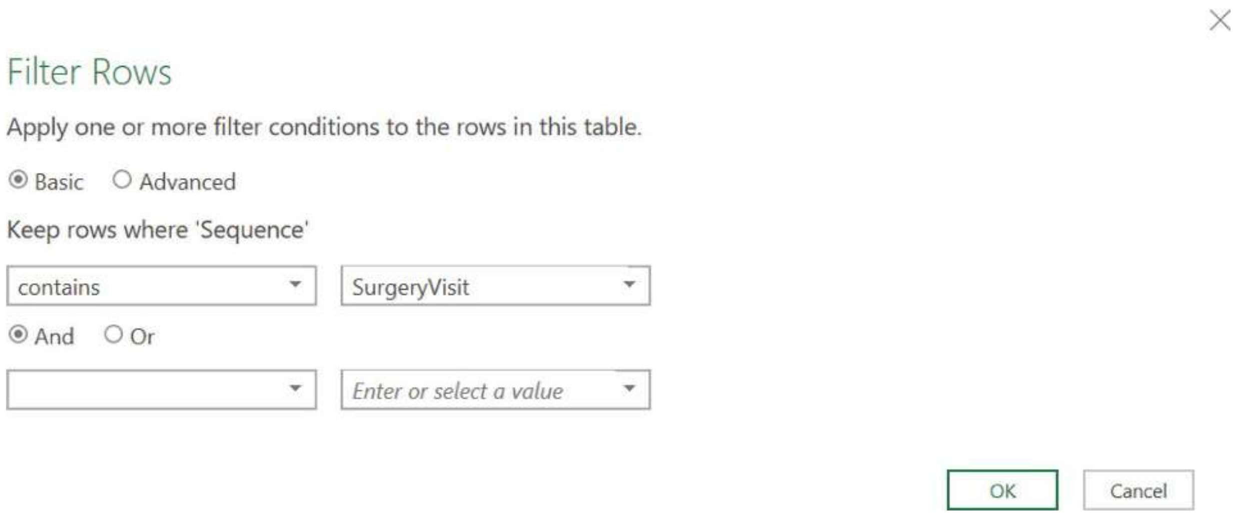
In the previous formula, replace the `List.Sum` with `Text.Combine` to obtain the sequence of referral for each patent. This is shown in Figure 3-30.



|  | Patient_ID | All | Sequence |
|---|---|---|---|
| 1 | P-01 | Table | VisitSurgeryVisit |
| 2 | P-02 | Table | Visit |
| 3 | P-03 | Table | Visit |
| 4 | P-04 | Table | VisitVisit |
| 5 | P-05 | Table | VisitSurgeryVisit |
| 6 | P-06 | Table | VisitVisitVisit |
| 7 | P-07 | Table | VisitSurgeryVisit |
| 8 | P-08 | Table | VisitSurgery |
| 9 | P-09 | Table | Visit |
| 10 | P-10 | Table | Visit |
| 11 | P-11 | Table | VisitVisit |
| 12 | P-12 | Table | VisitVisitVisit |
| 13 | P-13 | Table | Visit |
| 14 | P-14 | Table | SurgerySurgeryVisit |

***Figure 3-30*** The result of the replaced formula

At this stage, you use the filter arrow next to the Sequence column. Select Text Filter and then select the Contains option. In the open window, configure the settings as shown in Figure 3-31, and click OK, which results in Figure 3-32.


Filter Rows

Apply one or more filter conditions to the rows in this table.

[● Basic] ○ Advanced

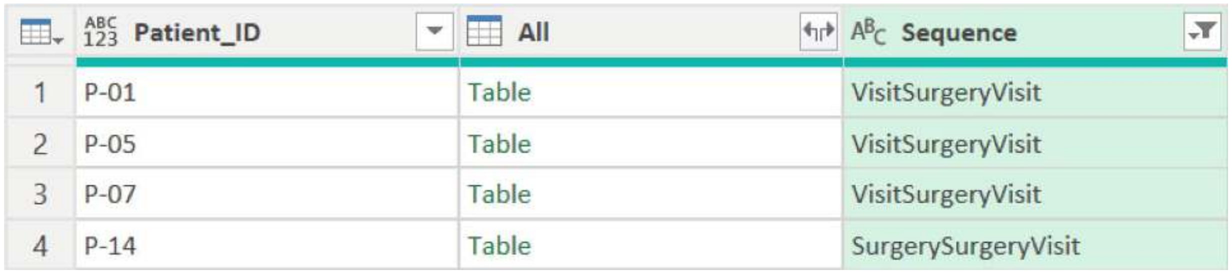
Keep rows where 'Sequence'

contains | SurgeryVisit

[● And] ○ Or

| Enter or select a value

*Figure 3-31* Setting the filtering option



| | Patient_ID | All | Sequence |
|---|---|---|---|
| 1 | P-01 | Table | VisitSurgeryVisit |
| 2 | P-05 | Table | VisitSurgeryVisit |
| 3 | P-07 | Table | VisitSurgeryVisit |
| 4 | P-14 | Table | SurgerySurgeryVisit |

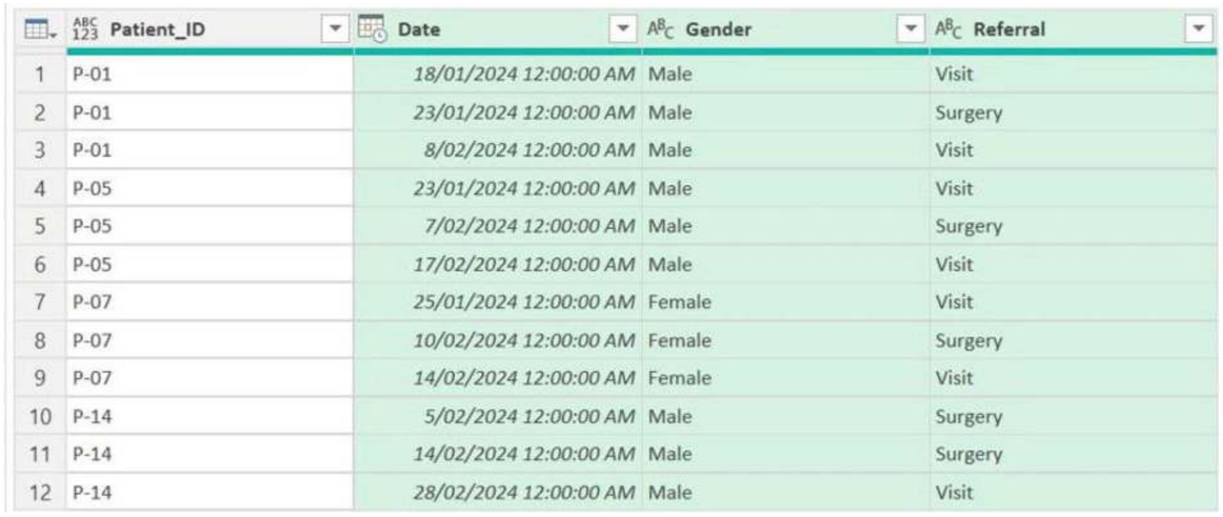
*Figure 3-32* The result of filtering

The previous step results in the following formula:

```
= Table.SelectRows(#"Grouped Rows", each
Text.Contains([Sequence], "SurgeryVisit"))
```

In this example, all the text is in the same format. However, if there are mixed cases of text (both lower- and uppercase), `Text.Contains([Sequence], "SurgeryVisit")` should be rewritten as `Text.Contains(Text.Lower([Sequence]), "surgeryvisit")` to ensure case-insensitive matching.

In the next step, remove the Sequence column and expand the All column to obtain the final result, shown in Figure 3-33.



| | Patient_ID | Date | Gender | Referral |
|---|---|---|---|---|
| 1 | P-01 | 18/01/2024 12:00:00 AM | Male | Visit |
| 2 | P-01 | 23/01/2024 12:00:00 AM | Male | Surgery |
| 3 | P-01 | 8/02/2024 12:00:00 AM | Male | Visit |
| 4 | P-05 | 23/01/2024 12:00:00 AM | Male | Visit |
| 5 | P-05 | 7/02/2024 12:00:00 AM | Male | Surgery |
| 6 | P-05 | 17/02/2024 12:00:00 AM | Male | Visit |
| 7 | P-07 | 25/01/2024 12:00:00 AM | Female | Visit |
| 8 | P-07 | 10/02/2024 12:00:00 AM | Female | Surgery |
| 9 | P-07 | 14/02/2024 12:00:00 AM | Female | Visit |
| 10 | P-14 | 5/02/2024 12:00:00 AM | Male | Surgery |
| 11 | P-14 | 14/02/2024 12:00:00 AM | Male | Surgery |
| 12 | P-14 | 28/02/2024 12:00:00 AM | Male | Visit |

***Figure 3-33*** The final result

**Efficiency Tips** Despite of number of steps needed to solve this problem, this is an efficient solution in terms of execution time. For a table with 10,000 rows, its execution time is around 0.2 seconds.

## Using Random Selection

Consider the Source table shown in Table 3-8, which contains staff information. Randomly select one person from each department.

***Table 3-8*** Source: Staff Info

| Department | Staff ID |
|---|---|
| HR | S_01 |
| Marketing | S_02 |
| Marketing | S_03 |
| IT | S_04 |
| Production | S_05 |
| R&D | S_06 |
| IT | S_07 |
| IT | S_08 |
| IT | S_09 |
| IT | S_10 |
| IT | S_11 |
| IT | S_12 |
| R&D | S_13 |

| Department | Staff ID |
|---|---|
| R&D | S_14 |
| R&D | S_15 |
| Production | S_16 |
| Production | S_17 |
| Production | S_18 |

**Note** The data in this example is provided in an Excel file titled `07 Random Selection.xlsx`.

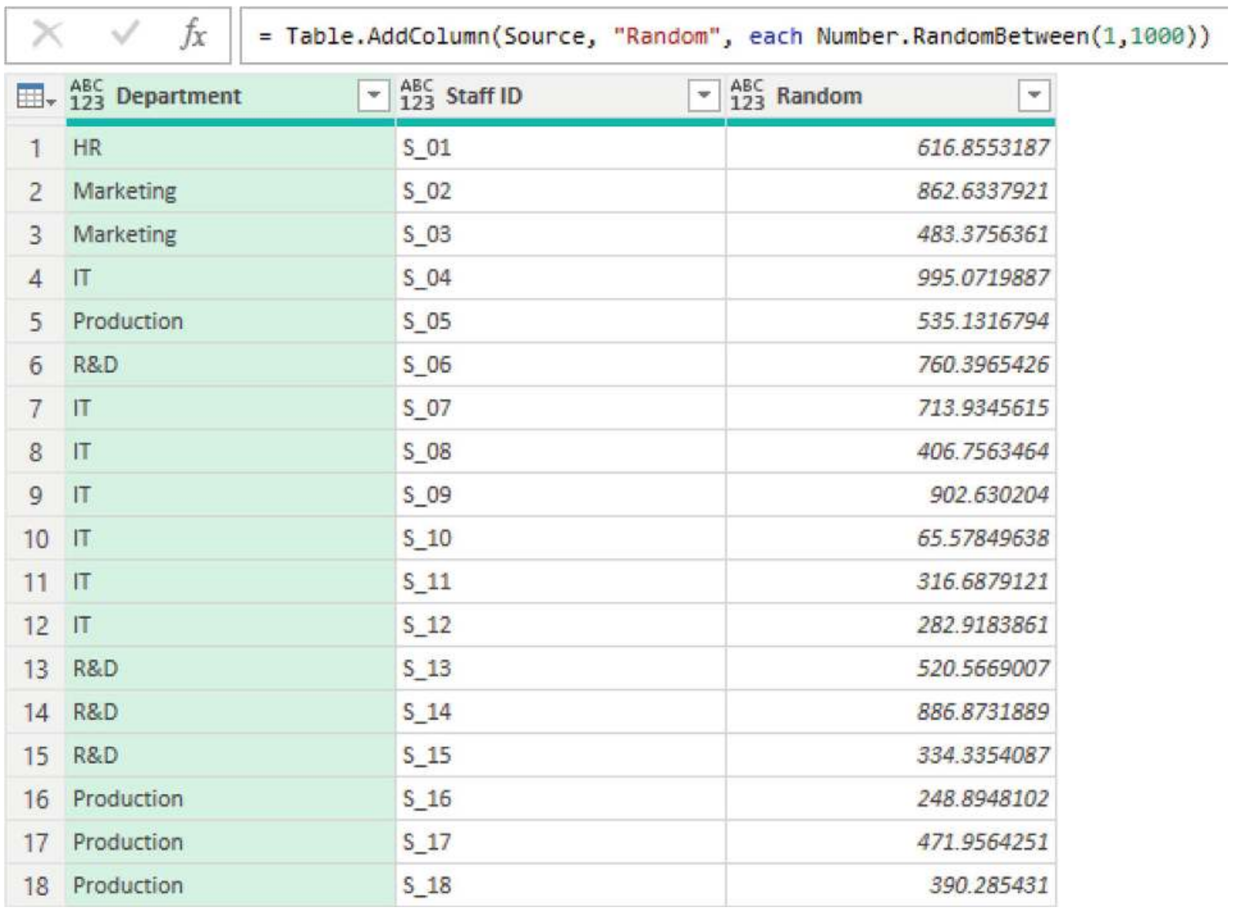
Two different solutions are provided for this problem.

## Solution 1: Reordering Rows and Removing Duplicates

As in the first solution provided in Section 3-4, this problem can be solved by randomly reordering the rows and then removing duplicates from the Department column. To shuffle the table rows, you'll add a column with random numbers and then sort the table based on this newly added column.

To do this, go to the Add Column tab and select the Custom Column command to add a new column named Random. Use the following formula in the Custom Column window, as shown in Figure 3-34.

```
=Number.RandomBetween(1,1000)
```



```
= Table.AddColumn(Source, "Random", each Number.RandomBetween(1,1000))
```

| | Department | Staff ID | Random |
|---|---|---|---|
| 1 | HR | S_01 | 616.8553187 |
| 2 | Marketing | S_02 | 862.6337921 |
| 3 | Marketing | S_03 | 483.3756361 |
| 4 | IT | S_04 | 995.0719887 |
| 5 | Production | S_05 | 535.1316794 |
| 6 | R&D | S_06 | 760.3965426 |
| 7 | IT | S_07 | 713.9345615 |
| 8 | IT | S_08 | 406.7563464 |
| 9 | IT | S_09 | 902.630204 |
| 10 | IT | S_10 | 65.57849638 |
| 11 | IT | S_11 | 316.6879121 |
| 12 | IT | S_12 | 282.9183861 |
| 13 | R&D | S_13 | 520.5669007 |
| 14 | R&D | S_14 | 886.8731889 |
| 15 | R&D | S_15 | 334.3354087 |
| 16 | Production | S_16 | 248.8948102 |
| 17 | Production | S_17 | 471.9564251 |
| 18 | Production | S_18 | 390.285431 |

***Figure 3-34*** Adding a custom column with random values

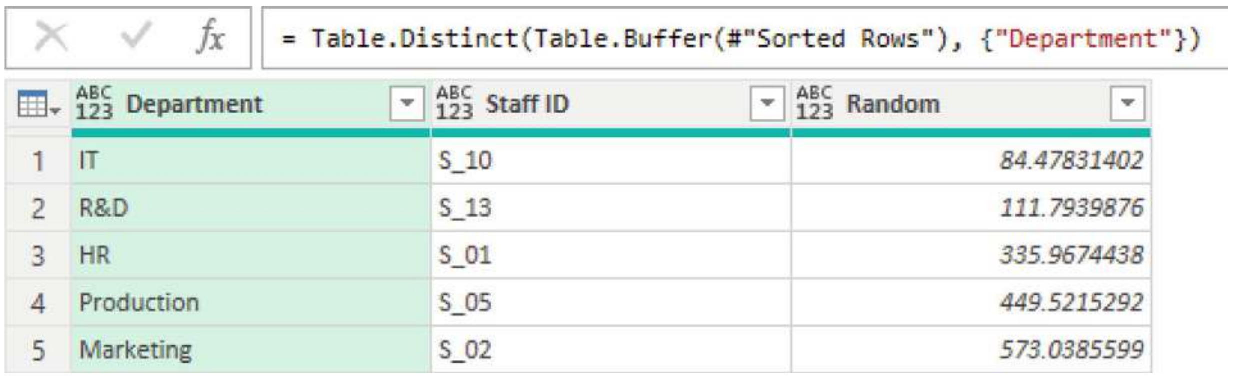
Now sort the table based on the Random column in ascending order. Then, right-click the Department column and select the Remove Duplicates command. This will result in one row for each department and generate the following formula in the formula bar:

```
= Table.Distinct(#"Sorted Rows", {"Department"})
```

Based on the explanation in Section 3-4, to ensure the sorting step runs before removing any duplicates, rewrite the formula as follows:

```
= Table.Distinct(Table.Buffer(#"Sorted Rows"),
{"Department"})
```

This results in a randomly selected row for each department, as shown in Figure 3-35.



```
= Table.Distinct(Table.Buffer(#"Sorted Rows"), {"Department"})
```

| | Department | Staff ID | Random |
|---|---|---|---|
| 1 | IT | S_10 | 84.47831402 |
| 2 | R&D | S_13 | 111.7939876 |
| 3 | HR | S_01 | 335.9674438 |
| 4 | Production | S_05 | 449.5215292 |
| 5 | Marketing | S_02 | 573.0385599 |

***Figure 3-35*** The result of randomly selected rows for each department

## Solution 2: Shuffle the Table Rows

In this solution, you will shuffle the table rows without adding the Random column. To do this, you need to understand more about the sorting logic using the `Table.Sort()` function in Power Query.

Consider the Source table in this example. Sorting the table based on the Department column in ascending order will generate the following formula in the formula bar, which includes two arguments—the first is the name of the table, and the second is the sorting logic.

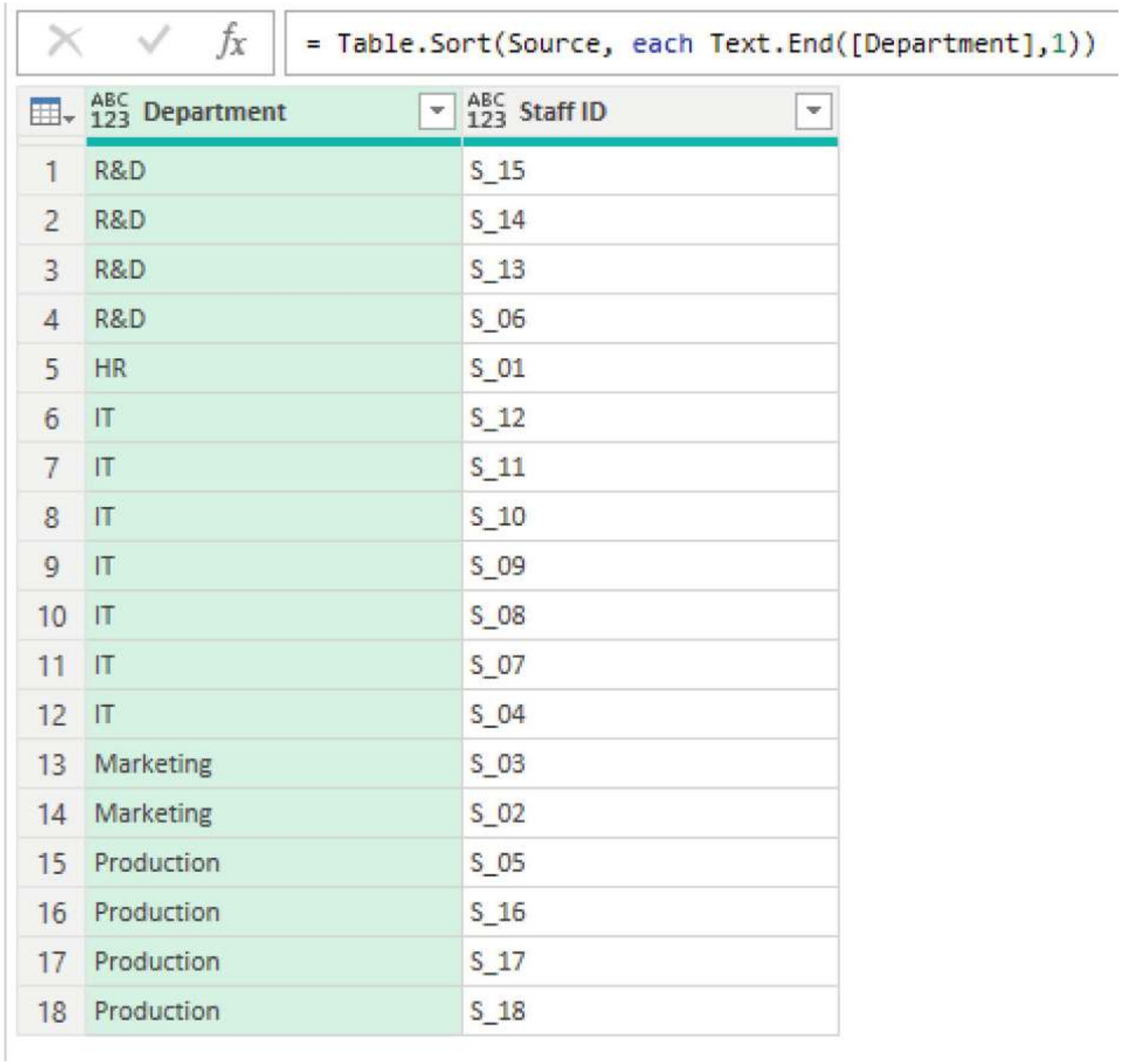
```
= Table.Sort(Source,{{"Department", Order.Ascending}})
```

The sorting logic can be a list, as shown in the previous formula, or it can be a custom function. For example, the following formula results in the same outcome as the previous one:

```
= Table.Sort(Source, each [Department])
```

In another case, instead of using the entire text in the Department column for sorting, you can sort the rows based on the last character of the text in this column using the following formula, which results in Figure 3-36.

```
= Table.Sort(Source, each Text.End([Department],1))
```



```
= Table.Sort(Source, each Text.End([Department],1))
```

|  | Department | Staff ID |
|---|---|---|
| 1 | R&D | S_15 |
| 2 | R&D | S_14 |
| 3 | R&D | S_13 |
| 4 | R&D | S_06 |
| 5 | HR | S_01 |
| 6 | IT | S_12 |
| 7 | IT | S_11 |
| 8 | IT | S_10 |
| 9 | IT | S_09 |
| 10 | IT | S_08 |
| 11 | IT | S_07 |
| 12 | IT | S_04 |
| 13 | Marketing | S_03 |
| 14 | Marketing | S_02 |
| 15 | Production | S_05 |
| 16 | Production | S_16 |
| 17 | Production | S_17 |
| 18 | Production | S_18 |

***Figure 3-36*** Sort based on the last character of values in the Department column

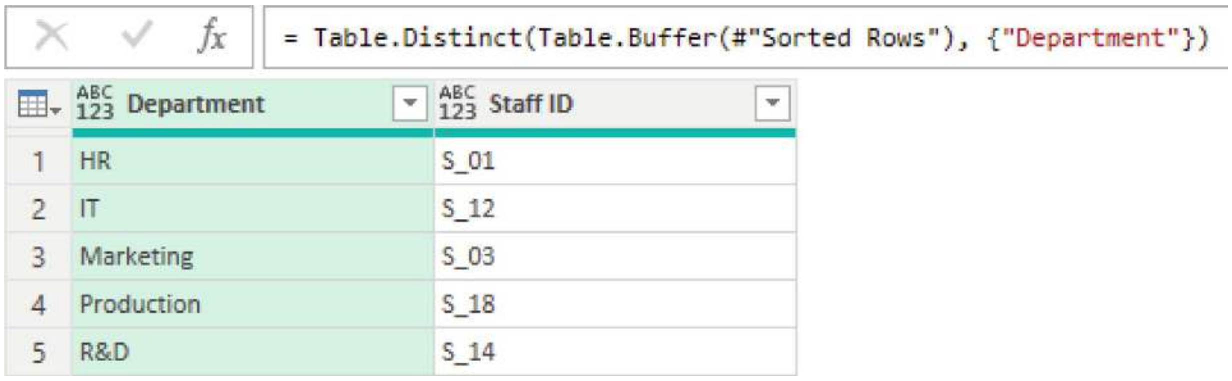
Based on this explanation, the following formula can be used to shuffle the table rows in Power Query:

```
= Table.Sort(Source,each Number.RandomBetween(1,1000))
```

This formula generates a random number for each row and sorts the table based on those values, effectively shuffling the rows.

Now, as in the previous solution, you simply need to right-click the Department column in the shuffled table and select Remove Duplicates. After that, add the `Table.Buffer()` function to the first argument of the resulting formula. This will solve the problem, as shown in Figure 3-37, using the following formula for all the steps shown in the Advanced Editor:

```
let
    Source = Excel.CurrentWorkbook(){[Name="Table1"]}
[Content],
    #"Sorted Rows" = Table.Sort(Source,each
Number.RandomBetween(1,1000)),
    #"Removed Duplicates" =
Table.Distinct(Table.Buffer(#"Sorted Rows"),
{"Department"})
in
    #"Removed Duplicates"
```



```
= Table.Distinct(Table.Buffer(#"Sorted Rows"), {"Department"})
```

|  | Department | Staff ID |
|---|---|---|
| 1 | HR | S_01 |
| 2 | IT | S_12 |
| 3 | Marketing | S_03 |
| 4 | Production | S_18 |
| 5 | R&D | S_14 |

***Figure 3-37*** Randomly selected staff

## Using Advanced Filtering Criteria

In multi-objective optimization models, rather than a single solution, you'll encounter a Pareto front, which includes all non-dominant solutions. Consider the solutions data provided in the Source table shown in Table 3-9. Filter out all non-dominant solutions.

***Table 3-9*** Source: Solutions

| Solution ID | Objective 1 | Objective 2 | Objective 3 |
|---|---|---|---|
| 1 | 32 | 5 | 32 |
| 2 | 84 | 2 | 20 |
| 3 | 91 | 1 | 73 |
| 4 | 29 | 9 | 78 |
| 5 | 52 | 3 | 30 |
| 6 | 21 | 8 | 77 |
| 7 | 80 | 9 | 41 |

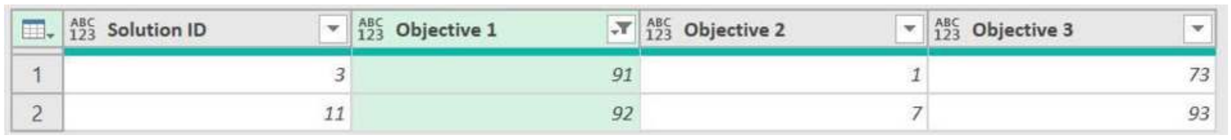
| Solution ID | Objective 1 | Objective 2 | Objective 3 |
|---|---|---|---|
| 8 | 74 | 5 | 73 |
| 9 | 57 | 6 | 94 |
| 10 | 74 | 4 | 95 |
| 11 | 92 | 7 | 93 |
| 12 | 76 | 6 | 11 |

A solution, like `a`, is considered non-dominant if there is no other solution, like `b` in the table, where all objective values of `b` are higher than those of `a`. So, Solution ID=1 is dominated by Solution ID=6, which has larger values in all three objectives.

**Note** The data in this example is provided in an Excel file titled `08 Advanced Filtering Criteria.xlsx`.

Before solving the problem for all the solution IDs, check the condition for Solution ID=3. To verify the non-domination condition for Solution ID=3, and determine the number of solutions that dominate this solution. Then filter the Source table using the `Objective 1 ≥ 91`, `Objective 2 ≥ 1`, and `Objective 3 ≥ 73` criteria with the following formula in the formula bar, which results in Figure 3-38:

```
= Table.SelectRows(Source, each [Objective 1] >= 91 and
[Objective 2] >= 1 and [Objective 3] >= 73)
```



| | Solution ID | Objective 1 | Objective 2 | Objective 3 |
|---|---|---|---|---|
| 1 | 3 | 91 | 1 | 73 |
| 2 | 11 | 92 | 7 | 93 |

*Figure 3-38* Dominant solutions for Solution ID=3

Since the formula returns two rows (more than one row), this solution (`ID=3`) is dominated by another (`ID=11`) and should be removed from the final table. As the result of the previous formula is a table and cannot be used directly as filter criteria in another filter, to convert it into a true or false value for filtering, the formula can be rewritten using the `Table.RowCount()` function. This will count the number of rows in the resulting table and then compare its result to the value 1, as shown here:

```
= Table.RowCount(Table.SelectRows(Source, each [Objective
1] >= 91 and [Objective 2] >= 1 and [Objective 3] >=
73))=1
```

The previous formula checks the non-domination criteria for `Solution ID=3`. By replacing the objective values of other solutions in the formula, if a solution is dominated by another, the result of the formula will be `false`. Otherwise, it results in `true`. Therefore, this formula can be used as criteria for filtering non-dominant solutions.

Before proceeding further, let's replace the `each _` logic in this formula with a custom function definition and rewrite the formula, as shown here, without altering the results:

```
= Table.RowCount(
      Table.SelectRows(
      Source,
      (x)=> x[Objective 1] >= 91 and x[Objective 2] >= 1
and x[Objective 3] >= 73
                                          )
      )=1
```

By considering this formula, let's return to the main question and filter the Source table by selecting only rows where Objective 1 equals 84. This results in the following formula in the formula bar:

```
= Table.SelectRows(Source, each ([Objective 1] = 84))
```

Now, replace the filtering criteria `([Objective 1] = 84)` in the previous formula with the criteria defined for `ID=3` in the previous steps. Rewrite the formula as shown here:

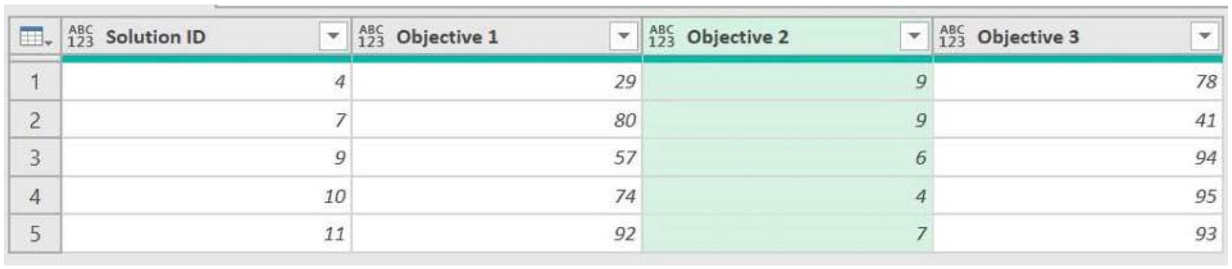
```
= Table.SelectRows(
      Source,
      each Table.RowCount(
                      Table.SelectRows(
                            Source,(x)=>
                                 x[Objective 1] >= 91
and
                                 x[Objective 2] >= 1 and
                                 x[Objective 3] >= 73)
                                 )=1)
```

The previous formula is hardcoded for `Solution ID=3`, and since it is dominated, the result of the criteria is `false` and the whole formula results in a blank table. To make the formula dynamic and evaluate the domination criteria for every row, the formula should be adjusted to dynamically use the values of the Objective 1, Objective 2, and Objective 3 columns from the Source table, instead of the 91, 1, and 73 values.

The challenge is that the Source table is referenced twice in this formula inside two `Table.SelectRows()` functions: first, through the `each _` definition, and second, by the `(x) =>` definition. To refer to columns in the first Source table, add an underscore (_)before the column names. For the second Source table, mention the variable `x` before the column names.

Therefore, the previous formula should be rewritten as follows, resulting in Figure 3-39, including all non-dominated IDs:

```
= Table.SelectRows(
       Source,
       each Table.RowCount(
                       Table.SelectRows(
                              Source,(x)=>
                                    x[Objective 1] >=
_[Objective 1] and
                                    x[Objective 2] >=
_[Objective 2] and
                                    x[Objective 3] >=
_[Objective 3])
                                    )=1)
```



| | Solution ID | Objective 1 | Objective 2 | Objective 3 |
|---|---|---|---|---|
| 1 | 4 | 29 | 9 | 78 |
| 2 | 7 | 80 | 9 | 41 |
| 3 | 9 | 57 | 6 | 94 |
| 4 | 10 | 74 | 4 | 95 |
| 5 | 11 | 92 | 7 | 93 |

***Figure 3-39*** The result

**Efficiency Tips** Even for a relatively small table with 10,000 rows, the code took 380 seconds to run, which is excessive. By applying the `Table.Buffer()` function to the Source table, the execution time was reduced to 129 seconds, but this is still quite high. Instead of buffering the entire table, buffering just the list of data, as shown here (make the changes on the Advanced Editor window), reduced the runtime to 17 seconds, making it more efficient compared to the previous solutions.

```
let
    Source = Excel.CurrentWorkbook(){[Name="Table1"]}
[Content],
    S=List.Buffer(Table.ToRows(Table.RemoveColumns(Source,
{"Solution ID"}))),
    #"Filtered Rows" = Table.SelectRows(
Source,
each List.Count(
                List.Select(
                      S,(x)=>
                                        x{0} >=
_[Objective 1] and
                                        x{1} >=
_[Objective 2] and
                                         x{2} >=
_[Objective 3])
                                       )=1)
in
    #"Filtered Rows"
```

## Summary

Filtering and sorting are fundamental to data analysis. This chapter dived deep into the `Table.Sort()` and `Table.SelectRows()` functions, providing insights on how to apply these methods to single and multiple columns. Different filtering approaches were illustrated, including using custom functions and simple selection criteria to streamline execution. `List.Sort()` was also introduced for reordering the table rows based on custom logic. Practical examples emphasized the importance of efficient criteria in improving query performance for both functions. Remember to be careful using `Table.Buffer()` with tables.

The next chapter covers the tips related to splitting a column into several columns or merging the values over multiple columns and providing them in a column.

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# 4. Column Splitting and Merging

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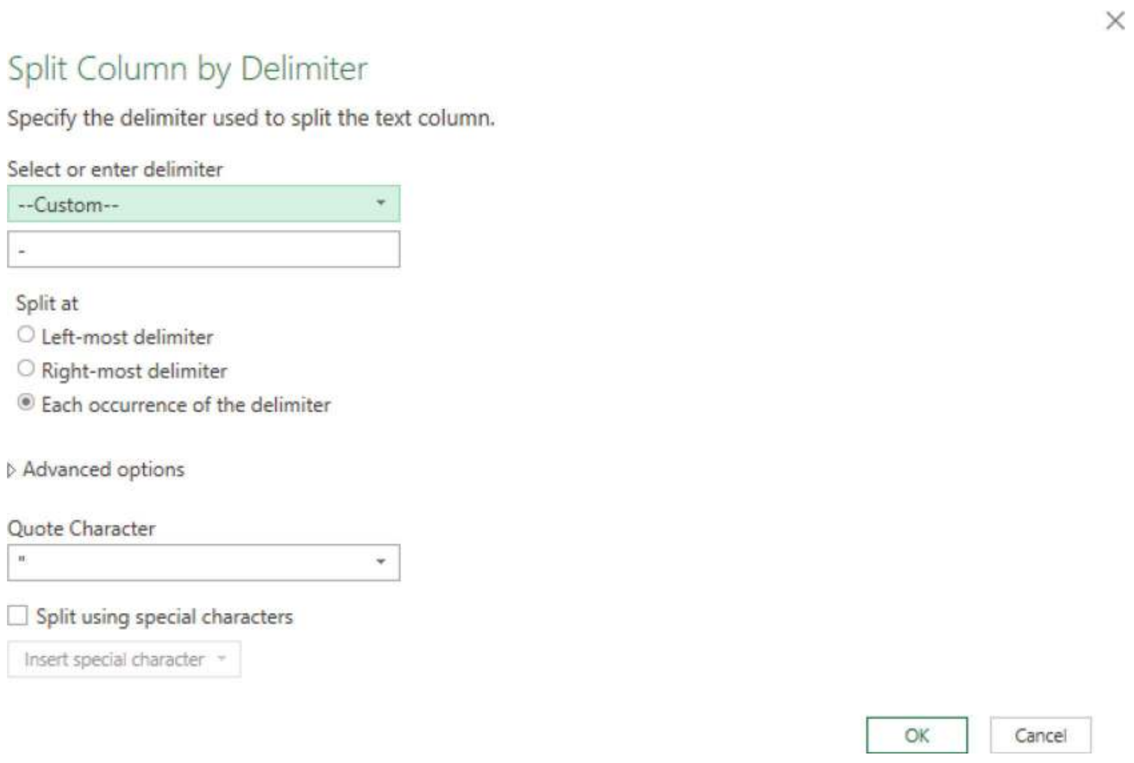
Splitting and merging columns are two common tasks involved in transforming data. Column splitting is the process of dividing a single column into multiple columns based on a specified delimiter or a fixed number of characters, and column merging is the process of combining multiple columns into a single column. These two tasks are useful for consolidating data, simplifying structures, and preparing data for analysis.

Consider Table 4-1 as the Source table, which includes product IDs with information about the production year, material type, color, and index, all separated by dashes.

***Table 4-1*** Source: Some Dates

| ID |
|---|
| 2022-Wo-Wh-12 |
| 2023-Wo-Bl-01 |
| 2024-Me-Bl-07 |
| 2024-Me-Bl-12 |
| 2024-Me-Bu-18 |
| 2024-Pl-Ye-12 |
| 2024-Wo-Re-84 |

To split the text in the ID column based on the − delimiter, select the column and go to the Home tab. Then choose the Split Columns command and select By Delimiter. Set the delimiter to Custom and choose Split at Each Occurrence, as shown in Figure 4-1, then click OK to achieve the result in Figure 4-2.


Split Column by Delimiter

Specify the delimiter used to split the text column.

Select or enter delimiter: --Custom--

-

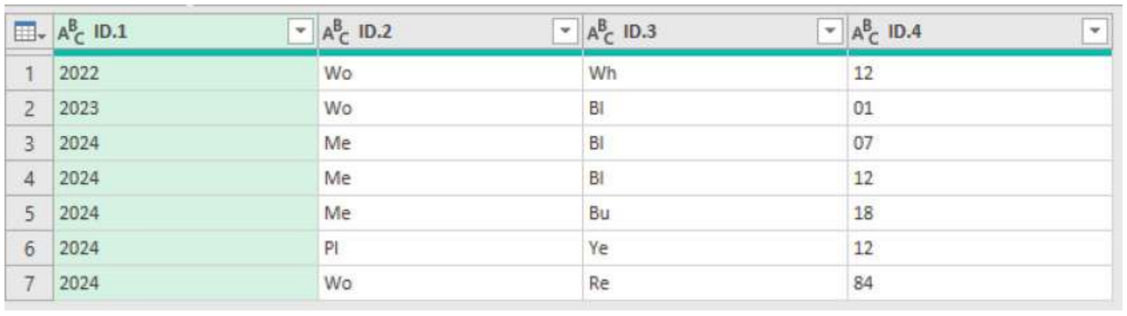
Split at
- Left-most delimiter
- Right-most delimiter
- [✓ Each occurrence of the delimiter]

Advanced options

Quote Character: "

Split using special characters

*Figure 4-1* Settings of the column split



| | ID.1 | ID.2 | ID.3 | ID.4 |
|---|---|---|---|---|
| 1 | 2022 | Wo | Wh | 12 |
| 2 | 2023 | Wo | Bl | 01 |
| 3 | 2024 | Me | Bl | 07 |
| 4 | 2024 | Me | Bl | 12 |
| 5 | 2024 | Me | Bu | 18 |
| 6 | 2024 | Pl | Ye | 12 |
| 7 | 2024 | Wo | Re | 84 |

*Figure 4-2* The result of the column split

Based on the previous settings, the following formula uses the `Table.SplitColumn()` function and is generated in the formula bar:

```
= Table.SplitColumn(
      #"Changed Type",
      "ID",
      Splitter.SplitTextByDelimiter("-", QuoteStyle.Csv),
      {"ID.1", "ID.2", "ID.3", "ID.4"})
```

Generally, the `Table.SplitColumn()` function is used to split a column into several columns based on the following six arguments (the last three arguments are optional):

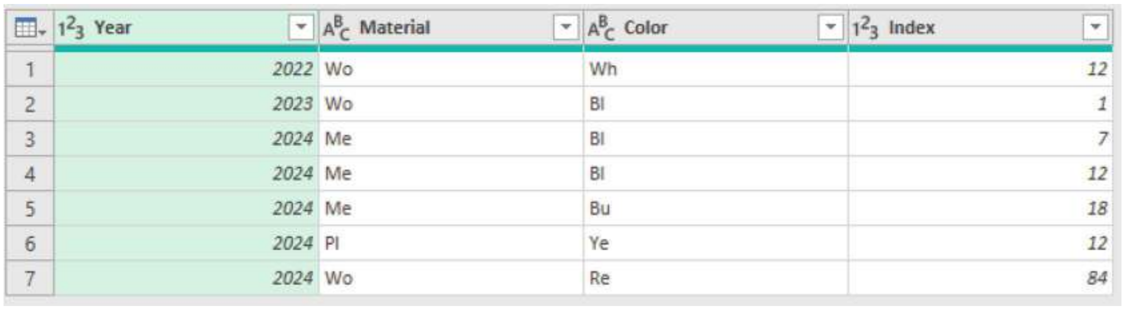
```
Table.SplitColumn(
      table as table,
      sourceColumn as text,
      splitter as function,
      optional columnNamesOrNumber as any,
      optional default as any,
      optional extraColumns as any
      ) as table
```

In the first and second arguments, you specify the name of the table and the column to split. The third argument defines the splitting logic, which can be one of the following functions or any other custom function under specific characteristics:

- `Splitter.SplitByNothing()`
- `Splitter.SplitTextByAnyDelimiter()`
- `Splitter.SplitTextByCharacterTransition()`
- `Splitter.SplitTextByDelimiter()`
- `Splitter.SplitTextByEachDelimiter()`
- `Splitter.SplitTextByLengths()`
- `Splitter.SplitTextByPositions()`
- `Splitter.SplitTextByRanges()`
- `Splitter.SplitTextByRepeatedLengths()`
- `Splitter.SplitTextByWhitespace()`

The fourth argument in this function is optional and is used to name the resulting columns after splitting. In this example, it can be left blank, set to the number 4, or specified as a list of four items to define the column names in the result table. Modifying the formula to the following will produce a table with different column names, as shown in Figure 4-3.

```
= Table.SplitColumn(#"Changed Type",
    "ID",
    Splitter.SplitTextByDelimiter("-", QuoteStyle.Csv),
    {"Year","Material","Color","Index"})
```



| | Year | Material | Color | Index |
|---|---|---|---|---|
| 1 | 2022 | Wo | Wh | 12 |
| 2 | 2023 | Wo | Bl | 1 |
| 3 | 2024 | Me | Bl | 7 |
| 4 | 2024 | Me | Bl | 12 |
| 5 | 2024 | Me | Bu | 18 |
| 6 | 2024 | Pl | Ye | 12 |
| 7 | 2024 | Wo | Re | 84 |

***Figure 4-3*** Changing the column name

If the fourth argument is left blank, the function will use the first row of the table to determine the number of columns for splitting. In this example, since all rows have the same length after splitting (i.e., the same number of split values), leaving the fourth argument blank does not impact the results. However, in cases with uneven splitting results, some parts of the text might be missed if this argument is left blank.

The fifth argument of the function is optional and is known as the default value. In the previous example, if the fourth argument is set to 5, the splitting will generate five columns. Since each row contains only four parts after splitting, the fifth column will contain null values for all rows. To replace these null values with another value, you can use the fifth argument of this function.

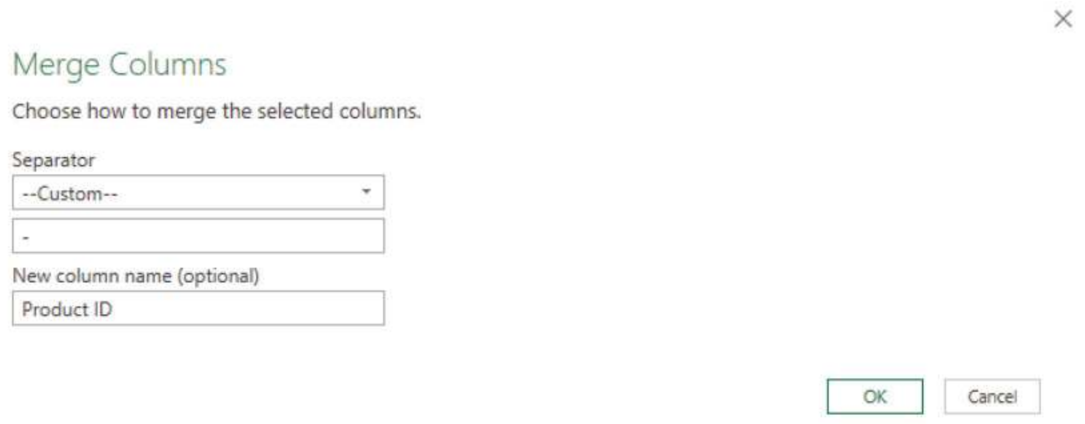
The sixth argument of the function allows you to manage the result based on conditions using one of the following options:

`ExtraValues.Error`: Throws an error if extra values are found.
`ExtraValues.Ignore`: Ignores extra values.
`ExtraValues.List`: Creates a list of extra values.

Merging columns performs the reverse operation of splitting columns and is used to combine values from several columns. Consider Table 4-2 as the Source table. To create the product ID by combining the values of each row, select all the relevant columns (note that the order of selection is important). Right-click one of the selected columns and choose Merge. In the dialog that appears, use a custom separator (in this case, a dash) and name the new column Product ID, as shown in Figure 4-4. Clicking OK will result in Figure 4-5.

***Table 4-2*** Source: Product info

| Year | Material | Color | Index |
|---|---|---|---|
| 2022 | Wo | Wh | 12 |
| 2023 | Wo | Bl | 1 |
| 2024 | Me | Bl | 7 |
| 2024 | Me | Bl | 12 |
| 2024 | Me | Bu | 18 |
| 2024 | Pl | Ye | 12 |
| 2024 | Wo | Re | 84 |


Merge Columns

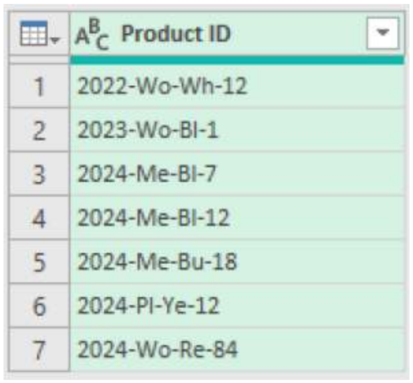
Choose how to merge the selected columns.

Separator: --Custom--

-

New column name (optional): Product ID

***Figure 4-4*** Merge Columns setting



| | Product ID |
|---|---|
| 1 | 2022-Wo-Wh-12 |
| 2 | 2023-Wo-Bl-1 |
| 3 | 2024-Me-Bl-7 |
| 4 | 2024-Me-Bl-12 |
| 5 | 2024-Me-Bu-18 |
| 6 | 2024-Pl-Ye-12 |
| 7 | 2024-Wo-Re-84 |

***Figure 4-5*** The result of merging the columns

The previous settings result in the use of the `Table.CombineColumns()` function in the formula bar with the following formula:

```
= Table.CombineColumns(
      Table.TransformColumnTypes(Source, {{"Year", type text}, {"Index",
type text}}, "en-AU"),
      {"Year", "Material", "Color", "Index"},
      Combiner.CombineTextByDelimiter("-", QuoteStyle.None),
      "Product ID")
```

In the initial argument of the `Table.CombineColumns()` function, the table name is specified. In this example, since the Year and Index columns are of type number and cannot be merged with text directly, their types are first converted to text using the `Table.TransformColumnTypes()` function, then the result is used in the first argument of the function. The second argument provides a list of column names for merging, formatted as text within a list. The third argument defines the merging logic, and the final argument specifies the name of the resulting column that will contain the merged values.

This chapter explores the more advanced applications of these two functions.

## Dynamic Splitting by Delimiter

The source table, as shown in Table 4-3, contains product IDs provided in a column, separated by commas. Split these product IDs into multiple columns. Ensure that your query is dynamic and can accommodate any newly added rows in the table.

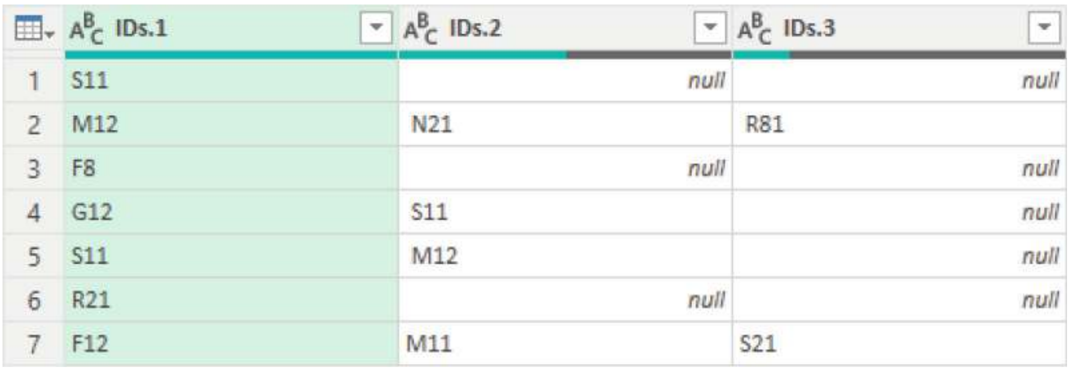
***Table 4-3*** Source: IDs

| IDs |
|---|
| S11 |
| M12, N21, R81 |
| F8 |
| G12, S11 |
| S11, M12 |
| R21 |
| F12,M11,S21,R18 |

**Note** The data in this example is provided in an Excel file titled `01 Dynamic splinting by delimiter.xlsx`.

To address this problem, select the IDs column, then navigate to the Home tab and choose the Split Column by Delimiter command. Select Comma as the delimiter and click OK. This will generate the following formula in the formula bar and the result shown in Figure 4-6.

```
= Table.SplitColumn(Source, "IDs", Splitter.SplitTextByDelimiter(",",
QuoteStyle.Csv), {"IDs.1", "IDs.2", "IDs.3"})
```

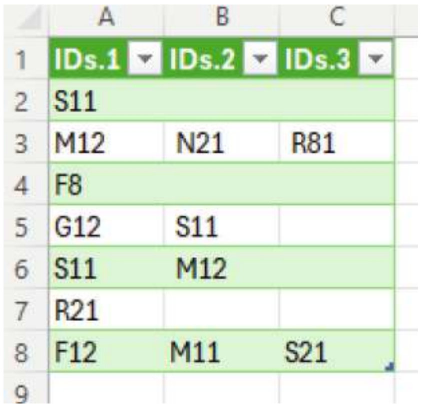


| | IDs.1 | IDs.2 | IDs.3 |
|---|---|---|---|
| 1 | S11 | null | null |
| 2 | M12 | N21 | R81 |
| 3 | F8 | null | null |
| 4 | G12 | S11 | null |
| 5 | S11 | M12 | null |
| 6 | R21 | null | null |
| 7 | F12 | M11 | S21 |

***Figure 4-6*** The result of splitting

Load the resulting table into Excel. It appears that this formula works correctly for the provided data; however, if you go to the Source table and add a new row containing more than two commas, such as

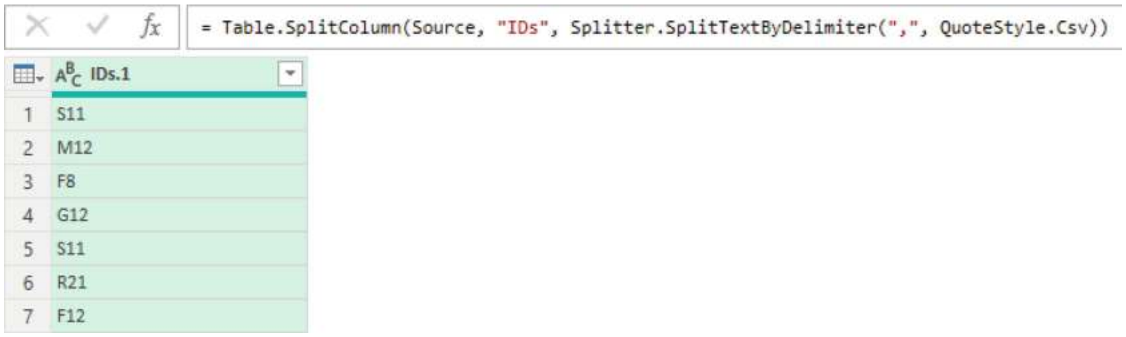
"F12,M11,S21,R18," and then refresh the query, notice that only the first three product IDs of this code are split, while the last part is neglected. This is shown in Figure 4-7.



| | A | B | C |
|---|---|---|---|
| 1 | IDs.1 | IDs.2 | IDs.3 |
| 2 | S11 | | |
| 3 | M12 | N21 | R81 |
| 4 | F8 | | |
| 5 | G12 | S11 | |
| 6 | S11 | M12 | |
| 7 | R21 | | |
| 8 | F12 | M11 | S21 |
| 9 | | | |

*Figure 4-7* The result of splitting after adding a new row

This issue is due to the last argument of the formula, which is {"IDs.1", "IDs.2", "IDs.3"}, indicating that the IDs column should be split into three columns. Removing this argument and rewriting the formula as follows makes the situation worse. In this case, as shown in Figure 4-8, only the first part of all the IDs will appear in the result table (where the first row of the table is considered as the pattern, and the number of columns is determined based on that).



```
= Table.SplitColumn(Source, "IDs", Splitter.SplitTextByDelimiter(",", QuoteStyle.Csv))
```

| | IDs.1 |
|---|---|
| 1 | S11 |
| 2 | M12 |
| 3 | F8 |
| 4 | G12 |
| 5 | S11 |
| 6 | R21 |
| 7 | F12 |

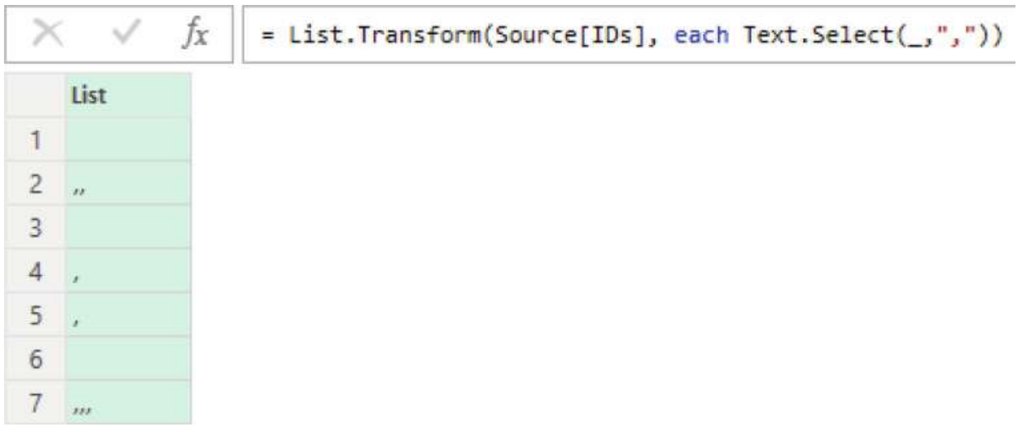
*Figure 4-8* The result of removing the fourth argument

```
= Table.SplitColumn(Source, "IDs", Splitter.SplitTextByDelimiter(",",
QuoteStyle.Csv))
```

To resolve this issue and make the formula dynamic, you need to count the number of occurrences of commas in each cell of the IDs column. Then, you take the largest count and add one to it, using that value as the fourth argument of the Table.SplitColumn() function.

To count the number of occurrences of "," in each cell, you know that the result of Source[IDs] is a list containing all the values in the IDs column. You can then apply the List.Transform() function to each item in this list to remove all characters except for commas by using the following formula, which results in Figure 4-9.

```
=List.Transform(Source[IDs], each Text.Select(_,","))
```



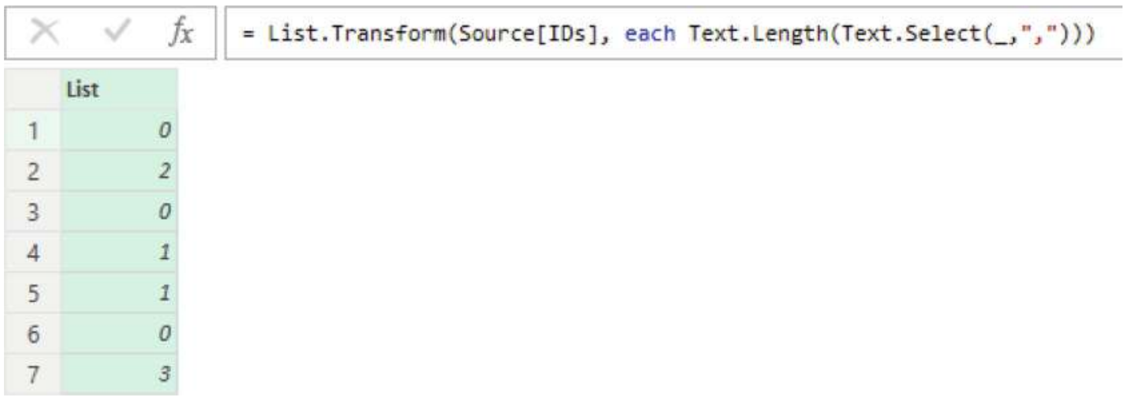
```
= List.Transform(Source[IDs], each Text.Select(_,","))
```

| | List |
|---|---|
| 1 | |
| 2 | ,, |
| 3 | |
| 4 | , |
| 5 | , |
| 6 | |
| 7 | ,,, |

***Figure 4-9*** The result of List.Transform

Instead of displaying just the commas, the formula can be rewritten to count the number of occurrences of commas in each cell of the IDs column, as follows, which results in Figure 4-10.

```
= List.Transform(Source[IDs], each Text.Length(Text.Select(_,",")))
```



```
= List.Transform(Source[IDs], each Text.Length(Text.Select(_,",")))
```

| | List |
|---|---|
| 1 | 0 |
| 2 | 2 |
| 3 | 0 |
| 4 | 1 |
| 5 | 1 |
| 6 | 0 |
| 7 | 3 |

***Figure 4-10*** The result of revised List.Transform

Therefore, the maximum number of commas can be extracted using the following formula:

```
=List.Max(List.Transform(Source[IDs], each Text.Length(Text.Select(_,","))))
```

In the case where a cell contains three commas, such as `"F12,M11,S21,R18,"` it should be split into four columns, so the result of the previous formula should be added by 1one. With this in mind, the splitting function can be rewritten as follows, which is completely dynamic.

```
=Table.SplitColumn(Source, "IDs", Splitter.SplitTextByDelimiter(",",
QuoteStyle.Csv),List.Max(List.Transform(Source[IDs], each
Text.Length(Text.Select(_,","))))+1)
```

Therefore, the previous formula is dynamic and will work for any new rows added to the table, regardless of the number of commas they contain.

## Splitting Text by Multiple Delimiters

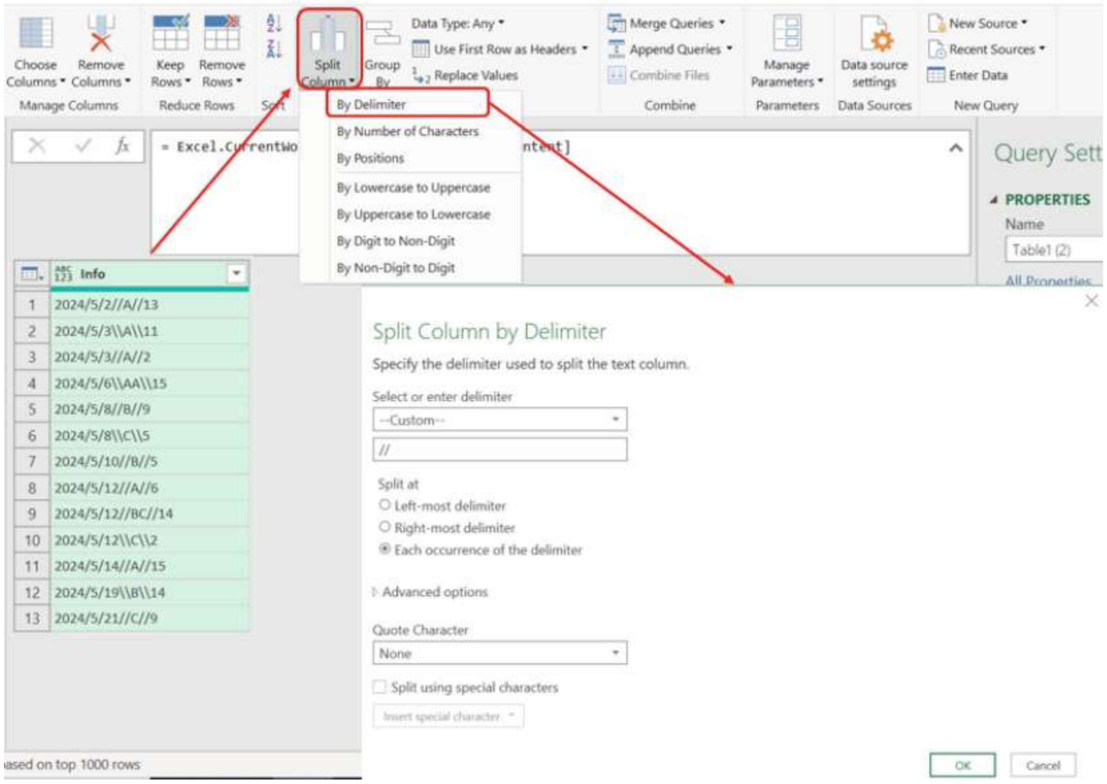
Consider the Source table shown in Table 4-4, which includes sales data (Date, Product Name, and Quantity) all in one column, separated by `"//"` or `"\\"`. Split this data into three separate columns.

***Table 4-4*** Source: List of Transactions

| Info |
|---|
| 2024/5/2//A//13 |
| 2024/5/3\\A\\11 |
| 2024/5/3//A//2 |
| 2024/5/6\\AA\\15 |
| 2024/5/8//B//9 |
| 2024/5/8\\C\\5 |
| 2024/5/10//B//5 |
| 2024/5/12//A//6 |
| 2024/5/12//BC//14 |
| 2024/5/12\\C\\2 |
| 2024/5/14//A//15 |
| 2024/5/19\\B\\14 |
| 2024/5/21//C//9 |

**Note** The data in this example is provided in an Excel file titled `02 Splitting Text by Multiple Delimiters.xlsx`.

To split this column based on the delimiter, select the column, go to the Home tab, choose the Split Column command, and select By Delimiter. As shown in Figure 4-11, choose Custom as the delimiter type and enter "\\" as the delimiter. This will result in Figure 4-12.



```
= Excel.CurrentWo...ntent]
```

| | Info |
|---|---|
| 1 | 2024/5/2//A//13 |
| 2 | 2024/5/3\\A\\11 |
| 3 | 2024/5/3//A//2 |
| 4 | 2024/5/6\\AA\\15 |
| 5 | 2024/5/8//B//9 |
| 6 | 2024/5/8\\C\\5 |
| 7 | 2024/5/10//B//5 |
| 8 | 2024/5/12//A//6 |
| 9 | 2024/5/12//BC//14 |
| 10 | 2024/5/12\\C\\2 |
| 11 | 2024/5/14//A//15 |
| 12 | 2024/5/19\\B\\14 |
| 13 | 2024/5/21//C//9 |

Split Column by Delimiter

Specify the delimiter used to split the text column.

Select or enter delimiter: --Custom--

//

Split at
- Left-most delimiter
- Right-most delimiter
- [✓ Each occurrence of the delimiter]

Advanced options

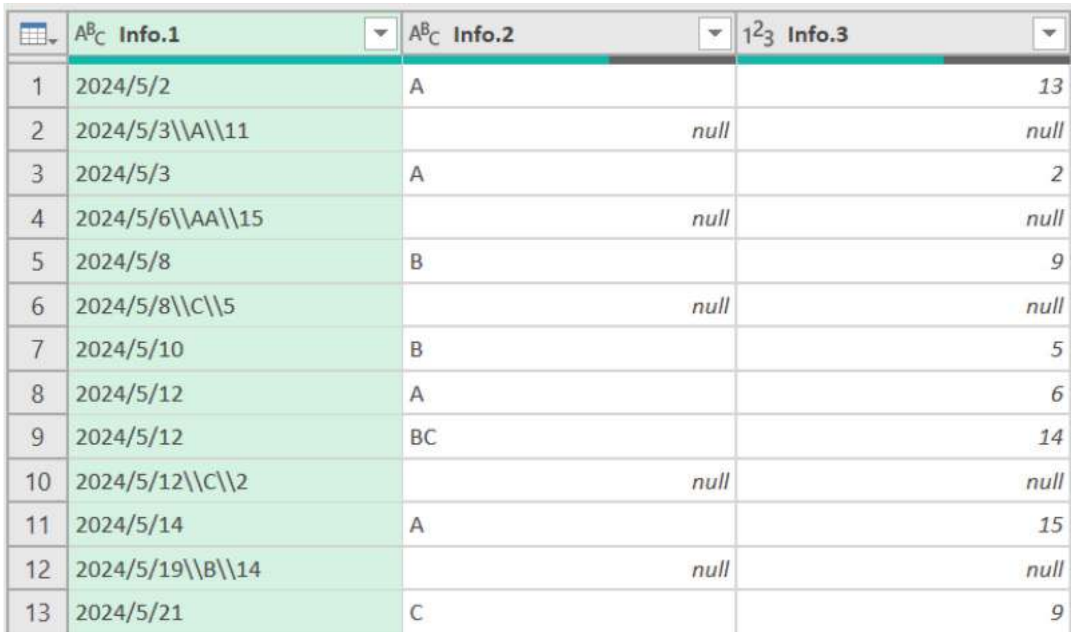
Quote Character: None

Split using special characters

Insert special character

OK Cancel

***Figure 4-11*** Column split setting



| | Info.1 | Info.2 | Info.3 |
|---|---|---|---|
| 1 | 2024/5/2 | A | 13 |
| 2 | 2024/5/3\\A\\11 | null | null |
| 3 | 2024/5/3 | A | 2 |
| 4 | 2024/5/6\\AA\\15 | null | null |
| 5 | 2024/5/8 | B | 9 |
| 6 | 2024/5/8\\C\\5 | null | null |
| 7 | 2024/5/10 | B | 5 |
| 8 | 2024/5/12 | A | 6 |
| 9 | 2024/5/12 | BC | 14 |
| 10 | 2024/5/12\\C\\2 | null | null |
| 11 | 2024/5/14 | A | 15 |
| 12 | 2024/5/19\\B\\14 | null | null |
| 13 | 2024/5/21 | C | 9 |

***Figure 4-12*** The result of the column split

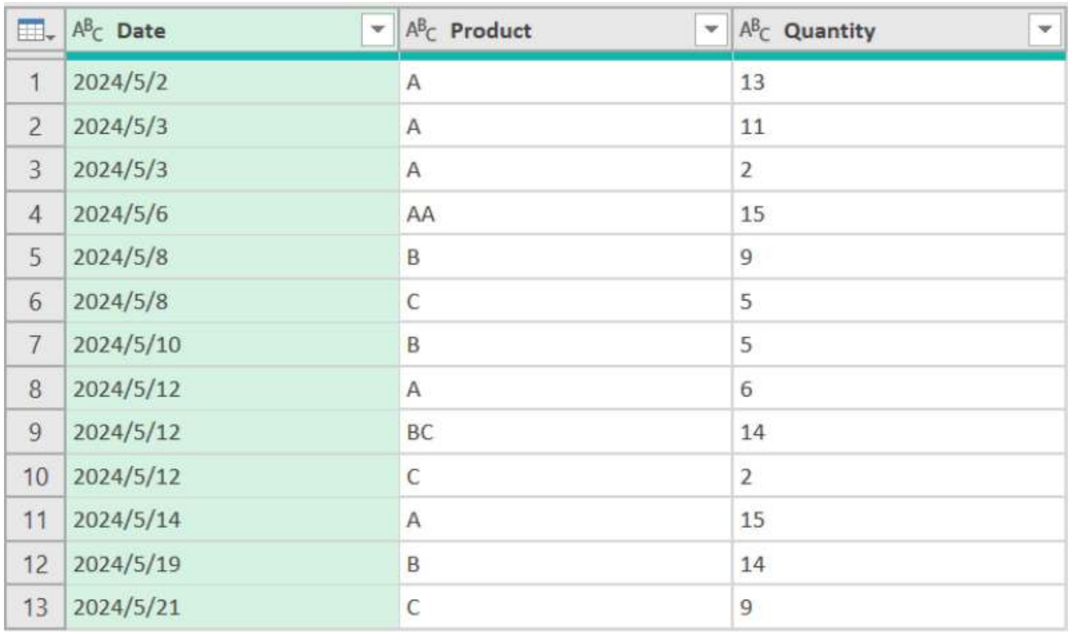
Based on the resulting table, the current approach works for rows with the "//" delimiter but fails for rows with other delimiters. To address this, examine the formula generated in the formula bar by the previous step as follows:

```
= Table.SplitColumn(
      Source,
      "Info",
      Splitter.SplitTextByDelimiter("//", QuoteStyle.None),
      {"Info.1", "Info.2", "Info.3"})
```

After using the column split feature, two steps are added to the query: one for splitting the columns and another for changing the types of the new columns. This discussion focuses on the formula related to the splitting step.

In this code, the `Splitter.SplitTextByDelimiter()` function is used as the splitter in the third argument, which allows only a single delimiter to be defined. However, it can be replaced with the `Splitter.SplitTextByAnyDelimiter()` function to specify multiple delimiters within a list. The formula can be rewritten as follows to solve the problem by defining multiple delimiters once, resulting in Figure 4-13. (The names of the new columns are provided in the fourth argument.)

```
= Table.SplitColumn(Source,
      "Info",
      Splitter.SplitTextByAnyDelimiter({"//","\\"}),
      {"Date", "Product", "Quantity"})
```

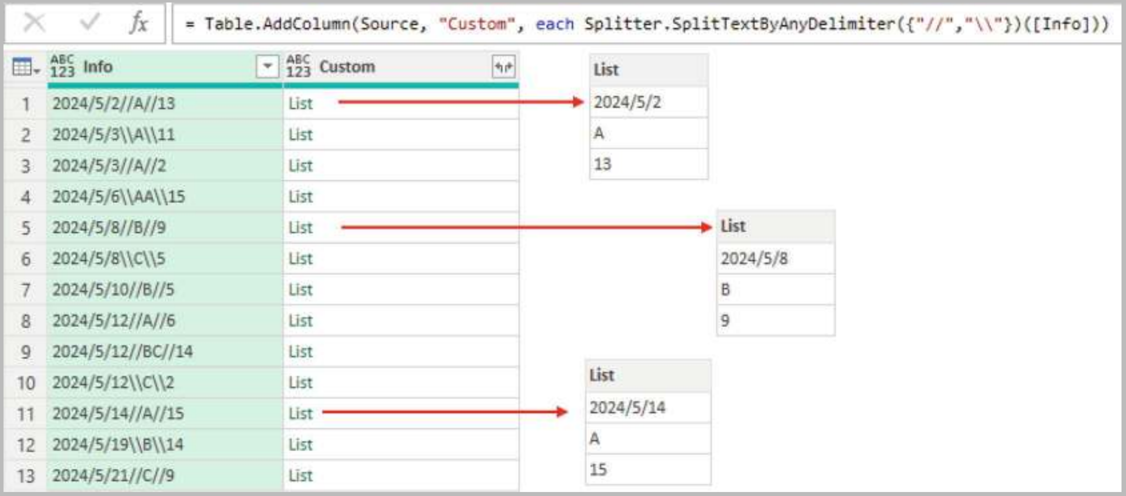


| | Date | Product | Quantity |
|---|---|---|---|
| 1 | 2024/5/2 | A | 13 |
| 2 | 2024/5/3 | A | 11 |
| 3 | 2024/5/3 | A | 2 |
| 4 | 2024/5/6 | AA | 15 |
| 5 | 2024/5/8 | B | 9 |
| 6 | 2024/5/8 | C | 5 |
| 7 | 2024/5/10 | B | 5 |
| 8 | 2024/5/12 | A | 6 |
| 9 | 2024/5/12 | BC | 14 |
| 10 | 2024/5/12 | C | 2 |
| 11 | 2024/5/14 | A | 15 |
| 12 | 2024/5/19 | B | 14 |
| 13 | 2024/5/21 | C | 9 |

*Figure 4-13* The result

**Note** These splitter functions like, `Splitter.SplitTextByAnyDelimiter()`, can also used directly in the custom column or to transform the values of a column. These approaches can be useful in certain scenarios.

For example, consider the Source table in this case. Go to the Add Column tab, select the Custom Column command, and in the open window, write the following formula, which results in Figure 4-14:



```
= Table.AddColumn(Source, "Custom", each Splitter.SplitTextByAnyDelimiter({"//","\\"})([Info]))
```

| | Info | Custom |
|---|---|---|
| 1 | 2024/5/2//A//13 | List |
| 2 | 2024/5/3\\A\\11 | List |
| 3 | 2024/5/3//A//2 | List |
| 4 | 2024/5/6\\AA\\15 | List |
| 5 | 2024/5/8//B//9 | List |
| 6 | 2024/5/8\\C\\5 | List |
| 7 | 2024/5/10//B//5 | List |
| 8 | 2024/5/12//A//6 | List |
| 9 | 2024/5/12//BC//14 | List |
| 10 | 2024/5/12\\C\\2 | List |
| 11 | 2024/5/14//A//15 | List |
| 12 | 2024/5/19\\B\\14 | List |
| 13 | 2024/5/21//C//9 | List |

| List |
|---|
| 2024/5/2 |
| A |
| 13 |

| List |
|---|
| 2024/5/8 |
| B |
| 9 |

| List |
|---|
| 2024/5/14 |
| A |
| 15 |

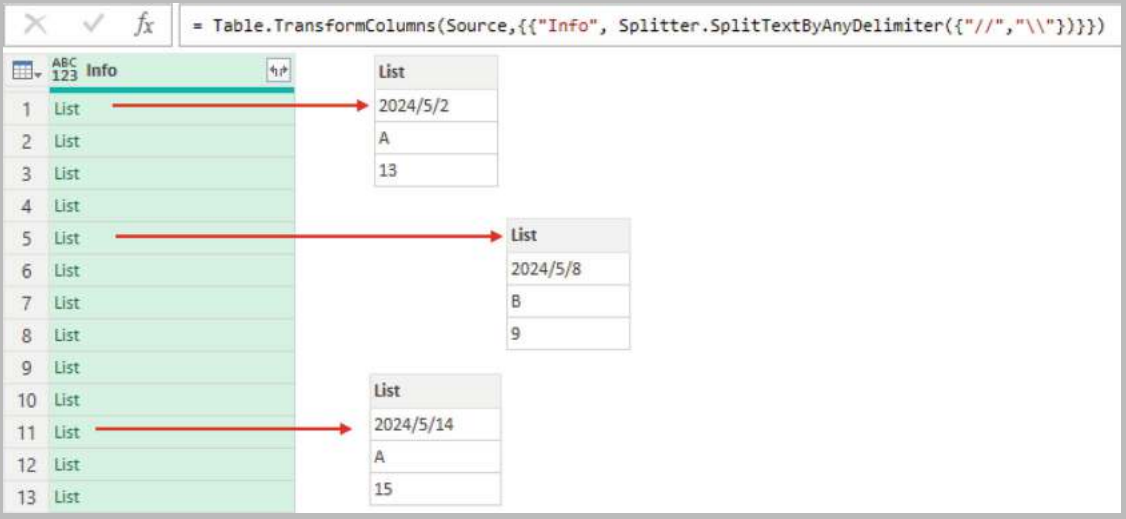
*Figure 4-14* The result of using Splitter.SplitTextByAnyDelimiter() in the Custom Column

```
=Splitter.SplitTextByAnyDelimiter({"//","\\"})([Info])
```

Alternatively, in another scenario, you can select the Info column, then go to the Transform tab. Under the Text Column section, in the Format group, choose any case option, such as lowercase. This will generate the following formula in the formula bar, which converts all the values in the Info column to lowercase.

```
= Table.TransformColumns(Source,{{"Info", Text.Lower, type text}})
```

In this case, `Text.Lower` can be replaced with `Splitter.SplitTextByAnyDelimiter({"//", "\\"})`. By removing the part related to the column type, type text, and rewriting the formula as follows, you will get the result in Figure 4-15.



```
= Table.TransformColumns(Source,{{"Info", Splitter.SplitTextByAnyDelimiter({"//","\\"})}})
```

| | Info |
|---|---|
| 1 | List |
| 2 | List |
| 3 | List |
| 4 | List |
| 5 | List |
| 6 | List |
| 7 | List |
| 8 | List |
| 9 | List |
| 10 | List |
| 11 | List |
| 12 | List |
| 13 | List |

| List |
|---|
| 2024/5/2 |
| A |
| 13 |

| List |
|---|
| 2024/5/8 |
| B |
| 9 |

| List |
|---|
| 2024/5/14 |
| A |
| 15 |

***Figure 4-15*** The result of using Splitter.SplitTextByAnyDelimiter() in column transformation

## Splitting Text by Position

Consider the Source table shown in Table 4-5, which includes different text describing product IDs in different lengths. Split the IDs into several columns with different numbers of characters following a specific pattern: `{2,1,2,1,2,1,...}`.

***Table 4-5*** Source: List of IDs

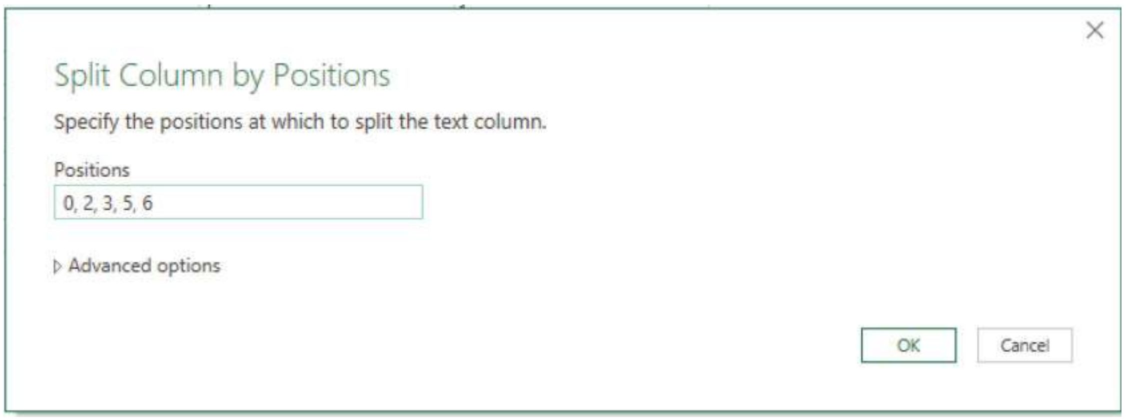
| ID |
|---|
| NG6GM5 |
| UD1OP3PL |
| RE4EA3R |
| EL8DC6JK |
| TO1TS9RU |
| PN6PU |
| UD8PD5 |
| RD5FS7J |
| TQ4BN8 |
| JF7 |
| LP7U |
| QB6JT5SA |
| IH7UL2 |
| TR7 |
| AT7JG |

For example, with the product ID `RD5FS7J`, the first two characters are placed in one column, the next character in the subsequent column, and this pattern continues until the end of the ID. The result would be split into “RD,” “5,” “FS,” “7,” and “J.”

**Note** The data in this example is provided in an Excel file titled `03 Splitting Text by Position.xlsx`.

To solve this problem, select the ID column, go to the Home tab, choose Split Column, and then select By Positions. Enter `0,2,3,5,6` as positions for splitting, as shown in Figure 4-16. This will generate the following formula in the formula bar and the resulting table shown in Figure 4-17.

```
= Table.SplitColumn(
      Source,
      "ID",
      Splitter.SplitTextByPositions({0, 2, 3, 5, 6}),
      {"ID.1", "ID.2", "ID.3", "ID.4", "ID.5"})
```



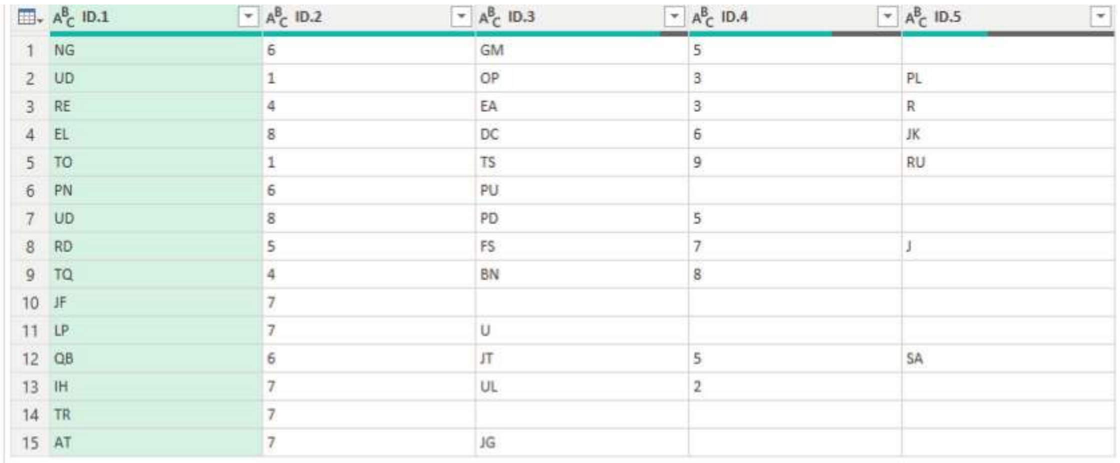
Split Column by Positions

Specify the positions at which to split the text column.

Positions

0, 2, 3, 5, 6

***Figure 4-16*** Settings of the column split



| | ID.1 | ID.2 | ID.3 | ID.4 | ID.5 |
|---|---|---|---|---|---|
| 1 | NG | 6 | GM | 5 | |
| 2 | UD | 1 | OP | 3 | PL |
| 3 | RE | 4 | EA | 3 | R |
| 4 | EL | 8 | DC | 6 | JK |
| 5 | TO | 1 | TS | 9 | RU |
| 6 | PN | 6 | PU | | |
| 7 | UD | 8 | PD | 5 | |
| 8 | RD | 5 | FS | 7 | J |
| 9 | TQ | 4 | BN | 8 | |
| 10 | JF | 7 | | | |
| 11 | LP | 7 | U | | |
| 12 | QB | 6 | JT | 5 | SA |
| 13 | IH | 7 | UL | 2 | |
| 14 | TR | 7 | | | |
| 15 | AT | 7 | JG | | |

***Figure 4-17*** The result of the column split

**Note** The previous formula solves the problem, but the `{0, 2, 3, 5, 6}` list and the fourth argument are hardcoded. While it works if the maximum ID length is six, in real-world scenarios, you can't always be certain about the length of the text in a column. Therefore, at the end of this section, you learn how to make the formula dynamic.

The provided formula splits the values in the ID column of the Source table. The splitting logic is defined by the third argument, which in this example uses the `Splitter.SplitTextByPositions()` function.

The syntax of the `Splitter.SplitTextByPositions()` function is as follows.

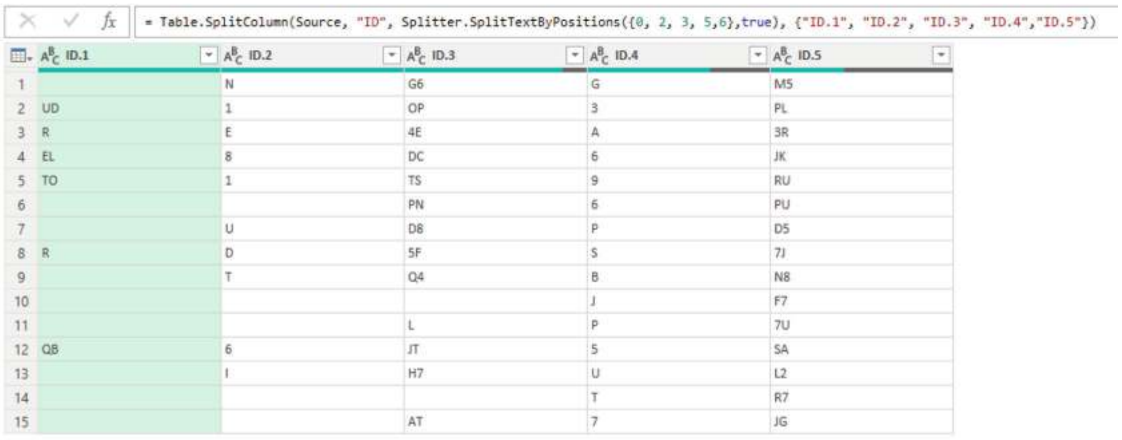
```
Splitter.SplitTextByPositions(
      positions as list,
      optional startAtEnd as nullable logical
```

```
                    ) as function
```

The first argument of this function is a list of numbers specifying the splitting positions in the text. Since Power Query indexing starts at 0, setting this argument to `{0, 2, 3, 5, 6}` means splitting the text after the beginning of the text, and after the second, third, fifth, and sixth characters, and then placing the resulting segments into new columns.

Additionally, according to the function definition, the second argument is optional and its default is false, so removing false from the formula will not affect the result. However, replacing it with true and rewriting the formula, as shown here, will change the splitting point starting from the end. The result is shown in Figure 4-18.

```
= Table.SplitColumn(
        Source,
        "ID",
        Splitter.SplitTextByPositions({0, 2, 3, 5, 6},true),
        {"ID.1", "ID.2", "ID.3", "ID.4", "ID.5"})
```



```
= Table.SplitColumn(Source, "ID", Splitter.SplitTextByPositions({0, 2, 3, 5,6},true), {"ID.1", "ID.2", "ID.3", "ID.4","ID.5"})
```

| | ID.1 | ID.2 | ID.3 | ID.4 | ID.5 |
|---|---|---|---|---|---|
| 1 | | N | G6 | G | M5 |
| 2 | UD | 1 | OP | 3 | PL |
| 3 | R | E | 4E | A | 3R |
| 4 | EL | 8 | DC | 6 | JK |
| 5 | TO | 1 | TS | 9 | RU |
| 6 | | | PN | 6 | PU |
| 7 | | U | D8 | P | D5 |
| 8 | R | D | 5F | S | 7J |
| 9 | | T | Q4 | B | N8 |
| 10 | | | | J | F7 |
| 11 | | | L | P | 7U |
| 12 | QB | 6 | JT | 5 | SA |
| 13 | | I | H7 | U | L2 |
| 14 | | | | T | R7 |
| 15 | | | AT | 7 | JG |

***Figure 4-18*** Revising the result

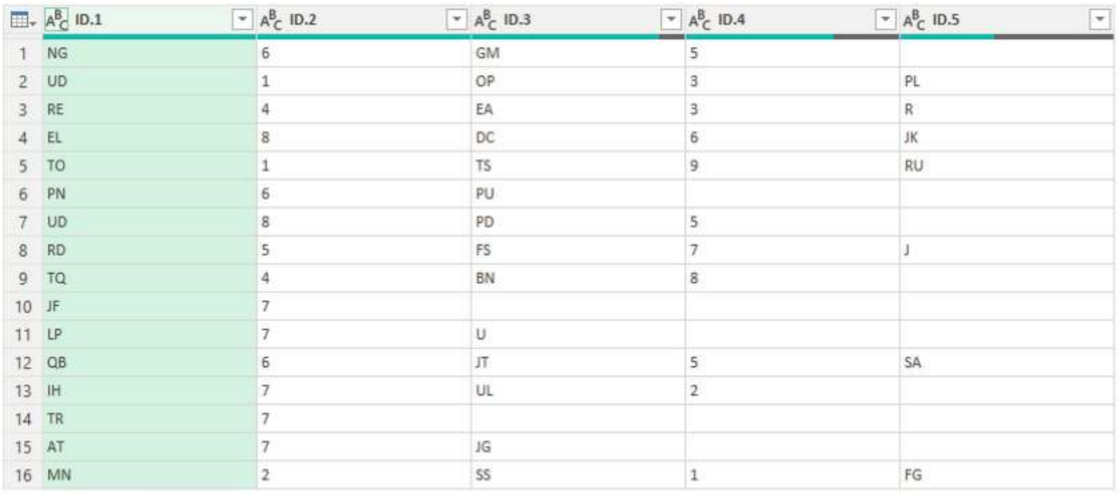
In this example, besides using `Splitter.SplitTextByPositions()` in the third argument, you can use the `Splitter.SplitTextByLengths()` function to solve this problem. Rather than specifying the positions for splitting, the number of characters to include in each split should be defined for this function. Therefore, the previous formula can be rewritten as follows:

```
= Table.SplitColumn(
        Source,
        "ID",
        Splitter.SplitTextByLengths({2, 1,2,1,2}),
        {"ID.1", "ID.2", "ID.3", "ID.4", "ID.5"})
```

In this example, neglecting the last input, the following formula does also work and provides the same result with different column names.

```
= Table.SplitColumn(
        Source,
        "ID",
        Splitter.SplitTextByLengths({2, 1,2,1,2}))
```

Both of these formulas work correctly for the provided data; however, if you add a new row to the data, such as "`MN2SS1FG5HR`" in the source table, as shown in Figure 4-19, the characters "`5HR`" are ignored in the resulting table after the splitting process.



| | ID.1 | ID.2 | ID.3 | ID.4 | ID.5 |
|---|---|---|---|---|---|
| 1 | NG | 6 | GM | 5 | |
| 2 | UD | 1 | OP | 3 | PL |
| 3 | RE | 4 | EA | 3 | R |
| 4 | EL | 8 | DC | 6 | JK |
| 5 | TO | 1 | TS | 9 | RU |
| 6 | PN | 6 | PU | | |
| 7 | UD | 8 | PD | 5 | |
| 8 | RD | 5 | FS | 7 | J |
| 9 | TQ | 4 | BN | 8 | |
| 10 | JF | 7 | | | |
| 11 | LP | 7 | U | | |
| 12 | QB | 6 | JT | 5 | SA |
| 13 | IH | 7 | UL | 2 | |
| 14 | TR | 7 | | | |
| 15 | AT | 7 | JG | | |
| 16 | MN | 2 | SS | 1 | FG |

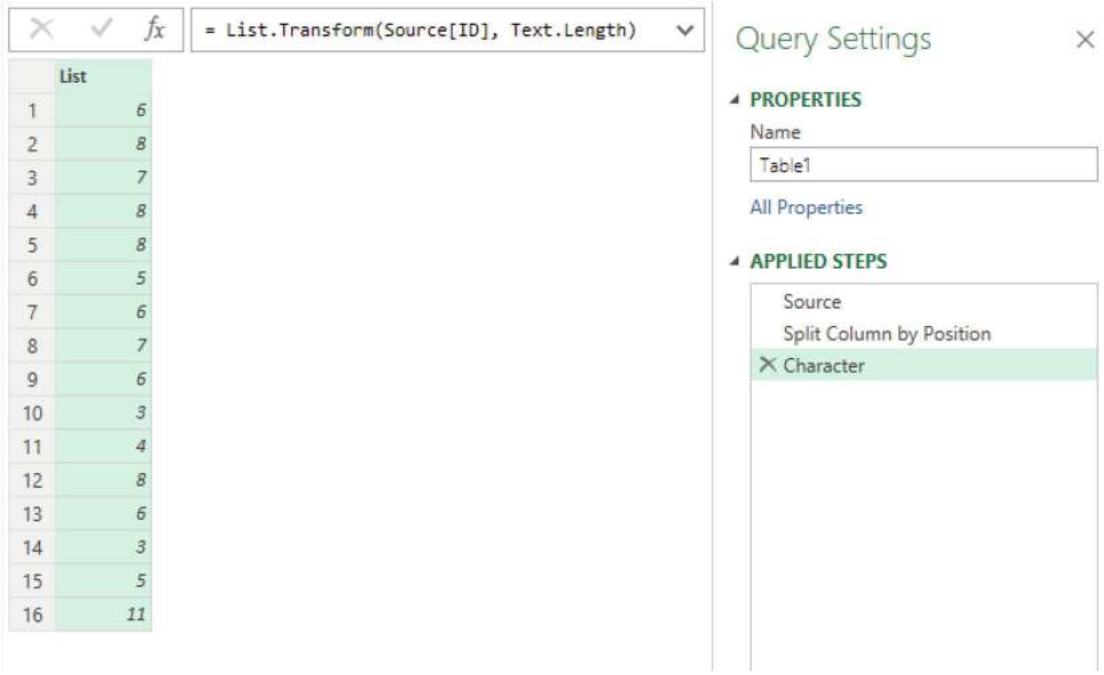
***Figure 4-19*** Revised splitting after adding new IDs

This issue arises because the splitting function `Splitter.SplitTextByLengths({2, 1, 2, 1, 2})` only accommodates the first eight characters (2+1+2+1+2=8) of the text. To make the formula dynamic, you need to extract the longest text in this column and use it to determine the number of splitting parts. Therefore, a new step, named Character, can be added to Power Query with one of the following formulas, resulting in Figure 4-20.

```
= List.Transform(Source[ID], each Text.Length(_))
```

of

```
= List.Transform(Source[ID], Text.Length)
```



```
= List.Transform(Source[ID], Text.Length)
```

| | List |
|---|---|
| 1 | 6 |
| 2 | 8 |
| 3 | 7 |
| 4 | 8 |
| 5 | 8 |
| 6 | 5 |
| 7 | 6 |
| 8 | 7 |
| 9 | 6 |
| 10 | 3 |
| 11 | 4 |
| 12 | 8 |
| 13 | 6 |
| 14 | 3 |
| 15 | 5 |
| 16 | 11 |

Query Settings

PROPERTIES

Name

Table1

All Properties

APPLIED STEPS

Source

Split Column by Position

Character

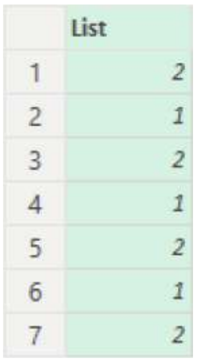
***Figure 4-20*** The result of the List.Transform() function

In this formula, the result of `Source[ID]` is a list that includes all the IDs from the source table, and the `List.Transform()` function is used to extract the length of each ID. To identify the largest length among all the lengths, rewrite the previous formula as follows to extract the maximum value, which is 11 for the provided data.

```
= List.Max(List.Transform(Source[ID], Text.Length))
```

Since the Character step represents the maximum number of characters in a cell among all the cells in the ID column, the next step involves converting this value into a list, such as `{2, 1}` or `{2,1,2}`. To do this, add a new step and rename it `ListofCharacters`. Use the following formula for this step, which will yield a list as shown in Figure 4-21, which can be utilized in the splitter function.

```
= List.Repeat({2,1},Number.IntegerDivide(Character,3)) & (if
Number.Mod(Character,3)=0 then {} else {2})
```



| | List |
|---|---|
| 1 | 2 |
| 2 | 1 |
| 3 | 2 |
| 4 | 1 |
| 5 | 2 |
| 6 | 1 |
| 7 | 2 |

***Figure 4-21*** The result of ListofCharacters

**Note** The following formula is used to convert the number 11 into a list equal to `{2,1,2,1,2,1,2}`.

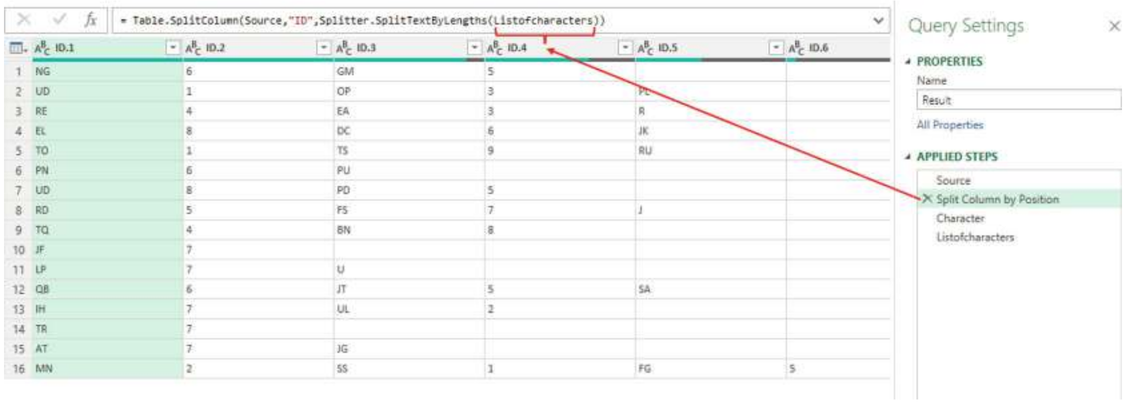
```
= List.Repeat({2,1},Number.IntegerDivide(Character,3)) & (if
Number.Mod(Character,3)=0 then {} else {2})
```

As the value of `Character` is 11, replace it with 11, the result of `Number.IntegerDivide(11,3)` is 3, and the result of `Number.Mod(11,3)` is 2, so the formula is equal to the following:

```
= List.Repeat({2,1},3) & (if 2=0 then {} else {2})
```

`List.Repeat({2,1},3)` means the `{2,1}` list should be repeated three times, so it is equal to `{2,1,2,1,2,1}`, and the result of `(if 2=0 then {} else {2})` is `{2}`, so the formula results in `{2,1,2,1,2,1} & {2}` which is equal to `{2,1,2,1,2,1,2}`.

You can now proceed to the Split Column by Position step and replace its fourth argument with the name of the `ListofCharacters` step. This change results in Figure 4-22; however, the desired result will appear in an intermediate step rather than the final step. Therefore, you need to reorder the steps accordingly.



```
= Table.SplitColumn(Source,"ID",Splitter.SplitTextByLengths(Listofcharacters))
```

| | ID.1 | ID.2 | ID.3 | ID.4 | ID.5 | ID.6 |
|---|---|---|---|---|---|---|
| 1 | NG | 6 | GM | 5 | | |
| 2 | UD | 1 | OP | 3 | PL | |
| 3 | RE | 4 | EA | 3 | R | |
| 4 | EL | 8 | DC | 6 | JK | |
| 5 | TO | 1 | TS | 9 | RU | |
| 6 | PN | 6 | PU | | | |
| 7 | UD | 8 | PD | 5 | | |
| 8 | RD | 5 | FS | 7 | J | |
| 9 | TQ | 4 | BN | 8 | | |
| 10 | JF | 7 | | | | |
| 11 | LP | 7 | U | | | |
| 12 | QB | 6 | JT | 5 | SA | |
| 13 | IH | 7 | UL | 2 | | |
| 14 | TR | 7 | | | | |
| 15 | AT | 7 | JG | | | |
| 16 | MN | 2 | SS | 1 | FG | 5 |

***Figure 4-22*** Replacing the fourth argument of Table.SplitColumn()

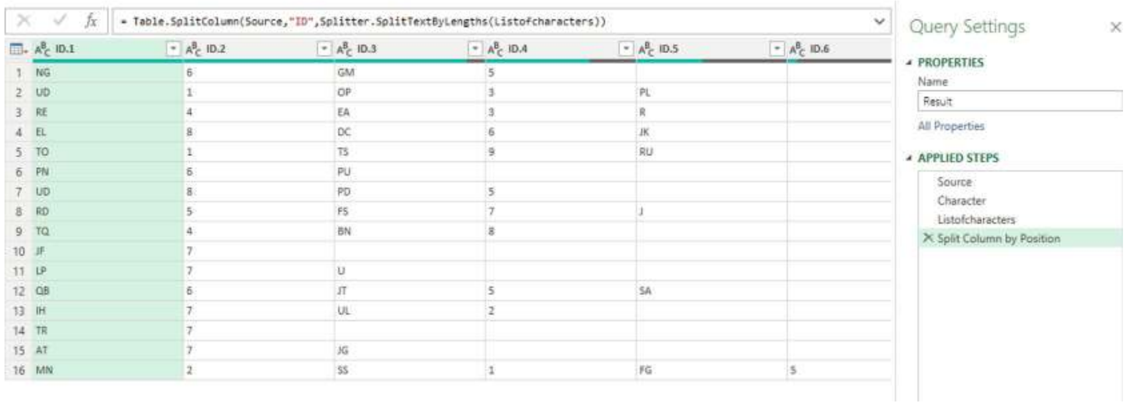
Go to the Home tab and choose the Advanced Editor command. The complete query including the following steps is shown in the open window:

```
let
    Source = Excel.CurrentWorkbook(){[Name="Table1"]}[Content],
     #"Split Column by Position"
=  Table.SplitColumn(Source,"ID",Splitter.SplitTextByLengths(Listofcharacters)
       Character = List.Max(List.Transform(Source[ID], Text.Length)),
    Listofcharacters = List.Repeat({2,1},Number.IntegerDivide(Character,3)) &
(if Number.Mod(Character,3)=0 then {} else {2})
in
    Listofcharacters
```

In the open window, reorder the steps (bring the `Character` and `ListofCharacters` steps before `#"Split Column by Position"`), then add `","` to the end of the `ListofCharacters` step, and remove `","` from the end of the `#"Split Column by Position"` step. Replace the `ListofCharacters` text with `#"Split Column by Position"` after the `in`, as shown here, to reach the dynamic solution, which results in Figure 4-23.

```
let
    Source = Excel.CurrentWorkbook(){[Name="Table1"]}[Content],
       Character = List.Max(List.Transform(Source[ID], Text.Length)),
    Listofcharacters = List.Repeat({2,1},Number.IntegerDivide(Character,3)) &
(if Number.Mod(Character,3)=0 then {} else {2}),
    #"Split Column by Position"
=  Table.SplitColumn(Source,"ID",Splitter.SplitTextByLengths(Listofcharacters)

in
    #"Split Column by Position"
```



```
= Table.SplitColumn(Source,"ID",Splitter.SplitTextByLengths(Listofcharacters))
```

| | ID.1 | ID.2 | ID.3 | ID.4 | ID.5 | ID.6 |
|---|---|---|---|---|---|---|
| 1 | NG | 6 | GM | 5 | | |
| 2 | UD | 1 | OP | 3 | PL | |
| 3 | RE | 4 | EA | 3 | R | |
| 4 | EL | 8 | DC | 6 | JK | |
| 5 | TO | 1 | TS | 9 | RU | |
| 6 | PN | 6 | PU | | | |
| 7 | UD | 8 | PD | 5 | | |
| 8 | RD | 5 | FS | 7 | J | |
| 9 | TQ | 4 | BN | 8 | | |
| 10 | JF | 7 | | | | |
| 11 | LP | 7 | U | | | |
| 12 | QB | 6 | JT | 5 | SA | |
| 13 | IH | 7 | UL | 2 | | |
| 14 | TR | 7 | | | | |
| 15 | AT | 7 | JG | | | |
| 16 | MN | 2 | SS | 1 | FG | 5 |

***Figure 4-23*** The final result after reordering the steps

## Extracting Text Between Parentheses

Consider the text provided in the Source table, shown in Table 4-6. Extract all the values between the parameters.

***Table 4-6*** Source: Text

| Text |
|---|
| Renewable energy resources (5), renewable energies (RE), renewable resource (28), 81 renewable energy source (47) |
| Electric batteries (6), energy storage (18), 12 battery storage (52) |
| Photovoltaic cells (7), photovoltaic system (8) |
| Wind power (9), wind turbines (12), wind (24) |
| Solar power (SP) generation (15), 3 solar energy (32), solar power (48) |
| Algorithm (16), algorithms (37), genetic algorithms (19), genetic algorithm (45) |
| Hybrid energy system (20), hybrid renewable energy systems (21), hybrid renewable energies (41) |
| Related but not exactly the same terms 5 |
| Optimization (3), Multi-objective optimization (13), particle swarm optimization (PSO) (10) |
| Electric power systems (EPS), 17 electric power transmission networks (40) |
| Energy management (EM), energy management systems (49) |
| 26 Economic analysis (26), cost analysis (33), cost effectiveness (30), cost benefit analysis (38) |

**Note** The data in this example is provided in an Excel file titled `04 Extracting Text Between Parentheses.xlsx`.

Three different solutions based on splitter functions and text functions are provided for this problem.

### Solution 1: Splitter-Based

At first glance, using a column splitter to split all the text after the opening parenthesis might seem like a viable solution. However, cleaning the results afterward can be quite challenging in this case. Instead, let's consider another type of splitter.

Among the available splitter functions, the `Splitter.SplitTextByRanges()` function can be useful for solving this problem. To check this function, consider the text in the first row of the Source table as variable `X`. The following formula extracts the character at the 28th position in `X`, resulting in `{5}` (the first value inside the parentheses).

```
= Splitter.SplitTextByRanges({{28,1}})(X)
```

Under similar conditions, the result of the following formula would be `{5, "RE", 28, 47}`, which is equal to all the values between the parentheses:

```
= Splitter.SplitTextByRanges({{28,1},{52,2},{77,2},{110,2}})(X)
```

As presented, the first argument used in this function is a list, including several sublists. In each sublist in `{{28,1},{52,2},{77,2},{110,2}}`, the first item presents the position of `"("` `+1` (the starting point for separation), and the second item presents the number of characters between each parentheses (the number of characters that should be extracted).

To solve the problem, you need to initially extract the position of every open parenthesis plus 1 (to reach the first character after the parentheses) and the number of characters between the parentheses to extract after the parenthesis in several sublists.

To determine the positions of the opening and closing parentheses, you can use the `Text.PositionOfAny()` function, as shown here. This function will return a list of the indexes for the occurrences of the `")"` and `"("` characters in the X variable, resulting in `{27, 29, 51, 54, 76, 79, 109, 112}`.

```
=Text.PositionOfAny(X,{"(",")"},2)
```

**Note** The `Text.PositionOfAny()` function is used to extract the positions of items in a list, with the following syntax:

```
Text.PositionOfAny(
    text as text,
    characters as list,
    optional occurrence as nullable number
        ) as any
```

This function takes three inputs as follows:

1. The reference text.
2. A list that contains the substrings that you want to search for their positions in the reference text.
3. This input is optional. By entering the numbers 0, 1, or 2, you specify whether the smallest number (first repetition at the beginning of the text), the largest number (last repetition at the end of the text), or all the numbers should be displayed in the output.

In the next step, you can use the `List.Split()` function to group the positions of each occurrence of `"("` and `")"` into sublists. This will organize the values into sublists as follows: `{{27, 29}, {51, 54}, {76, 79}, {109, 112}}`.

```
=List.Split(
      Text.PositionOfAny(X,{"(",")"},2)
      ,2)
```

Considering the first sublist, the `"("` is at the 27th character in `X`, and `")"` is at the 29th character. To use these values in the splitter function, they need to be adjusted to `{27 + 1, 29 - 27 - 1}`, resulting in `{28, 1}`.

To convert the sublists into the correct format for the splitter function, you can use the `List.Transform()` function, and the previous formula can be rewritten as follows:

```
=List.Transform(
    List.Split(
                     Text.PositionOfAny(X,{"(",")"},2),
                     2),
    (y)=>{y{0}+1,y{1}-y{0}-1})
```

This transforms the values in the format `{start position, number of characters}`. So, the formula results in `{{28, 1}, {52, 2}, {77, 2}, {110, 2}}`.

To understand what happened in the previous formula, let's replace the first argument of `List.Transform()` with its value, which results in the following formula.

```
=List.Transform(
    {{27, 29}, {51, 54}, {76, 79}, {109, 112}},
    (y)=>{y{0}+1,y{1}-y{0}-1})
```

This means that the transformation function `(y) => {y{0} + 1, y{1} - y{0} - 1}` is applied to each item in the list `{{27, 29},{51, 54},{76, 79},{109, 112}}`.

For the first item, `y` is `{27, 29}`, so `y{0}` is `27` and `y{1}` is `29`. As a result, `{y{0} + 1, y{1} - y{0} - 1}` becomes `{27 + 1, 29 - 27 - 1}`, which simplifies to `{28, 1}`.

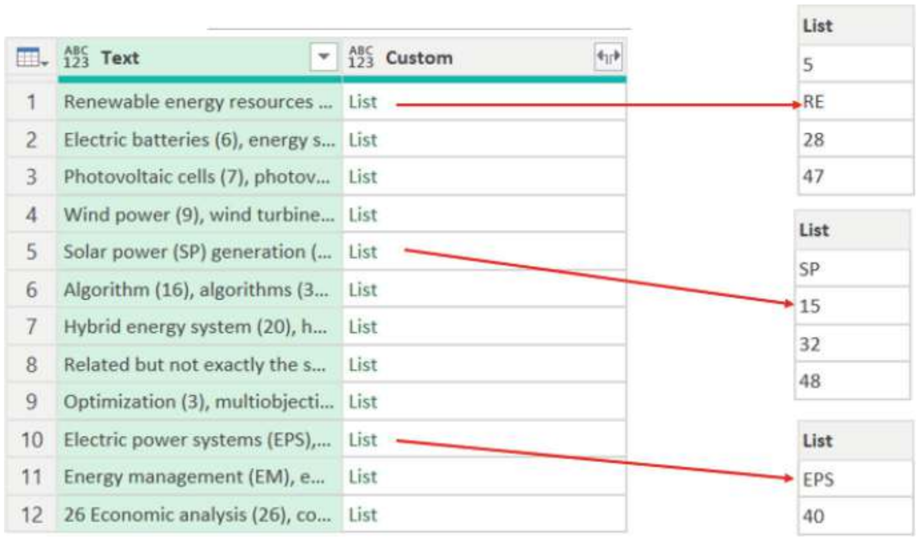
The same process is applied to the other items in the list, resulting in `{{28, 1}, {52, 2}, {77, 2}, {110, 2}}`.

After transforming the list items into the right shape, you can use this formula as the range positions for splitting in the first argument of the `Splitter.SplitTextByRanges()` function to extract all the values inside the parentheses from `X` as follows. This approach enables you to split the text at the specified ranges and retrieve the desired substrings.

```
=Splitter.SplitTextByRanges(
        List.Transform(List.Split(
                                   Text.PositionOfAny(X,{"(",")"},2),
                                   2),
        (y)=>{y{0}+1,y{1}-y{0}-1})
        )(X)
```

This formula is used for a single piece of text, but it can be applied to all the values on the Text column. Back to the main question—the defined custom splitter function can be applied in a new column by adding a custom column, and using the following formula in the formula bar, which will result in Figure 4-24 (producing a list of extracted values).

```
= Table.AddColumn(Source, "Custom", each Splitter.SplitTextByRanges(
List.Transform(List.Split(Text.PositionOfAny([Text],{"(",")"},2),2), (y)=>
{y{0}+1,y{1}-y{0}-1}))([Text]))
```



| | Text | Custom |
|---|---|---|
| 1 | Renewable energy resources ... | List |
| 2 | Electric batteries (6), energy s... | List |
| 3 | Photovoltaic cells (7), photov... | List |
| 4 | Wind power (9), wind turbine... | List |
| 5 | Solar power (SP) generation (... | List |
| 6 | Algorithm (16), algorithms (3... | List |
| 7 | Hybrid energy system (20), h... | List |
| 8 | Related but not exactly the s... | List |
| 9 | Optimization (3), multiobjecti... | List |
| 10 | Electric power systems (EPS),... | List |
| 11 | Energy management (EM), e... | List |
| 12 | 26 Economic analysis (26), co... | List |

| List |
|---|
| 5 |
| RE |
| 28 |
| 47 |

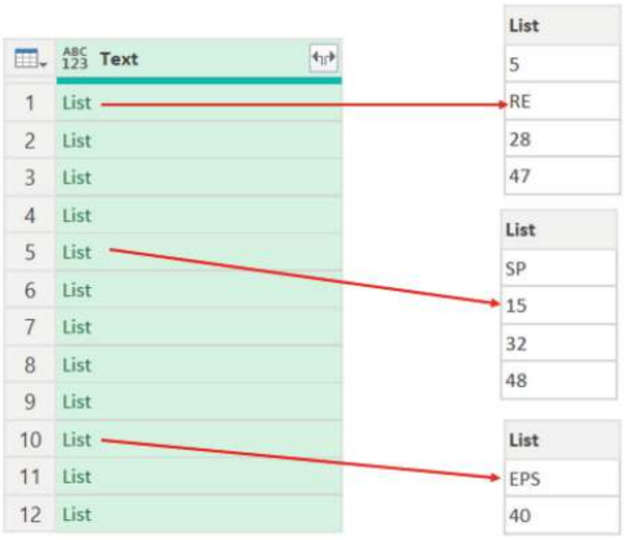
| List |
|---|
| SP |
| 15 |
| 32 |
| 48 |

| List |
|---|
| EPS |
| 40 |

***Figure 4-24*** The result of adding a new column

This formula can also be used in the `Table.TransformColumns()` function by entering the following formula in the formula bar, which results in Figure 4-25.

```
= Table.TransformColumns(
  Source,
  {
    "Text",
    each Splitter.SplitTextByRanges(
      List.Transform(
        List.Split(Text.PositionOfAny(_, {"(", ")"}, 2), 2),
        (y) => {y{0} + 1, y{1} - y{0} - 1}
      )
    )(_)
  }
)
```



|  | Text |
|---|---|
| 1 | List |
| 2 | List |
| 3 | List |
| 4 | List |
| 5 | List |
| 6 | List |
| 7 | List |
| 8 | List |
| 9 | List |
| 10 | List |
| 11 | List |
| 12 | List |

| List |
|---|
| 5 |
| RE |
| 28 |
| 47 |

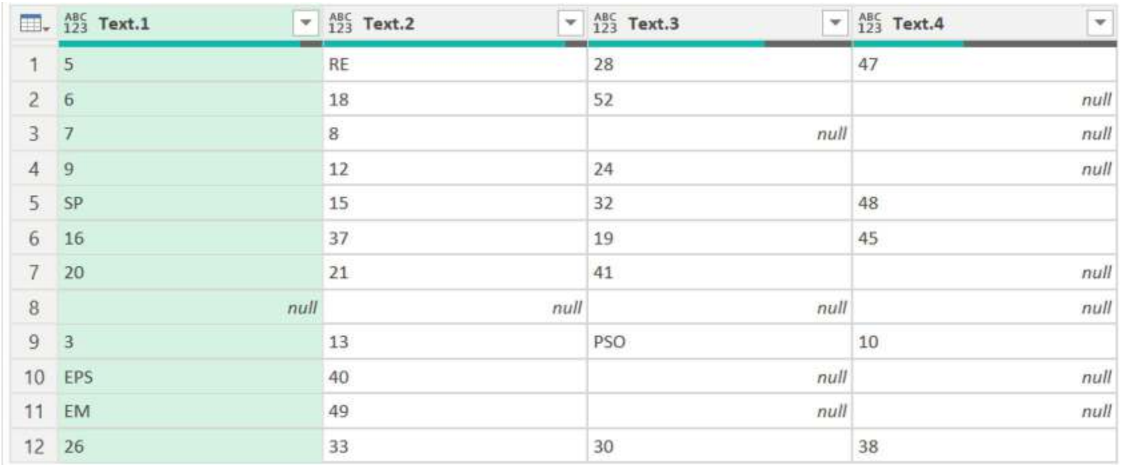
| List |
|---|
| SP |
| 15 |
| 32 |
| 48 |

| List |
|---|
| EPS |
| 40 |

***Figure 4-25*** The result of the column transform

Or it can be used in the `Table.SplitColumn()` using the following formula in the formula bar, which results in Figure 4-26 (the number of columns after splitting is determined by the first row).

```
= Table.SplitColumn(
      Source,
      "Text",
      each Splitter.SplitTextByRanges(
                  List.Transform(
                         List.Split(
                               Text.PositionOfAny(_,{"(",")"},2)
                                     ,2)
                                     , (y)=> {y{0}+1,y{1}-y{0}-1})
                                                 )(_)
      )
```



| | Text.1 | Text.2 | Text.3 | Text.4 |
|---|---|---|---|---|
| 1 | 5 | RE | 28 | 47 |
| 2 | 6 | 18 | 52 | null |
| 3 | 7 | 8 | null | null |
| 4 | 9 | 12 | 24 | null |
| 5 | SP | 15 | 32 | 48 |
| 6 | 16 | 37 | 19 | 45 |
| 7 | 20 | 21 | 41 | null |
| 8 | null | null | null | null |
| 9 | 3 | 13 | PSO | 10 |
| 10 | EPS | 40 | null | null |
| 11 | EM | 49 | null | null |
| 12 | 26 | 33 | 30 | 38 |

*Figure 4-26* Extracting all the values from parenthesis

## Solution 2: Text Functions

The previous formula solved the problem, but it was not efficient. Power Query provides a useful function for extracting text between delimiters, called `Text.BetweenDelimiters()`. Given the previous variable `X`, the result of the following formula is `5`, which represents the first value between the parentheses.

```
= Text.BetweenDelimiters(X,"(",")")
```

The result of the following formula is `"RE"`, which is the value between the second parentheses:

```
=Text.BetweenDelimiters(X,"(",")",1)
```

You can use the fourth argument of this function to evaluate which parentheses you are searching for. The combination of this function and the `List.Transform()` function can help you solve this problem. Use the following formula to extract the values inside the first four parentheses in `X`, resulting in `{5, "RE", 28, 47}`.

```
= List.Transform(
    {0..3},
    (y)=>Text.BetweenDelimiters(X,"(",")",y))
```

The hardcoded part (the first argument that determined the number of parentheses in the text) of the previous formula can be replaced with the following formula:

```
=List.Transform(
    List.Positions(Text.PositionOf(X,"(",2)),
    (y)=>Text.BetweenDelimiters(X,"(",")",y))
```

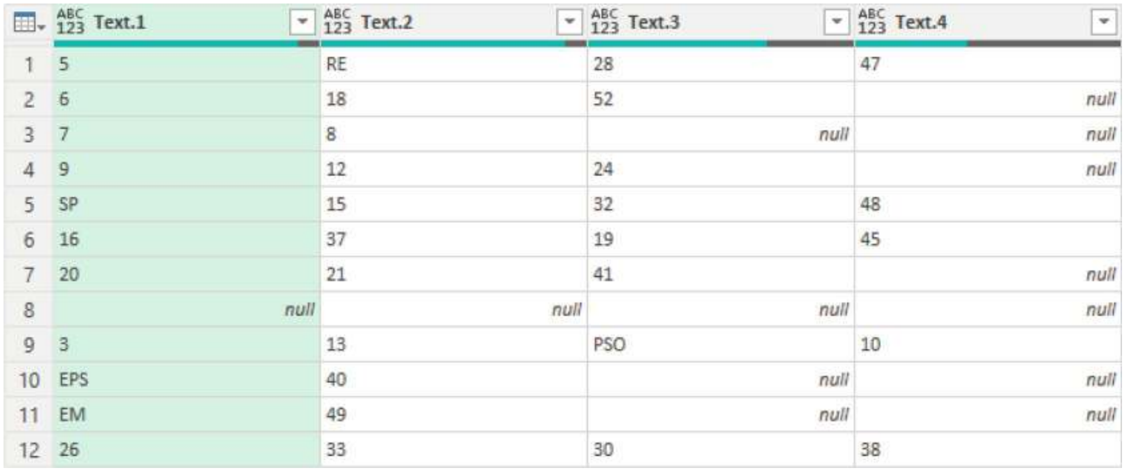
This formula dynamically generates the number of parentheses in the text and extracts the text between them.

You can use the previous formula as a custom splitter in the `Table.SplitColumn()` function by entering the following formula in the formula bar, which results in Figure 4-27, and solves the problem.

```
= Table.SplitColumn(
      Source,
      "Text",
      each List.Transform(
                                   List.Positions(Text.PositionOf(_,"(",2)),
                                   (y)=>Text.BetweenDelimiters(_,"(",")",y)))
```

**Note** Like the previous formula, the following formula can also be used to extract the values between parentheses in X using similar logic.

```
= List.Transform(Text.Split(X, "("), (y)=> Text.BeforeDelimiter (y,")"))
```



| | Text.1 | Text.2 | Text.3 | Text.4 |
|---|---|---|---|---|
| 1 | 5 | RE | 28 | 47 |
| 2 | 6 | 18 | 52 | null |
| 3 | 7 | 8 | null | null |
| 4 | 9 | 12 | 24 | null |
| 5 | SP | 15 | 32 | 48 |
| 6 | 16 | 37 | 19 | 45 |
| 7 | 20 | 21 | 41 | null |
| 8 | null | null | null | null |
| 9 | 3 | 13 | PSO | 10 |
| 10 | EPS | 40 | null | null |
| 11 | EM | 49 | null | null |
| 12 | 26 | 33 | 30 | 38 |

***Figure 4-27*** The final table

**Note** In both of the previous solutions, the number of columns after splitting is determined by the number of parentheses in the first row of the table. In this example, since the first row contains four parentheses, the data will be split into four columns. However, if any row has more than four parentheses, the information inside the fifth and subsequent parentheses will be ignored. To resolve this and make the formula dynamic, the number of columns after splitting should be determined using the fourth argument of the function. The following formula calculates the maximum number of parentheses across all rows:

```
= List.Max( List.Transform(Source[Text],each Text.Length(Text.Select(_,"
("))))
```

By adding this formula to the fourth argument of the function and rewriting it as follows, the solution becomes dynamic. This ensures the correct number of columns is generated based on the maximum number of parentheses in any row.

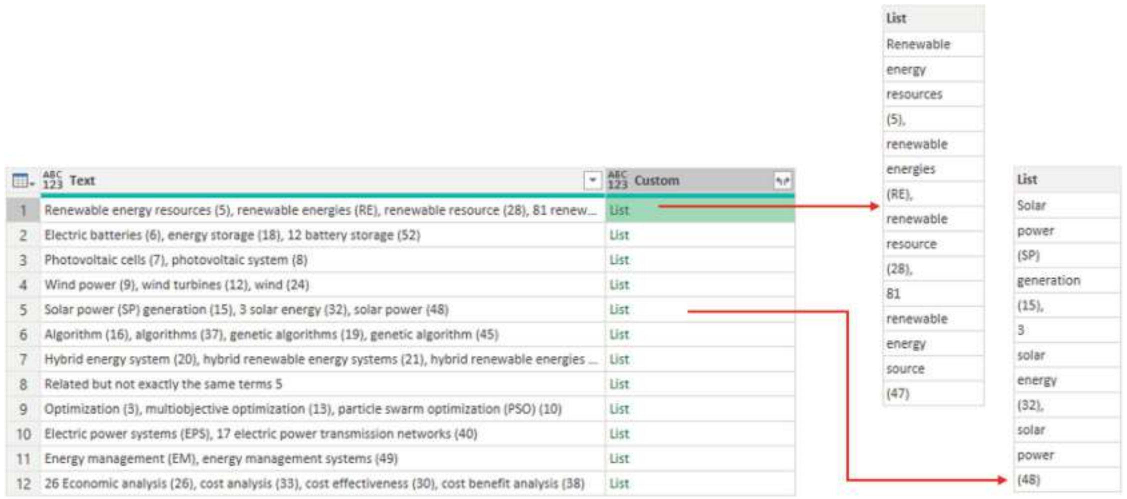
```
= Table.SplitColumn(
      Source,
      "Text",
      each List.Transform(
                                       List.Positions(Text.PositionOf(_,"(",2)),
                                       (y)=>Text.BetweenDelimiters(_,"
(",")",y)),
      List.Max( List.Transform(Source[Text],each
Text.Length(Text.Select(_,"("))))))
```

## Solution 3: Using Text.Split

Although both of the previously mentioned solutions work correctly, this solution may be more efficient. However, it only works if the text within the parentheses is continuous, with no spaces. To try this solution, consider the source table and add a new column named Inside the Parentheses using the following formula:

```
=Text.Split([Text]," ")
```

This formula splits each word in the text based on spaces, resulting in a list of individual words, as shown in Figure 4-28.



| | Text | Custom |
|---|---|---|
| 1 | Renewable energy resources (5), renewable energies (RE), renewable resource (28), 81 renew... | List |
| 2 | Electric batteries (6), energy storage (18), 12 battery storage (52) | List |
| 3 | Photovoltaic cells (7), photovoltaic system (8) | List |
| 4 | Wind power (9), wind turbines (12), wind (24) | List |
| 5 | Solar power (SP) generation (15), 3 solar energy (32), solar power (48) | List |
| 6 | Algorithm (16), algorithms (37), genetic algorithms (19), genetic algorithm (45) | List |
| 7 | Hybrid energy system (20), hybrid renewable energy systems (21), hybrid renewable energies ... | List |
| 8 | Related but not exactly the same terms 5 | List |
| 9 | Optimization (3), multiobjective optimization (13), particle swarm optimization (PSO) (10) | List |
| 10 | Electric power systems (EPS), 17 electric power transmission networks (40) | List |
| 11 | Energy management (EM), energy management systems (49) | List |
| 12 | 26 Economic analysis (26), cost analysis (33), cost effectiveness (30), cost benefit analysis (38) | List |

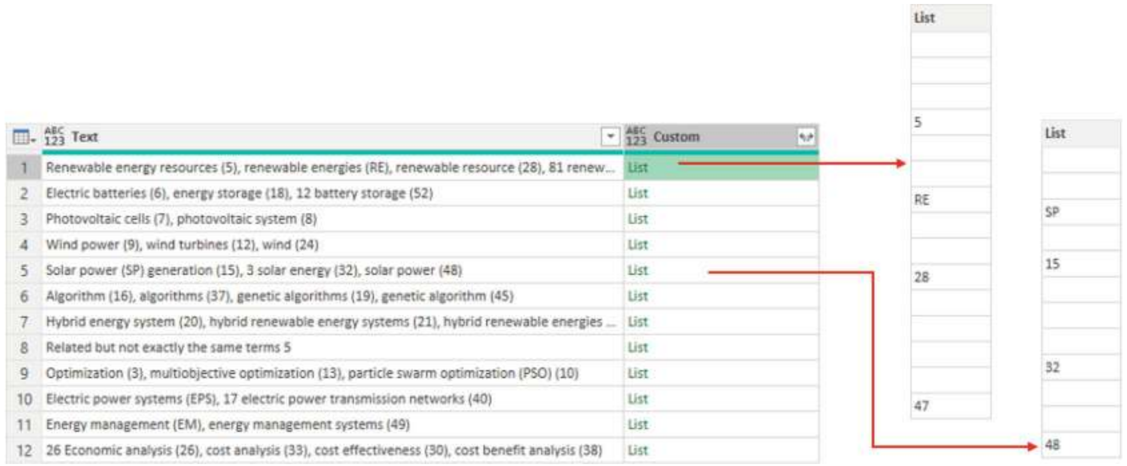
| List |
|---|
| Renewable |
| energy |
| resources |
| (5), |
| renewable |
| energies |
| (RE), |
| renewable |
| resource |
| (28), |
| 81 |
| renewable |
| energy |
| source |
| (47) |

| List |
|---|
| Solar |
| power |
| (SP) |
| generation |
| (15), |
| 3 |
| solar |
| energy |
| (32), |
| solar |
| power |
| (48) |

*Figure 4-28* The result of Text.Split()

Out of all the items in the resulting list, you want to extract only the values between the parentheses. By rewriting the formula as follows, the result will be updated as shown in Figure 4-29 and include only the values between the parentheses:

```
=List.Transform(Text.Split([Text]," "), each Text.BetweenDelimiters(_,"
(",")"))
```



| | Text | Custom |
|---|---|---|
| 1 | Renewable energy resources (5), renewable energies (RE), renewable resource (28), 81 renew... | List |
| 2 | Electric batteries (6), energy storage (18), 12 battery storage (52) | List |
| 3 | Photovoltaic cells (7), photovoltaic system (8) | List |
| 4 | Wind power (9), wind turbines (12), wind (24) | List |
| 5 | Solar power (SP) generation (15), 3 solar energy (32), solar power (48) | List |
| 6 | Algorithm (16), algorithms (37), genetic algorithms (19), genetic algorithm (45) | List |
| 7 | Hybrid energy system (20), hybrid renewable energy systems (21), hybrid renewable energies ... | List |
| 8 | Related but not exactly the same terms 5 | List |
| 9 | Optimization (3), multiobjective optimization (13), particle swarm optimization (PSO) (10) | List |
| 10 | Electric power systems (EPS), 17 electric power transmission networks (40) | List |
| 11 | Energy management (EM), energy management systems (49) | List |
| 12 | 26 Economic analysis (26), cost analysis (33), cost effectiveness (30), cost benefit analysis (38) | List |

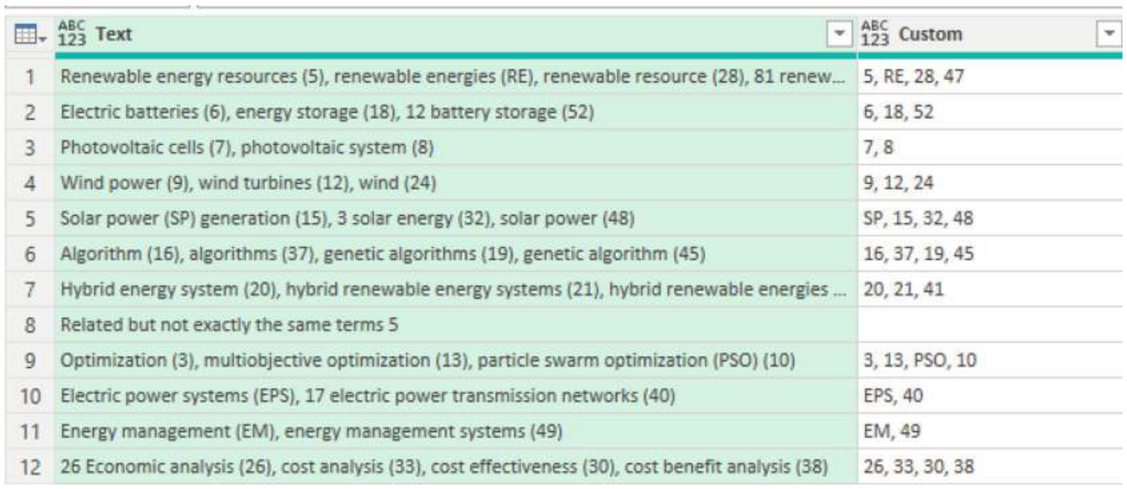
| List |
|---|
| |
| |
| |
| 5 |
| |
| |
| RE |
| |
| |
| 28 |
| |
| |
| |
| |
| 47 |

| List |
|---|
| |
| |
| SP |
| |
| 15 |
| |
| |
| |
| 32 |
| |
| |
| 48 |

*Figure 4-29* The result of the updated formula

To finalize this solution, you just need to remove the blank items from the list, using the `List.RemoveItems()` function, and then combine the remaining values using the `Text.Combine()` function. Replacing the formula with the following one can solve the problem and provide the final table shown in Figure 4-30:

```
=Text.Combine(List.RemoveItems(List.Transform(Text.Split([Text]," "), each
Text.BetweenDelimiters(_,"(",")")),{""}),", ")
```



| | Text | Custom |
|---|---|---|
| 1 | Renewable energy resources (5), renewable energies (RE), renewable resource (28), 81 renew... | 5, RE, 28, 47 |
| 2 | Electric batteries (6), energy storage (18), 12 battery storage (52) | 6, 18, 52 |
| 3 | Photovoltaic cells (7), photovoltaic system (8) | 7, 8 |
| 4 | Wind power (9), wind turbines (12), wind (24) | 9, 12, 24 |
| 5 | Solar power (SP) generation (15), 3 solar energy (32), solar power (48) | SP, 15, 32, 48 |
| 6 | Algorithm (16), algorithms (37), genetic algorithms (19), genetic algorithm (45) | 16, 37, 19, 45 |
| 7 | Hybrid energy system (20), hybrid renewable energy systems (21), hybrid renewable energies ... | 20, 21, 41 |
| 8 | Related but not exactly the same terms 5 | |
| 9 | Optimization (3), multiobjective optimization (13), particle swarm optimization (PSO) (10) | 3, 13, PSO, 10 |
| 10 | Electric power systems (EPS), 17 electric power transmission networks (40) | EPS, 40 |
| 11 | Energy management (EM), energy management systems (49) | EM, 49 |
| 12 | 26 Economic analysis (26), cost analysis (33), cost effectiveness (30), cost benefit analysis (38) | 26, 33, 30, 38 |

***Figure 4-30*** The final result

## Extracting Email Addresses

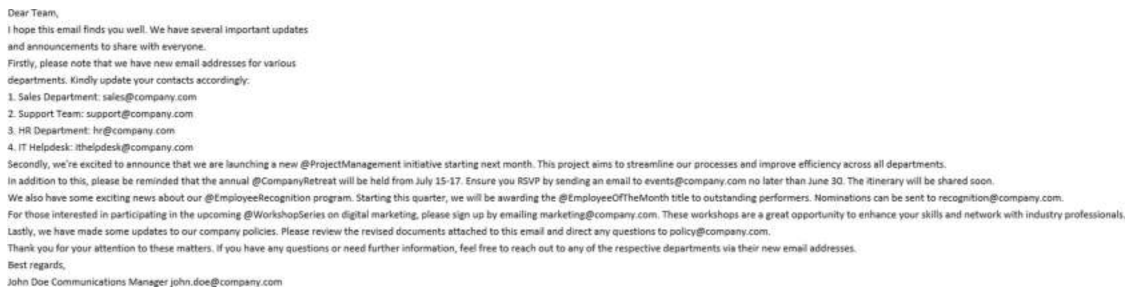
Consider a source table containing the text (generated by ChatGPT) shown in Table 4-7. Extract all the email addresses from this text.

***Table 4-7*** Source: Sample Text

| Text |
|---|
| Dear Team, |
| I hope this email finds you well. We have several important updates |
| and announcements to share with everyone. |
| Firstly, please note that we have new email addresses for various |
| departments. Kindly update your contacts accordingly: |
| 1. Sales Department: sales@company.com |
| 2. Support Team: support@company.com |
| 3. HR Department: hr@company.com |
| 4. IT Helpdesk: ithelpdesk@company.com |
| Secondly, we're excited to announce that we are launching a new @ProjectManagement initiative starting next month. This project aims to streamline our processes and improve efficiency across all departments. |
| In addition to this, please be reminded that the annual @CompanyRetreat will be held from July 15-17. Ensure you RSVP by sending an email to events@company.com no later than June 30. The itinerary will be shared soon. |
| We also have some exciting news about our @EmployeeRecognition program. Starting this quarter, we will be awarding the @EmployeeOfTheMonth title to outstanding performers. Nominations can be sent to recognition@company.com. |
| For those interested in participating in the upcoming @WorkshopSeries on digital marketing, please sign up by emailing marketing@company.com. These workshops are a great opportunity to enhance your skills and network with industry professionals. |
| Lastly, we have made some updates to our company policies. Please review the revised documents attached to this email and direct any questions to policy@company.com. |
| Thank you for your attention to these matters. If you have any questions or need further information, feel free to reach out to any of the respective departments via their new email addresses. |
| Best regards, |
| John Doe Communications Manager john.doe@company.com |

**Note** The data in this example is provided in an Excel file titled `05 Extracting Email Addresses.xlsx`.

To solve this problem, you can use the `Source[Text]{0}` formula to get the text from the first row of the Text column (instead of working on a single column and row table, it would be better to work on the text), which will result in the text shown in Figure 4-31. (If the Text column contains more than one row, use the `Text.Combine(Source[Text]," ")` formula to concatenate all rows into a single text string.)

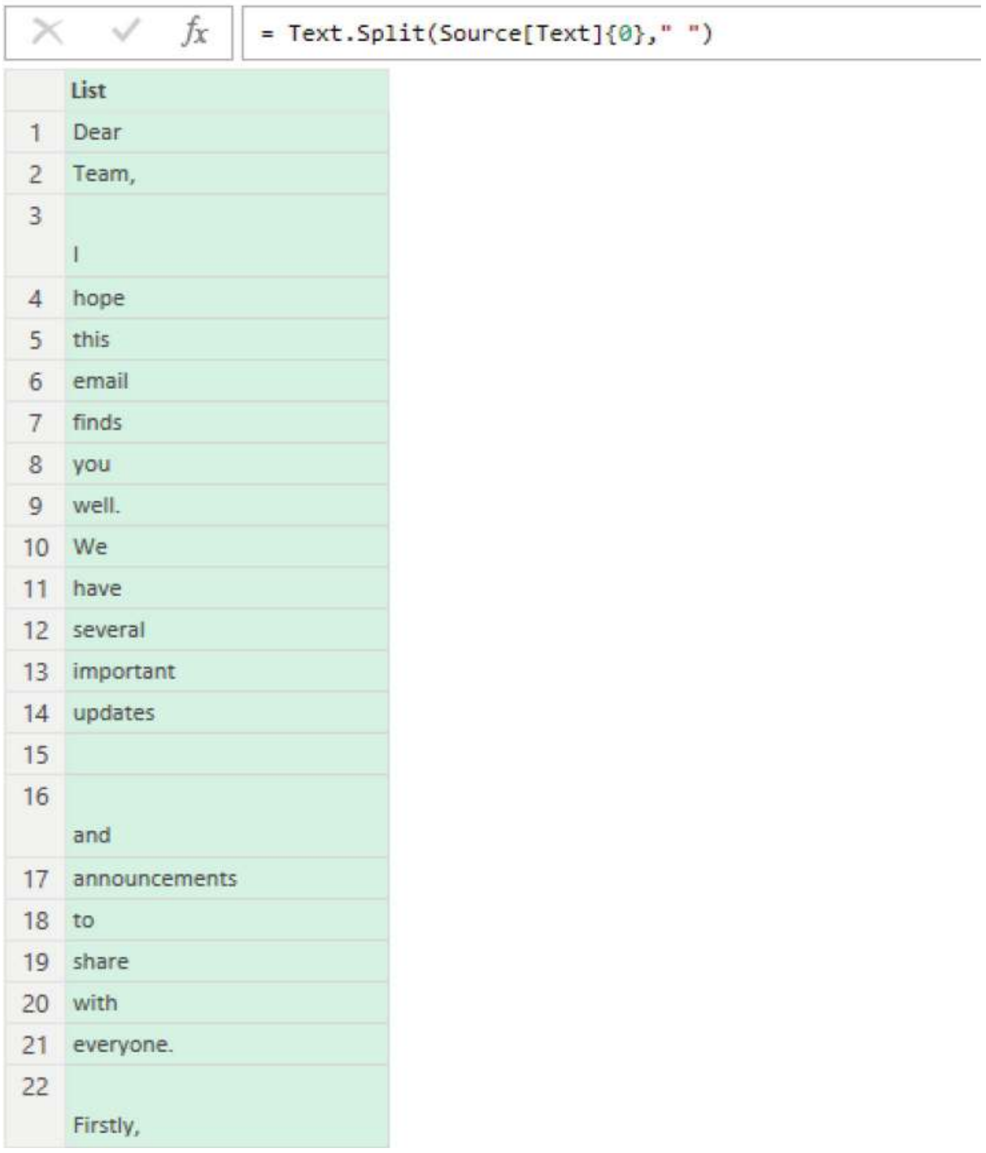


```
Dear Team,
I hope this email finds you well. We have several important updates
and announcements to share with everyone.
Firstly, please note that we have new email addresses for various
departments. Kindly update your contacts accordingly:
1. Sales Department: sales@company.com
2. Support Team: support@company.com
3. HR Department: hr@company.com
4. IT Helpdesk: ithelpdesk@company.com
Secondly, we're excited to announce that we are launching a new @ProjectManagement initiative starting next month. This project aims to streamline our processes and improve efficiency across all departments.
In addition to this, please be reminded that the annual @CompanyRetreat will be held from July 15-17. Ensure you RSVP by sending an email to events@company.com no later than June 30. The itinerary will be shared soon.
We also have some exciting news about our @EmployeeRecognition program. Starting this quarter, we will be awarding the @EmployeeOfTheMonth title to outstanding performers. Nominations can be sent to recognition@company.com.
For those interested in participating in the upcoming @WorkshopSeries on digital marketing, please sign up by emailing marketing@company.com. These workshops are a great opportunity to enhance your skills and network with industry professionals.
Lastly, we have made some updates to our company policies. Please review the revised documents attached to this email and direct any questions to policy@company.com.
Thank you for your attention to these matters. If you have any questions or need further information, feel free to reach out to any of the respective departments via their new email addresses.
Best regards,
John Doe Communications Manager john.doe@company.com
```

***Figure 4-31*** Converting the table into text

To solve this problem, in the first step, split the text into words based on spaces using the `Text.Split()` function as the following formula, resulting in a list containing all the words, as shown in Figure 4-32.

```
= Text.Split(Source[Text]{0}," ")
```



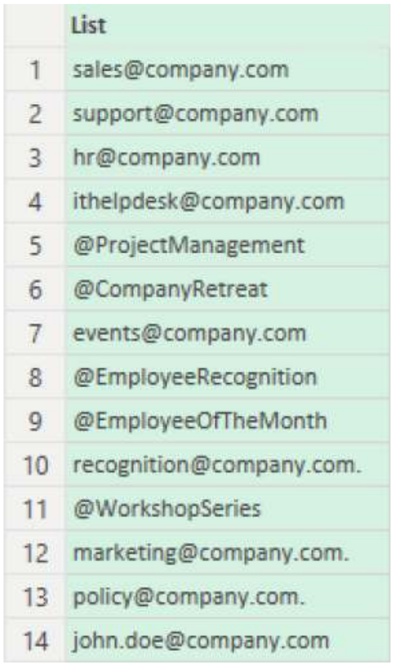
```
= Text.Split(Source[Text]{0}," ")
```

|  | List |
|---|---|
| 1 | Dear |
| 2 | Team, |
| 3 | I |
| 4 | hope |
| 5 | this |
| 6 | email |
| 7 | finds |
| 8 | you |
| 9 | well. |
| 10 | We |
| 11 | have |
| 12 | several |
| 13 | important |
| 14 | updates |
| 15 |  |
| 16 | and |
| 17 | announcements |
| 18 | to |
| 19 | share |
| 20 | with |
| 21 | everyone. |
| 22 | Firstly, |

***Figure 4-32*** The result of Text.Split

To filter out the words containing `"@"`, you can use the `List.Select()` function. This function takes two arguments—the reference list and the selection criteria to extract the desired items from the list. You can use `Text.Split(Source[Text]{0}," ")` as a reference list and then use the `Text.Contains()` function to define the selection criteria as follows. This results in all the items in the list including `"@"`, resulting in Figure 4-33.

```
= List.Select(
    Text.Split(Source[Text]{0}," "),
    each Text.Contains(_,"@"))
```

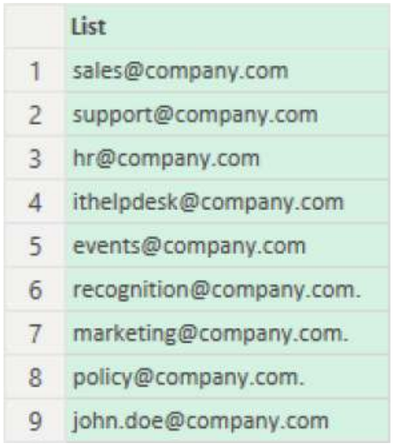


| | List |
|---|---|
| 1 | sales@company.com |
| 2 | support@company.com |
| 3 | hr@company.com |
| 4 | ithelpdesk@company.com |
| 5 | @ProjectManagement |
| 6 | @CompanyRetreat |
| 7 | events@company.com |
| 8 | @EmployeeRecognition |
| 9 | @EmployeeOfTheMonth |
| 10 | recognition@company.com. |
| 11 | @WorkshopSeries |
| 12 | marketing@company.com. |
| 13 | policy@company.com. |
| 14 | john.doe@company.com |

***Figure 4-33*** The result of the filtering list

To exclude words that start with `"@"`, you need to revise the selection criteria. You can use the `Text.StartsWith()` function to check the first argument of any text. So, the previous formula can be rewritten as the following formula to filter out the words starting with `"@"`. The updated formula will result in Figure 4-34 and extract all the emails.

```
= List.Select(Text.Split(Source[Text]{0}," "),each Text.Contains(_,"@") and
not Text.StartsWith(_,"@"))
```



| | List |
|---|---|
| 1 | sales@company.com |
| 2 | support@company.com |
| 3 | hr@company.com |
| 4 | ithelpdesk@company.com |
| 5 | events@company.com |
| 6 | recognition@company.com. |
| 7 | marketing@company.com. |
| 8 | policy@company.com. |
| 9 | john.doe@company.com |

***Figure 4-34*** Extracting all the emails

> **Note** This formula works for the specific data provided here, but if the text contains words like `"M@joun"`, it is also included in the result, even though it is not an email. In Chapter 10, this issue is addressed using advanced tools of the Regex function to account for all possible situations.

## Using a Multiline Splitter

Consider the Source table shown in Table 4-8, which includes sales data (Date, Product Name, and Quantity). On a certain date, more than one transaction might happen, and they are separated by `","`. Split the data into three separate columns: Date, Product Name, and Quantity.

***Table 4-8*** Source: Transactions

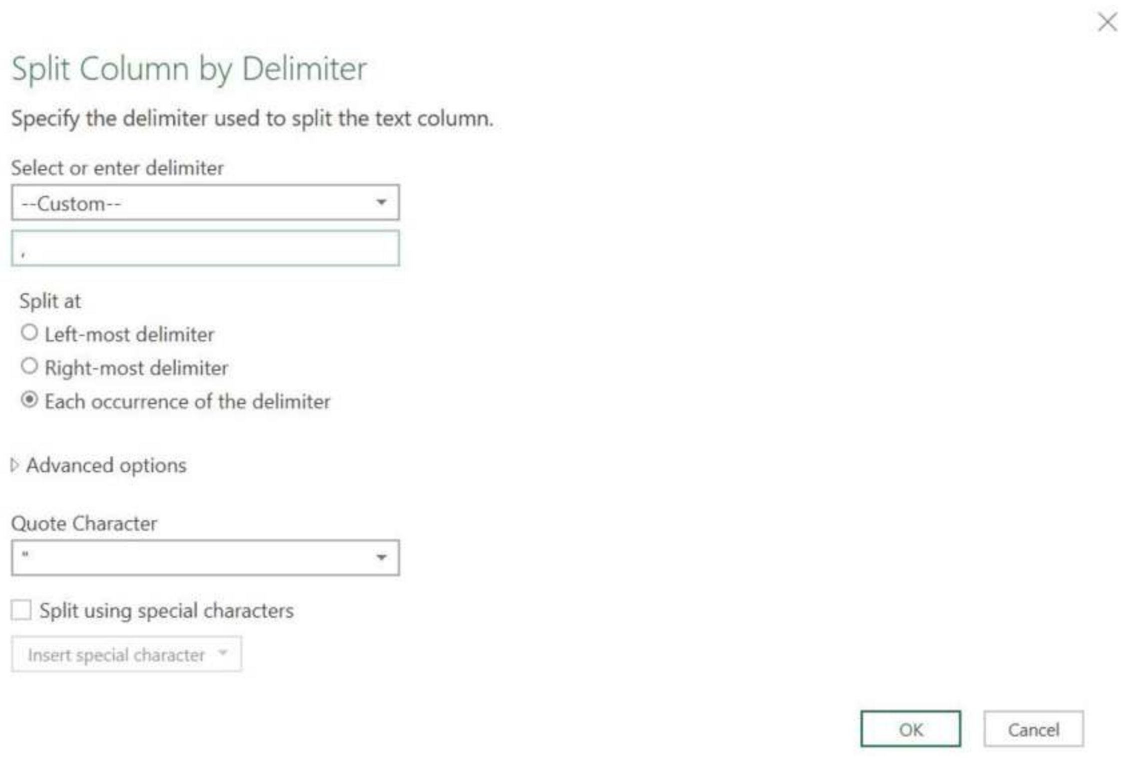
| Info |
|---|
| 2024/04/04, A 10, B 5 |
| 2024/04/13, AS 1, A 1, M 2 |
| 2024/04/15, A 1 |
| 2024/04/22, B 3 |
| 2024/04/30, A 1, B 1 |
| 2024/05/04, AB 2 |
| 2024/05/07, AB 3, AS 4 |

> **Note** The data in this example is provided in an Excel file titled `06 Multi-Line Splitter.xlsx`.

Two separate solutions are provided to solve this problem.

### Solution 1

For the first solution, select the Info column, then go to the Home tab and choose the Split Column command. Select By Delimiter and provide `", "` (a comma and a space) as the delimiter, as shown in Figure 4-35. Then click OK to get resulting table, as shown in Figure 4-36.



Split Column by Delimiter

Specify the delimiter used to split the text column.

Select or enter delimiter

--Custom--

,

Split at

Left-most delimiter

Right-most delimiter

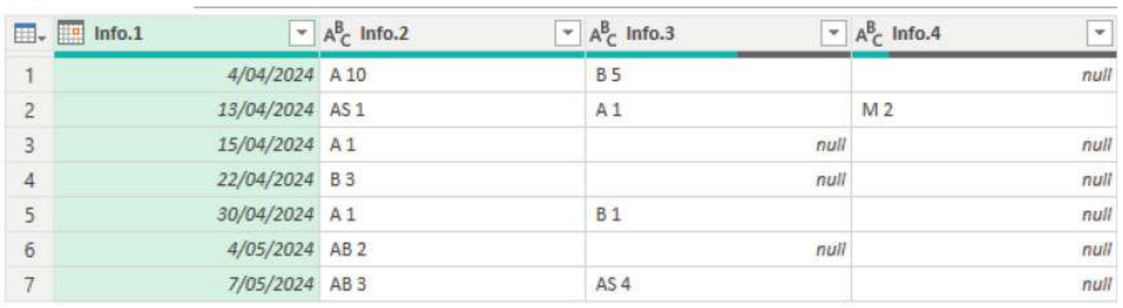
[✓ Each occurrence of the delimiter]

Quote Character

"

Split using special characters

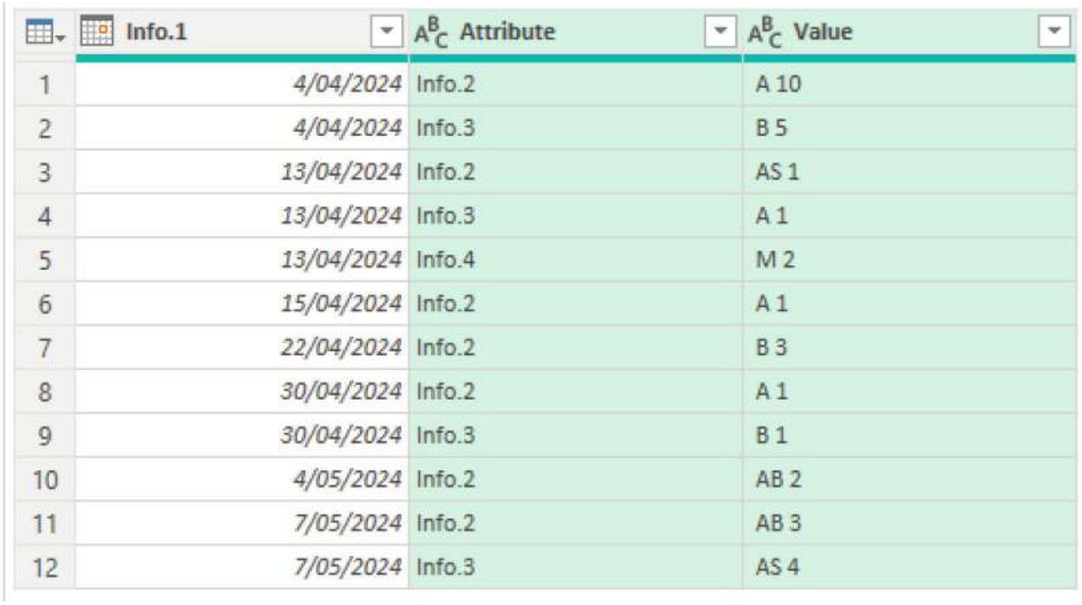
***Figure 4-35*** Setting for the splitting command



|  | Info.1 | Info.2 | Info.3 | Info.4 |
|---|---|---|---|---|
| 1 | 4/04/2024 | A 10 | B 5 | null |
| 2 | 13/04/2024 | AS 1 | A 1 | M 2 |
| 3 | 15/04/2024 | A 1 | null | null |
| 4 | 22/04/2024 | B 3 | null | null |
| 5 | 30/04/2024 | A 1 | B 1 | null |
| 6 | 4/05/2024 | AB 2 | null | null |
| 7 | 7/05/2024 | AB 3 | AS 4 | null |

***Figure 4-36*** The result of splitting

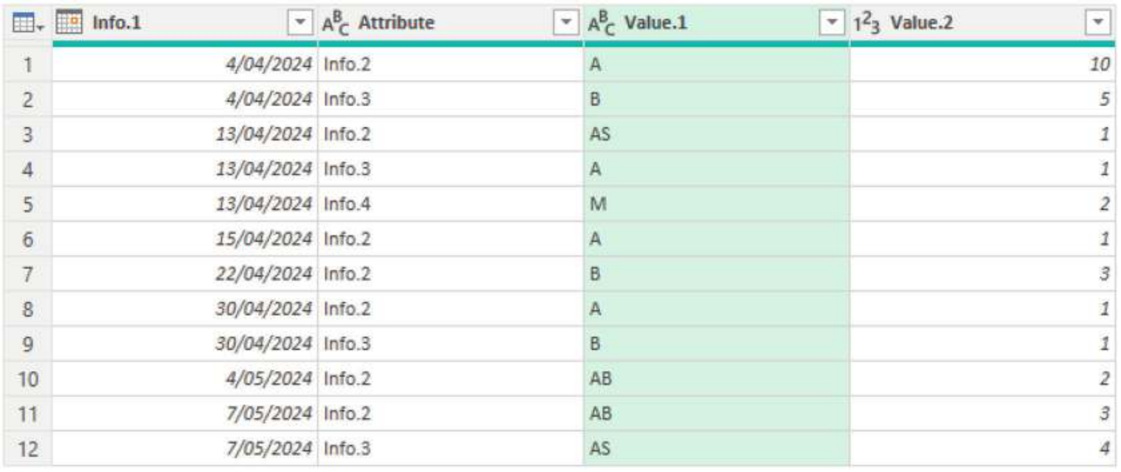
Next, right-click the Info.1 column and choose Unpivot Other Columns to achieve Figure 4-37.



| | Info.1 | Attribute | Value |
|---|---|---|---|
| 1 | 4/04/2024 | Info.2 | A 10 |
| 2 | 4/04/2024 | Info.3 | B 5 |
| 3 | 13/04/2024 | Info.2 | AS 1 |
| 4 | 13/04/2024 | Info.3 | A 1 |
| 5 | 13/04/2024 | Info.4 | M 2 |
| 6 | 15/04/2024 | Info.2 | A 1 |
| 7 | 22/04/2024 | Info.2 | B 3 |
| 8 | 30/04/2024 | Info.2 | A 1 |
| 9 | 30/04/2024 | Info.3 | B 1 |
| 10 | 4/05/2024 | Info.2 | AB 2 |
| 11 | 7/05/2024 | Info.2 | AB 3 |
| 12 | 7/05/2024 | Info.3 | AS 4 |

***Figure 4-37*** The result of unpivoting

Then, select the Value column and use a space as the delimiter to obtain Figure 4-38.



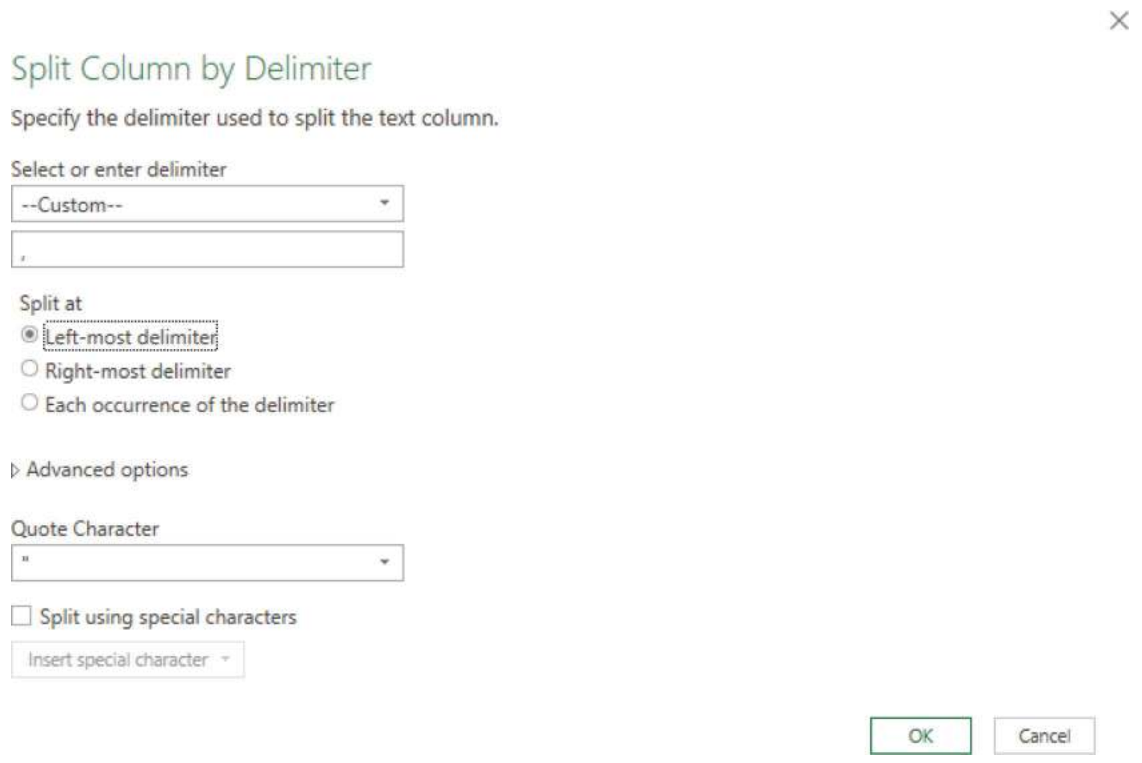
| | Info.1 | Attribute | Value.1 | Value.2 |
|---|---|---|---|---|
| 1 | 4/04/2024 | Info.2 | A | 10 |
| 2 | 4/04/2024 | Info.3 | B | 5 |
| 3 | 13/04/2024 | Info.2 | AS | 1 |
| 4 | 13/04/2024 | Info.3 | A | 1 |
| 5 | 13/04/2024 | Info.4 | M | 2 |
| 6 | 15/04/2024 | Info.2 | A | 1 |
| 7 | 22/04/2024 | Info.2 | B | 3 |
| 8 | 30/04/2024 | Info.2 | A | 1 |
| 9 | 30/04/2024 | Info.3 | B | 1 |
| 10 | 4/05/2024 | Info.2 | AB | 2 |
| 11 | 7/05/2024 | Info.2 | AB | 3 |
| 12 | 7/05/2024 | Info.3 | AS | 4 |

***Figure 4-38*** The result of splitting

Finally, remove the Attribute column and rename the remaining columns to complete the table.

## Solution 2

For the second solution, select the Info column, then navigate to the Home tab and choose the Split Column command. Select By Delimiter and enter `", "` (a comma and a space) as the delimiter. However, in this solution, instead of selecting Each Occurrence of the Delimiter, choose Left-Most Delimiter, as shown in Figure 4-39. Then click OK to obtain Figure 4-40.


Split Column by Delimiter

Specify the delimiter used to split the text column.

Select or enter delimiter

--Custom--

,

Split at

(●) Left-most delimiter
( ) Right-most delimiter
( ) Each occurrence of the delimiter

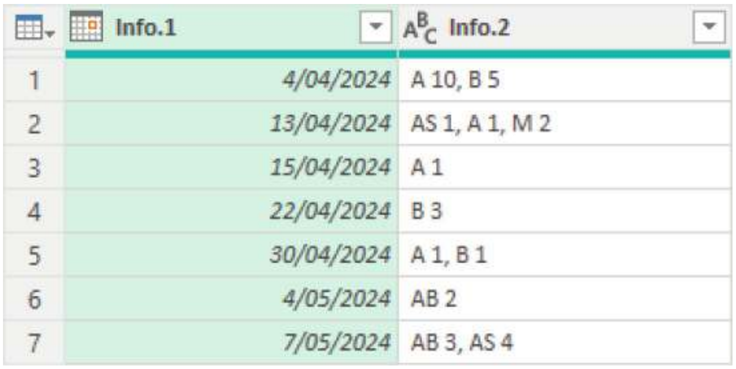
▷ Advanced options

Quote Character

"

☐ Split using special characters

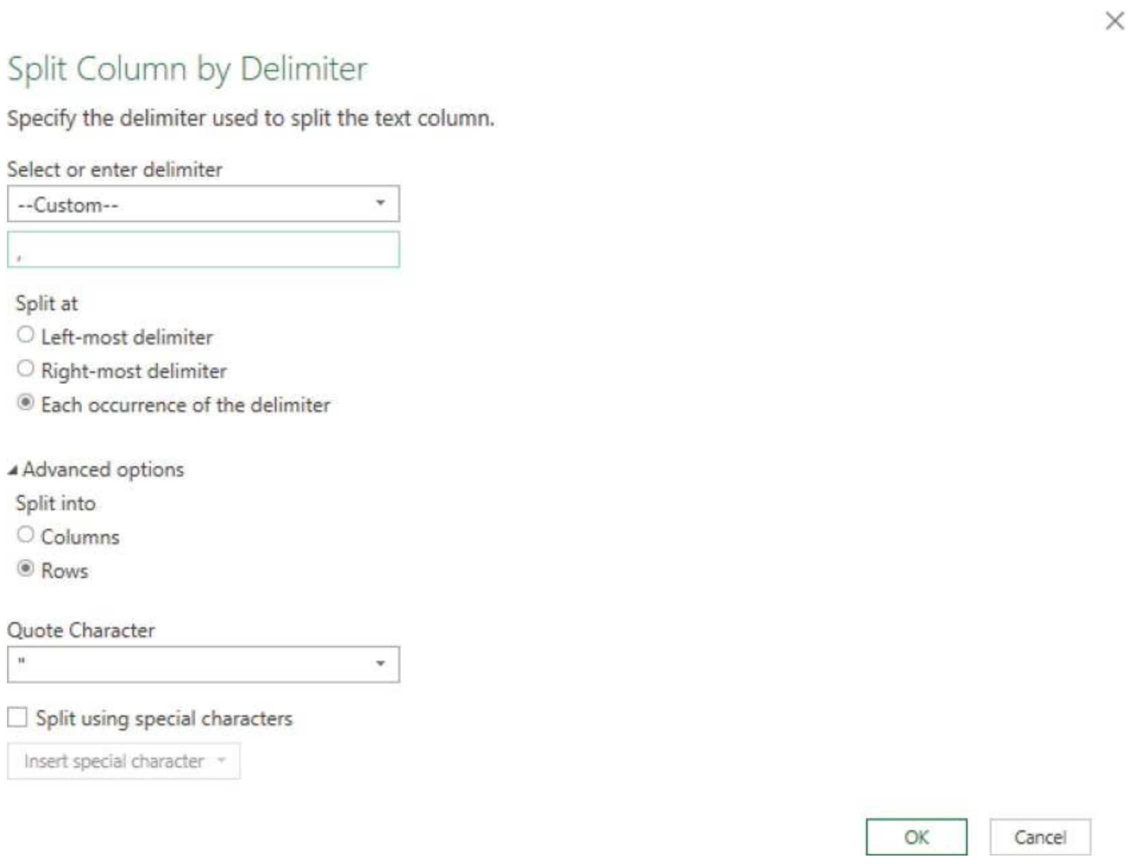
***Figure 4-39*** Setting for splitting



|  | Info.1 | Info.2 |
|---|---|---|
| 1 | 4/04/2024 | A 10, B 5 |
| 2 | 13/04/2024 | AS 1, A 1, M 2 |
| 3 | 15/04/2024 | A 1 |
| 4 | 22/04/2024 | B 3 |
| 5 | 30/04/2024 | A 1, B 1 |
| 6 | 4/05/2024 | AB 2 |
| 7 | 7/05/2024 | AB 3, AS 4 |

***Figure 4-40*** The result of splitting

Next, select the Info.2 column, then navigate to the Home tab and choose the Split Column command. Select By Delimiter and enter `", "` (a comma and a space) as the delimiter. However, this time, in the Advanced options, select Rows instead of Columns, as shown in Figure 4-41. Then click OK to obtain Figure 4-42.


Split Column by Delimiter

Specify the delimiter used to split the text column.

Select or enter delimiter: --Custom--

,

Split at
- ◯ Left-most delimiter
- ◯ Right-most delimiter
- ● Each occurrence of the delimiter

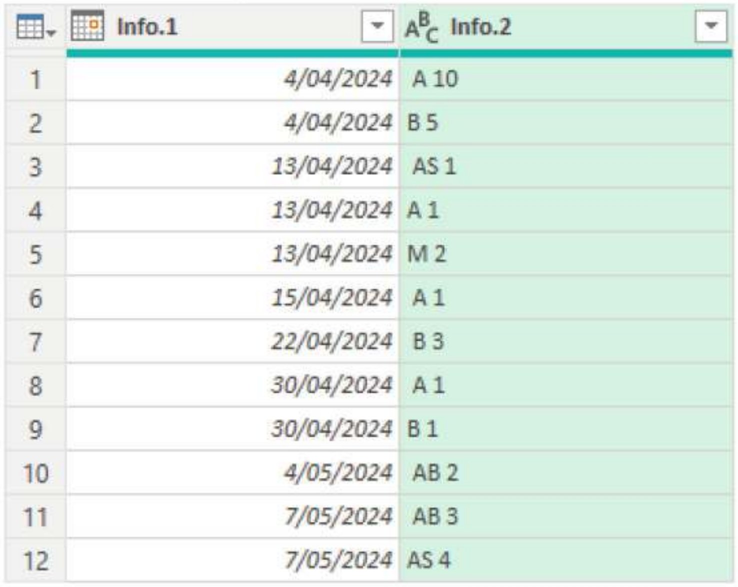
Advanced options

Split into
- ◯ Columns
- ● Rows

Quote Character: "

☐ Split using special characters

*Figure 4-41* Setting of splitting



| | Info.1 | Info.2 |
|---|---|---|
| 1 | 4/04/2024 | A 10 |
| 2 | 4/04/2024 | B 5 |
| 3 | 13/04/2024 | AS 1 |
| 4 | 13/04/2024 | A 1 |
| 5 | 13/04/2024 | M 2 |
| 6 | 15/04/2024 | A 1 |
| 7 | 22/04/2024 | B 3 |
| 8 | 30/04/2024 | A 1 |
| 9 | 30/04/2024 | B 1 |
| 10 | 4/05/2024 | AB 2 |
| 11 | 7/05/2024 | AB 3 |
| 12 | 7/05/2024 | AS 4 |

*Figure 4-42* The result of splitting

As provided in the previous step, instead of placing the splitting values into different columns, the values are arranged in different rows. Therefore, in the final step, you just need to apply another splitting operation on the Info.2 column based on space to achieve the final result.

## Splitting Text by Changing Character Type, Part 1

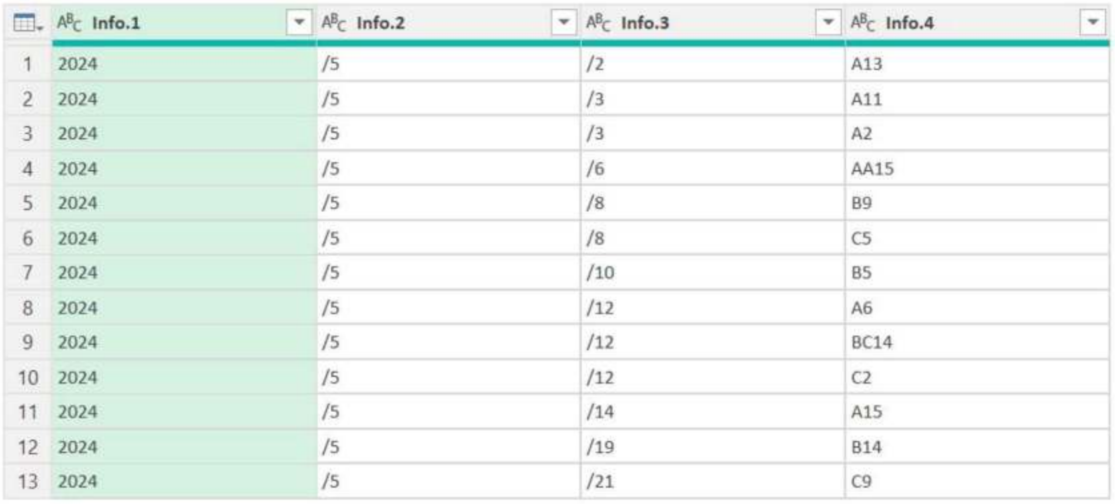
Consider the Source table in Table 4-9, which contains sales data (Date, Product Name, and Quantity) all combined into a single column. Split this data into three separate columns: Date, Product Name, and Quantity.

***Table 4-9*** Source: Transactions

| Info |
|---|
| 2024/5/2A13 |
| 2024/5/3A11 |
| 2024/5/3A2 |
| 2024/5/6AA15 |
| 2024/5/8B9 |
| 2024/5/8C5 |
| 2024/5/10B5 |
| 2024/5/12A6 |
| 2024/5/12BC14 |
| 2024/5/12C2 |
| 2024/5/14A15 |
| 2024/5/19B14 |
| 2024/5/21C9 |

**Note** The data in this example is provided in an Excel file titled `07 Splitting Text by Changing Character type part 1.xlsx`.

For this task, any transition from numbers to text or reverse should be considered as splitting points. To achieve this, select the column, then go to the Home tab, and choose the Split Column command. Select By Digit to Non-Digit to split the data accordingly. This results in Figure 4-43, which shows the text split at any transition from digit to non-digit values. This also considers "/", which is part of dates, as a non-digit character, and it is used for splitting points if it comes after a digit.



| | Info.1 | Info.2 | Info.3 | Info.4 |
|---|---|---|---|---|
| 1 | 2024 | /5 | /2 | A13 |
| 2 | 2024 | /5 | /3 | A11 |
| 3 | 2024 | /5 | /3 | A2 |
| 4 | 2024 | /5 | /6 | AA15 |
| 5 | 2024 | /5 | /8 | B9 |
| 6 | 2024 | /5 | /8 | C5 |
| 7 | 2024 | /5 | /10 | B5 |
| 8 | 2024 | /5 | /12 | A6 |
| 9 | 2024 | /5 | /12 | BC14 |
| 10 | 2024 | /5 | /12 | C2 |
| 11 | 2024 | /5 | /14 | A15 |
| 12 | 2024 | /5 | /19 | B14 |
| 13 | 2024 | /5 | /21 | C9 |

***Figure 4-43*** Splitting digit to non-digit type

The previous steps lead to the following formula in the formula bar.

```
= Table.SplitColumn(
      Source,
      "Info",
      Splitter.SplitTextByCharacterTransition({"0".."9"}, (c) => not
List.Contains({"0".."9"}, c)),
      {"Info.1", "Info.2", "Info.3", "Info.4"})
```

In this case, the `Splitter.SplitTextByCharacterTransition()` is used in the third argument as the splitter function.

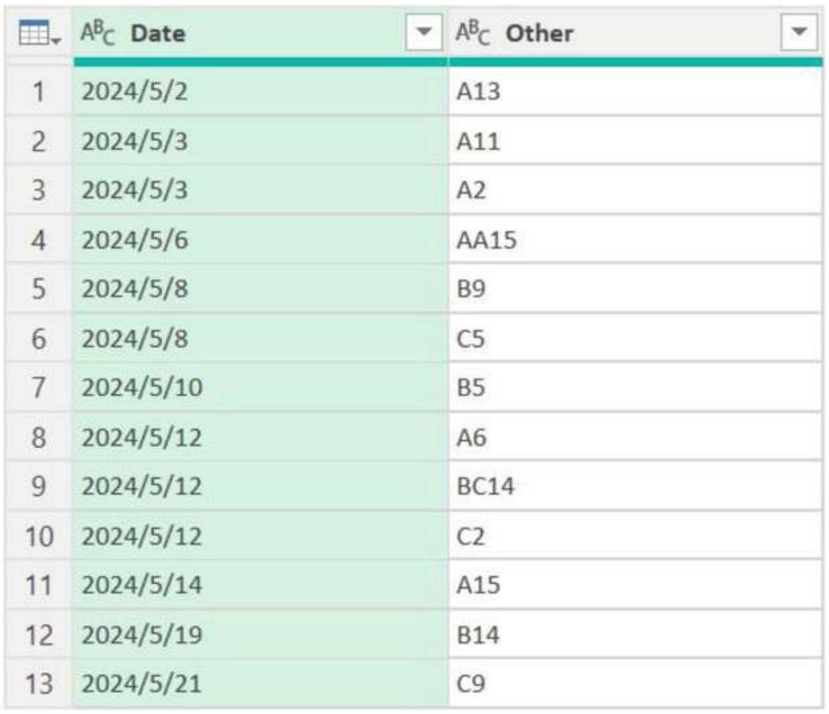
The `Splitter.SplitTextByCharacterTransition()` function takes two arguments, typically lists or functions. To check its functionality over text, consider the first argument of this function as a list (or a function) called A, and the second argument as a list (or a function) called B. The splitting process applies to all characters in the text. For any character `a` at position `i` and its subsequent character `b` at position `i+1`, if `a` is in list A (or the result of function `A` for `a` is `true`) and `b` is in list B (or the result of function `B` for `b` is `true`), the text is split at position `i+1`.

In the generated formula, `{"0".."9"}`, is used as the first argument of `Splitter.SplitTextByCharacterTransition()`, and `(c) => not List.Contains({"0".."9"}, c)` is used as the second argument. So, if `a` is one of the items in the list `{"0".."9"}`, and its subsequent character satisfies the condition `(c) => not List.Contains({"0".."9"}, c)`, which means the subsequent character is any value except `{"0".."9"}`, then the split occurs between the current character and the next one. In the first row, with the value `"2024/5/2A13"` consider the fifth and sixth characters as `"4/"`, as 4 is a member of `{"0".."9"}`, and the result of `(c) => not List.Contains({"0".."9"}, c)` for `c="/"` is `true`. The text is split between `"4"` and `"/"`, which is not desirable.

To prevent splitting at these character transitions and only split when transitioning from numeric to alphabetic characters, the formula can be rewritten as the following formula in the formula bar:

```
= Table.SplitColumn(
      Source,
      "Info",
      Splitter.SplitTextByCharacterTransition({"0".."9"},{"A".."Z"}) ,
      {"Date","Other"})
```

If the text includes lowercase characters, the second argument should be rewritten to include both uppercase and lowercase characters as follows: `{"A".."Z", "a".."z"})`, which results in Figure 4-44.

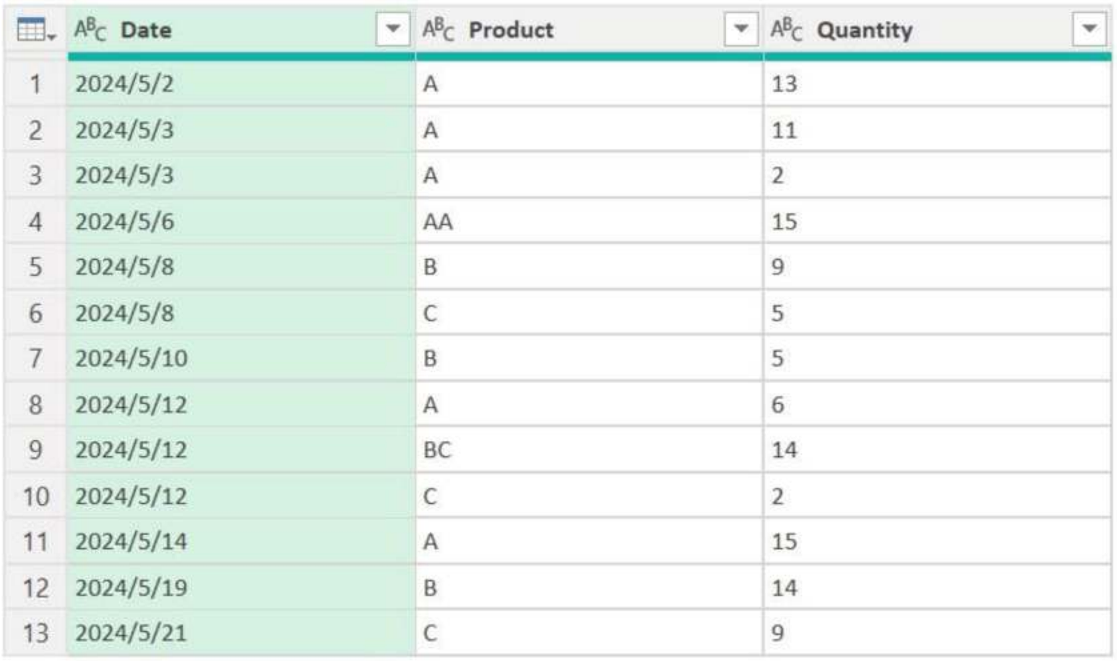


| | Date | Other |
|---|---|---|
| 1 | 2024/5/2 | A13 |
| 2 | 2024/5/3 | A11 |
| 3 | 2024/5/3 | A2 |
| 4 | 2024/5/6 | AA15 |
| 5 | 2024/5/8 | B9 |
| 6 | 2024/5/8 | C5 |
| 7 | 2024/5/10 | B5 |
| 8 | 2024/5/12 | A6 |
| 9 | 2024/5/12 | BC14 |
| 10 | 2024/5/12 | C2 |
| 11 | 2024/5/14 | A15 |
| 12 | 2024/5/19 | B14 |
| 13 | 2024/5/21 | C9 |

***Figure 4-44*** Splitting digit to non-digit type

The values of the dates are now separated. Now it needs to split the Other column into the Product and Quantity columns. Considering the name of the previous step result was Split Column by Character Transition, apply the same process to the Other column to split it into two separate columns: Product and Quantity. Use the following formula to achieve this, resulting in Figure 4-45.

```
=Table.SplitColumn(
      #"Split Column by Character Transition",
      "Other",
      Splitter.SplitTextByCharacterTransition({"A".."Z"},{"0".."9"}),
      {"Product","Quantity"})
```



| | Date | Product | Quantity |
|---|---|---|---|
| 1 | 2024/5/2 | A | 13 |
| 2 | 2024/5/3 | A | 11 |
| 3 | 2024/5/3 | A | 2 |
| 4 | 2024/5/6 | AA | 15 |
| 5 | 2024/5/8 | B | 9 |
| 6 | 2024/5/8 | C | 5 |
| 7 | 2024/5/10 | B | 5 |
| 8 | 2024/5/12 | A | 6 |
| 9 | 2024/5/12 | BC | 14 |
| 10 | 2024/5/12 | C | 2 |
| 11 | 2024/5/14 | A | 15 |
| 12 | 2024/5/19 | B | 14 |
| 13 | 2024/5/21 | C | 9 |

***Figure 4-45*** The final result

## Splitting Text by Changing Character Type, Part 2

Consider the previous example, except that multiple transactions happen on each date and are presented in a cell, like the Source table shown in Table 4-10. Split the data into three separate columns—Date, Product, and Quantity.

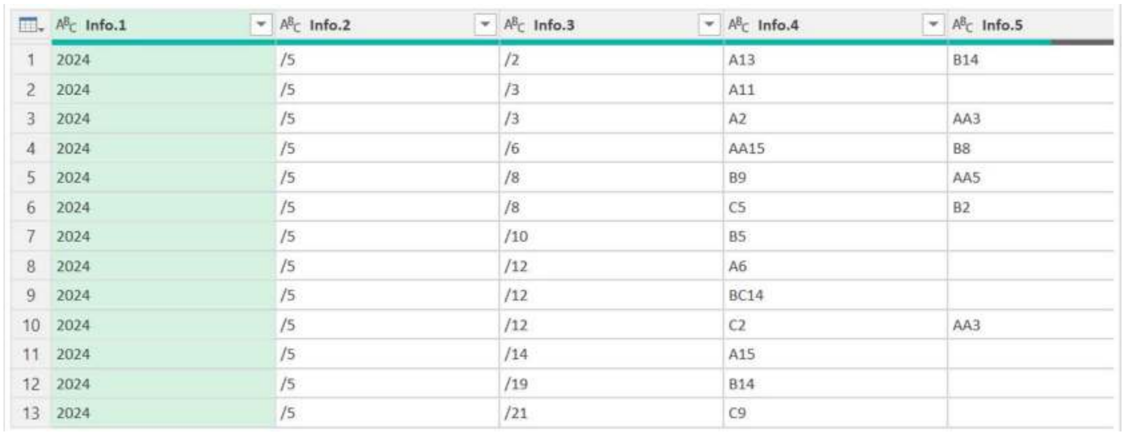
***Table 4-10*** Source: Transactions

| Info |
|---|
| 2024/5/2A13B14C10 |
| 2024/5/3A11 |
| 2024/5/3A2AA3 |
| 2024/5/6AA15B8 |
| 2024/5/8B9AA5 |
| 2024/5/8C5B2A5 |
| 2024/5/10B5 |
| 2024/5/12A6 |
| 2024/5/12BC14 |
| 2024/5/12C2AA3B18 |
| 2024/5/14A15 |
| 2024/5/19B14 |
| 2024/5/21C9 |

**Note** The data in this example is provided in an Excel file titled `08 Splitting Text by Changing Character type part 2.xlsx`.

In this example, similar to the previous one, you can use `Splitter.SplitTextByCharacterTransition()` to split the column into several columns. However, since different transactions of products and quantities are provided for each date, some modification is required. As in the previous example, select the Info column, go to the Home tab, and choose Split Column. Then choose By Digit to Non-Digit. This will lead to the following formula in the formula bar and the result in Figure 4-46.

```
= Table.SplitColumn(Source, "Info",
Splitter.SplitTextByCharacterTransition({"0".."9"}, (c) => not
List.Contains({"0".."9"}, c)), {"Info.1", "Info.2", "Info.3", "Info.4",
"Info.5", "Info.6"})
```

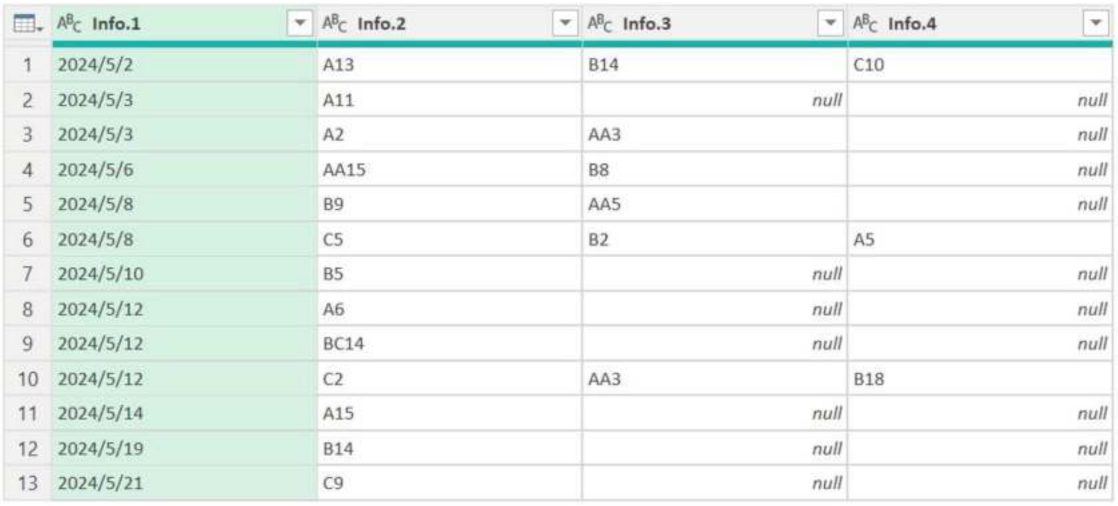


|  | Info.1 | Info.2 | Info.3 | Info.4 | Info.5 |
|---|---|---|---|---|---|
| 1 | 2024 | /5 | /2 | A13 | B14 |
| 2 | 2024 | /5 | /3 | A11 |  |
| 3 | 2024 | /5 | /3 | A2 | AA3 |
| 4 | 2024 | /5 | /6 | AA15 | B8 |
| 5 | 2024 | /5 | /8 | B9 | AA5 |
| 6 | 2024 | /5 | /8 | C5 | B2 |
| 7 | 2024 | /5 | /10 | B5 |  |
| 8 | 2024 | /5 | /12 | A6 |  |
| 9 | 2024 | /5 | /12 | BC14 |  |
| 10 | 2024 | /5 | /12 | C2 | AA3 |
| 11 | 2024 | /5 | /14 | A15 |  |
| 12 | 2024 | /5 | /19 | B14 |  |
| 13 | 2024 | /5 | /21 | C9 |  |

***Figure 4-46*** Splitting the values

Similar to the previous example, modify the formula in the formula bar as follows, which will result in Figure 4-47.

```
= Table.SplitColumn(Source, "Info",
Splitter.SplitTextByCharacterTransition({"0".."9"}, {"A".."Z"}))
```



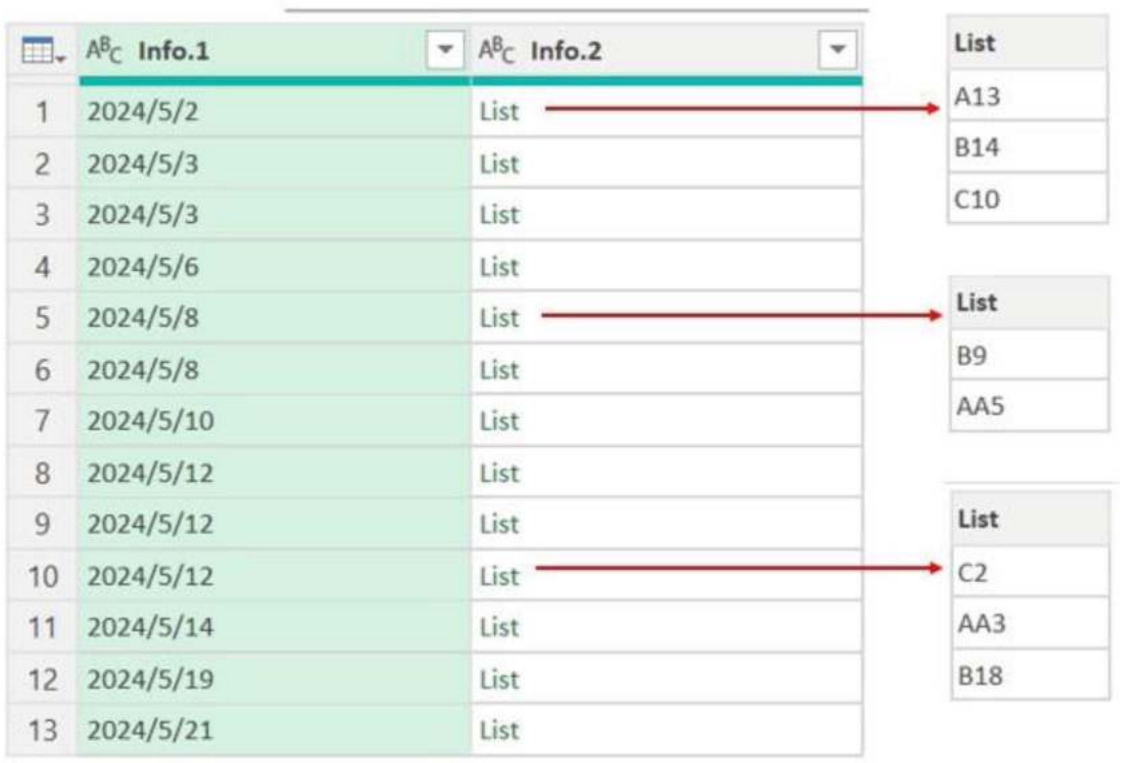
| | Info.1 | Info.2 | Info.3 | Info.4 |
|---|---|---|---|---|
| 1 | 2024/5/2 | A13 | B14 | C10 |
| 2 | 2024/5/3 | A11 | null | null |
| 3 | 2024/5/3 | A2 | AA3 | null |
| 4 | 2024/5/6 | AA15 | B8 | null |
| 5 | 2024/5/8 | B9 | AA5 | null |
| 6 | 2024/5/8 | C5 | B2 | A5 |
| 7 | 2024/5/10 | B5 | null | null |
| 8 | 2024/5/12 | A6 | null | null |
| 9 | 2024/5/12 | BC14 | null | null |
| 10 | 2024/5/12 | C2 | AA3 | B18 |
| 11 | 2024/5/14 | A15 | null | null |
| 12 | 2024/5/19 | B14 | null | null |
| 13 | 2024/5/21 | C9 | null | null |

***Figure 4-47*** The result of the revised split

As shown, the resulting table contains information related to different transactions across different columns. Each of these columns needs to be split separately based on the transition from non-digit to digit values. However, since the number of columns is not predefined, applying this transformation to each column individually would not be efficient, especially when dealing with lots of columns. Instead, you can rewrite the previous formula as follows:

```
= Table.SplitColumn(
      Source,
      "Info",
      Splitter.SplitTextByCharacterTransition({"0".."9"}, {"A".."Z"}),
      2,
      "",
      ExtraValues.List)
```

Using `2` in the fourth argument specifies that the Info column should split into two columns and using `ExtraValues.List` in the sixth argument indicates that after splitting, any extra values except the first one will be provided in a list. The result is shown in Figure 4-48.



| | Info.1 | Info.2 |
|---|---|---|
| 1 | 2024/5/2 | List |
| 2 | 2024/5/3 | List |
| 3 | 2024/5/3 | List |
| 4 | 2024/5/6 | List |
| 5 | 2024/5/8 | List |
| 6 | 2024/5/8 | List |
| 7 | 2024/5/10 | List |
| 8 | 2024/5/12 | List |
| 9 | 2024/5/12 | List |
| 10 | 2024/5/12 | List |
| 11 | 2024/5/14 | List |
| 12 | 2024/5/19 | List |
| 13 | 2024/5/21 | List |

| List |
|---|
| A13 |
| B14 |
| C10 |

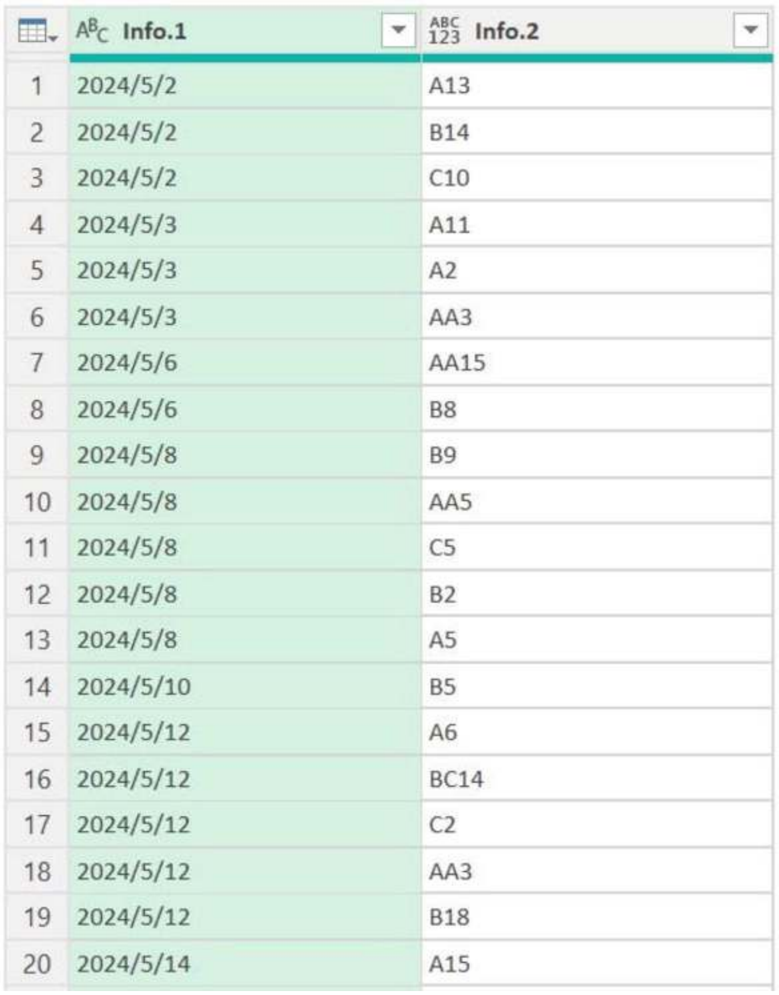
| List |
|---|
| B9 |
| AA5 |

| List |
|---|
| C2 |
| AA3 |
| B18 |

***Figure 4-48*** The result of the revised split

Given the result of the previous step was Split Column by Character Transition, use the following formula in the formula bar to expand the Info.2 column into new rows. This will result in Figure 4-49.

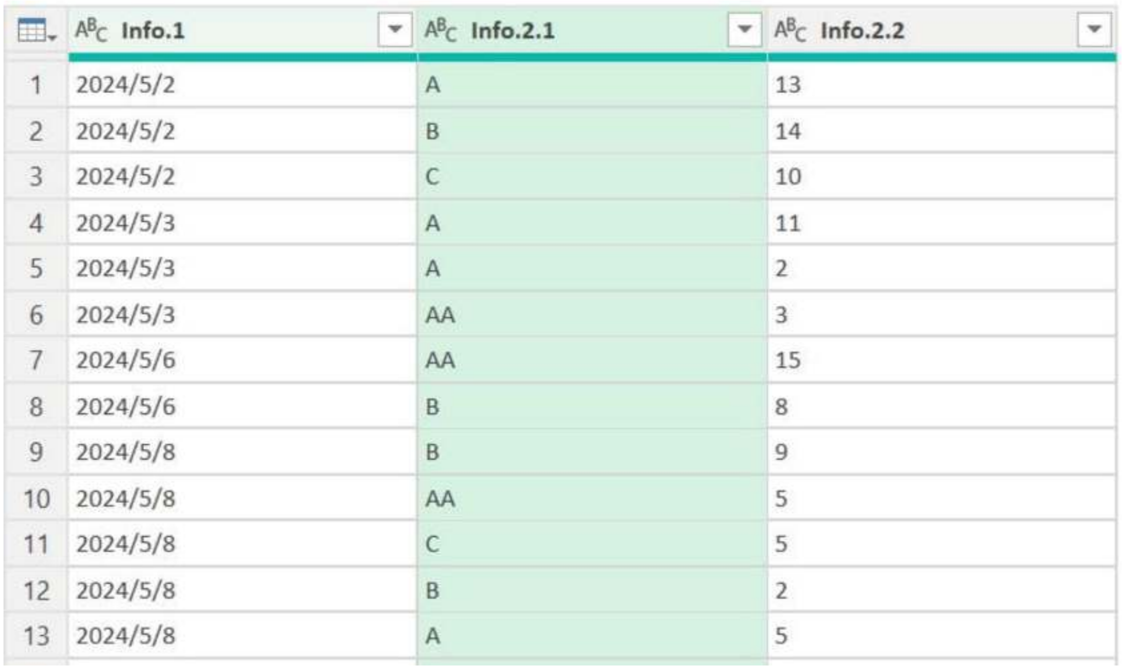
```
= Table.ExpandListColumn(#"Split Column by Character Transition", "Info.2")
```



| | Info.1 | Info.2 |
|---|---|---|
| 1 | 2024/5/2 | A13 |
| 2 | 2024/5/2 | B14 |
| 3 | 2024/5/2 | C10 |
| 4 | 2024/5/3 | A11 |
| 5 | 2024/5/3 | A2 |
| 6 | 2024/5/3 | AA3 |
| 7 | 2024/5/6 | AA15 |
| 8 | 2024/5/6 | B8 |
| 9 | 2024/5/8 | B9 |
| 10 | 2024/5/8 | AA5 |
| 11 | 2024/5/8 | C5 |
| 12 | 2024/5/8 | B2 |
| 13 | 2024/5/8 | A5 |
| 14 | 2024/5/10 | B5 |
| 15 | 2024/5/12 | A6 |
| 16 | 2024/5/12 | BC14 |
| 17 | 2024/5/12 | C2 |
| 18 | 2024/5/12 | AA3 |
| 19 | 2024/5/12 | B18 |
| 20 | 2024/5/14 | A15 |

***Figure 4-49*** The result of expanding the Info.2 column

Selecting the Info.2 column and using Split Column with the By Non-Digit to Digit option will result in Figure 4-50. The problem is solved!



| | Info.1 | Info.2.1 | Info.2.2 |
|---|---|---|---|
| 1 | 2024/5/2 | A | 13 |
| 2 | 2024/5/2 | B | 14 |
| 3 | 2024/5/2 | C | 10 |
| 4 | 2024/5/3 | A | 11 |
| 5 | 2024/5/3 | A | 2 |
| 6 | 2024/5/3 | AA | 3 |
| 7 | 2024/5/6 | AA | 15 |
| 8 | 2024/5/6 | B | 8 |
| 9 | 2024/5/8 | B | 9 |
| 10 | 2024/5/8 | AA | 5 |
| 11 | 2024/5/8 | C | 5 |
| 12 | 2024/5/8 | B | 2 |
| 13 | 2024/5/8 | A | 5 |

***Figure 4-50*** The final result

## Merging with a Custom Operation

Consider the source table in Table 4-11, including a customer's energy consumption at different times of the day (morning, evening, and night) for various dates. Convert this data to a daily table and create a table that shows the total energy consumption for each date by summing the values from the three columns.

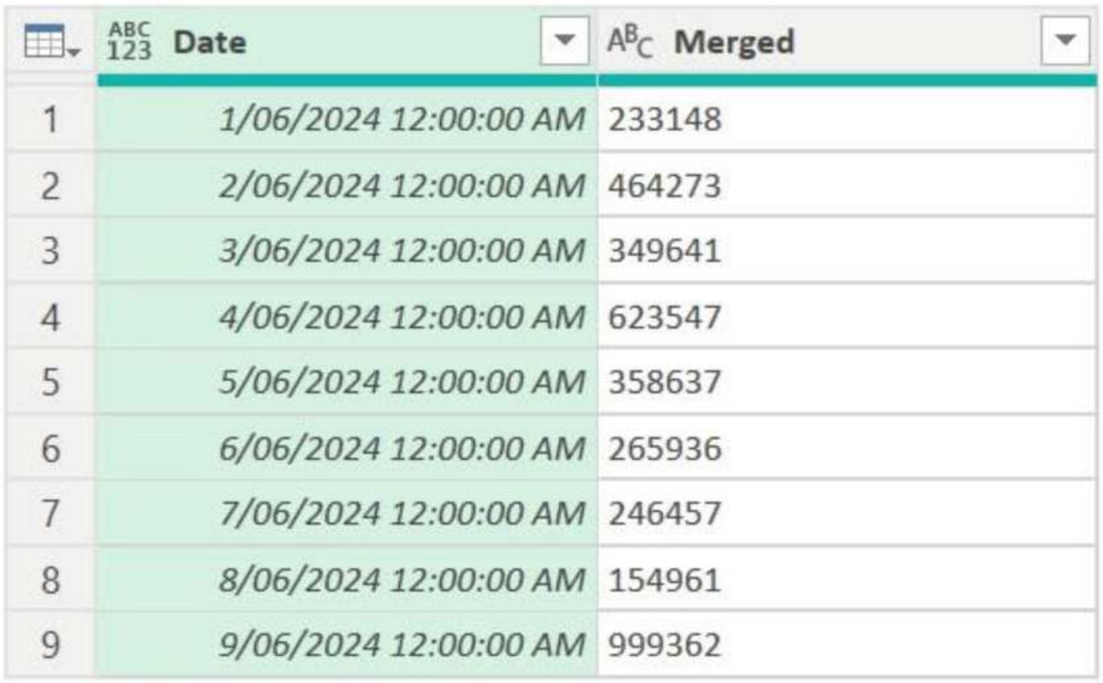
***Table 4-11*** Source: Warehouse Transactions

| Date | Morning | Evening | Night |
|---|---|---|---|
| 1/06/2024 | 23 | 31 | 48 |
| 2/06/2024 | 46 | 42 | 73 |
| 3/06/2024 | 34 | 96 | 41 |
| 4/06/2024 | 62 | 35 | 47 |
| 5/06/2024 | 35 | 86 | 37 |
| 6/06/2024 | 26 | 59 | 36 |
| 7/06/2024 | 24 | 64 | 57 |
| 8/06/2024 | 15 | 49 | 61 |
| 9/06/2024 | 99 | 93 | 62 |

**Note** The data in this example is provided in an Excel file titled `09 Merging with Custom Operation.xlsx`.

To solve this problem, you can add a new column by summing the available three columns and then removing these three columns. But instead of this solution, you can use `Table.CombineColumns()`. Select the Morning, Evening, and Night columns, then right-click one of them and choose the Merge option. In the dialog box that appears, select None as the separator. This action will generate the following formula in the formula bar. The result is in Figure 4-51.

```
= Table.CombineColumns(
      Table.TransformColumnTypes(Source, {{"Morning", type text},
{"Evening", type text}, {"Night", type text}}, "en-AU"),
      {"Morning", "Evening", "Night"},
      Combiner.CombineTextByDelimiter("", QuoteStyle.None),
      "Merged")
```

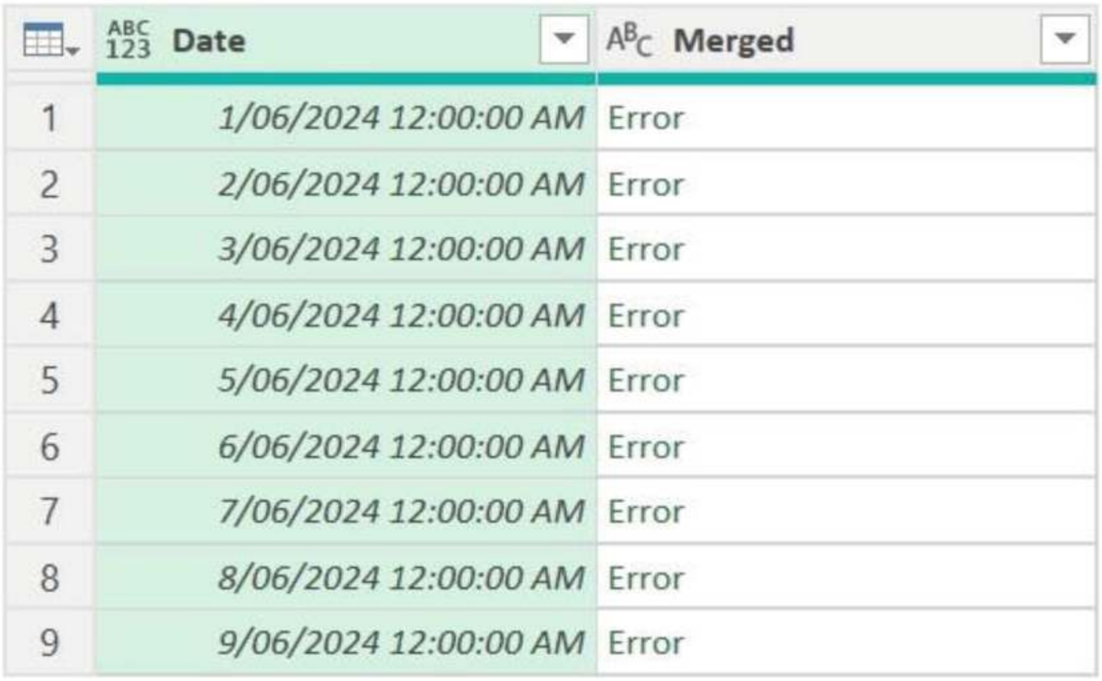


|  | Date | Merged |
|---|---|---|
| 1 | 1/06/2024 12:00:00 AM | 233148 |
| 2 | 2/06/2024 12:00:00 AM | 464273 |
| 3 | 3/06/2024 12:00:00 AM | 349641 |
| 4 | 4/06/2024 12:00:00 AM | 623547 |
| 5 | 5/06/2024 12:00:00 AM | 358637 |
| 6 | 6/06/2024 12:00:00 AM | 265936 |
| 7 | 7/06/2024 12:00:00 AM | 246457 |
| 8 | 8/06/2024 12:00:00 AM | 154961 |
| 9 | 9/06/2024 12:00:00 AM | 999362 |

***Figure 4-51*** The result of merging columns

In this case, since `Combiner.CombineTextByDelimiter()` is used to combine the values in the third argument of `Table.CombineColumns()`, and the selected columns are of type number, the values are initially converted to text using the `Table.TransformColumnTypes()` function (in the first argument). The values of these columns are then concatenated. But, as you want to sum the values rather than connect them, you do not need to convert these columns to type text. So, the revised formula is shown here, resulting in Figure 4-52.

```
= Table.CombineColumns(Source,{"Morning", "Evening",
"Night"},Combiner.CombineTextByDelimiter("", QuoteStyle.None),"Merged")
```

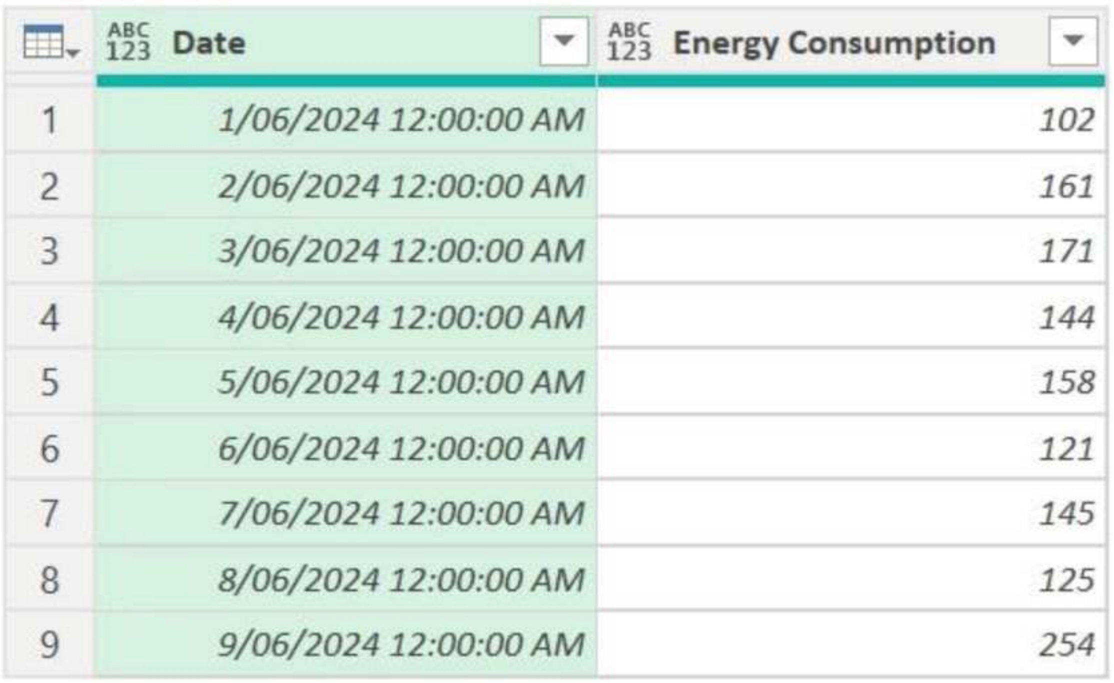


| | Date | Merged |
|---|---|---|
| 1 | 1/06/2024 12:00:00 AM | Error |
| 2 | 2/06/2024 12:00:00 AM | Error |
| 3 | 3/06/2024 12:00:00 AM | Error |
| 4 | 4/06/2024 12:00:00 AM | Error |
| 5 | 5/06/2024 12:00:00 AM | Error |
| 6 | 6/06/2024 12:00:00 AM | Error |
| 7 | 7/06/2024 12:00:00 AM | Error |
| 8 | 8/06/2024 12:00:00 AM | Error |
| 9 | 9/06/2024 12:00:00 AM | Error |

***Figure 4-52*** The result of merging

Another modification is still required in the previous formula, and the combiner should be converted to summing the values instead of using `Combiner.CombineTextByDelimiter()`. So, replace this function with `List.Sum()` to sum the values of the selected columns. Additionally, update the fourth argument to a more appropriate column name. The revised formula, which results in Figure 4-53, is as follows:

```
= Table.CombineColumns(
      Source,
      {"Morning", "Evening", "Night"},
      List.Sum,
      "Energy Consumption")
```



| | Date | Energy Consumption |
|---|---|---|
| 1 | 1/06/2024 12:00:00 AM | 102 |
| 2 | 2/06/2024 12:00:00 AM | 161 |
| 3 | 3/06/2024 12:00:00 AM | 171 |
| 4 | 4/06/2024 12:00:00 AM | 144 |
| 5 | 5/06/2024 12:00:00 AM | 158 |
| 6 | 6/06/2024 12:00:00 AM | 121 |
| 7 | 7/06/2024 12:00:00 AM | 145 |
| 8 | 8/06/2024 12:00:00 AM | 125 |
| 9 | 9/06/2024 12:00:00 AM | 254 |

***Figure 4-53*** The final result

## Merging Instead of Adding a Column

The Source table shown in Table 4-12 contains warehouse transactions. Calculate the final inventory of products using this formula: Final inventory = Initial value + Add - Reduce.

***Table 4-12*** Source: Warehouse Transactions

| Date | Product | Type | Quantity |
|---|---|---|---|
| 1/01/2024 | A | Initial value | 75 |
| 1/01/2024 | B | Initial value | 80 |
| 1/01/2024 | C | Initial value | 20 |
| 5/01/2024 | A | Reduce | 30 |
| 10/01/2024 | A | Reduce | 20 |
| 15/01/2024 | C | Reduce | 10 |
| 20/01/2024 | A | Add | 20 |
| 21/01/2024 | B | Reduce | 60 |
| 25/01/2024 | A | Add | 50 |
| 25/01/2024 | B | Add | 50 |
| 4/02/2024 | B | Reduce | 30 |
| 15/02/2024 | C | Reduce | 5 |
| 17/02/2024 | A | Reduce | 70 |
| 17/02/2024 | A | Reduce | 20 |
| 21/02/2024 | B | Reduce | 25 |
| 23/02/2024 | A | Reduce | 2 |
| 27/02/2024 | B | Reduce | 10 |

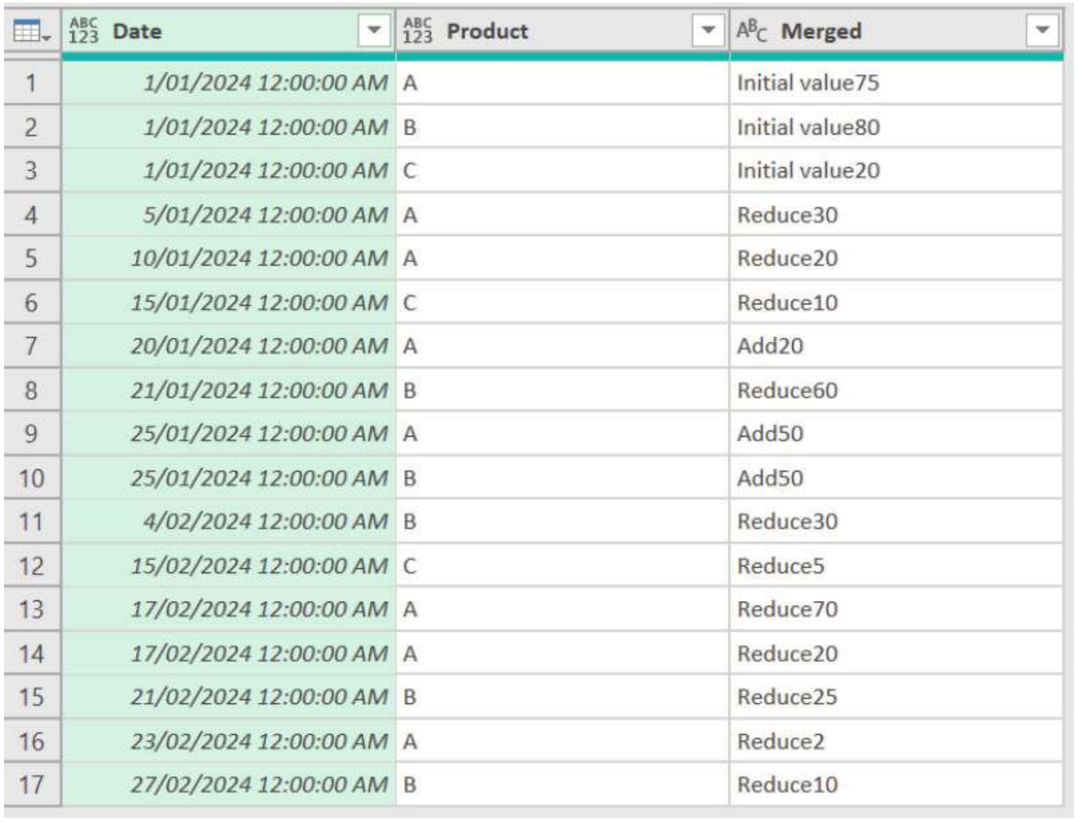
**Note** The data in this example is provided in an Excel file titled `10 Merging Instead of Adding a Column.xlsx`.

To solve this problem, you first need to convert the sign of the `Quantity` values for rows related to the `Reduce` transactions to negative. Then, you'll perform a grouping operation to calculate the last inventory. To adjust the signs of the quantities, you could add a new column to the table with the following formula.

```
if [Type]="Reduce" then -[Quantity] else [Quantity]
```

However, in this example, the problem can be addressed by merging the existing columns instead of adding a new one (this problem is just defined to discover the feature of merging the columns). Select the Type and Quantity columns and right-click one of them. Then choose the Merge command. Use no separator to generate the following formula in the formula bar, which results in Figure 4-54.

```
= Table.CombineColumns(
      Table.TransformColumnTypes(Source, {{"Quantity", type text}}, "en-
AU"),
      {"Type", "Quantity"},
      Combiner.CombineTextByDelimiter("", QuoteStyle.None),
      "Merged")
```

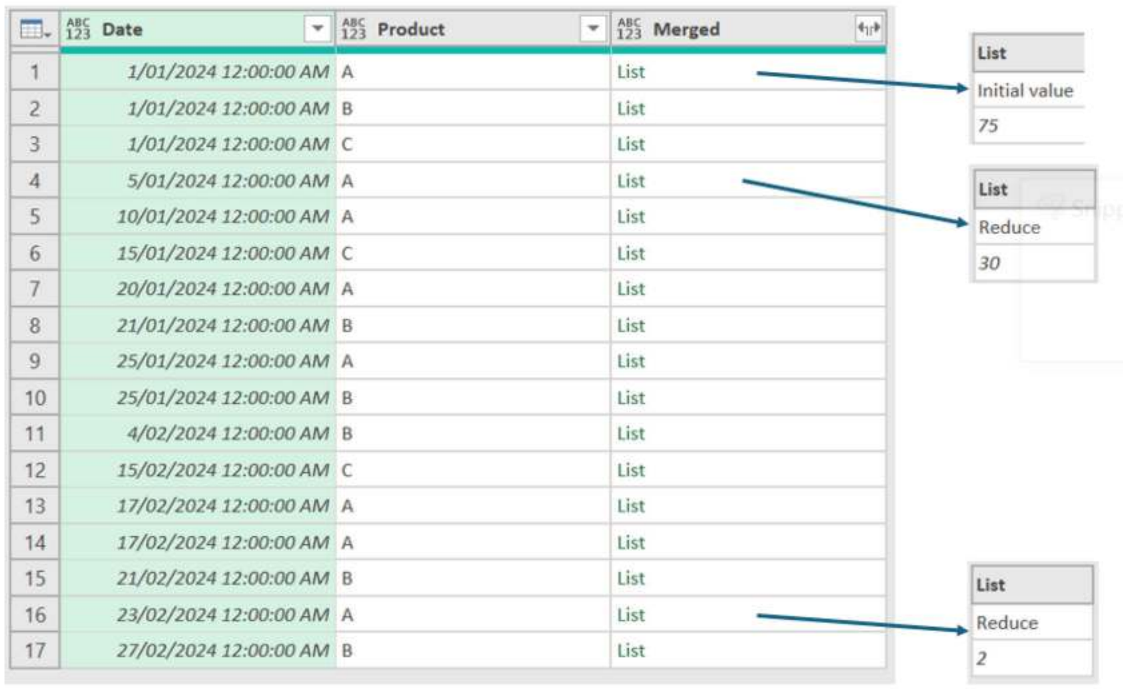


| | Date | Product | Merged |
|---|---|---|---|
| 1 | 1/01/2024 12:00:00 AM | A | Initial value75 |
| 2 | 1/01/2024 12:00:00 AM | B | Initial value80 |
| 3 | 1/01/2024 12:00:00 AM | C | Initial value20 |
| 4 | 5/01/2024 12:00:00 AM | A | Reduce30 |
| 5 | 10/01/2024 12:00:00 AM | A | Reduce20 |
| 6 | 15/01/2024 12:00:00 AM | C | Reduce10 |
| 7 | 20/01/2024 12:00:00 AM | A | Add20 |
| 8 | 21/01/2024 12:00:00 AM | B | Reduce60 |
| 9 | 25/01/2024 12:00:00 AM | A | Add50 |
| 10 | 25/01/2024 12:00:00 AM | B | Add50 |
| 11 | 4/02/2024 12:00:00 AM | B | Reduce30 |
| 12 | 15/02/2024 12:00:00 AM | C | Reduce5 |
| 13 | 17/02/2024 12:00:00 AM | A | Reduce70 |
| 14 | 17/02/2024 12:00:00 AM | A | Reduce20 |
| 15 | 21/02/2024 12:00:00 AM | B | Reduce25 |
| 16 | 23/02/2024 12:00:00 AM | A | Reduce2 |
| 17 | 27/02/2024 12:00:00 AM | B | Reduce10 |

***Figure 4-54*** The result of merging

In this example, since the values in the Quantity column are of type number, by applying the merging command, `Table.TransformColumnTypes()` is used automatically to convert these values to text. Then, column merging is applied to the selected columns. As you do not want to concatenate the values of selected columns, rewrite the formula as shown here (replace the first argument with the name of the table, and the third argument with `each _`). This results in Figure 4-55.

```
= Table.CombineColumns(
      Source,
      {"Type","Quantity"},
      each _,
      "Merged")
```



|  | Date | Product | Merged |
|---|---|---|---|
| 1 | 1/01/2024 12:00:00 AM | A | List |
| 2 | 1/01/2024 12:00:00 AM | B | List |
| 3 | 1/01/2024 12:00:00 AM | C | List |
| 4 | 5/01/2024 12:00:00 AM | A | List |
| 5 | 10/01/2024 12:00:00 AM | A | List |
| 6 | 15/01/2024 12:00:00 AM | C | List |
| 7 | 20/01/2024 12:00:00 AM | A | List |
| 8 | 21/01/2024 12:00:00 AM | B | List |
| 9 | 25/01/2024 12:00:00 AM | A | List |
| 10 | 25/01/2024 12:00:00 AM | B | List |
| 11 | 4/02/2024 12:00:00 AM | B | List |
| 12 | 15/02/2024 12:00:00 AM | C | List |
| 13 | 17/02/2024 12:00:00 AM | A | List |
| 14 | 17/02/2024 12:00:00 AM | A | List |
| 15 | 21/02/2024 12:00:00 AM | B | List |
| 16 | 23/02/2024 12:00:00 AM | A | List |
| 17 | 27/02/2024 12:00:00 AM | B | List |

| List |
|---|
| Initial value |
| 75 |

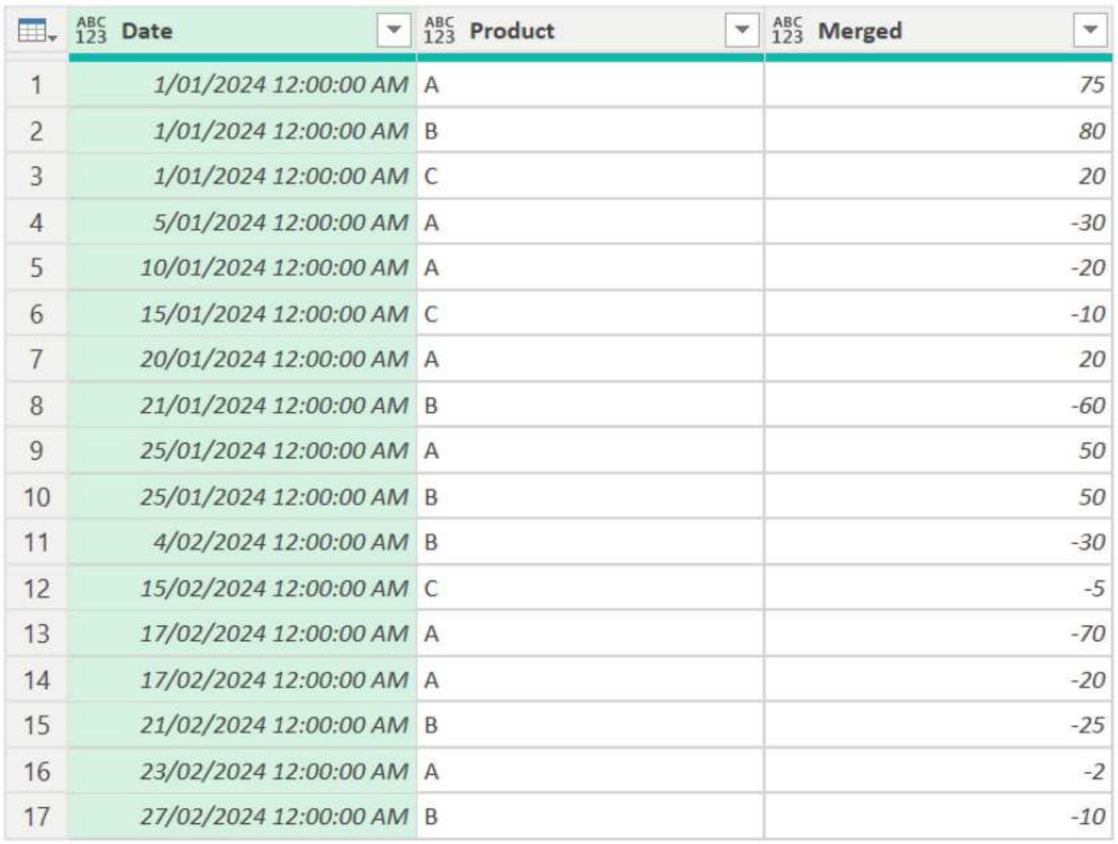
| List |
|---|
| Reduce |
| 30 |

| List |
|---|
| Reduce |
| 2 |

***Figure 4-55*** The result of revised merging

By using `each _` in the third argument of `Table.CombineColumns()` (the merging command), the values of the selected columns (Type and Quantity) are provided in a list with the selection order. The first item (`_{0}`) in the list determines the transaction type, and the second item (`_{1}`) specifies the quantity. Therefore, the formula can be rewritten as shown here to apply the sign to the Quantity based on the transaction type, resulting in Figure 4-56.

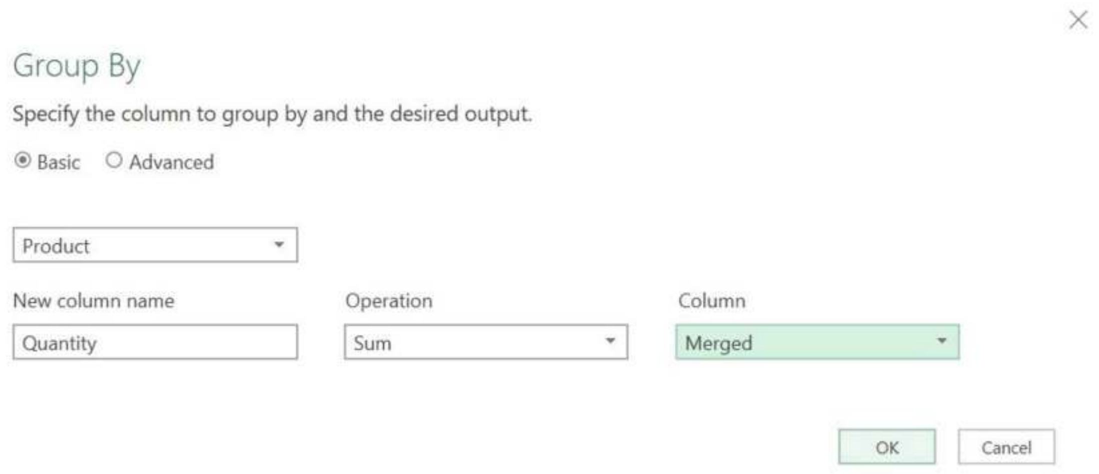
```
= Table.CombineColumns(
        Source,
        {"Type","Quantity"},
        each if _{0}="Reduce" then -_{1} else _{1},
        "Merged")
```



| | Date | Product | Merged |
|---|---|---|---|
| 1 | 1/01/2024 12:00:00 AM | A | 75 |
| 2 | 1/01/2024 12:00:00 AM | B | 80 |
| 3 | 1/01/2024 12:00:00 AM | C | 20 |
| 4 | 5/01/2024 12:00:00 AM | A | -30 |
| 5 | 10/01/2024 12:00:00 AM | A | -20 |
| 6 | 15/01/2024 12:00:00 AM | C | -10 |
| 7 | 20/01/2024 12:00:00 AM | A | 20 |
| 8 | 21/01/2024 12:00:00 AM | B | -60 |
| 9 | 25/01/2024 12:00:00 AM | A | 50 |
| 10 | 25/01/2024 12:00:00 AM | B | 50 |
| 11 | 4/02/2024 12:00:00 AM | B | -30 |
| 12 | 15/02/2024 12:00:00 AM | C | -5 |
| 13 | 17/02/2024 12:00:00 AM | A | -70 |
| 14 | 17/02/2024 12:00:00 AM | A | -20 |
| 15 | 21/02/2024 12:00:00 AM | B | -25 |
| 16 | 23/02/2024 12:00:00 AM | A | -2 |
| 17 | 27/02/2024 12:00:00 AM | B | -10 |

***Figure 4-56*** Adding sign by merging columns

From the Home tab, select Group By and apply the settings provided in Figure 4-57. This will result in Figure 4-58, including the last inventory of products.



Group By

Specify the column to group by and the desired output.

[✓ Basic] Advanced

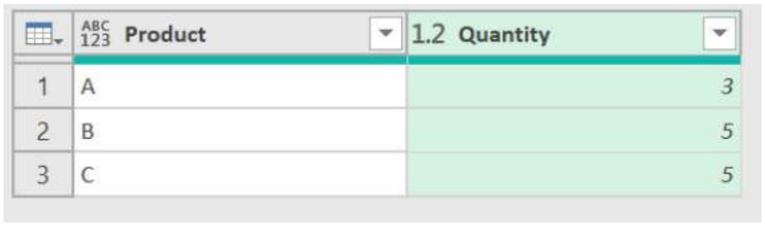
Product

New column name: Quantity

Operation: Sum

Column: Merged

***Figure 4-57*** Setting of Group By



| | Product | Quantity |
|---|---|---|
| 1 | A | 3 |
| 2 | B | 5 |
| 3 | C | 5 |

***Figure 4-58*** Final inventory levels of products

## Merging Date Information

Consider the source table in Table 4-13, which contains date information in an inappropriate format. Extract and convert the date information for each row.

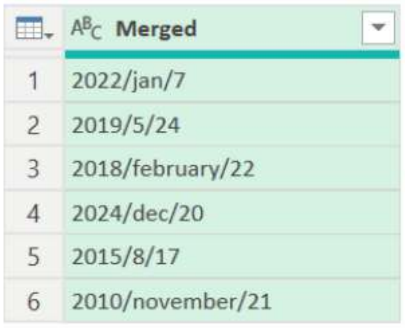
***Table 4-13*** Source: Sample Data

| Year | Month | Day |
|---|---|---|
| 2022 | jan | 7 |
| 2019 | 5 | 24 |
| 2018 | february | 22 |
| 2024 | dec | 20 |
| 2015 | 8 | 17 |
| 2010 | november | 21 |

**Note** The data in this example is provided in an Excel file titled `11 Merging Date Information .xlsx`.

Similar to the previous example, select the columns in the following order: Year, Month, and Day. Right-click one of the selected columns and choose Merge. Select the custom merge option and enter "/" as the separator. This will produce the following formula and the result in Figure 4-59.

```
=Table.CombineColumns(
      Table.TransformColumnTypes(
            Source,
            {{"Year", type text}, {"Month", type text}, {"Day", type text}},
            "en-AU"
      ),
      {"Year", "Month", "Day"},
      Combiner.CombineTextByDelimiter("/", QuoteStyle.None),
      "Merged"
)
```

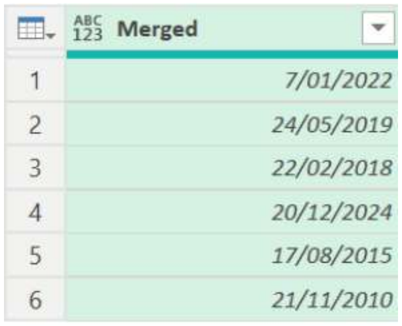


| | Merged |
|---|---|
| 1 | 2022/jan/7 |
| 2 | 2019/5/24 |
| 3 | 2018/february/22 |
| 4 | 2024/dec/20 |
| 5 | 2015/8/17 |
| 6 | 2010/november/21 |

***Figure 4-59*** The result of merging

The previous formula results in the connected values in a mix of number and text formats, without considering that their type is Date. To address this problem, you can use the `Date.From()` function, as shown in the following formula, to convert the text values into a date format. This results in Figure 4-60.

```
= Table.CombineColumns(
      Table.TransformColumnTypes(
            Source,
            {{"Year", type text}, {"Month", type text}, {"Day", type text}},
            "en-AU"
      ),
      {"Year", "Month", "Day"},
      each Date.From(Combiner.CombineTextByDelimiter("/", QuoteStyle.None)
(_)),
      "Merged"
)
```



|  | Merged |
|---|---|
| 1 | 7/01/2022 |
| 2 | 24/05/2019 |
| 3 | 22/02/2018 |
| 4 | 20/12/2024 |
| 5 | 17/08/2015 |
| 6 | 21/11/2010 |

***Figure 4-60*** The result of merging

It is true that the previous formula solves the problem, but it can also be rewritten using the `Text.Combine()` function instead of `Combiner.CombineTextByDelimiter()` as the combiner:

```
= Table.CombineColumns(
      Table.TransformColumnTypes(
            Source,
            {{"Year", type text}, {"Month", type text}, {"Day", type text}},
            "en-AU"
      ),
      {"Year", "Month", "Day"},
      each Date.From(Text.Combine(_, "/")),
      "Merged"
)
```

In the shortest version, instead of using `Table.TransformColumnTypes()` to convert the values to type text, you can use `List.Transform()`. The following formula can also be used to solve this problem:

```
= Table.CombineColumns(
      Source,
      {"Year", "Month", "Day"},
      each Date.From(Text.Combine(List.Transform(_,Text.From),"/")),
      "Merged")
```

To examine the formula, consider the first row of the table. The Year, Month, and Day columns are selected for merging. `each _` in the third input represents a list containing `{2022, "Jan", 7}`.

Using `List.Transform(_, Text.From)` converts all values for each row to text. For the first row, this results in `{"2022", "Jan", "7"}`. Next, `Text.Combine(List.Transform(_, Text.From),`

`"/")` combines these text values with `"/"` as the separator, resulting in `"2022/Jan/7"`. Finally, `Date.From()` converts this combined text into the date format.

---

## Summary

This chapter explored techniques for splitting a column into several columns using `Table.SplitColumn()` and merging multiple columns into a single column with `Table.CombineColumns()`. You learned that `Table.SplitColumn()` requires six arguments: the table containing the column to be split, the name of the column to split, a custom function defining the splitting logic, the number or names of the resulting columns, as well as logic for handling extra values, and null values in rows with fewer splitting values. Among these arguments, the third and fourth are crucial for creating dynamic splitting logic.

Conversely, you discovered how to use `Table.CombineColumns()` to merge values from multiple columns. This function accepts four arguments: the name of the table, the names of the columns to be merged, the merging function, and the name of the new column that will contain the combined values. While the user interface restricts the merging function to text-related functions in the third argument, using M-code allows for more flexibility to apply different functions as needed.

The next chapter provides insights into using the `Table.Pivot()` and `Table.UnpivotColumns()` functions to transform multiple columns into rows and vice versa.

O. Motamedisedeh, *96 Common Challenges in Power Query*
https://doi.org/10.1007/979-8-8688-1288-0_5

# 5. Pivoting and Unpivoting Tables

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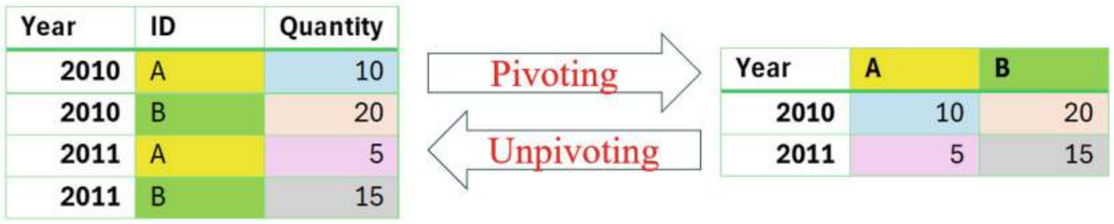
Pivoting and unpivoting are important commands for reshaping data in order to achieve the desired structure during the cleaning process. This chapter covers the hidden features of these two amazing functions in Power Query.

As shown in Figure 5-1, pivoting in Power Query is the process of transforming data from a long format (where multiple rows contain information that should be spread across columns) into a wide format (where distinct values from a column become the headers of new columns), and unpivoting is the opposite process. In other words, if you've used Pivot Tables in Excel, pivoting is like moving a field from the Rows area (quadrant) to the Columns area (quadrant), while unpivoting is the reverse—moving the field from the Columns area back to the Rows area.



| Year | ID | Quantity |
|---|---|---|
| 2010 | A | 10 |
| 2010 | B | 20 |
| 2011 | A | 5 |
| 2011 | B | 15 |

| Year | A | B |
|---|---|---|
| 2010 | 10 | 20 |
| 2011 | 5 | 15 |

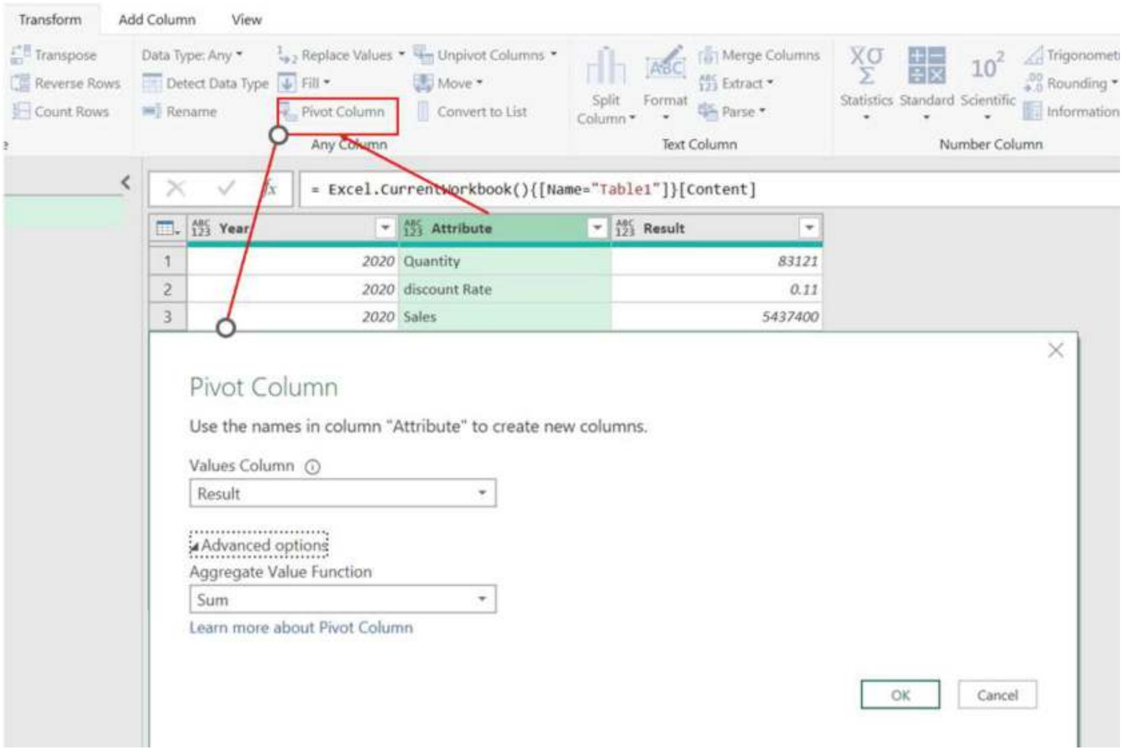
***Figure 5-1*** Settings of pivot columns

To show you how to use pivoting in Power Query, this chapter uses the Source table in Table 5-1, which includes yearly data.

***Table 5-1*** Source: Sales Info

| Year | Attribute | result |
|---|---|---|
| 2020 | Quantity | 83121 |
| 2020 | discount Rate | 11% |
| 2020 | Sales | 5437400 |
| 2021 | Quantity | 30293 |
| 2021 | discount Rate | 5% |
| 2021 | Sales | 9772700 |
| 2022 | Quantity | 79865 |
| 2022 | discount Rate | 10% |
| 2022 | Sales | 3137600 |
| 2023 | Quantity | 87445 |
| 2023 | discount Rate | 11% |
| 2023 | Sales | 5472500 |
| 2023 | Sales | 45 |

In the Source table, each row contains information about quantity, sales, and discount rates for different years. To reshape the table and separate this information into distinct columns, select the Attribute column, then go to the Transform tab, and apply the pivot operation by clicking the Pivot Column command. Then configure the settings on the open window, by choosing Result as the value column and Sum, or any other functions as the aggregation function from advanced options, as shown in Figure 5-2. Then click OK, which results in the pivoted version of source table, as shown in Figure 5-3.



```
= Excel.CurrentWorkbook(){[Name="Table1"]}[Content]
```

| | Year | Attribute | Result |
|---|---|---|---|
| 1 | 2020 | Quantity | 83121 |
| 2 | 2020 | discount Rate | 0.11 |
| 3 | 2020 | Sales | 5437400 |

Pivot Column

Use the names in column "Attribute" to create new columns.

Values Column: Result

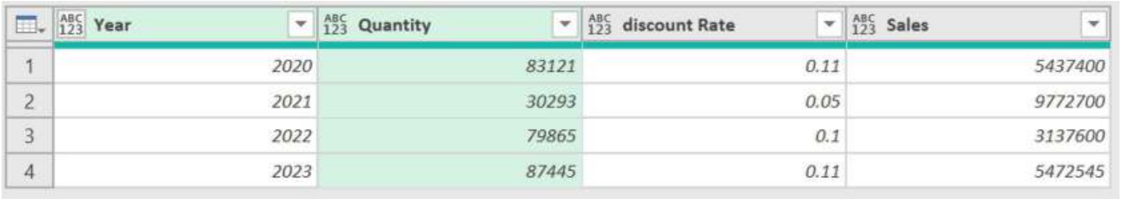
Advanced options

Aggregate Value Function: Sum

Learn more about Pivot Column

OK Cancel

***Figure 5-2*** Settings of the pivot columns



| | Year | Quantity | discount Rate | Sales |
|---|---|---|---|---|
| 1 | 2020 | 83121 | 0.11 | 5437400 |
| 2 | 2021 | 30293 | 0.05 | 9772700 |
| 3 | 2022 | 79865 | 0.1 | 3137600 |
| 4 | 2023 | 87445 | 0.11 | 5472545 |

***Figure 5-3*** The result of pivot columns

The previous steps result in the following formula in the formula bar, based on the `Table.Pivot()` function, which includes five key components as follows:

1. **Name of the table:** The original table being transformed is entered in the first argument.
2. **New columns:** The columns to be created in the reshaped table should be determined in the second argument.
3. **Pivot column:** The column from the original table that will be used to create the new columns.
4. **Value column:** The column whose values will be aggregated and placed under the new columns.
5. **Aggregation function:** The function used to aggregate the values, such as `Sum`.

```
= Table.Pivot(
     Source,
     List.Distinct(Source[Attribute]),
     "Attribute",
     "Result",
     List.Sum)
```

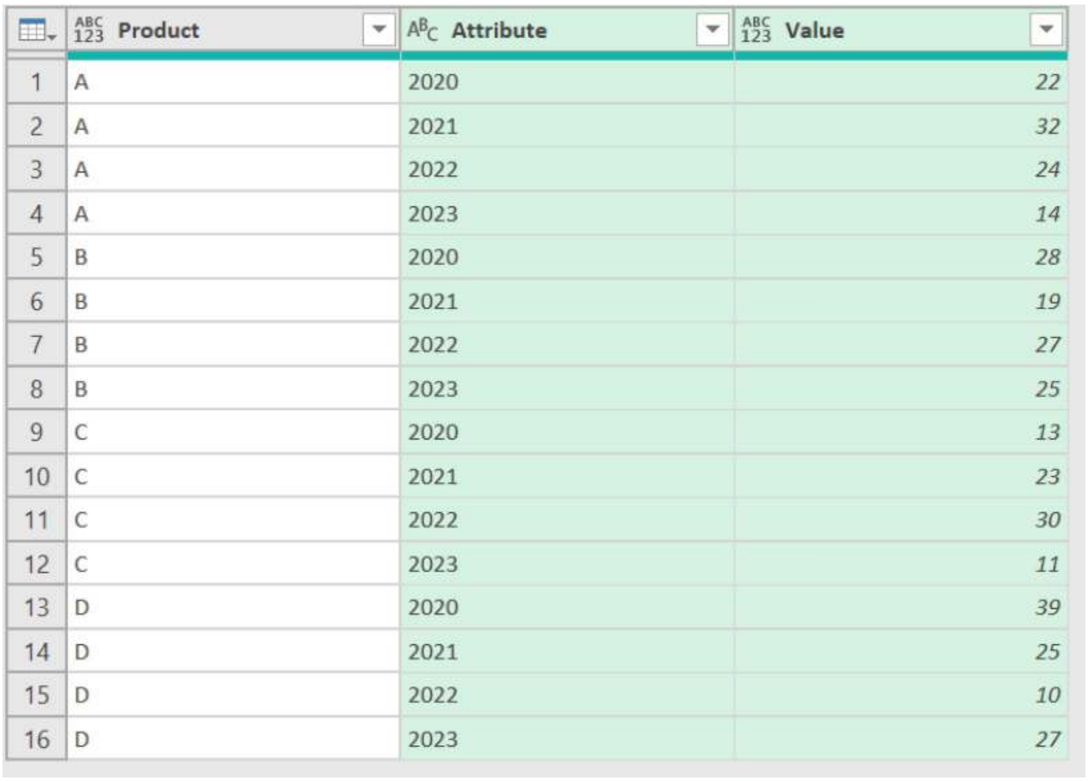
On the other hand, unpivoting is the process of transforming columns into rows, effectively converting a wide table with many columns into a longer, narrower format. This technique helps organize data that is structured in a tabular format, making it easier to analyze.

For example, consider the Source table shown in Table 5-2, which includes sales values across various years, presented in different columns. Unpivoting this table will consolidate the column headers into a single column and convert the associated values into rows, thus simplifying the data structure for analysis.

***Table 5-2*** Source: Sales info

| Product | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|
| A | 22 | 32 | 24 | 14 |
| B | 28 | 19 | 27 | 25 |
| C | 13 | 23 | 30 | 11 |
| D | 39 | 25 | 10 | 27 |

To consolidate sales data for different years into a single column, select columns 2020 to 2023, right-click one of them, and choose the Unpivot Columns command. You should get the unpivot version of the table shown in Figure 5-4.



|  | Product | Attribute | Value |
|---|---|---|---|
| 1 | A | 2020 | 22 |
| 2 | A | 2021 | 32 |
| 3 | A | 2022 | 24 |
| 4 | A | 2023 | 14 |
| 5 | B | 2020 | 28 |
| 6 | B | 2021 | 19 |
| 7 | B | 2022 | 27 |
| 8 | B | 2023 | 25 |
| 9 | C | 2020 | 13 |
| 10 | C | 2021 | 23 |
| 11 | C | 2022 | 30 |
| 12 | C | 2023 | 11 |
| 13 | D | 2020 | 39 |
| 14 | D | 2021 | 25 |
| 15 | D | 2022 | 10 |
| 16 | D | 2023 | 27 |

***Figure 5-4*** Results of unpivoting columns

Alternatively, if you select only the Product column and right-click it, then choose Unpivot Other Columns, you will achieve the same result as using the following formula:

```
 = Table.UnpivotOtherColumns(Source, {"Product"}, "Attribute", "Value")
```

The rest of this chapter explains these two advanced functions in Power Query.

## Managing Product IDs

The Source table contains Product IDs, as shown in Table 5-3. Generate a unique list of all Product IDs in a single column.

***Table 5-3*** Source: Product IDs

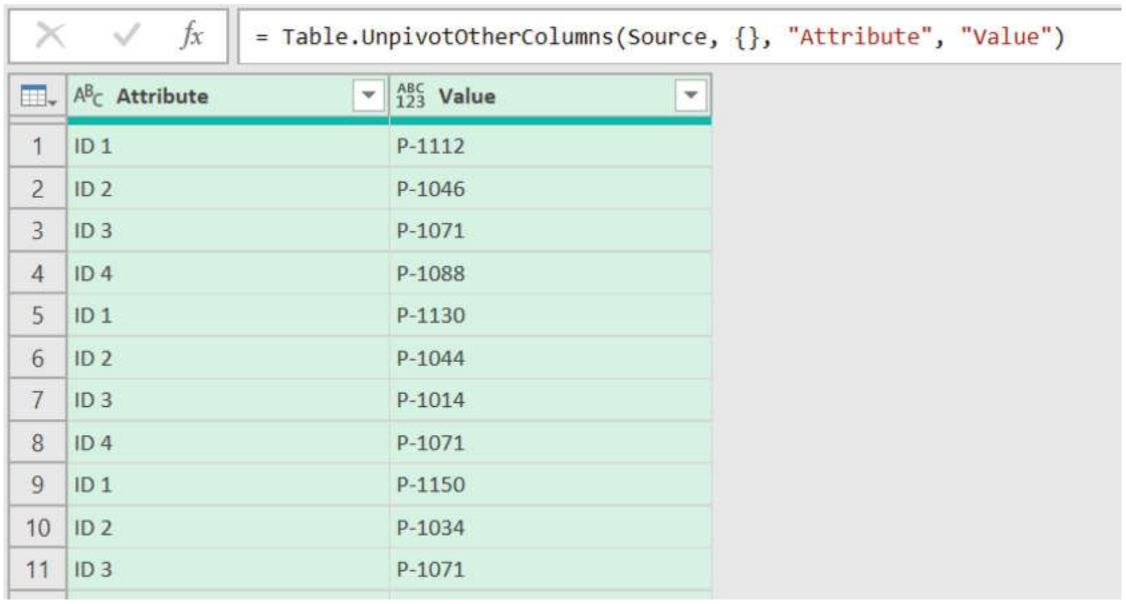
| ID 1 | ID 2 | ID 3 | ID 4 |
|---|---|---|---|
| P-1112 | P-1046 | P-1071 | P-1088 |
| P-1130 | P-1044 | P-1014 | P-1071 |
| P-1150 | P-1034 | P-1071 | P-1082 |
| P-1108 | P-1082 | | |
| P-1013 | P-1082 | | |
| P-1134 | P-1013 | P-1030 | P-1082 |
| P-1013 | P-1038 | P-1007 | |
| P-1165 | P-1076 | P-1089 | |
| P-1157 | P-1050 | | |

**Note** The data in this example is provided in an Excel file titled `01 Managing Product IDs.xlsx`.

Two different solutions, based on unpivoting and using M functions, are provided for this problem.

### Solution 1: Using Unpivoting

To solve this question, you need to provide all the IDs from the four columns into a single column under each other, and then remove any duplicate values from that column. Transforming IDs from multiple columns into a single column is precisely what unpivoting is designed to do. To extract a unique list of Product IDs in a column, select all the columns, right-click one, and choose Unpivot Columns, which results in a table with two columns—one containing all the IDs, typically labeled Value, and the other, called Attribute, showing the original column names where the IDs were located. See Figure 5-5.

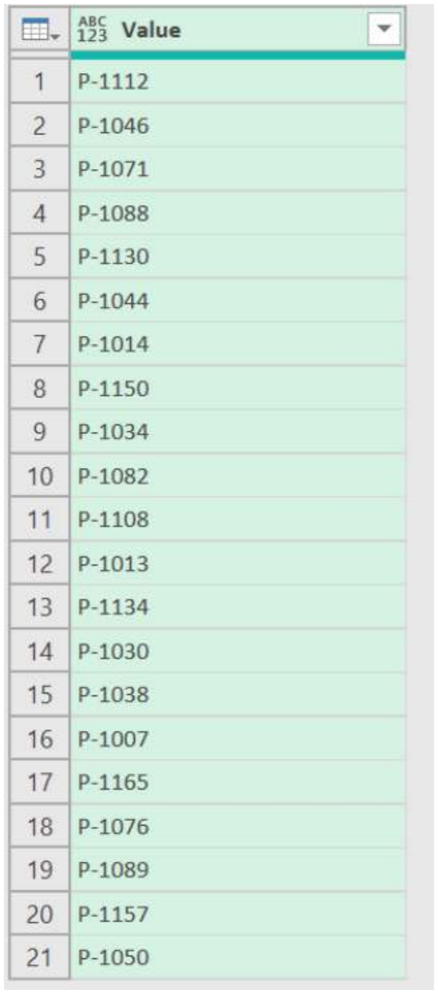


```
= Table.UnpivotOtherColumns(Source, {}, "Attribute", "Value")
```

| | Attribute | Value |
|---|---|---|
| 1 | ID 1 | P-1112 |
| 2 | ID 2 | P-1046 |
| 3 | ID 3 | P-1071 |
| 4 | ID 4 | P-1088 |
| 5 | ID 1 | P-1130 |
| 6 | ID 2 | P-1044 |
| 7 | ID 3 | P-1014 |
| 8 | ID 4 | P-1071 |
| 9 | ID 1 | P-1150 |
| 10 | ID 2 | P-1034 |
| 11 | ID 3 | P-1071 |

***Figure 5-5*** The result of unpivoting

In this example, you do not need the Attribute column, so, remove it. Then, to remove repetitive IDs, right-click the Value column and select Remove Duplicates to obtain Figure 5-6, including all the IDs.



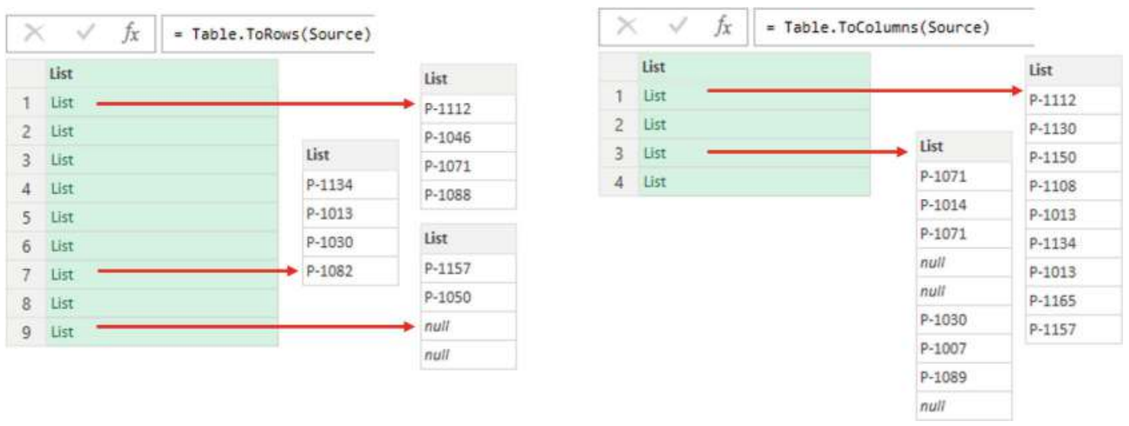
| | Value |
|---|---|
| 1 | P-1112 |
| 2 | P-1046 |
| 3 | P-1071 |
| 4 | P-1088 |
| 5 | P-1130 |
| 6 | P-1044 |
| 7 | P-1014 |
| 8 | P-1150 |
| 9 | P-1034 |
| 10 | P-1082 |
| 11 | P-1108 |
| 12 | P-1013 |
| 13 | P-1134 |
| 14 | P-1030 |
| 15 | P-1038 |
| 16 | P-1007 |
| 17 | P-1165 |
| 18 | P-1076 |
| 19 | P-1089 |
| 20 | P-1157 |
| 21 | P-1050 |

***Figure 5-6*** Removing duplicates

## Solution 2: Using M Functions

Power Query provides two powerful functions to convert all the values in a table into a list: `Table.ToRows()` and `Table.ToColumns()`. Both functions are easy to use; you only need to input the table name as the first argument. To use them, click the *fx* icon next to the formula bar to create a new step, and then use one of the following formulas. This will result in Figure 5-7.

```
=Table.ToRows(Source)
=Table.ToColumns(Source)
```



```
= Table.ToRows(Source)
```

| | List |
|---|---|
| 1 | List |
| 2 | List |
| 3 | List |
| 4 | List |
| 5 | List |
| 6 | List |
| 7 | List |
| 8 | List |
| 9 | List |

| List |
|---|
| P-1112 |
| P-1046 |
| P-1071 |
| P-1088 |

| List |
|---|
| P-1134 |
| P-1013 |
| P-1030 |
| P-1082 |

| List |
|---|
| P-1157 |
| P-1050 |
| null |
| null |

```
= Table.ToColumns(Source)
```

| | List |
|---|---|
| 1 | List |
| 2 | List |
| 3 | List |
| 4 | List |

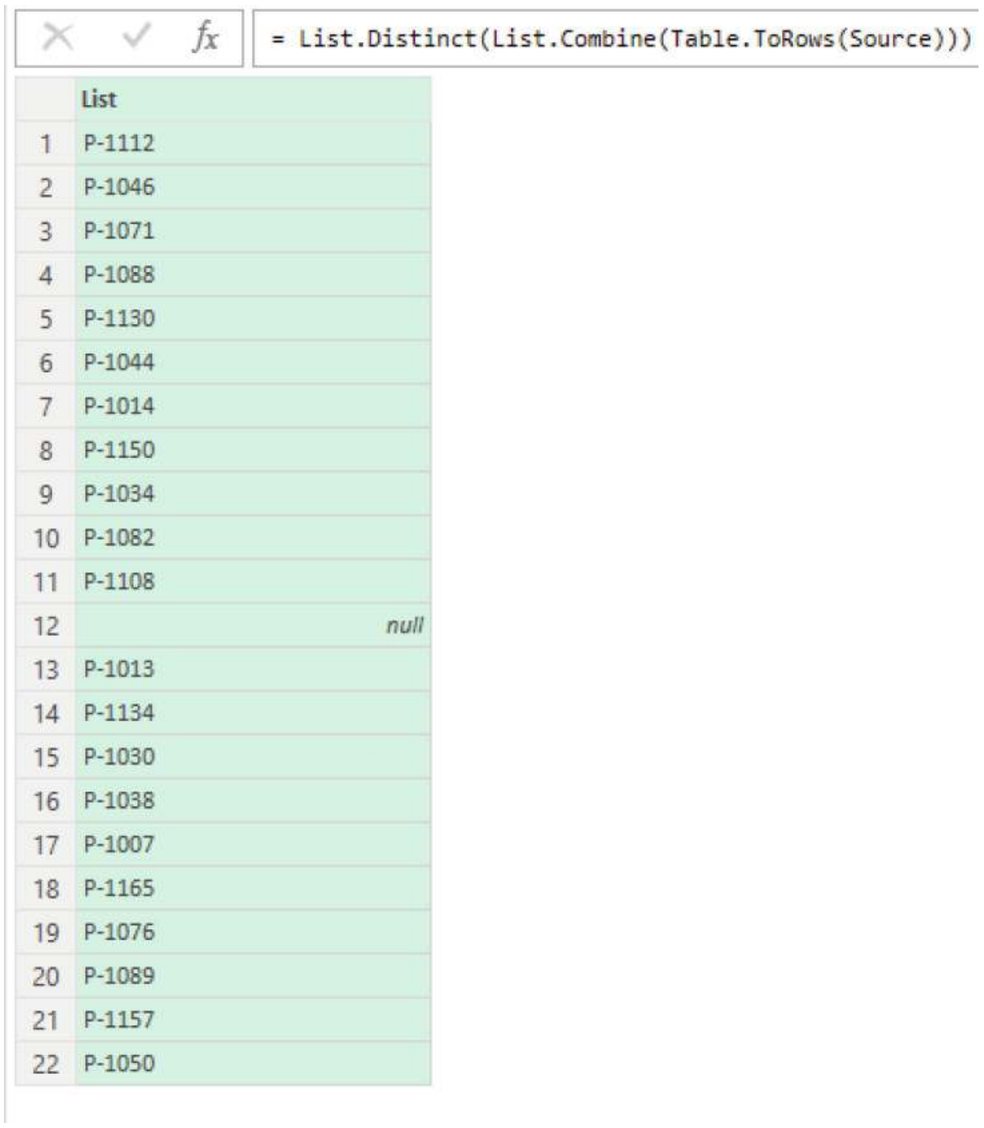
| List |
|---|
| P-1112 |
| P-1130 |
| P-1150 |
| P-1108 |
| P-1013 |
| P-1134 |
| P-1013 |
| P-1165 |
| P-1157 |

| List |
|---|
| P-1071 |
| P-1014 |
| P-1071 |
| null |
| null |
| P-1030 |
| P-1007 |
| P-1089 |
| null |

***Figure 5-7*** The results of using Table.ToRows() or Table.ToColumns()

No matter which formula you use, the remaining steps will be the same (I continue the explanation using `Table.ToRows()`). The result of `Table.ToRows(Source)` is a list containing several sublists, where each sublist represents the information from a single row of the source table. To extract the unique IDs, you need to combine these sublists into a single list using the `List.Combine()` function and then remove duplicates with the `List.Distinct()` function. You can rewrite the previous formula as follows to extract the unique IDs, as shown in Figure 5-8.

```
=List.Distinct(List.Combine(Table.ToRows(Source)))
```



= List.Distinct(List.Combine(Table.ToRows(Source)))

| | List |
|---|---|
| 1 | P-1112 |
| 2 | P-1046 |
| 3 | P-1071 |
| 4 | P-1088 |
| 5 | P-1130 |
| 6 | P-1044 |
| 7 | P-1014 |
| 8 | P-1150 |
| 9 | P-1034 |
| 10 | P-1082 |
| 11 | P-1108 |
| 12 | null |
| 13 | P-1013 |
| 14 | P-1134 |
| 15 | P-1030 |
| 16 | P-1038 |
| 17 | P-1007 |
| 18 | P-1165 |
| 19 | P-1076 |
| 20 | P-1089 |
| 21 | P-1157 |
| 22 | P-1050 |

***Figure 5-8*** The result of combining the sublists and removing duplicates

Instead of using the previous formula, which combines `List.Combine()` and `List.Distinct()`, you can use the `List.Union()` function as follows. This approach achieves the same result more directly.

```
=List.Union(Table.ToRows(Source))
```

Some of the cells in the source table are blank, so the result of the previous formula also includes null values. To remove these nulls from the list, you can use the `List.RemoveNulls()` function by modifying the formula as follows.

```
= List.RemoveNulls(List.Union(Table.ToRows(Source)))
```

**Note** In the second solution, the final result is of type list, whereas the result of the first solution is of type table.

## Value Repeated in Several Columns

The data in Table 5-4 displays products sold across different seasons. Extract the following lists:

a) Product IDs sold during all seasons.

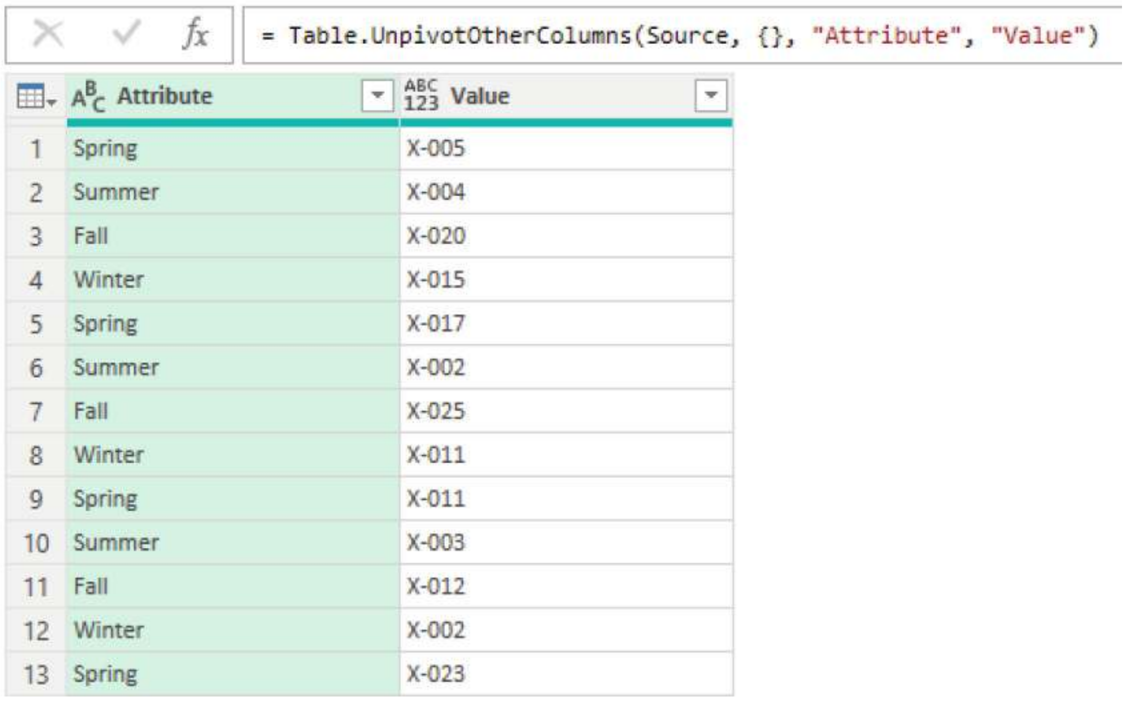
b) Product IDs sold during only one season.

> **Note**The data in this example is provided in an Excel file titled `02 Value repeated in several columns.xlsx`.

*Table 5-4* Source: Historical Sales Value

| Spring | Summer | Fall | Winter |
|---|---|---|---|
| X-005 | X-004 | X-020 | X-015 |
| X-017 | X-002 | X-025 | X-011 |
| X-011 | X-003 | X-012 | X-002 |
| X-023 | X-017 | X-025 | X-022 |
| X-015 | X-012 | X-012 | X-017 |
| X-004 | X-023 | X-012 | X-006 |
| X-015 | X-019 | X-010 | X-022 |
| X-008 | X-008 | X-019 | X-018 |
| X-012 | X-016 | X-016 | X-003 |
| X-021 | X-020 | X-025 | X-013 |
| X-012 | X-009 | X-014 | X-023 |
| X-014 | X-004 | X-025 | X-003 |
| X-013 | X-016 | X-024 | X-021 |
| X-004 | X-001 | X-015 | X-012 |

To solve this problem, the current table structure is not ideal. Converting it into a table with two columns—one for the seasons and the other for the Product IDs—can be helpful. This is where the Unpivoting command becomes invaluable. Select all the columns in the Source table. Then, from the Transform tab, choose the Unpivot Columns command. This action will create the unpivoted table shown in Figure 5-9.



```
= Table.UnpivotOtherColumns(Source, {}, "Attribute", "Value")
```

| | Attribute | Value |
|---|---|---|
| 1 | Spring | X-005 |
| 2 | Summer | X-004 |
| 3 | Fall | X-020 |
| 4 | Winter | X-015 |
| 5 | Spring | X-017 |
| 6 | Summer | X-002 |
| 7 | Fall | X-025 |
| 8 | Winter | X-011 |
| 9 | Spring | X-011 |
| 10 | Summer | X-003 |
| 11 | Fall | X-012 |
| 12 | Winter | X-002 |
| 13 | Spring | X-023 |

***Figure 5-9*** Unpivoted table

The data structure is suitable for counting the number of seasons in which an ID was sold on them, and then filtering the rows with a value of 4 in the count column. This is different from counting the number of repetitions of each ID, as an ID might appear multiple times for the same season. To ensure accurate results, let's first remove duplicate entries. So, select the Attribute and Value columns. Then, as shown in Figure 5-10, go to the Home tab, choose the Remove Rows command, and then select Remove Duplicates (or right-click one of the selected columns and choose the Remove Duplicates command). This action will yield a table where each product ID appears only once per season, as shown in Figure 5-11.

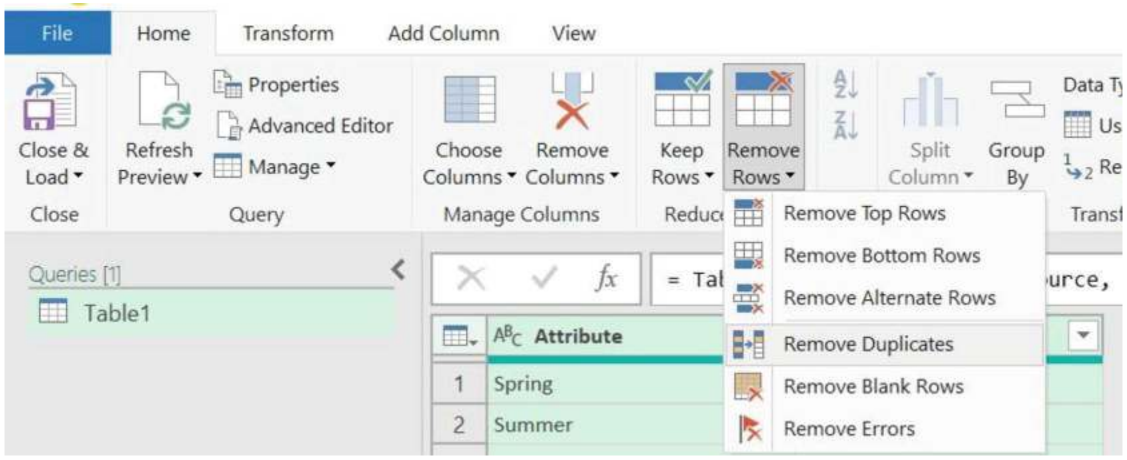
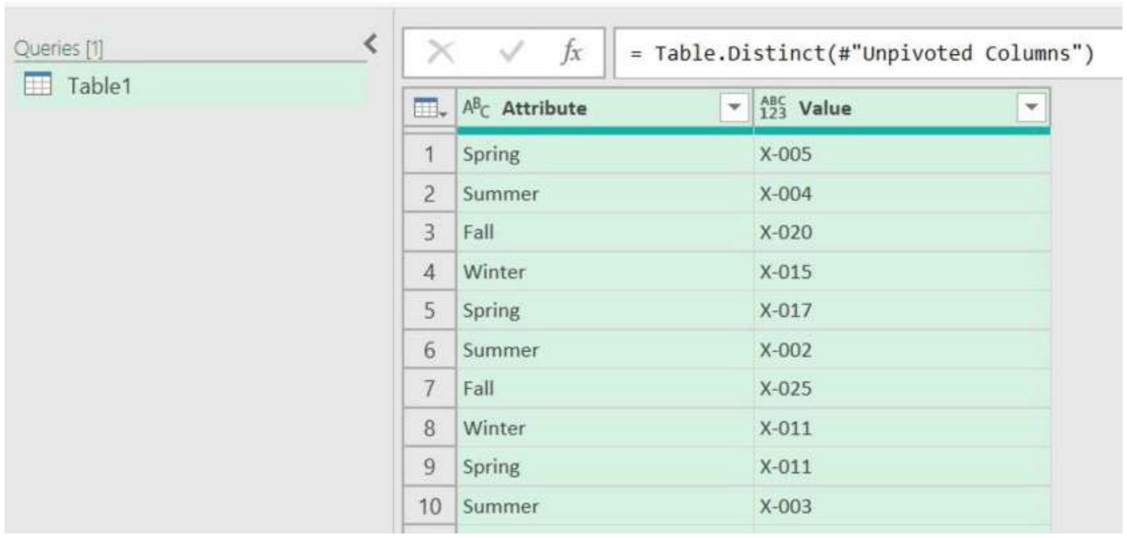


***Figure 5-10*** The Remove Duplicates command

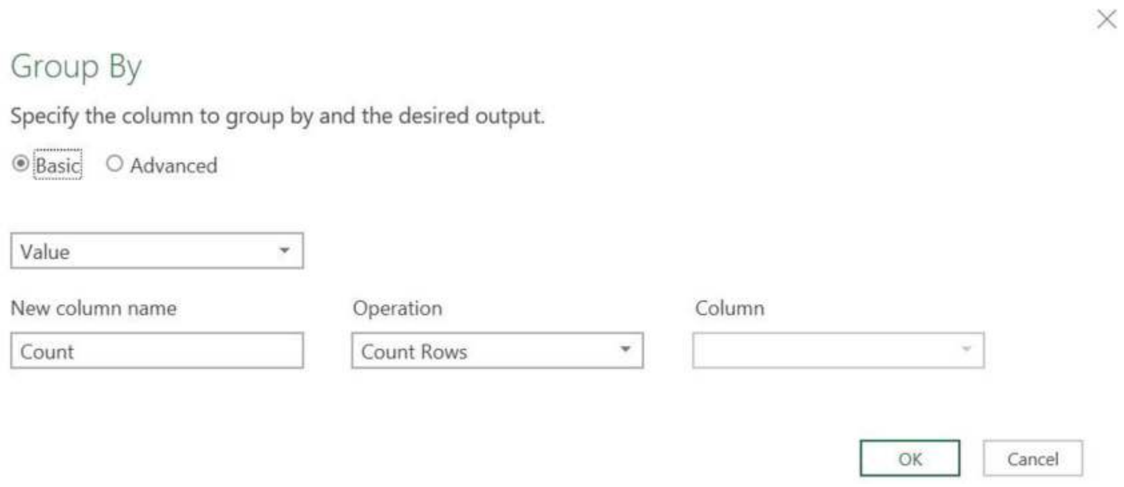


```
= Table.Distinct(#"Unpivoted Columns")
```

| | Attribute | Value |
|---|---|---|
| 1 | Spring | X-005 |
| 2 | Summer | X-004 |
| 3 | Fall | X-020 |
| 4 | Winter | X-015 |
| 5 | Spring | X-017 |
| 6 | Summer | X-002 |
| 7 | Fall | X-025 |
| 8 | Winter | X-011 |
| 9 | Spring | X-011 |
| 10 | Summer | X-003 |

***Figure 5-11*** The result of removing duplicates

After obtaining the table with unique product IDs for each season, it is time to count the number of repetitions of each ID in the table. Select the Value column. Then, right-click it and choose the Group By command. Apply the settings shown in Figure 5-12. This operation will result in the table displayed in Figure 5-13.


Group By

Specify the column to group by and the desired output.

[✓ Basic] Advanced

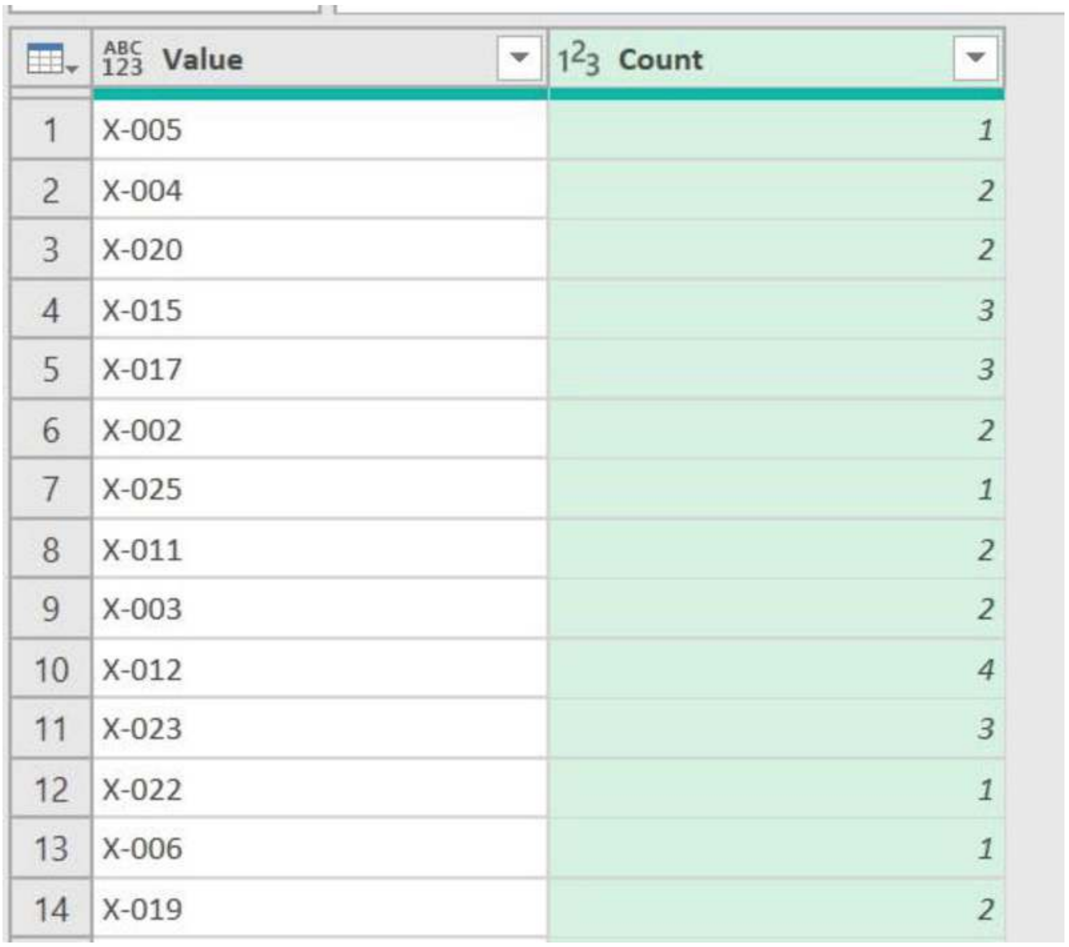
Value

New column name: Count

Operation: Count Rows

Column:

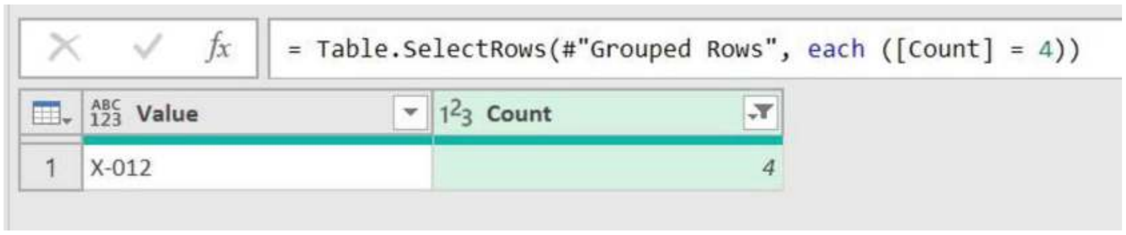
***Figure 5-12*** Setting of Group By



| | Value | Count |
|---|---|---|
| 1 | X-005 | 1 |
| 2 | X-004 | 2 |
| 3 | X-020 | 2 |
| 4 | X-015 | 3 |
| 5 | X-017 | 3 |
| 6 | X-002 | 2 |
| 7 | X-025 | 1 |
| 8 | X-011 | 2 |
| 9 | X-003 | 2 |
| 10 | X-012 | 4 |
| 11 | X-023 | 3 |
| 12 | X-022 | 1 |
| 13 | X-006 | 1 |
| 14 | X-019 | 2 |

***Figure 5-13*** The result of Group By

In the resulting table, each product ID is listed along with the count of seasons it was sold in. To identify products sold in all seasons, filter the Count column for the number 4. This will give you the list of product IDs that were sold in every season, as shown in Figure 5-14.

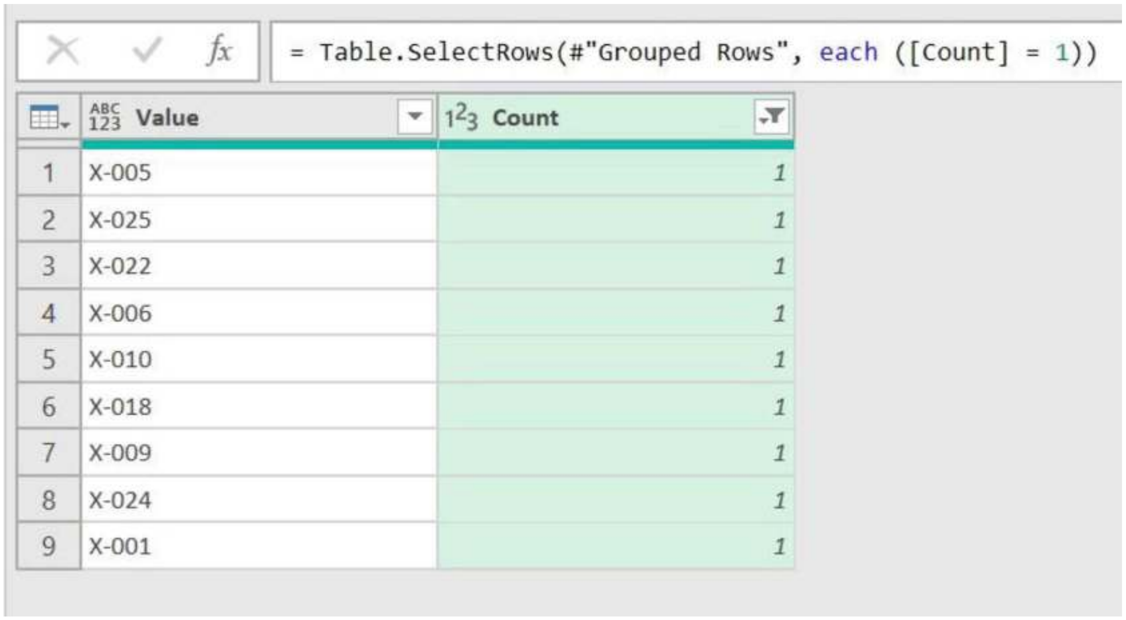


```
= Table.SelectRows(#"Grouped Rows", each ([Count] = 4))
```

| | Value | Count |
|---|---|---|
| 1 | X-012 | 4 |

***Figure 5-14*** Result of filtering 4 on the column count

Similarly, to find product IDs sold in just one season, filter the Count column for the number 1. The resulting list of product IDs will be extracted, as shown in Figure 5-15.



```
= Table.SelectRows(#"Grouped Rows", each ([Count] = 1))
```

| | Value | Count |
|---|---|---|
| 1 | X-005 | 1 |
| 2 | X-025 | 1 |
| 3 | X-022 | 1 |
| 4 | X-006 | 1 |
| 5 | X-010 | 1 |
| 6 | X-018 | 1 |
| 7 | X-009 | 1 |
| 8 | X-024 | 1 |
| 9 | X-001 | 1 |

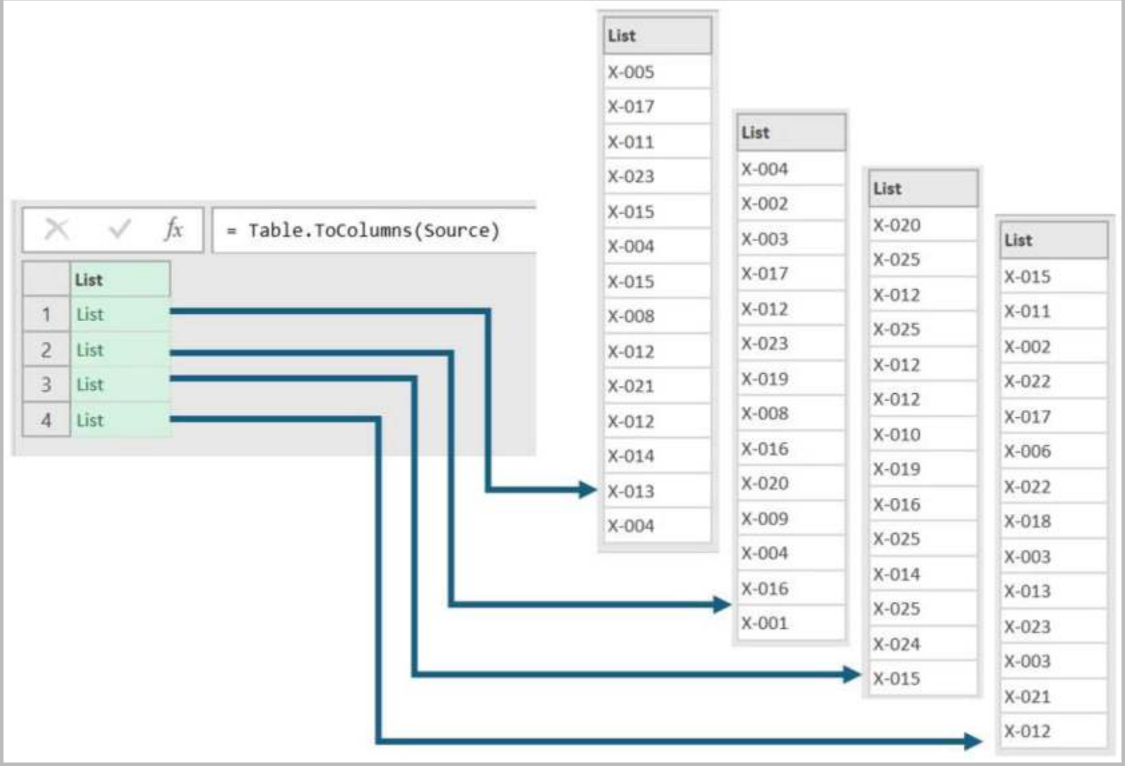
***Figure 5-15*** The result of filtering 1 on the column count

Following the steps, if you select the Advanced Editor command in the Home tab, the M-code generated by the whole steps is as follows:

```
let
    Source = Excel.CurrentWorkbook(){[Name="Table1"]}[Content],
    #"Unpivoted Columns" = Table.UnpivotOtherColumns(Source, {},
"Attribute", "Value"),
    #"Removed Duplicates" = Table.Distinct(#"Unpivoted Columns"),
    #"Grouped Rows" = Table.Group(#"Removed Duplicates", {"Value"},
{{"Count", each Table.RowCount(_), Int64.Type}}),
    #"Filtered Rows" = Table.SelectRows(#"Grouped Rows", each ([Count] = 1))
in
    #"Filtered Rows"
```

**Note** While the problem can be solved using the UI, as shown in the first solution, you can use List functions to extract IDs repeated in all seasons in an easy way. Here we explore how to use such functions.

Start with the source table, then select *fx* next to the formula bar to create a new step. Use the `Table.ToColumns()` function, as follows, in the formula bar. This will convert the table into a list with four sublists, each representing a list of product IDs sold in one season (one column), as shown in Figure 5-16.


```
= Table.ToColumns(Source)
```

| | List |
|---|---|
| 1 | List |
| 2 | List |
| 3 | List |
| 4 | List |

| List |
|---|
| X-005 |
| X-017 |
| X-011 |
| X-023 |
| X-015 |
| X-004 |
| X-015 |
| X-008 |
| X-012 |
| X-021 |
| X-012 |
| X-014 |
| X-013 |
| X-004 |

| List |
|---|
| X-004 |
| X-002 |
| X-003 |
| X-017 |
| X-012 |
| X-023 |
| X-019 |
| X-008 |
| X-016 |
| X-020 |
| X-009 |
| X-004 |
| X-016 |
| X-001 |

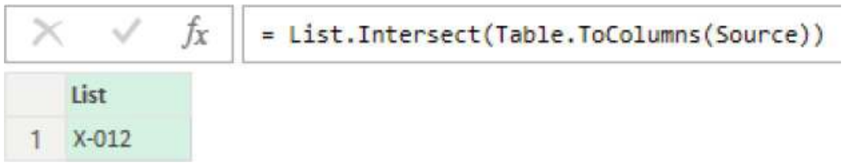
| List |
|---|
| X-020 |
| X-025 |
| X-012 |
| X-025 |
| X-012 |
| X-012 |
| X-010 |
| X-019 |
| X-016 |
| X-025 |
| X-014 |
| X-025 |
| X-024 |
| X-015 |

| List |
|---|
| X-015 |
| X-011 |
| X-002 |
| X-022 |
| X-017 |
| X-006 |
| X-022 |
| X-018 |
| X-003 |
| X-013 |
| X-023 |
| X-003 |
| X-021 |
| X-012 |

***Figure 5-16*** The result of Table.ToColumn

You can use `List.Intersect()` to extract the value that's common in all the sublists. Revising the previous formula will return the IDs repeated in all the seasons, as shown in Figure 5-17.

```
= List.Intersect(Table.ToColumns(Source))
```


```
= List.Intersect(Table.ToColumns(Source))
```

| | List |
|---|---|
| 1 | X-012 |

***Figure 5-17*** Extracting IDs sold in all the seasons

## Removing Blank Columns

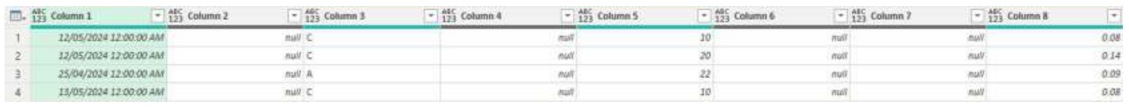
Table 5-5 shows the Source table imported from a CSV file into Power Query. Remove columns that contain only blank values.

***Table 5-5*** Source: Product ID

| Col 1 | Col 2 | Col 3 | Col 4 | Col 5 | Col 6 | Col 7 | Col 8 |
|---|---|---|---|---|---|---|---|
| 12/05/2024 | | C | | 10 | | | 8% |
| 12/05/2024 | | C | | 20 | | | 14% |
| 25/04/2024 | | A | | 22 | | | 9% |
| 13/05/2024 | | C | | 10 | | | 8% |

**Note** The data in this example is provided in an Excel file titled `03 Removing Blank Columns .xlsx`.

When you load this table into Power Query, the blank cells are shown as null, as shown in Figure 5-18.

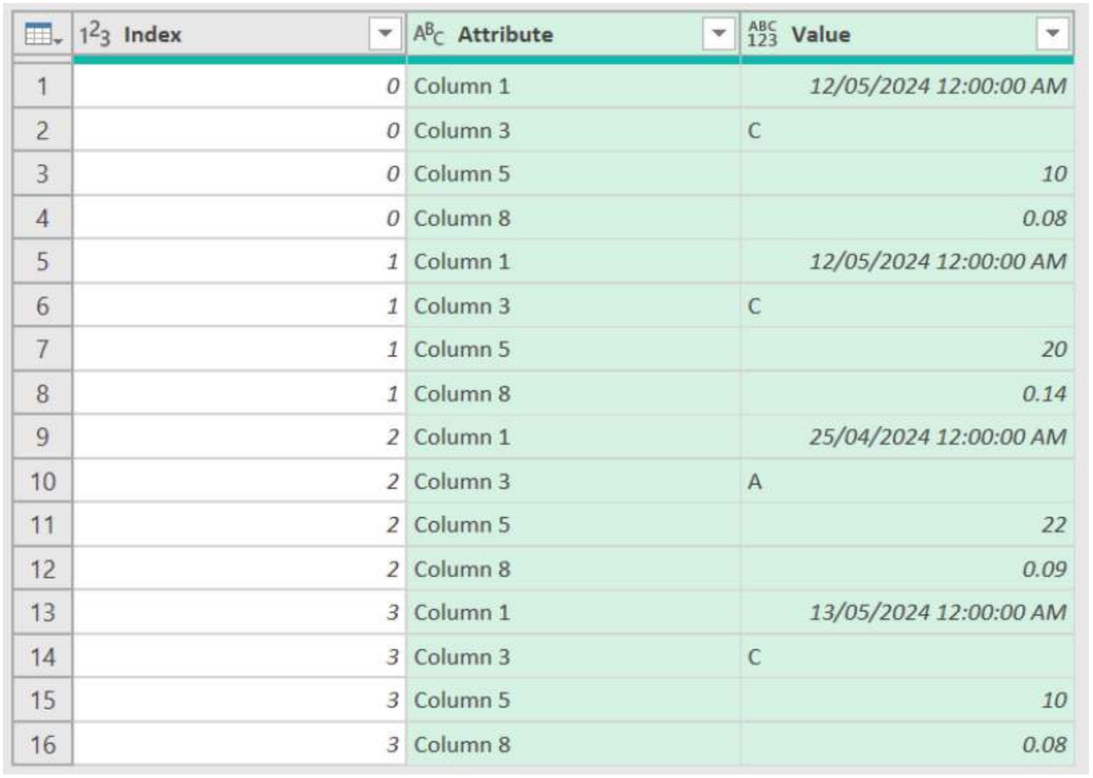


| | Column 1 | Column 2 | Column 3 | Column 4 | Column 5 | Column 6 | Column 7 | Column 8 |
|---|---|---|---|---|---|---|---|---|
| 1 | 12/05/2024 12:00:00 AM | null | C | null | 10 | null | null | 0.08 |
| 2 | 12/05/2024 12:00:00 AM | null | C | null | 20 | null | null | 0.14 |
| 3 | 25/04/2024 12:00:00 AM | null | A | null | 22 | null | null | 0.09 |
| 4 | 13/05/2024 12:00:00 AM | null | C | null | 10 | null | null | 0.08 |

***Figure 5-18*** Loading data in Power Query

Thanks to the unpivot and pivot commands in Power Query, removing blank columns is straightforward by following the following three steps:

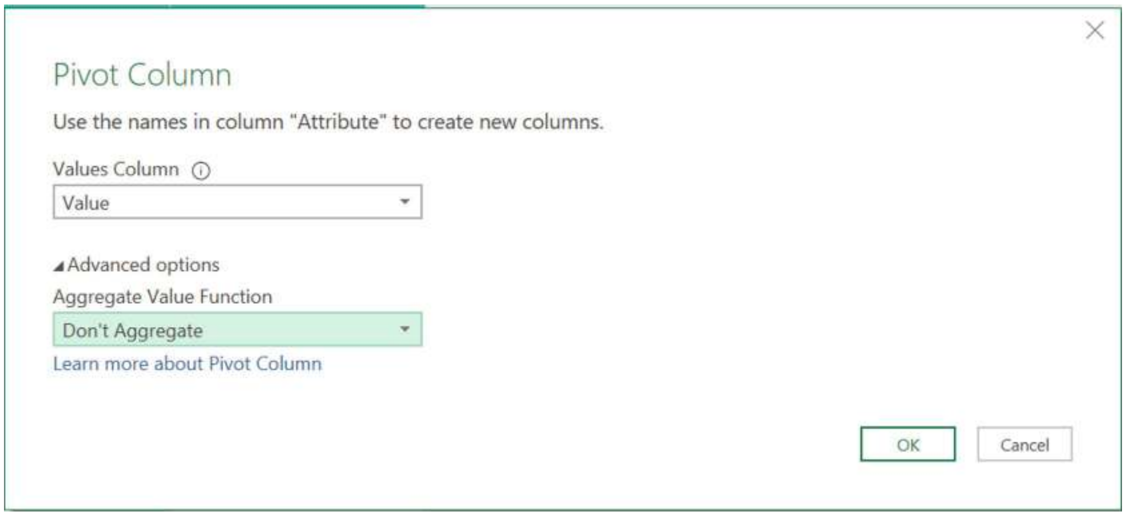
1. First, add an index column to the Source table by selecting the Add Index command in the Add Column tab.
2. Then right-click the Index column and choose Unpivot Other Columns. This will result in Figure 5-19. It’s important to note that after unpivoting a table, cells with null values will be ignored and will not appear in the resulting unpivoted table. Only the cells with actual data will be included in the transformation.



| | Index | Attribute | Value |
|---|---|---|---|
| 1 | 0 | Column 1 | 12/05/2024 12:00:00 AM |
| 2 | 0 | Column 3 | C |
| 3 | 0 | Column 5 | 10 |
| 4 | 0 | Column 8 | 0.08 |
| 5 | 1 | Column 1 | 12/05/2024 12:00:00 AM |
| 6 | 1 | Column 3 | C |
| 7 | 1 | Column 5 | 20 |
| 8 | 1 | Column 8 | 0.14 |
| 9 | 2 | Column 1 | 25/04/2024 12:00:00 AM |
| 10 | 2 | Column 3 | A |
| 11 | 2 | Column 5 | 22 |
| 12 | 2 | Column 8 | 0.09 |
| 13 | 3 | Column 1 | 13/05/2024 12:00:00 AM |
| 14 | 3 | Column 3 | C |
| 15 | 3 | Column 5 | 10 |
| 16 | 3 | Column 8 | 0.08 |

***Figure 5-19*** The result of unpivoting

3. Next, select the Attribute column, go to the Transform tab, and select Pivot Column. In the settings, choose Value as the Value Column and Don’t Aggregate as the aggregator, as shown in Figure 5-20. Click OK to obtain Figure 5-21, which is the source table without any blank columns.


Pivot Column

Use the names in column "Attribute" to create new columns.

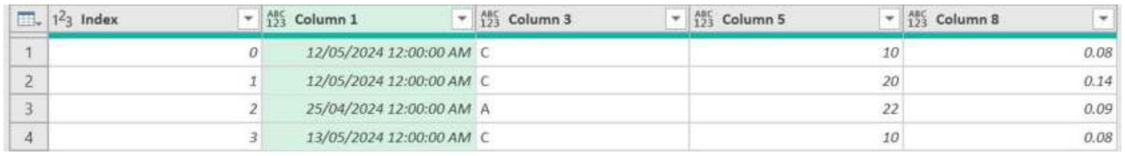
Values Column: Value

Advanced options

Aggregate Value Function: Don't Aggregate

Learn more about Pivot Column

*Figure 5-20* The settings for pivoting



|  | Index | Column 1 | Column 3 | Column 5 | Column 8 |
|---|---|---|---|---|---|
| 1 | 0 | 12/05/2024 12:00:00 AM | C | 10 | 0.08 |
| 2 | 1 | 12/05/2024 12:00:00 AM | C | 20 | 0.14 |
| 3 | 2 | 25/04/2024 12:00:00 AM | A | 22 | 0.09 |
| 4 | 3 | 13/05/2024 12:00:00 AM | C | 10 | 0.08 |

*Figure 5-21* The result of pivoting

## Transforming Columns, Part 1

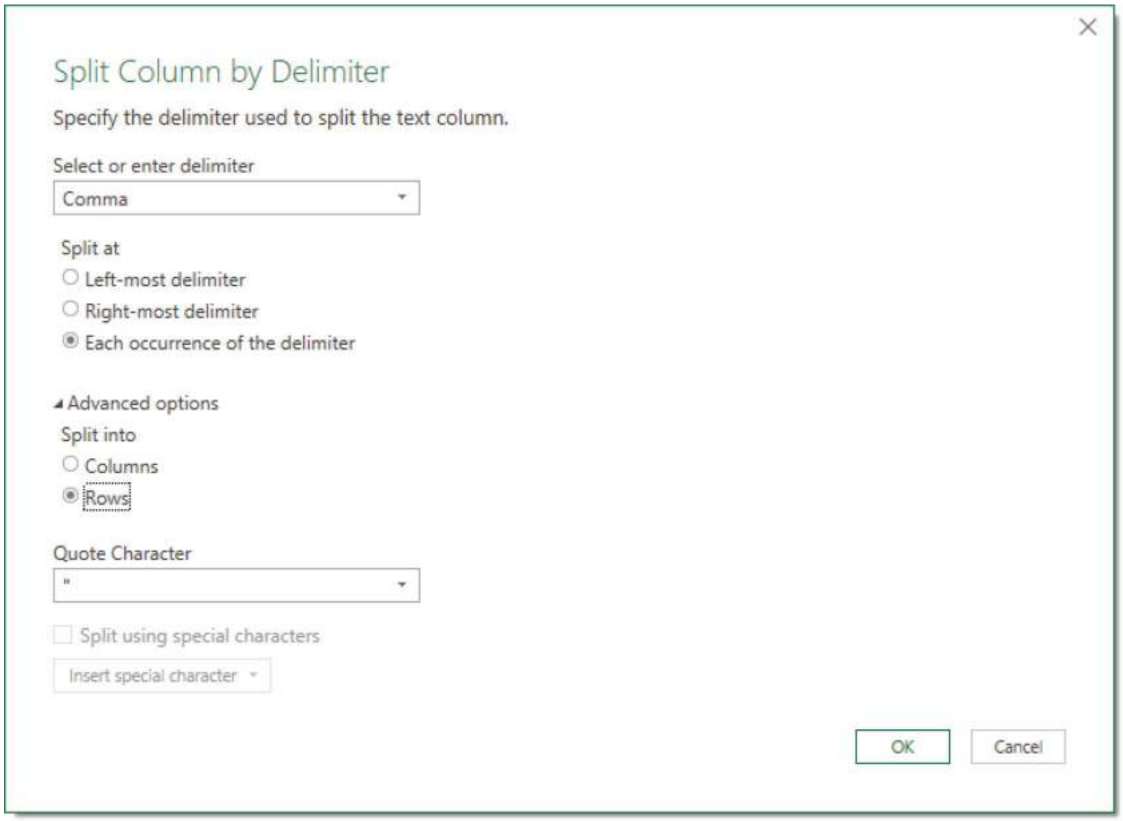
The Source table, shown as Table 5-6, contains a list of machinery codes and the product codes that each machinery can produce. Transform this table into a new table, with two columns, the first including product codes, and the second including corresponding machinery codes capable of producing that product.

*Table 5-6* Source: Machinery-Product

| Machinery Code | Products Code |
|---|---|
| M-112 | P-1071,P-1082,P-1088 |
| M-130 | P-1082,P-1014,P-1088 |
| M-150 | P-1034,P-1071,P-1082 |
| M-108 | P-1082 |
| M-106 | P-1082 |
| M-134 | P-1076,P-1014,P-1082 |
| M-102 | P-1082,P-1076 |
| M-165 | P-1076,P-1034 |
| M-157 | P-1071 |

**Note** The data in this example is provided in an Excel file titled `04 Transforming Columns Part 1.xlsx`.

To address this question, you need to separate the list of products and provide them under each other. So, select the Product Code column, go to the ***Home*** tab, and choose the Split Column ➤ By Delimiter command. Use comma delimiter, and as shown in Figure 5-22. From Advance options, choose Rows instead of Columns to provide the results split into rows.



Split Column by Delimiter

Specify the delimiter used to split the text column.

Select or enter delimiter: Comma

Split at
- Left-most delimiter
- Right-most delimiter
- [✓ Each occurrence of the delimiter]

Advanced options

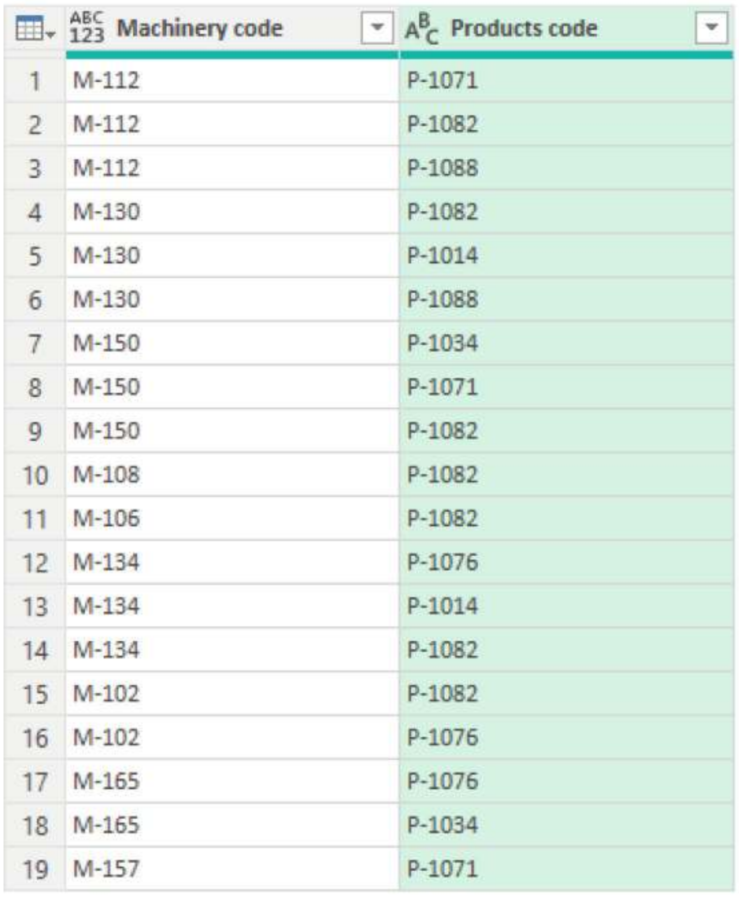
Split into
- Columns
- [✓ Rows]

Quote Character: "

Split using special characters

*Figure 5-22* Setting the splitting product code column

Click OK to obtain the result shown in Figure 5-23.

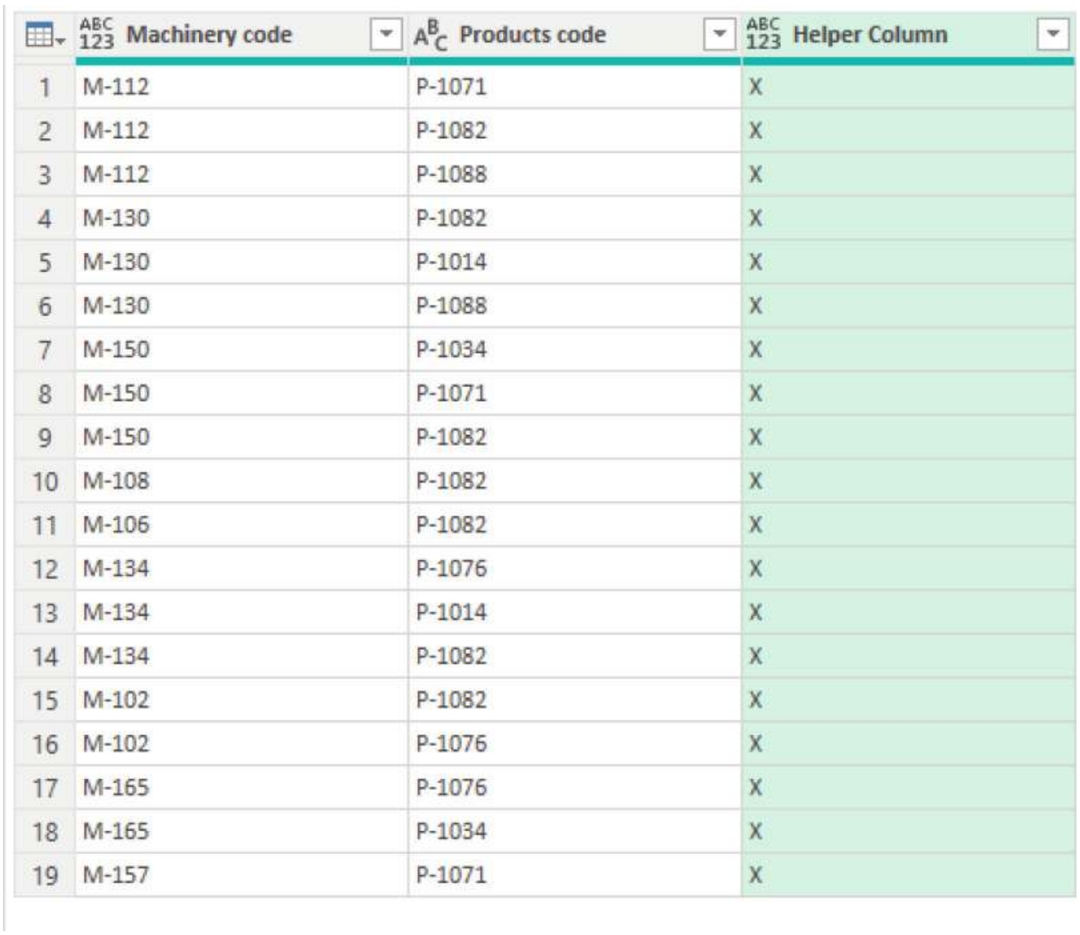


| | Machinery code | Products code |
|---|---|---|
| 1 | M-112 | P-1071 |
| 2 | M-112 | P-1082 |
| 3 | M-112 | P-1088 |
| 4 | M-130 | P-1082 |
| 5 | M-130 | P-1014 |
| 6 | M-130 | P-1088 |
| 7 | M-150 | P-1034 |
| 8 | M-150 | P-1071 |
| 9 | M-150 | P-1082 |
| 10 | M-108 | P-1082 |
| 11 | M-106 | P-1082 |
| 12 | M-134 | P-1076 |
| 13 | M-134 | P-1014 |
| 14 | M-134 | P-1082 |
| 15 | M-102 | P-1082 |
| 16 | M-102 | P-1076 |
| 17 | M-165 | P-1076 |
| 18 | M-165 | P-1034 |
| 19 | M-157 | P-1071 |

***Figure 5-23*** The results of column splitting

The table structure is good to use for the `Table.Group()` and `Table.Pivot()` functions, to create a list of machinery per product code. I explain `Table.Group()` later in Chapter 6, but this section focused on the `Table.Pivot()` scenario.

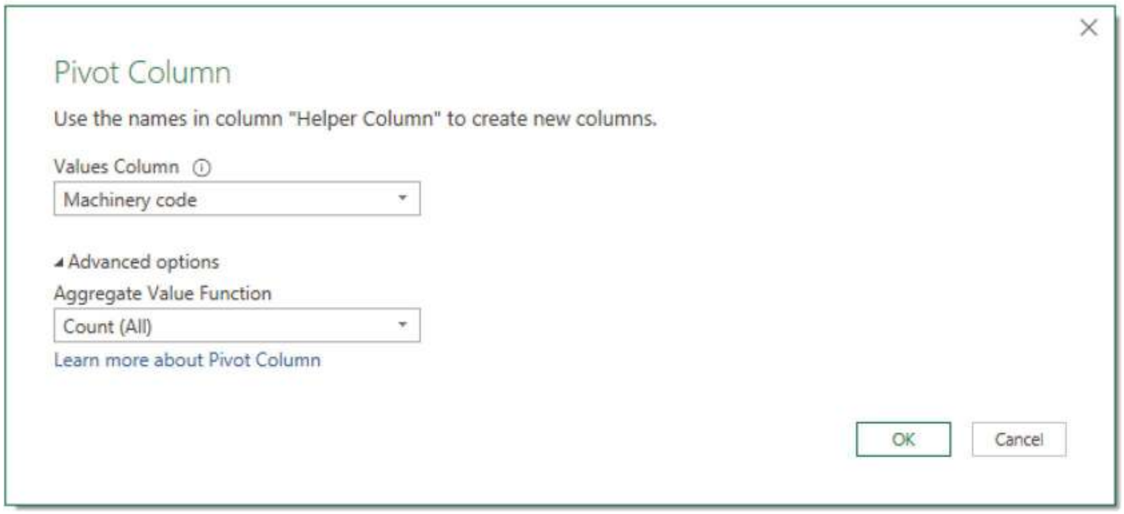
To use the Pivot Column command in this example, you need a helper column with the same value for all rows. So, from the Add Column tab, choose the Custom Column command to add a new column to the table. Name the new column Helper Column and write the formula of `="X"` in the Custom Column window. Then click OK, which produces the results shown in Figure 5-24.



| | Machinery code | Products code | Helper Column |
|---|---|---|---|
| 1 | M-112 | P-1071 | X |
| 2 | M-112 | P-1082 | X |
| 3 | M-112 | P-1088 | X |
| 4 | M-130 | P-1082 | X |
| 5 | M-130 | P-1014 | X |
| 6 | M-130 | P-1088 | X |
| 7 | M-150 | P-1034 | X |
| 8 | M-150 | P-1071 | X |
| 9 | M-150 | P-1082 | X |
| 10 | M-108 | P-1082 | X |
| 11 | M-106 | P-1082 | X |
| 12 | M-134 | P-1076 | X |
| 13 | M-134 | P-1014 | X |
| 14 | M-134 | P-1082 | X |
| 15 | M-102 | P-1082 | X |
| 16 | M-102 | P-1076 | X |
| 17 | M-165 | P-1076 | X |
| 18 | M-165 | P-1034 | X |
| 19 | M-157 | P-1071 | X |

***Figure 5-24*** Setting for extracting first

Now, you can use the Helper Column for pivoting. So, select the Helper Column, go to the Transform tab, and choose Pivot Column. In the new window, set Machinery Code as the Value Column, and in the Advanced options, choose Count as the aggregation function, similar to the setting shown in Figure 5-25. (The values in the Machinery Code column are in type text, and you want to concatenate them, but there is no such aggregation function in the provided list in Advanced options, so the Count is selected and then you have to revise the formula.)



Pivot Column

Use the names in column "Helper Column" to create new columns.

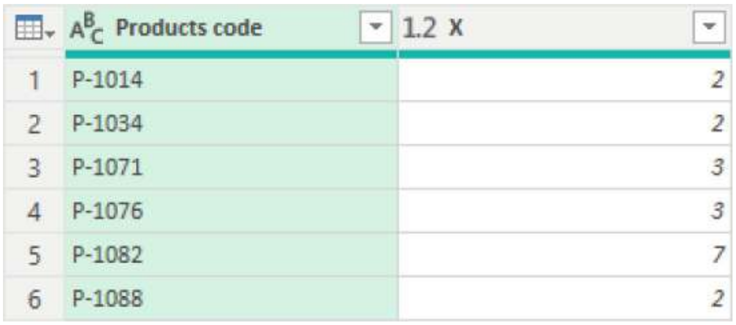
Values Column: Machinery code

Advanced options

Aggregate Value Function: Count (All)

*Figure 5-25* Setting for Table.Pivot

Click OK, leading to Figure 5-26. Since the helper column contains the same value ("X") for all rows, pivoting the table based on this column results in a new column named "X" in the pivoted table. By selecting Count as the aggregation operator, the new column will display the number of machines used for each product code.



| | Products code | X |
|---|---|---|
| 1 | P-1014 | 2 |
| 2 | P-1034 | 2 |
| 3 | P-1071 | 3 |
| 4 | P-1076 | 3 |
| 5 | P-1082 | 7 |
| 6 | P-1088 | 2 |

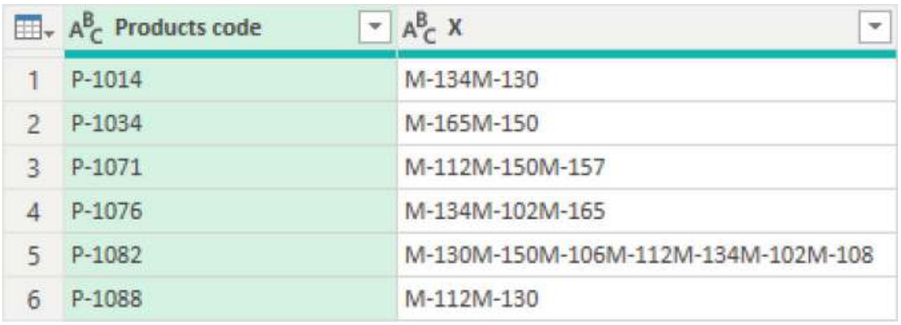
*Figure 5-26* The result of pivoting columns

Using the pivoting command with the previous setting, generate the following formula in the formula bar:

```
= Table.Pivot(#"Added Custom", List.Distinct(#"Added Custom"[#"Helper
Column"]), "Helper Column", "Machinery code", List.Count)
```

Instead of using the `List.Count()` function as the aggregation in the previous formula, you'll use the `Text.Combine()` function to concatenate the machinery IDs, using `","` as a separator. Replacing `List.Count` with `Text.Combine` in the previous formula and rewriting it as follows will result in Figure 5-27, which concatenates all the Machinery IDs without a separator.

```
= Table.Pivot(#"Added Custom", List.Distinct(#"Added Custom"[#"Helper
Column"]), "Helper Column", "Machinery code",  Text.Combine )
```



| | Products code | X |
|---|---|---|
| 1 | P-1014 | M-134M-130 |
| 2 | P-1034 | M-165M-150 |
| 3 | P-1071 | M-112M-150M-157 |
| 4 | P-1076 | M-134M-102M-165 |
| 5 | P-1082 | M-130M-150M-106M-112M-134M-102M-108 |
| 6 | P-1088 | M-112M-130 |

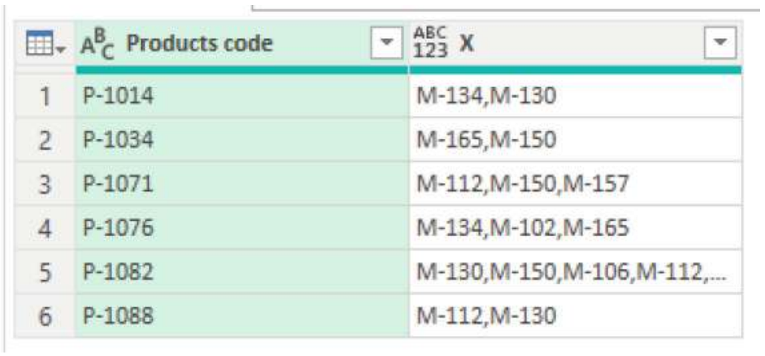
*Figure 5-27* Using Text.Combine()

To use a separator in the `Text.Combine()` function, you can use its second argument. However, when you're using more than one argument in the aggregation function inside the `Table.Pivot()` function, you need to highlight the first argument as well. But what should you use for the first argument?

To clarify, consider the previous formula. Using `Text.Combine` or `each Text.Combine(_)` in the aggregation part of the formula produces the same result. However, if you only want to use one argument in the aggregation function, you can remove the `each` and `(_)` parts, to make the formula shorter and clearer. But, if you need to use the second argument of the aggregation function (like a separator), you cannot omit these parts.

Based on this explanation, you can rewrite the previous formula as follows, by replacing `Text.Combine` with each `Text.Combine(_, ",")`, which will resolve the problem and produce the result shown in Figure 5-28.

```
= Table.Pivot(#"Added Custom", List.Distinct(#"Added Custom"[#"Helper
Column"]), "Helper Column", "Machinery code",  each Text.Combine(_,", ") )
```



| | Products code | X |
|---|---|---|
| 1 | P-1014 | M-134,M-130 |
| 2 | P-1034 | M-165,M-150 |
| 3 | P-1071 | M-112,M-150,M-157 |
| 4 | P-1076 | M-134,M-102,M-165 |
| 5 | P-1082 | M-130,M-150,M-106,M-112,... |
| 6 | P-1088 | M-112,M-130 |

***Figure 5-28*** The final result

## Transforming Columns, Part 2

The Source table in Table 5-7 provides the distances between every pair of cities. Create a From-To table, as shown in Table 5-8.

***Table 5-7*** City Distances

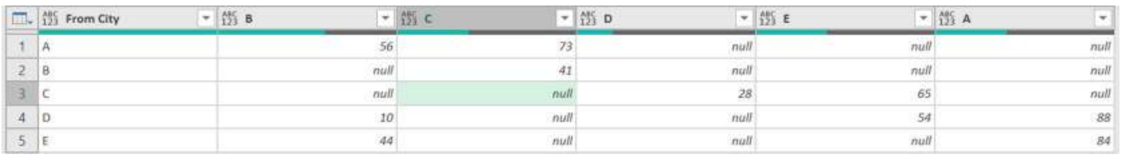
| From City | To City | Distance |
|---|---|---|
| A | B | 56 |
| A | C | 73 |
| A | D | 88 |
| A | E | 84 |
| B | C | 41 |
| B | D | 10 |
| B | E | 44 |
| C | D | 28 |
| C | E | 65 |
| D | E | 54 |

***Table 5-8*** The From-To Table

| | A | B | C | D | E |
|---|---|---|---|---|---|
| A | 0 | 56 | 73 | 88 | 84 |
| B | 56 | 0 | 41 | 10 | 44 |
| C | 73 | 41 | 0 | 28 | 65 |
| D | 88 | 10 | 28 | 0 | 54 |
| E | 84 | 44 | 65 | 54 | 0 |

**Note** The data in this example is provided in an Excel file titled `05 Transforming Columns Part 2.xlsx`.

To solve this problem, select the To City column and use the Pivot Column command from the Transform tab. In the open window, choose Distance for the Values column and use Sum as the aggregator. Then click OK, resulting in Figure 5-29.



| | From City | B | C | D | E | A |
|---|---|---|---|---|---|---|
| 1 | A | 56 | 73 | null | null | null |
| 2 | B | null | 41 | null | null | null |
| 3 | C | null | null | 28 | 65 | null |
| 4 | D | 10 | null | null | 54 | 88 |
| 5 | E | 44 | null | null | null | 84 |

***Figure 5-29*** The result of pivoting

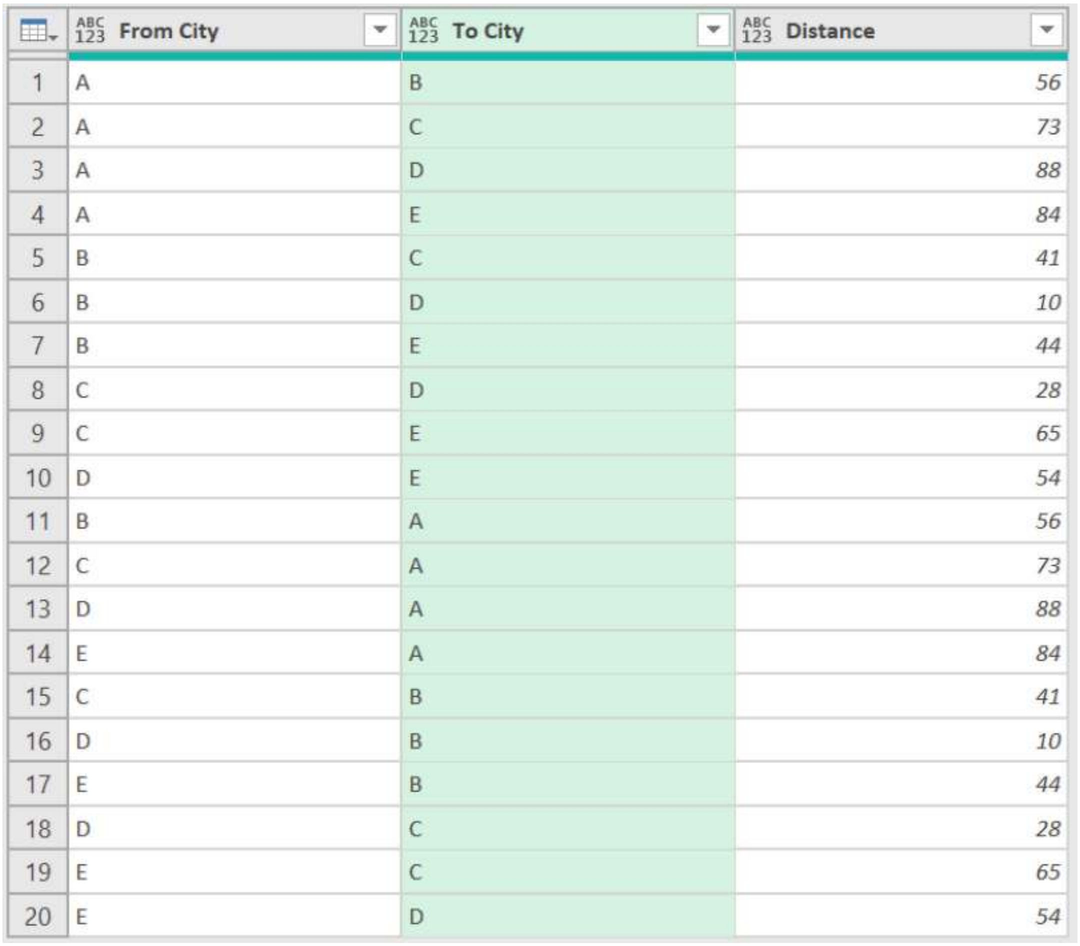
Although based on the question, the distance from C to B is the same as from B to C, in the resulting table, the distance from C to B is reported as null, as there is no row in the Source table including the value of C, B, and 41 for the From City, To City, and Distance columns, respectively. To address this issue, you need to complete the Source table by adding rows where From City and To City are swapped.

Consider the Source table. You can use the following formula to swap the name of columns in the Source table.

```
=RenameColumns(Source,{{"From City","To City"},{"To City","From City"}})
```

Rewrite the previous formula as follows, to combine the modified table with the original Source table. This results in Figure 5-30:

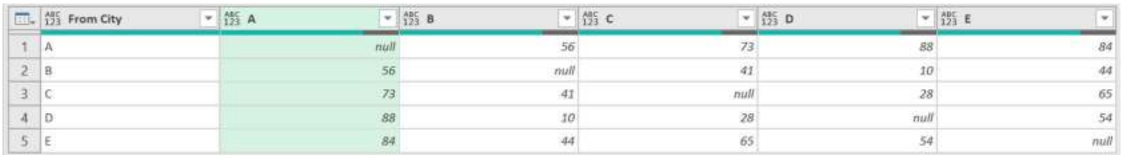
```
= Table.Combine(
      {Source,
      Table.RenameColumns(Source,{{"From City","To City"},{"To City","From
City"}})})
```



| | From City | To City | Distance |
|---|---|---|---|
| 1 | A | B | 56 |
| 2 | A | C | 73 |
| 3 | A | D | 88 |
| 4 | A | E | 84 |
| 5 | B | C | 41 |
| 6 | B | D | 10 |
| 7 | B | E | 44 |
| 8 | C | D | 28 |
| 9 | C | E | 65 |
| 10 | D | E | 54 |
| 11 | B | A | 56 |
| 12 | C | A | 73 |
| 13 | D | A | 88 |
| 14 | E | A | 84 |
| 15 | C | B | 41 |
| 16 | D | B | 10 |
| 17 | E | B | 44 |
| 18 | D | C | 28 |
| 19 | E | C | 65 |
| 20 | E | D | 54 |

***Figure 5-30*** The result of combining tables

Now you have separate rows for the distance from city C to B and the reverse. Sort the rows based on the To City column in ascending order and then pivot it in the way mentioned at the beginning of this question, to achieve Figure 5-31, based on the following formula.



| | From City | A | B | C | D | E |
|---|---|---|---|---|---|---|
| 1 | A | null | 56 | 73 | 88 | 84 |
| 2 | B | 56 | null | 41 | 10 | 44 |
| 3 | C | 73 | 41 | null | 28 | 65 |
| 4 | D | 88 | 10 | 28 | null | 54 |
| 5 | E | 84 | 44 | 65 | 54 | null |

***Figure 5-31*** The result of pivoting

```
= Table.Pivot(
      #"Sorted Rows",
      List.Distinct(#"Sorted Rows"[#"To City"]),
      "To City",
      "Distance",
      List.Sum)
```

To replace null values with zeros in the resulting table, you can modify the fifth argument of the formula as follows:

```
= Table.Pivot(
      #"Sorted Rows",
      List.Distinct(#"Sorted Rows"[#"To City"]),
      "To City",
      "Distance",
      each List.Sum(_)??0)
```

## Transforming Columns, Part 3

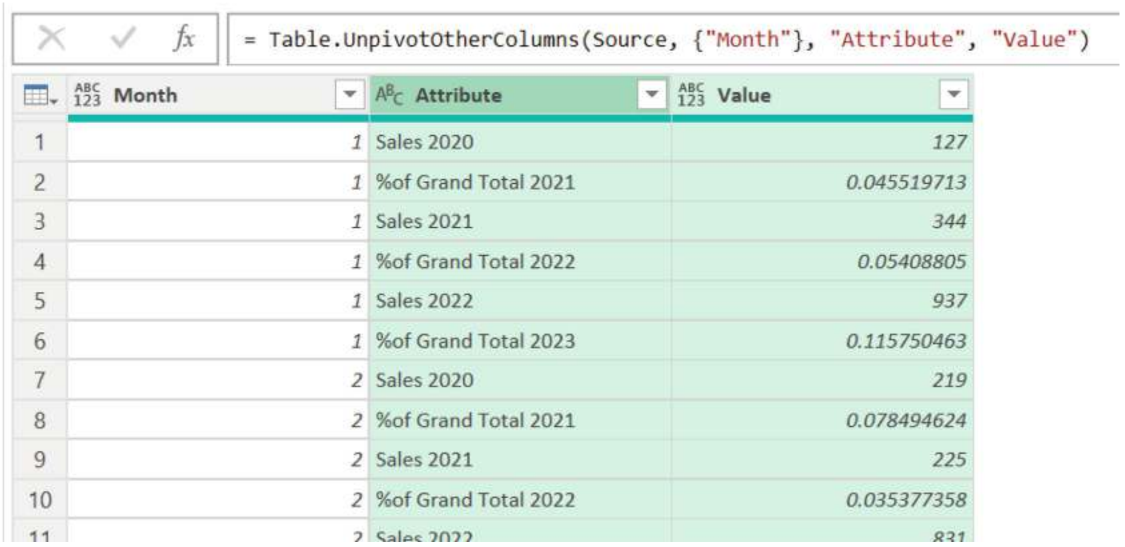
This Source table contains sales information, as shown in Table 5-9. Reshape the table to include three columns—Year, Month, and Sales—ensuring that any values related to the percentage of the grand total are removed.

***Table 5-9*** Source: Sales Info

| Month | Sales 2020 | Percent of Grand Total 2021 | Sales 2021 | Percent of Grand Total 2022 | Sales 2022 | Percent of Grand Total 2023 |
|---|---|---|---|---|---|---|
| 1 | 127 | 5% | 344 | 5% | 937 | 12% |
| 2 | 219 | 8% | 225 | 4% | 831 | 10% |
| 3 | 451 | 16% | 601 | 9% | 590 | 7% |
| 4 | 77 | 3% | 250 | 4% | 480 | 6% |
| 5 | 130 | 5% | 118 | 2% | 761 | 9% |
| 6 | 376 | 13% | 191 | 3% | 869 | 11% |
| 7 | 417 | 15% | 810 | 13% | 762 | 9% |
| 8 | 135 | 5% | 988 | 16% | 566 | 7% |
| 9 | 211 | 8% | 831 | 13% | 463 | 6% |
| 10 | 71 | 3% | 144 | 2% | 596 | 7% |
| 11 | 360 | 13% | 936 | 15% | 816 | 10% |
| 12 | 216 | 8% | 922 | 14% | 424 | 5% |

**Note** The data in this example is provided in an Excel file titled `06 Transforming Columns Part 3.xlsx`.

In this problem, if the number of percentage columns is limited and their names are constant, you can remove them directly. But if you are faced with tables in different structures for different companies, it would be better to use a more dynamic way using unpivoting commands. You can do this by right-clicking the Month column and selecting Unpivot Other Columns, which will result in Figure 5-32.

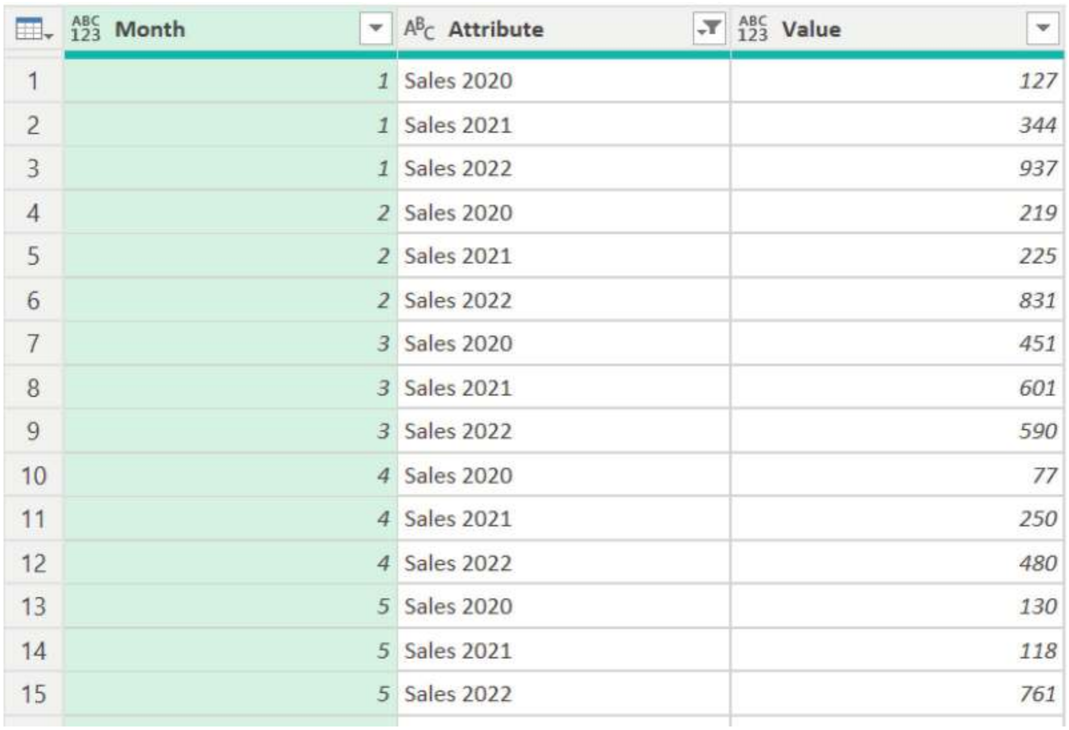


```
= Table.UnpivotOtherColumns(Source, {"Month"}, "Attribute", "Value")
```

|  | Month | Attribute | Value |
|---|---|---|---|
| 1 | 1 | Sales 2020 | 127 |
| 2 | 1 | %of Grand Total 2021 | 0.045519713 |
| 3 | 1 | Sales 2021 | 344 |
| 4 | 1 | %of Grand Total 2022 | 0.05408805 |
| 5 | 1 | Sales 2022 | 937 |
| 6 | 1 | %of Grand Total 2023 | 0.115750463 |
| 7 | 2 | Sales 2020 | 219 |
| 8 | 2 | %of Grand Total 2021 | 0.078494624 |
| 9 | 2 | Sales 2021 | 225 |
| 10 | 2 | %of Grand Total 2022 | 0.035377358 |
| 11 | 2 | Sales 2022 | 831 |

***Figure 5-32*** Unpivoting other columns

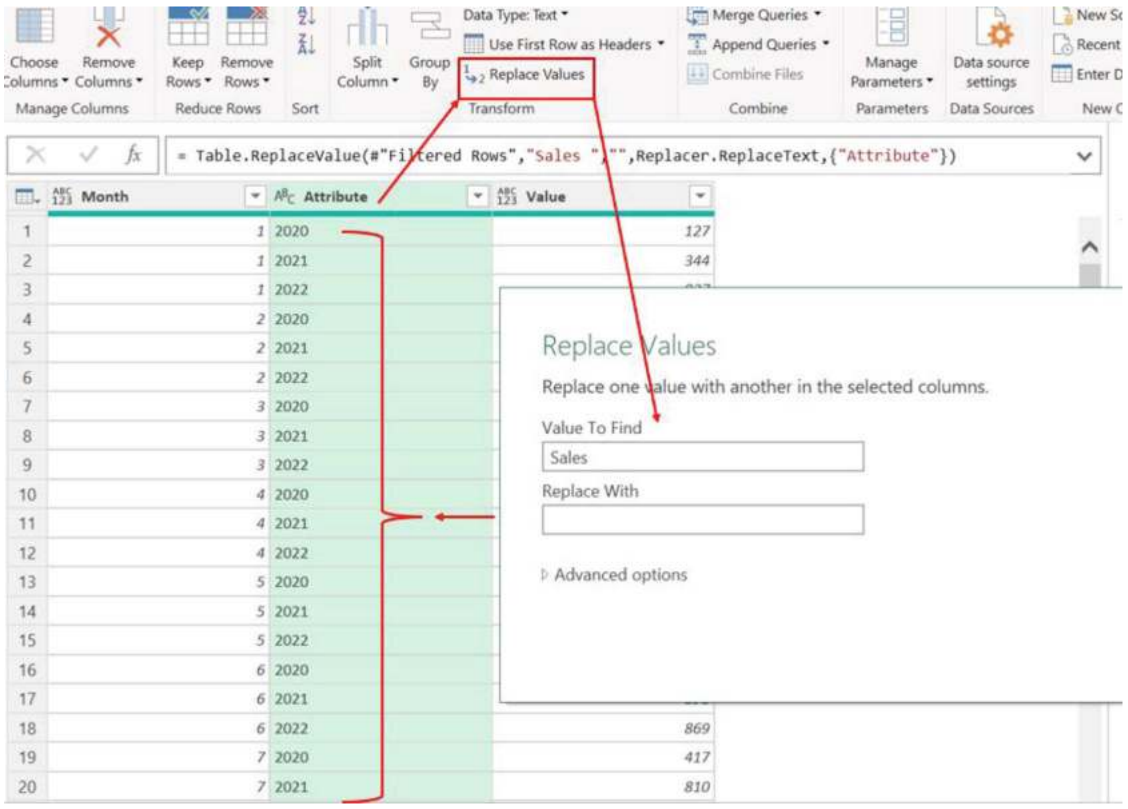
Next, use the filter option next to the Attribute column to select the text that does not contain `%`, achieving Figure 5-33.



| Month | Attribute | Value |
|---|---|---|
| 1 | Sales 2020 | 127 |
| 1 | Sales 2021 | 344 |
| 1 | Sales 2022 | 937 |
| 2 | Sales 2020 | 219 |
| 2 | Sales 2021 | 225 |
| 2 | Sales 2022 | 831 |
| 3 | Sales 2020 | 451 |
| 3 | Sales 2021 | 601 |
| 3 | Sales 2022 | 590 |
| 4 | Sales 2020 | 77 |
| 4 | Sales 2021 | 250 |
| 4 | Sales 2022 | 480 |
| 5 | Sales 2020 | 130 |
| 5 | Sales 2021 | 118 |
| 5 | Sales 2022 | 761 |

***Figure 5-33*** The result of the filter

To remove the Sales text in the cells of the Attribute column, select that column, go to the Home tab, choose the Replace Values command, and enter Sales in the Value To Find box while leaving the Replace With box empty, as shown in Figure 5-34. Click OK to remove this text over the cells on the Attribute column.



```
= Table.ReplaceValue(#"Filtered Rows","Sales ","",Replacer.ReplaceText,{"Attribute"})
```

| Month | Attribute | Value |
|---|---|---|
| 1 | 2020 | 127 |
| 1 | 2021 | 344 |
| 1 | 2022 | |
| 2 | 2020 | |
| 2 | 2021 | |
| 2 | 2022 | |
| 3 | 2020 | |
| 3 | 2021 | |
| 3 | 2022 | |
| 4 | 2020 | |
| 4 | 2021 | |
| 4 | 2022 | |
| 5 | 2020 | |
| 5 | 2021 | |
| 5 | 2022 | |
| 6 | 2020 | |
| 6 | 2021 | |
| 6 | 2022 | 869 |
| 7 | 2020 | 417 |
| 7 | 2021 | 810 |

Replace Values

Replace one value with another in the selected columns.

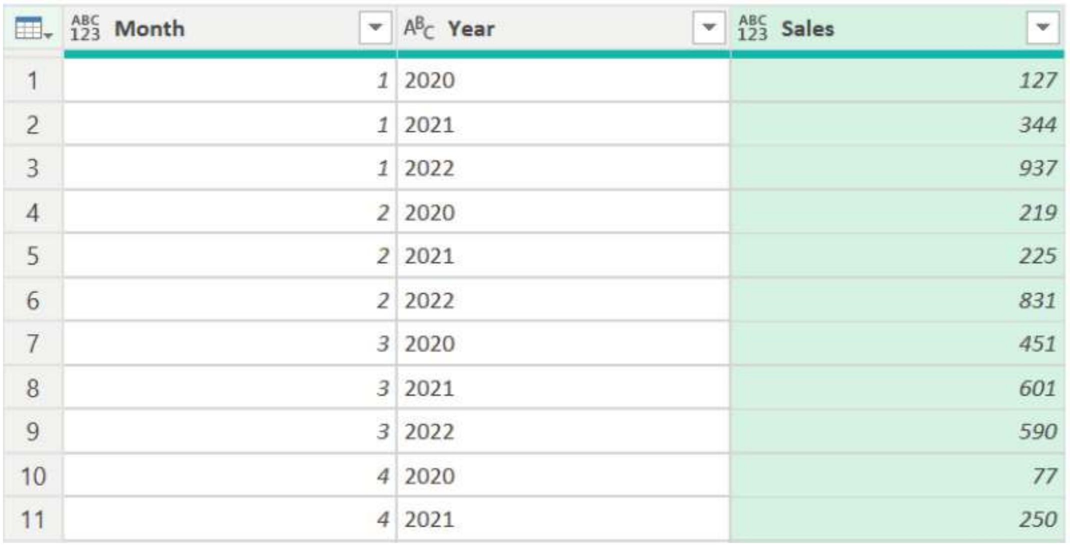
Value To Find: Sales

Replace With:

Advanced options

*Figure 5-34* Removing the Sales text in the Attribute column

Finally, rename the Attribute and Value columns to Year and Sales, respectively, to achieve the final result shown in Figure 5-35.



| | Month | Year | Sales |
|---|---|---|---|
| 1 | 1 | 2020 | 127 |
| 2 | 1 | 2021 | 344 |
| 3 | 1 | 2022 | 937 |
| 4 | 2 | 2020 | 219 |
| 5 | 2 | 2021 | 225 |
| 6 | 2 | 2022 | 831 |
| 7 | 3 | 2020 | 451 |
| 8 | 3 | 2021 | 601 |
| 9 | 3 | 2022 | 590 |
| 10 | 4 | 2020 | 77 |
| 11 | 4 | 2021 | 250 |

*Figure 5-35* The final result

## Merging Rows

Given the historical sales data in the Source table, which is shown in Table 5-10, where sales for each product are spread across multiple rows, transform the table so that the sales for each product are consolidated into a single row.

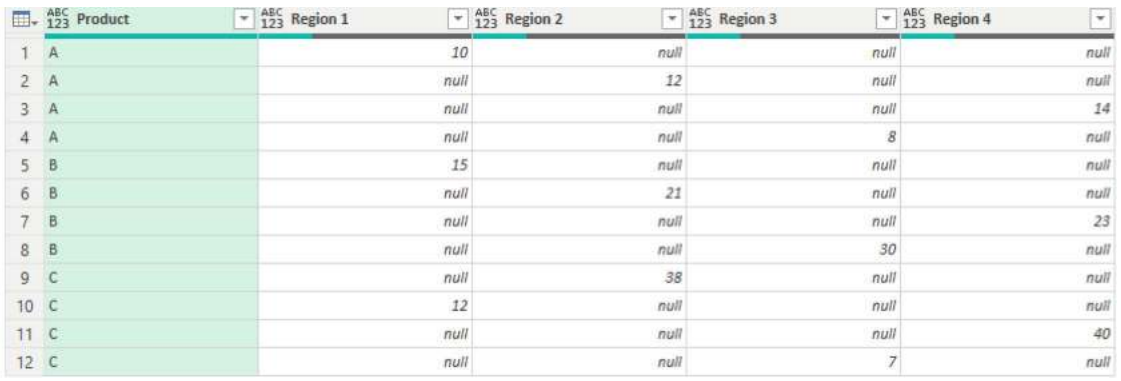
*Table 5-10* Source: Sales Info

| Product | Region 1 | Region 2 | Region 3 | Region 4 |
|---|---|---|---|---|
| A | 10 | | | |
| A | | 12 | | |
| A | | | | 14 |
| A | | | 8 | |
| B | 15 | | | |
| B | | 21 | | |
| B | | | | 23 |
| B | | | 30 | |
| C | | 38 | | |
| C | 12 | | | |
| C | | | | 40 |
| C | | | 7 | |

**Note** The data in this example is provided in an Excel file titled `07 Merging rows .xlsx`.

This problem can be solved either by using the Group By command or by combining unpivoting and pivoting commands over the source table. The Group By command is explained in depth in Chapter 6, so here, you see how to use the combination of unpivoting and pivoting the table.

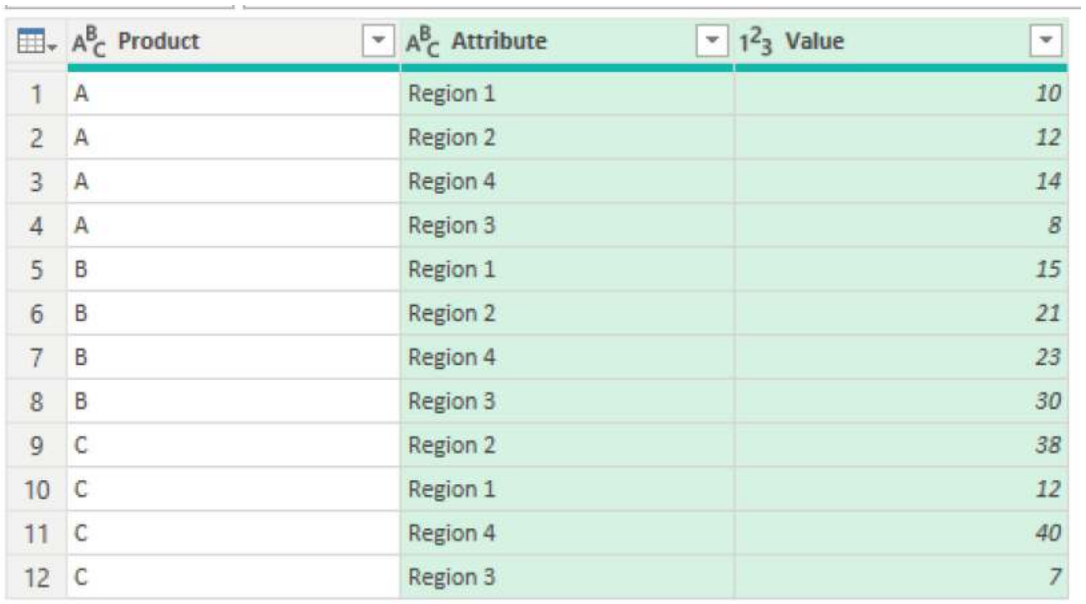
To solve this problem, you need to load data into the Power Query Editor. As shown in Figure 5-36, loading the table into the Power Query Editor will replace the blank cells with null values.



| | Product | Region 1 | Region 2 | Region 3 | Region 4 |
|---|---|---|---|---|---|
| 1 | A | 10 | null | null | null |
| 2 | A | null | 12 | null | null |
| 3 | A | null | null | null | 14 |
| 4 | A | null | null | 8 | null |
| 5 | B | 15 | null | null | null |
| 6 | B | null | 21 | null | null |
| 7 | B | null | null | null | 23 |
| 8 | B | null | null | 30 | null |
| 9 | C | null | 38 | null | null |
| 10 | C | 12 | null | null | null |
| 11 | C | null | null | null | 40 |
| 12 | C | null | null | 7 | null |

***Figure 5-36*** Loading data into Power Query Editor

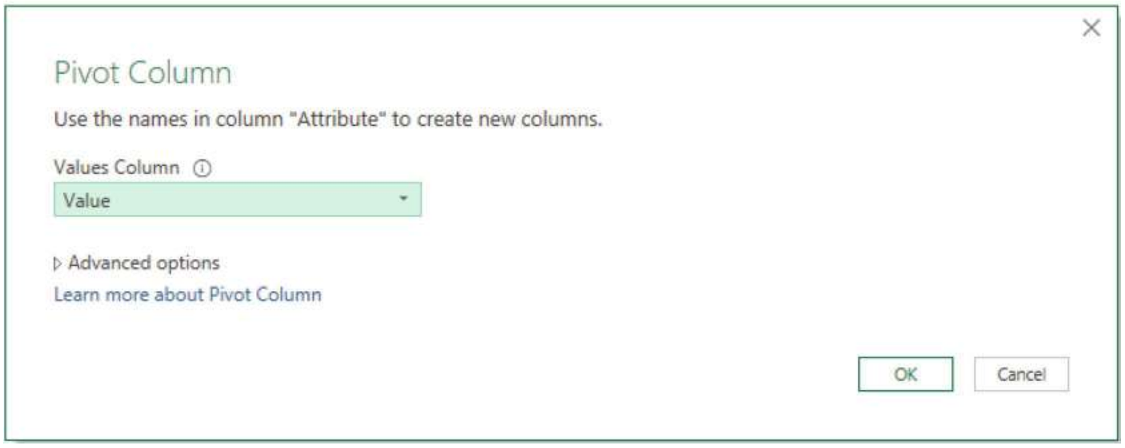
As mentioned in Section 5-3, by unpivoting columns, the null values will be ignored. Right-click the Product column and choose the Unpivot Other Columns command to achieve the format shown in Figure 5-37.



| | Product | Attribute | Value |
|---|---|---|---|
| 1 | A | Region 1 | 10 |
| 2 | A | Region 2 | 12 |
| 3 | A | Region 4 | 14 |
| 4 | A | Region 3 | 8 |
| 5 | B | Region 1 | 15 |
| 6 | B | Region 2 | 21 |
| 7 | B | Region 4 | 23 |
| 8 | B | Region 3 | 30 |
| 9 | C | Region 2 | 38 |
| 10 | C | Region 1 | 12 |
| 11 | C | Region 4 | 40 |
| 12 | C | Region 3 | 7 |

***Figure 5-37*** Resulting table Unpivoting other columns

Next, select the Attribute column and, from the Transform tab, choose Pivot Column with the settings shown in Figure 5-38.


Pivot Column

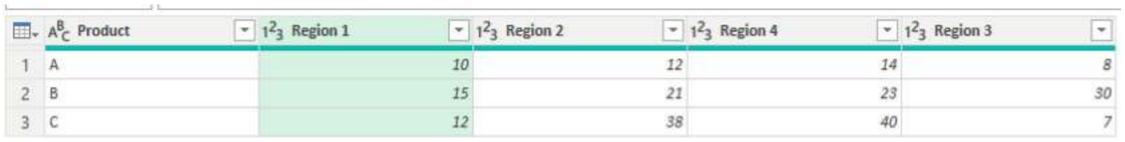
Use the names in column "Attribute" to create new columns.

Values Column: Value

*Figure 5-38* Pivoting settings

After clicking OK, you'll see the result shown in Figure 5-39. The following formula is in the formula bar.

```
= Table.Pivot(#"Unpivoted Other Columns", List.Distinct(#"Unpivoted Other
Columns"[Attribute]), "Attribute", "Value", List.Sum)
```

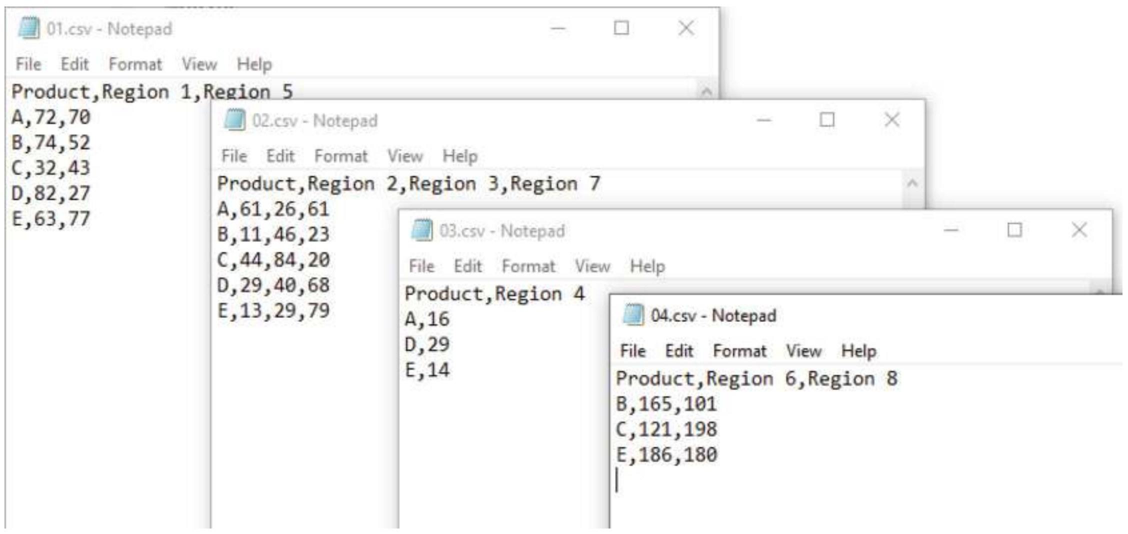


| | Product | Region 1 | Region 2 | Region 4 | Region 3 |
|---|---|---|---|---|---|
| 1 | A | 10 | 12 | 14 | 8 |
| 2 | B | 15 | 21 | 23 | 30 |
| 3 | C | 12 | 38 | 40 | 7 |

*Figure 5-39* The result of pivoting

## Merging Several Tables at Once

Consolidate the historical sales data for products across various regions, stored in multiple CSV files located in a specific directory, as shown in Figure 5-40. Each file contains sales data for different regions, and the number of files may vary. Combine these tables into a single table that presents the sales data for different products across all regions.


01.csv - Notepad

```
Product,Region 1,Region 5
A,72,70
B,74,52
C,32,43
D,82,27
E,63,77
```

02.csv - Notepad

```
Product,Region 2,Region 3,Region 7
A,61,26,61
B,11,46,23
C,44,84,20
D,29,40,68
E,13,29,79
```

03.csv - Notepad

```
Product,Region 4
A,16
D,29
E,14
```

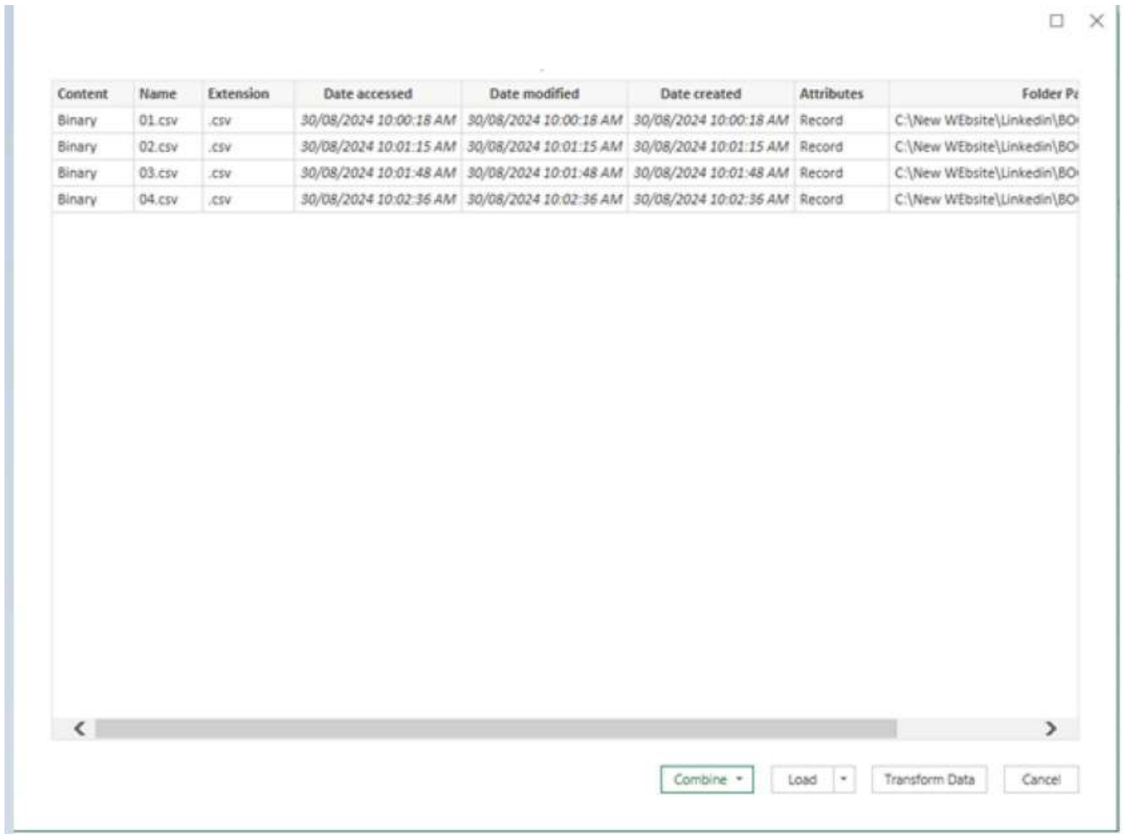
04.csv - Notepad

```
Product,Region 6,Region 8
B,165,101
C,121,198
E,186,180
```

*Figure 5-40* The CSV files

**Note** The data in this example is provided in the folder with the name `08 Merging several tables once`.

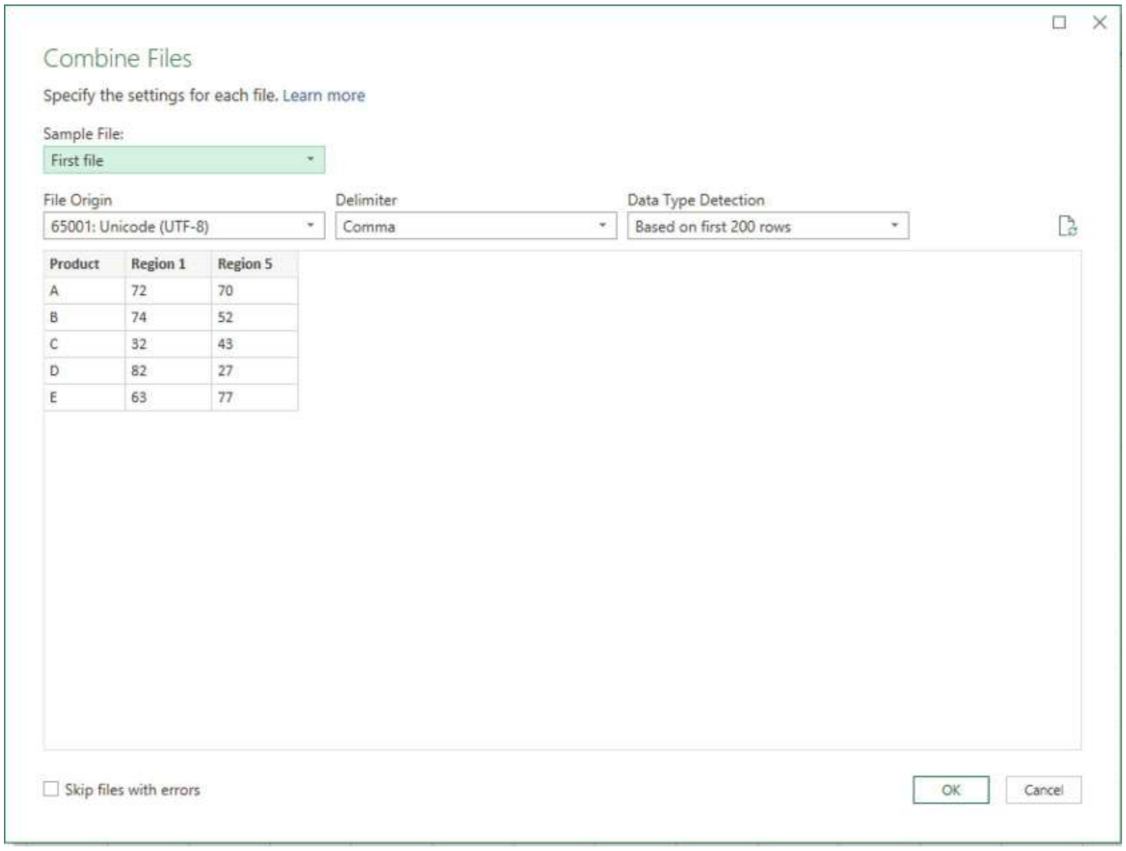
To solve this problem, go to the Data tab in Excel and select Get Data From File. Then choose From Folder. Navigate to the folder containing the CSV files to reach the Navigation window, as shown in Figure 5-41.



| Content | Name | Extension | Date accessed | Date modified | Date created | Attributes | Folder Pa |
|---|---|---|---|---|---|---|---|
| Binary | 01.csv | .csv | 30/08/2024 10:00:18 AM | 30/08/2024 10:00:18 AM | 30/08/2024 10:00:18 AM | Record | C:\New WEbsite\Linkedin\BO |
| Binary | 02.csv | .csv | 30/08/2024 10:01:15 AM | 30/08/2024 10:01:15 AM | 30/08/2024 10:01:15 AM | Record | C:\New WEbsite\Linkedin\BO |
| Binary | 03.csv | .csv | 30/08/2024 10:01:48 AM | 30/08/2024 10:01:48 AM | 30/08/2024 10:01:48 AM | Record | C:\New WEbsite\Linkedin\BO |
| Binary | 04.csv | .csv | 30/08/2024 10:02:36 AM | 30/08/2024 10:02:36 AM | 30/08/2024 10:02:36 AM | Record | C:\New WEbsite\Linkedin\BO |

***Figure 5-41*** Navigation

From all the options under the Combine button, select Combine & Transform Data. As shown in Figure 5-42, a new window called Combine Files will appear, where you can select the sample file to combine the data.



Combine Files

Specify the settings for each file. Learn more

Sample File: First file

File Origin: 65001: Unicode (UTF-8)

Delimiter: Comma

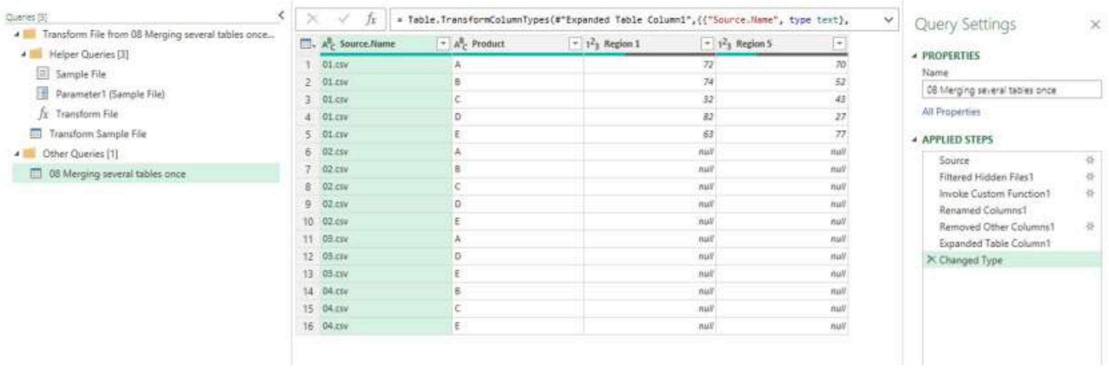
Data Type Detection: Based on first 200 rows

| Product | Region 1 | Region 5 |
|---|---|---|
| A | 72 | 70 |
| B | 74 | 52 |
| C | 32 | 43 |
| D | 82 | 27 |
| E | 63 | 77 |

☐ Skip files with errors

*Figure 5-42* The Combine Files window

Select the first file as the sample file and click OK. This will result in two groups of queries: Helper Queries and Other Queries. The desired query will be found in the Other Queries group, and it will include seven steps, as shown in the Applied Steps section. See Figure 5-43.



Queries [3]
- Transform File from 08 Merging several tables once...
  - Helper Queries [3]
    - Sample File
    - Parameter1 (Sample File)
    - Transform File
  - Transform Sample File
- Other Queries [1]
  - 08 Merging several tables once

```
= Table.TransformColumnTypes(#"Expanded Table Column1",{{"Source.Name", type text},
```

| | Source.Name | Product | Region 1 | Region 5 |
|---|---|---|---|---|
| 1 | 01.csv | A | 72 | 70 |
| 2 | 01.csv | B | 74 | 52 |
| 3 | 01.csv | C | 32 | 43 |
| 4 | 01.csv | D | 82 | 27 |
| 5 | 01.csv | E | 63 | 77 |
| 6 | 02.csv | A | null | null |
| 7 | 02.csv | B | null | null |
| 8 | 02.csv | C | null | null |
| 9 | 02.csv | D | null | null |
| 10 | 02.csv | E | null | null |
| 11 | 03.csv | A | null | null |
| 12 | 03.csv | D | null | null |
| 13 | 03.csv | E | null | null |
| 14 | 04.csv | B | null | null |
| 15 | 04.csv | C | null | null |
| 16 | 04.csv | E | null | null |

Query Settings

PROPERTIES

Name: 08 Merging several tables once

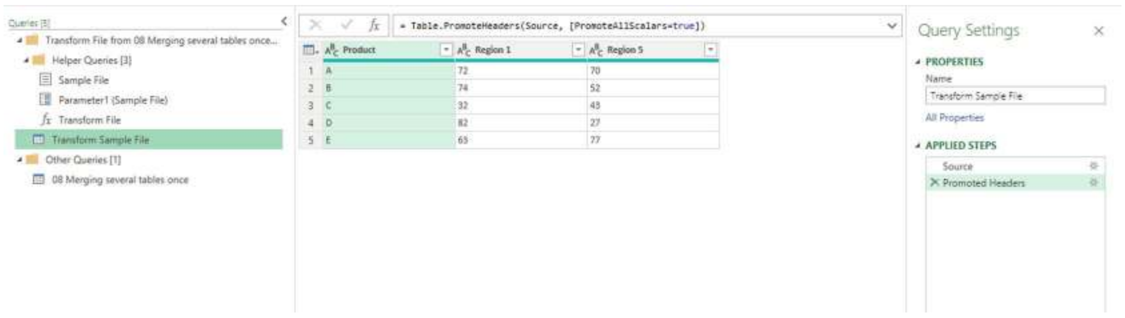
All Properties

APPLIED STEPS
- Source
- Filtered Hidden Files1
- Invoke Custom Function1
- Renamed Columns1
- Removed Other Columns1
- Expanded Table Column1
- Changed Type

*Figure 5-43* The result of combining the files

Since the selected sample file only includes the Product, Region 1, and Region 5 columns, the resulting table will contain these three columns, along with the Source.Name column, while columns related to other regions will be excluded.

As explained in Chapter 1, you can modify the result by editing the query named Transform Sample File. As shown in Figure 5-44, this query includes two steps: Source and Promoted Headers. This means that these two steps should be applied to all the CSV files, and then their results will be combined on the main query (called `08 Merging several tables once`).



```
= Table.PromoteHeaders(Source, [PromoteAllScalars=true])
```

|  | Product | Region 1 | Region 5 |
|---|---|---|---|
| 1 | A | 72 | 70 |
| 2 | B | 74 | 52 |
| 3 | C | 32 | 43 |
| 4 | D | 82 | 27 |
| 5 | E | 65 | 77 |

*Figure 5-44* Transforming the sample file query

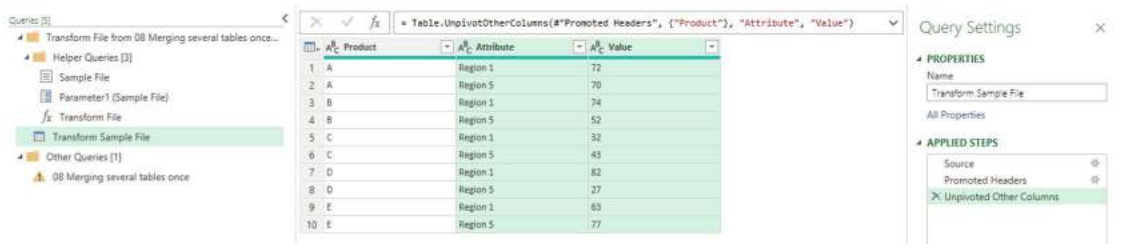
By selecting the Source step in this query, the following formula will appear in the formula bar, based on the sample file:

```
= Csv.Document(Parameter1,[Delimiter=",", Columns=3, Encoding=65001,
QuoteStyle=QuoteStyle.None])
```

An important issue here is that the number of columns is specified as `3` in this code. So, if a file contains more than three columns, the extra columns will be ignored. To avoid this, you can modify the formula as follows by removing the part related to specifying the number of columns, which means that the number of columns for each file should be determined separately:

```
= Csv.Document(Parameter1,[Delimiter=",",  Encoding=65001,
QuoteStyle=QuoteStyle.None])
```

In addition to these two predefined steps, you can add another step to this query. Select the last step, then select the Product column, right-click it, and choose Unpivot Other Columns. The result is shown in Figure 5-45. So, for all the CSV files, after promoting the headers, all columns except the Product column will be unpivoted, and the data will be organized into two columns: Attribute and Value. The columns of all the tables that came from different files are the same.

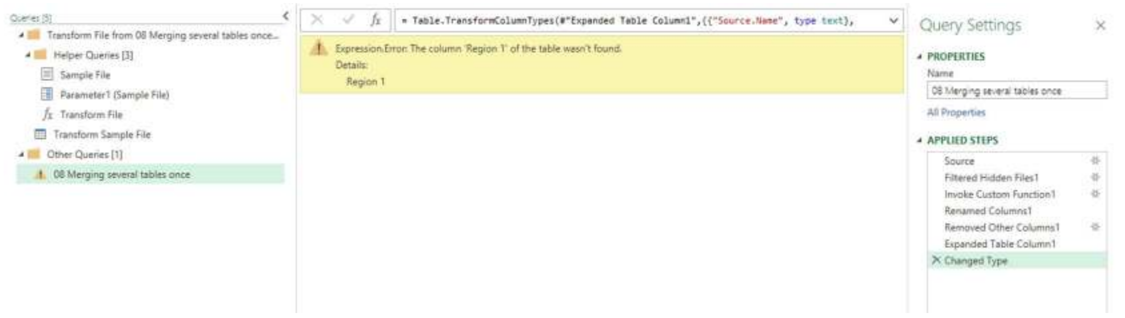


```
= Table.UnpivotOtherColumns(#"Promoted Headers", {"Product"}, "Attribute", "Value")
```

|  | Product | Attribute | Value |
|---|---|---|---|
| 1 | A | Region 1 | 72 |
| 2 | A | Region 5 | 70 |
| 3 | B | Region 1 | 74 |
| 4 | B | Region 5 | 52 |
| 5 | C | Region 1 | 32 |
| 6 | C | Region 5 | 43 |
| 7 | D | Region 1 | 82 |
| 8 | D | Region 5 | 27 |
| 9 | E | Region 1 | 65 |
| 10 | E | Region 5 | 77 |

*Figure 5-45* Unpivoting other columns in the sample file query

After making this change, when you select the query named `08 Merging several tables once`, as shown in Figure 5-46, you'll notice that the result of the last step (Changed Type) is an error. This error occurs because the column titles were changed during the unpivoting process.

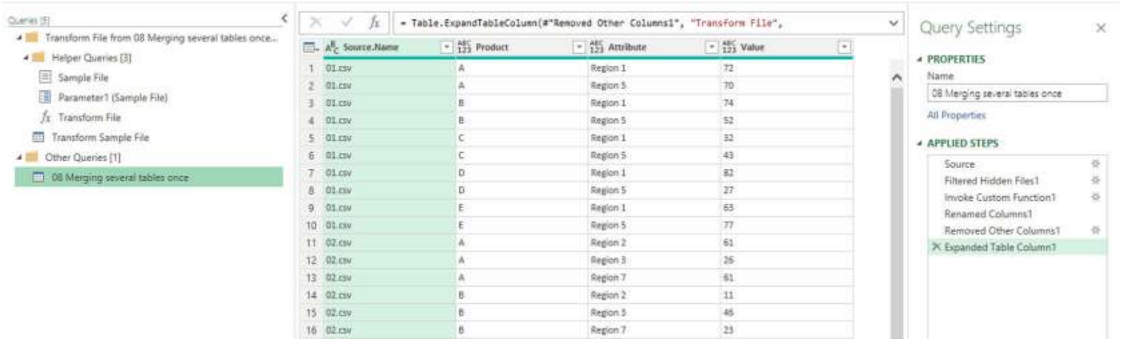


```
= Table.TransformColumnTypes(#"Expanded Table Column1",{{"Source.Name", type text},
```

```
Expression.Error: The column 'Region 1' of the table wasn't found.
Details:
    Region 1
```

*Figure 5-46* The result of the main query

Removing this step will result in the query proceeding without the error, as shown in Figure 5-47.



Queries [5]
- Transform File from 08 Merging several tables once...
  - Helper Queries [3]
    - Sample File
    - Parameter1 (Sample File)
    - Transform File
  - Transform Sample File
- Other Queries [1]
  - 08 Merging several tables once

```
= Table.ExpandTableColumn(#"Removed Other Columns1", "Transform File",
```

| | Source.Name | Product | Attribute | Value |
|---|---|---|---|---|
| 1 | 01.csv | A | Region 1 | 72 |
| 2 | 01.csv | A | Region 5 | 70 |
| 3 | 01.csv | B | Region 1 | 74 |
| 4 | 01.csv | B | Region 5 | 52 |
| 5 | 01.csv | C | Region 1 | 32 |
| 6 | 01.csv | C | Region 5 | 43 |
| 7 | 01.csv | D | Region 1 | 82 |
| 8 | 01.csv | D | Region 5 | 27 |
| 9 | 01.csv | E | Region 1 | 63 |
| 10 | 01.csv | E | Region 5 | 77 |
| 11 | 02.csv | A | Region 2 | 61 |
| 12 | 02.csv | A | Region 3 | 26 |
| 13 | 02.csv | A | Region 7 | 61 |
| 14 | 02.csv | B | Region 2 | 11 |
| 15 | 02.csv | B | Region 3 | 46 |
| 16 | 02.csv | B | Region 7 | 23 |

Query Settings

PROPERTIES

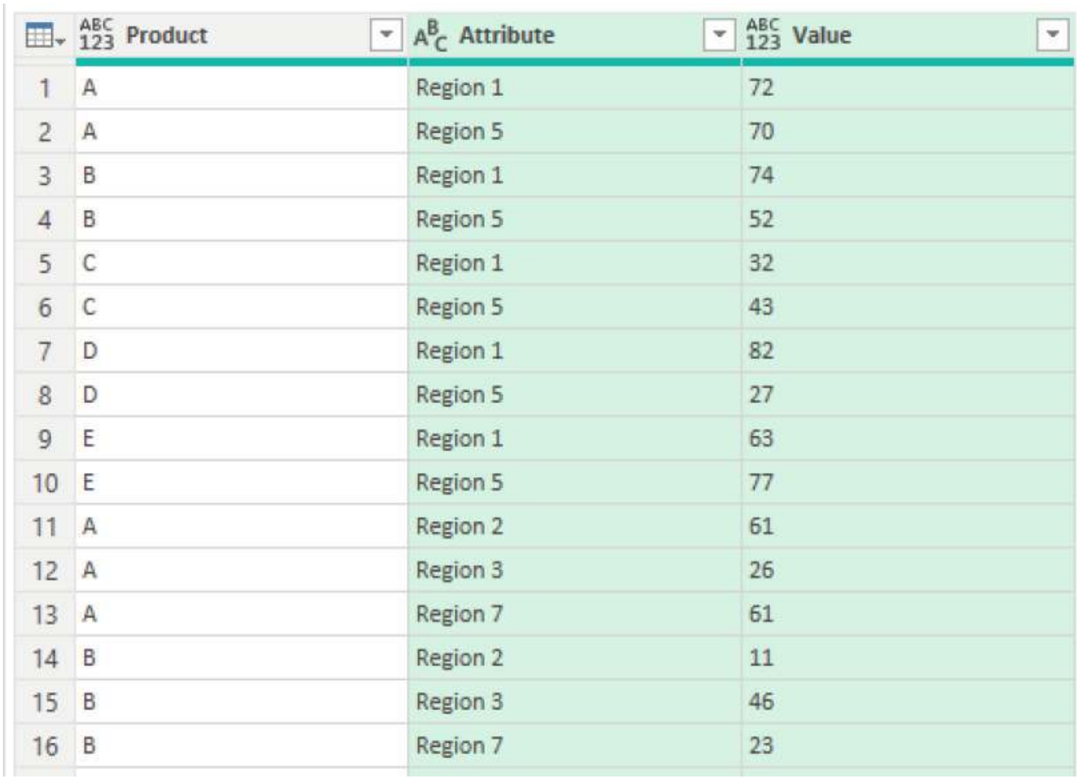
Name: 08 Merging several tables once

All Properties

APPLIED STEPS
- Source
- Filtered Hidden Files1
- Invoke Custom Function1
- Renamed Columns1
- Removed Other Columns1
- Expanded Table Column1

*Figure 5-47* The result of main query after removing the step related to changing the type

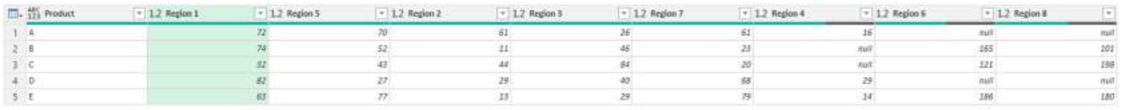
In the resulting table, you do not need the values in the Source.Name column. Remove that table to achieve Figure 5-48.



| | Product | Attribute | Value |
|---|---|---|---|
| 1 | A | Region 1 | 72 |
| 2 | A | Region 5 | 70 |
| 3 | B | Region 1 | 74 |
| 4 | B | Region 5 | 52 |
| 5 | C | Region 1 | 32 |
| 6 | C | Region 5 | 43 |
| 7 | D | Region 1 | 82 |
| 8 | D | Region 5 | 27 |
| 9 | E | Region 1 | 63 |
| 10 | E | Region 5 | 77 |
| 11 | A | Region 2 | 61 |
| 12 | A | Region 3 | 26 |
| 13 | A | Region 7 | 61 |
| 14 | B | Region 2 | 11 |
| 15 | B | Region 3 | 46 |
| 16 | B | Region 7 | 23 |

*Figure 5-48* Result of unpivoting

Next, select the Value column and convert its type into the number (from the Home tab in the Transform section). Then, select the Attribute column, go to the Transform tab, and choose Pivot Column. This sets the Values column as the field to be pivoted. Click OK. This will format the data as desired, resulting in Figure 5-49.



| | Product | Region 1 | Region 5 | Region 2 | Region 3 | Region 7 | Region 4 | Region 6 | Region 8 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | A | 72 | 70 | 61 | 26 | 61 | 16 | null | null |
| 2 | B | 74 | 52 | 11 | 46 | 23 | null | 165 | 101 |
| 3 | C | 32 | 43 | 44 | 84 | 20 | null | 121 | 198 |
| 4 | D | 82 | 27 | 29 | 40 | 68 | 29 | null | null |
| 5 | E | 63 | 77 | 13 | 29 | 79 | 14 | 186 | 180 |

***Figure 5-49*** Result of pivoting

## Transformations, Part 4

In a shipment company, historical data is provided in the Source table in an incorrect format, as shown in Table 5-11. Use Power Query to transform this table into a standard format with five columns: Product, Shipment Number (extract it from headers), Ship Date, PO Number, and PO Quantity.

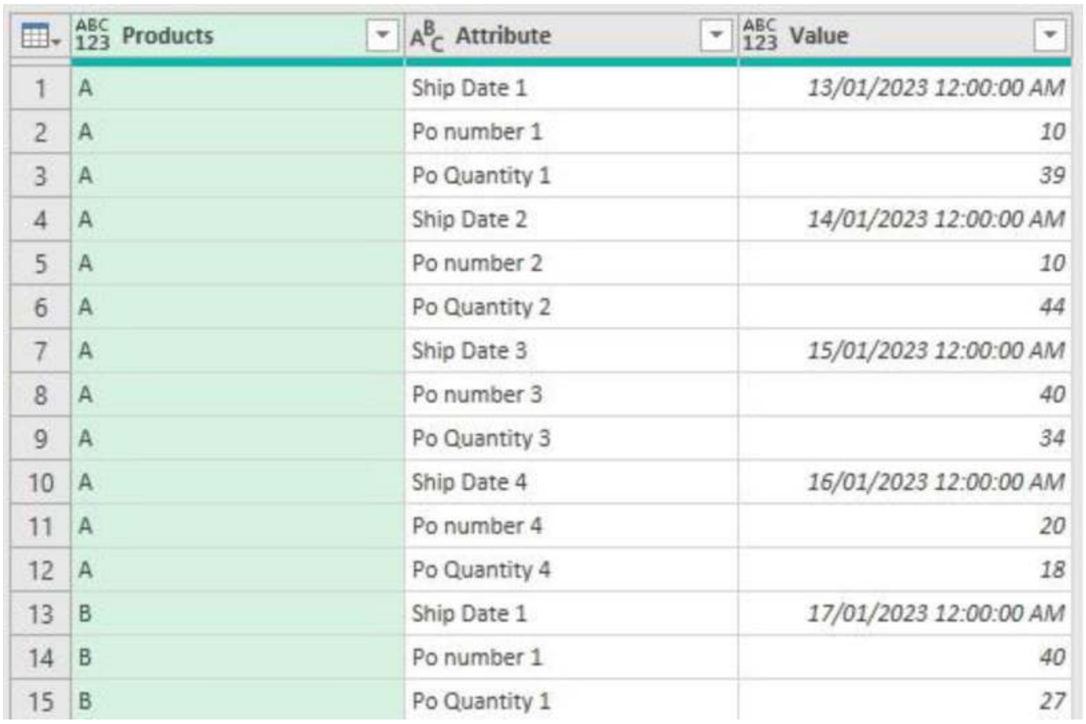
*Table 5-11* Source: Shipment Data

| Products | Ship Date 1 | Po number 1 | Po Quantity 1 | Ship Date 2 | Po number 2 | Po Quantity 2 | Ship Date 3 | Po number 3 | Po Quantity 3 | Ship Date 4 | Po number 4 | Po Quanti 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 13/01/2023 | 10 | 39 | 14/01/2023 | 10 | 44 | 15/01/2023 | 40 | 34 | 16/01/2023 | 20 | 18 |
| B | 17/01/2023 | 40 | 27 | 19/01/2023 | 40 | 39 | 21/01/2023 | 40 | 11 | | | |
| C | 26/01/2023 | 10 | 11 | 27/01/2023 | 40 | 48 | | | | | | |
| D | 11/12/2023 | 10 | 42 | | | | | | | | | |

**Note** The data in this example is provided in an Excel file titled `09 Transformations Part 4.xlsx`.

Unfortunately, there's no way to directly unpivot bulk groups of columns (for example every three columns) in Power Query so you have to find a longer way to solve this problem.

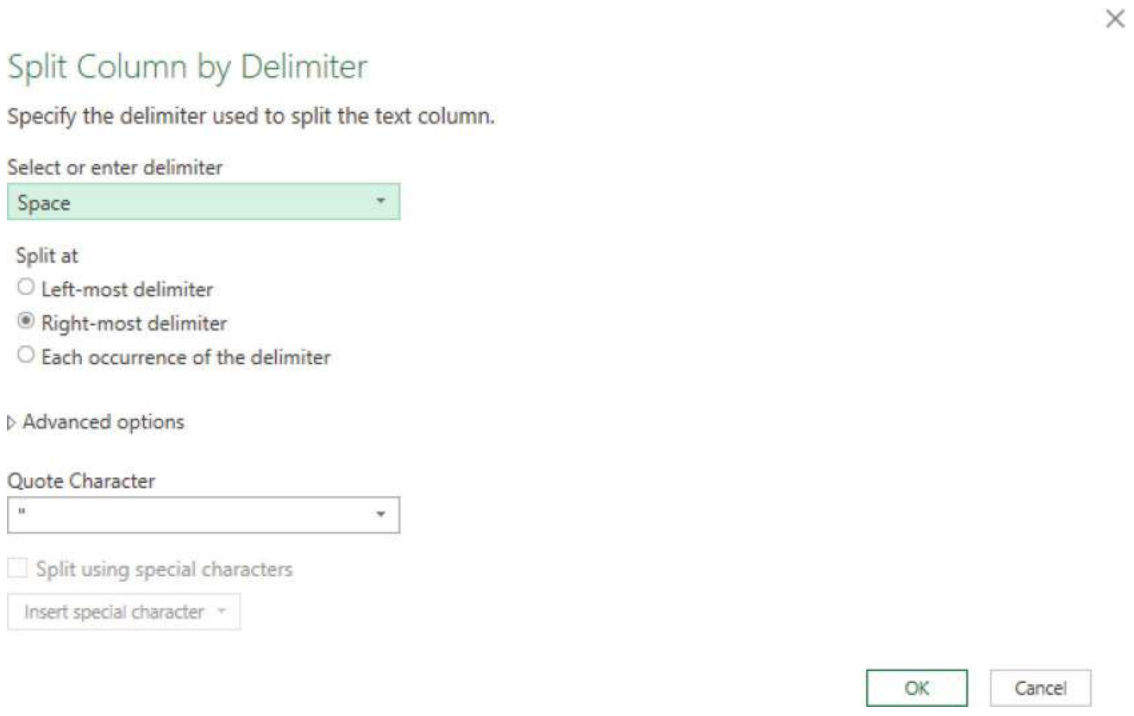
In this case, since you don't know how many columns you might encounter in the future, it's a good idea to unpivot the columns and convert them into rows. Start by right-clicking the Product column and selecting Unpivot Other Columns, leading to a table with three columns—Product, Attribute, and Value—as shown in Figure 5-50.



| | Products | Attribute | Value |
|---|---|---|---|
| 1 | A | Ship Date 1 | 13/01/2023 12:00:00 AM |
| 2 | A | Po number 1 | 10 |
| 3 | A | Po Quantity 1 | 39 |
| 4 | A | Ship Date 2 | 14/01/2023 12:00:00 AM |
| 5 | A | Po number 2 | 10 |
| 6 | A | Po Quantity 2 | 44 |
| 7 | A | Ship Date 3 | 15/01/2023 12:00:00 AM |
| 8 | A | Po number 3 | 40 |
| 9 | A | Po Quantity 3 | 34 |
| 10 | A | Ship Date 4 | 16/01/2023 12:00:00 AM |
| 11 | A | Po number 4 | 20 |
| 12 | A | Po Quantity 4 | 18 |
| 13 | B | Ship Date 1 | 17/01/2023 12:00:00 AM |
| 14 | B | Po number 1 | 40 |
| 15 | B | Po Quantity 1 | 27 |

*Figure 5-50* Unpivoted table

The Attribute column in the resulting table includes both the type of value and the shipment number, while you need these two features separately. To split the values in this column and extract the number mentioned at the end of the text in this column, select the Attribute column, and from the Home tab, choose Split Column by Delimiter. In the open window, make the settings shown in Figure 5-51, and click OK, which results in Figure 5-52. (Selecting the Right-Most Delimiter option means splitting the values at the location of the last space in the cell.)


Split Column by Delimiter

Specify the delimiter used to split the text column.

Select or enter delimiter: Space

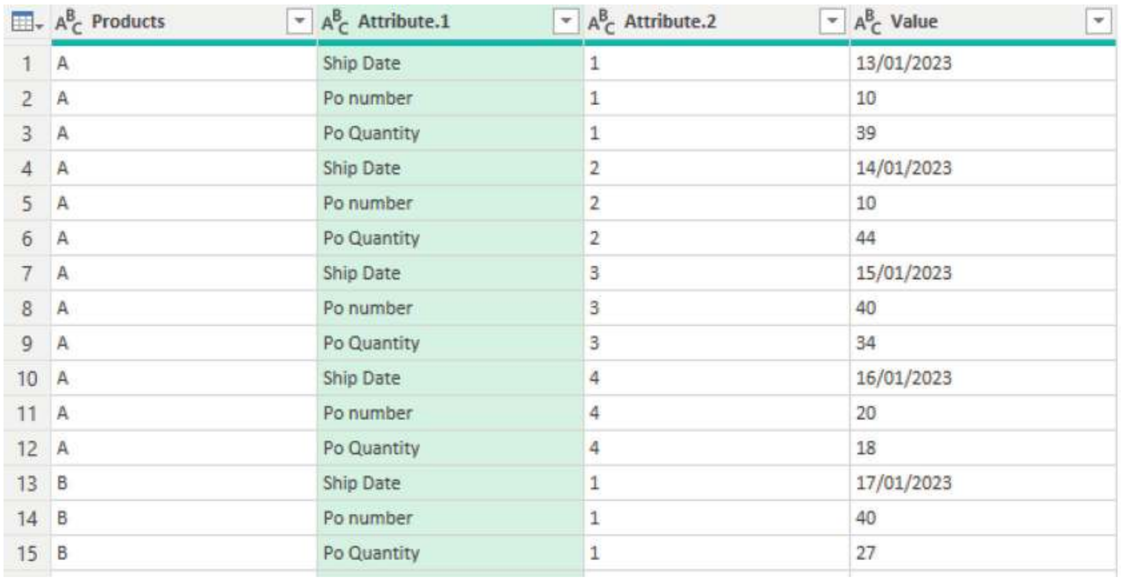
Split at
- ( ) Left-most delimiter
- [✓ Right-most delimiter]
- ( ) Each occurrence of the delimiter

▷ Advanced options

Quote Character: "

☐ Split using special characters

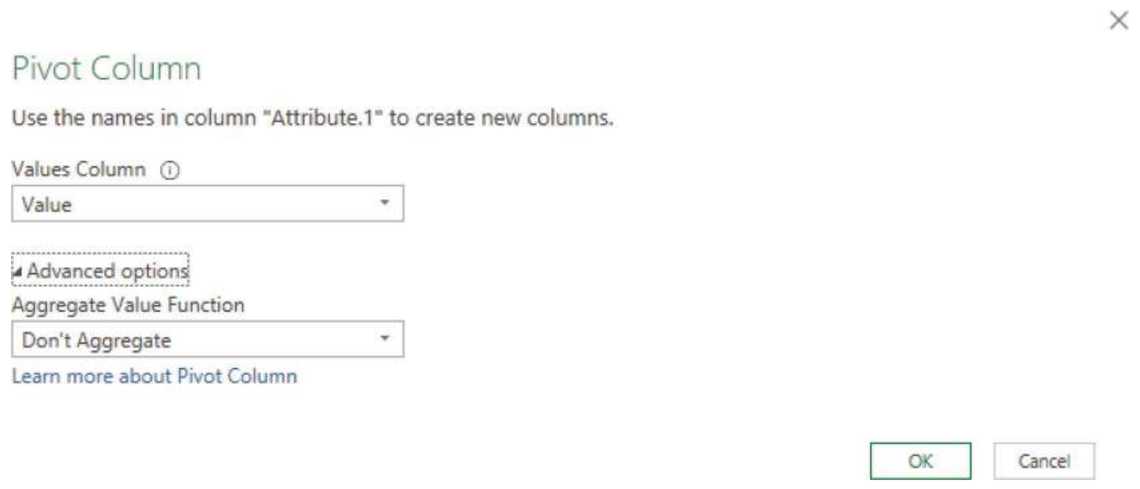
*Figure 5-51* Settings for splitting



| | Products | Attribute.1 | Attribute.2 | Value |
|---|---|---|---|---|
| 1 | A | Ship Date | 1 | 13/01/2023 |
| 2 | A | Po number | 1 | 10 |
| 3 | A | Po Quantity | 1 | 39 |
| 4 | A | Ship Date | 2 | 14/01/2023 |
| 5 | A | Po number | 2 | 10 |
| 6 | A | Po Quantity | 2 | 44 |
| 7 | A | Ship Date | 3 | 15/01/2023 |
| 8 | A | Po number | 3 | 40 |
| 9 | A | Po Quantity | 3 | 34 |
| 10 | A | Ship Date | 4 | 16/01/2023 |
| 11 | A | Po number | 4 | 20 |
| 12 | A | Po Quantity | 4 | 18 |
| 13 | B | Ship Date | 1 | 17/01/2023 |
| 14 | B | Po number | 1 | 40 |
| 15 | B | Po Quantity | 1 | 27 |

*Figure 5-52* Result of splitting

Now it is time to use the Pivot command to put the values on the Attribute.1 column as the header of the new columns and provide the value on the Value column beneath them for each shipment number in each date. Select the Attribute.1 column and, from the Transform tab, choose the Pivot Column command. Then, in the open window, make the settings shown in Figure 5-53.


Pivot Column

Use the names in column "Attribute.1" to create new columns.

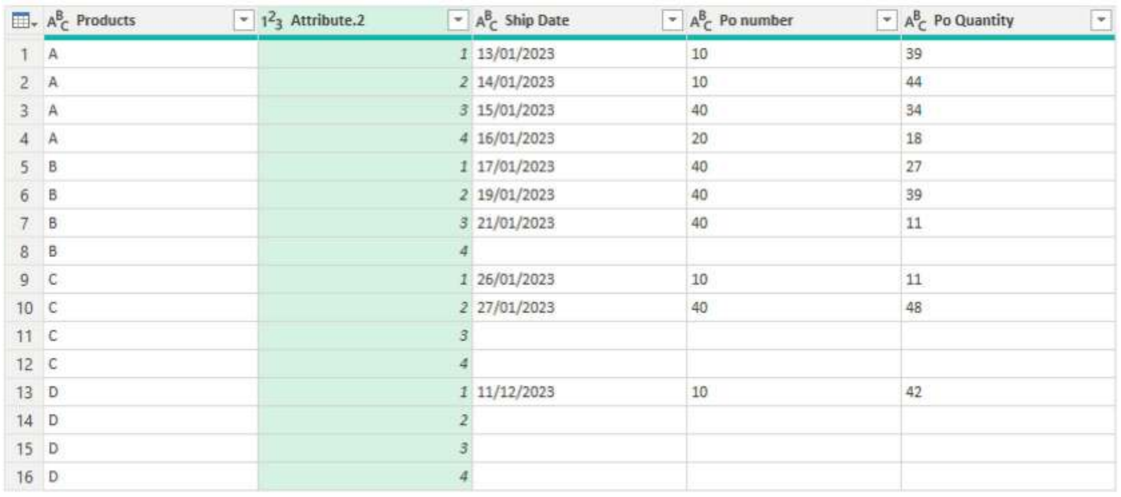
Values Column: Value

Advanced options

Aggregate Value Function: Don't Aggregate

*Figure 5-53* The settings of the pivot column

Clicking OK results in Figure 5-54.



| | Products | Attribute.2 | Ship Date | Po number | Po Quantity |
|---|---|---|---|---|---|
| 1 | A | 1 | 13/01/2023 | 10 | 39 |
| 2 | A | 2 | 14/01/2023 | 10 | 44 |
| 3 | A | 3 | 15/01/2023 | 40 | 34 |
| 4 | A | 4 | 16/01/2023 | 20 | 18 |
| 5 | B | 1 | 17/01/2023 | 40 | 27 |
| 6 | B | 2 | 19/01/2023 | 40 | 39 |
| 7 | B | 3 | 21/01/2023 | 40 | 11 |
| 8 | B | 4 | | | |
| 9 | C | 1 | 26/01/2023 | 10 | 11 |
| 10 | C | 2 | 27/01/2023 | 40 | 48 |
| 11 | C | 3 | | | |
| 12 | C | 4 | | | |
| 13 | D | 1 | 11/12/2023 | 10 | 42 |
| 14 | D | 2 | | | |
| 15 | D | 3 | | | |
| 16 | D | 4 | | | |

*Figure 5-54* The result of the revised Group By

In the last step, you just need to rename the columns and filter the rows with blank values on the Ship Date column to reach the final table.

## Summary

In the data-cleaning process, reshaping tables by converting several columns into rows or transforming values from a column into multiple columns is crucial. In this chapter, you learned how to use the `Table.Pivot()`, `Table.UnpivotColumns()`, and `Table.UnpivotOtherColumns()` functions to reshape your tables according to your needs.

Continuing your data-cleaning journey, the next chapter explains one of the most important functions in Power Query, called `Table.Group()`. It allows you to summarize a table with numerous rows in a more concise format.

O. Motamedisedeh, *96 Common Challenges in Power Query*
https://doi.org/10.1007/979-8-8688-1288-0_6

# 6. Grouping Rows with Table.Group()

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The Group By command in Power Query is a powerful feature that allows you to aggregate and summarize data by grouping it based on one or more columns. This command is based on the `Table.Group()` function, and it is essential for performing data analysis and creating meaningful summaries from large datasets. The syntax of `Table.Group()` is:

```
=Table.Group(table, key, aggregatedColumns, groupKind, optional comparer) as
table
```

The `table` is the table, the `key` is any, `aggregatedColumns` is a list, `groupKind` is option, and the `optional comparer` is a nullable function.

This function accepts five arguments, with the last two being optional. While the first three arguments can be modified through the Power Query UI, the last two must be entered manually.

In this chapter, this function and all of its arguments are explained in depth.

## Introducing Table.Group()

Based on the historical sales data provided in the Source table shown in Table 6-1, calculate the total sales per product.

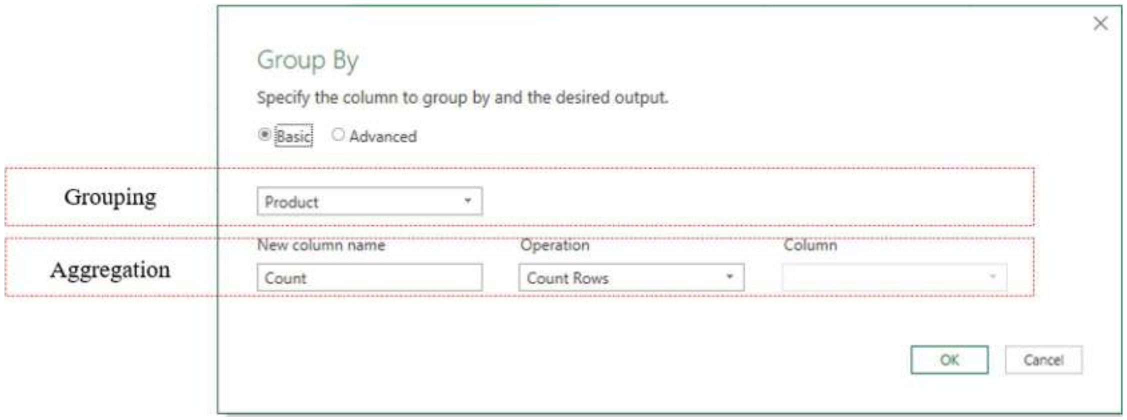
***Table 6-1*** Source: Historical Sales Value

| Month | Week | Product | Colour | Quantity |
|---|---|---|---|---|
| **January** | W1 | A | Black | 6 |
| | W1 | B | Blue | 9 |
| | W1 | B | Yellow | 2 |
| | W2 | A | Black | 6 |
| | W2 | B | Red | 7 |
| | W2 | C | Red | 5 |
| | W3 | B | Yellow | 13 |
| | W3 | B | Red | 3 |
| | W4 | A | Blue | 7 |
| | W4 | C | Red | 6 |
| February | W1 | A | Yellow | 7 |
| | W2 | A | Red | 8 |
| | W3 | B | Black | 10 |
| | W3 | C | Blue | 14 |
| | W4 | D | Red | 9 |

**Note** The data in this example is provided in an Excel file titled `01 Introduction to Table.Group().xlsx`.

As stated in the question, in this example, you'll see how to combine the rows of the table by combining rows with the same product name into a single row and calculating the sum of their quantities. This process is precisely what is referred to as grouping in Power Query. You can explore how to use this amazing tool to solve the problem by following these steps:

1. In Power Query, select the Product column (as the column you want to grouped the rows based on), and from the Home tab, choose the Group By command (or right-click the Product column and select Group By from the list of commands). This will open a new window, as shown in Figure 6-1.


Group By

Specify the column to group by and the desired output.

◉ Basic ○ Advanced

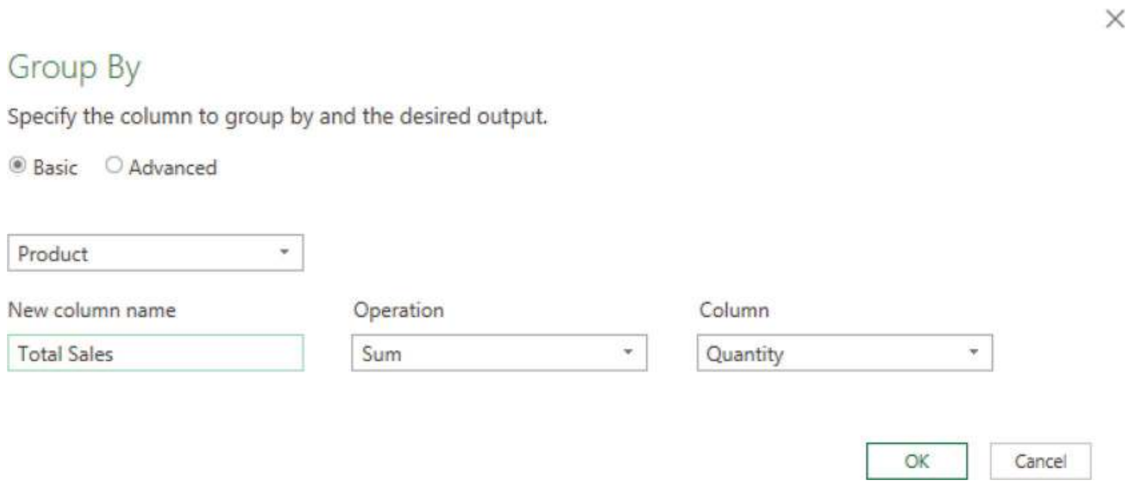
Grouping: Product

Aggregation: New column name: Count; Operation: Count Rows; Column:

*Figure 6-1* The Group By window

2. The Group By window consists of two main sections: the Grouping section, which is used to determine which column should be used to group the rows of the main table, and the Aggregation section, which is used to add calculated columns to the resulting table. In the Basic view, you can select only one item for each section. However, if you need to use multiple columns for grouping or aggregation, you can switch to the Advanced view.

You can solve the presented problem using the settings available in the Basic view. So, as shown in Figure 6-2, select the Product column in the Grouping option, and in the Aggregation part, set the name of the new column to Total Sales, the Operation to Sum, and the Column to Quantity.


Group By

Specify the column to group by and the desired output.

◉ Basic ○ Advanced

Product

New column name: Total Sales

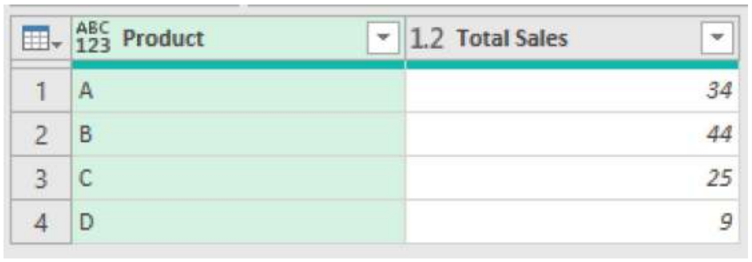
Operation: Sum

Column: Quantity

*Figure 6-2* The Group By setting

By clicking OK, you'll get the result depicted in Figure 6-3, and the following formula will be shown the formula bar.

```
= Table.Group(Source, {"Product"}, {{"Total Sales", each
List.Sum([Quantity]), type number}})
```



| | Product | Total Sales |
|---|---|---|
| 1 | A | 34 |
| 2 | B | 44 |
| 3 | C | 25 |
| 4 | D | 9 |

***Figure 6-3*** The result of Group By

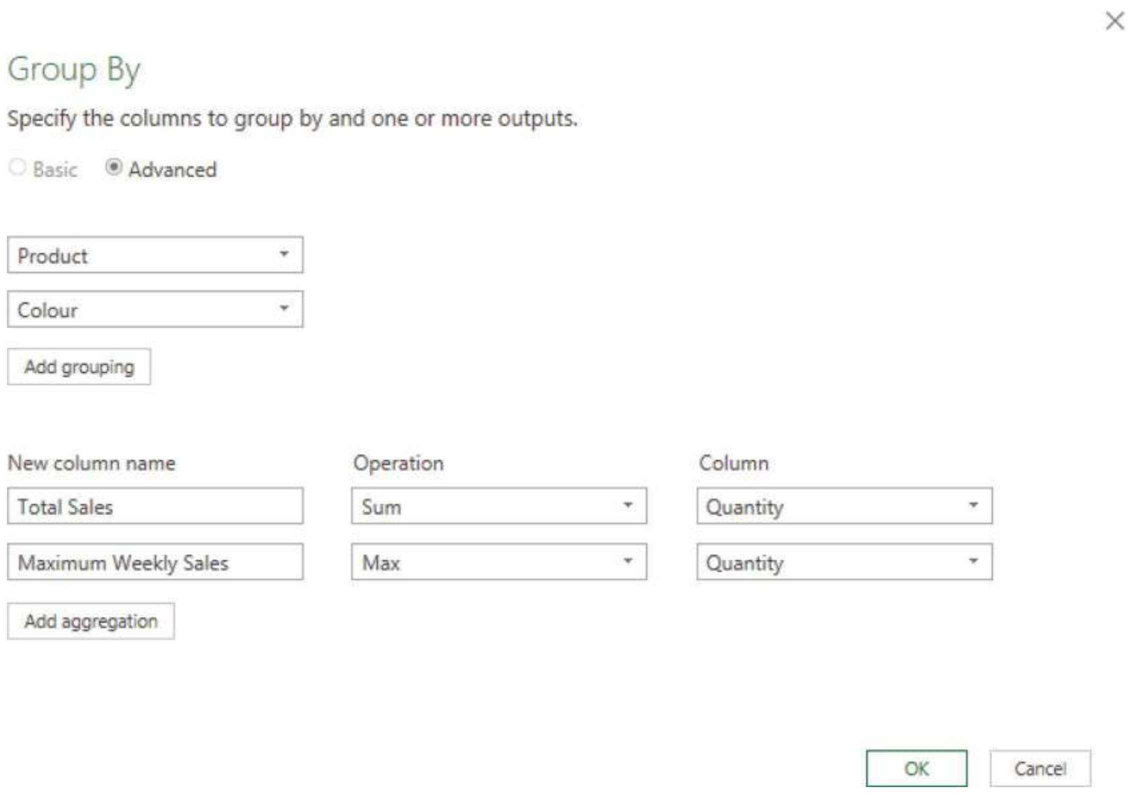
The `Table.Group()` function in the generated formula takes three inputs:

– The table name (`Source`) is entered as the first argument.
– The column to group the rows based on that (`{"Product"}`) is entered as a list in the second argument.
– The third argument is the type of list, which includes several sublists (in this example there is just one sublist). Each sublist includes three main elements:

- The name of the new column, entered as text.
- An aggregate function. While various aggregation operations can be applied to the values of the grouped rows, in the UI settings, you can only select `Sum`, `Average`, `Count`, `Min`, `Max`, and `All` Rows. You can use other aggregations by editing the formula manually.
- The type of values in the new column (which is optional). Since determining the column type is optional, the third argument in this formula can also be written as `{{"Total Sales", each List.Sum([Quantity])}}`.

Note To shorten the formula and increase readability, in the rest of this chapter, the column type, which is optional, is omitted from the formula.

As mentioned earlier, the Group By window, shown in Figure 6-3 include two views of basic and advanced. In this example, by clicking the Advanced option and changing the settings shown in Figure 6-4, the rows are grouped based on the product names and colors and total sales, and maximum weekly sales are provided as new columns by applying `Sum` and `Max` over the values of the grouped rows. Clicking OK will result Figure 6-5.



Group By

Specify the columns to group by and one or more outputs.

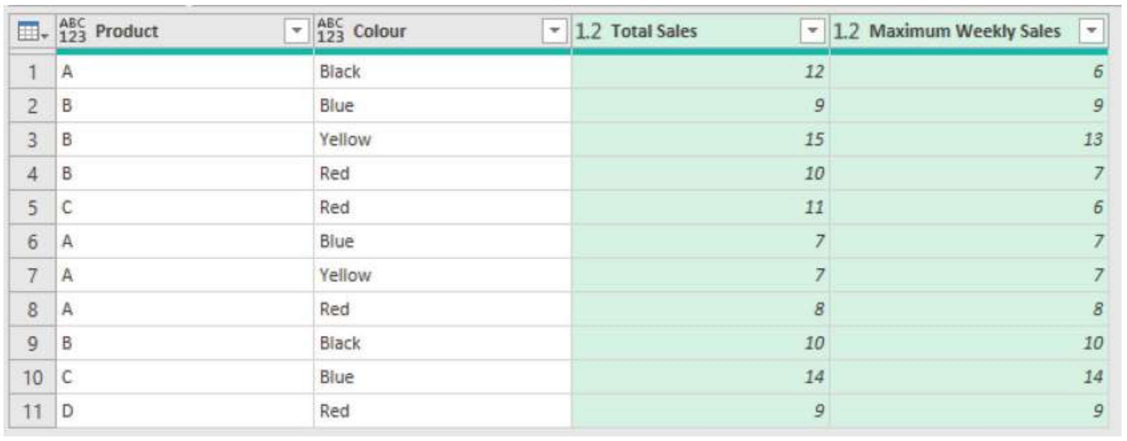
Basic [✓ Advanced]

Product

Colour

| New column name | Operation | Column |
|---|---|---|
| Total Sales | Sum | Quantity |
| Maximum Weekly Sales | Max | Quantity |

***Figure 6-4*** Advanced Group By



| | Product | Colour | Total Sales | Maximum Weekly Sales |
|---|---|---|---|---|
| 1 | A | Black | 12 | 6 |
| 2 | B | Blue | 9 | 9 |
| 3 | B | Yellow | 15 | 13 |
| 4 | B | Red | 10 | 7 |
| 5 | C | Red | 11 | 6 |
| 6 | A | Blue | 7 | 7 |
| 7 | A | Yellow | 7 | 7 |
| 8 | A | Red | 8 | 8 |
| 9 | B | Black | 10 | 10 |
| 10 | C | Blue | 14 | 14 |
| 11 | D | Red | 9 | 9 |

***Figure 6-5*** The result of Advanced Group By

With these changes, the following formula will be shown in the formula bar. This version includes two column names in the second input and two sublists in the third input: one for Total Sales and another for Maximum Weekly Sales. The `List.Sum()` and `List.Max()` functions are applied to the Quantity column in the Source table for these two new columns.

```
= Table.Group(Source,
              {"Product", "Colour"},
               {
                    {"Total Sales", each List.Sum([Quantity]), type number},
                    {"Maximum Weekly Sales", each List.Max([Quantity]), type
number}
                 })
```

As mentioned previously, without altering the result, this formula can be simplified by omitting the optional argument for column type. So, the revised formula is as follows:

```
= Table.Group(Source,
              {"Product", "Colour"},
               {
                    {"Total Sales", each List.Sum([Quantity])},
                    {"Maximum Weekly Sales", each List.Max([Quantity])}
                 })
```

**Efficiency Tips** The execution time of the `Table.Group()` function depends on various factors, but in its basic use (without manually adjusting parameters), it runs quickly. In this example, for a table with 10,000 rows, it takes less than a second to complete.

## Modifying the Third Input in Table.Group()

Using the historical sales data provided in the Source table shown in Table 6-2, calculate the total sales and list of colors sold (in a cell) per product.

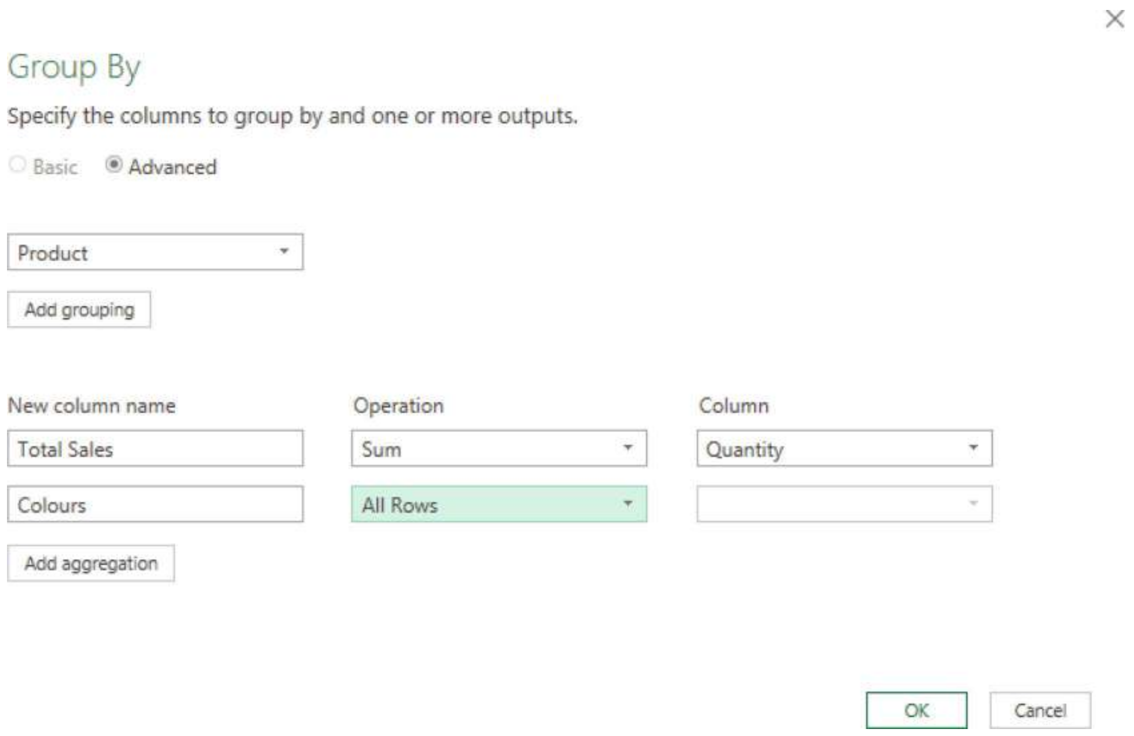
***Table 6-2*** Source: Historical Sales Value

| Month | Week | Product | Color | Quantity |
|---|---|---|---|---|
| **January** | W1 | A | Black | 6 |
|  | W1 | B | Blue | 9 |
|  | W1 | B | Yellow | 2 |
|  | W2 | A | Black | 6 |
|  | W2 | B | Red | 7 |
|  | W2 | C | Red | 5 |
|  | W3 | B | Yellow | 13 |
|  | W3 | B | Red | 3 |
|  | W4 | A | Blue | 7 |
|  | W4 | C | Red | 6 |
| February | W1 | A | Yellow | 7 |
|  | W2 | A | Red | 8 |
|  | W3 | B | Black | 10 |
|  | W3 | C | Blue | 14 |
|  | W4 | D | Red | 9 |

**Note** The data in this example is provided in an Excel file titled `02 Modifying the Third Input in Table.Group().xlsx`.

This example is similar to the Example 6-1, with the difference that a new column, including all the sold colors, should also be added to the resulting table during the process of grouping. To calculate the value of this new column, the colors of the grouped rows should be concatenated. However, there is no such operation in the Group By window's operation list, so you need to use Group By first and modify it manually.

Select the Group By command and configure the settings as shown in Figure 6-6. Since there is no useful operation for text columns in the Operation list, select All Rows for the Colours column. This will produce the table in Figure 6-7.


Group By

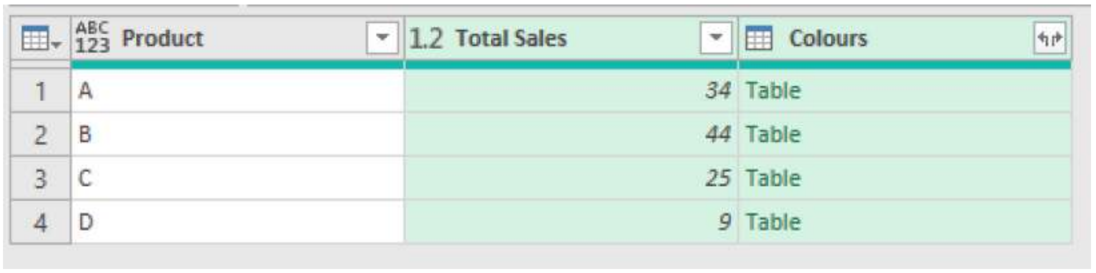
Specify the columns to group by and one or more outputs.

Basic [✓ Advanced]

Product

| New column name | Operation | Column |
|---|---|---|
| Total Sales | Sum | Quantity |
| Colours | All Rows | |

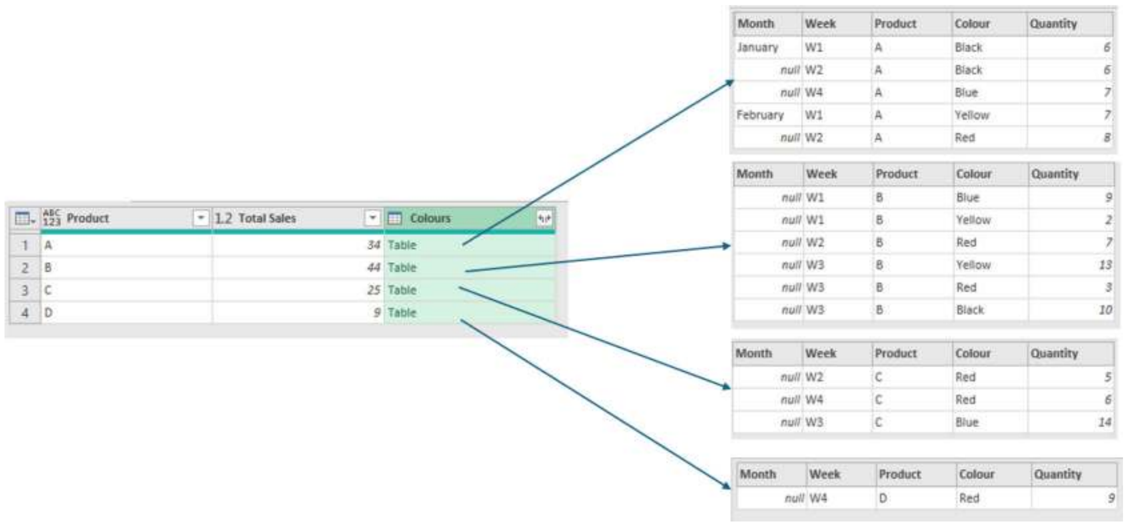
*Figure 6-6* Group By



| | Product | Total Sales | Colours |
|---|---|---|---|
| 1 | A | 34 | Table |
| 2 | B | 44 | Table |
| 3 | C | 25 | Table |
| 4 | D | 9 | Table |

*Figure 6-7* The result of grouping

The Colours column now contains Table values, which represent all the rows from the Source table related to each product, as shown in Figure 6-8.



| | Product | Total Sales | Colours |
|---|---|---|---|
| 1 | A | 34 | Table |
| 2 | B | 44 | Table |
| 3 | C | 25 | Table |
| 4 | D | 9 | Table |

| Month | Week | Product | Colour | Quantity |
|---|---|---|---|---|
| January | W1 | A | Black | 6 |
| null | W2 | A | Black | 6 |
| null | W4 | A | Blue | 7 |
| February | W1 | A | Yellow | 7 |
| null | W2 | A | Red | 8 |

| Month | Week | Product | Colour | Quantity |
|---|---|---|---|---|
| null | W1 | B | Blue | 9 |
| null | W1 | B | Yellow | 2 |
| null | W2 | B | Red | 7 |
| null | W3 | B | Yellow | 13 |
| null | W3 | B | Red | 3 |
| null | W3 | B | Black | 10 |

| Month | Week | Product | Colour | Quantity |
|---|---|---|---|---|
| null | W2 | C | Red | 5 |
| null | W4 | C | Red | 6 |
| null | W3 | C | Blue | 14 |

| Month | Week | Product | Colour | Quantity |
|---|---|---|---|---|
| null | W4 | D | Red | 9 |

***Figure 6-8*** The result of the All Row operation

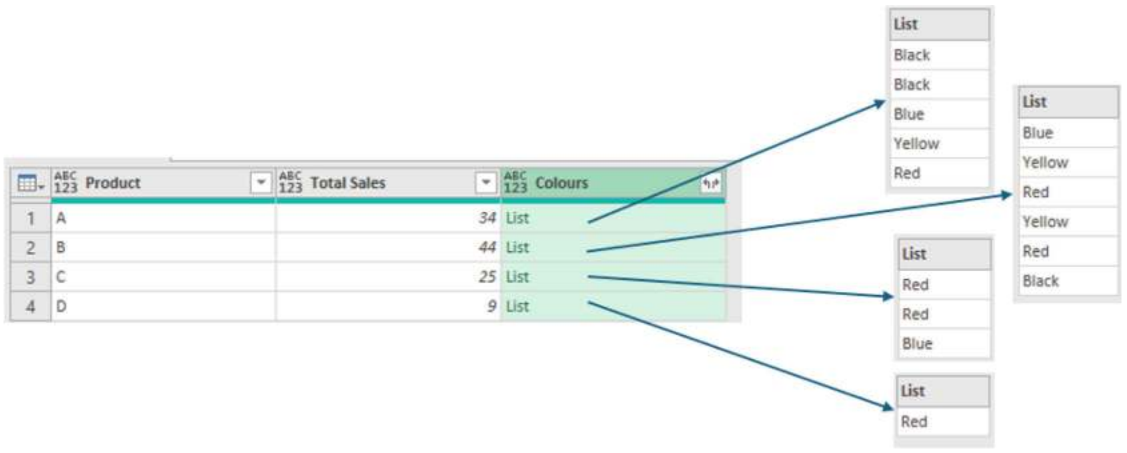
Instead of presenting all the values in a table format, you need the concatenated version of the colors. This can be achieved by modifying the formula. Consider the following formula displayed in the formula bar after clicking OK in the Group By window:

```
= Table.Group(Source, {"Product"},
      {
          {"Total Sales", each List.Sum([Quantity]), type number},
          {"Colours", each _, type table [Month=nullable text, Week=text, 
Product=text,
             Colour=text, Quantity=number]}
      })
```

As mentioned, without altering the result, the type of result columns can be omitted from the third item of sublists, in the third argument of the function. So, the updated formula, which is shorter, is as follows:

```
= Table.Group(Source, {"Product"},
      {
          {"Total Sales", each List.Sum([Quantity]) },
          {"Colours", each _}
      })
```

For the Colours column, `each _` is used as an operator, leading to all the rows and columns for each product, while you only need the values from the Colours column for each product in the Source table. To extract the values from the Colours column, replace "`each _`" with "`each _[Colour]`" in the previous formula. This changes the result to Figure 6-9, where the tables are converted to lists that include the sold colors.



| | Product | Total Sales | Colours |
|---|---|---|---|
| 1 | A | 34 | List |
| 2 | B | 44 | List |
| 3 | C | 25 | List |
| 4 | D | 9 | List |

| List |
|---|
| Black |
| Black |
| Blue |
| Yellow |
| Red |

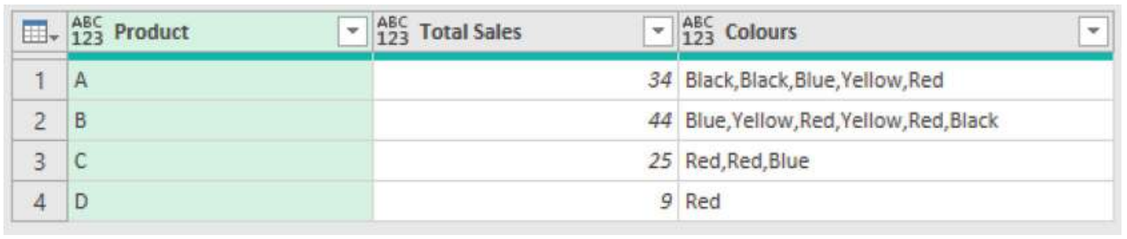
| List |
|---|
| Blue |
| Yellow |
| Red |
| Yellow |
| Red |
| Black |

| List |
|---|
| Red |
| Red |
| Blue |

| List |
|---|
| Red |

*Figure 6-9* The result of each _[Colour]

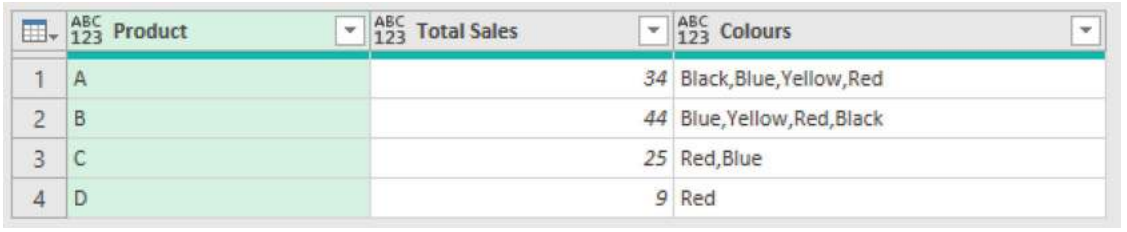
To concatenate the color values and convert the lists of colors to single text, you can use the `Text.Combine()` function with a `","` separator. Thus, `each _[Colour]` is replaced with `each Text.Combine(_[Colour],",")`, resulting in Figure 6-10.



| | Product | Total Sales | Colours |
|---|---|---|---|
| 1 | A | 34 | Black,Black,Blue,Yellow,Red |
| 2 | B | 44 | Blue,Yellow,Red,Yellow,Red,Black |
| 3 | C | 25 | Red,Red,Blue |
| 4 | D | 9 | Red |

*Figure 6-10* The result of Text.Combine(_[Colour],",")

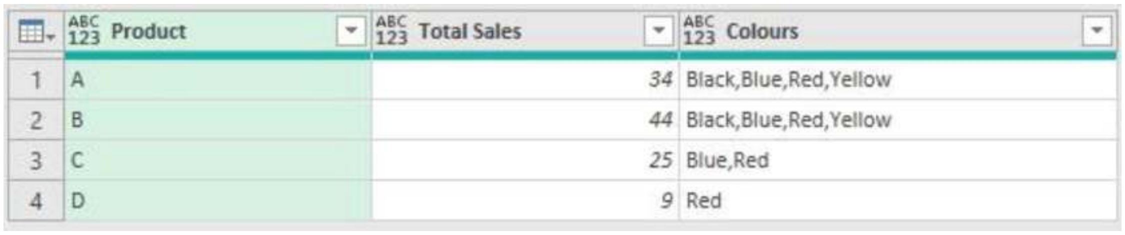
Since some colors, like Black for Product A, are repeated, the Colours column in the resulting table includes these repetitive colors. These duplicate colors should be removed from the list before using it inside `Text.Combine()`. Therefore, you need to rewrite the operation for the Colours column as `each Text.Combine(List.Distinct(_[Colour]),",")`, resulting in Figure 6-11.



| | Product | Total Sales | Colours |
|---|---|---|---|
| 1 | A | 34 | Black,Blue,Yellow,Red |
| 2 | B | 44 | Blue,Yellow,Red,Black |
| 3 | C | 25 | Red,Blue |
| 4 | D | 9 | Red |

*Figure 6-11* Removing the repetitive colors

In this case, if you want to show the colors in the Colours column in alphabetic order, you can add the `List.Sort()` to the operation function and rewrite it as `each Text.Combine(List.Sort(List.Distinct(_[Colour])),",")`. This results in Figure 6-12.



| | Product | Total Sales | Colours |
|---|---|---|---|
| 1 | A | 34 | Black,Blue,Red,Yellow |
| 2 | B | 44 | Black,Blue,Red,Yellow |
| 3 | C | 25 | Blue,Red |
| 4 | D | 9 | Red |

***Figure 6-12*** Sorting the colors

The revised formula for solving the problem and presenting the sold colors per product next to the Total Sales is:

```
= Table.Group(Source, {"Product"},
      {
         {"Total Sales", each List.Sum([Quantity])},
         {"Colours", each
Text.Combine(List.Sort(List.Distinct(_[Colour])),",")}
      })
```

**Efficiency Tips** Modifying the third argument of the `Table.Group()` function in this example does not increase its execution time, and for a dataset with 10,000 rows, it still runs in under a second.

## Matching Items in Groups

The Source table in Table 6-3 contains product transactions between the technical and warehouse departments. Some products are returned to the warehouse in the same year or years later, indicated by the same Order No. having a negative quantity. Extract the net quantity of items sent per product in each year that aren't returned.

***Table 6-3*** Source: Product Transactions

| Date | Order No | Product | Quantity |
|---|---|---|---|
| 27/05/2022 | 1 | B | 5 |
| 7/08/2022 | 2 | C | 7 |
| 8/09/2022 | 3 | A | 2 |
| 19/10/2022 | 4 | A | 3 |
| 22/12/2022 | 5 | C | 3 |
| 12/01/2023 | 3 | A | -1 |
| 6/03/2023 | 6 | A | 7 |
| 25/06/2023 | 1 | B | -2 |
| 28/06/2023 | 4 | A | -3 |
| 1/08/2023 | 7 | C | 2 |
| 14/09/2023 | 1 | B | -1 |
| 16/07/2024 | 3 | A | -1 |
| 10/09/2024 | 5 | C | -2 |
| 4/10/2024 | 1 | B | -2 |
| 9/10/2024 | 6 | A | -3 |
| 20/10/2024 | 8 | B | 1 |
| 22/12/2024 | 5 | C | -1 |

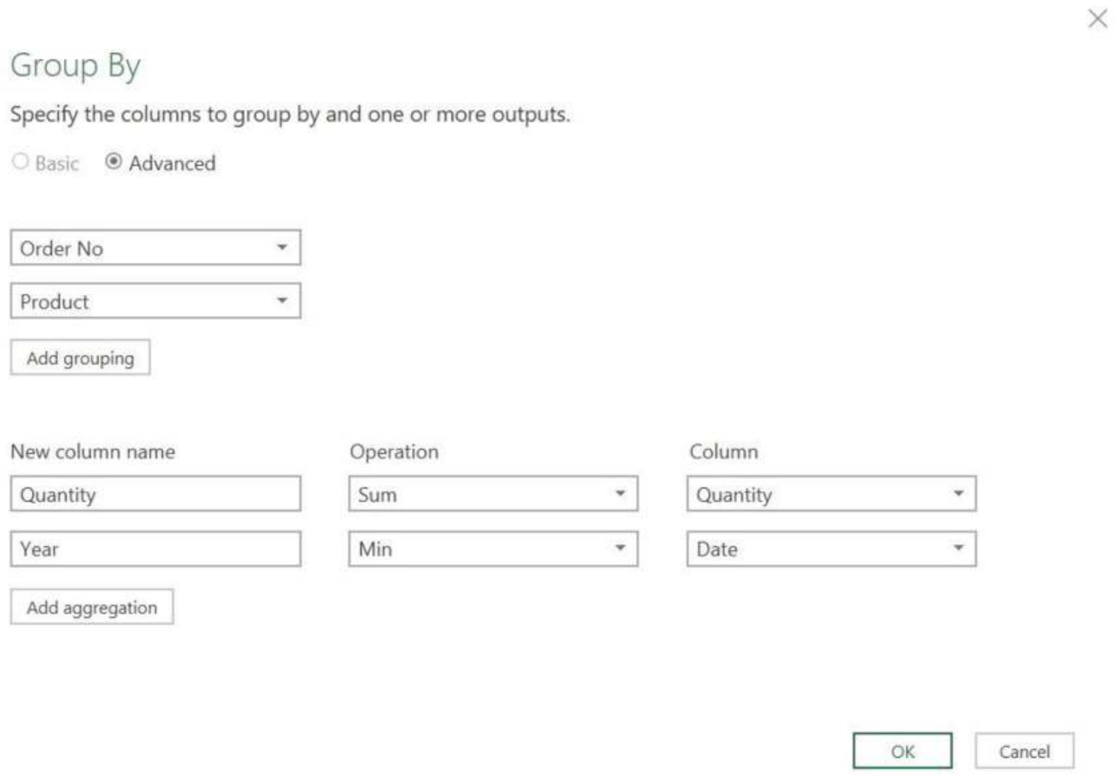
For example, in 2022 for product B, just on orders, Order No. 1 was issued. Based on this order, on 27/05/2022, five items of Product B were sent. Out of these, two were returned on 25/06/2023, one was returned on 14/09/2023, and the remaining two were returned on 04/10/2024. Since all items from this order were eventually returned, the net quantity of unreturned items for Product B in 2022 is 0.

For Product C in 2022, two different orders, Order No. 2 and Order No. 5, were issued with quantities of seven and three, respectively. All three items sent in Order No. 5 were returned, while none of the items from Order No. 2 were returned. Therefore, the net quantity of unreturned items for Product C in 2022 is seven, meaning 7 should be recorded for this product in that year.

**Note** The data in this example is provided in an Excel file titled `03 Matching Items in Groups.xlsx`.

To solve this problem, you need to group the rows by each Order No. and calculate the total sum of the Quantity column for each order to determine the net quantity of purchases items per Order No. In addition to calculating the net quantity, you also need to extract the year in which each order was issued.

To group these rows, go to the Home tab, select Group By, switch to the Advanced mode, and configure the settings shown in Figure 6-13.


Group By

Specify the columns to group by and one or more outputs.

Basic [✓ Advanced]

Order No

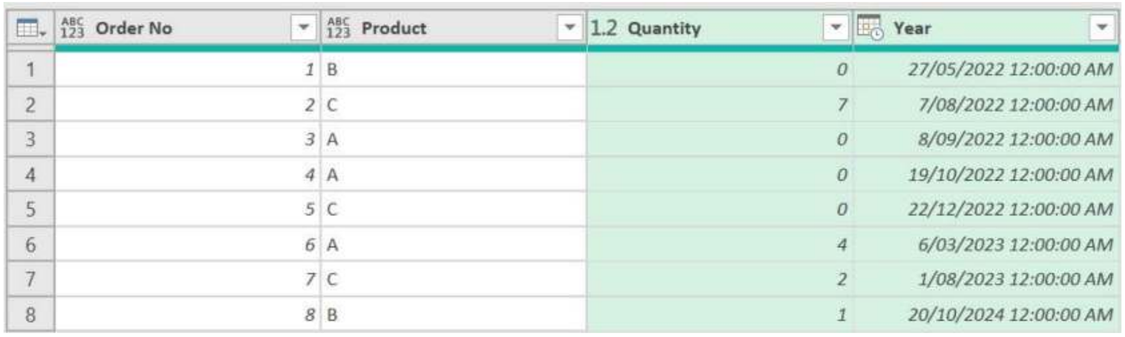
Product

| New column name | Operation | Column |
|---|---|---|
| Quantity | Sum | Quantity |
| Year | Min | Date |

*Figure 6-13* Group By settings

This configuration generates the following formula in the formula bar, which results in Figure 6-14.

```
= Table.Group(Source,
      {"Order No", "Product"},
      {
         {"Quantity", each List.Sum([Quantity]), type number},
         {"Year", each List.Min([Date]), type datetime}
      })
```



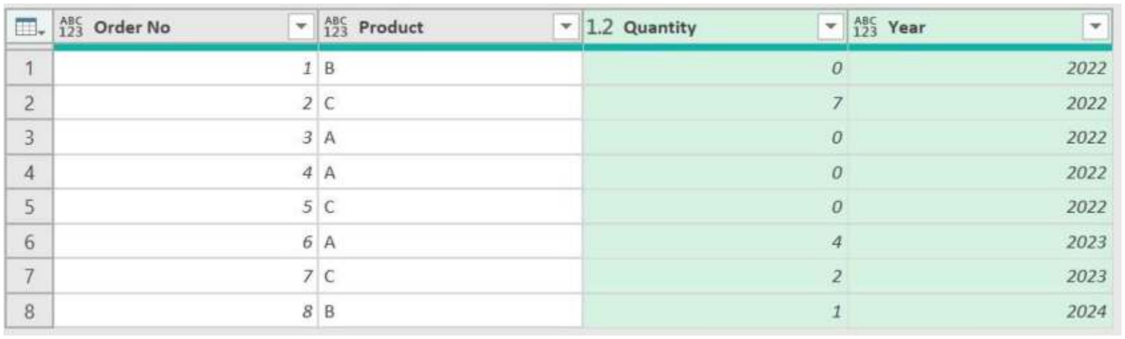
| | Order No | Product | Quantity | Year |
|---|---|---|---|---|
| 1 | 1 | B | 0 | 27/05/2022 12:00:00 AM |
| 2 | 2 | C | 7 | 7/08/2022 12:00:00 AM |
| 3 | 3 | A | 0 | 8/09/2022 12:00:00 AM |
| 4 | 4 | A | 0 | 19/10/2022 12:00:00 AM |
| 5 | 5 | C | 0 | 22/12/2022 12:00:00 AM |
| 6 | 6 | A | 4 | 6/03/2023 12:00:00 AM |
| 7 | 7 | C | 2 | 1/08/2023 12:00:00 AM |
| 8 | 8 | B | 1 | 20/10/2024 12:00:00 AM |

***Figure 6-14*** The result of Table.Group

The values in the Year column are in date format, and the year of each date can be extracted by rewriting the formula as follows:

```
= Table.Group(Source,
      {"Order No", "Product"},
      {
         {"Quantity", each List.Sum([Quantity]), type number},
         {"Year", each Date.Year(List.Min([Date])) }
      })
```

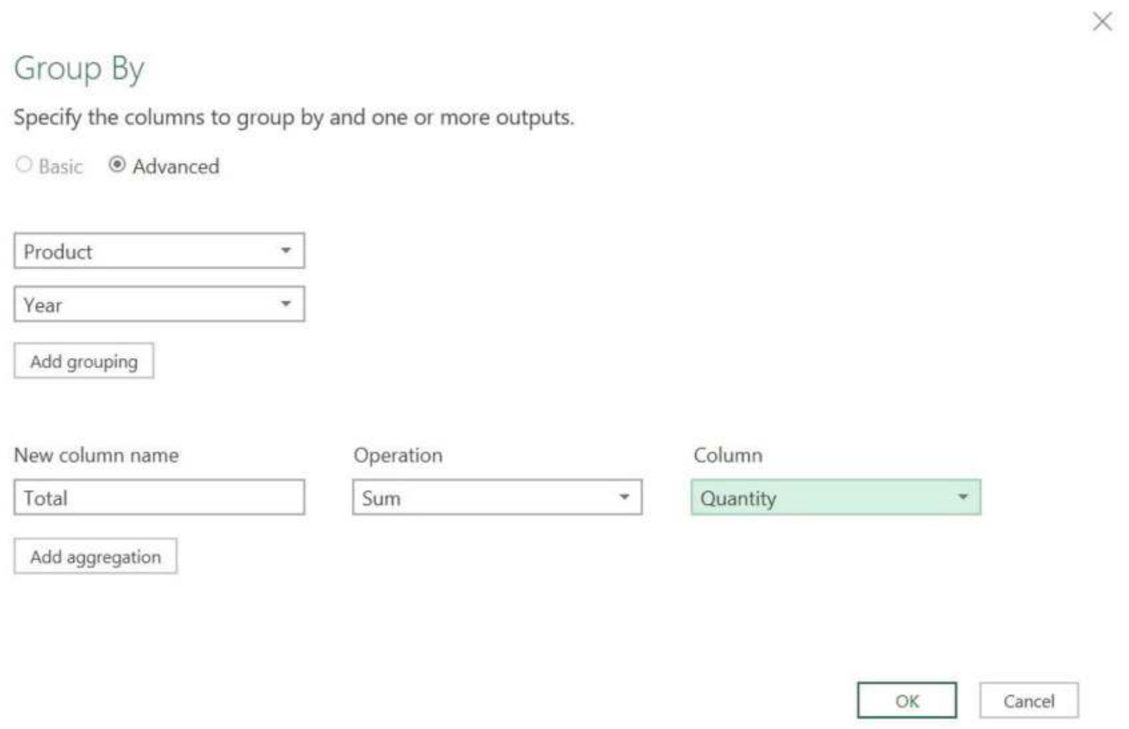
This results in Figure 6-15, which provides the net quantity of non-returned items per product, sent in each year.



| | Order No | Product | Quantity | Year |
|---|---|---|---|---|
| 1 | 1 | B | 0 | 2022 |
| 2 | 2 | C | 7 | 2022 |
| 3 | 3 | A | 0 | 2022 |
| 4 | 4 | A | 0 | 2022 |
| 5 | 5 | C | 0 | 2022 |
| 6 | 6 | A | 4 | 2023 |
| 7 | 7 | C | 2 | 2023 |
| 8 | 8 | B | 1 | 2024 |

***Figure 6-15*** The result of the revised version

As a final step, use the Group By command again with the settings provided in Figure 6-16, and click OK. This results in Figure 6-17.



Group By

Specify the columns to group by and one or more outputs.

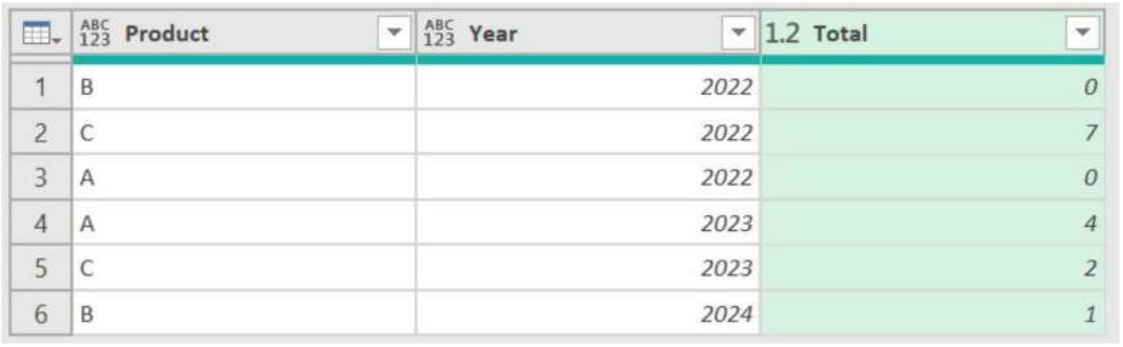
Basic [✓ Advanced]

Product

Year

| New column name | Operation | Column |
|---|---|---|
| Total | Sum | Quantity |

*Figure 6-16* The second use of Group By



| | Product | Year | Total |
|---|---|---|---|
| 1 | B | 2022 | 0 |
| 2 | C | 2022 | 7 |
| 3 | A | 2022 | 0 |
| 4 | A | 2023 | 4 |
| 5 | C | 2023 | 2 |
| 6 | B | 2024 | 1 |

*Figure 6-17* The final result

To clean the results, filter out the rows where the quantity column has a 0 value.

## Identifying All-Season Products

In the Source table, part of which is shown in Table 6-4, the sales values for different products across various dates are provided. Extract the products that have been sold at least once in each of the months.

*Table 6-4* Comparison Matrix

| Date | Product | Quantity |
|---|---|---|
| 13/01/2023 | A | 8 |
| 14/01/2023 | C | 4 |
| 15/01/2023 | D | 3 |
| 16/01/2023 | E | 2 |
| 17/01/2023 | J | 2 |
| 19/01/2023 | A | 6 |
| 21/01/2023 | H | 7 |

| Date | Product | Quantity |
|---|---|---|
| 26/01/2023 | C | 5 |
| 27/01/2023 | B | 2 |
| 30/01/2023 | A | 5 |
| 2/02/2023 | F | 2 |
| 3/02/2023 | J | 9 |
| 7/02/2023 | G | 3 |
| 10/02/2023 | A | 4 |
| 11/02/2023 | C | 5 |

**Note** The data in this example is provided in an Excel file titled `04 Identifying All-Season Products.xlsx`.

To solve this problem, you need to determine the number of months each product was sold. To simplify the process, you can extract the month from each transaction date. This can be done by selecting the Date column, then navigating to the Transform tab, and in the Date & Time column section, selecting Month under the Date options, as shown in Figure 6-18. This will result in the table shown in Figure 6-19.

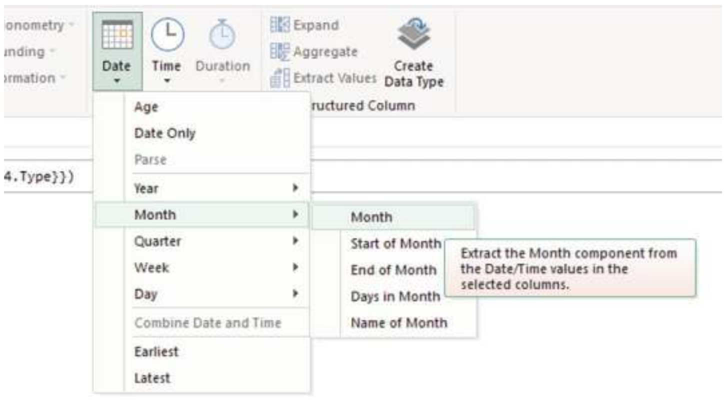
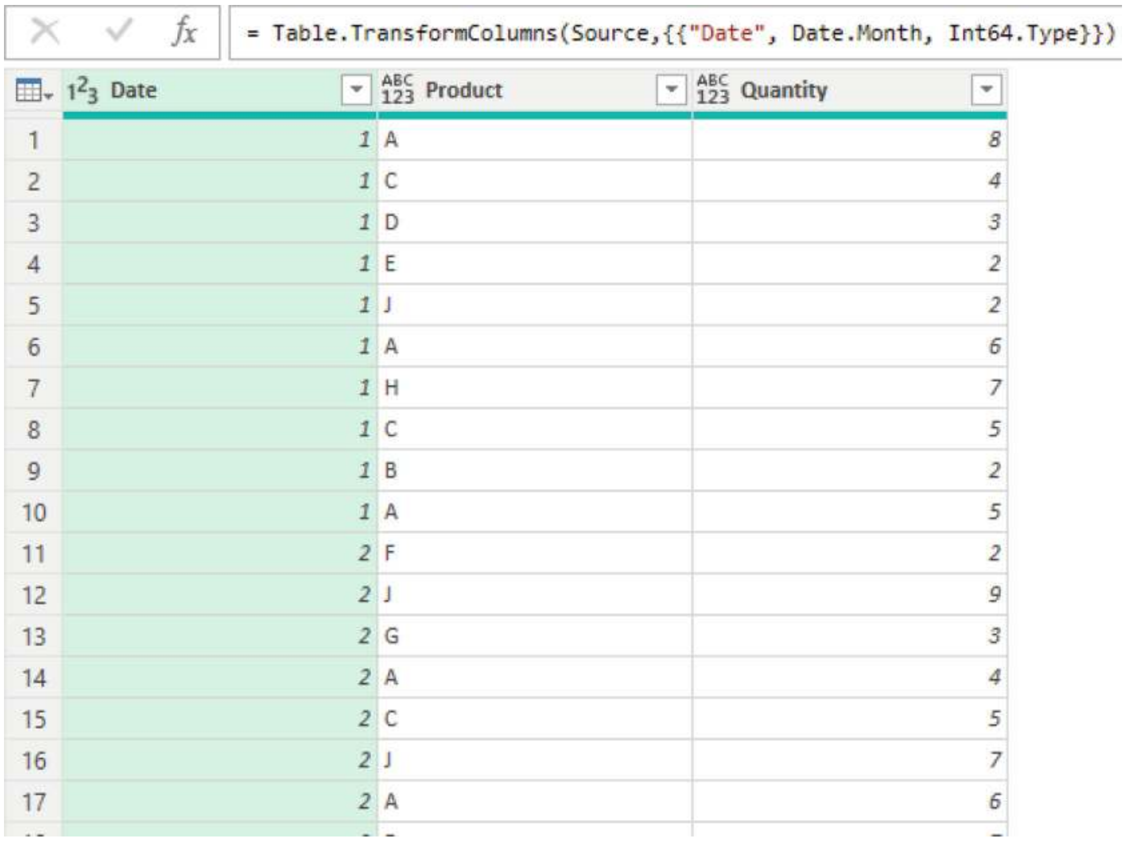


*Figure 6-18* Setting for converting Date to Month

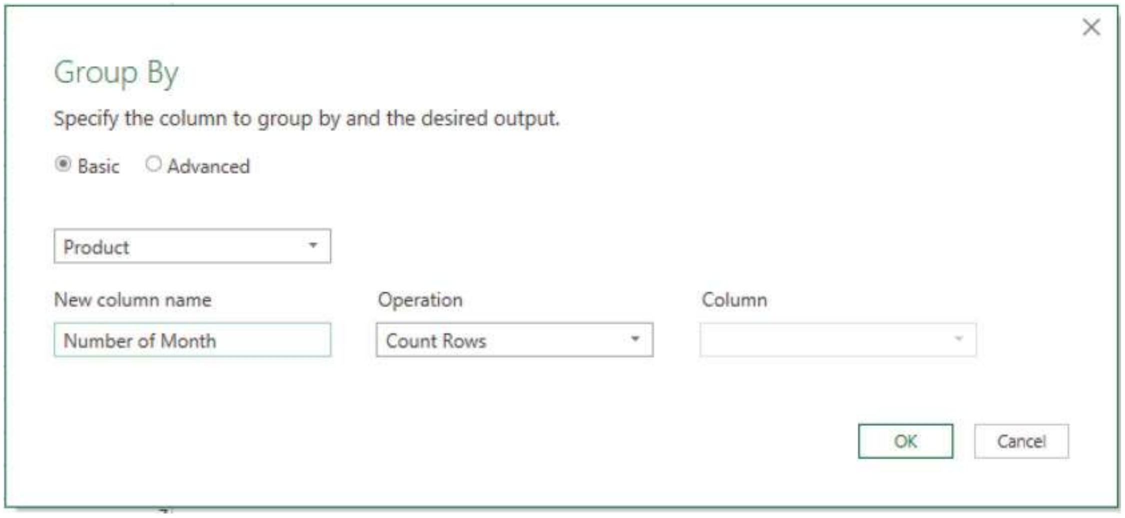


```
= Table.TransformColumns(Source,{{"Date", Date.Month, Int64.Type}})
```

| | Date | Product | Quantity |
|---|---|---|---|
| 1 | 1 | A | 8 |
| 2 | 1 | C | 4 |
| 3 | 1 | D | 3 |
| 4 | 1 | E | 2 |
| 5 | 1 | J | 2 |
| 6 | 1 | A | 6 |
| 7 | 1 | H | 7 |
| 8 | 1 | C | 5 |
| 9 | 1 | B | 2 |
| 10 | 1 | A | 5 |
| 11 | 2 | F | 2 |
| 12 | 2 | J | 9 |
| 13 | 2 | G | 3 |
| 14 | 2 | A | 4 |
| 15 | 2 | C | 5 |
| 16 | 2 | J | 7 |
| 17 | 2 | A | 6 |

***Figure 6-19*** Converting dates to month

In the next step, you need to calculate the number of months each product was sold. To do this, select the Group By command and configure the settings shown in Figure 6-20. This will produce the results displayed in Figure 6-21.



Group By

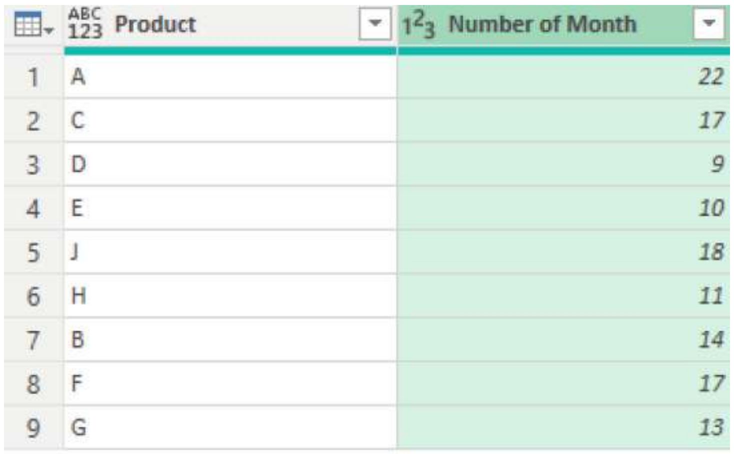
Specify the column to group by and the desired output.

[✓ Basic] Advanced

Product

| New column name | Operation | Column |
|---|---|---|
| Number of Month | Count Rows | |

***Figure 6-20*** Setting for Group By



| | Product | Number of Month |
|---|---|---|
| 1 | A | 22 |
| 2 | C | 17 |
| 3 | D | 9 |
| 4 | E | 10 |
| 5 | J | 18 |
| 6 | H | 11 |
| 7 | B | 14 |
| 8 | F | 17 |
| 9 | G | 13 |

***Figure 6-21*** The result of group By

In the Group By settings, Count Rows as initially selected as the operation. However, the goal is to count the number of unique months each product was sold in, rather than counting all the rows.

To adjust this, first examine the formula generated by the previous step in the formula bar:

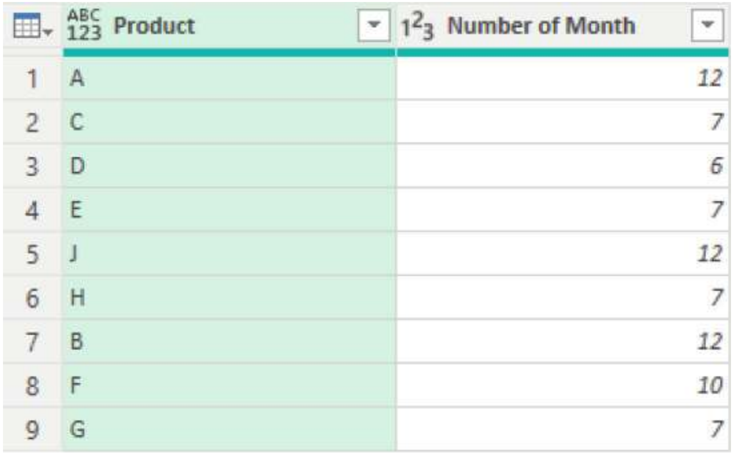
```
= Table.Group(#"Extracted Month", {"Product"}, {{"Number of Month", each
Table.RowCount(_), Int64.Type}})
```

Instead of using `each Table.RowCount(_)`, which counts all rows, you need to extract the unique values from the Date column for each product. You can achieve this by replacing it with `each _[Date]`, which retrieves all date values per product.

To filter out duplicate months, use `List.Distinct(_[Date])`, and to count the unique months, wrap it with `List.Count()`. The revised formula is as follows:

```
= Table.Group(
  #"Extracted Month",
  {"Product"},
  {{"Number of Month", each List.Count(List.Distinct(_[Date])), Int64.Type}}
)
```

This updated formula provides the number of months each product was sold, as shown in Figure 6-22. Finally, to find products sold in all 12 months, simply filter the Number of Month column to keep rows where the value is 12.



| | Product | Number of Month |
|---|---|---|
| 1 | A | 12 |
| 2 | C | 7 |
| 3 | D | 6 |
| 4 | E | 7 |
| 5 | J | 12 |
| 6 | H | 7 |
| 7 | B | 12 |
| 8 | F | 10 |
| 9 | G | 7 |

***Figure 6-22*** The result of revised Group By

## Grouping Based on the Date

Consider the sales data (sorted by the Date column) shown in Table 6-5 as the source table.

***Table 6-5*** Source: Historical Sales

| Date | Quantity |
|---|---|
| 25/06/2024 | 84 |
| 26/06/2024 | 23 |
| 27/06/2024 | 87 |
| 28/06/2024 | 26 |
| 30/06/2024 | 67 |
| 2/07/2024 | 42 |
| 3/07/2024 | 40 |
| 4/07/2024 | 14 |
| 5/07/2024 | 69 |
| 6/07/2024 | 32 |
| 7/07/2024 | 44 |
| 8/07/2024 | 56 |
| 9/07/2024 | 25 |
| 11/07/2024 | 15 |
| 12/07/2024 | 84 |
| 13/07/2024 | 25 |
| 14/07/2024 | 46 |
| 15/07/2024 | 38 |
| 17/07/2024 | 45 |
| 18/07/2024 | 76 |
| 19/07/2024 | 44 |

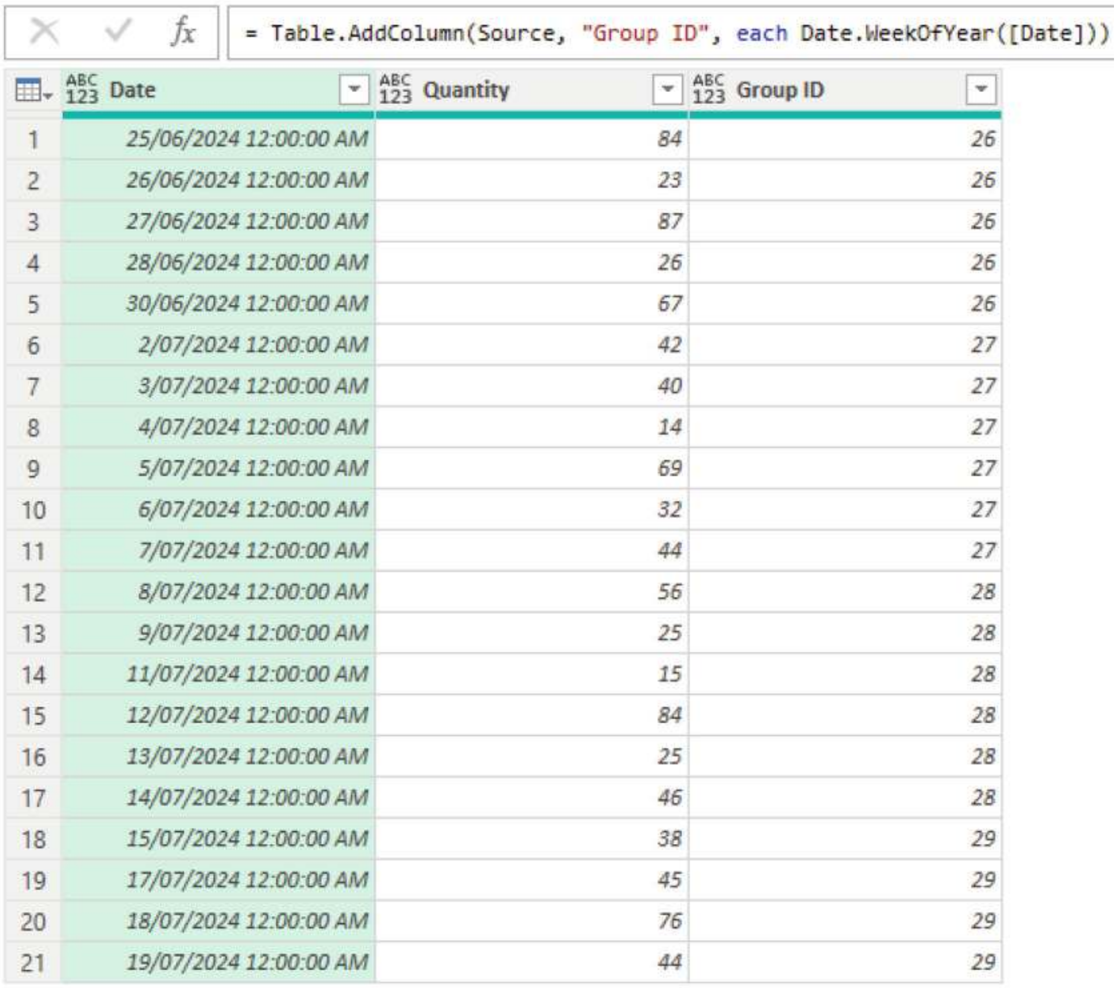
**Note** The data in this example is provided in an Excel file titled `05 Group based on the Date.xlsx`.

Group the rows based on the following scenarios:

- Group the values for each week, starting on Monday.
- Group the values for each week, starting on Wednesday.
- Group the values for every ten days, starting at the beginning of the year.
- Group the first ten days (from the 1st to the 10th of the month), the second ten days (from the 11th to the 20th), and the remaining days (from the 21st to the end of the month) into three separate groups for each month.

To solve such problems, you simply need to add a new custom column with values corresponding to the different groups. For example, to group by week across the year, you can add a new custom column using the formula provided in the Custom Column window, which determines the week number of each date, as shown in Figure 6-23. This column can then be used for grouping.

```
=Date.WeekOfYear([Date])
```



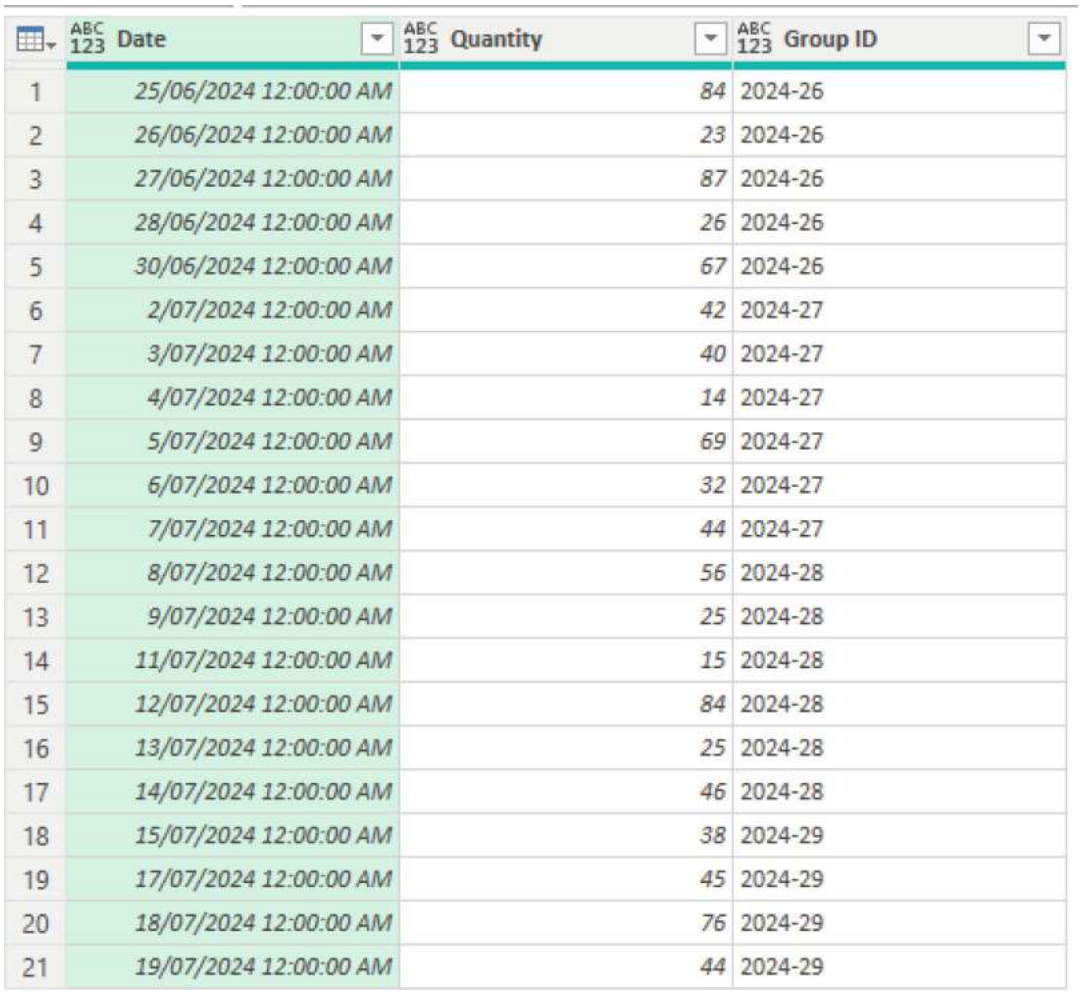
```
= Table.AddColumn(Source, "Group ID", each Date.WeekOfYear([Date]))
```

| | Date | Quantity | Group ID |
|---|---|---|---|
| 1 | 25/06/2024 12:00:00 AM | 84 | 26 |
| 2 | 26/06/2024 12:00:00 AM | 23 | 26 |
| 3 | 27/06/2024 12:00:00 AM | 87 | 26 |
| 4 | 28/06/2024 12:00:00 AM | 26 | 26 |
| 5 | 30/06/2024 12:00:00 AM | 67 | 26 |
| 6 | 2/07/2024 12:00:00 AM | 42 | 27 |
| 7 | 3/07/2024 12:00:00 AM | 40 | 27 |
| 8 | 4/07/2024 12:00:00 AM | 14 | 27 |
| 9 | 5/07/2024 12:00:00 AM | 69 | 27 |
| 10 | 6/07/2024 12:00:00 AM | 32 | 27 |
| 11 | 7/07/2024 12:00:00 AM | 44 | 27 |
| 12 | 8/07/2024 12:00:00 AM | 56 | 28 |
| 13 | 9/07/2024 12:00:00 AM | 25 | 28 |
| 14 | 11/07/2024 12:00:00 AM | 15 | 28 |
| 15 | 12/07/2024 12:00:00 AM | 84 | 28 |
| 16 | 13/07/2024 12:00:00 AM | 25 | 28 |
| 17 | 14/07/2024 12:00:00 AM | 46 | 28 |
| 18 | 15/07/2024 12:00:00 AM | 38 | 29 |
| 19 | 17/07/2024 12:00:00 AM | 45 | 29 |
| 20 | 18/07/2024 12:00:00 AM | 76 | 29 |
| 21 | 19/07/2024 12:00:00 AM | 44 | 29 |

***Figure 6-23*** The result of the formula for every week

If the table includes information related to other years, the formula can be modified as follows, resulting in Figure 6-24.

```
= DateTime.ToText([Date],"yyyy-") & Text.From(Date.WeekOfYear([Date]))
```



| | Date | Quantity | Group ID |
|---|---|---|---|
| 1 | 25/06/2024 12:00:00 AM | 84 | 2024-26 |
| 2 | 26/06/2024 12:00:00 AM | 23 | 2024-26 |
| 3 | 27/06/2024 12:00:00 AM | 87 | 2024-26 |
| 4 | 28/06/2024 12:00:00 AM | 26 | 2024-26 |
| 5 | 30/06/2024 12:00:00 AM | 67 | 2024-26 |
| 6 | 2/07/2024 12:00:00 AM | 42 | 2024-27 |
| 7 | 3/07/2024 12:00:00 AM | 40 | 2024-27 |
| 8 | 4/07/2024 12:00:00 AM | 14 | 2024-27 |
| 9 | 5/07/2024 12:00:00 AM | 69 | 2024-27 |
| 10 | 6/07/2024 12:00:00 AM | 32 | 2024-27 |
| 11 | 7/07/2024 12:00:00 AM | 44 | 2024-27 |
| 12 | 8/07/2024 12:00:00 AM | 56 | 2024-28 |
| 13 | 9/07/2024 12:00:00 AM | 25 | 2024-28 |
| 14 | 11/07/2024 12:00:00 AM | 15 | 2024-28 |
| 15 | 12/07/2024 12:00:00 AM | 84 | 2024-28 |
| 16 | 13/07/2024 12:00:00 AM | 25 | 2024-28 |
| 17 | 14/07/2024 12:00:00 AM | 46 | 2024-28 |
| 18 | 15/07/2024 12:00:00 AM | 38 | 2024-29 |
| 19 | 17/07/2024 12:00:00 AM | 45 | 2024-29 |
| 20 | 18/07/2024 12:00:00 AM | 76 | 2024-29 |
| 21 | 19/07/2024 12:00:00 AM | 44 | 2024-29 |

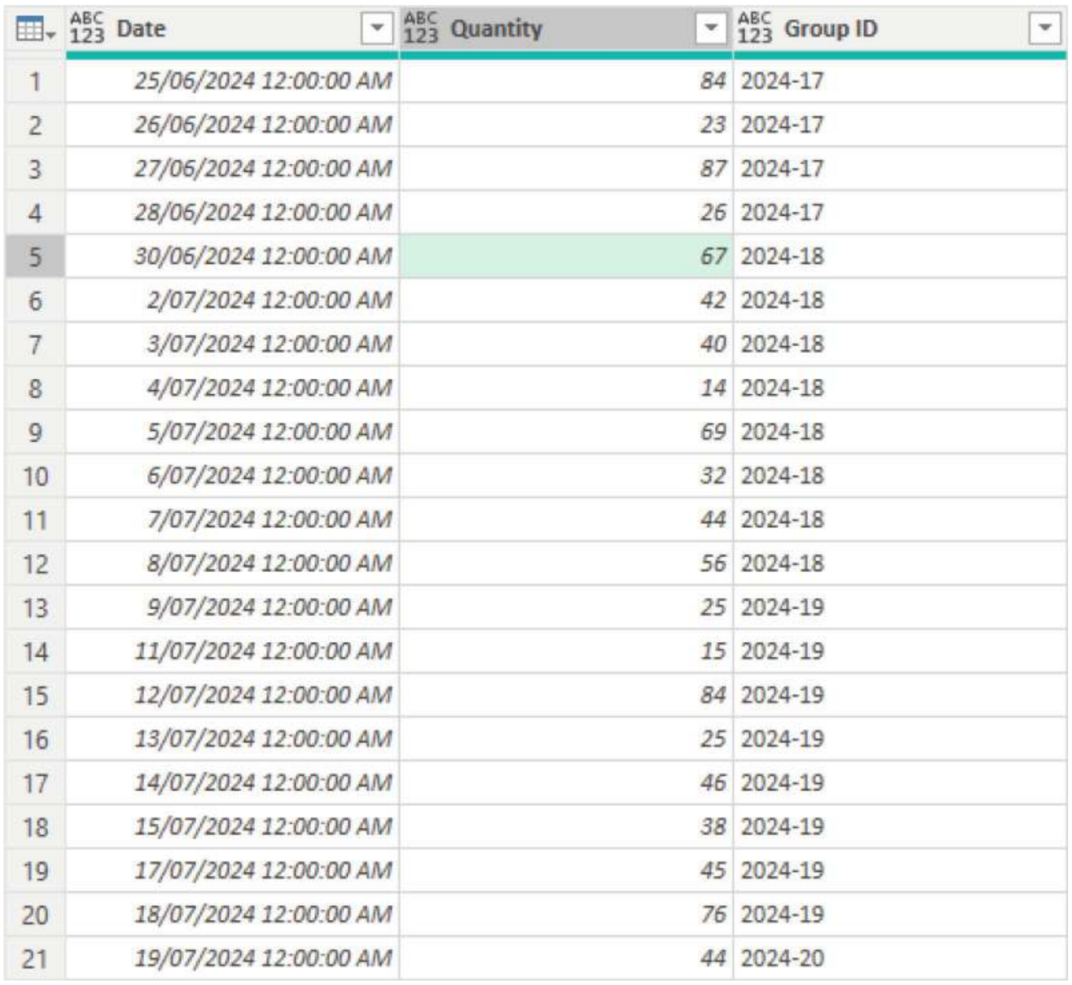
***Figure 6-24*** The result of the formula for every week starting on Wednesday

To change the starting date to Wednesday, simply use the second argument of the `Date.WeekOfYear()` function and rewrite the formula as follows.

```
=DateTime.ToText([Date],"yyyy-") & Text.From(Date.WeekOfYear([Date],
Day.Wednesday))
```

To group the rows every ten days, starting from the first date of the year, you can use the formula for the Group ID as follows, resulting in Figure 6-25.

```
=DateTime.ToText([Date],"yyyy-") &
Text.From(1+Number.IntegerDivide(Date.DayOfYear([Date])-1,10))
```

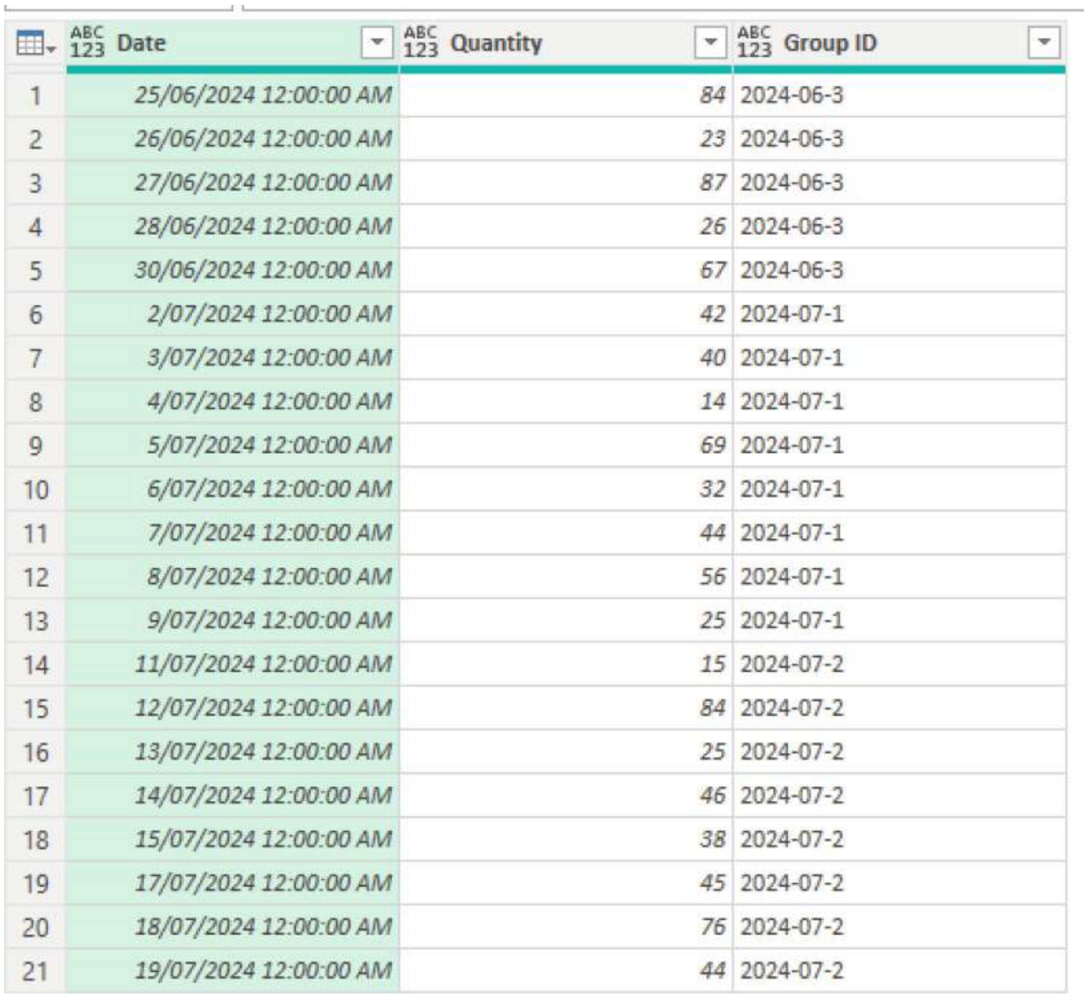


| | Date | Quantity | Group ID |
|---|---|---|---|
| 1 | 25/06/2024 12:00:00 AM | 84 | 2024-17 |
| 2 | 26/06/2024 12:00:00 AM | 23 | 2024-17 |
| 3 | 27/06/2024 12:00:00 AM | 87 | 2024-17 |
| 4 | 28/06/2024 12:00:00 AM | 26 | 2024-17 |
| 5 | 30/06/2024 12:00:00 AM | 67 | 2024-18 |
| 6 | 2/07/2024 12:00:00 AM | 42 | 2024-18 |
| 7 | 3/07/2024 12:00:00 AM | 40 | 2024-18 |
| 8 | 4/07/2024 12:00:00 AM | 14 | 2024-18 |
| 9 | 5/07/2024 12:00:00 AM | 69 | 2024-18 |
| 10 | 6/07/2024 12:00:00 AM | 32 | 2024-18 |
| 11 | 7/07/2024 12:00:00 AM | 44 | 2024-18 |
| 12 | 8/07/2024 12:00:00 AM | 56 | 2024-18 |
| 13 | 9/07/2024 12:00:00 AM | 25 | 2024-19 |
| 14 | 11/07/2024 12:00:00 AM | 15 | 2024-19 |
| 15 | 12/07/2024 12:00:00 AM | 84 | 2024-19 |
| 16 | 13/07/2024 12:00:00 AM | 25 | 2024-19 |
| 17 | 14/07/2024 12:00:00 AM | 46 | 2024-19 |
| 18 | 15/07/2024 12:00:00 AM | 38 | 2024-19 |
| 19 | 17/07/2024 12:00:00 AM | 45 | 2024-19 |
| 20 | 18/07/2024 12:00:00 AM | 76 | 2024-19 |
| 21 | 19/07/2024 12:00:00 AM | 44 | 2024-20 |

***Figure 6-25*** The result of formula for every ten days starting from the beginning of the year

For the last scenario, you can use the following formula, resulting in Figure 6-26.

```
DateTime.ToText([Date],"yyyy-MM-") &
Text.From(List.Min({3,1+Number.IntegerDivide(Date.Day([Date])-1,10)}))
```



| | Date | Quantity | Group ID |
|---|---|---|---|
| 1 | 25/06/2024 12:00:00 AM | 84 | 2024-06-3 |
| 2 | 26/06/2024 12:00:00 AM | 23 | 2024-06-3 |
| 3 | 27/06/2024 12:00:00 AM | 87 | 2024-06-3 |
| 4 | 28/06/2024 12:00:00 AM | 26 | 2024-06-3 |
| 5 | 30/06/2024 12:00:00 AM | 67 | 2024-06-3 |
| 6 | 2/07/2024 12:00:00 AM | 42 | 2024-07-1 |
| 7 | 3/07/2024 12:00:00 AM | 40 | 2024-07-1 |
| 8 | 4/07/2024 12:00:00 AM | 14 | 2024-07-1 |
| 9 | 5/07/2024 12:00:00 AM | 69 | 2024-07-1 |
| 10 | 6/07/2024 12:00:00 AM | 32 | 2024-07-1 |
| 11 | 7/07/2024 12:00:00 AM | 44 | 2024-07-1 |
| 12 | 8/07/2024 12:00:00 AM | 56 | 2024-07-1 |
| 13 | 9/07/2024 12:00:00 AM | 25 | 2024-07-1 |
| 14 | 11/07/2024 12:00:00 AM | 15 | 2024-07-2 |
| 15 | 12/07/2024 12:00:00 AM | 84 | 2024-07-2 |
| 16 | 13/07/2024 12:00:00 AM | 25 | 2024-07-2 |
| 17 | 14/07/2024 12:00:00 AM | 46 | 2024-07-2 |
| 18 | 15/07/2024 12:00:00 AM | 38 | 2024-07-2 |
| 19 | 17/07/2024 12:00:00 AM | 45 | 2024-07-2 |
| 20 | 18/07/2024 12:00:00 AM | 76 | 2024-07-2 |
| 21 | 19/07/2024 12:00:00 AM | 44 | 2024-07-2 |

***Figure 6-26*** The result of formula for every ten days in each month

## Using the Fourth Input in Table.Group()

Consider the historical sales data provided in the Source table shown in Table 6-6. Calculate the total sales per week, ensuring that the weeks from different months are grouped separately.

***Table 6-6*** Source: Historical Sales Value

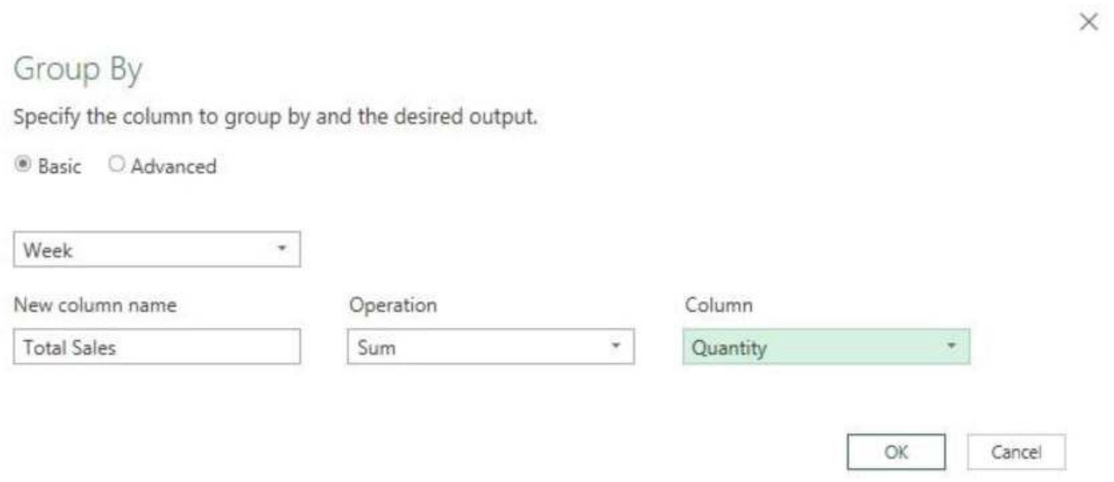
| Month | Week | Product | Colour | Quantity |
|---|---|---|---|---|
| **January** | W1 | A | Black | 6 |
| | W1 | B | Blue | 9 |
| | W1 | B | Yellow | 2 |
| | W2 | A | Black | 6 |
| | W2 | B | Red | 7 |
| | W2 | C | Red | 5 |
| | W3 | B | Yellow | 13 |
| | W3 | B | Red | 3 |
| | W4 | A | Blue | 7 |
| | W4 | C | Red | 6 |
| February | W1 | A | Yellow | 7 |
| | W2 | A | Red | 8 |

| Month | Week | Product | Colour | Quantity |
|---|---|---|---|---|
| | W3 | B | Black | 10 |
| | W3 | C | Blue | 14 |
| | W4 | D | Red | 9 |

**Note** The data in this example is provided in an Excel file titled `06 Using the Fourth Input in Table.Group.xlsx`.

In this problem, you want to group the rows of the table based on the values in the Week column. The challenge is that the rows for the first week of January should be grouped together and should not include the values for the first week of February, even though both are labelled as W1. In other words, you want to group the rows with the same Week value only if they are in consecutive rows; otherwise, they should be placed in different groups. This is where the fourth argument of this function comes to the rescue. (This example can be solved in different ways, but in this example you use it to learn about the fourth argument of the `Table.Group()` function.)

As in the previous examples, right-click the Week column, select the Group By command, and adjust the settings as shown in Figure 6-27.



Week

New column name: Total Sales

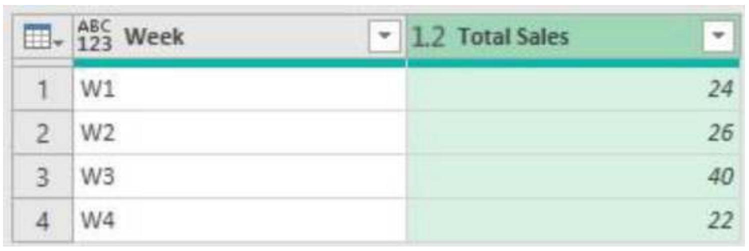
Operation: Sum

Column: Quantity

*Figure 6-27* Settings for Group By week

Click OK, leading to the result shown in Figure 6-28, where weeks from different months are also grouped, and generate the following formula in the formula bar.

```
= Table.Group(Source, {"Week"}, {{"Total Sales", each List.Sum([Quantity]),
type number}})
```



| | Week | Total Sales |
|---|---|---|
| 1 | W1 | 24 |
| 2 | W2 | 26 |
| 3 | W3 | 40 |
| 4 | W4 | 22 |

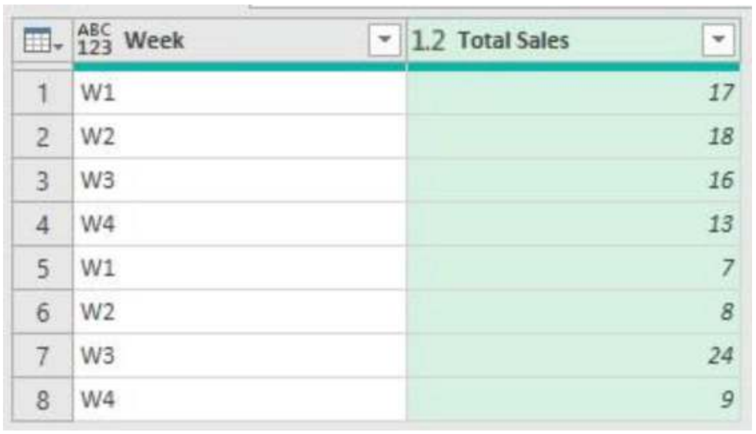
*Figure 6-28* The result of Group By week

The predefined logic of the `Table.Group()` function for grouping rows is global, meaning it groups all the rows in the table that have the same value in the Week column. However, this logic can be changed to a local one by manually modifying the fourth argument of the function.

In other words, you can use the fourth argument in the `Table.Group()` function to change the grouping logic by entering `GroupKind.Local` (or 0) or `GroupKind.Global` (or 1) in this argument. By default, `GroupKind.Global` is used, which groups similar values in the columns across the entire table. However, by entering `GroupKind.Local` in the fourth argument, the grouping logic is changed, and only rows with the same value that are adjacent to each other will be grouped together.

To solve this problem, add `GroupKind.Local` or value 0 in the fourth argument of the previous formula and rewrite it as shown here. This will result in the desired grouping, as shown in Figure 6-29, which solves the problem.

```
= Table.Group(Source, {"Week"}, {{"Total Sales", each List.Sum([Quantity]),
type number}},0)
```



| | Week | Total Sales |
|---|---|---|
| 1 | W1 | 17 |
| 2 | W2 | 18 |
| 3 | W3 | 16 |
| 4 | W4 | 13 |
| 5 | W1 | 7 |
| 6 | W2 | 8 |
| 7 | W3 | 24 |
| 8 | W4 | 9 |

*Figure 6-29* The result of changing the grouping logic to GroupKind.Local

**Note** When you're using the fourth input, ensure that the grouping columns are sorted correctly.

## Ignoring Case Sensitivity in Grouping

Given the sales information in the Source table in Table 6-7, calculate the total quantity for each product.

*Table 6-7* Source: Sales Info

| Week | Product | Colour | Quantity |
|---|---|---|---|
| W1 | A | Black | 6 |
| W1 | B | Blue | 9 |
| W1 | B | Yellow | 2 |
| W2 | a | Black | 6 |
| W2 | B | Red | 7 |
| W2 | C | Red | 5 |
| W3 | b | Yellow | 13 |
| W3 | b | Red | 3 |
| W4 | A | Blue | 7 |
| W4 | c | Red | 6 |

**Note** The data in this example is provided in an Excel file titled `07 Ignoring Case Sensitivity in Grouping .xlsx`.

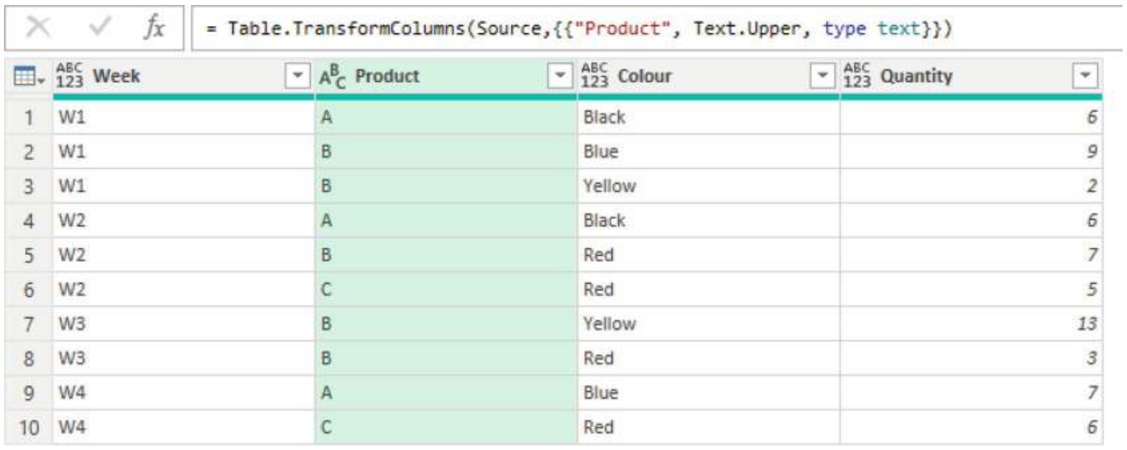
To solve this problem, two different solutions are provided. The first is the easiest one, and it is based solely on the UI. The second solution is more advanced and helps you become familiar with the fifth argument in the `Table.Group()` function.

## Solution 1: Based on UI

This is exactly the same as Example 1 in this chapter, with the difference that the product names are in uppercase and lowercase. Since Power Query is case-sensitive, "a" and "A" are considered different values. Applying the Group By command (without any modifications) directly on this table will result in two different rows for "a" and "A".

Therefore, it would be better to first convert all the product names to the same case and then apply the Group By command on the updated table.

To convert all the product names to uppercase, select the Product Name column. Then, from the Transform tab, in the Text Column section, under the Format command, choose Uppercase to convert all the product names to uppercase, as shown in Figure 6-30.

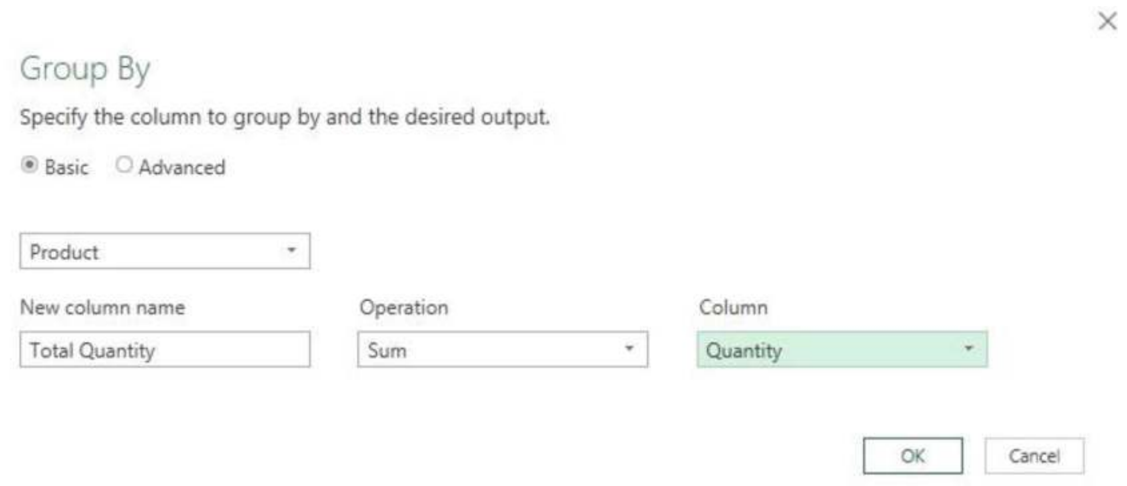


```
= Table.TransformColumns(Source,{{"Product", Text.Upper, type text}})
```

| | Week | Product | Colour | Quantity |
|---|---|---|---|---|
| 1 | W1 | A | Black | 6 |
| 2 | W1 | B | Blue | 9 |
| 3 | W1 | B | Yellow | 2 |
| 4 | W2 | A | Black | 6 |
| 5 | W2 | B | Red | 7 |
| 6 | W2 | C | Red | 5 |
| 7 | W3 | B | Yellow | 13 |
| 8 | W3 | B | Red | 3 |
| 9 | W4 | A | Blue | 7 |
| 10 | W4 | C | Red | 6 |

*Figure 6-30* Converting product names to uppercase

The Group By command now has the settings shown in Figure 6-31.



Group By

Specify the column to group by and the desired output.

[✓ Basic] Advanced

Product

New column name: Total Quantity

Operation: Sum

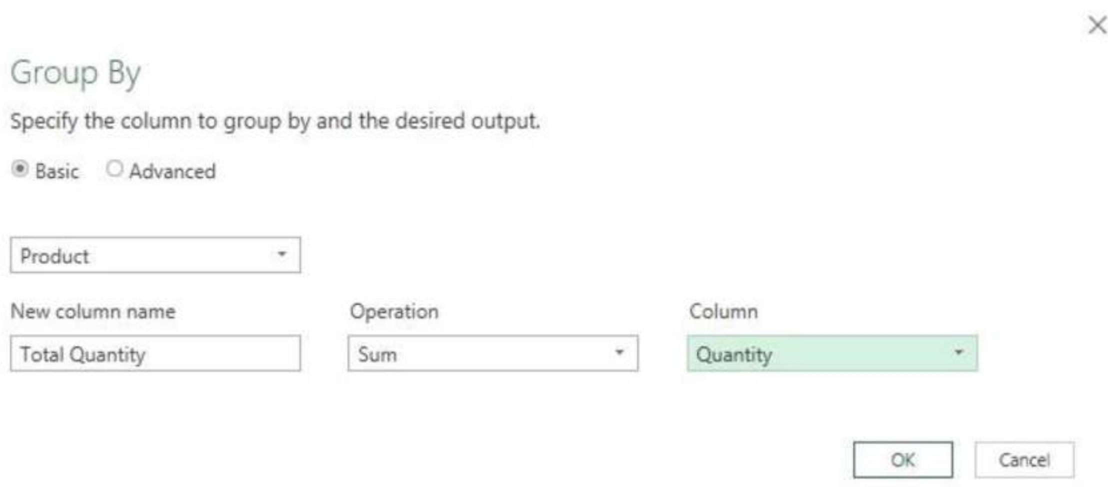
Column: Quantity

*Figure 6-31* Grouping settings

## Solution 2: Using the Fifth Argument of Table.Group()

Besides the previously presented solution, this problem can also be solved using the `Table.Group()` function without changing the product names, if you are familiar with the fifth argument of this function.

Consider the source table unchanged, then select the Product column, select the Group By command in the Home tab, and change the settings as shown in Figure 6-32, which results in Figure 6-33. Since Power Query is case-sensitive, there are different rows in the resulting table for product "a" and "A".


Group By

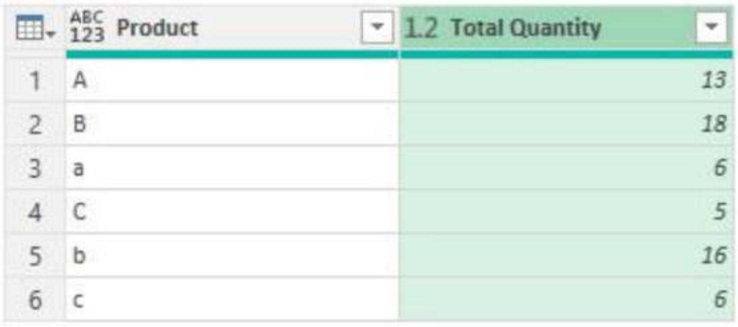
Specify the column to group by and the desired output.

[✓ Basic] Advanced

Product

| New column name | Operation | Column |
|---|---|---|
| Total Quantity | Sum | Quantity |

*Figure 6-32* Grouping setting



| | Product | Total Quantity |
|---|---|---|
| 1 | A | 13 |
| 2 | B | 18 |
| 3 | a | 6 |
| 4 | C | 5 |
| 5 | b | 16 |
| 6 | c | 6 |

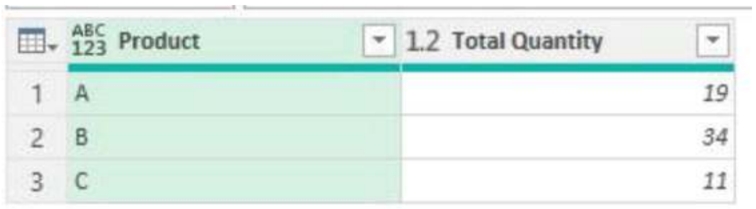
*Figure 6-33* Result of grouping

The previous setting for the grouping command will result in the following formula in the formula bar with three arguments:

```
= Table.Group(
      Source,
      {"Product"},
      {{"Total Quantity", each List.Sum([Quantity]), type number}})
```

As mentioned in the previous example, adding 1 to the fourth argument (or `GroupKind.Global`) doesn't change the result. However, to use the fifth argument, you need to define all four arguments first. So, after entering 1 in the fourth argument, you can use `Comparer.OrdinalIgnoreCase` in the fifth argument of this function, as shown here, to ignore the case differences. This results in Figure 6-34 and solves the problem.

```
= Table.Group(
      Source,
      {"Product"},
      {{"Total Quantity", each List.Sum([Quantity]), type number}},
      1,
      Comparer.OrdinalIgnoreCase)
```



|  | Product | Total Quantity |
|---|---|---|
| 1 | A | 19 |
| 2 | B | 34 |
| 3 | C | 11 |

*Figure 6-34* Final result

**Note** As mentioned in the syntax of the `Table.Group()` function, the fifth argument is the comparer, which you can use to define the condition for grouping the rows. This allows users to apply any custom logic for grouping the rows, in addition to using `Comparer.OrdinalIgnoreCase`.

A custom comparer, in the fifth argument of `Table.Group()`, can be a custom function with two input arguments, such as `(s,c)=>f(s,c)`. The `s` and `c` are the input parameters, each representing a row of the table, and `f(s,c)` should be results in an integer number. You can use any notation, but `s` and `c` are generally used to stand for state and current.

Based on this description, the `Value.Compare()` is a useful function commonly used in this argument, instead of `f(s,c)`. The `Value.Comparer(s,c)` always returns `-1,0,1`, based on the condition:

– Returns `0` if `s` and `c` are equal
– Returns `-1` if `s` is less than `c`.

Returns `1` if `s` is greater than `c`.

Using the `(s,c)=>Value.Comparer(f(s),f(c))` indicates the values of `f(s)` and `f(c)` are compared, and if `f(s)` and `f(c)` are equal, then the rows are grouped together. This is instead of comparing the values on the column (columns) selected in the second argument.

Based on this explanation, this problem can also be solved with the following formula, by replacing `Comparer.OrdinalIgnoreCase` with a custom compare, which does almost the same thing (the difference is that, by using `Value.Comparer()`, the resulting table will be sorted based on the logic defined in this function). This formula means that, instead of comparing the rows based on the lowercase values in the Product column, the values in this column should be compared:

```
= Table.Group(
      Source,
      {"Product"},
      {{"Total Quantity", each List.Sum([Quantity]), type number}},
1,
       (s,c)=>
Value.Compare(Text.Lower(s[Product]),Text.Lower(c[Product])))
```

In the previous formula, as each `s` and `c` represent a row of the table, they are in the type of record, with the number of fields equal to the number of columns entered in the second argument of `Table.Group()` function. The field titles in `s` and `c` are also the same as the name of the column entered in the second argument of `Table.Group`.

## Using Value.Comparer for Grouping

Given the staff age information in the Source table in Table 6-8, group the rows by age decades and extract the staff IDs for each group.

*Table 6-8* Source: Warehouse Transactions

| Age | Staff ID |
|---|---|
| 45 | I-01 |

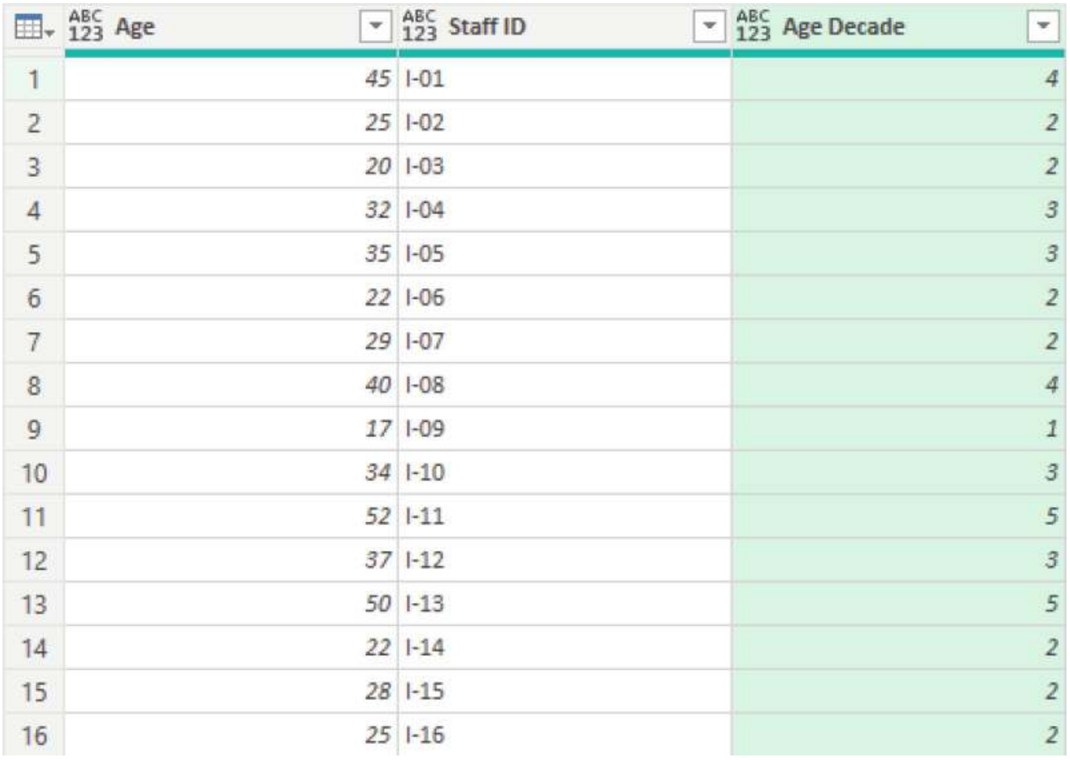
| Age | Staff ID |
|---|---|
| 25 | I-02 |
| 20 | I-03 |
| 32 | I-04 |
| 35 | I-05 |
| 22 | I-06 |
| 29 | I-07 |
| 40 | I-08 |
| 17 | I-09 |
| 34 | I-10 |
| 52 | I-11 |
| 37 | I-12 |
| 50 | I-13 |
| 22 | I-14 |
| 28 | I-15 |
| 25 | I-16 |
| 41 | I-17 |
| 22 | I-18 |
| 38 | I-19 |
| 33 | I-20 |
| 18 | I-21 |
| 27 | I-22 |
| 49 | I-23 |
| 21 | I-24 |
| 53 | I-25 |
| 50 | I-26 |
| 19 | I-27 |
| 46 | I-28 |
| 37 | I-29 |
| 38 | I-30 |
| 30 | I-31 |

**Note** The data in this example is provided in an Excel file titled `08 Using Value.Comparer for Grouping .xlsx`.

To solve this problem, two different solutions are provided. The first solution involves adding a custom column to calculate the age decades and then grouping the rows based on this new column. The second solution uses the Group By command directly, leveraging the fifth argument in the `Table.Group()` function to achieve the desired result.

## Solution 1: Using a Custom Column

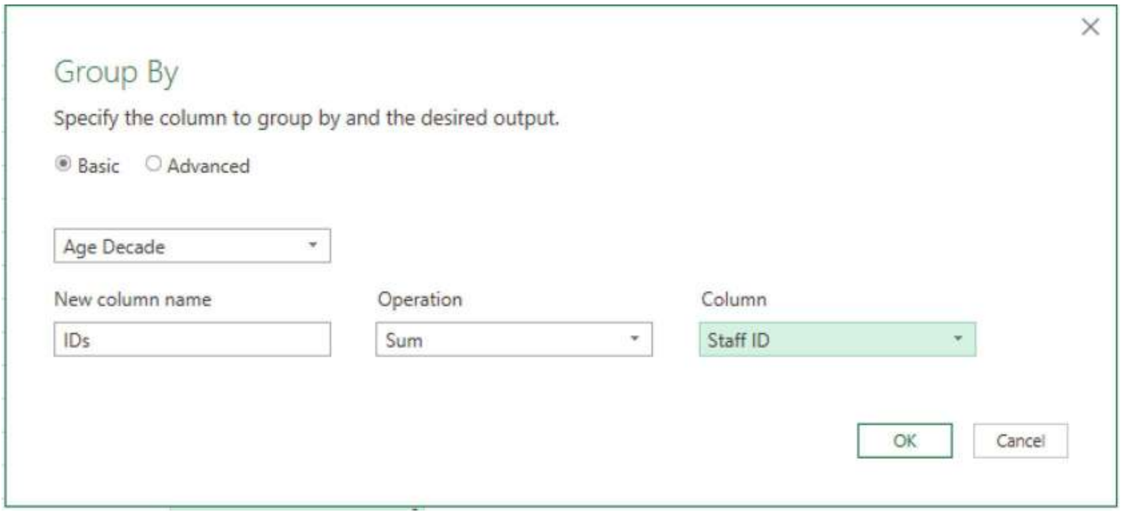
In this example, the rows need to be grouped by decade of age, even though no column currently provides this information. As a first step, add a new custom column called Age Decade using the following formula in the Custom Column window, which will result in Figure 6-35.



| | Age | Staff ID | Age Decade |
|---|---|---|---|
| 1 | 45 | I-01 | 4 |
| 2 | 25 | I-02 | 2 |
| 3 | 20 | I-03 | 2 |
| 4 | 32 | I-04 | 3 |
| 5 | 35 | I-05 | 3 |
| 6 | 22 | I-06 | 2 |
| 7 | 29 | I-07 | 2 |
| 8 | 40 | I-08 | 4 |
| 9 | 17 | I-09 | 1 |
| 10 | 34 | I-10 | 3 |
| 11 | 52 | I-11 | 5 |
| 12 | 37 | I-12 | 3 |
| 13 | 50 | I-13 | 5 |
| 14 | 22 | I-14 | 2 |
| 15 | 28 | I-15 | 2 |
| 16 | 25 | I-16 | 2 |

***Figure 6-35*** The result of adding the decade of ages

In the next step, right-click the Age Decade column and select the Group By command. In the window that opens, apply the settings provided in Figure 6-36. Clicking OK will result in Figure 6-37.



Group By

Specify the column to group by and the desired output.

● Basic ○ Advanced

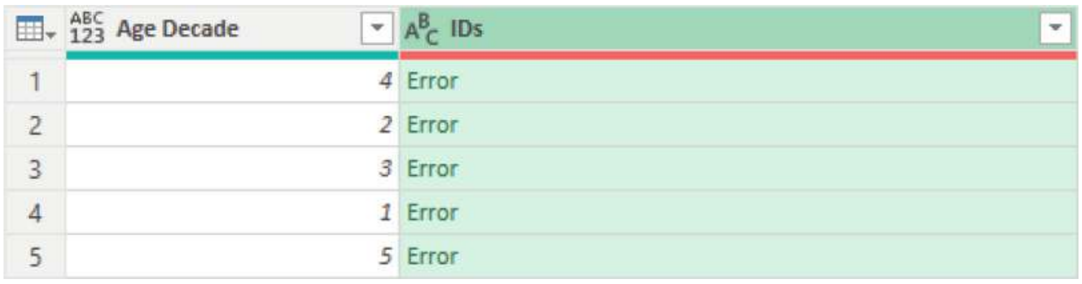
Age Decade

New column name: IDs

Operation: Sum

Column: Staff ID

***Figure 6-36*** Setting of grouping



| | Age Decade | IDs |
|---|---|---|
| 1 | 4 | Error |
| 2 | 2 | Error |
| 3 | 3 | Error |
| 4 | 1 | Error |
| 5 | 5 | Error |

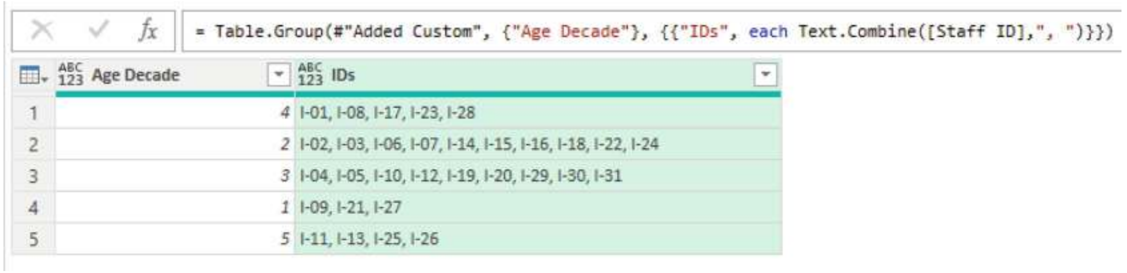
***Figure 6-37*** Result of grouping

In the Group By window, you initially selected the `Sum` operation for the Staff ID column, which contains text values. The resulting column therefore displays an error for all the rows. To resolve this, you need to replace the `Sum` operation with a `Concatenate` operation by manually modifying the formula. Consider this generated formula in the formula bar after the previous step:

```
= Table.Group(#"Added Custom", {"Age Decade"}, {{"IDs", each List.Sum([Staff
ID]), type text}})
```

Modifying this formula as shown will solve the problem and results in Figure 6-38:

```
= Table.Group(#"Added Custom", {"Age Decade"}, {{"IDs", each
Text.Combine([Staff ID],", ")}})
```



```
= Table.Group(#"Added Custom", {"Age Decade"}, {{"IDs", each Text.Combine([Staff ID],", ")}})
```

| | Age Decade | IDs |
|---|---|---|
| 1 | 4 | I-01, I-08, I-17, I-23, I-28 |
| 2 | 2 | I-02, I-03, I-06, I-07, I-14, I-15, I-16, I-18, I-22, I-24 |
| 3 | 3 | I-04, I-05, I-10, I-12, I-19, I-20, I-29, I-30, I-31 |
| 4 | 1 | I-09, I-21, I-27 |
| 5 | 5 | I-11, I-13, I-25, I-26 |

***Figure 6-38*** The result of modified grouping

## Solution 2: Using the Fifth Argument in the Table.Group()

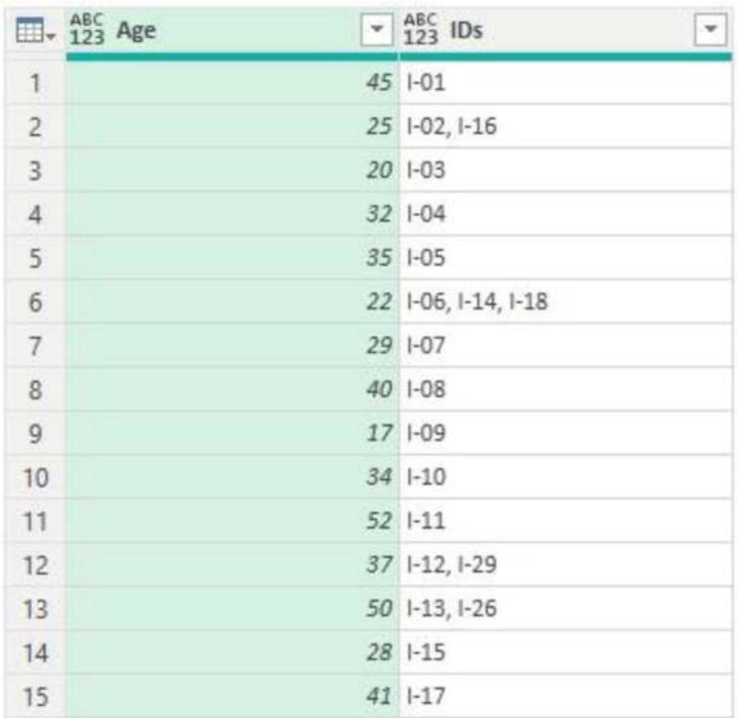
In the previous solution, you solved the problem using a straightforward approach by first adding a new column and then grouping the rows based on the values in that column. Alternatively, this problem can be solved directly using `Table.Group()` and the fifth argument in `Table.Group()`.

To use `Table.Group()` directly, using the source table, right-click the Age column, select the Group By command, and select All Rows as the operation. You'll get the following formula:

```
= Table.Group(Source, {"Age"}, {{"Count", each _, type table [Age=number,
Staff ID=text]}})
```

To combine the staff IDs for each age group, modify the formula to the following to reach Figure 6-39:

```
= Table.Group(Source, {"Age"}, {{"IDs", each Text.Combine(_[Staff ID],",
")}})
```



| | Age | IDs |
|---|---|---|
| 1 | 45 | I-01 |
| 2 | 25 | I-02, I-16 |
| 3 | 20 | I-03 |
| 4 | 32 | I-04 |
| 5 | 35 | I-05 |
| 6 | 22 | I-06, I-14, I-18 |
| 7 | 29 | I-07 |
| 8 | 40 | I-08 |
| 9 | 17 | I-09 |
| 10 | 34 | I-10 |
| 11 | 52 | I-11 |
| 12 | 37 | I-12, I-29 |
| 13 | 50 | I-13, I-26 |
| 14 | 28 | I-15 |
| 15 | 41 | I-17 |

***Figure 6-39*** The result of grouping

In this formula, the ages of two rows are compared, and if they are equal, the rows are grouped together; otherwise, they are not grouped. However, in this example, you want to change the comparison logic from comparing the exact ages to comparing the age decades. As mentioned in the previous example, you can use the fifth argument of `Table.Group()` to change the logic for comparing the rows and decide whether to group those rows or not.

Staff with the same age are grouped together, but you want to group the rows based on age decades. To change the criteria for comparing the rows and decide whether to group them or not, you can use the fifth argument. The fifth argument of `Table.Group()` is a custom function with two arguments mostly in the type record, each one present on a row of the table. If the result of this function becomes 0, the rows will be grouped together. (An important note—using the fifth argument might change the order of the rows used in the table.)

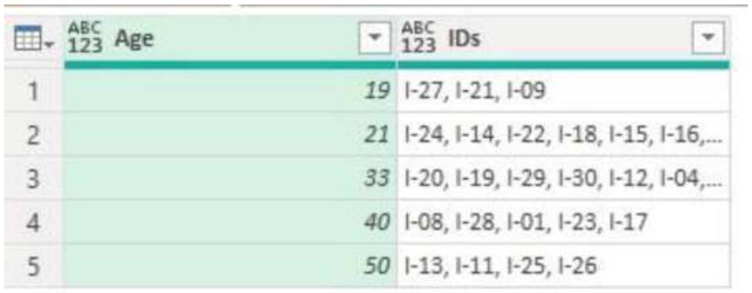
In this example, the previous formula can be rewritten as follows:

```
= Table.Group(
      Source,
      {"Age"},
      {{"IDs", each Text.Combine(_[Staff ID],", ")}},
      1,
       (s,c)=>Value.Compare(s[Age],c[Age]))
```

The result of this formula is that the table becomes sorted based on the age decades. When you use the fifth argument, the rows represented by `s` and `c` will be grouped if `s[Age]` and `c[Age]` are equal .

In this example, instead of comparing the exact ages of `s[Age]` and `c[Age]`, you want to group the rows based on the decade of ages by comparing the result of `Number.IntegerDivide(s[Age],10)` and `Number.IntegerDivide(c[Age],10)`. To achieve this, rewrite the formula to group by the decade of ages. The result is shown in Figure 6-40.

```
= Table.Group(
      Source,
      {"Age"},
        {{"IDs", each Text.Combine(_[Staff ID],", ")}},
        1,
         (s,c)=>Value.Compare(
                       Number.IntegerDivide(s[Age],10),
                        Number.IntegerDivide(c[Age],10)
                                                 )
        )
```

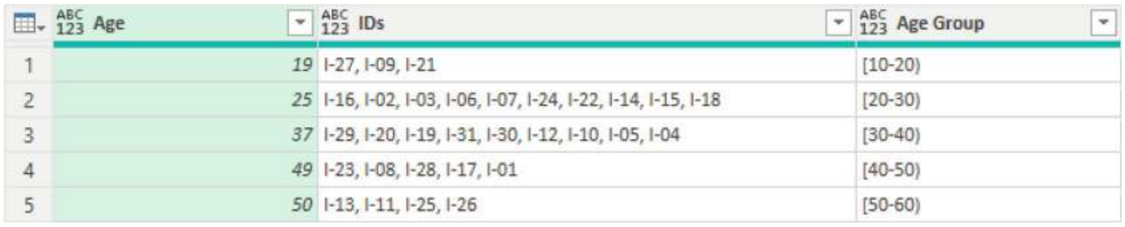


| | Age | IDs |
|---|---|---|
| 1 | 19 | I-27, I-21, I-09 |
| 2 | 21 | I-24, I-14, I-22, I-18, I-15, I-16,... |
| 3 | 33 | I-20, I-19, I-29, I-30, I-12, I-04,... |
| 4 | 40 | I-08, I-28, I-01, I-23, I-17 |
| 5 | 50 | I-13, I-11, I-25, I-26 |

*Figure 6-40* The result of modified grouping

In the resulting table, to clarify the age groups of each row, the formula can be rewritten to include a column that explicitly shows the age decade. This helps in understanding the grouping better. Here's how you can modify the following formula, which solves the problem and results in Figure 6-41. In this formula, for the Age Group column, a predefined list as `{"","[10-20)","[20-30)","[30-40)","[40-50)","[50-60)"}` is defined, then based on the result of `{Number.IntegerDivide([Age]{0},10)}`, the ith item in this list will show a result. If `{Number.IntegerDivide([Age]{0},10)}` results in `1` (the age group between 10-20), the item with index 1 will be shown.

```
= Table.Group(
        Source,
        {"Age"},
        {
                     {"IDs", each Text.Combine(_[Staff ID],", ")},
                      {"Age Group", each {"","[10-20)","[20-30)","[30-40)","[4(
60)"} {Number.IntegerDivide([Age]{0},10)}}},
        1,
         (s,c)=>Value.Compare(Number.IntegerDivide(s[Age],10),Number.IntegerDiv
```



| | Age | IDs | Age Group |
|---|---|---|---|
| 1 | 19 | I-27, I-09, I-21 | [10-20) |
| 2 | 25 | I-16, I-02, I-03, I-06, I-07, I-24, I-22, I-14, I-15, I-18 | [20-30) |
| 3 | 37 | I-29, I-20, I-19, I-31, I-30, I-12, I-10, I-05, I-04 | [30-40) |
| 4 | 49 | I-23, I-08, I-28, I-17, I-01 | [40-50) |
| 5 | 50 | I-13, I-11, I-25, I-26 | [50-60) |

*Figure 6-41* Clarifying the age groups

**Note** In this example, since the rows are grouped solely based on the values in the Age column, the second input can be rewritten as text (`"Age"`) instead of as `list({"Age"})`. This means that `s` and `c` in the fifth argument are no longer records and can be referenced directly. Therefore, the formula can be rewritten as follows, producing the same result.

```
= Table.Group(
        Source,
        "Age",
      {
                    {"IDs", each Text.Combine(_[Staff ID],", ")},
                     {"Age Group", each {"","[10-20)","[20-30)","[30-40)","[4
50)","[50-60)"} {Number.IntegerDivide([Age]{0},10)}}},
      1,
       (s,c)=>Value.Compare(Number.IntegerDivide(s,10),Number.IntegerDivide(c
```

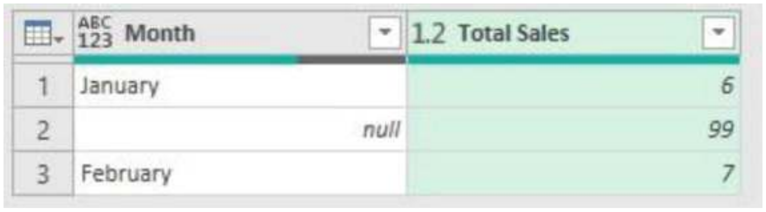
As in the previous example of `Table.Group()`, this one also runs 10,000 rows in less than a second.

## Using the Fifth Input in Table.Group() Based on One Value

Consider the first example of this chapter and calculate the total sales per month.

**Note** The data in this example is provided in an Excel file titled `09 Using the Fifth Input in Table.Group Based on one Value.xlsx`.

In this case, if you apply the grouping directly based on the Month column, which includes null values, you will encounter the result shown in Figure 6-42.



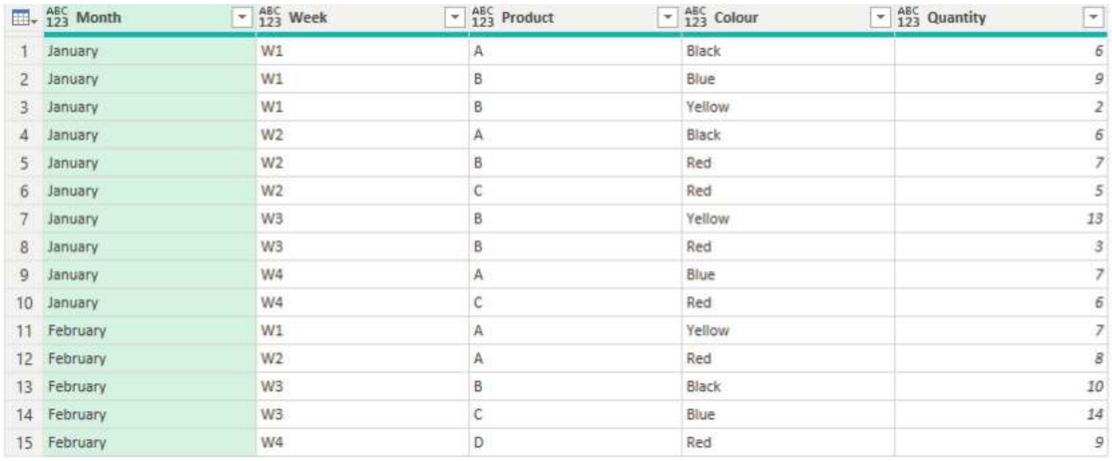
| | Month | Total Sales |
|---|---|---|
| 1 | January | 6 |
| 2 | null | 99 |
| 3 | February | 7 |

*Figure 6-42* Calculation for total sales per month

To solve this problem, you must first replace the null value and then use the Group By command, or apply the Group By command directly by using its fifth argument. Both solutions are covered in this section.

### Solution 1: Using Fill Down Followed by Table.Group()

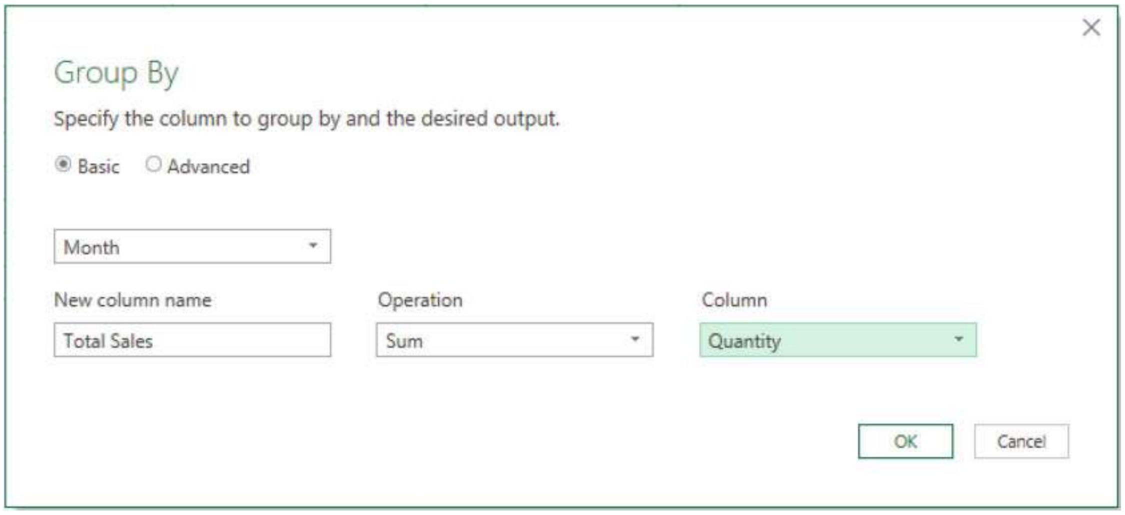
In this approach, select the Month column, then go to the Transform tab and choose the Fill Down command. This will replace any null values in the column with the value from the row above it, ensuring that each row has a valid month value. You'll see the result shown in Figure 6-43.



| | Month | Week | Product | Colour | Quantity |
|---|---|---|---|---|---|
| 1 | January | W1 | A | Black | 6 |
| 2 | January | W1 | B | Blue | 9 |
| 3 | January | W1 | B | Yellow | 2 |
| 4 | January | W2 | A | Black | 6 |
| 5 | January | W2 | B | Red | 7 |
| 6 | January | W2 | C | Red | 5 |
| 7 | January | W3 | B | Yellow | 13 |
| 8 | January | W3 | B | Red | 3 |
| 9 | January | W4 | A | Blue | 7 |
| 10 | January | W4 | C | Red | 6 |
| 11 | February | W1 | A | Yellow | 7 |
| 12 | February | W2 | A | Red | 8 |
| 13 | February | W3 | B | Black | 10 |
| 14 | February | W3 | C | Blue | 14 |
| 15 | February | W4 | D | Red | 9 |

*Figure 6-43* Using Fill Down

Now that all cells contain valid values, applying the Group By command using the settings shown in Figure 6-44 will effectively solve the problem.


Group By

Specify the column to group by and the desired output.

Basic [✓] Advanced

Month

| New column name | Operation | Column |
|---|---|---|
| Total Sales | Sum | Quantity |

***Figure 6-44*** Setting for Group By

## Solution 2: Using Table.Group() Directly

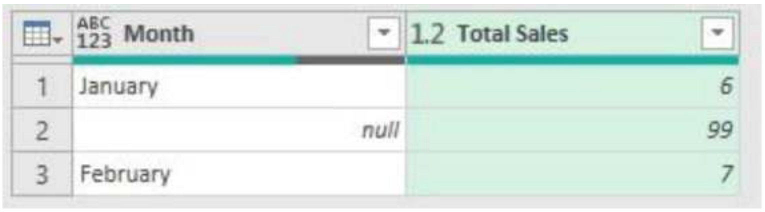
In this alternative approach, you use the fifth argument of the `Table.Group()` function.

> **Note** This solution is not recommended for this type of problem. Instead, the previous solution is a better approach. However, this method is included to help you become more familiar with the fifth argument of the `Table.Group()` function, which is used in later examples.

By examining the table, it seems like a good approach to start grouping from the first row and include all subsequent rows in the same group until encountering a row where the Month column contains a non-null value. When reaching such a row, you should close the previous group and start a new one. This is exactly what this example aims to achieve, using the fifth argument of the `Table.Group()` function.

Instead of writing all the formula manual, you'll use the UI and then modify its resulting formula. Select the Month column and apply the Group By command. Set the New column name to Total Sales. Select `Sum` as the operation and choose Quantity as the column. This will generate the following formula in the formula bar and results in Figure 6-45.

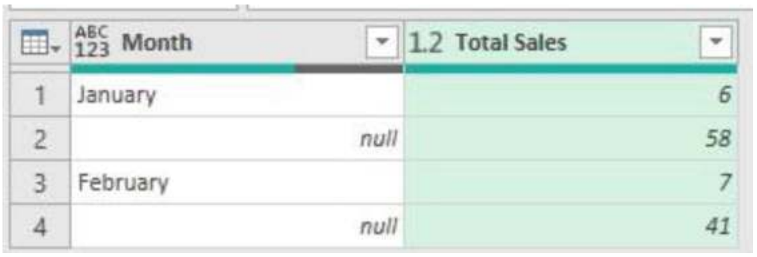
```
= Table.Group(Source, {"Month"}, {{"Total Sales", each List.Sum([Quantity]),
type number}})
```



| | Month | Total Sales |
|---|---|---|
| 1 | January | 6 |
| 2 | null | 99 |
| 3 | February | 7 |

***Figure 6-45*** Calculation for total sales per month

As you start grouping from the first row and want to group the consecutive rows, change the grouping logic to local by entering 0 as the fourth input of the previous formula. The result will change to Figure 6-46.



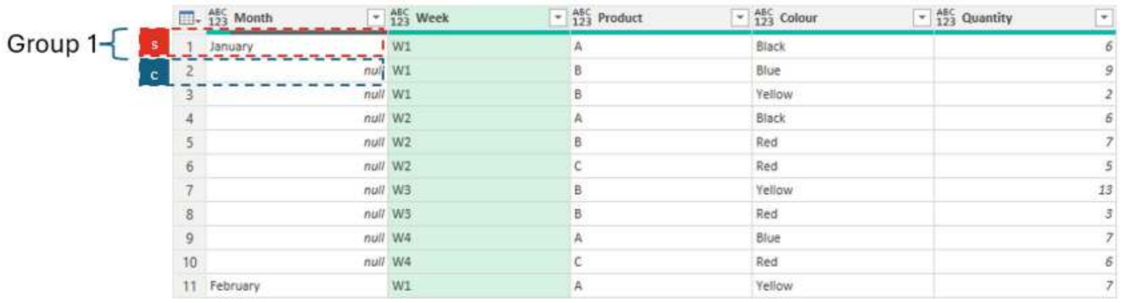
| | Month | Total Sales |
|---|---|---|
| 1 | January | 6 |
| 2 | null | 58 |
| 3 | February | 7 |
| 4 | null | 41 |

***Figure 6-46*** Changing the group kind to local

Now, you can use the fifth argument in the form of `(s, c) => f(s, c)`. In this example, since you set the fourth argument to 0 (indicating local grouping), you can define `f(s, c)` to return either `0` or `1`.

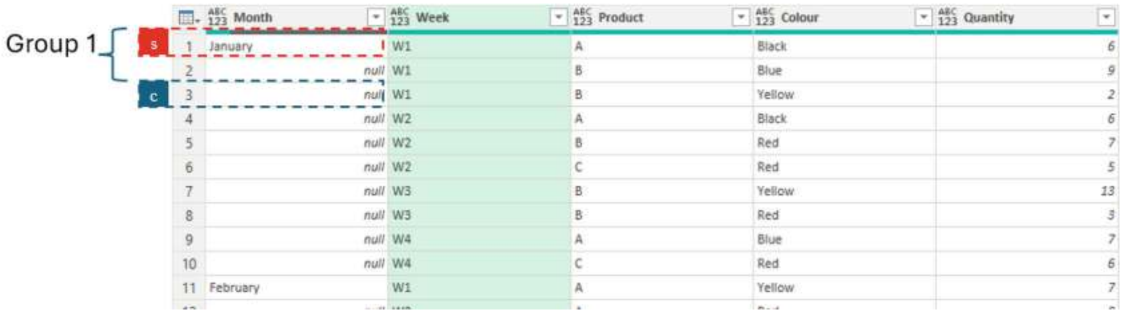
As shown in Figure 6-47, at the first step, the first row is represented by `s`, and the next row is represented by `c`. The function `f(s, c)` is then calculated.

- If `f(s, c) = 0`, the two rows are combined into the same group. For the next iteration, `s` remains fixed, and `c` moves to the next row, as illustrated in Figure 6-48.
- If `f(s, c) = 1`, the current group is closed (containing only the first row), and `s` and `c` are both updated to start a new group, as shown in Figure 6-49.



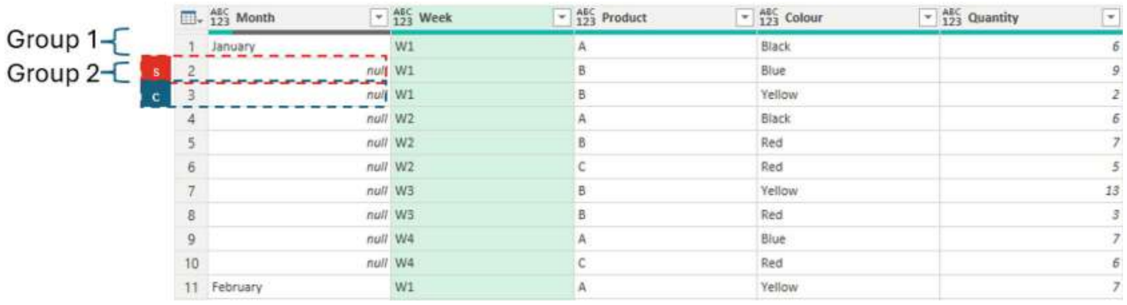
| | Month | Week | Product | Colour | Quantity |
|---|---|---|---|---|---|
| 1 | January | W1 | A | Black | 6 |
| 2 | null | W1 | B | Blue | 9 |
| 3 | null | W1 | B | Yellow | 2 |
| 4 | null | W2 | A | Black | 6 |
| 5 | null | W2 | B | Red | 7 |
| 6 | null | W2 | C | Red | 5 |
| 7 | null | W3 | B | Yellow | 13 |
| 8 | null | W3 | B | Red | 3 |
| 9 | null | W4 | A | Blue | 7 |
| 10 | null | W4 | C | Red | 6 |
| 11 | February | W1 | A | Yellow | 7 |

***Figure 6-47*** Beginning of grouping



| | Month | Week | Product | Colour | Quantity |
|---|---|---|---|---|---|
| 1 | January | W1 | A | Black | 6 |
| 2 | null | W1 | B | Blue | 9 |
| 3 | null | W1 | B | Yellow | 2 |
| 4 | null | W2 | A | Black | 6 |
| 5 | null | W2 | B | Red | 7 |
| 6 | null | W2 | C | Red | 5 |
| 7 | null | W3 | B | Yellow | 13 |
| 8 | null | W3 | B | Red | 3 |
| 9 | null | W4 | A | Blue | 7 |
| 10 | null | W4 | C | Red | 6 |
| 11 | February | W1 | A | Yellow | 7 |

***Figure 6-48*** Second iteration if f(s,c) results in 0



| | Month | Week | Product | Colour | Quantity |
|---|---|---|---|---|---|
| 1 | January | W1 | A | Black | 6 |
| 2 | null | W1 | B | Blue | 9 |
| 3 | null | W1 | B | Yellow | 2 |
| 4 | null | W2 | A | Black | 6 |
| 5 | null | W2 | B | Red | 7 |
| 6 | null | W2 | C | Red | 5 |
| 7 | null | W3 | B | Yellow | 13 |
| 8 | null | W3 | B | Red | 3 |
| 9 | null | W4 | A | Blue | 7 |
| 10 | null | W4 | C | Red | 6 |
| 11 | February | W1 | A | Yellow | 7 |

***Figure 6-49*** Second iteration if f(s,c) results in 1

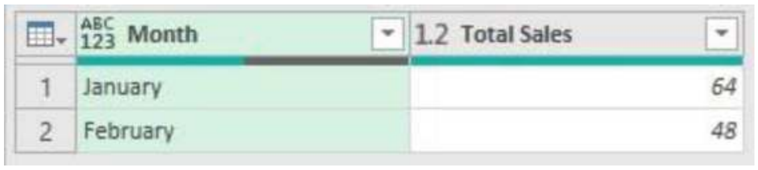
Based on this explanation, the algorithm starts from the state shown in Figure 6-47 and the first group should continue until c reaches the row corresponding to the next month (row #11). To achieve this, f(s, c) should return 0 as long as c has not yet reached a row where the Month column contains a non-null value. In other words, grouping should continue until c[Month] <> null.

However, since f(s, c) must return 0 (to continue grouping) or 1 (to stop the current group and create a new one), you need to convert the Boolean expression c[Month] <> null, which evaluates to true or false, into a numeric value.

To achieve this conversion, you can use the Number.From() function by rewriting the formula as Number.From(c[Month] <> null), converting true to 1 and false to 0.

As you determined the f(s,c) is Number.From(c[Month] <> null), the Table.Group() formula can be rewritten as the following formula, which solves the problem and results in Figure 6-50:

```
= Table.Group(Source,
      {"Month"},
      {{"Total Sales", each List.Sum([Quantity]) }},
      0,
       (s,c)=>Number.From(c[Month]<>null))
```



|  | Month | Total Sales |
|---|---|---|
| 1 | January | 64 |
| 2 | February | 48 |

***Figure 6-50*** Using the fifth argument

**Note** Based on the explanation in the previous example, as you use just a column for grouping, instead of writing its name as a {"Month"} list in the second argument, you can write it as "Month" text. By doing this, s and c are not in type record anymore and they are simply text. The formula can be also rewritten as follows, which leads to the same results:

```
= Table.Group(Source,
      "Month",
      {{"Total Sales", each List.Sum([Quantity]) }},
      0,
      (s,c)=>Number.From(c[Month<>,null))
```

On the other hand, you can also use Value.Comparer() in this formula.

```
= Table.Group(Source,
      "Month",
      {{"Total Sales", each List.Sum([Quantity]) }},
      0,
      (s,c)=>Value.Compare(y,null))
```

## Transforming Tables

Consider the Source table, which includes the customer information shown in Table 6-9. For each customer, their data—name, family, phone, and website—is provided across four rows. Transform this table so that each customer has a single row with four columns: Name, Family, Phone, and Website.

***Table 6-9*** Source: Customer info

| Info | Info2 |
|---|---|
| Name | John |

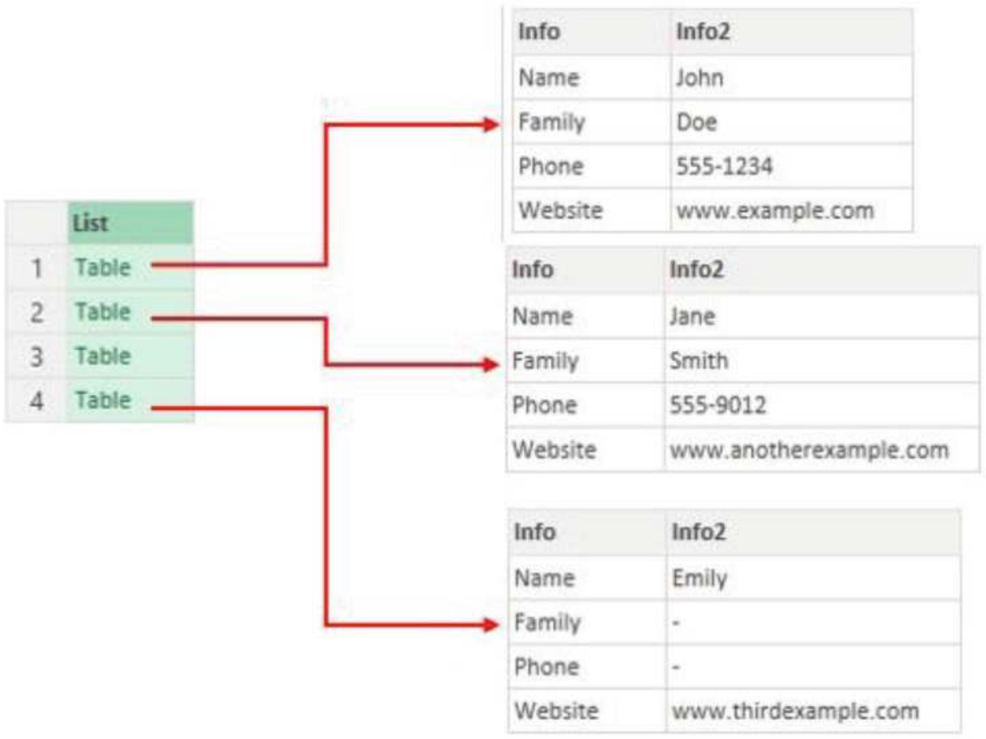
| Info | Info2 |
|---|---|
| Family | Doe |
| Phone | 555-1234 |
| Website | www.example.com |
| Name | Jane |
| Family | Smith |
| Phone | 555-9012 |
| Website | www.anotherexample.com |
| Name | Alex |
| Family | Johnson |
| Phone | - |
| Website | WWW.ThirdExample.Com |
| Name | Emily |
| Family | - |
| Phone | - |
| Website | www.thirdexample.com |

**Note** The data in this example is provided in an Excel file titled `10 Table Transformations .xlsx`.

In this question, four rows are provided per customer, so you can use the `Table.Split()` function to split the Source table into multiple smaller tables, with each table containing the information for one customer. Each sub-table will include four rows (name, family, phone, and website). On the formula bar, click *fx* and write the following formula in it:

```
= Table.Split(Source,4)
```

This will result in a list containing four items, as shown in Figure 6-51.



| | List |
|---|---|
| 1 | Table |
| 2 | Table |
| 3 | Table |
| 4 | Table |

| Info | Info2 |
|---|---|
| Name | John |
| Family | Doe |
| Phone | 555-1234 |
| Website | www.example.com |

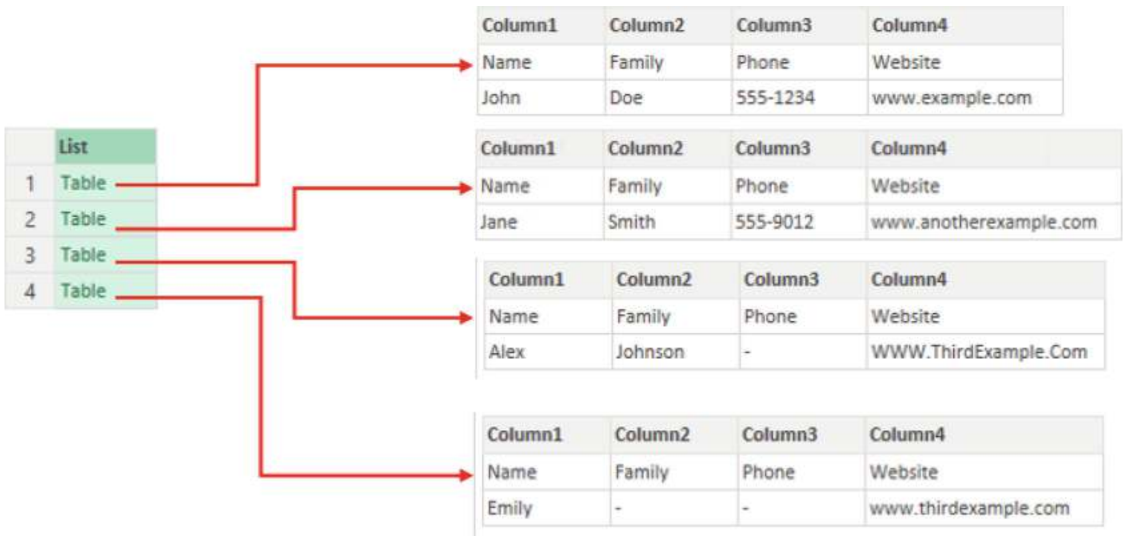
| Info | Info2 |
|---|---|
| Name | Jane |
| Family | Smith |
| Phone | 555-9012 |
| Website | www.anotherexample.com |

| Info | Info2 |
|---|---|
| Name | Emily |
| Family | - |
| Phone | - |
| Website | www.thirdexample.com |

*Figure 6-51* The result of Table.Split()

The previous step results in a list, including four sublists. Each sublist includes a table for the information of a customer. It would be a good idea to transpose every single in each sublist. To modify items in a list, you can use `List.Transform()`. Rewriting the previous formula as the following achieves the desired result, as shown in Figure 6-52:

```
= List.Transform(Table.Split(Source,4),
        each Table.Transpose(_))
```



| | List |
|---|---|
| 1 | Table |
| 2 | Table |
| 3 | Table |
| 4 | Table |

| Column1 | Column2 | Column3 | Column4 |
|---|---|---|---|
| Name | Family | Phone | Website |
| John | Doe | 555-1234 | www.example.com |

| Column1 | Column2 | Column3 | Column4 |
|---|---|---|---|
| Name | Family | Phone | Website |
| Jane | Smith | 555-9012 | www.anotherexample.com |

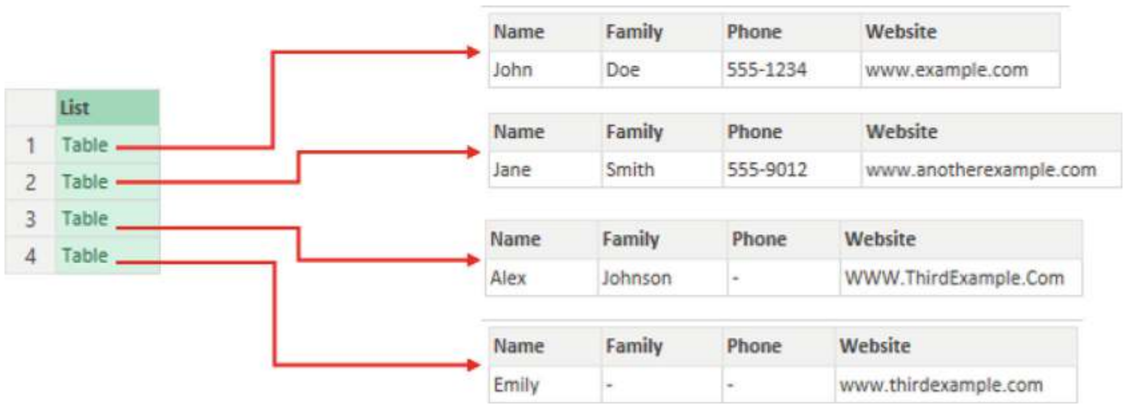
| Column1 | Column2 | Column3 | Column4 |
|---|---|---|---|
| Name | Family | Phone | Website |
| Alex | Johnson | - | WWW.ThirdExample.Com |

| Column1 | Column2 | Column3 | Column4 |
|---|---|---|---|
| Name | Family | Phone | Website |
| Emily | - | - | www.thirdexample.com |

*Figure 6-52* The result of List.Transform()

In the previous formula, all tables are transposed, but in addition to transposing them, you also need to promote the first row of the resulting tables as headers. These two tasks can be combined into a single step by modifying the previous formula as follows, ensuring that the first row of each transposed table is promoted to a header. The result is shown in Figure 6-53.

```
= List.Transform(Table.Split(Source,4),
        each Table.PromoteHeaders(Table.Transpose(_)))
```



| | List |
|---|---|
| 1 | Table |
| 2 | Table |
| 3 | Table |
| 4 | Table |

| Name | Family | Phone | Website |
|---|---|---|---|
| John | Doe | 555-1234 | www.example.com |

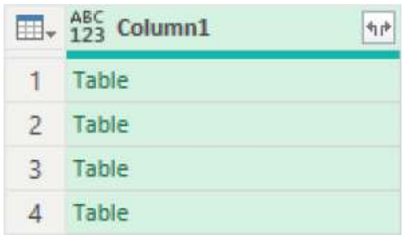
| Name | Family | Phone | Website |
|---|---|---|---|
| Jane | Smith | 555-9012 | www.anotherexample.com |

| Name | Family | Phone | Website |
|---|---|---|---|
| Alex | Johnson | - | WWW.ThirdExample.Com |

| Name | Family | Phone | Website |
|---|---|---|---|
| Emily | - | - | www.thirdexample.com |

*Figure 6-53* The result of promoting the headers after transformation

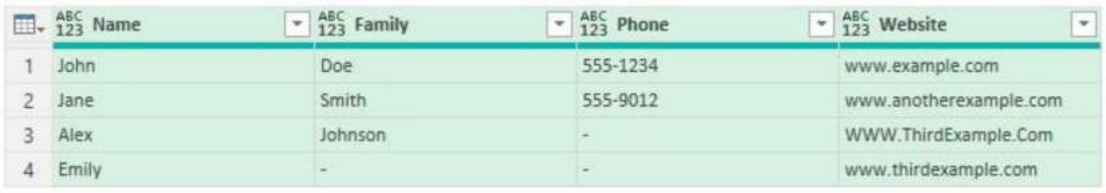
Now it is time to convert the results into a table. You do this by selecting the To Table command from the Transform tab. This step converts the list into a structured table, leading to the final result shown in Figure 6-54.



| | Column1 |
|---|---|
| 1 | Table |
| 2 | Table |
| 3 | Table |
| 4 | Table |

***Figure 6-54*** Converting the result into a table

In the next step, expand column 1 to combine the promoted sub-tables into a single table with the desired format. This will result in a table where each row represents a customer, and the columns include name, family, phone, and website, as shown in Figure 6-55.



| | Name | Family | Phone | Website |
|---|---|---|---|---|
| 1 | John | Doe | 555-1234 | www.example.com |
| 2 | Jane | Smith | 555-9012 | www.anotherexample.com |
| 3 | Alex | Johnson | - | WWW.ThirdExample.Com |
| 4 | Emily | - | - | www.thirdexample.com |

***Figure 6-55*** Expanding column 1

**Note** Instead of using the `List.Transform()` function to solve this problem, you can use the `Table.FromList()` function, as shown in the following formula. The key difference is that `Table.FromList()` returns a table (instead of a list), and it allows you to add multiple columns to the resulting table in a single step.

```
=Table.FromList(
    Table.Split(Source,4),
    each {Table.PromoteHeaders(Table.Transpose(_))})
```

## Transforming Tables Within Table.Group()

Transform the Source table, provided in Table 6-10, into a new format with four columns: Name, Family, Phone, and Website. Ensure that each customer's information is organized into a single row. Note that the row related to each new customer starts with the attribute related to Name.

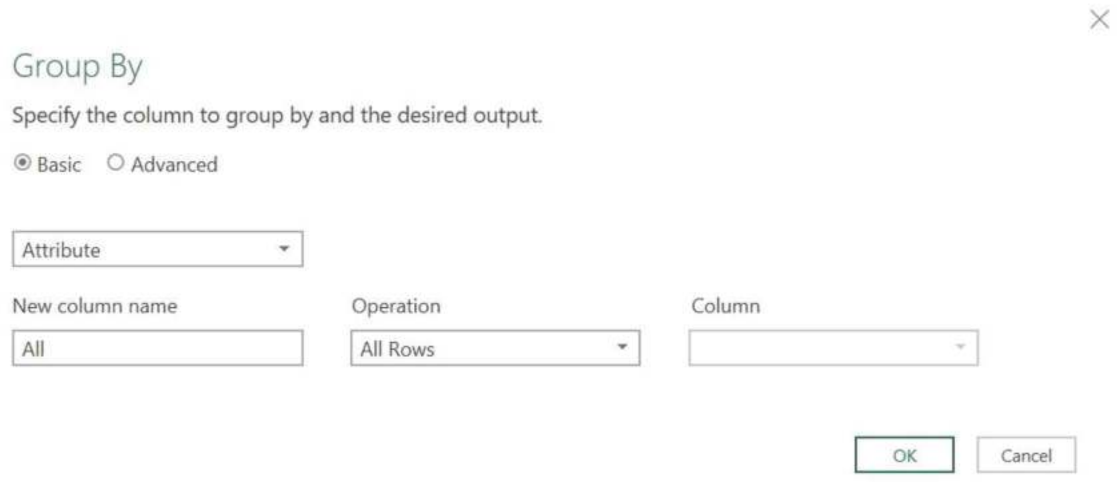
***Table 6-10*** Source: People Info

| Attribute | Value |
|---|---|
| Name | John |
| Family | Doe |
| Phone | 555-1234 |
| Website | www.example.com |
| Name | Jane |
| Family | Smith |
| Phone | 555-5678 |
| Website | www.anotherexample.com |
| Name | Alex |
| Family | Johnson |
| Name | Emily |
| Website | www.thirdexample.com |

**Note** The data in this example is provided in an Excel file titled `11 Transformations within Table.Group().xlsx`.

This table is similar to the one presented in the previous question, with the key difference being that there is no fixed number of rows for each customer. As a result, you cannot use `Table.Split()` to separate the information for each customer. Therefore, you need to find an alternative solution to handle this dynamic grouping.

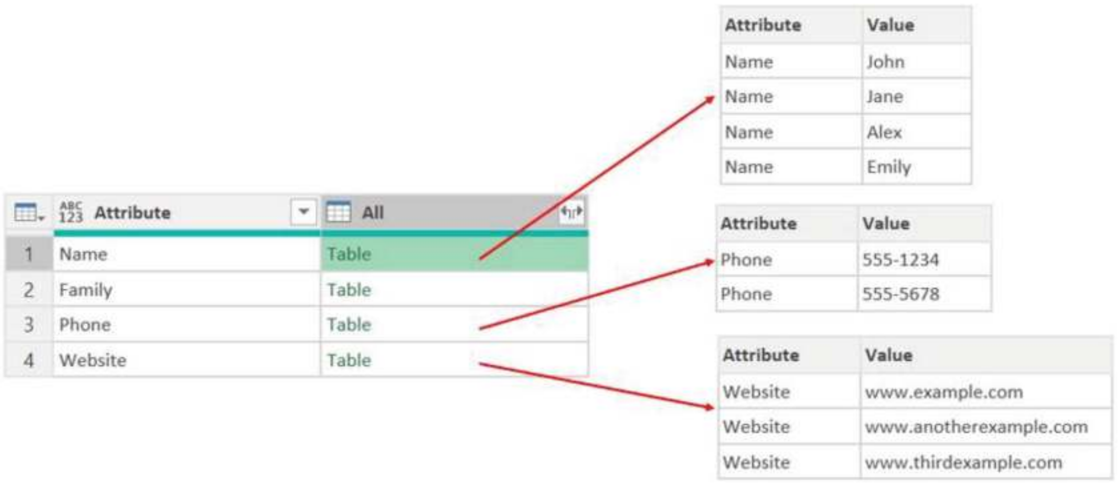
Since the row of each customer starts with the Name field, you can use the fifth argument in the `Table.Group()` function to separate the rows related each customer and solve this problem. To solve this problem, group the table rows based on the Attribute column using the settings provided in Figure 6-56. This will result in Figure 6-57.



Group by: Attribute

| New column name | Operation | Column |
|---|---|---|
| All | All Rows | |

*Figure 6-56* Grouping settings



| | Attribute | All |
|---|---|---|
| 1 | Name | Table |
| 2 | Family | Table |
| 3 | Phone | Table |
| 4 | Website | Table |

| Attribute | Value |
|---|---|
| Name | John |
| Name | Jane |
| Name | Alex |
| Name | Emily |

| Attribute | Value |
|---|---|
| Phone | 555-1234 |
| Phone | 555-5678 |

| Attribute | Value |
|---|---|
| Website | www.example.com |
| Website | www.anotherexample.com |
| Website | www.thirdexample.com |

*Figure 6-57* The result of grouping

The initial step generates the following formula in the formula bar:

```
= Table.Group(Source, {"Attribute"}, {{"All", each _, type table
[Attribute=text, Value=text]}})
```

That formula can be simplified to the following one:

```
= Table.Group(Source, {"Attribute"}, {"All", each _})
```

Similar to Example 6-7, in this case, grouping will start from the first row and continue until a row with a value of Name in the Attribute column is reached. In the previous formula, enter the fourth argument as `0`. To define the fifth argument in the format `(s, c) => f(s, c)`, `s` initially represents the first row, and c represents the second row, as the first and second row are related to the same customer—in this case `f(s,c)` should result in `0` to continue grouping.

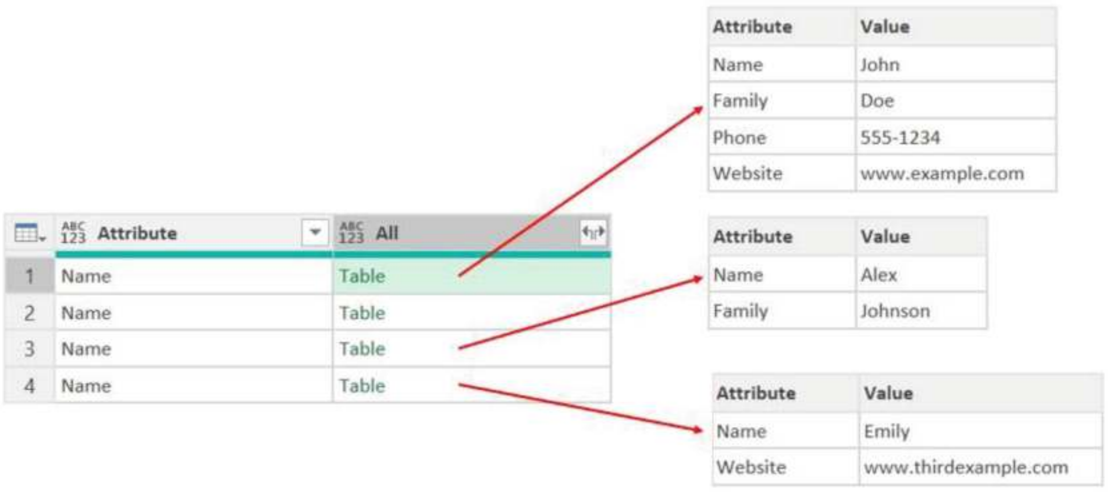
In the next iteration, `s` still represents the first row of the table, and `c` represents the third row, which is still related to the information of the first customer. Therefore, `f(s, c)` should return `0`.

The `f(s, c)` should continue to return `0` for the next rows until `c` represents the fifth row, which is related to the next customer. At this point, `f(s, c)` should return `1`, as it encounters the Name value in the Attribute column, signaling the start of a new group. The first group should continue until `s[Attribute]="Name"`.

In another word, to extract all the information about the first customer, `f(s, c)` should return `0`. That indicates that the grouping should continue until a row with the Name value in the Attribute column is encountered. At that point, the grouping should stop, and a new group can be created. The criteria for closing this group for a customer and creating a new group for the next customer can be defined as `c[Attribute]="Name"`.

Based on this explanation, use the `(s,c)=>Number.From(c[Attribute]="Name")` formula as the comparer in the fifth argument of the previous formula, as shown in the following formula. This results in Figure 6-58.

```
= Table.Group(
      Source,
      {"Attribute"},
      {"All", each _},
      0,
       (s,c)=>Number.From(c[Attribute]="Name"))
```



| | Attribute | All |
|---|---|---|
| 1 | Name | Table |
| 2 | Name | Table |
| 3 | Name | Table |
| 4 | Name | Table |

| Attribute | Value |
|---|---|
| Name | John |
| Family | Doe |
| Phone | 555-1234 |
| Website | www.example.com |

| Attribute | Value |
|---|---|
| Name | Alex |
| Family | Johnson |

| Attribute | Value |
|---|---|
| Name | Emily |
| Website | www.thirdexample.com |

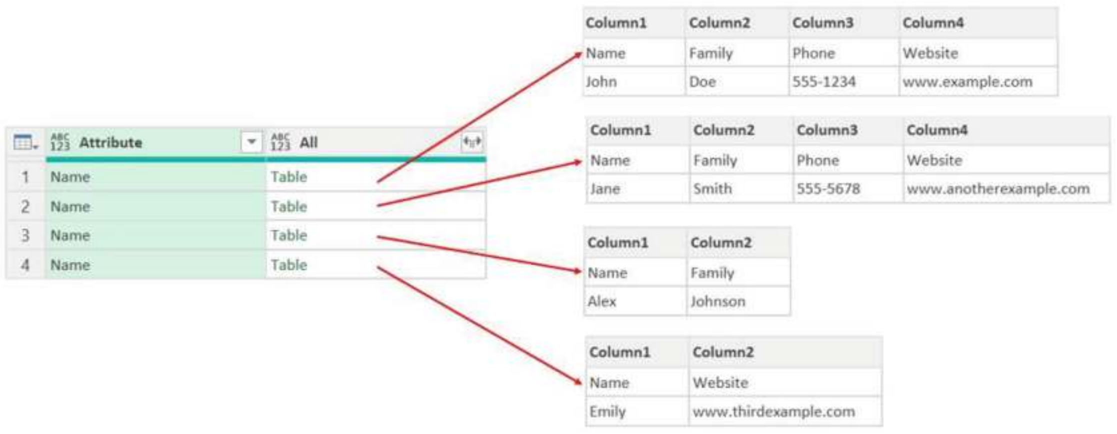
***Figure 6-58*** The result of grouping

Now the information of each customer is separated, and to transform its information into the right shape, you can use some functions similar to the ones used in the previous example.

In the previous formula, the second argument for the All column is defined as `each _`, which results in the information of each customer in a table. To transpose the values within each table in the All column, you can use the `Table.Transpose()` function and rewrite the formula as follows:

```
= Table.Group(5
      Source,
      {"Attribute"},
      {"All", each Table.Transpose(_)},
      0,
       (s,c)=>Number.From(c[Attribute]="Name")
```

This will transpose the values in each table within the All column, resulting in Figure 6-59.



| | Attribute | All |
|---|---|---|
| 1 | Name | Table |
| 2 | Name | Table |
| 3 | Name | Table |
| 4 | Name | Table |

| Column1 | Column2 | Column3 | Column4 |
|---|---|---|---|
| Name | Family | Phone | Website |
| John | Doe | 555-1234 | www.example.com |

| Column1 | Column2 | Column3 | Column4 |
|---|---|---|---|
| Name | Family | Phone | Website |
| Jane | Smith | 555-5678 | www.anotherexample.com |

| Column1 | Column2 |
|---|---|
| Name | Family |
| Alex | Johnson |

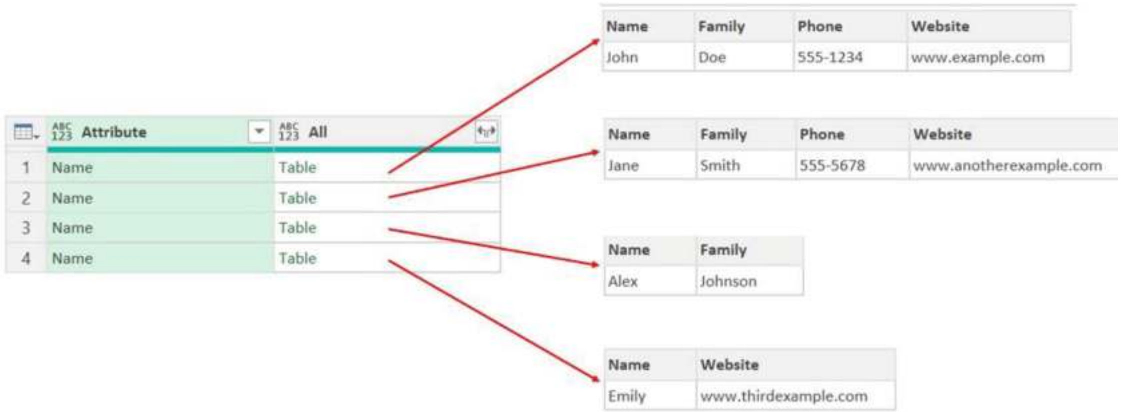
| Column1 | Column2 |
|---|---|
| Name | Website |
| Emily | www.thirdexample.com |

***Figure 6-59*** The result of adding Table.Transpose()

Based on the result, each sub-table includes two rows: one for the headers and one for the values. To promote the first row to headers and use the second row as values, add the `Table.PromoteHeaders()` function to the previous formula and rewrite it:

```
= Table.Group(
        Source,
        {"Attribute"},
        {"All", each Table.PromoteHeaders(Table.Transpose(_))},
        0,
         (s,c)=>Number.From(c[Attribute]="Name")
```

This will promote the first row to headers and keep the second row as values, resulting in Figure 6-60.



| | Attribute | All |
|---|---|---|
| 1 | Name | Table |
| 2 | Name | Table |
| 3 | Name | Table |
| 4 | Name | Table |

| Name | Family | Phone | Website |
|---|---|---|---|
| John | Doe | 555-1234 | www.example.com |

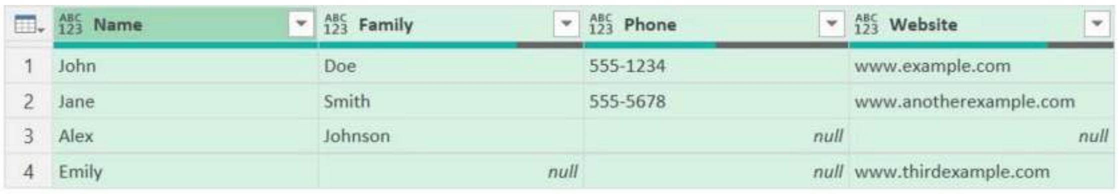
| Name | Family | Phone | Website |
|---|---|---|---|
| Jane | Smith | 555-5678 | www.anotherexample.com |

| Name | Family |
|---|---|
| Alex | Johnson |

| Name | Website |
|---|---|
| Emily | www.thirdexample.com |

***Figure 6-60*** The result of permuting headers in sub-tables

The problem is almost solved. To finalize the transformation, delete the Attribute column and expand the All column. This will result in Figure 6-61.



|  | Name | Family | Phone | Website |
|---|---|---|---|---|
| 1 | John | Doe | 555-1234 | www.example.com |
| 2 | Jane | Smith | 555-5678 | www.anotherexample.com |
| 3 | Alex | Johnson | null | null |
| 4 | Emily | null | null | www.thirdexample.com |

***Figure 6-61*** The final result

## Grouping Consecutive Dates

Consider the sales data shown in Table 6-11. Group all consecutive dates and provide a report of total sales for each group of consecutive dates. Note by loading this data into the Power Query, the values in the column Date use the `DateTime` type.

***Table 6-11*** Source: Historical Sales

| Date | Quantity |
|---|---|
| 25/06/2024 | 84 |
| 26/06/2024 | 23 |
| 27/06/2024 | 87 |
| 28/06/2024 | 26 |
| 30/06/2024 | 67 |
| 2/07/2024 | 42 |
| 3/07/2024 | 40 |
| 4/07/2024 | 14 |
| 5/07/2024 | 69 |
| 6/07/2024 | 32 |
| 7/07/2024 | 44 |
| 8/07/2024 | 56 |
| 9/07/2024 | 25 |
| 11/07/2024 | 15 |
| 12/07/2024 | 84 |
| 13/07/2024 | 25 |
| 14/07/2024 | 46 |
| 15/07/2024 | 38 |
| 17/07/2024 | 45 |
| 18/07/2024 | 76 |
| 19/07/2024 | 44 |

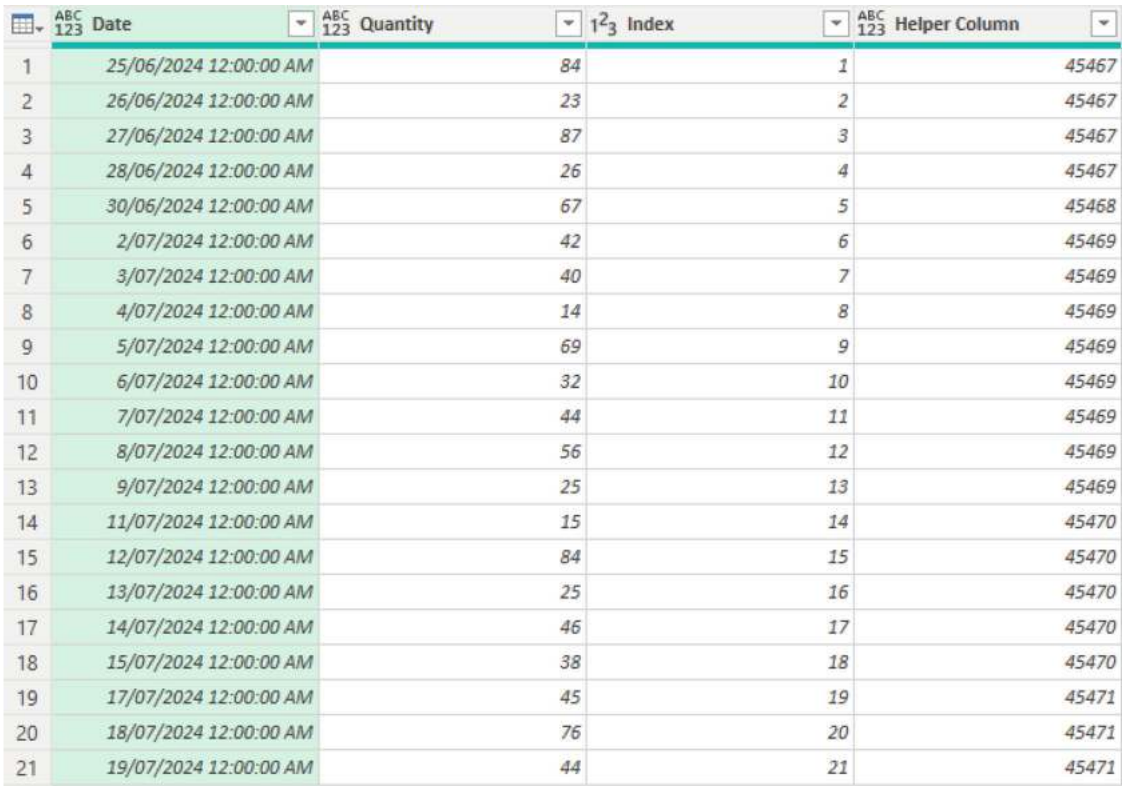
**Note** The data in this example is provided in an Excel file titled `12 Grouping Consecutive Dates.xlsx`.

Two different solutions are provided for this problem: one using a helper column and one without it.

### Solution 1: Using a Helper Column

In the first solution, you add an index column starting at 1. Then add a Custom Column called Helper Column, using the following formula in the Custom Column window to achieve Figure 6-62.

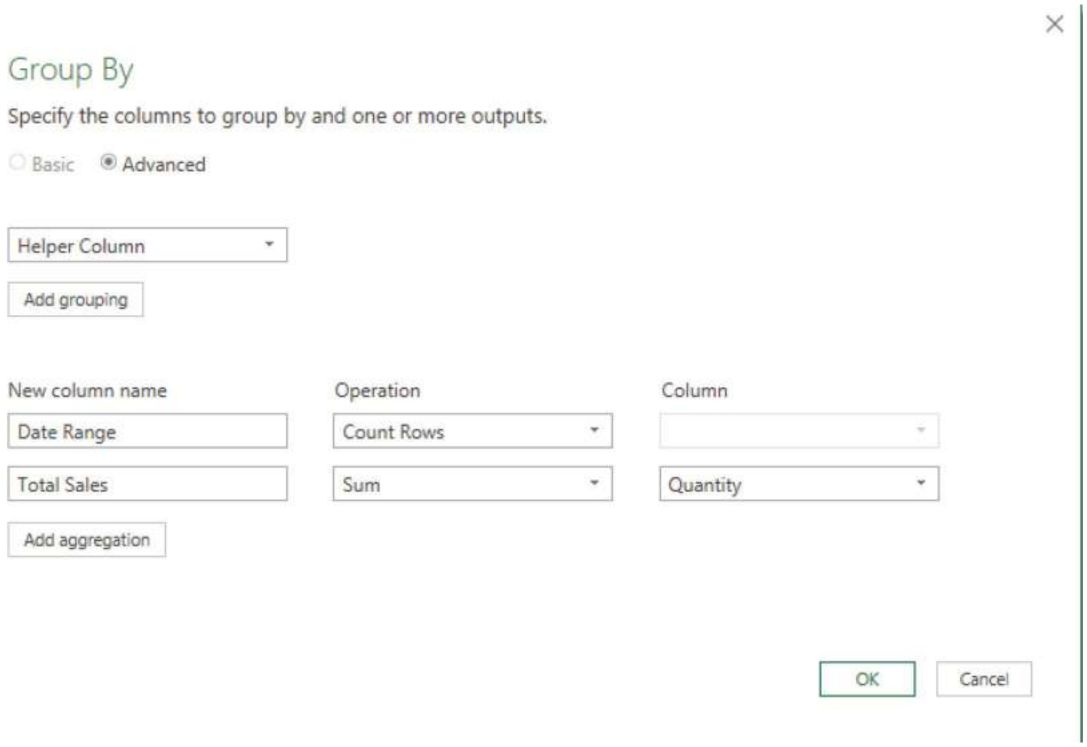
```
=Number.From([Date])-[Index]
```



| | Date | Quantity | Index | Helper Column |
|---|---|---|---|---|
| 1 | 25/06/2024 12:00:00 AM | 84 | 1 | 45467 |
| 2 | 26/06/2024 12:00:00 AM | 23 | 2 | 45467 |
| 3 | 27/06/2024 12:00:00 AM | 87 | 3 | 45467 |
| 4 | 28/06/2024 12:00:00 AM | 26 | 4 | 45467 |
| 5 | 30/06/2024 12:00:00 AM | 67 | 5 | 45468 |
| 6 | 2/07/2024 12:00:00 AM | 42 | 6 | 45469 |
| 7 | 3/07/2024 12:00:00 AM | 40 | 7 | 45469 |
| 8 | 4/07/2024 12:00:00 AM | 14 | 8 | 45469 |
| 9 | 5/07/2024 12:00:00 AM | 69 | 9 | 45469 |
| 10 | 6/07/2024 12:00:00 AM | 32 | 10 | 45469 |
| 11 | 7/07/2024 12:00:00 AM | 44 | 11 | 45469 |
| 12 | 8/07/2024 12:00:00 AM | 56 | 12 | 45469 |
| 13 | 9/07/2024 12:00:00 AM | 25 | 13 | 45469 |
| 14 | 11/07/2024 12:00:00 AM | 15 | 14 | 45470 |
| 15 | 12/07/2024 12:00:00 AM | 84 | 15 | 45470 |
| 16 | 13/07/2024 12:00:00 AM | 25 | 16 | 45470 |
| 17 | 14/07/2024 12:00:00 AM | 46 | 17 | 45470 |
| 18 | 15/07/2024 12:00:00 AM | 38 | 18 | 45470 |
| 19 | 17/07/2024 12:00:00 AM | 45 | 19 | 45471 |
| 20 | 18/07/2024 12:00:00 AM | 76 | 20 | 45471 |
| 21 | 19/07/2024 12:00:00 AM | 44 | 21 | 45471 |

***Figure 6-62*** The result of adding the custom column

The helper column for consecutive dates contains the same value for each group of consecutive dates, and you can use this column to group the rows. Select this column, right-click it, and apply the settings shown in Figure 6-63. When you click OK, you'll get Figure 6-64.



Group By

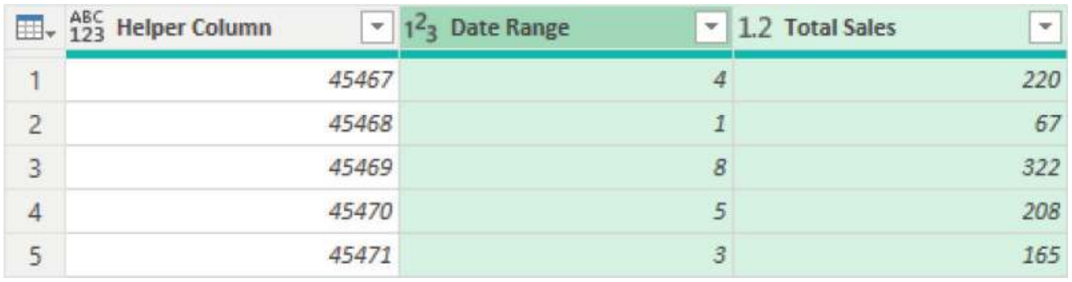
Specify the columns to group by and one or more outputs.

Basic [✓ Advanced]

Helper Column

| New column name | Operation | Column |
|---|---|---|
| Date Range | Count Rows | |
| Total Sales | Sum | Quantity |

***Figure 6-63*** Settings for Table.Group()



| | Helper Column | Date Range | Total Sales |
|---|---|---|---|
| 1 | 45467 | 4 | 220 |
| 2 | 45468 | 1 | 67 |
| 3 | 45469 | 8 | 322 |
| 4 | 45470 | 5 | 208 |
| 5 | 45471 | 3 | 165 |

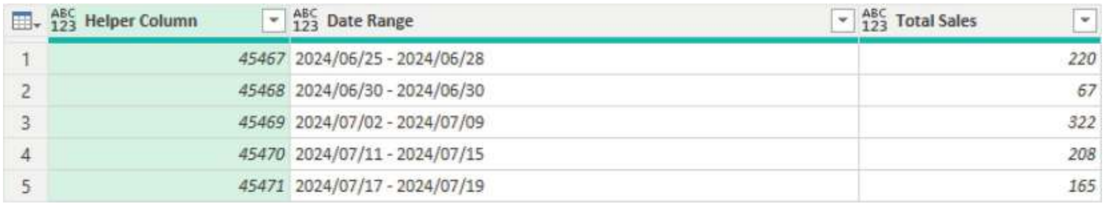
***Figure 6-64*** The result of grouping

The previous step leads to the following simplified formula:

```
= Table.Group(
      #"Added Custom",
      {"Helper Column"},
      {{"Date Range", each Table.RowCount(_)},
      {"Total Sales", each List.Sum([Quantity])}})
```

At this step, the values in the Date Range column are calculated using `Table.RowCount(_)`, which returns the number of rows for each group of consecutive dates. To replace these values with the actual date range, modify this part of the formula with the following updated formula. This will result in Figure 6-65, and by removing the helper column, the problem will be solved.

```
each DateTime.ToText(List.First(_[Date]),"yyyy/MM/dd") & " - " &
DateTime.ToText(List.Last(_[Date]),"yyyy/MM/dd")
```



| | Helper Column | Date Range | Total Sales |
|---|---|---|---|
| 1 | 45467 | 2024/06/25 - 2024/06/28 | 220 |
| 2 | 45468 | 2024/06/30 - 2024/06/30 | 67 |
| 3 | 45469 | 2024/07/02 - 2024/07/09 | 322 |
| 4 | 45470 | 2024/07/11 - 2024/07/15 | 208 |
| 5 | 45471 | 2024/07/17 - 2024/07/19 | 165 |

***Figure 6-65*** The final result of grouping

## Solution 2: Using the Fifth Argument

Although I recommend using the previous solution for similar problems, the problem can also be solved without using a helper column. To do so, you need to identify from which row a new group should be created.

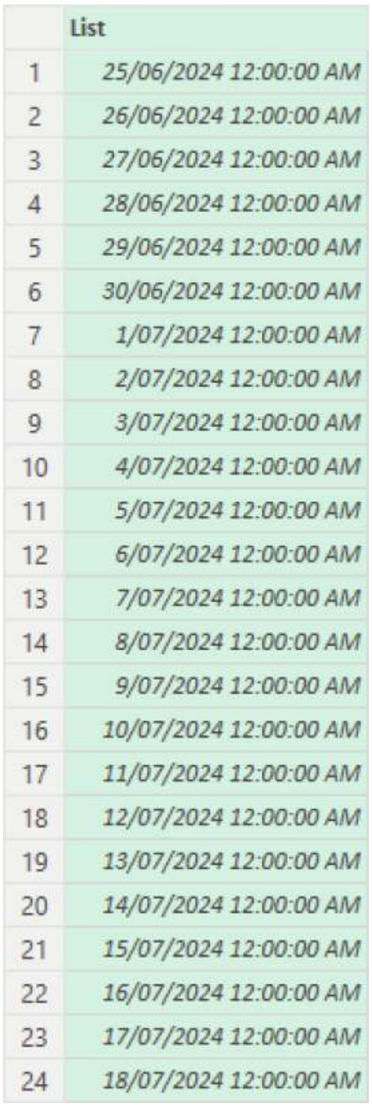
By examining the data, it is clear that the first group starts at the first row and continues until the fifth row. However, the fifth row does not belong to the first group, as there is a gap between it and the data in the previous row. In other words, the table does not include the date related to the previous day of 2024/06/30.

Therefore, for each date, if the table does not include the date that corresponds to the previous day, a new grouping should begin. To solve this problem, you initially need to determine which dates aren't mentioned in the table.

To extract missing dates, you first need to determine all the dates within the surveyed period. You can use `List.Min(Source[Date]), List.Max(Source[Date])`, and `Duration.Days(List.Max(Source[Date])-List.Min(Source[Date]))`, respectively, to extract minimum date, maximum date, and duration between the minimum and maximum date.

After clicking *fx* in the formula bar, write the following formula to list all the dates within the surveyed period, as shown in Figure 6-66.

```
= List.DateTimes(
  List.Min(Source[Date]),
  Duration.Days(List.Max(Source[Date]) - List.Min(Source[Date])),
  #duration(1, 0, 0, 0)
)
```

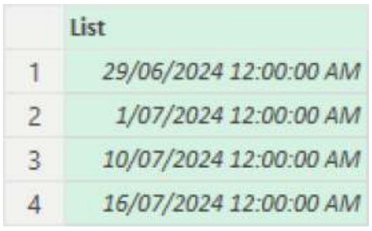


|  | List |
|---|---|
| 1 | 25/06/2024 12:00:00 AM |
| 2 | 26/06/2024 12:00:00 AM |
| 3 | 27/06/2024 12:00:00 AM |
| 4 | 28/06/2024 12:00:00 AM |
| 5 | 29/06/2024 12:00:00 AM |
| 6 | 30/06/2024 12:00:00 AM |
| 7 | 1/07/2024 12:00:00 AM |
| 8 | 2/07/2024 12:00:00 AM |
| 9 | 3/07/2024 12:00:00 AM |
| 10 | 4/07/2024 12:00:00 AM |
| 11 | 5/07/2024 12:00:00 AM |
| 12 | 6/07/2024 12:00:00 AM |
| 13 | 7/07/2024 12:00:00 AM |
| 14 | 8/07/2024 12:00:00 AM |
| 15 | 9/07/2024 12:00:00 AM |
| 16 | 10/07/2024 12:00:00 AM |
| 17 | 11/07/2024 12:00:00 AM |
| 18 | 12/07/2024 12:00:00 AM |
| 19 | 13/07/2024 12:00:00 AM |
| 20 | 14/07/2024 12:00:00 AM |
| 21 | 15/07/2024 12:00:00 AM |
| 22 | 16/07/2024 12:00:00 AM |
| 23 | 17/07/2024 12:00:00 AM |
| 24 | 18/07/2024 12:00:00 AM |

***Figure 6-66*** List of all the dates and times

To extract the missing dates, rewrite the previous formula using the following updated version, which results in Figure 6-67.

```
=List.Difference(
  List.DateTimes(
    List.Min(Source[Date]),
    Duration.Days(List.Max(Source[Date]) - List.Min(Source[Date])),
    #duration(1, 0, 0, 0)
  ),
  Source[Date]
)
```

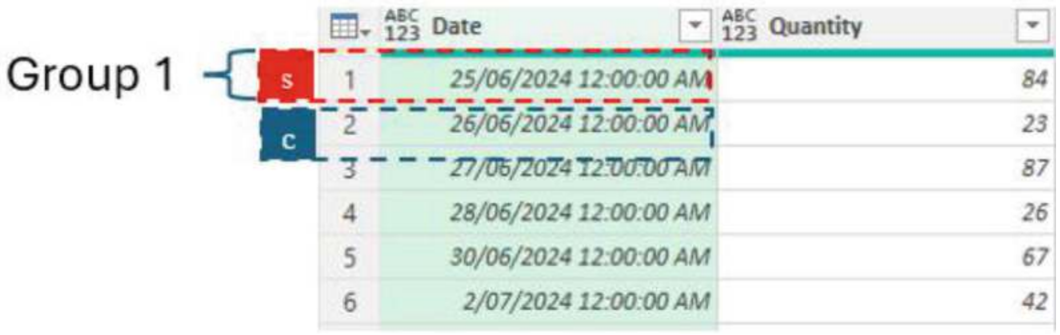


|  | List |
|---|---|
| 1 | 29/06/2024 12:00:00 AM |
| 2 | 1/07/2024 12:00:00 AM |
| 3 | 10/07/2024 12:00:00 AM |
| 4 | 16/07/2024 12:00:00 AM |

*Figure 6-67* Extracting the missing dates

Let's call the list resulting from the previous formula `MissingDates` and define the custom comparer as `(s, c) => f(s, c)`, which works as follows.

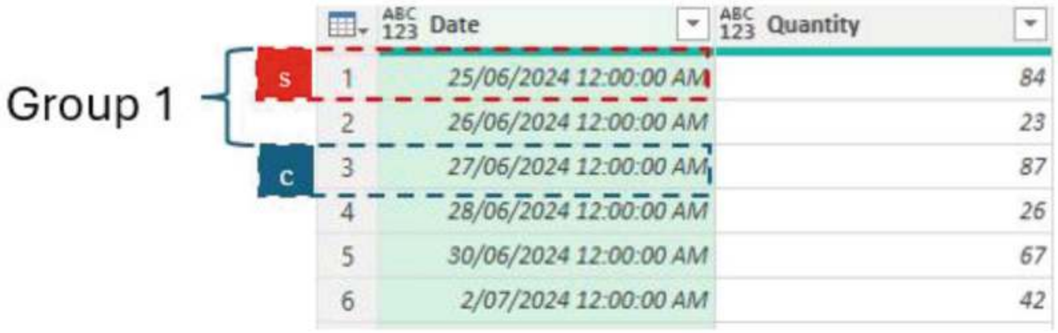
As shown in Figure 6-68, s initially represents the first row, and `c` represents the second row. Since `MissingDates` does not include the day before the date in the second row (represented by `c`), `f(s, c)` should return `0`, meaning that the second row becomes part of the first group.



|  | Date | Quantity |
|---|---|---|
| 1 | 25/06/2024 12:00:00 AM | 84 |
| 2 | 26/06/2024 12:00:00 AM | 23 |
| 3 | 27/06/2024 12:00:00 AM | 87 |
| 4 | 28/06/2024 12:00:00 AM | 26 |
| 5 | 30/06/2024 12:00:00 AM | 67 |
| 6 | 2/07/2024 12:00:00 AM | 42 |

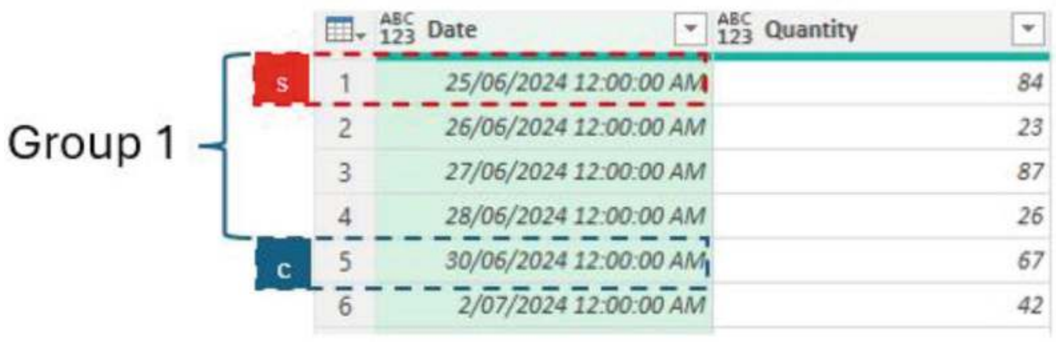
*Figure 6-68* Beginning of grouping

Then, as shown in Figure 6-69, in the next iteration, `c` represents the third row. Again, as `MissingDates` does not include the day before the date represented by `c`, `f(s, c)` should return `0`. This process continues until `c` reaches the fifth row, as shown in Figure 6-70. At this point, the date in `c` is 30/06/2024 12:00:00 AM. One day before this date is 29/06/2024 12:00:00 AM, which is in the `MissingDates` list. So, here, `f(s, c)` should return `1`, signaling the closure of the first group and the start of the next group. See Figure 6-71.



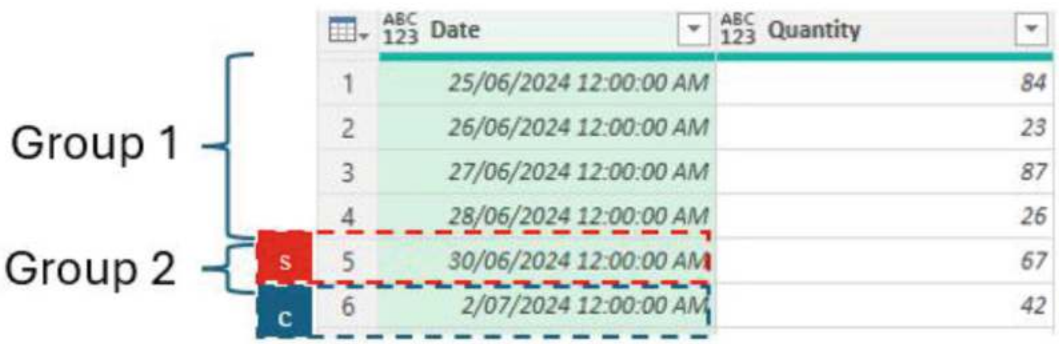
|  | Date | Quantity |
|---|---|---|
| 1 | 25/06/2024 12:00:00 AM | 84 |
| 2 | 26/06/2024 12:00:00 AM | 23 |
| 3 | 27/06/2024 12:00:00 AM | 87 |
| 4 | 28/06/2024 12:00:00 AM | 26 |
| 5 | 30/06/2024 12:00:00 AM | 67 |
| 6 | 2/07/2024 12:00:00 AM | 42 |

*Figure 6-69* Second iteration of the grouping



| | Date | Quantity |
|---|---|---|
| 1 | 25/06/2024 12:00:00 AM | 84 |
| 2 | 26/06/2024 12:00:00 AM | 23 |
| 3 | 27/06/2024 12:00:00 AM | 87 |
| 4 | 28/06/2024 12:00:00 AM | 26 |
| 5 | 30/06/2024 12:00:00 AM | 67 |
| 6 | 2/07/2024 12:00:00 AM | 42 |

***Figure 6-70*** Fourth iteration of the grouping



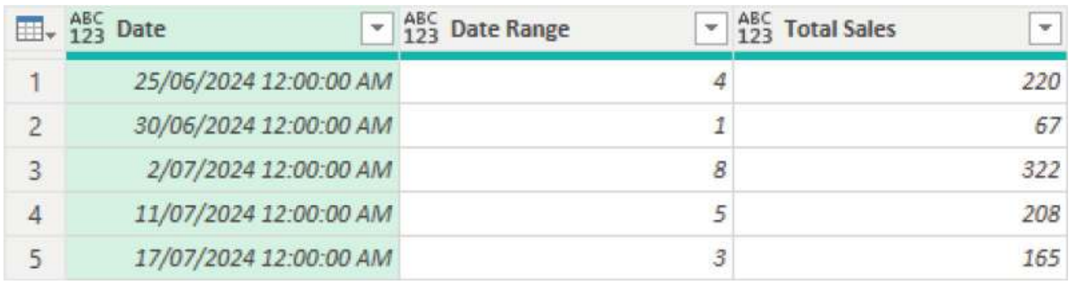
| | Date | Quantity |
|---|---|---|
| 1 | 25/06/2024 12:00:00 AM | 84 |
| 2 | 26/06/2024 12:00:00 AM | 23 |
| 3 | 27/06/2024 12:00:00 AM | 87 |
| 4 | 28/06/2024 12:00:00 AM | 26 |
| 5 | 30/06/2024 12:00:00 AM | 67 |
| 6 | 2/07/2024 12:00:00 AM | 42 |

***Figure 6-71*** Fifth iteration of the grouping

To implement this, the grouping should close if the formula `List.Contains(MissingDates, one day before c[Date])` evaluates to `true`. This can be written as `List.Contains(MissingDates, c[Date] - #duration(1, 0, 0, 0))`. Thus, the fifth argument of the `Table.Group()` function will be `(s, c) => Number.From(List.Contains(MissingDates, c[Date] - #duration(1, 0, 0, 0)))`.

By replacing `MissingDates` with its formula and incorporating it into the fifth argument of the `Table.Group()` function, the full formula becomes as follows, which results in Figure 6-72.

```
Table.Group(Source, "Date",
  {{"Date Range",Table.RowCount(_)},
    {"Total Sales", each List.Sum([Quantity])}},
  0,
  (s,c) =>
    Number.From(
      List.Contains(
        List.Difference(
          List.DateTimes(
            List.Min(Source[Date]),
            Duration.Days(List.Max(Source[Date]) - List.Min(Source[Date])),
            #duration(1, 0, 0, 0)
          ),
          Source[Date]
        ),
        c - #duration(1, 0, 0, 0)
      )
    )
)
```



|  | Date | Date Range | Total Sales |
|---|---|---|---|
| 1 | 25/06/2024 12:00:00 AM | 4 | 220 |
| 2 | 30/06/2024 12:00:00 AM | 1 | 67 |
| 3 | 2/07/2024 12:00:00 AM | 8 | 322 |
| 4 | 11/07/2024 12:00:00 AM | 5 | 208 |
| 5 | 17/07/2024 12:00:00 AM | 3 | 165 |

***Figure 6-72*** Result of the grouping

Similar to the first solution, the second argument can be modified to display date ranges instead of the number of rows in each group.

**Efficiency Tip** Both previously mentioned solutions produce the same result, but their execution times differ significantly. While the first solution solves the problem quickly, the second solution takes around 17 seconds even for a small table with 1,000 rows, which is excessive. So it is recommended to use the first solution.

In case you have to use the second solution, let's check the cause of its slow performance. The delay is caused by the calculation of the `MissingDates`, which is part of the `Table.Group()` formula, and will be calculated several times. To improve performance when using such a formula, it's recommended to separate the `XXX` part into its own step and apply `List.Buffer()` to it. Rewriting the code in the Advanced Editor, as shown here, reduces the execution time for 1,000 rows to 0.08 seconds and for 10,000 rows to 4.7 seconds (the first solution still outperforms it by solving the 10,000-row table in less than a second).

```
  let
  Source = Excel.CurrentWorkbook(){[Name = "Question"]}[Content],
  XXX = List.Buffer(
          List.Difference(
        List.DateTimes(
          List.Min(Source[Date]),
          Duration.Days(List.Max(Source[Date]) - List.Min(Source[Date])),
           Source[Date]
      ),
      each _ + #duration(1, 0, 0, 0)
    )
  ),
  GroupBy = Table.Group(
    Source,
    "Date",
    {
      {
        "Date Range",
        each DateTime.ToText(List.First(_[Date]), "yyyy/MM/dd")
          & " - "
          & DateTime.ToText(List.Last(_[Date]), "yyyy/MM/dd")
      },
      {"Total Sales", each List.Sum([Quantity])}
    },
    0,
    (x, y) => Number.From(List.Contains(XXX, y-#duration(1, 0, 0, 0)))
  )
in
  GroupBy
```

## Using the Fifth Input in Table.Group Based on Two Values

Consider the Source table shown in Table 6-12. Group the rows, starting at the first row, under the condition that the difference between the first and last date of each group is fewer than ten days.

***Table 6-12*** Source: Historical Sales

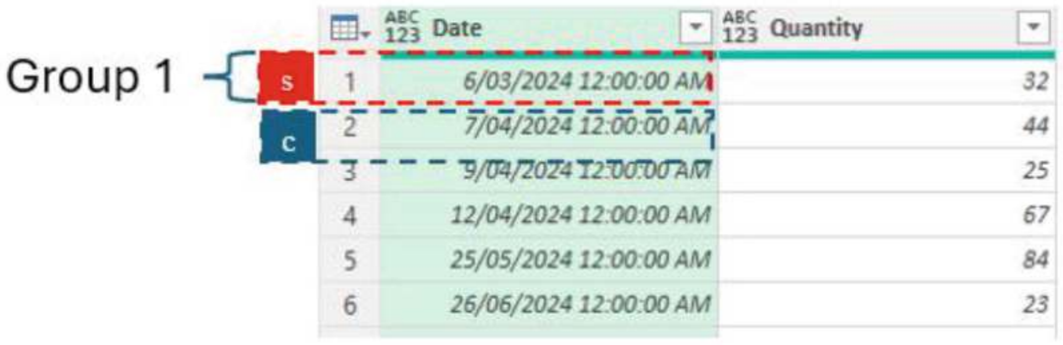
| Date | Quantity |
|---|---|
| 6/03/2024 | 32 |
| 7/04/2024 | 44 |
| 9/04/2024 | 25 |
| 12/04/2024 | 67 |
| 25/05/2024 | 84 |
| 26/06/2024 | 23 |
| 27/06/2024 | 87 |
| 28/06/2024 | 26 |
| 2/07/2024 | 42 |
| 3/07/2024 | 40 |
| 4/07/2024 | 14 |
| 5/07/2024 | 69 |
| 8/07/2024 | 56 |
| 11/07/2024 | 15 |
| 12/07/2024 | 84 |
| 13/07/2024 | 25 |
| 14/07/2024 | 46 |
| 15/07/2024 | 38 |
| 17/07/2024 | 45 |
| 18/07/2024 | 76 |
| 19/07/2024 | 44 |

**Note** The data in this example is provided in an Excel file titled `13 Using the Fifth Input in Table.Group Based on Two Values.xlsx`.

You can solve this problem using the fifth argument of the `Table.Group()` function in the form of `(s, c) => f(s, c)`. However, this problem is different from the previous ones that were solved using the fifth argument of `Table.Group()`. In those cases, the condition for stopping the current group was determined based solely on the row represented by `c`. In this case, however, you need to compare the starting date and the ending date within the group to decide whether to continue the current group or start a new one.

Consider the first iteration of grouping shown in Figure 6-73, where `s[Date]` and `c[Date]` should be compared. If the difference between these dates is fewer than ten days, `f(s, c)` should return `0`. Otherwise, it should return `1` to close the current group and create the next one. To calculate the difference between these two dates, you can use the `Duration.Days()` function as `Duration.Days(c[Date] - s[Date])`. To compare the result with `10`, the formula is `Duration.Days(c[Date] - s[Date]) >= 10`.

However, as mentioned earlier, the comparer used with the local grouping should return `0` or `1`. To convert the Boolean result (`True` or `False`) into a `1` or `0`, use the `Number.From()` function. The entire comparer can be written as `(s,c)=> Number.From(Duration.Days(c[Date] - s[Date]) >= 10)`. See Figure



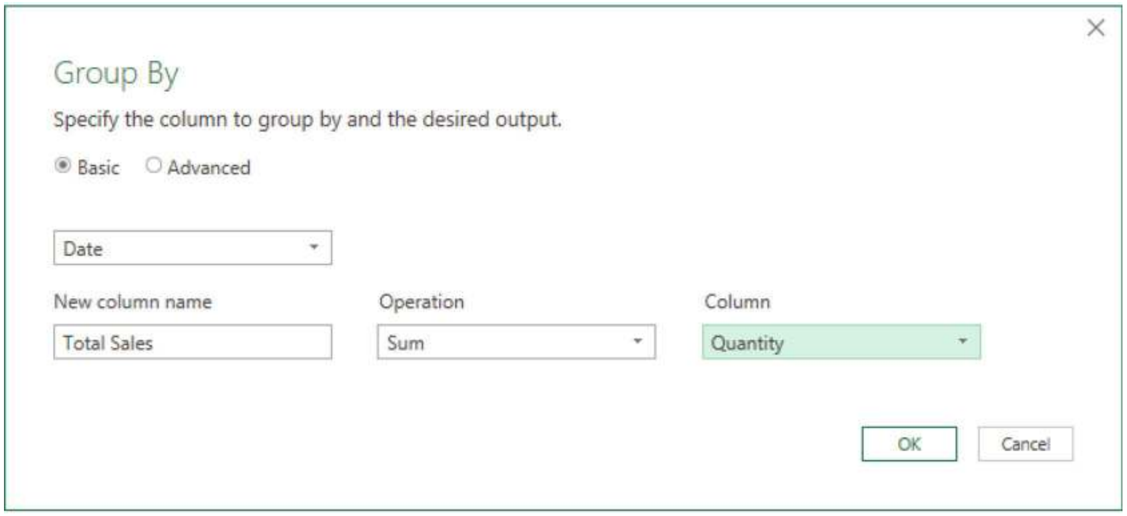
|  | Date | Quantity |
|---|---|---|
| 1 | 6/03/2024 12:00:00 AM | 32 |
| 2 | 7/04/2024 12:00:00 AM | 44 |
| 3 | 9/04/2024 12:00:00 AM | 25 |
| 4 | 12/04/2024 12:00:00 AM | 67 |
| 5 | 25/05/2024 12:00:00 AM | 84 |
| 6 | 26/06/2024 12:00:00 AM | 23 |

***Figure 6-73*** The first iteration of grouping

6-73.

Based on this introduction and using the source table, select the Group By command. Then, apply the settings shown in Figure 6-74 and click OK, which will result in the following formula in the formula bar:

```
= Table.Group(Source, {"Date"}, {{"Total Sales", each List.Sum([Quantity]),
type number}})
```



Group By

Specify the column to group by and the desired output.

[✓ Basic] Advanced

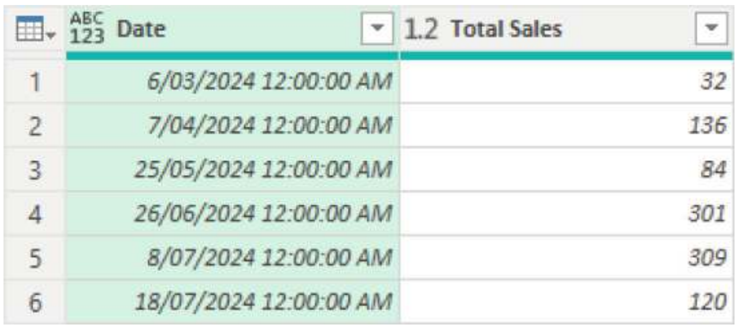
Date

New column name: Total Sales
Operation: Sum
Column: Quantity

***Figure 6-74*** Grouping settings

In the generated formula, insert 0 as the fourth argument and use the comparer defined earlier as the fifth argument to reach the following formula. This results in Figure 6-75.

```
= Table.Group(Source, {"Date"}, {{"Total Sales", each List.Sum([Quantity]),
type number}},0,(s,c)=> Number.From(Duration.Days(c[Date] - s[Date]) >= 10))
```

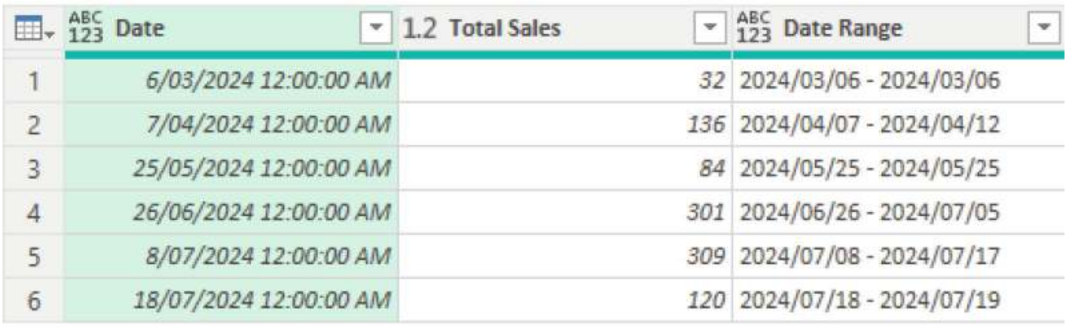


|  | Date | Total Sales |
|---|---|---|
| 1 | 6/03/2024 12:00:00 AM | 32 |
| 2 | 7/04/2024 12:00:00 AM | 136 |
| 3 | 25/05/2024 12:00:00 AM | 84 |
| 4 | 26/06/2024 12:00:00 AM | 301 |
| 5 | 8/07/2024 12:00:00 AM | 309 |
| 6 | 18/07/2024 12:00:00 AM | 120 |

*Figure 6-75* The result of revised formula

In the resulting table, the Date column only shows the starting date of each group. To display the range of dates for each group, the previous formula can be rewritten as follows, which results in Figure 6-76.

```
= Table.Group(Source, {"Date"}, {{"Total Sales", each List.Sum([Quantity]),
type number},{"Date Range", each
DateTime.ToText(List.First(_[Date]),"yyyy/MM/dd") & " - " &
DateTime.ToText(List.Last(_[Date]),"yyyy/MM/dd")}},0,(s,c)=>
Number.From(Duration.Days(c[Date] - s[Date]) >= 10))
```



| | Date | Total Sales | Date Range |
|---|---|---|---|
| 1 | 6/03/2024 12:00:00 AM | 32 | 2024/03/06 - 2024/03/06 |
| 2 | 7/04/2024 12:00:00 AM | 136 | 2024/04/07 - 2024/04/12 |
| 3 | 25/05/2024 12:00:00 AM | 84 | 2024/05/25 - 2024/05/25 |
| 4 | 26/06/2024 12:00:00 AM | 301 | 2024/06/26 - 2024/07/05 |
| 5 | 8/07/2024 12:00:00 AM | 309 | 2024/07/08 - 2024/07/17 |
| 6 | 18/07/2024 12:00:00 AM | 120 | 2024/07/18 - 2024/07/19 |

*Figure 6-76* The final result

## Using the Fifth Input in Table.Group Based on All the Group items

Consider the historical complaint values shown in the Source table in Table 6-13. All the complaints need to be inspected by different people, and each person can inspect five complaints (No.). Group the rows of the table, from the top, into different groups, each including a maximum of five complaints (the sum of the values on the Complaint No. column in each group should be less than or equal to 5).

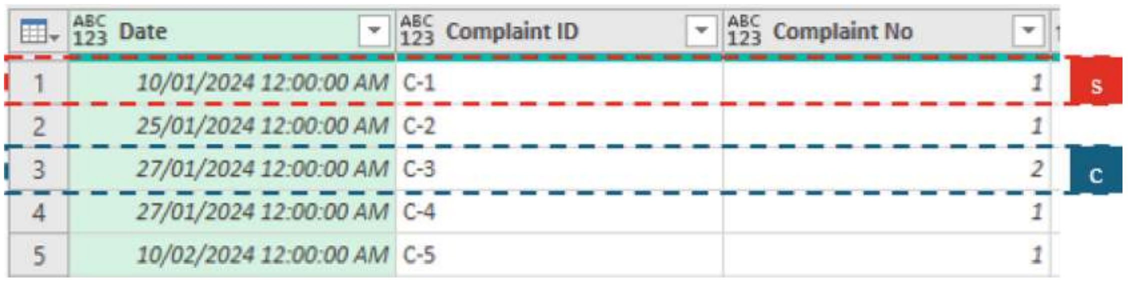
*Table 6-13* Source: Historical Complaint

| Date | Complaint ID | Complaint No. |
|---|---|---|
| 10/01/2024 | C-1 | 1 |
| 25/01/2024 | C-2 | 1 |
| 27/01/2024 | C-3 | 2 |
| 27/01/2024 | C-4 | 1 |
| 10/02/2024 | C-5 | 1 |
| 3/03/2024 | C-6 | 4 |
| 14/03/2024 | C-7 | 1 |
| 11/04/2024 | C-8 | 3 |
| 17/05/2024 | C-9 | 1 |
| 17/05/2024 | C-10 | 1 |
| 1/06/2024 | C-11 | 2 |
| 17/06/2024 | C-12 | 1 |
| 21/06/2024 | C-13 | 1 |
| 24/06/2024 | C-14 | 1 |
| 11/07/2024 | C-15 | 1 |
| 20/08/2024 | C-16 | 1 |
| 22/09/2024 | C-17 | 2 |
| 26/09/2024 | C-18 | 1 |
| 30/09/2024 | C-19 | 1 |

**Note** The data in this example is provided in an Excel file titled `14 Using the Fifth Input in Table.Group Based on All the Group items.xlsx`.

In the previous example, the rows were grouped based on the first and last row of each group. However, in this example, the grouping logic is determined by all the rows within the group. Despite the difficulty of this problem, it can be solved with the fifth argument of `Table.Group()`, which allows for more complex grouping logic. The idea is to group the rows from the top row, ensuring that each group contains five or fewer complaints.

As in the previous example, you need to use local grouping and define the fifth argument as `(s,c) => f(s,c)`. However, before you start the solution, consider the second iteration of grouping shown in Figure 6-77.

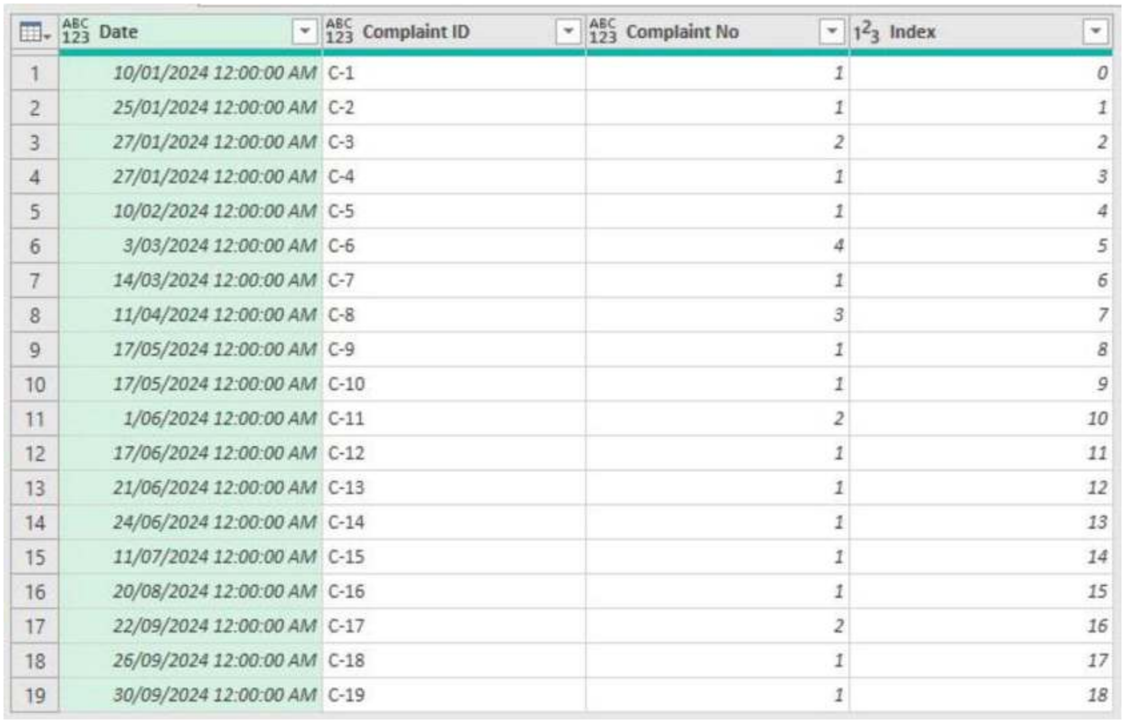


| | Date | Complaint ID | Complaint No |
|---|---|---|---|
| 1 | 10/01/2024 12:00:00 AM | C-1 | 1 |
| 2 | 25/01/2024 12:00:00 AM | C-2 | 1 |
| 3 | 27/01/2024 12:00:00 AM | C-3 | 2 |
| 4 | 27/01/2024 12:00:00 AM | C-4 | 1 |
| 5 | 10/02/2024 12:00:00 AM | C-5 | 1 |

*Figure 6-77* Second iteration of grouping

As presented, to determine the grouping, you need to consider the first three rows, where `s` represents the first row and `c` represents the third row. However, you don't have direct access to the rows between these two.

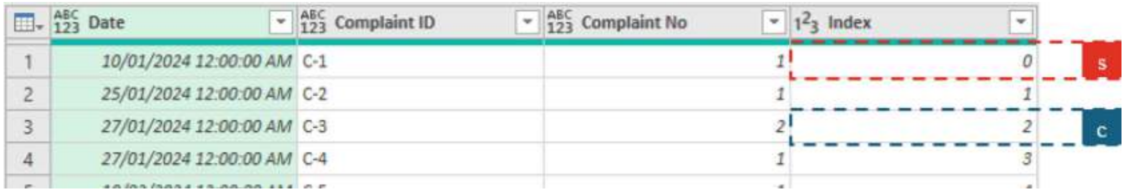
To address this issue and simplify the process, add an index column, which will help you later access the intermediate rows between the starting and ending rows of the group. Select the Index column from the Add Column tab, which creates a new column with sequential numbers starting from 1, as shown in Figure 6-78.



| | Date | Complaint ID | Complaint No | Index |
|---|---|---|---|---|
| 1 | 10/01/2024 12:00:00 AM | C-1 | 1 | 0 |
| 2 | 25/01/2024 12:00:00 AM | C-2 | 1 | 1 |
| 3 | 27/01/2024 12:00:00 AM | C-3 | 2 | 2 |
| 4 | 27/01/2024 12:00:00 AM | C-4 | 1 | 3 |
| 5 | 10/02/2024 12:00:00 AM | C-5 | 1 | 4 |
| 6 | 3/03/2024 12:00:00 AM | C-6 | 4 | 5 |
| 7 | 14/03/2024 12:00:00 AM | C-7 | 1 | 6 |
| 8 | 11/04/2024 12:00:00 AM | C-8 | 3 | 7 |
| 9 | 17/05/2024 12:00:00 AM | C-9 | 1 | 8 |
| 10 | 17/05/2024 12:00:00 AM | C-10 | 1 | 9 |
| 11 | 1/06/2024 12:00:00 AM | C-11 | 2 | 10 |
| 12 | 17/06/2024 12:00:00 AM | C-12 | 1 | 11 |
| 13 | 21/06/2024 12:00:00 AM | C-13 | 1 | 12 |
| 14 | 24/06/2024 12:00:00 AM | C-14 | 1 | 13 |
| 15 | 11/07/2024 12:00:00 AM | C-15 | 1 | 14 |
| 16 | 20/08/2024 12:00:00 AM | C-16 | 1 | 15 |
| 17 | 22/09/2024 12:00:00 AM | C-17 | 2 | 16 |
| 18 | 26/09/2024 12:00:00 AM | C-18 | 1 | 17 |
| 19 | 30/09/2024 12:00:00 AM | C-19 | 1 | 18 |

*Figure 6-78* The result of adding an Index column

After adding this new column, reconsider the second iteration, as shown in Figure 6-79.



| | Date | Complaint ID | Complaint No | Index |
|---|---|---|---|---|
| 1 | 10/01/2024 12:00:00 AM | C-1 | 1 | 0 |
| 2 | 25/01/2024 12:00:00 AM | C-2 | 1 | 1 |
| 3 | 27/01/2024 12:00:00 AM | C-3 | 2 | 2 |
| 4 | 27/01/2024 12:00:00 AM | C-4 | 1 | 3 |

*Figure 6-79* Second iteration of grouping after adding a custom column

In this case, `s[Index]` is `0`, which represents the starting row of the grouping, and `c[Index]` is `2`, which represents the ending row for the grouping. To decide about the grouping, you need to extract all the values from the Complain No. column in the Source table, from `s[Index]` to `c[Index]`. This can be done using the following formula:

```
List.Range(Source[Complaint No],s[Index],c[Index]-s[Index]+1)
```

To calculate the sum of complaints, you can rewrite it as follows:

```
List.Sum(List.Range(Source[Complaint No],s[Index],c[Index]-s[Index]+1))
```

Since you have a cap on the number of complaints in each group (five), the formula can be further rewritten as follows:

```
List.Sum(List.Range(Source[Complaint No],s[Index],c[Index]-s[Index]+1))>5
```

Finally, to convert the Boolean value into a 0-1 value, you modify the formula and write the comparer as follows:

```
F(s,c)=>Number.From(List.Sum(List.Range(Source[Complaint
No],s[Index],c[Index]-s[Index]+1))>5)
```

You can use this comparer in the Group By to solve the problem. Consider the table after adding the Index column. Right-click the Index column, apply the Group By operation, and choose the All Rows option. The following M-code will then be generated in the formula bar:

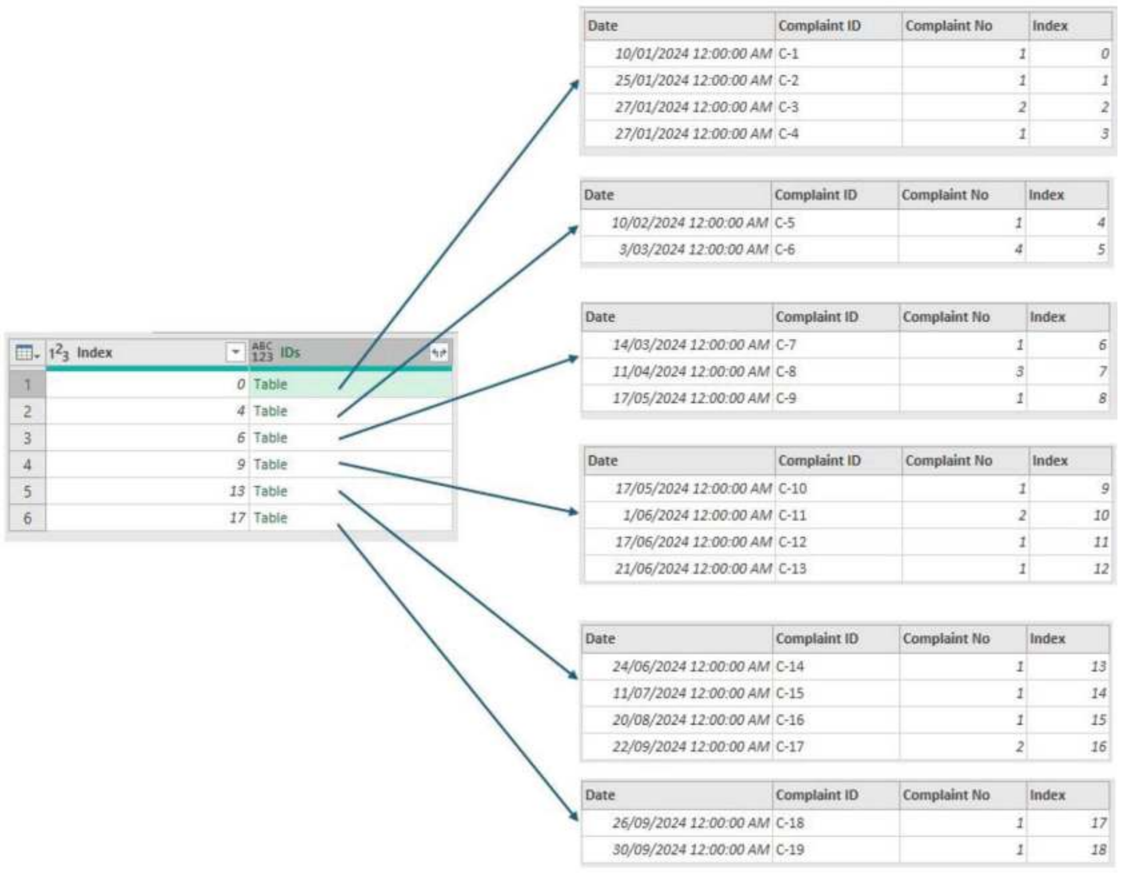
```
= Table.Group(#"Added Index", {"Index"}, {{"IDs", each _, type table
[Date=datetime, Complaint ID=text, Complaint No=number, Index=number]}})
```

This can be shortened to the following formula:

```
= Table.Group(#"Added Index", "Index", {{"IDs", each }})
```

To revise the grouping criteria, enter `0` in the fourth input and use the defined comparer in the fifth input as follows. This adjustment will result in Figure 6-80, which includes the groups where the complaint number is less than or equal to five.

```
= Table.Group(
      #"Added Index",
      {"Index"},
      {{"IDs", each _}},
      0,
       (s,c)=>Number.From(
                        List.Sum(
                              List.Range(Source,s[Index],c[Index]-
s[Index]+1)
                                           )>5))
```



| | Index | IDs |
|---|---|---|
| 1 | 0 | Table |
| 2 | 4 | Table |
| 3 | 6 | Table |
| 4 | 9 | Table |
| 5 | 13 | Table |
| 6 | 17 | Table |

| Date | Complaint ID | Complaint No | Index |
|---|---|---|---|
| 10/01/2024 12:00:00 AM | C-1 | 1 | 0 |
| 25/01/2024 12:00:00 AM | C-2 | 1 | 1 |
| 27/01/2024 12:00:00 AM | C-3 | 2 | 2 |
| 27/01/2024 12:00:00 AM | C-4 | 1 | 3 |

| Date | Complaint ID | Complaint No | Index |
|---|---|---|---|
| 10/02/2024 12:00:00 AM | C-5 | 1 | 4 |
| 3/03/2024 12:00:00 AM | C-6 | 4 | 5 |

| Date | Complaint ID | Complaint No | Index |
|---|---|---|---|
| 14/03/2024 12:00:00 AM | C-7 | 1 | 6 |
| 11/04/2024 12:00:00 AM | C-8 | 3 | 7 |
| 17/05/2024 12:00:00 AM | C-9 | 1 | 8 |

| Date | Complaint ID | Complaint No | Index |
|---|---|---|---|
| 17/05/2024 12:00:00 AM | C-10 | 1 | 9 |
| 1/06/2024 12:00:00 AM | C-11 | 2 | 10 |
| 17/06/2024 12:00:00 AM | C-12 | 1 | 11 |
| 21/06/2024 12:00:00 AM | C-13 | 1 | 12 |

| Date | Complaint ID | Complaint No | Index |
|---|---|---|---|
| 24/06/2024 12:00:00 AM | C-14 | 1 | 13 |
| 11/07/2024 12:00:00 AM | C-15 | 1 | 14 |
| 20/08/2024 12:00:00 AM | C-16 | 1 | 15 |
| 22/09/2024 12:00:00 AM | C-17 | 2 | 16 |

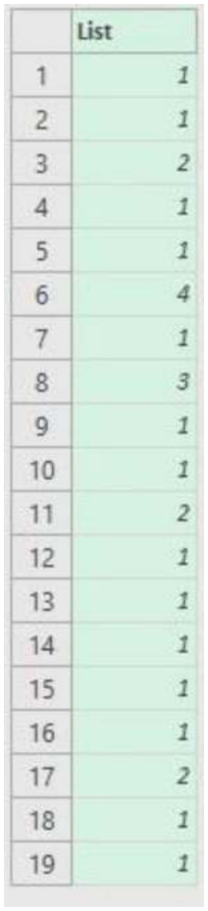
| Date | Complaint ID | Complaint No | Index |
|---|---|---|---|
| 26/09/2024 12:00:00 AM | C-18 | 1 | 17 |
| 30/09/2024 12:00:00 AM | C-19 | 1 | 18 |

***Figure 6-80*** The result of advanced grouping

Table 6-14 summarizes the results of each part of the formula in different iterations. Review each iteration for grouping based on this table. In the following steps, `Source[Complaint No]` refers to the values in the Complaint Number column shown in Figure 6-81.

***Table 6-14*** Summarizing the Steps of Running the Fifth Input

| Step | s[Index] | c[Index] | s[Index]-c[Index]+1 | List.Range (…) | List.Sum (…) | Number.From (…) | Group |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 1 | 2 | {1,1} | 2 | 0 | 1 |
| 2 | 0 | 2 | 3 | {1,1,2} | 4 | 0 | 1 |
| 3 | 0 | 3 | 4 | {1,1,2,1} | 5 | 0 | 1 |
| 4 | 0 | 4 | 5 | {1,1,2,1,1} | 6 | 1 | - |
| 4 | 4 | 5 | 2 | {1,4} | 5 | 0 | 2 |
| 5 | 4 | 6 | 3 | {1,4,1} | 6 | 1 | - |
| 5 | 6 | 7 | 2 | {1,3} | 4 | 0 | 3 |



|  | List |
|---|---|
| 1 | 1 |
| 2 | 1 |
| 3 | 2 |
| 4 | 1 |
| 5 | 1 |
| 6 | 4 |
| 7 | 1 |
| 8 | 3 |
| 9 | 1 |
| 10 | 1 |
| 11 | 2 |
| 12 | 1 |
| 13 | 1 |
| 14 | 1 |
| 15 | 1 |
| 16 | 1 |
| 17 | 2 |
| 18 | 1 |
| 19 | 1 |

***Figure 6-81*** #"Added Index"[Complaint No]

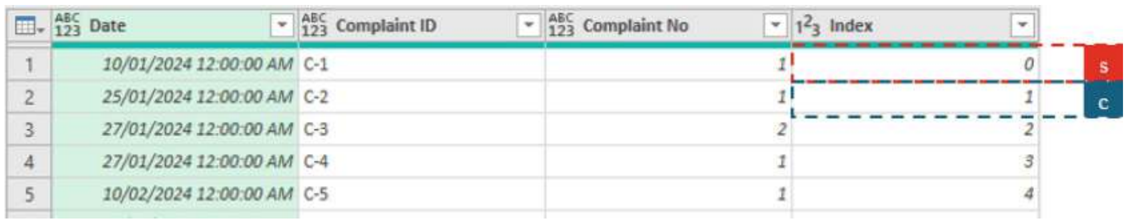
Group 1, Step 1:

The second argument of `Table.Group()` is provided as a list, so `s` and `c` in the fifth argument are of type record. Since the list in the second argument of `Table.Group()` contains only one column name (Index), `s` and `c` are both records with a single field named `Index`. (If the second argument of `Table.Group()` were written as the text `"Index"` instead of the list `{"Index"}`, then `s` and `c` would both be of type number.)

Figure 6-82 shows `s` and `c` in the first step, where `s` is the record `[Index = 0]`, and `c` is the record `[Index = 1]`. The result of `s[Index]` is `0` and the result of `c[Index]` is `1`, and `c[Index] - s[Index] + 1` is equal to `2`.

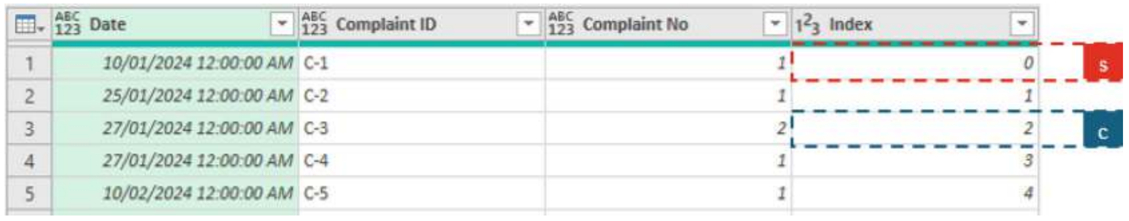
Based on these values, `List.Range(Source[Complaint No], s[Index], c[Index] - s[Index] + 1)` can be rewritten as `List.Range(Source[Complaint No], 0, 1-0+ 1)`, which equals to the first two values from the complaint list (shown on Figure 6-81), which are `{1, 1}`.

So, `List.Sum(List.Range(Source[Complaint No], s[Index], c[Index] - s[Index] + 1))` in this step is equal to `List.Sum({1,1})`, which is `2`. Because the result of `List.Sum()` is not greater than five, the result of `Number.From()` is `0`, so the grouping continues, and `c` moves to the next row. See Figure 6-83.



|  | Date | Complaint ID | Complaint No | Index |
|---|---|---|---|---|
| 1 | 10/01/2024 12:00:00 AM | C-1 | 1 | 0 |
| 2 | 25/01/2024 12:00:00 AM | C-2 | 1 | 1 |
| 3 | 27/01/2024 12:00:00 AM | C-3 | 2 | 2 |
| 4 | 27/01/2024 12:00:00 AM | C-4 | 1 | 3 |
| 5 | 10/02/2024 12:00:00 AM | C-5 | 1 | 4 |

***Figure 6-82*** The s and c in step 1

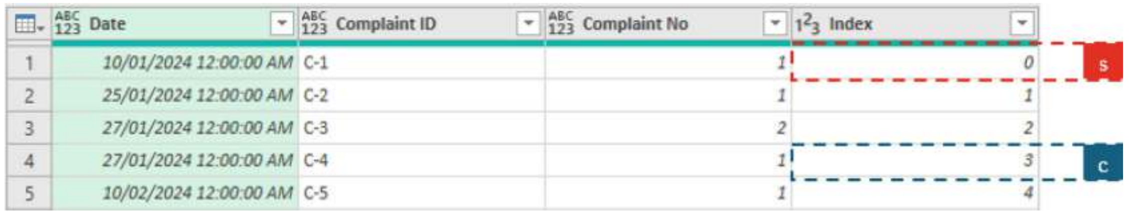


|  | Date | Complaint ID | Complaint No | Index |
|---|---|---|---|---|
| 1 | 10/01/2024 12:00:00 AM | C-1 | 1 | 0 |
| 2 | 25/01/2024 12:00:00 AM | C-2 | 1 | 1 |
| 3 | 27/01/2024 12:00:00 AM | C-3 | 2 | 2 |
| 4 | 27/01/2024 12:00:00 AM | C-4 | 1 | 3 |
| 5 | 10/02/2024 12:00:00 AM | C-5 | 1 | 4 |

***Figure 6-83*** The s and c in step 2

Group 1. Step 2:

In this step, `s[Index] = 0, c[Index] = 2` and `c[Index] - s[Index] + 1 = 3`. Applying these values to `List.Range(Source[Complaint No], s[Index], c[Index] - s[Index] + 1)` results in `{1, 1, 2}`. Since the result of `List.Sum()` for the resulting list is `4`, which is not greater than five, the result of `Number.From()` is `0`. Therefore, the grouping continues, and `c` moves to the next row. See Figure 6-84.

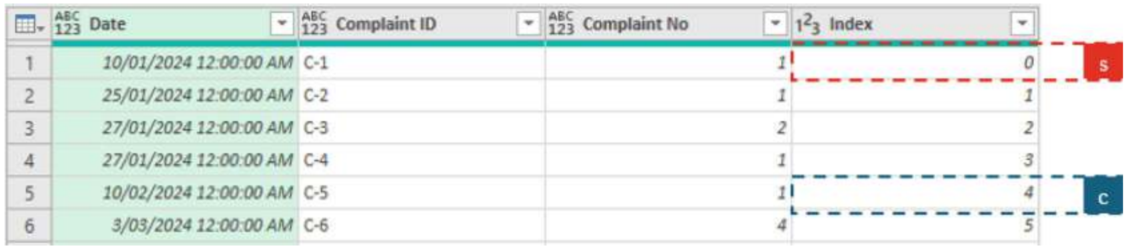


|  | Date | Complaint ID | Complaint No | Index |
|---|---|---|---|---|
| 1 | 10/01/2024 12:00:00 AM | C-1 | 1 | 0 |
| 2 | 25/01/2024 12:00:00 AM | C-2 | 1 | 1 |
| 3 | 27/01/2024 12:00:00 AM | C-3 | 2 | 2 |
| 4 | 27/01/2024 12:00:00 AM | C-4 | 1 | 3 |
| 5 | 10/02/2024 12:00:00 AM | C-5 | 1 | 4 |

***Figure 6-84*** The s and c in step 3

Group 1. Step 3:

In this step, `s[Index] = 0, c[Index] = 3, and c[Index] - s[Index] + 1 = 4`. Applying these values to `List.Range(Source[Complaint No], s[Index], c[Index] - s[Index] + 1)`, you get `{1, 1, 2, 1}`. Since `List.Sum()` equals five, which is not greater than five, the result of `Number.From()` is `0`. Therefore, the grouping continues, and `c` moves to the next row, as shown in Figure 6-85.



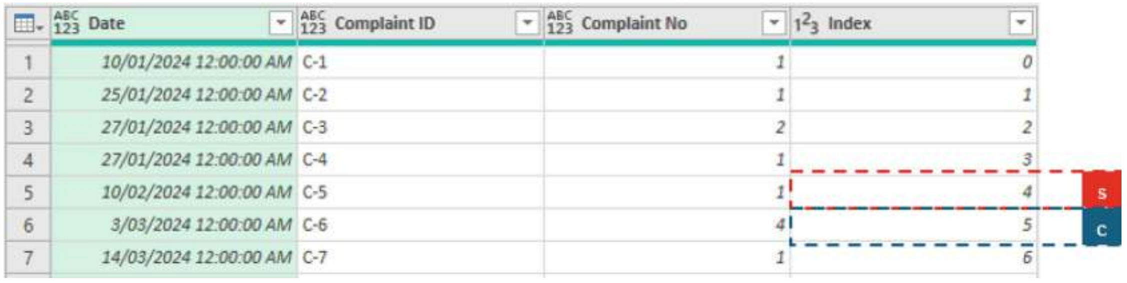
|  | Date | Complaint ID | Complaint No | Index |
|---|---|---|---|---|
| 1 | 10/01/2024 12:00:00 AM | C-1 | 1 | 0 |
| 2 | 25/01/2024 12:00:00 AM | C-2 | 1 | 1 |
| 3 | 27/01/2024 12:00:00 AM | C-3 | 2 | 2 |
| 4 | 27/01/2024 12:00:00 AM | C-4 | 1 | 3 |
| 5 | 10/02/2024 12:00:00 AM | C-5 | 1 | 4 |
| 6 | 3/03/2024 12:00:00 AM | C-6 | 4 | 5 |

***Figure 6-85*** The s and c in step 4

Moving to Group 2:

In this step, `s[Index] = 0, c[Index] = 4, and c[Index] - s[Index] + 1 = 5`. The result of `List.Range(Source[Complaint No], s[Index], c[Index] - s[Index] + 1)` is `{1, 1, 2, 1, 1}`. Since `List.Sum()` over the items in the resulting list equals six, which is greater than five, the result of `Number.From()` is `1`. This means Group 1 should be closed, and the row presented by `c` becomes the starting row for Group 2.

Consequently, as shown in Figure 6-86, `s` and `c` are updated, and `s[Index]`, `c[Index]`, and `c[Index] - s[Index] + 1` are now `4`, `5`, and `2`, respectively.



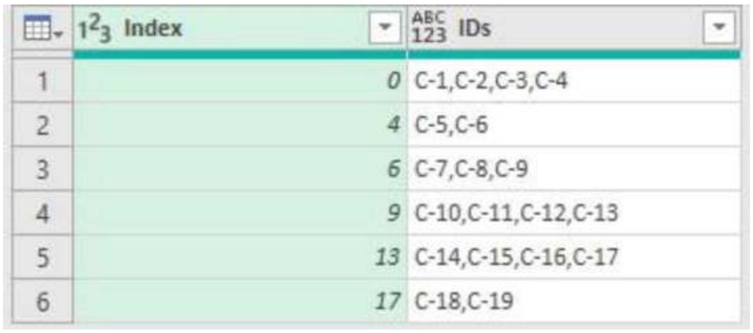
| | Date | Complaint ID | Complaint No | Index |
|---|---|---|---|---|
| 1 | 10/01/2024 12:00:00 AM | C-1 | 1 | 0 |
| 2 | 25/01/2024 12:00:00 AM | C-2 | 1 | 1 |
| 3 | 27/01/2024 12:00:00 AM | C-3 | 2 | 2 |
| 4 | 27/01/2024 12:00:00 AM | C-4 | 1 | 3 |
| 5 | 10/02/2024 12:00:00 AM | C-5 | 1 | 4 |
| 6 | 3/03/2024 12:00:00 AM | C-6 | 4 | 5 |
| 7 | 14/03/2024 12:00:00 AM | C-7 | 1 | 6 |

***Figure 6-86*** The s and c in step 1 for Group 2

As in the previous step, this process will continue until the last row of Source table. Table 6-14 summarizes this process.

Now that the grouping is functioning correctly, you can include the Complaint IDs in the resulting table. To achieve this, modify the formula by revising the third argument, to present Groups and Complaint IDs within each group. The updated M-code to accomplish this is as follows, which results in Figure 6-87.

```
= Table.Group(
      #"Added Index",
      {"Index"},
      {{"IDs", each Text.Combine(_[Complaint ID],",")}},
      0,
       (s,c)=>Number.From(
                        List.Sum(
                              List.Range(Source[Complaint
No],s[Index],c[Index]-s[Index]+1)
                                       )>5))
```



| | Index | IDs |
|---|---|---|
| 1 | 0 | C-1,C-2,C-3,C-4 |
| 2 | 4 | C-5,C-6 |
| 3 | 6 | C-7,C-8,C-9 |
| 4 | 9 | C-10,C-11,C-12,C-13 |
| 5 | 13 | C-14,C-15,C-16,C-17 |
| 6 | 17 | C-18,C-19 |

***Figure 6-87*** The resulting table

**Note** In this example, since one column is used in the second input of the function, the name of the column can be directly inserted as text instead of using list syntax. Therefore, for the fifth argument, instead of using `s[Index]` and `c[Index]`, you can simply use `s` and `c`. The revised version of the formula is as follows:

```
= Table.Group(
      #"Added Index",
      "Index",
      {{"IDs", each Text.Combine(_[Complaint ID],",")}},
       0,
        (s,c)=>Number.From(
                         List.Sum(
                               List.Range(Source[Complaint No],s,c-s+1)
                                            )>5))
```

Additionally, in this example, the values in the Date column in the source table are unique, so instead of adding an Index column, you can use this column to extract the values between the starting row and ending row of groupings. Here's how you can modify the approach to use the Date column without adding an Index column (this can be used only when the Date column is unique):

```
= Table.Group(
      Source,
      "Date",
                        {{"IDs", each Text.Combine(_[Complaint ID],",")}},
      0,
       (s,c)=>Number.From(
                        List.Sum(
                              Table.SelectRows(
                           Source,each [Date]>=s and [Date]<=c)[Complaint
No]
                                           )>=5))
```

**Efficiency Tip** To check the execution time of the proposed formula, a table with 3,000 rows was used. Without buffering, the execution time was 26 seconds. However, by buffering `Source[Complaint No]`, the execution time was reduced to less than a second for the same table, and for a table with 100,000 rows, it took 21 seconds, which is high.

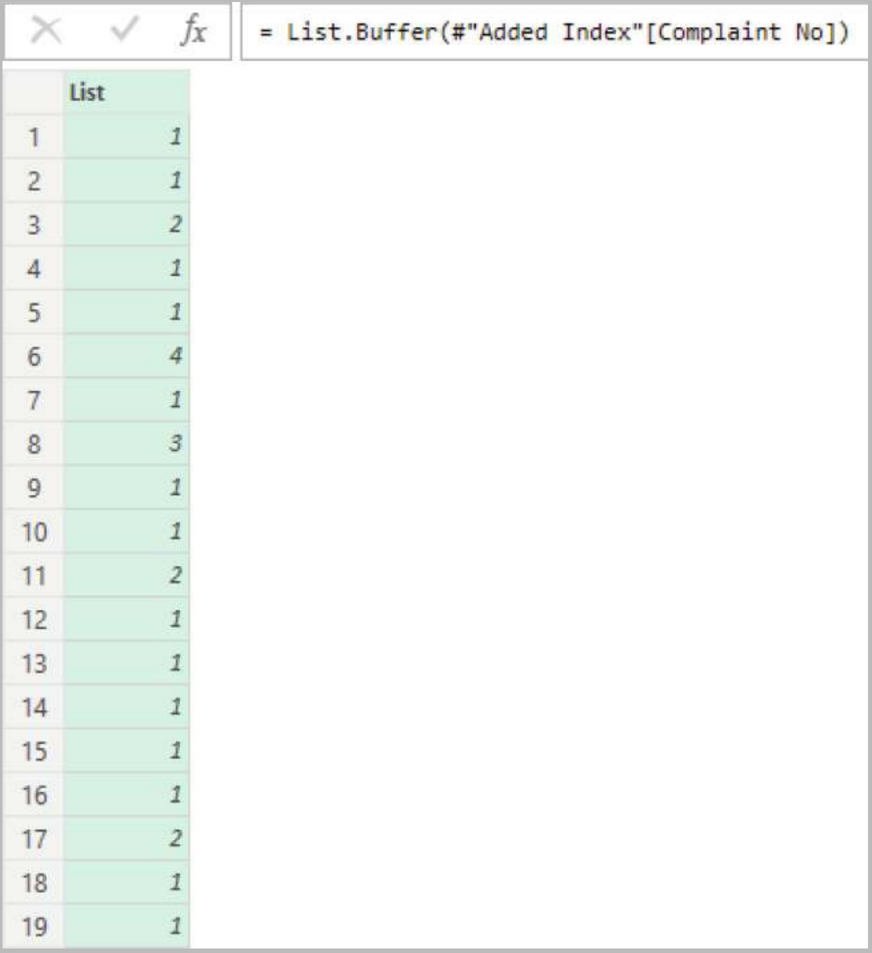
The whole formula using buffering is provided here:

```
let
    Source = Excel.CurrentWorkbook(){[Name="Table2"]}[Content],
    #"Added Index" = Table.AddIndexColumn(Source, "Index", 0, 1,
Int64.Type),
    Buffer=List.Buffer(Source[Complaint No]),
    #"Grouped Rows" = Table.Group(
#"Added Index",
"Index",
 {{"IDs", each Text.Combine(_[Complaint ID],",")}},
0,
(s,c)=>Number.From(
                  List.Sum(
                        List.Range(Buffer,s,c-s+1)
                                     )>5))
in
    #"Grouped Rows"
```

In the provided solution, during each iteration of grouping, all the values in the group are examined using `List.Sum(List.Range(Buffer, s, c - s + 1)`, which increases execution time. An alternative solution is proposed that determines grouping by comparing the cumulative complaints for the row related to the start and end of each group, instead of evaluating a range of complaints for all the rows inside each group.

To implement this solution, first add a new index column to the source table, starting at `0`. Then click the *fx* button to add a new step called Custom1. Then use the following formula in the formula bar, which generates a list of all complaints, resulting in Figure 6-88.

```
= List.Buffer(#"Added Index"[Complaint No])
```



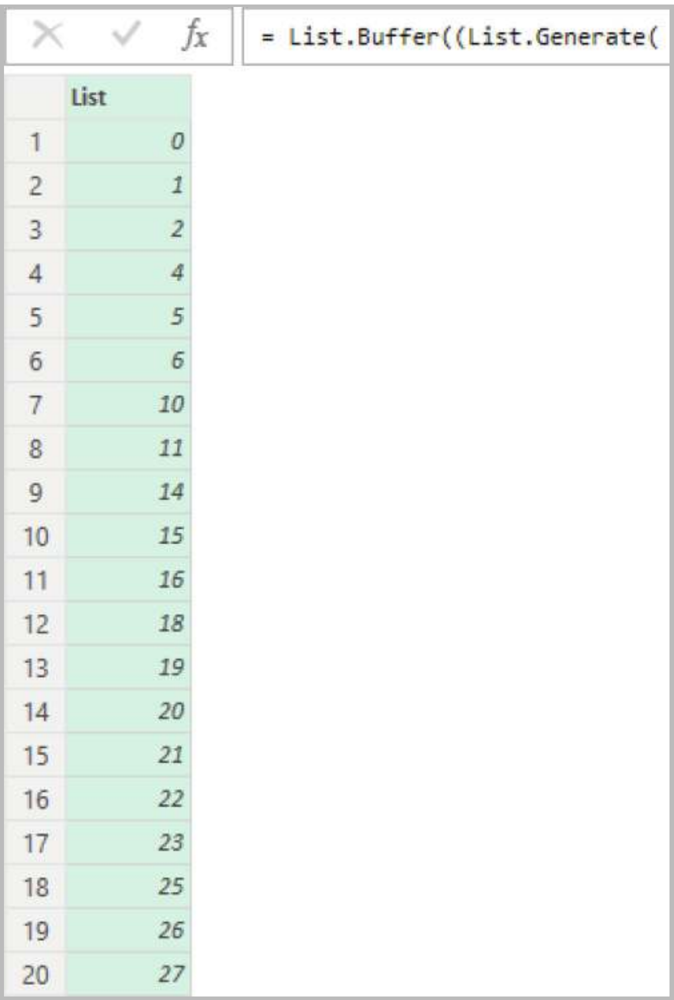
```
= List.Buffer(#"Added Index"[Complaint No])
```

| | List |
|---|---|
| 1 | 1 |
| 2 | 1 |
| 3 | 2 |
| 4 | 1 |
| 5 | 1 |
| 6 | 4 |
| 7 | 1 |
| 8 | 3 |
| 9 | 1 |
| 10 | 1 |
| 11 | 2 |
| 12 | 1 |
| 13 | 1 |
| 14 | 1 |
| 15 | 1 |
| 16 | 1 |
| 17 | 2 |
| 18 | 1 |
| 19 | 1 |

***Figure 6-88*** List of complains

Rename the new step to Complaint. In the next step, you need a list starting from `0` that includes the cumulative values from the complaint list. There are several ways to achieve this, but one of the most efficient methods is by using the following formula, using the `List.Generate()` function (this function is explained in depth in Chapter 9), which results in Figure 6-89.

```
= List.Buffer((List.Generate(
            () => {0,0},
            each  _{0} <= List.Count(Complaint),
            each {_{0}+1,_{1}+ Complaint{_{0}}},
            each _{1})))
```



```
= List.Buffer((List.Generate(
```

| | List |
|---|---|
| 1 | 0 |
| 2 | 1 |
| 3 | 2 |
| 4 | 4 |
| 5 | 5 |
| 6 | 6 |
| 7 | 10 |
| 8 | 11 |
| 9 | 14 |
| 10 | 15 |
| 11 | 16 |
| 12 | 18 |
| 13 | 19 |
| 14 | 20 |
| 15 | 21 |
| 16 | 22 |
| 17 | 23 |
| 18 | 25 |
| 19 | 26 |
| 20 | 27 |

***Figure 6-89*** Cumulative list of complaints

Let's call the previous step Buffer. By using the following formula, you can solve the problem in a more efficient way:

```
= Table.Group(
        #"Added Index",
        "Index",
        {{"IDs", each Text.Combine(_[Complaint ID],",")}},
        0,
        (s,c)=>Number.From((Buffer{c+1}-Buffer{s})>5))
```

The initial steps of this formula are provided in Table 6-15.

***Table 6-15*** Summary of the Steps

| Step | s | c | Buffer{c+1} | Buffer{s} | Number.From(..) | Group |
|---|---|---|---|---|---|---|
| 1 | 0 | 1 | 2 | 0 | 0 | 1 |
| 2 | 0 | 2 | 4 | 0 | 0 | 1 |
| 3 | 0 | 3 | 5 | 0 | 0 | 1 |
| 4 | 0 | 4 | 6 | 0 | 1 | - |
| 4 | 4 | 5 | 6 | 5 | 0 | 2 |
| 5 | 4 | 6 | 10 | 5 | 0 | 2 |
| 6 | 4 | 7 | 11 | 5 | 1 | - |

| Step | s | c | Buffer{c+1} | Buffer{s} | Number.From(..) | Group |
|---|---|---|---|---|---|---|
| 6 | 7 | 8 | 15 | 11 | 0 | 3 |
| 7 | 7 | 9 | 16 | 11 | 0 | 3 |
| 7 | 7 | 10 | 18 | 11 | 1 | - |

The complete code for solving this problem is provided here, and it executes in under a second for a table with 1 million rows.

```
let
  Source = Excel.CurrentWorkbook(){[Name = "Table2"]}[Content],
  #"Added Index" = Table.AddIndexColumn(Source, "Index", 0, 1,
Int64.Type),
  Complaint = List.Buffer(#"Added Index"[Complaint No]),
  Buffer = List.Buffer(
    (
      List.Generate(
        () => {0, 0},
        each _{0} <= List.Count(Complaint),
        each {_{0} + 1, _{1} + Complaint{_{0}}},
        each _{1}
      )
    )
  ),
  #"Grouped Rows" = Table.Group(
    #"Added Index",
    "Index",
    {{"IDs", each Text.Combine(_[Complaint ID], ",")}},
    0,
    (s, c) => Number.From((Buffer{c + 1} - Buffer{s}) > 5)
  )
in
  #"Grouped Rows"
```

## Summary

The advanced `Table.Group()` function in Power Query is presented in this chapter as a tool for effectively summarizing rows within a table. Using the UI, the function's first three arguments allow users to specify the table name, the column used for grouping, and a list of new column names with their respective operations.

These three arguments alone can address numerous real-world challenges. However, the fourth and fifth arguments significantly enhance the function's versatility. The fourth argument allows you to switch the grouping logic from global (across all rows) to local (among neighboring rows), while the fifth enables you to use custom grouping criteria. In this fifth argument, you can define a custom function. The custom function should include two arguments (usually in the type of record) that represent rows from the source table. For every two rows represented by the custom function arguments, when the custom function returns a value of `1`, the rows are grouped together in the result; otherwise, they are placed in separate groups.

The next chapter covers essential tips for merging and appending multiple tables.

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# 7. Merging and Appending Tables

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When working with multiple tables, you might need to combine them in different ways by using append or merge. The *append* process involves stacking tables on top of each other, essentially putting rows from multiple tables under each other in a single table. This is useful when you have similar datasets across different tables and want to consolidate them into one unified dataset. The *merge* process, on the other hand, involves combining columns from multiple tables based on one (or more) common key or column. This allows you to enrich one table with data from another table by aligning them side by side based on matching values and selected merging logic.

Consider the Source1 and Source2 tables, which contain historical sales data for the years 2022 and 2023, respectively. They are shown in Table 7-1 and Table 7-2.

***Table 7-1*** Source1: Sales in 2022

| Year | Product | Sales |
|---|---|---|
| 2022 | A | 140 |
| 2022 | B | 210 |
| 2022 | C | 410 |

***Table 7-2*** Source1: Sales in 2023

| Year | Product | Sales |
|---|---|---|
| 2023 | A | 25 |
| 2023 | B | 360 |
| 2023 | C | 800 |
| 2024 | D | 51 |

In this example, the tables contain data from different years, but they have the same columns. To append the tables and stack them vertically, follow these steps.

Select one of the tables, go to the Home tab, and choose Append Queries, as shown in Figure 7-1. In the dialog that appears, configure the settings as shown in Figure 7-2. This will result in a combined table, as illustrated in Figure 7-3.

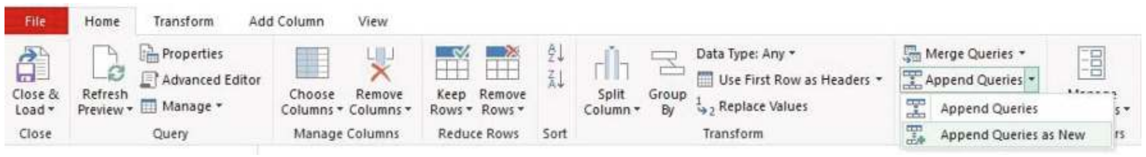
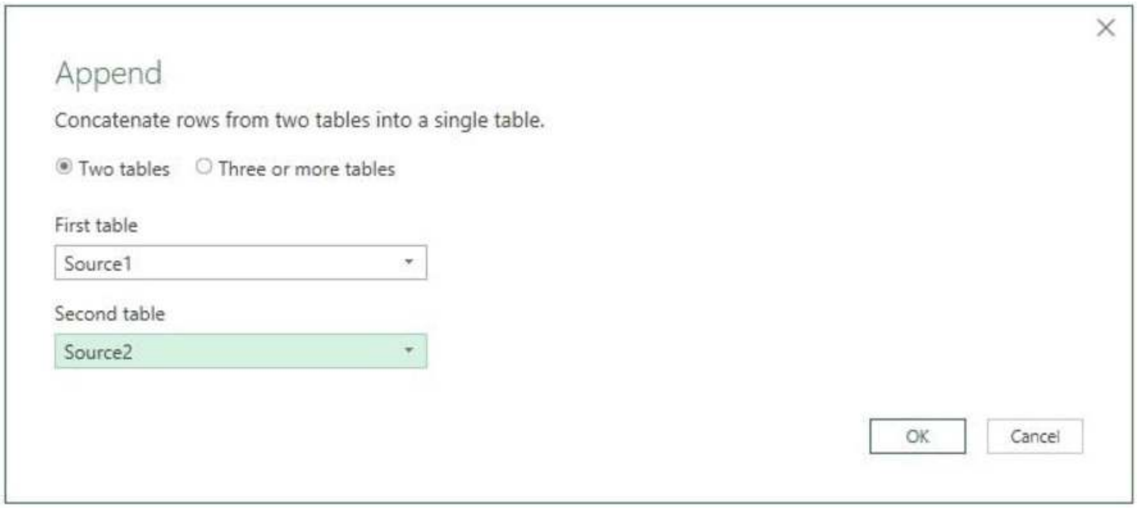


***Figure 7-1*** Choosing Append Queries as New



Append

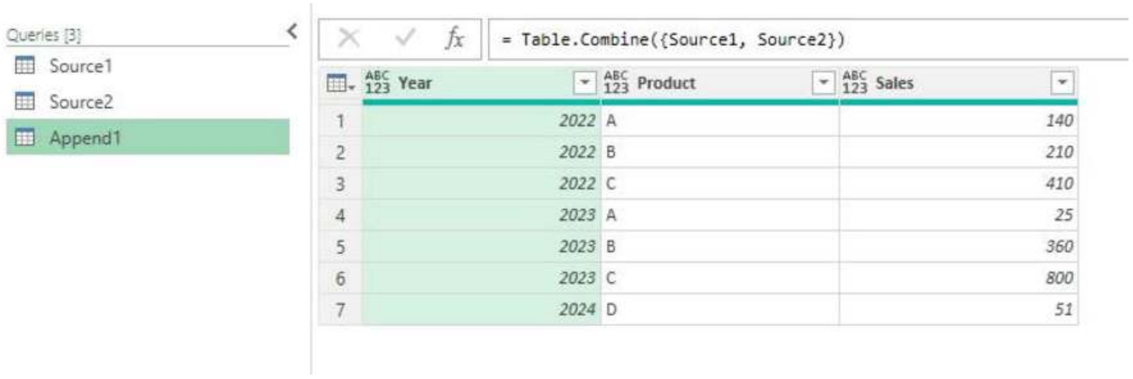
Concatenate rows from two tables into a single table.

[✓ Two tables] Three or more tables

First table: Source1

Second table: Source2

***Figure 7-2*** Setting the Append query



```
= Table.Combine({Source1, Source2})
```

| | Year | Product | Sales |
|---|---|---|---|
| 1 | 2022 | A | 140 |
| 2 | 2022 | B | 210 |
| 3 | 2022 | C | 410 |
| 4 | 2023 | A | 25 |
| 5 | 2023 | B | 360 |
| 6 | 2023 | C | 800 |
| 7 | 2024 | D | 51 |

***Figure 7-3*** The result of the "Append Queries as New" option

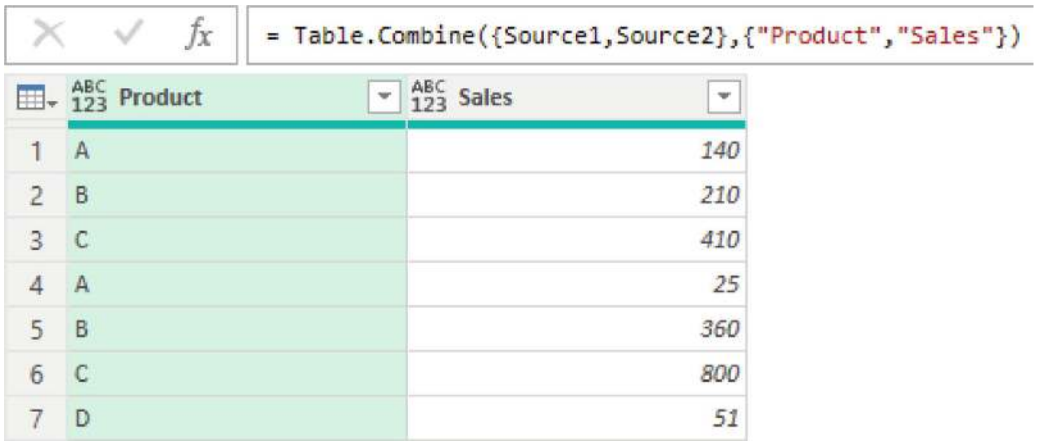
**Note** As shown in Figure 7-1, there are two options for appending queries: Append Queries and Append Queries as New. Selecting Append Queries as New creates a new query, where the appended table is provided as the result, as shown in Figure 7-3. Selecting Append Queries adds the appended table as a new step within the existing selected query.

The previous steps result in the following formula in the formula bar, which combines (appends) two or more tables vertically:

```
= Table.Combine({Source1, Source2})
```

This example uses the `Table.Combine()` function to append tables in Power Query. It takes two arguments—the first argument is a list containing the names of the tables to be combined, and you can use the second argument to limit the resulting table to specific columns. You do this by specifying the column names in the second argument of the `Table.Combine()` functions in the type list. Rewriting the previous formula as shown here will result in an appended table that includes only the Product and Year columns (see Figure 7-4):

```
= Table.Combine({Source1,Source2},{"Product","Sales"})
```



```
= Table.Combine({Source1,Source2},{"Product","Sales"})
```

|  | Product | Sales |
|---|---|---|
| 1 | A | 140 |
| 2 | B | 210 |
| 3 | C | 410 |
| 4 | A | 25 |
| 5 | B | 360 |
| 6 | C | 800 |
| 7 | D | 51 |

***Figure 7-4*** Selecting the column list for appending

**Note** In addition to using the `Table.Combine()` function, the `&` operator can also be used to append tables. These formulas produce the same result:

```
= Table.Combine({Source1, Source2})
```

```
=Source1 & Source2
```

In this case, as explained in Chapter 2, you can limit the result to specific columns by specifying the desired column names in brackets. The following formula returns only the Product and Sales columns in the resulting table:

```
= (Source1 & Source2)[[Product],[Sales]]
```

In another scenario, you may need to extract information from one table and add it as a new column to another table. For example, consider the Historical_Sales and Product_Info tables, as shown in Table 7-3 and Table 7-4.

***Table 7-3*** Historical_Sales Table

| Date | Product | Quantity |
|---|---|---|
| 2/21/2024 | A | 2 |
| 2/22/2024 | B | 2 |
| 2/23/2024 | A | 1 |
| 2/23/2024 | C | 3 |

***Table 7-4*** Product_Info Table

| Product Name | Price |
|---|---|
| A | 100 |
| B | 150 |
| C | 200 |

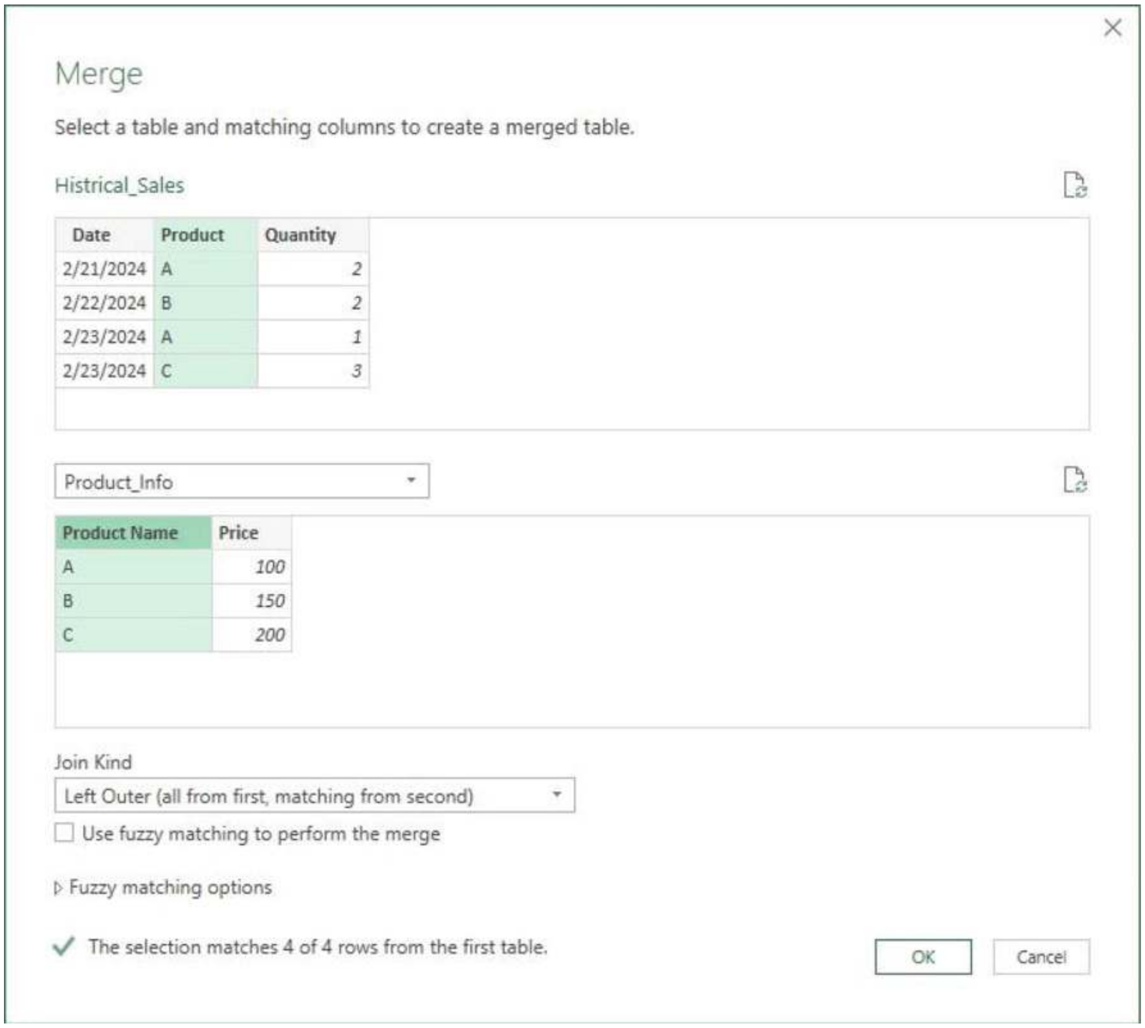
To extract product prices from the Product_Info table and add them as a new column to the Historical_Sales table, follow these steps:

1. Select the Historical_Sales table.

2. From the Home tab, select the Merge Queries command. This opens the Merge window, where the Historical_Sales table is automatically selected at the top.

3. Next, in the bottom part, choose the table from which you want to extract information—in this case, Product_Info.

4. Then, select the common column(s) that exist in both tables. In this example, the common column is the product name, which appears as the Product column in the `Historical_Sales` table and as the Product Name column in the `Product_Info` table. Configure the settings as shown in Figure 7-5 by selecting the mentioned columns and clicking OK. This results in Figure 7-6.



Merge

Select a table and matching columns to create a merged table.

Histrical_Sales

| Date | Product | Quantity |
|---|---|---|
| 2/21/2024 | A | 2 |
| 2/22/2024 | B | 2 |
| 2/23/2024 | A | 1 |
| 2/23/2024 | C | 3 |

Product_Info

| Product Name | Price |
|---|---|
| A | 100 |
| B | 150 |
| C | 200 |

Join Kind

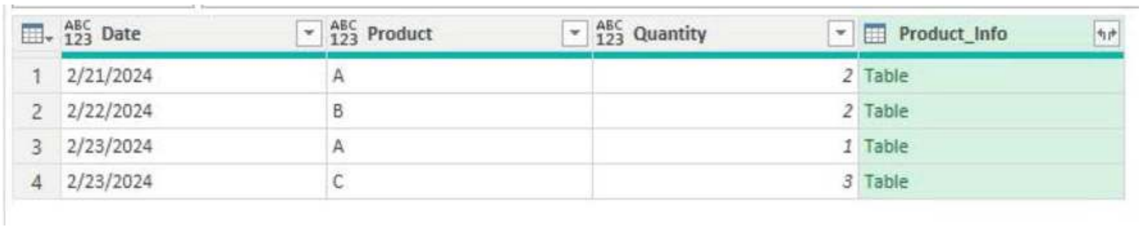
Left Outer (all from first, matching from second)

☐ Use fuzzy matching to perform the merge

Fuzzy matching options

✓ The selection matches 4 of 4 rows from the first table.

*Figure 7-5* Setting the merging query



| | Date | Product | Quantity | Product_Info |
|---|---|---|---|---|
| 1 | 2/21/2024 | A | 2 | Table |
| 2 | 2/22/2024 | B | 2 | Table |
| 3 | 2/23/2024 | A | 1 | Table |
| 4 | 2/23/2024 | C | 3 | Table |

*Figure 7-6* The result of the merging query

In the resulting table, a new column called Product_Info, including the information of the matched rows in the `Product_Info` table, will be added to the `Historical_Sales` table. You can then extract the product price by expanding this new column. After applying this step, the formula for merging the tables generated in the formula bar is as follows:

```
= Table.NestedJoin(Source, {"Product"}, Product_Info, {"Product Name"},
"Product_Info", JoinKind.LeftOuter)
```

As shown in Figure 7-5, the Merge window includes a setting for Join Kind, which offers various options, including Left Outer, Right Outer, Full Outer, Inner, Left Anti, and Right Anti. Each option affects the merging logic differently, determining how matched and unmatched rows are handled. (In this example, the `Historical_Sales` table is the left table, and the `Product_Info` table is the right table.)

Now revise the `Product_Info` table, as shown in Table 7-5, and consider the `Historical_Sales` table as previously shown. In this case:

– Product B appears only in the left table.
– Product A is repeated twice in the left table, and once in the right table.
– Product D appears only in the right table and is listed twice.
– Product C appears twice in the right table and once in the left table.

The resulting tables of applying different Join Kind settings under each merge logic are shown in Figure 7-7 to Figure 7-12:

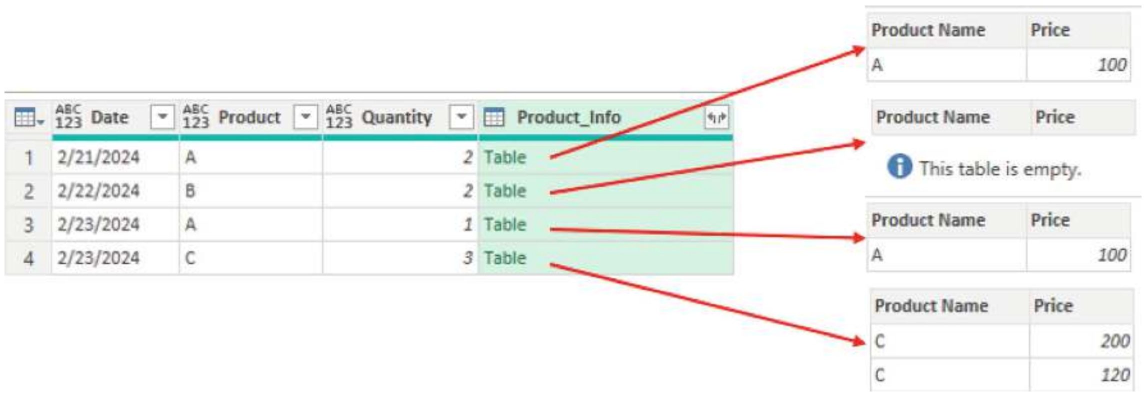
- **Left Outer Join:** In the Left Outer Join, the merge keeps all rows from the left table and brings in matching rows from the right table wherever possible. If a match exists, the corresponding data from the right table is included; otherwise, NULL values appear for unmatched rows. In this case, Product B has no match in the right table, so it remains in the result with NULL values in the merged columns. Product A appears twice in the left table but has only one corresponding row in the right table, meaning both instances of A will get the same match. Product C, however, appears twice in the right table but only once in the left table, causing it to be duplicated in the result.
- **Right Outer Join:** This merge keeps all rows from the right table, ensuring that every row from it appears in the final result. Any matching rows from the left table are brought in, while NULL values appear where no match exists. In this scenario, Product D, which is only present in the right table, appears in the result with NULLs from the left table. Product B doesn't appear in the resulting table.
- **Full Outer Join:** This merge includes all rows from both tables, regardless of whether a match exists. If a product appears in both tables, the corresponding values are merged; otherwise, NULL values fill the gaps. This ensures that Product B, which only exists in the left table, and Product D, which only exists in the right table, both appear in the result with NULL values for the missing side. Products A and C, which exist in both tables, are merged based on matching logic, leading to multiple rows when necessary.
- **Inner Join:** This merge keeps only the rows that have a match in both tables, effectively filtering out any records that don't exist in both datasets. This means that Product B, which only appears in the left table, and Product D, which only appears in the right table, will be completely excluded. The remaining products, A and C, will be matched based on their occurrences, ensuring that every possible combination of left and right matches appears in the final result.
- **Left Anti Join:** This merge returns only the rows from the left table that do not have a match in the right table. It essentially filters out all products that appear in both tables. In this scenario, Product B is the only product unique to the left table, meaning it is the only row that remains in the final result. All other products are excluded since they have corresponding matches in the right table.
- **Right Anti Join:** This merge works in the opposite way to the Left Anti Join, keeping only rows from the right table that have no match in the left table. Here, Product D is the only product unique to the right table, so it is the only row that appears in the final result. All other products, which have at least one match in the left table, are filtered out.

The rest of this chapter explores more tips about using append and merge queries.

***Table 7-5*** Product_Info table

| Product Name | Price |
|---|---|
| A | 100 |
| C | 200 |

| Product Name | Price |
|---|---|
| D | 50 |
| D | 25 |
| C | 120 |



| | Date | Product | Quantity | Product_Info |
|---|---|---|---|---|
| 1 | 2/21/2024 | A | 2 | Table |
| 2 | 2/22/2024 | B | 2 | Table |
| 3 | 2/23/2024 | A | 1 | Table |
| 4 | 2/23/2024 | C | 3 | Table |

| Product Name | Price |
|---|---|
| A | 100 |

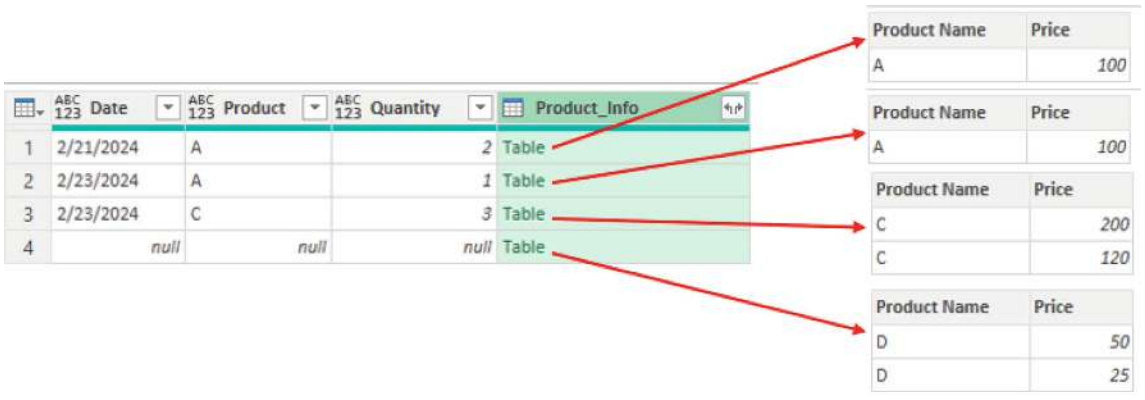
| Product Name | Price |
|---|---|

This table is empty.

| Product Name | Price |
|---|---|
| A | 100 |

| Product Name | Price |
|---|---|
| C | 200 |
| C | 120 |

*Figure 7-7* The resulting table under the Left Outer logic



| | Date | Product | Quantity | Product_Info |
|---|---|---|---|---|
| 1 | 2/21/2024 | A | 2 | Table |
| 2 | 2/23/2024 | A | 1 | Table |
| 3 | 2/23/2024 | C | 3 | Table |
| 4 | null | null | null | Table |

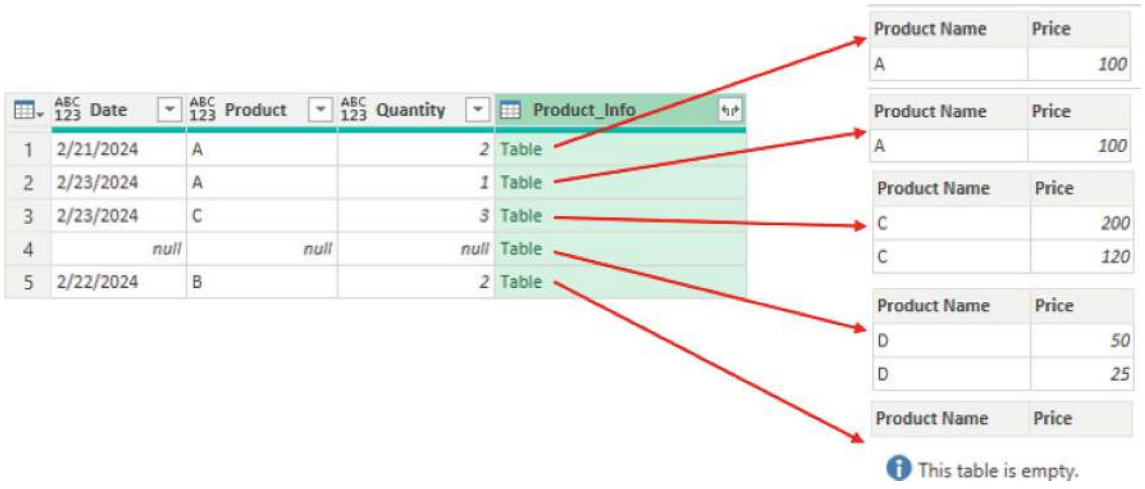
| Product Name | Price |
|---|---|
| A | 100 |

| Product Name | Price |
|---|---|
| A | 100 |

| Product Name | Price |
|---|---|
| C | 200 |
| C | 120 |

| Product Name | Price |
|---|---|
| D | 50 |
| D | 25 |

*Figure 7-8* The resulting table under the Right Outer logic



| | Date | Product | Quantity | Product_Info |
|---|---|---|---|---|
| 1 | 2/21/2024 | A | 2 | Table |
| 2 | 2/23/2024 | A | 1 | Table |
| 3 | 2/23/2024 | C | 3 | Table |
| 4 | null | null | null | Table |
| 5 | 2/22/2024 | B | 2 | Table |

| Product Name | Price |
|---|---|
| A | 100 |

| Product Name | Price |
|---|---|
| A | 100 |

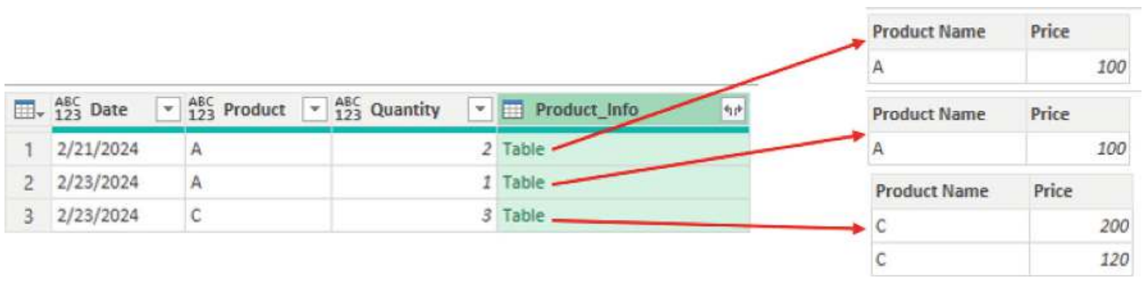
| Product Name | Price |
|---|---|
| C | 200 |
| C | 120 |

| Product Name | Price |
|---|---|
| D | 50 |
| D | 25 |

| Product Name | Price |
|---|---|

This table is empty.

*Figure 7-9* The resulting table under the Full Outer logic



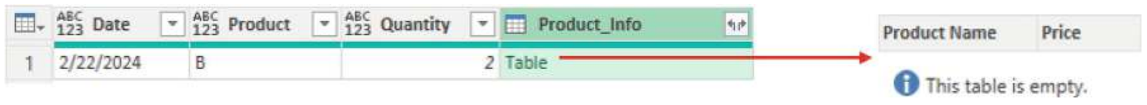
|  | Date | Product | Quantity | Product_Info |
|---|---|---|---|---|
| 1 | 2/21/2024 | A | 2 | Table |
| 2 | 2/23/2024 | A | 1 | Table |
| 3 | 2/23/2024 | C | 3 | Table |

| Product Name | Price |
|---|---|
| A | 100 |

| Product Name | Price |
|---|---|
| A | 100 |

| Product Name | Price |
|---|---|
| C | 200 |
| C | 120 |

*Figure 7-10* The resulting table under the Inner logic

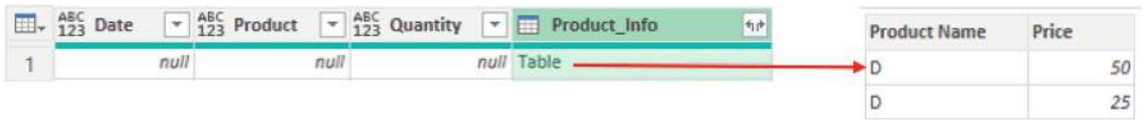


|  | Date | Product | Quantity | Product_Info |
|---|---|---|---|---|
| 1 | 2/22/2024 | B | 2 | Table |

| Product Name | Price |
|---|---|

This table is empty.

*Figure 7-11* The resulting table under the Left Anti logic



|  | Date | Product | Quantity | Product_Info |
|---|---|---|---|---|
| 1 | null | null | null | Table |

| Product Name | Price |
|---|---|
| D | 50 |
| D | 25 |

*Figure 7-12* The resulting table under the Right Anti logic

## Combining Tables

Consider the monthly sales data for Spring provided in Table 7-6, Table 7-7, and Table 7-8. Combine all these tables to create a unified table for Spring, where each row represents a region, each column represents a product, and the values show the total sales of each product in that region across different months.

*Table 7-6* Table1: Sales in March

| Regions | Product A | Product B | Product E |
|---|---|---|---|
| Region 1 | 98 | 45 | 91 |
| Region 2 | 37 | 71 | 23 |
| Region 3 | 92 | 39 | 90 |

*Table 7-7* Table2: Sales in April

| Regions | Product A | Product D | Product C | Product E |
|---|---|---|---|---|
| Region 1 | 90 | 30 | 95 | 74 |
| Region 4 | 51 | 41 | 80 | 17 |
| Region 3 | 88 | 37 | 69 | 70 |

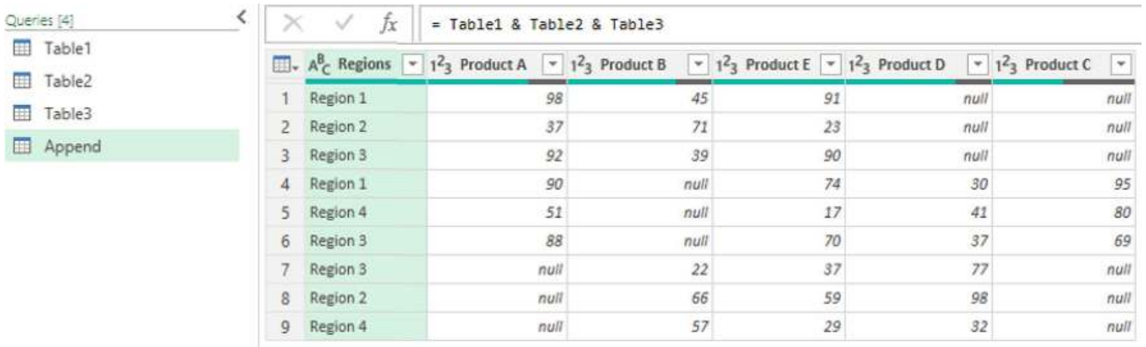
*Table 7-8* Table3: Sales in May

| Regions | Product D | Product B | Product E |
|---|---|---|---|
| Region 3 | 77 | 22 | 37 |
| Region 2 | 98 | 66 | 59 |
| Region 4 | 32 | 57 | 29 |

**Note** The data in this example is provided in an Excel file titled `01 Combining Tables.xlsx`.

As mentioned in the introduction, tables can be appended using the `Table.Combine()` function or the `&` operator. To solve this problem, create a blank query and write the following formula in the formula bar, resulting in the appended version of the tables shown in Figure 7-13:

```
= Table1 & Table2 & Table3
```



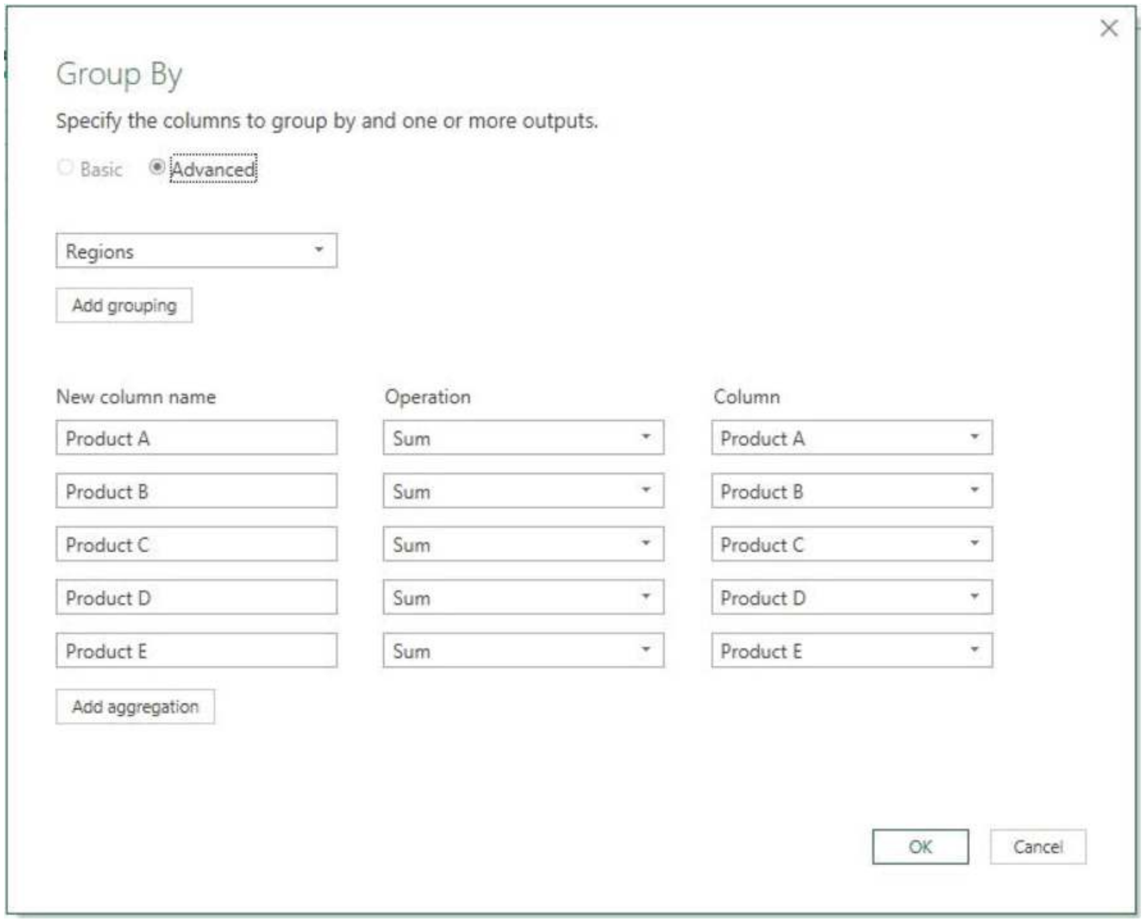
Queries [4]: Table1, Table2, Table3, Append

```
= Table1 & Table2 & Table3
```

| | Regions | Product A | Product B | Product E | Product D | Product C |
|---|---|---|---|---|---|---|
| 1 | Region 1 | 98 | 45 | 91 | null | null |
| 2 | Region 2 | 37 | 71 | 23 | null | null |
| 3 | Region 3 | 92 | 39 | 90 | null | null |
| 4 | Region 1 | 90 | null | 74 | 30 | 95 |
| 5 | Region 4 | 51 | null | 17 | 41 | 80 |
| 6 | Region 3 | 88 | null | 70 | 37 | 69 |
| 7 | Region 3 | null | 22 | 37 | 77 | null |
| 8 | Region 2 | null | 66 | 59 | 98 | null |
| 9 | Region 4 | null | 57 | 29 | 32 | null |

***Figure 7-13*** Combining tables

In the next step, rows belonging to the same region need to be aggregated. For example, rows 1 and 4 represent Region 1 and should be combined accordingly using the Group By command (or unpivoting the table and then using pivoting, as explained in Chapter 5, which is a better solution when faced with several column names). See Figure 7-14 for the proper settings. Click OK to get the result in Figure 7-15.



Group By

Specify the columns to group by and one or more outputs.

Basic [✓ Advanced]

Regions

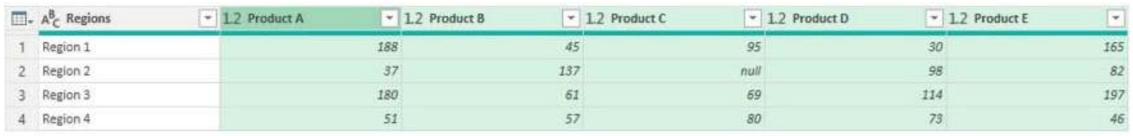
Add grouping

| New column name | Operation | Column |
|---|---|---|
| Product A | Sum | Product A |
| Product B | Sum | Product B |
| Product C | Sum | Product C |
| Product D | Sum | Product D |
| Product E | Sum | Product E |

Add aggregation

OK Cancel

***Figure 7-14*** Settings of Group By



| | Regions | Product A | Product B | Product C | Product D | Product E |
|---|---|---|---|---|---|---|
| 1 | Region 1 | 188 | 45 | 95 | 30 | 165 |
| 2 | Region 2 | 37 | 137 | null | 98 | 82 |
| 3 | Region 3 | 180 | 61 | 69 | 114 | 197 |
| 4 | Region 4 | 51 | 57 | 80 | 73 | 46 |

***Figure 7-15*** The results of Group By

## Calculating Weighted Averages

The Production table includes monthly production figures (in meters) for various machines. It's shown in Table 7-9. The Sample table lists the weight (kg/m) of product samples produced by different machines and is shown Table 7-10. Calculate the average weight of products (kg/m) produced each month using these tables.

***Table 7-9*** Production: Monthly Production by Meter by Different Machinery

| Month | Machine Code | Production (m) |
|---|---|---|
| 1 | A | 100 |
| 2 | A | 183 |
| 3 | A | 55 |
| 1 | B | 220 |
| 3 | B | 231 |
| 2 | C | 100 |
| 3 | C | 220 |

***Table 7-10*** Sample: Weight of Samples

| Machine Code | Month | Sample | Weight (kg/Meter) |
|---|---|---|---|
| A | 1 | 1 | 1.25 |
| A | 1 | 2 | 1.2 |
| B | 1 | 1 | 1.25 |
| A | 1 | 3 | 1.22 |
| A | 1 | 4 | 1.24 |
| B | 1 | 2 | 1.25 |
| C | 2 | 1 | 1.29 |
| C | 2 | 2 | 1.22 |
| A | 2 | 1 | 1.33 |
| C | 2 | 3 | 1.39 |
| A | 2 | 2 | 1.26 |
| C | 2 | 4 | 1.21 |
| C | 3 | 1 | 1.32 |
| A | 3 | 1 | 1.28 |
| A | 3 | 2 | 1.33 |
| B | 3 | 1 | 1.27 |

**Note** The data in this example is provided in an Excel file titled `02 Calculating Weighted Averages.xlsx`.

To address this problem for Month 1, follow these steps:

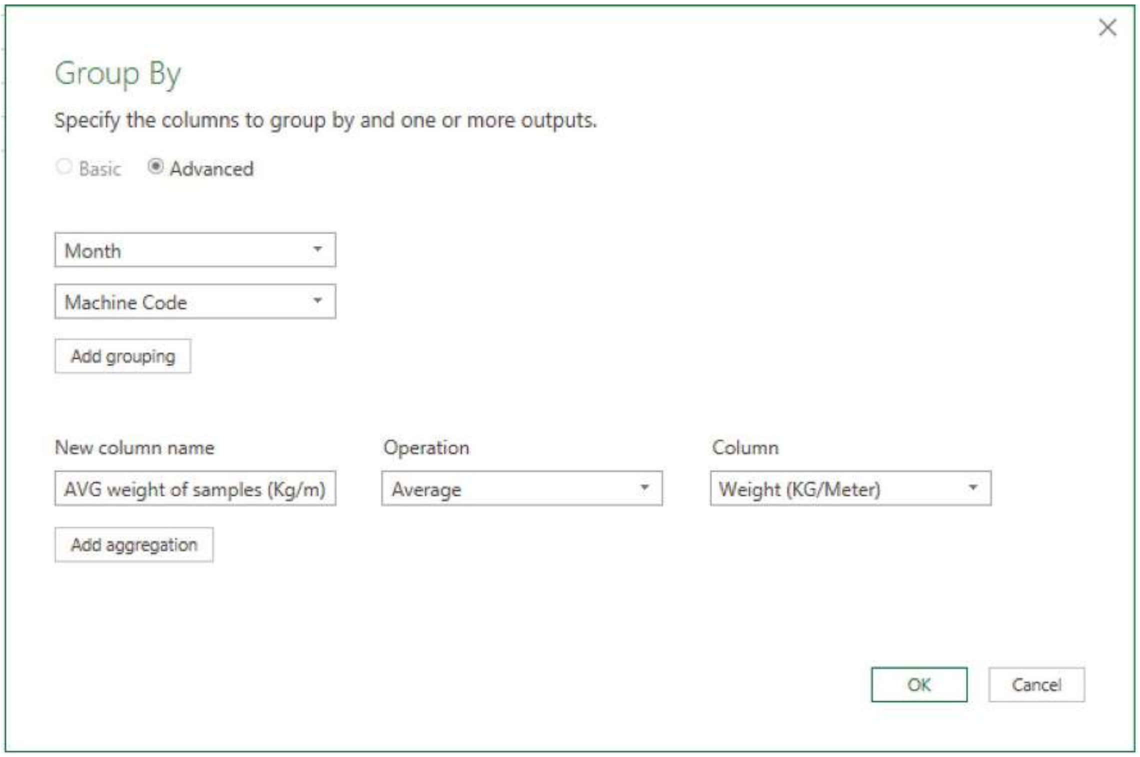
1. **Calculate Average Weights (kg/m):** First, compute the average weights of a meter for the sample products produced by each machine in each month presented in the Sample table:

– For machinery A in month 1: Average weight of samples per meter = (1.25+1.2+1.22+1.24)/4= 1.2275
– For machinery B in month 1: Average weight of samples per meter = (1.25+1.25)/2=1.25

2. Calculate the average of Production Weight (kg/m) for each month. For example for month 1:

– Machinery A produced 100 meters of products. The average weight per meter, calculated in the previous step, is 1.2275 kg/m.
– Machinery B produced 220 meters with an average weight per meter of 1.25 kg/m.
– The average weight of each meter of products (kg/m) produced in this month is calculated by (100*1.2275+220*1.25)/(100+220)=397/320=1.242

To solve the problem according to the first step and calculate the average weight of each meter of product produced by each machine in each month, you can use the Group By command. Select the Sample table, and from the Home tab, choose the Group By command. Then apply the settings shown in Figure 7-16 to group the Sample table by Month and Machine Code. Use the Average operation over the Weight column to achieve the table shown in Figure 7-17.


Group By

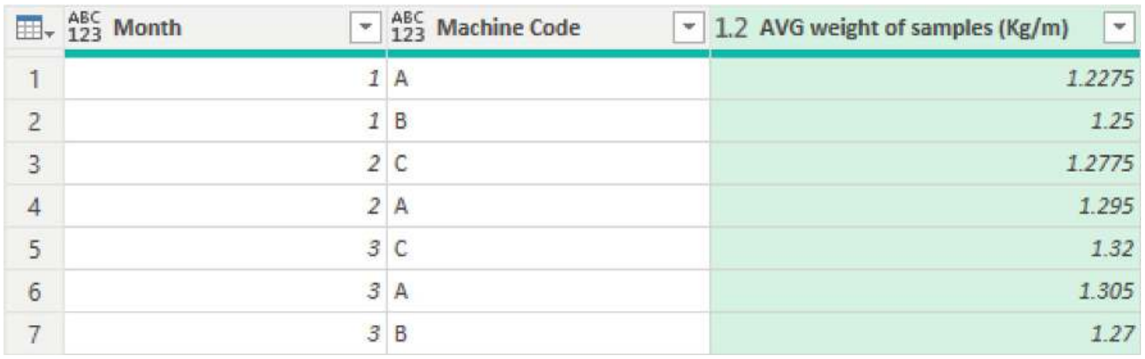
Specify the columns to group by and one or more outputs.

Basic [✓ Advanced]

Month
Machine Code

New column name: AVG weight of samples (Kg/m)
Operation: Average
Column: Weight (KG/Meter)

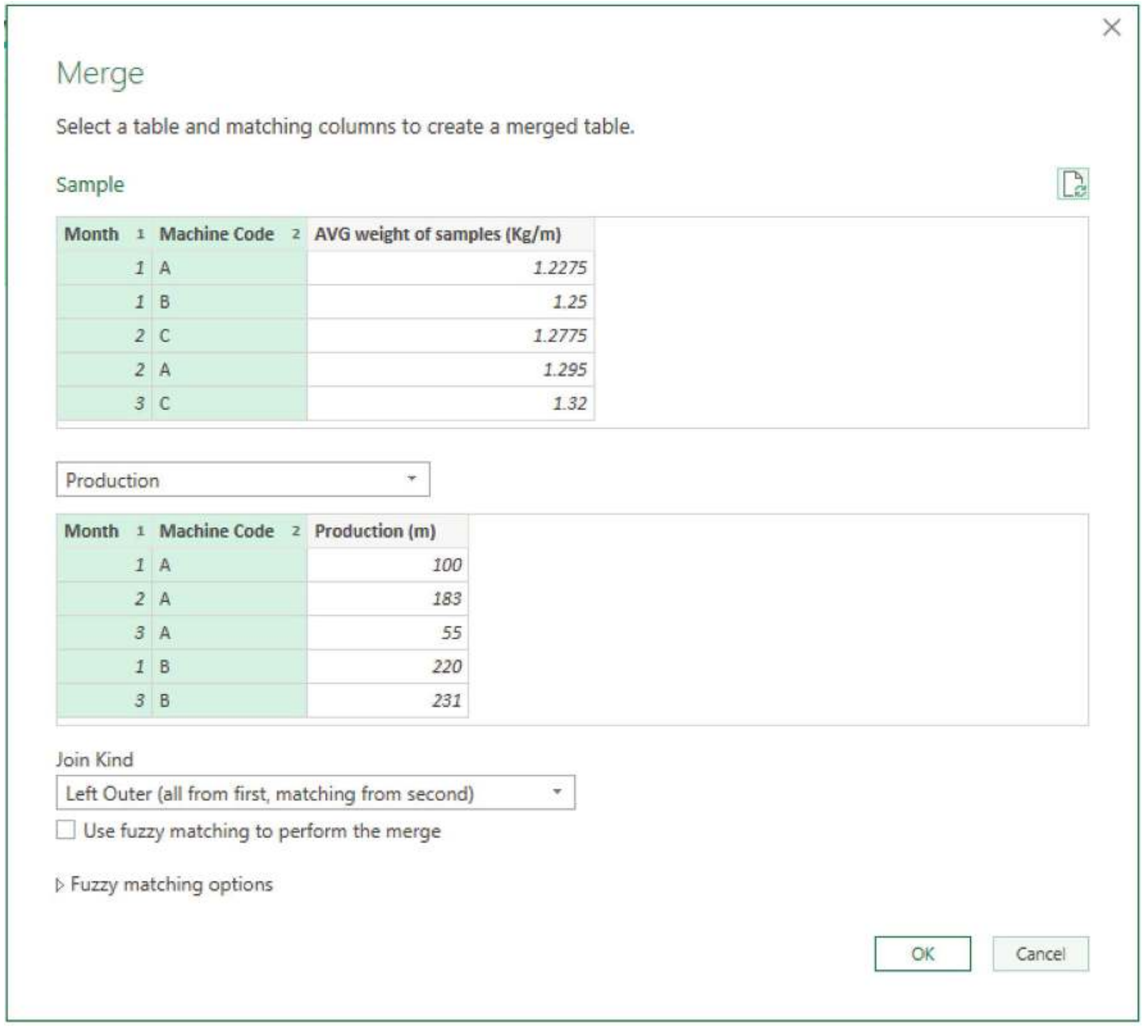
*Figure 7-16* Settings of Group By



| | Month | Machine Code | AVG weight of samples (Kg/m) |
|---|---|---|---|
| 1 | 1 | A | 1.2275 |
| 2 | 1 | B | 1.25 |
| 3 | 2 | C | 1.2775 |
| 4 | 2 | A | 1.295 |
| 5 | 3 | C | 1.32 |
| 6 | 3 | A | 1.305 |
| 7 | 3 | B | 1.27 |

*Figure 7-17* The results of Group By

The resulting table shows the average weight of samples (kg/m) produced by each machine in different months. This information needs to be merged with the data from the Production table based on the Month and Machine Code columns. To merge the tables, select the Sample table. Then go to the Home tab and click Merge Queries. In the Merge window, select the Production code for the right table. In this example, two columns should be considered for merging, so in the left table, first select Month column, then hold Ctrl and select the Machine Code column as the second column. Repeat this process on the right table, ensuring the selection is in the same order (Month and Machine Code). This will show the numbers 1 and 2 next to the column names, as shown in Figure 7-18. Clicking OK results in the table shown in Figure 7-19.


Merge

Select a table and matching columns to create a merged table.

Sample

| Month 1 | Machine Code 2 | AVG weight of samples (Kg/m) |
|---|---|---|
| 1 | A | 1.2275 |
| 1 | B | 1.25 |
| 2 | C | 1.2775 |
| 2 | A | 1.295 |
| 3 | C | 1.32 |

Production

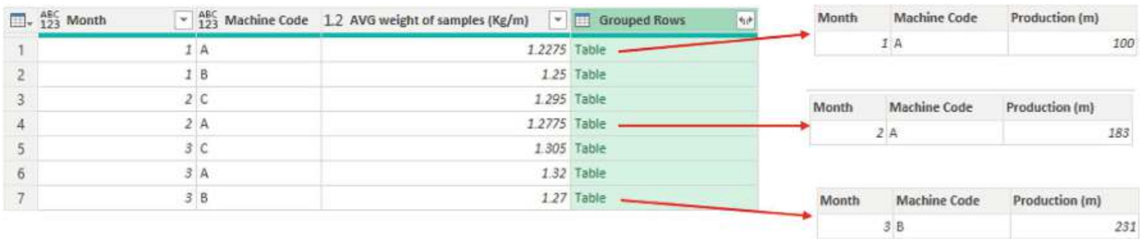
| Month 1 | Machine Code 2 | Production (m) |
|---|---|---|
| 1 | A | 100 |
| 2 | A | 183 |
| 3 | A | 55 |
| 1 | B | 220 |
| 3 | B | 231 |

Join Kind

Left Outer (all from first, matching from second)

☐ Use fuzzy matching to perform the merge

*Figure 7-18* Settings of merging queries



|  | Month | Machine Code | AVG weight of samples (Kg/m) | Grouped Rows |
|---|---|---|---|---|
| 1 | 1 | A | 1.2275 | Table |
| 2 | 1 | B | 1.25 | Table |
| 3 | 2 | C | 1.295 | Table |
| 4 | 2 | A | 1.2775 | Table |
| 5 | 3 | C | 1.305 | Table |
| 6 | 3 | A | 1.32 | Table |
| 7 | 3 | B | 1.27 | Table |

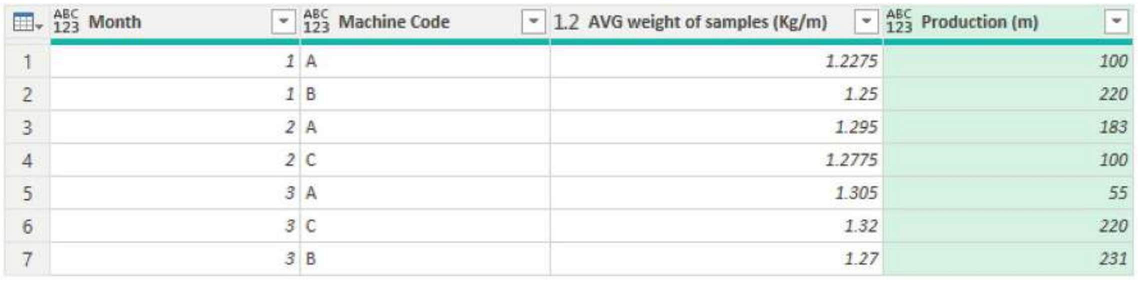
| Month | Machine Code | Production (m) |
|---|---|---|
| 1 | A | 100 |

| Month | Machine Code | Production (m) |
|---|---|---|
| 2 | A | 183 |

| Month | Machine Code | Production (m) |
|---|---|---|
| 3 | B | 231 |

*Figure 7-19* Results of merging queries

Expand the new column named Grouped Rows by selecting only the Production (m) column to obtain Figure 7-20.



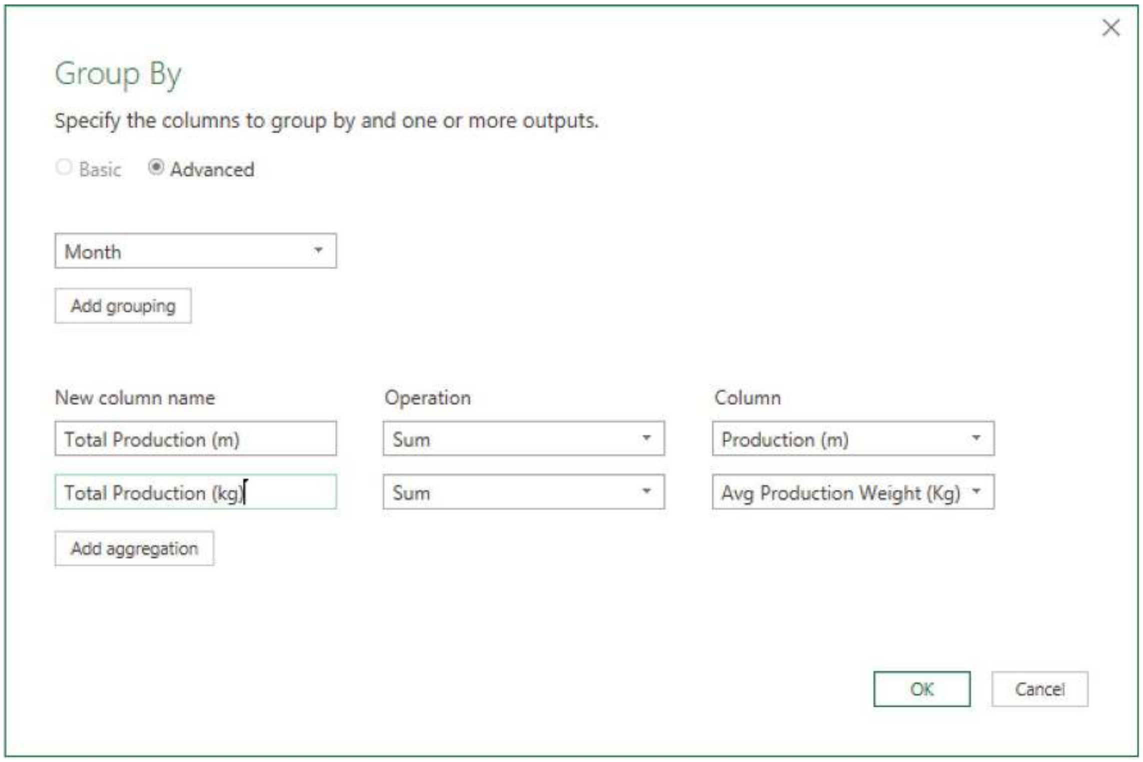
| | Month | Machine Code | AVG weight of samples (Kg/m) | Production (m) |
|---|---|---|---|---|
| 1 | 1 | A | 1.2275 | 100 |
| 2 | 1 | B | 1.25 | 220 |
| 3 | 2 | A | 1.295 | 183 |
| 4 | 2 | C | 1.2775 | 100 |
| 5 | 3 | A | 1.305 | 55 |
| 6 | 3 | C | 1.32 | 220 |
| 7 | 3 | B | 1.27 | 231 |

*Figure 7-20* The result of expanding the Grouped Rows column

The resulting table includes both the average weight of samples (kg/m) and the total production (m) for each machine in each month. To calculate the total weight of production for each machine in each month, multiply the values in these two columns (average weight and total production). Add a new column called Avg Production Weight (Kg) using the following formula in the Custom Column window.

```
=[#"AVG weight of samples (Kg/m)"]*[#"Production (m)"]
```

In the next step, you can group the rows by month and calculate the total production in meters and kilograms for each month. Using the Group By command with the settings shown in Figure 7-21 results in the table shown in Figure 7-22.



Group By

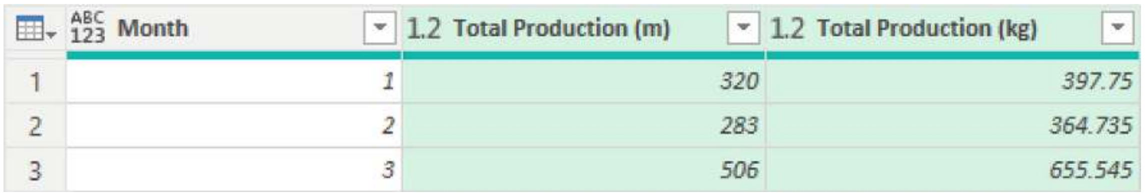
Specify the columns to group by and one or more outputs.

Basic [✓ Advanced]

Month

| New column name | Operation | Column |
|---|---|---|
| Total Production (m) | Sum | Production (m) |
| Total Production (kg) | Sum | Avg Production Weight (Kg) |

*Figure 7-21* Setting for Group By



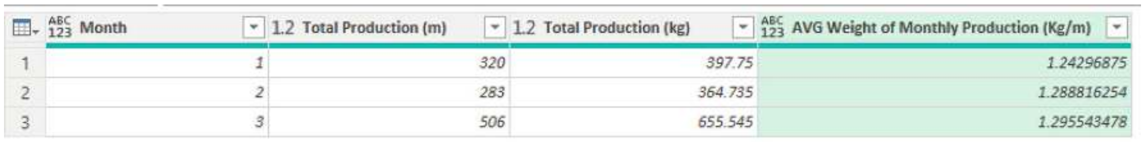
| | Month | Total Production (m) | Total Production (kg) |
|---|---|---|---|
| 1 | 1 | 320 | 397.75 |
| 2 | 2 | 283 | 364.735 |
| 3 | 3 | 506 | 655.545 |

***Figure 7-22*** The result of grouping

As the final step, add a new column called AVG Weight of Monthly Production (Kg/m) with the following formula in the Custom Column window.

```
=[#"Total Production (kg)"]/[#"Total Production (m)"]
```

This formula calculates the average weight of monthly production, as shown in Figure 7-23. Remove any extra columns to achieve the result.



| | Month | Total Production (m) | Total Production (kg) | AVG Weight of Monthly Production (Kg/m) |
|---|---|---|---|---|
| 1 | 1 | 320 | 397.75 | 1.24296875 |
| 2 | 2 | 283 | 364.735 | 1.288816254 |
| 3 | 3 | 506 | 655.545 | 1.295543478 |

***Figure 7-23*** The final result

## Reconciliation, Part 1

Consider Table 7-11, including the bank statement, and Table 7-12, including the finance department's records, for the same period. Reconcile these two tables and identify any mismatched rows. (A row is considered a mismatch if there is no corresponding transaction in the other table with the same amount on the same date.)

*Table 7-11* Bank: Including Bank Statements

| Date | Transaction Type | Amount | Transaction Category | Source |
|---|---|---|---|---|
| 19/02/2024 | Online | 700 | Flights | Bank |
| 19/02/2024 | Online | 150 | Transportation | Bank |
| 19/02/2024 | Online | 120 | Transportation | Bank |
| 19/02/2024 | In-person | 250 | Food | Bank |
| 19/02/2024 | In-person | 160 | Lodging | Bank |
| 20/02/2024 | Online | 150 | Official | Bank |
| 20/02/2024 | Online | 115 | Official | Bank |
| 20/02/2024 | Online | 5 | Official | Bank |
| 20/02/2024 | In-person | 180 | Transportation | Bank |
| 20/02/2024 | Online | 2 | Food | Bank |
| 20/02/2024 | In-person | 160 | Food | Bank |
| 20/02/2024 | Online | 10 | Food | Bank |
| 21/02/2024 | Online | 250 | Lodging | Bank |
| 21/02/2024 | In-person | 90 | Official | Bank |
| 21/02/2024 | Online | 160 | Official | Bank |
| 21/02/2024 | Online | 10 | Food | Bank |

*Table 7-12* Finance: Records on Company

| Date | Department Budget | Amount | Source |
|---|---|---|---|
| 19/02/2024 | HR | 700 | Finance |
| 19/02/2024 | Sales | 150 | Finance |
| 19/02/2024 | HR | 120 | Finance |
| 19/02/2024 | Finance | 250 | Finance |
| 19/02/2024 | HR | 160 | Finance |
| 19/02/2024 | Sales | 10 | Finance |
| 20/02/2024 | HR | 150 | Finance |
| 20/02/2024 | Sales | 120 | Finance |
| 20/02/2024 | Finance | 250 | Finance |
| 20/02/2024 | HR | 160 | Finance |
| 20/02/2024 | HR | 10 | Finance |
| 21/02/2024 | Sales | 150 | Finance |
| 21/02/2024 | Finance | 120 | Finance |
| 21/02/2024 | HR | 250 | Finance |
| 21/02/2024 | HR | 160 | Finance |
| 21/02/2024 | Sales | 10 | Finance |

In this example, for simplicity, the column names are the same in both tables, and both tables include a column indicating the source of each table. It is also assumed that there is no transaction with the similar date and amount. (This assumption is removed in the next example.)

**Note** The data in this example is provided in an Excel file titled `03 Reconciliation Part 1.xlsx`.

In finance, reconciliation refers to the process of ensuring that two sets of financial records are in agreement. The goal is to verify that the amounts in one set of records match those in another, typically comparing transactions or balances across different systems or accounts. For example:

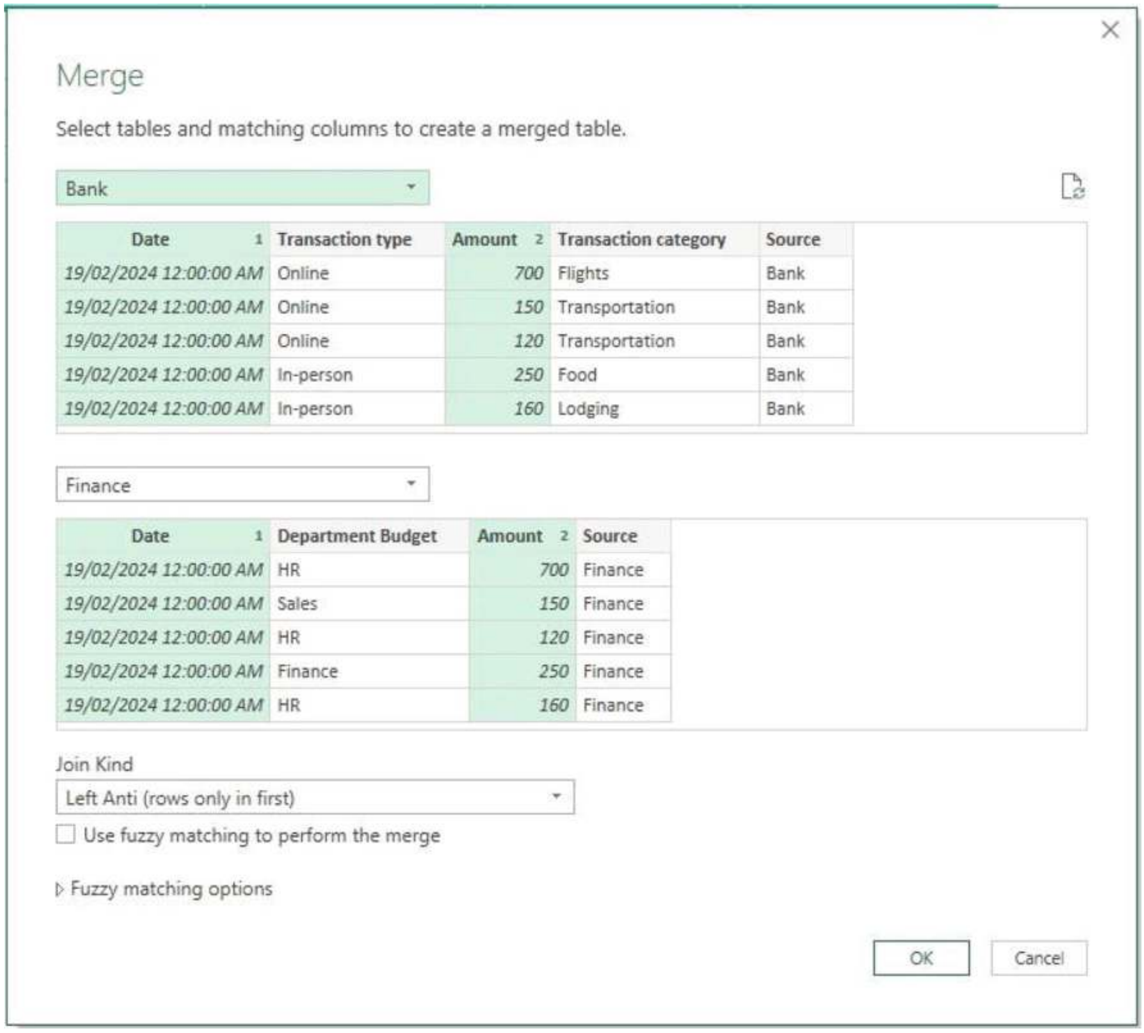
**Bank reconciliation** Comparing a company's internal financial records with the bank statement to ensure both sets match and to identify any discrepancies (such as missing transactions or errors).

**Account reconciliation** Ensuring that the balances in different accounts (e.g., accounts payable, accounts receivable) are consistent and correct.

In short, reconciliation ensures that financial data is accurate, complete, and consistent across different sources, helping to prevent errors and detect fraud.

In practice, reconciliation can be a challenging task because a row in one table might be split into multiple rows in another table. This situation cannot be easily handled by simply merging the tables. Advanced functions like `List.Generate()` and `List.Accumulate()` are often required to address such cases.

In this example, to identify the rows that are common in both tables based on the transaction date and amount, you can use the Merge command. Select the Bank table and use the Merge Queries as New option. Then apply the settings shown in Figure 7-24, ensuring that the Date and Amount columns are both selected in the same order for both tables. Set the Join Kind to Left Anti and click OK to reach Figure 7-25.



Merge

Select tables and matching columns to create a merged table.

Bank

| Date | Transaction type | Amount | Transaction category | Source |
|---|---|---|---|---|
| 19/02/2024 12:00:00 AM | Online | 700 | Flights | Bank |
| 19/02/2024 12:00:00 AM | Online | 150 | Transportation | Bank |
| 19/02/2024 12:00:00 AM | Online | 120 | Transportation | Bank |
| 19/02/2024 12:00:00 AM | In-person | 250 | Food | Bank |
| 19/02/2024 12:00:00 AM | In-person | 160 | Lodging | Bank |

Finance

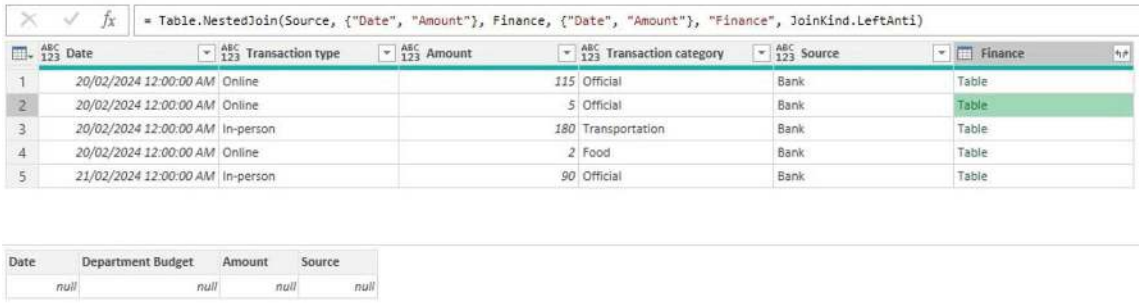
| Date | Department Budget | Amount | Source |
|---|---|---|---|
| 19/02/2024 12:00:00 AM | HR | 700 | Finance |
| 19/02/2024 12:00:00 AM | Sales | 150 | Finance |
| 19/02/2024 12:00:00 AM | HR | 120 | Finance |
| 19/02/2024 12:00:00 AM | Finance | 250 | Finance |
| 19/02/2024 12:00:00 AM | HR | 160 | Finance |

Join Kind

Left Anti (rows only in first)

☐ Use fuzzy matching to perform the merge

*Figure 7-24* Merge setting for Left Anti



```
= Table.NestedJoin(Source, {"Date", "Amount"}, Finance, {"Date", "Amount"}, "Finance", JoinKind.LeftAnti)
```

|  | Date | Transaction type | Amount | Transaction category | Source | Finance |
|---|---|---|---|---|---|---|
| 1 | 20/02/2024 12:00:00 AM | Online | 115 | Official | Bank | Table |
| 2 | 20/02/2024 12:00:00 AM | Online | 5 | Official | Bank | Table |
| 3 | 20/02/2024 12:00:00 AM | In-person | 180 | Transportation | Bank | Table |
| 4 | 20/02/2024 12:00:00 AM | Online | 2 | Food | Bank | Table |
| 5 | 21/02/2024 12:00:00 AM | In-person | 90 | Official | Bank | Table |

| Date | Department Budget | Amount | Source |
|---|---|---|---|
| null | null | null | null |

*Figure 7-25* The result of merge for Left Anti

This will allow you to extract the transactions that are present in the bank statement (the Bank table) but not in the company records (the Finance table).

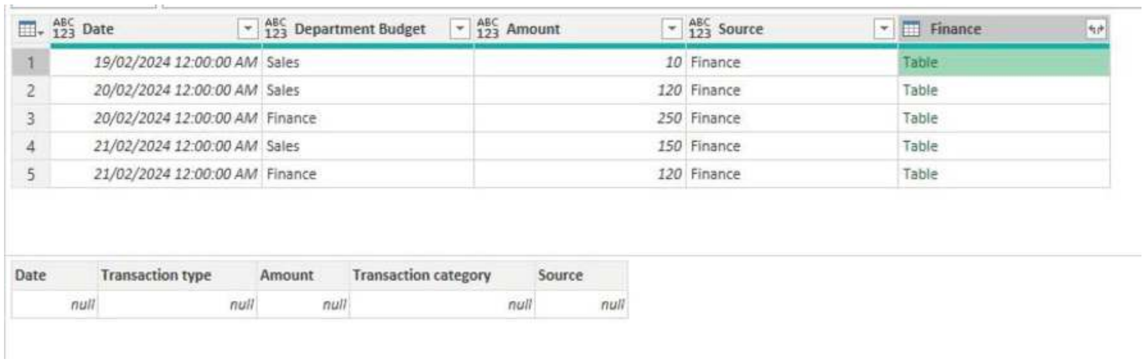
Although the resulting rows in the new Finance column are marked as Table, they all contain a null row for all the rows, as shown in Figure 7-25.

The previous steps lead to the following formula in the formula bar. It's used to merge both the tables —Bank and Finance—based on the Date and Amount columns on both the tables.

```
= Table.NestedJoin(Bank, {"Date", "Amount"}, Finance, {"Date", "Amount"},
"Finance", JoinKind.LeftAnti)
```

In the previous formula, by swapping the first and third arguments (and if the column names in both tables don't match exactly, the second argument should be swapped with the fourth argument as well), the result will change to display rows that are in the company file but not in the bank statement, as shown in Figure 7-26.

```
= Table.NestedJoin(Finance, {"Date", "Amount"}, Bank, {"Date", "Amount"},
"Finance", JoinKind.LeftAnti)
```



| | Date | Department Budget | Amount | Source | Finance |
|---|---|---|---|---|---|
| 1 | 19/02/2024 12:00:00 AM | Sales | 10 | Finance | Table |
| 2 | 20/02/2024 12:00:00 AM | Sales | 120 | Finance | Table |
| 3 | 20/02/2024 12:00:00 AM | Finance | 250 | Finance | Table |
| 4 | 21/02/2024 12:00:00 AM | Sales | 150 | Finance | Table |
| 5 | 21/02/2024 12:00:00 AM | Finance | 120 | Finance | Table |

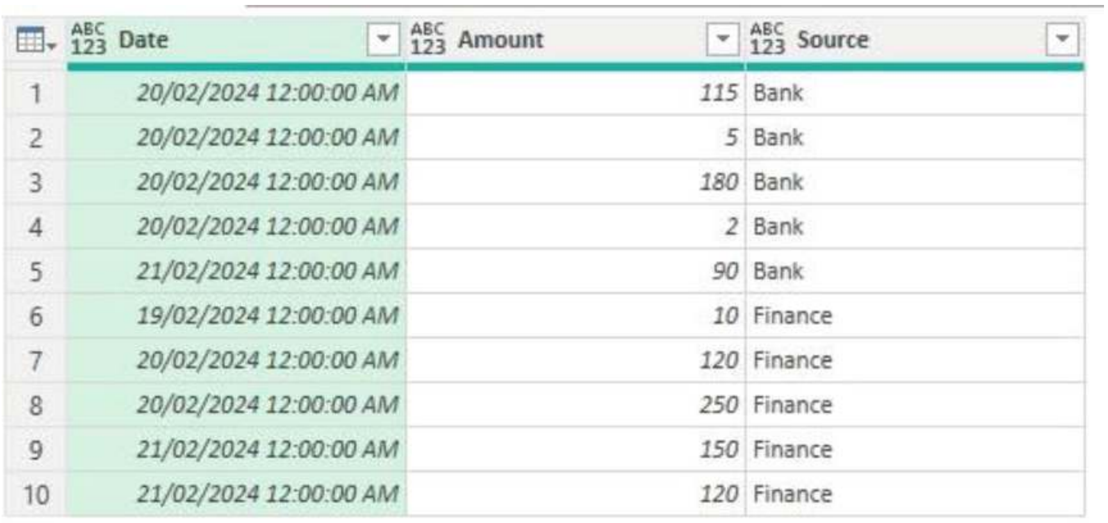
| Date | Transaction type | Amount | Transaction category | Source |
|---|---|---|---|---|
| null | null | null | null | null |

*Figure 7-26* The result of swapping arguments on the merge function

**Note** In the previous step, instead of swapping the tables, changing the merge logic to Right Anti and expanding the generated column will also lead to the same result.

You have two formulas: one returns the transactions that are in the Bank table but not in the Finance table, and the other returns the transactions that are in the Finance table but not in the Bank table. Appending these two tables will result in a complete list of all mismatched rows. Using the following formula in the formula bar will produce the output shown in Figure 7-27.

```
= Table.Combine(
      {Table.NestedJoin(Bank, {"Date", "Amount"}, Finance, {"Date",
"Amount"}, "Finance", JoinKind.LeftAnti),
      Table.NestedJoin(Finance, {"Date", "Amount"}, Bank, {"Date",
"Amount"}, "Finance", JoinKind.LeftAnti)},
      {"Date","Amount","Source"})
```



| | Date | Amount | Source |
|---|---|---|---|
| 1 | 20/02/2024 12:00:00 AM | 115 | Bank |
| 2 | 20/02/2024 12:00:00 AM | 5 | Bank |
| 3 | 20/02/2024 12:00:00 AM | 180 | Bank |
| 4 | 20/02/2024 12:00:00 AM | 2 | Bank |
| 5 | 21/02/2024 12:00:00 AM | 90 | Bank |
| 6 | 19/02/2024 12:00:00 AM | 10 | Finance |
| 7 | 20/02/2024 12:00:00 AM | 120 | Finance |
| 8 | 20/02/2024 12:00:00 AM | 250 | Finance |
| 9 | 21/02/2024 12:00:00 AM | 150 | Finance |
| 10 | 21/02/2024 12:00:00 AM | 120 | Finance |

***Figure 7-27*** The result of reconciliation

In the resulting table, the first five rows represent transactions that appear on the bank statements but not in the company records. The remaining rows correspond to transactions that are recorded in the company files but are missing from the bank statements.

## Reconciliation, Part 2

As in the previous example, this example considers the bank statement and company records tables, shown in Table 7-13 and Table 7-14, with the difference that the tables are included the rows with the same Date and Amount values. The goal is to reconcile these two tables and identify any mismatched records. For simplicity, the column names are the same in both tables, and there is a column called `Source`, which represents the source of table.

***Table 7-13*** Bank: Including Bank Statements

| Date | Transaction Type | Amount | Transaction Category | Source |
|---|---|---|---|---|
| 19/02/2024 | Online | 700 | Flights | Bank |
| 19/02/2024 | Online | 700 | Transportation | Bank |
| 19/02/2024 | Online | 120 | Transportation | Bank |
| 19/02/2024 | In-person | 250 | Food | Bank |
| 19/02/2024 | In-person | 160 | Lodging | Bank |
| 20/02/2024 | Online | 150 | Official | Bank |
| 20/02/2024 | Online | 115 | Official | Bank |
| 20/02/2024 | Online | 115 | Official | Bank |
| 20/02/2024 | In-person | 115 | Transportation | Bank |
| 20/02/2024 | Online | 2 | Food | Bank |
| 20/02/2024 | In-person | 160 | Food | Bank |
| 20/02/2024 | Online | 10 | Food | Bank |
| 21/02/2024 | Online | 250 | Lodging | Bank |
| 21/02/2024 | In-person | 90 | Official | Bank |
| 21/02/2024 | Online | 160 | Official | Bank |
| 21/02/2024 | Online | 10 | Food | Bank |

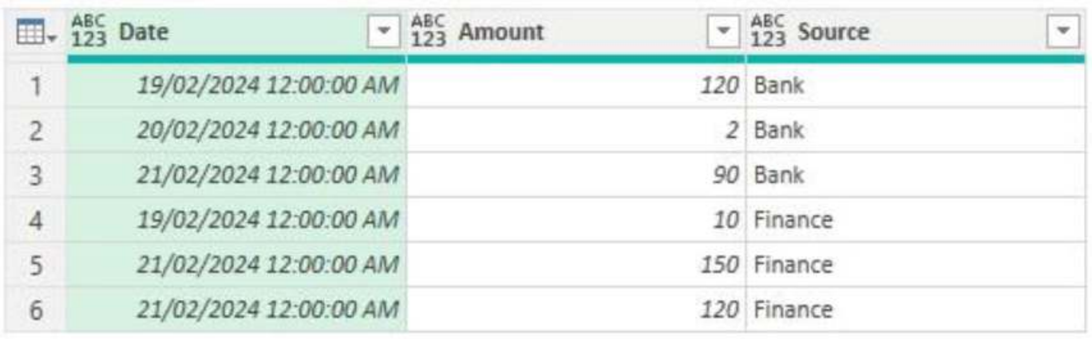
***Table 7-14*** Finance: Records on Company

| Date | Department Budget | Amount | Source |
|---|---|---|---|
| 19/02/2024 | HR | 700 | Finance |
| 19/02/2024 | Sales | 700 | Finance |
| 19/02/2024 | HR | 700 | Finance |
| 19/02/2024 | Finance | 250 | Finance |
| 19/02/2024 | HR | 160 | Finance |
| 19/02/2024 | Sales | 10 | Finance |
| 20/02/2024 | HR | 150 | Finance |
| 20/02/2024 | Sales | 115 | Finance |
| 20/02/2024 | Finance | 115 | Finance |
| 20/02/2024 | HR | 160 | Finance |
| 20/02/2024 | HR | 10 | Finance |
| 21/02/2024 | Sales | 150 | Finance |
| 21/02/2024 | Finance | 120 | Finance |
| 21/02/2024 | HR | 250 | Finance |
| 21/02/2024 | HR | 160 | Finance |
| 21/02/2024 | Sales | 10 | Finance |

**Note** The data in this example is provided in an Excel file titled `04 Reconciliation Part 2.xlsx`.

The key difference between this problem and the previous one is that, in the previous scenario, you assumed that the values of rows in the Amount column for each date were unique (i.e., no rows with duplicate amounts and dates). However, in this example, the amount of 700 on the date 19/02/2024 appears twice in the Bank table and three times in the Finance table.

Applying the solution in the previous example to these two tables results in the table shown in Figure 7-28. Although the transaction of 19/02/2024 with an amount of 700 is recorded more frequently in the Finance table, the resulting table does not show it as a mismatch row. This means it does not properly handle cases where amounts are repeated, such as 700 on 19/02/2024 and 115 on 20/02/2024.



| | Date | Amount | Source |
|---|---|---|---|
| 1 | 19/02/2024 12:00:00 AM | 120 | Bank |
| 2 | 20/02/2024 12:00:00 AM | 2 | Bank |
| 3 | 21/02/2024 12:00:00 AM | 90 | Bank |
| 4 | 19/02/2024 12:00:00 AM | 10 | Finance |
| 5 | 21/02/2024 12:00:00 AM | 150 | Finance |
| 6 | 21/02/2024 12:00:00 AM | 120 | Finance |

***Figure 7-28*** The result of reconciliation

Merging the tables presented in this chapter does not resolve the issue in this case. However, there is a powerful function called `List.Difference()` that can help extract mismatched items by considering the number of repetitions, but it just works on lists.

The `List.Difference()` function takes three arguments, the last being optional and for changing the matching criteria. In the first two arguments, two lists will be entered. The function returns all the items that are in the first list but not in the second list. For example, `List.Difference({1,2,3}, {1,2,4})` results in `{3}`, and `List.Difference({1,2,3,1},{1,2,4})` results in `{3,1}`.

In the advanced version of this function, the lists in the first two arguments can be in type record (or even list and table), so the field of records will be compared and the ones in the first list and not in the second list will be returned. So the following formula results in `{[X=2,Y=1],[X=1,Y=2]}`:

```
= List.Difference({[X=1,Y=1],[X=2,Y=1],[X=1,Y=2]},{[X=1,Y=1],[X=1,Y=10]})
```

In this case, the first list include three items all in type record with two fields of `X` and `Y`, and the second list include two items in type record, and the function results in the records that are in the first list but not in the second list. In Power Query, two records are equal if they have the same number of fields with the same field name and equal field values.

In the previous example, to adjust the logic for comparing the records and compare only the values of the `X` field (ignoring the other fields), you can use the third argument of the `List.Difference()` function. The formula can be rewritten as follows, which results in `{[X=2, Y=1]}`:

```
= List.Difference({[X=1,Y=1], [X=2,Y=1], [X=1,Y=2]}, {[X=1,Y=1],
[X=1,Y=1]},each _[X])
```

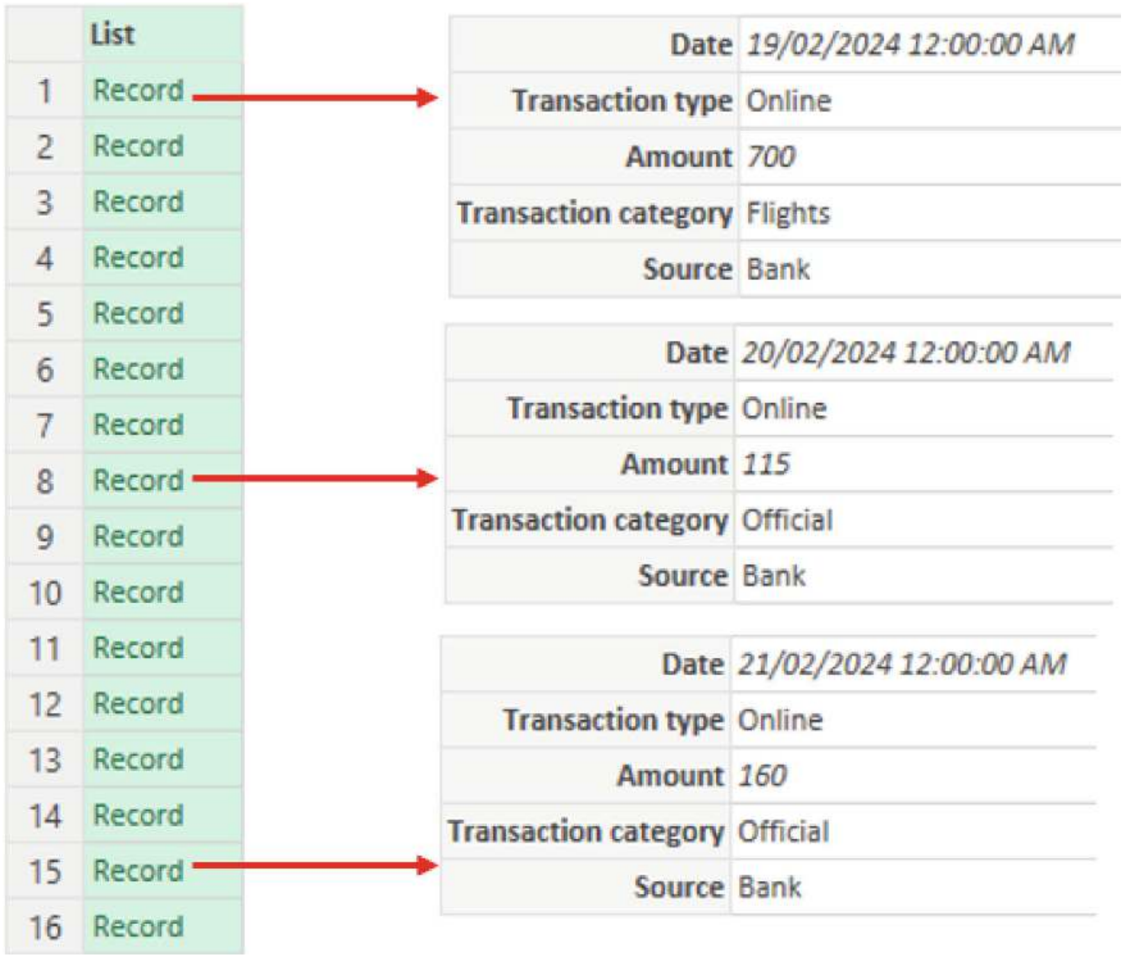
In this case, using `each _[X]` as a custom equality means, that only the values on the field of `X` are considered for comparison. In this case, the records of `[X=1,Y=2]` are equal to the record of `[X=1,Y=10]`, as they have the same number in the `X` field. As a result, from the first list, `[X=1,Y=1]` is removed because it is already present in the second list. Similarly, `[X=1,Y=2]` is removed because there is a record in the second list, `[X=1,Y=10]`, that has the same value for `X`.

Based on this explanation, this problem can be solved by converting each table into a list of records, where each record represents a row from the table. These lists can then be used in the

`List.Difference()` function, with the third argument specifying that only the Date and Amount fields should be considered for comparison.

To reshape the tables into the appropriate format, you can use the `Table.ToRecords()` function, converting the rows of the table into a record which is presented in a list. Create a new query, and in the formula bar, enter the following formula to represent each row of the Bank table as a record, all provided in a list, as shown in Figure 7-30.

```
=Table.ToRecords(Bank)
```



| | List |
|---|---|
| 1 | Record |
| 2 | Record |
| 3 | Record |
| 4 | Record |
| 5 | Record |
| 6 | Record |
| 7 | Record |
| 8 | Record |
| 9 | Record |
| 10 | Record |
| 11 | Record |
| 12 | Record |
| 13 | Record |
| 14 | Record |
| 15 | Record |
| 16 | Record |

| | |
|---|---|
| Date | 19/02/2024 12:00:00 AM |
| Transaction type | Online |
| Amount | 700 |
| Transaction category | Flights |
| Source | Bank |

| | |
|---|---|
| Date | 20/02/2024 12:00:00 AM |
| Transaction type | Online |
| Amount | 115 |
| Transaction category | Official |
| Source | Bank |

| | |
|---|---|
| Date | 21/02/2024 12:00:00 AM |
| Transaction type | Online |
| Amount | 160 |
| Transaction category | Official |
| Source | Bank |

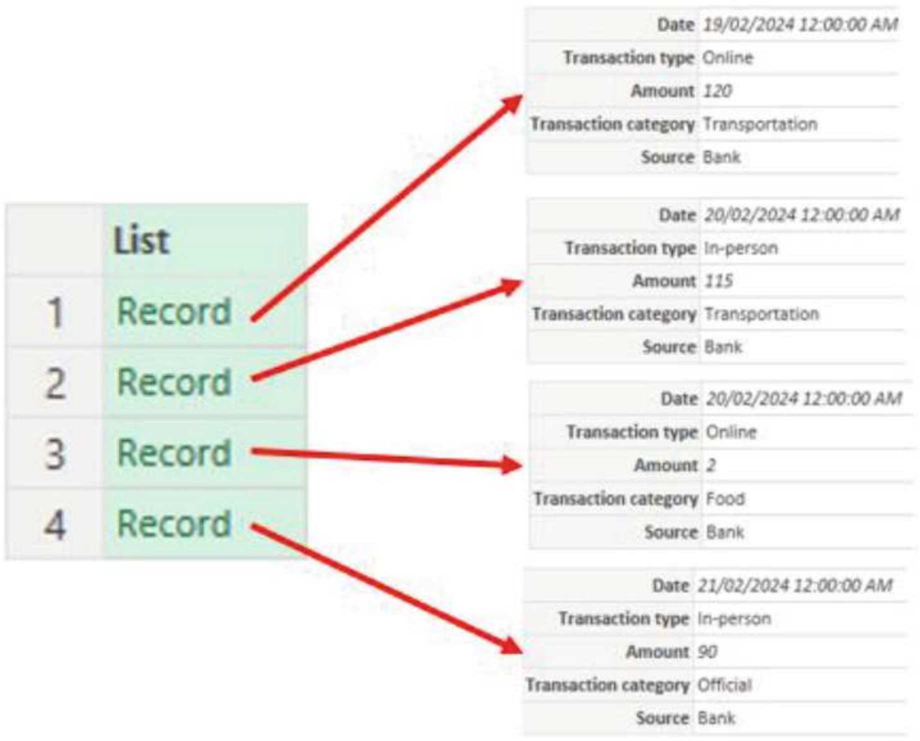
***Figure 7-29*** Using Table.ToRecords()

Based on the result of `Table.ToRecords()`, rewriting the previous formula as follows will compare the rows of the two tables based on all their fields:

```
=  List.Difference(Table.ToRecords(Bank),Table.ToRecords(Finance))
```

To limit the comparison to just the Date and Amount fields, you can adjust the formula by using the third argument of the `List.Difference()` function. This modified formula will return all the rows available in the Bank table that are not present in the Finance table, based on the values in the Date and Amount columns, as shown in Figure 7-30.

```
= List.Difference(Table.ToRecords(Bank),Table.ToRecords(Finance), each
{_[Date],_[Amount]})
```



| | List |
|---|---|
| 1 | Record |
| 2 | Record |
| 3 | Record |
| 4 | Record |

| | |
|---|---|
| Date | 19/02/2024 12:00:00 AM |
| Transaction type | Online |
| Amount | 120 |
| Transaction category | Transportation |
| Source | Bank |

| | |
|---|---|
| Date | 20/02/2024 12:00:00 AM |
| Transaction type | In-person |
| Amount | 115 |
| Transaction category | Transportation |
| Source | Bank |

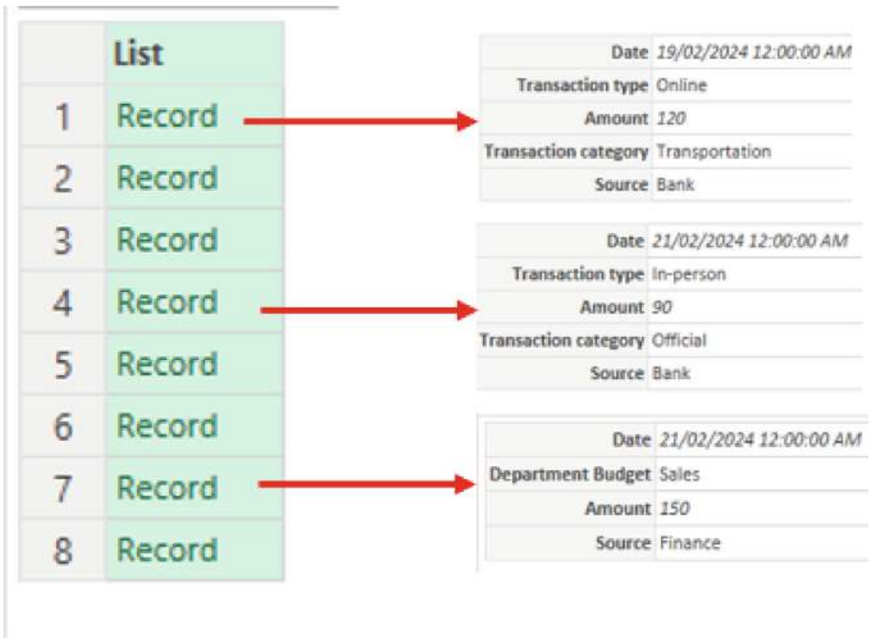
| | |
|---|---|
| Date | 20/02/2024 12:00:00 AM |
| Transaction type | Online |
| Amount | 2 |
| Transaction category | Food |
| Source | Bank |

| | |
|---|---|
| Date | 21/02/2024 12:00:00 AM |
| Transaction type | In-person |
| Amount | 90 |
| Transaction category | Official |
| Source | Bank |

***Figure 7-30*** The result of using List.Difference()

Swapping the Bank and Finance tables will return the rows that exist in the Finance table, but not in the Bank table. By combining the previous formula with its swapped version and rewriting it as follows in the formula bar, you can retrieve all mismatched rows from both tables. The result is shown in Figure 7-31.

```
= List.Difference(Table.ToRecords(Bank),Table.ToRecords(Finance), each
{_[Date],_[Amount]}) &
List.Difference(Table.ToRecords(Finance),Table.ToRecords(Bank), each
{_[Date],_[Amount]})
```



| | List |
|---|---|
| 1 | Record |
| 2 | Record |
| 3 | Record |
| 4 | Record |
| 5 | Record |
| 6 | Record |
| 7 | Record |
| 8 | Record |

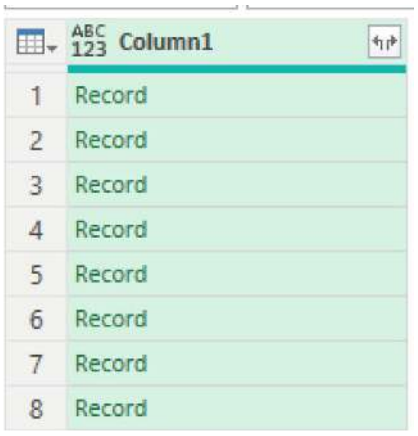
| | |
|---|---|
| Date | 19/02/2024 12:00:00 AM |
| Transaction type | Online |
| Amount | 120 |
| Transaction category | Transportation |
| Source | Bank |

| | |
|---|---|
| Date | 21/02/2024 12:00:00 AM |
| Transaction type | In-person |
| Amount | 90 |
| Transaction category | Official |
| Source | Bank |

| | |
|---|---|
| Date | 21/02/2024 12:00:00 AM |
| Department Budget | Sales |
| Amount | 150 |
| Source | Finance |

***Figure 7-31*** List of all mismatched items

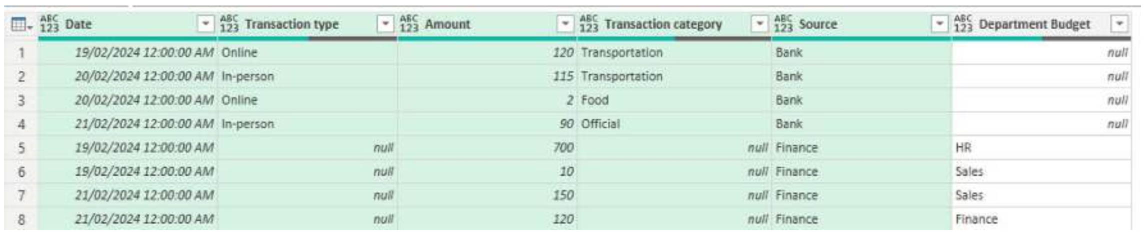
In the next step, to convert the result from a list to a table, go to the Transform tab and select the To Table command. In the dialog window that appears, choose None as the delimiter and click OK to obtain the final result, shown in Figure 7-32.



| | Column1 |
|---|---|
| 1 | Record |
| 2 | Record |
| 3 | Record |
| 4 | Record |
| 5 | Record |
| 6 | Record |
| 7 | Record |
| 8 | Record |

***Figure 7-32*** Converting the result to a table

In the final step, expand Column1 to extract the individual fields from the records. This will transform the data into a structured table, solving the problem and producing the final results, as shown in Figure 7-33.



| | Date | Transaction type | Amount | Transaction category | Source | Department Budget |
|---|---|---|---|---|---|---|
| 1 | 19/02/2024 12:00:00 AM | Online | 120 | Transportation | Bank | null |
| 2 | 20/02/2024 12:00:00 AM | In-person | 115 | Transportation | Bank | null |
| 3 | 20/02/2024 12:00:00 AM | Online | 2 | Food | Bank | null |
| 4 | 21/02/2024 12:00:00 AM | In-person | 90 | Official | Bank | null |
| 5 | 19/02/2024 12:00:00 AM | null | 700 | null | Finance | HR |
| 6 | 19/02/2024 12:00:00 AM | null | 10 | null | Finance | Sales |
| 7 | 21/02/2024 12:00:00 AM | null | 150 | null | Finance | Sales |
| 8 | 21/02/2024 12:00:00 AM | null | 120 | null | Finance | Finance |

***Figure 7-33*** The final table

## Fuzzy Merging

Consider the Historical Sales info and Product Info tables provided on Table 7-15 and Table 7-16. Add the product price from the Product Info table into the Historical Sales info. The product IDs do not exactly match in the tables, so you have to extract the similar information.

***Table 7-15*** Sales: Historical Sales Info

| Date | Product ID | Quantity |
|---|---|---|
| 24/07/2024 | PNX4 | 2 |
| 24/07/2024 | LMYL1 | 7 |
| 25/07/2024 | PN-X | 5 |
| 25/07/2024 | PNX41 | 1 |
| 28/07/2024 | nc | 2 |
| 29/07/2024 | PNX6 | 6 |
| 29/07/2024 | LMYL-pnx | 3 |
| 29/07/2024 | NC2 | 3 |
| 29/07/2024 | PNX5 | 2 |
| 30/07/2024 | LMYLL | 2 |
| 30/07/2024 | NC6 | 2 |

***Table 7-16*** Info: Product Price Info

| Product ID | Price |
|---|---|
| Pnx | 10 |
| LMYL | 7 |
| NC-2 | 5 |

**Note** The data in this example is provided in an Excel file titled `05 Fuzzy Merging.xlsx`.

In this example, the IDs are not clean. For instance, in the Info table, an ID like NC-2 appears in different variations in the Sales table, such as nc, NC2, and NC6. Similarly, for LMYL, multiple variations like LMYL1, LMYLL, and LMYL-pnx exist. This leads to several challenges, including:

– Extra characters in some ID variations
– Inconsistent character casing (uppercase vs. lowercase)
– Combinations of IDs in different formats

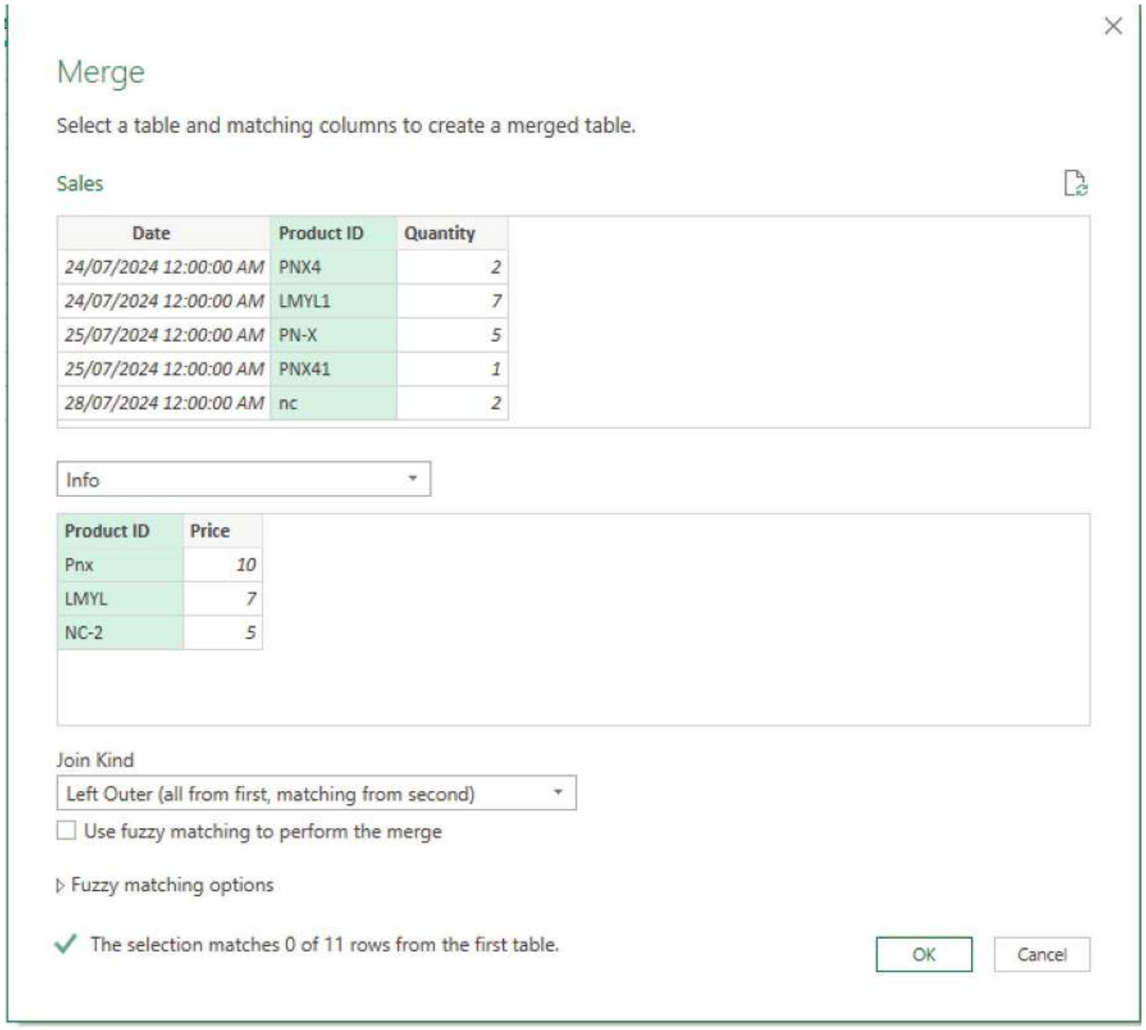
Handling these inconsistencies requires a robust approach to standardize and correctly match the IDs across both tables.

Since the IDs follow inconsistent patterns and variations, it is difficult to clean them automatically and use them directly in a merge process. The lack of a uniform structure makes it challenging to apply simple transformations like trimming, case conversion, or substring extraction to standardize the IDs. As a result, a more advanced approach, called fuzzy matching or custom mapping, may be required to correctly align the IDs across both tables.

**Note** In the *fuzzy logic,* instead of comparing two values like nc and NC2 and saying they are equal or not, a similarity value is defined based on a threshold defined by user. This determines whether they are the same. However, in Power Query, it works like a black box and you might be faced with unexpected results.

To use fuzzy merge, the common column in the right-side table must be of type text. The Product ID column in the Info table needs to be converted to text. This can be done by selecting the Info table, navigating to the Transform tab, and using the Detect Data Type option to ensure the column is recognized as text. It is not required but it is better to do the same for the Info table.

Once the column type is set correctly, the merge process can be performed. Selecting the Sales table and using the Merge Queries option from the Home tab allows for merging with the Product Info table. In the merge window, the Product ID column should be selected from both tables to establish the relationship. However, as shown in Figure 7-34, no matching rows appear due to inconsistencies in the Product ID formatting across the tables.


Merge

Select a table and matching columns to create a merged table.

Sales

| Date | Product ID | Quantity |
|---|---|---|
| 24/07/2024 12:00:00 AM | PNX4 | 2 |
| 24/07/2024 12:00:00 AM | LMYL1 | 7 |
| 25/07/2024 12:00:00 AM | PN-X | 5 |
| 25/07/2024 12:00:00 AM | PNX41 | 1 |
| 28/07/2024 12:00:00 AM | nc | 2 |

Info

| Product ID | Price |
|---|---|
| Pnx | 10 |
| LMYL | 7 |
| NC-2 | 5 |

Join Kind

Left Outer (all from first, matching from second)

☐ Use fuzzy matching to perform the merge

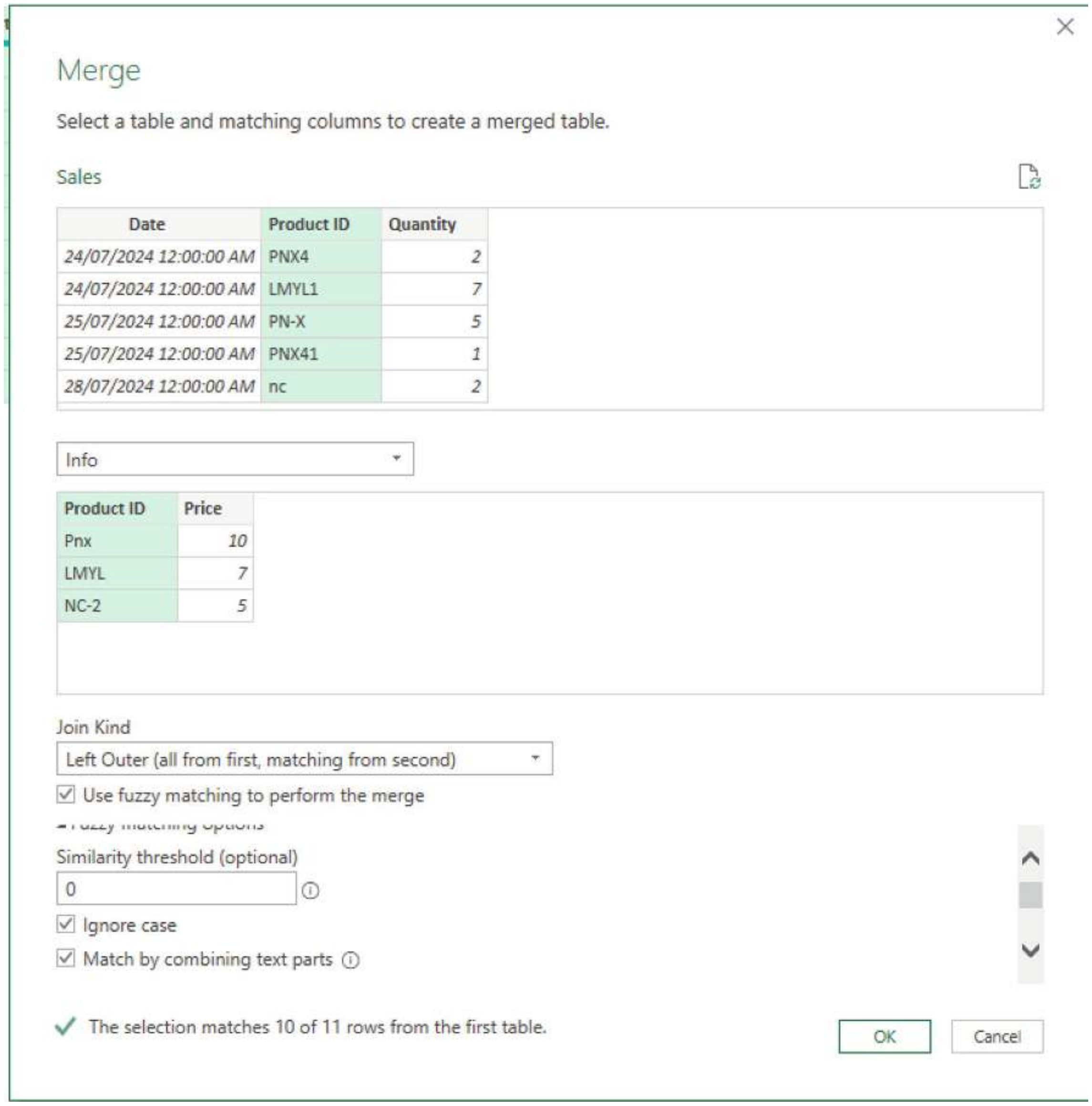
▷ Fuzzy matching options

✓ The selection matches 0 of 11 rows from the first table.

*Figure 7-34* Merging setting

Instead of using a simple merge, fuzzy matching should be enabled, allowing adjustments to its parameters and settings. After enabling the Fuzzy Matching option, you can adjust its settings and observe the number of matching rows. By tweaking parameters like the similarity threshold and the matching methods, you can fine-tune the merge process. As you make these adjustments, Power Query will display the updated number of rows that match based on the defined criteria, allowing you to evaluate the effectiveness of the fuzzy matching configuration

In this example, selecting Ignore Case and Match by Combining Text Parts, along with setting the similarity threshold to `0`, ensures the highest possible match (10 out of 11 rows), as shown in Figure 7-35. These settings help account for variations in ID formatting, thus improving the accuracy of the merge process.



Merge

Select a table and matching columns to create a merged table.

Sales

| Date | Product ID | Quantity |
|---|---|---|
| 24/07/2024 12:00:00 AM | PNX4 | 2 |
| 24/07/2024 12:00:00 AM | LMYL1 | 7 |
| 25/07/2024 12:00:00 AM | PN-X | 5 |
| 25/07/2024 12:00:00 AM | PNX41 | 1 |
| 28/07/2024 12:00:00 AM | nc | 2 |

Info

| Product ID | Price |
|---|---|
| Pnx | 10 |
| LMYL | 7 |
| NC-2 | 5 |

Join Kind

Left Outer (all from first, matching from second)

☑ Use fuzzy matching to perform the merge

Fuzzy matching options

Similarity threshold (optional)

0

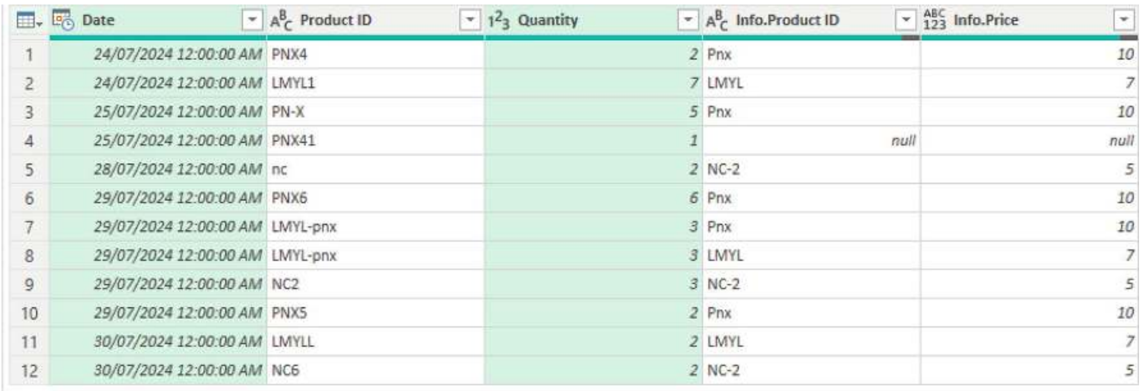
☑ Ignore case

☑ Match by combining text parts

✓ The selection matches 10 of 11 rows from the first table.

*Figure 7-35* Fuzzy matching setting

Clicking OK and expanding the result column will produce the table shown in Figure 7-36. As seen, LMYL-pnx is matched to both LYML and Pnx IDs. Additionally, the row with PNX41 does not match any ID.



| | Date | Product ID | Quantity | Info.Product ID | Info.Price |
|---|---|---|---|---|---|
| 1 | 24/07/2024 12:00:00 AM | PNX4 | 2 | Pnx | 10 |
| 2 | 24/07/2024 12:00:00 AM | LMYL1 | 7 | LMYL | 7 |
| 3 | 25/07/2024 12:00:00 AM | PN-X | 5 | Pnx | 10 |
| 4 | 25/07/2024 12:00:00 AM | PNX41 | 1 | null | null |
| 5 | 28/07/2024 12:00:00 AM | nc | 2 | NC-2 | 5 |
| 6 | 29/07/2024 12:00:00 AM | PNX6 | 6 | Pnx | 10 |
| 7 | 29/07/2024 12:00:00 AM | LMYL-pnx | 3 | Pnx | 10 |
| 8 | 29/07/2024 12:00:00 AM | LMYL-pnx | 3 | LMYL | 7 |
| 9 | 29/07/2024 12:00:00 AM | NC2 | 3 | NC-2 | 5 |
| 10 | 29/07/2024 12:00:00 AM | PNX5 | 2 | Pnx | 10 |
| 11 | 30/07/2024 12:00:00 AM | LMYLL | 2 | LMYL | 7 |
| 12 | 30/07/2024 12:00:00 AM | NC6 | 2 | NC-2 | 5 |

*Figure 7-36* The result of fuzzy merging

**Note** Fuzzy matching is highly beneficial when working with inconsistent data, such as slight variations in spelling, case, or formatting. It enables merging tables even when values in the common columns are not exact matches, for example, matching NY to New York or NC2 to nc. It also allows for flexibility in controlling the matching criteria through adjustable similarity thresholds, ensuring that users can customize how strict or lenient the matching process should be. Additionally, fuzzy matching automates the merging process, saving time and reducing the need for manual data cleaning, especially when handling large datasets with variations.

Despite its advantages, fuzzy matching can yield unpredictable results. Since the algorithm works by calculating similarity scores, it may sometimes incorrectly match records that appear similar but are not actually the same. Furthermore, the fuzzy matching process in Power Query lacks transparency, as the exact algorithm used for calculating similarity is not visible or adjustable. This can make troubleshooting difficult when the results don't meet your expectations. Additionally, fuzzy merging can be performance-intensive, especially with large datasets, and may cause delays or slowdowns, particularly when a low similarity threshold is set, making the matching criteria more lenient.

## Conditional Merging

Historical sales transactions are stored in the Sales table as shown in Table 7-17, and customer location, which may change over time, is recorded in the Info table, as illustrated in Table 7-18. Based on the information provided, calculate the total sales per state.

*Table 7-17* Sales: Historical Sales Info

| Date | Customer ID | Quantity |
|---|---|---|
| 18/07/2023 | C-2 | 40 |
| 31/07/2023 | C-3 | 31 |
| 31/07/2023 | C-3 | 35 |
| 3/08/2023 | C-3 | 25 |
| 30/08/2023 | C-2 | 11 |
| 31/08/2023 | C-3 | 25 |
| 3/09/2023 | C-1 | 36 |
| 8/09/2023 | C-3 | 28 |
| 14/09/2023 | C-1 | 12 |
| 2/10/2023 | C-1 | 34 |
| 2/10/2023 | C-1 | 25 |
| 21/10/2023 | C-1 | 33 |
| 23/10/2023 | C-3 | 23 |
| 10/11/2023 | C-2 | 35 |
| 26/12/2023 | C-3 | 15 |
| 1/01/2024 | C-2 | 21 |
| 10/01/2024 | C-2 | 30 |
| 14/01/2024 | C-3 | 24 |
| 26/02/2024 | C-2 | 23 |
| 28/02/2024 | C-3 | 10 |
| 1/03/2024 | C-2 | 15 |
| 12/04/2024 | C-3 | 37 |
| 27/04/2024 | C-3 | 18 |

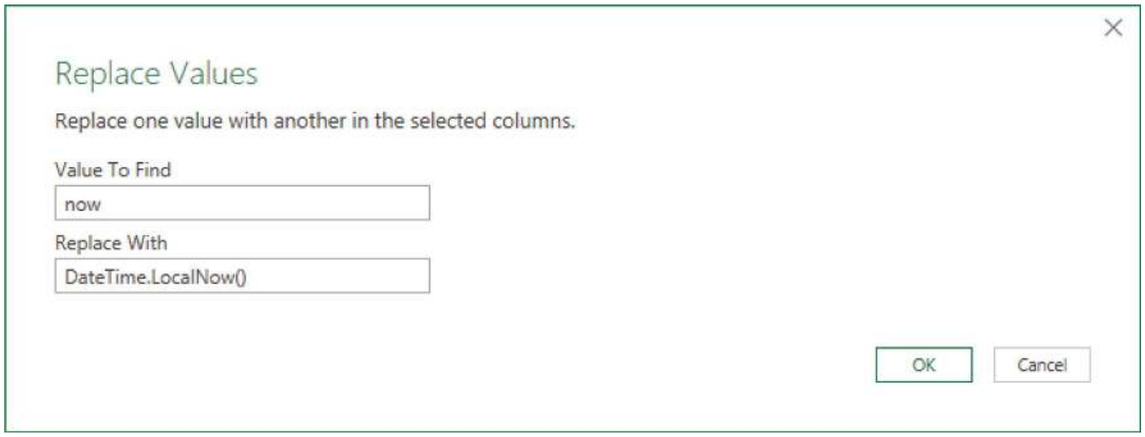
*Table 7-18* Info: Customer Info

| From | To | Customer ID | States |
|---|---|---|---|

| From | To | Customer ID | States |
|---|---|---|---|
| 1/07/2023 | now | C-1 | TA |
| 1/07/2023 | 22/11/2023 | C-2 | NSW |
| 1/07/2023 | 30/10/2023 | C-3 | NSW |
| 30/10/2023 | 3/01/2024 | C-3 | TA |
| 22/11/2023 | now | C-2 | WA |
| 3/01/2024 | 12/02/2024 | C-3 | NSW |
| 12/02/2024 | now | C-3 | QLD |

**Note** The data in this example is provided in an Excel file titled `06 Conditional Merging .xlsx`.

This problem can be solved using the techniques presented in Chapter 3, but in this case, you will solve it using the Merge command. Before merging the tables, you'll replace the "now" text in the To column of the Info table with more meaningful values. To do this, select the column, then from the Home tab, click the Replace Values command. As shown in Figure 7-37, in the Value to Find box, enter now, and in the Replace with box, enter `DateTime.LocalNow()` (or alternatively, you can choose a future date, such as 2050/01/01).


Replace Values

Replace one value with another in the selected columns.

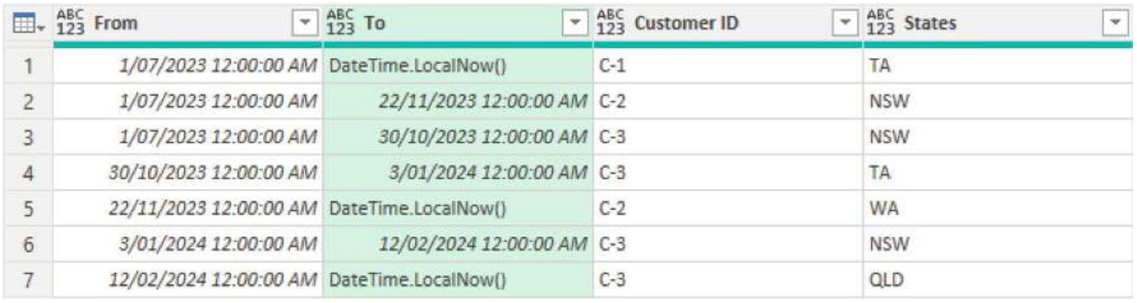
Value To Find: now

Replace With: DateTime.LocalNow()

*Figure 7-37* Replacement setting

This process will replace "now" with `DateTime.LocalNow()`, as shown in the Figure 7-38.

```
=
Table.ReplaceValue(Source,"now","DateTime.LocalNow()",Replacer.ReplaceValue,
{"To"})
```

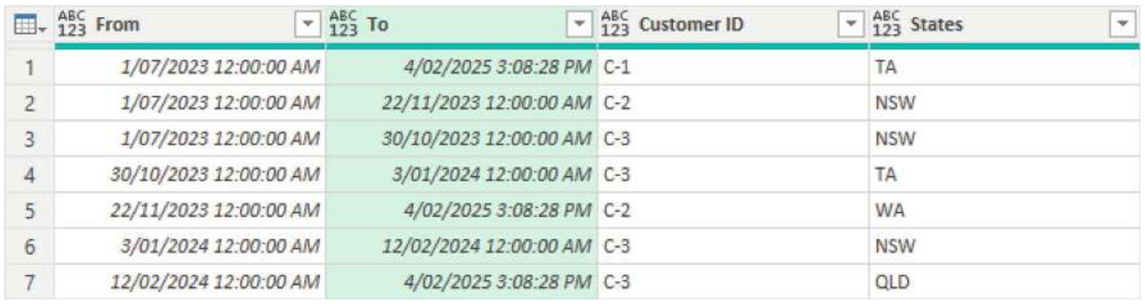


|  | From | To | Customer ID | States |
|---|---|---|---|---|
| 1 | 1/07/2023 12:00:00 AM | DateTime.LocalNow() | C-1 | TA |
| 2 | 1/07/2023 12:00:00 AM | 22/11/2023 12:00:00 AM | C-2 | NSW |
| 3 | 1/07/2023 12:00:00 AM | 30/10/2023 12:00:00 AM | C-3 | NSW |
| 4 | 30/10/2023 12:00:00 AM | 3/01/2024 12:00:00 AM | C-3 | TA |
| 5 | 22/11/2023 12:00:00 AM | DateTime.LocalNow() | C-2 | WA |
| 6 | 3/01/2024 12:00:00 AM | 12/02/2024 12:00:00 AM | C-3 | NSW |
| 7 | 12/02/2024 12:00:00 AM | DateTime.LocalNow() | C-3 | QLD |

*Figure 7-38* The result of replacement

Removing the double quotation marks around "`DateTime.LocalNow()`" and rewriting the formula as follows will result in today's date and current time, as shown in Figure 7-39.

```
=
Table.ReplaceValue(Source,"now",DateTime.LocalNow(),Replacer.ReplaceValue,
{"To"})
```

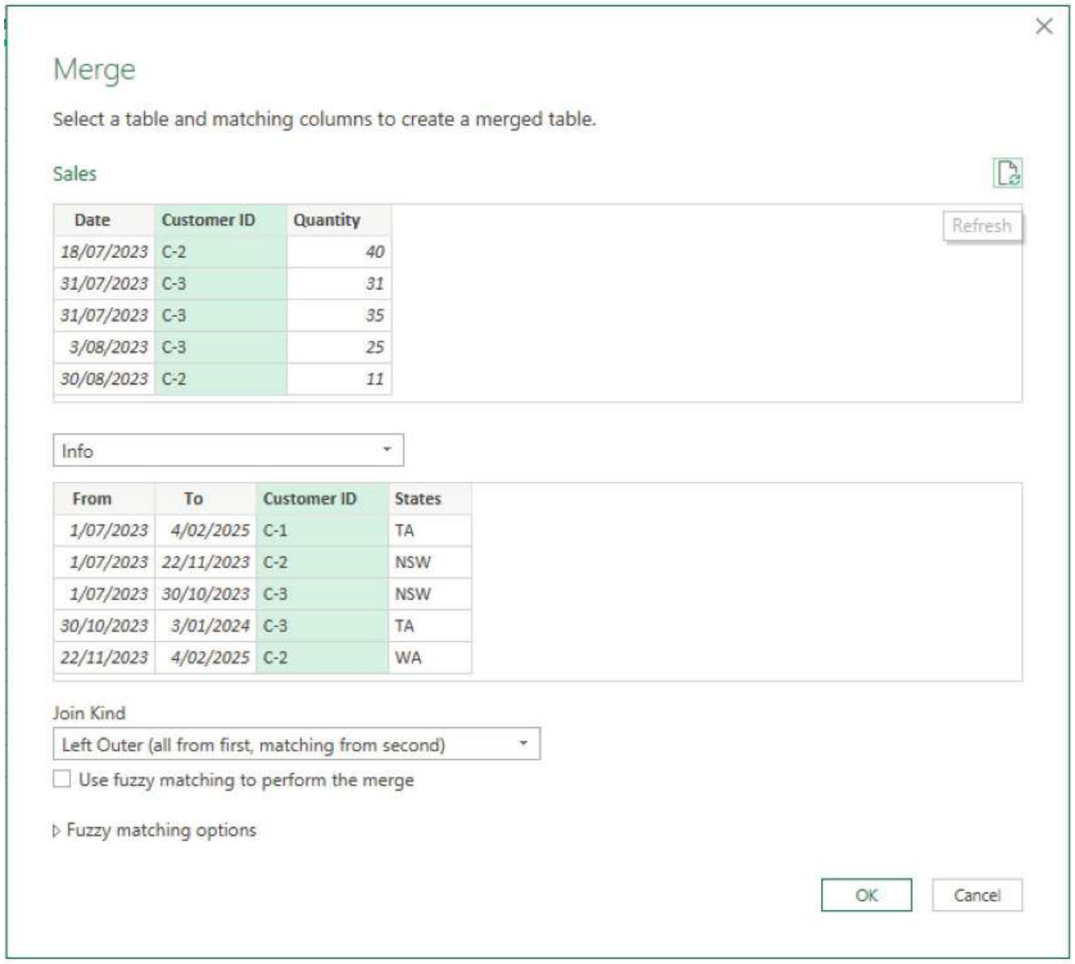


| | ABC 123 From | ABC 123 To | ABC 123 Customer ID | ABC 123 States |
|---|---|---|---|---|
| 1 | 1/07/2023 12:00:00 AM | 4/02/2025 3:08:28 PM | C-1 | TA |
| 2 | 1/07/2023 12:00:00 AM | 22/11/2023 12:00:00 AM | C-2 | NSW |
| 3 | 1/07/2023 12:00:00 AM | 30/10/2023 12:00:00 AM | C-3 | NSW |
| 4 | 30/10/2023 12:00:00 AM | 3/01/2024 12:00:00 AM | C-3 | TA |
| 5 | 22/11/2023 12:00:00 AM | 4/02/2025 3:08:28 PM | C-2 | WA |
| 6 | 3/01/2024 12:00:00 AM | 12/02/2024 12:00:00 AM | C-3 | NSW |
| 7 | 12/02/2024 12:00:00 AM | 4/02/2025 3:08:28 PM | C-3 | QLD |

***Figure 7-39*** The result of modified formula

Now select the From and To columns in the Info table and change the type of values on them to Date. Then perform the same action for the Date column in the Sales table.

In this next step, you need to extract the customer location from the Info table and add it to the Sales table. Select the Sales table. Then, from the Home tab, select Merge Queries and choose the Info table as the second table. Choose Customer ID as the linked column between the two tables, using the settings provided in Figure 7-40.



Merge

Select a table and matching columns to create a merged table.

Sales

| Date | Customer ID | Quantity |
|---|---|---|
| 18/07/2023 | C-2 | 40 |
| 31/07/2023 | C-3 | 31 |
| 31/07/2023 | C-3 | 35 |
| 3/08/2023 | C-3 | 25 |
| 30/08/2023 | C-2 | 11 |

Info

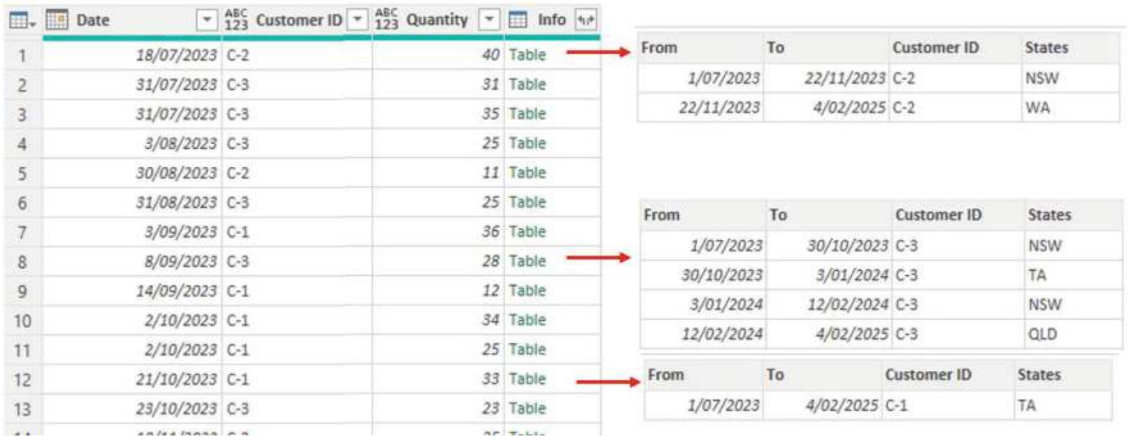
| From | To | Customer ID | States |
|---|---|---|---|
| 1/07/2023 | 4/02/2025 | C-1 | TA |
| 1/07/2023 | 22/11/2023 | C-2 | NSW |
| 1/07/2023 | 30/10/2023 | C-3 | NSW |
| 30/10/2023 | 3/01/2024 | C-3 | TA |
| 22/11/2023 | 4/02/2025 | C-2 | WA |

Join Kind: Left Outer (all from first, matching from second)

☐ Use fuzzy matching to perform the merge

*Figure 7-40* Settings for merging tables

After clicking OK, you will see the merged table shown in Figure 7-41. In this example, since the Customer ID C-3 is repeated multiple times in the Info table, the resulting column includes several rows from the Info table being matched with the row in the Sales table. You need to filter the rows in the resulting table based on the transaction date to select the correct location data.



| | Date | Customer ID | Quantity | Info |
|---|---|---|---|---|
| 1 | 18/07/2023 | C-2 | 40 | Table |
| 2 | 31/07/2023 | C-3 | 31 | Table |
| 3 | 31/07/2023 | C-3 | 35 | Table |
| 4 | 3/08/2023 | C-3 | 25 | Table |
| 5 | 30/08/2023 | C-2 | 11 | Table |
| 6 | 31/08/2023 | C-3 | 25 | Table |
| 7 | 3/09/2023 | C-1 | 36 | Table |
| 8 | 8/09/2023 | C-3 | 28 | Table |
| 9 | 14/09/2023 | C-1 | 12 | Table |
| 10 | 2/10/2023 | C-1 | 34 | Table |
| 11 | 2/10/2023 | C-1 | 25 | Table |
| 12 | 21/10/2023 | C-1 | 33 | Table |
| 13 | 23/10/2023 | C-3 | 23 | Table |

| From | To | Customer ID | States |
|---|---|---|---|
| 1/07/2023 | 22/11/2023 | C-2 | NSW |
| 22/11/2023 | 4/02/2025 | C-2 | WA |

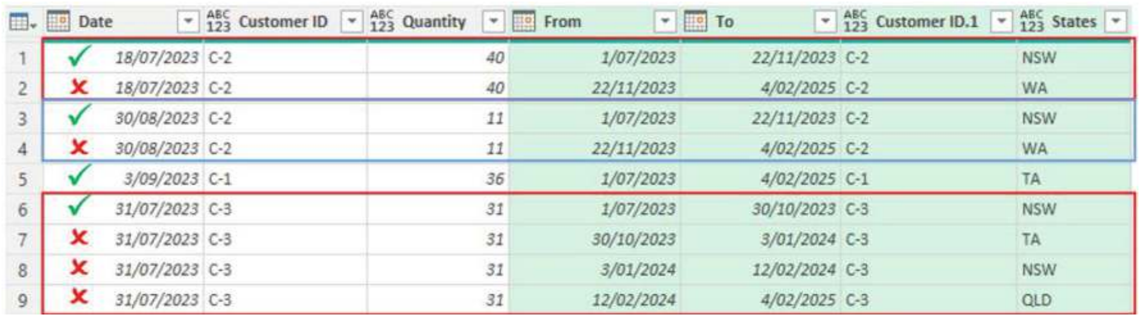
| From | To | Customer ID | States |
|---|---|---|---|
| 1/07/2023 | 30/10/2023 | C-3 | NSW |
| 30/10/2023 | 3/01/2024 | C-3 | TA |
| 3/01/2024 | 12/02/2024 | C-3 | NSW |
| 12/02/2024 | 4/02/2025 | C-3 | QLD |

| From | To | Customer ID | States |
|---|---|---|---|
| 1/07/2023 | 4/02/2025 | C-1 | TA |

*Figure 7-41* The results of merging

To extract the customer location from the transaction date, you can use the method presented in the Chapter 3, but this section shows a solution based on the UI. Expand all the items on the newly added column called Info to reach the result presented in Figure 7-42.

As shown in Figure 7-42, only the rows where the value in the Date column falls between the values in the From and To columns are considered valid for the location. All other rows should be excluded.



| | | Date | Customer ID | Quantity | From | To | Customer ID.1 | States |
|---|---|---|---|---|---|---|---|---|
| 1 | ✓ | 18/07/2023 | C-2 | 40 | 1/07/2023 | 22/11/2023 | C-2 | NSW |
| 2 | ✗ | 18/07/2023 | C-2 | 40 | 22/11/2023 | 4/02/2025 | C-2 | WA |
| 3 | ✓ | 30/08/2023 | C-2 | 11 | 1/07/2023 | 22/11/2023 | C-2 | NSW |
| 4 | ✗ | 30/08/2023 | C-2 | 11 | 22/11/2023 | 4/02/2025 | C-2 | WA |
| 5 | ✓ | 3/09/2023 | C-1 | 36 | 1/07/2023 | 4/02/2025 | C-1 | TA |
| 6 | ✓ | 31/07/2023 | C-3 | 31 | 1/07/2023 | 30/10/2023 | C-3 | NSW |
| 7 | ✗ | 31/07/2023 | C-3 | 31 | 30/10/2023 | 3/01/2024 | C-3 | TA |
| 8 | ✗ | 31/07/2023 | C-3 | 31 | 3/01/2024 | 12/02/2024 | C-3 | NSW |
| 9 | ✗ | 31/07/2023 | C-3 | 31 | 12/02/2024 | 4/02/2025 | C-3 | QLD |

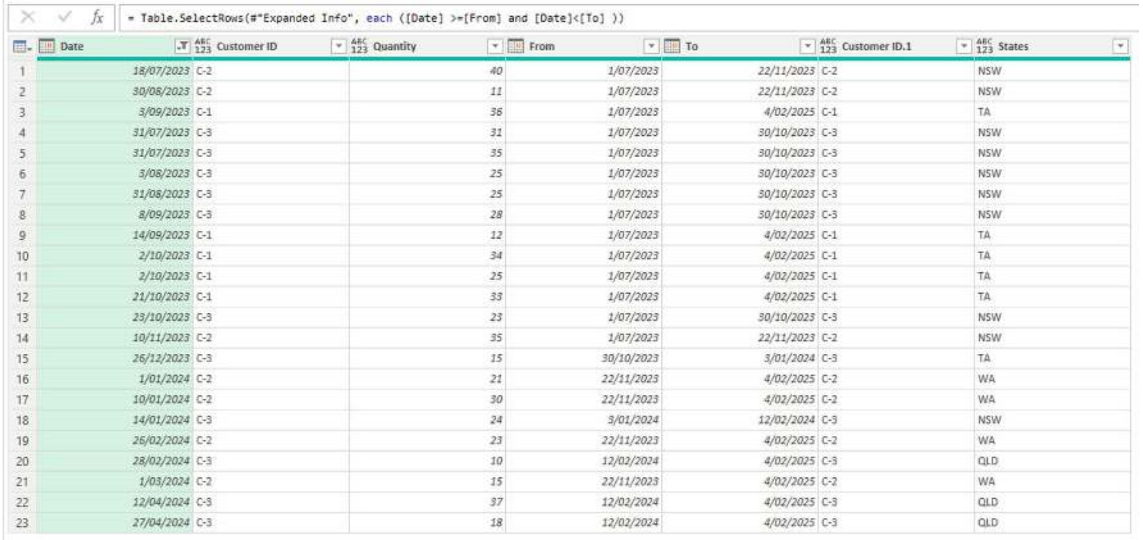
*Figure 7-42* Filtering the previous date

To extract the valid rows, apply a filter on the Date column and select a specific date. This results in the following formula:

```
= Table.SelectRows(#"Expanded Info", each ([Date] = #date(2023, 8, 3)))
```

To modify the condition and filter rows where the value in the Date column is less than the To column value and greater than or equal to the From column value, you can rewrite the formula as follows, which results in Figure 7-43:

```
= Table.SelectRows(#"Expanded Info", each ([Date] >=[From] and [Date]<[To]
))
```

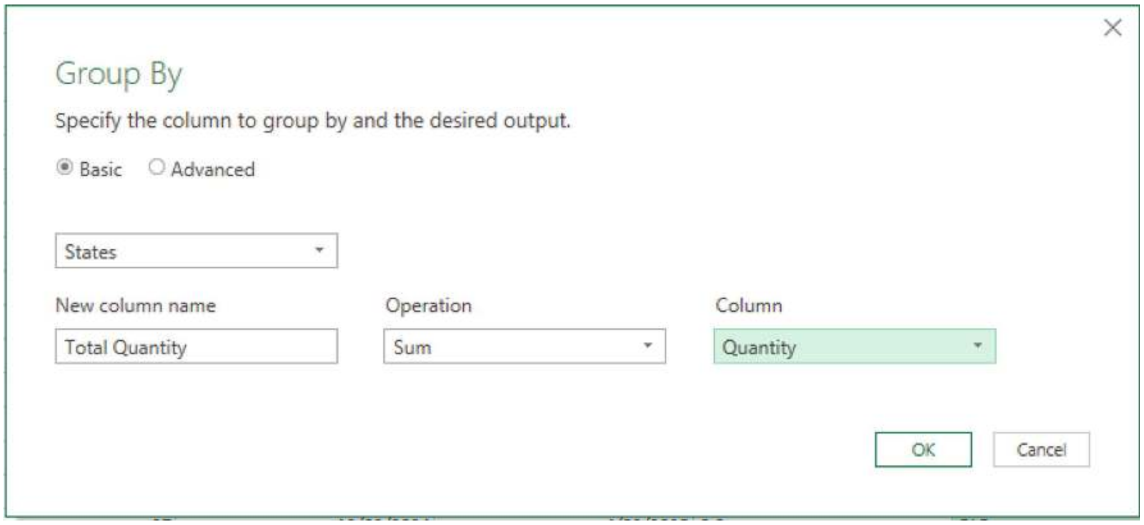


```
= Table.SelectRows(#"Expanded Info", each ([Date] >=[From] and [Date]<[To] ))
```

| | Date | Customer ID | Quantity | From | To | Customer ID.1 | States |
|---|---|---|---|---|---|---|---|
| 1 | 18/07/2023 | C-2 | 40 | 1/07/2023 | 22/11/2023 | C-2 | NSW |
| 2 | 30/08/2023 | C-2 | 11 | 1/07/2023 | 22/11/2023 | C-2 | NSW |
| 3 | 3/09/2023 | C-1 | 36 | 1/07/2023 | 4/02/2025 | C-1 | TA |
| 4 | 31/07/2023 | C-3 | 31 | 1/07/2023 | 30/10/2023 | C-3 | NSW |
| 5 | 31/07/2023 | C-3 | 35 | 1/07/2023 | 30/10/2023 | C-3 | NSW |
| 6 | 3/08/2023 | C-3 | 25 | 1/07/2023 | 30/10/2023 | C-3 | NSW |
| 7 | 31/08/2023 | C-3 | 25 | 1/07/2023 | 30/10/2023 | C-3 | NSW |
| 8 | 8/09/2023 | C-3 | 28 | 1/07/2023 | 30/10/2023 | C-3 | NSW |
| 9 | 14/09/2023 | C-1 | 12 | 1/07/2023 | 4/02/2025 | C-1 | TA |
| 10 | 2/10/2023 | C-1 | 34 | 1/07/2023 | 4/02/2025 | C-1 | TA |
| 11 | 2/10/2023 | C-1 | 25 | 1/07/2023 | 4/02/2025 | C-1 | TA |
| 12 | 21/10/2023 | C-1 | 33 | 1/07/2023 | 4/02/2025 | C-1 | TA |
| 13 | 23/10/2023 | C-3 | 23 | 1/07/2023 | 30/10/2023 | C-3 | NSW |
| 14 | 10/11/2023 | C-2 | 35 | 1/07/2023 | 22/11/2023 | C-2 | NSW |
| 15 | 26/12/2023 | C-3 | 15 | 30/10/2023 | 3/01/2024 | C-3 | TA |
| 16 | 1/01/2024 | C-2 | 21 | 22/11/2023 | 4/02/2025 | C-2 | WA |
| 17 | 10/01/2024 | C-2 | 30 | 22/11/2023 | 4/02/2025 | C-2 | WA |
| 18 | 14/01/2024 | C-3 | 24 | 3/01/2024 | 12/02/2024 | C-3 | NSW |
| 19 | 26/02/2024 | C-2 | 23 | 22/11/2023 | 4/02/2025 | C-2 | WA |
| 20 | 28/02/2024 | C-3 | 10 | 12/02/2024 | 4/02/2025 | C-3 | QLD |
| 21 | 1/03/2024 | C-2 | 15 | 22/11/2023 | 4/02/2025 | C-2 | WA |
| 22 | 12/04/2024 | C-3 | 37 | 12/02/2024 | 4/02/2025 | C-3 | QLD |
| 23 | 27/04/2024 | C-3 | 18 | 12/02/2024 | 4/02/2025 | C-3 | QLD |

*Figure 7-43* Extracting the last row

The state of each transaction has now been determined. Applying the Group By command with the settings shown in Figure 7-44 will resolve the issue, resulting in the table shown in Figure 7-45.


Group By

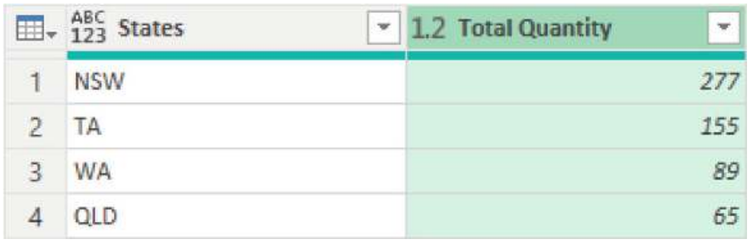
Specify the column to group by and the desired output.

(● Basic) ○ Advanced

States

| New column name | Operation | Column |
|---|---|---|
| Total Quantity | Sum | Quantity |

*Figure 7-44* Extracting the states



| | States | Total Quantity |
|---|---|---|
| 1 | NSW | 277 |
| 2 | TA | 155 |
| 3 | WA | 89 |
| 4 | QLD | 65 |

*Figure 7-45* The final table

## Self-Merging

Historical sales transactions are shown in the Sales table in Table 7-19, and you'll calculate the sales per customer. However, the Customer ID may change over time, and these changes are recorded in the Info table shown in Table 7-20. Based on the Info table, the ID of Customer C-1 was first changed to C-7, then to C-9, and finally to C-13. Thus, all these IDs (C-1, C-7, C-9, and C-13) refer to the same customer, so you need to sum all the values for these IDs and present it as the Total Quantity for C-13. Initially extract the last Customer ID for each customer, then, calculate the total quantity per customer using the latest Customer ID.

*Table 7-19* Sales: Historical Sales Info

| Date | Customer ID | Quantity |
|---|---|---|
| 18/07/2023 | C-2 | 40 |
| 19/07/2023 | C-5 | 22 |
| 26/07/2023 | C-3 | 24 |
| 27/07/2023 | C-2 | 12 |
| 31/07/2023 | C-1 | 31 |
| 31/07/2023 | C-1 | 35 |
| 3/08/2023 | C-3 | 25 |
| 19/08/2023 | C-10 | 10 |
| 30/08/2023 | C-4 | 11 |
| 31/08/2023 | C-15 | 25 |
| 9/09/2023 | C-11 | 11 |
| 13/10/2023 | C-11 | 24 |

| Date | Customer ID | Quantity |
|---|---|---|
| 21/10/2023 | C-1 | 33 |
| 23/10/2023 | C-15 | 23 |
| 10/11/2023 | C-10 | 35 |
| 16/11/2023 | C-7 | 27 |
| 2/12/2023 | C-8 | 30 |
| 4/12/2023 | C-12 | 13 |
| 16/12/2023 | C-9 | 22 |
| 24/12/2023 | C-13 | 34 |
| 26/12/2023 | C-14 | 15 |
| 1/01/2024 | C-13 | 21 |
| 10/01/2024 | C-13 | 30 |
| 14/01/2024 | C-14 | 24 |

***Table 7-20*** Info: Customer Info

| Old ID | New ID |
|---|---|
| C-1 | C-7 |
| C-5 | C-8 |
| C-7 | C-9 |
| C-9 | C-13 |
| C-2 | C-12 |
| C-12 | C-14 |

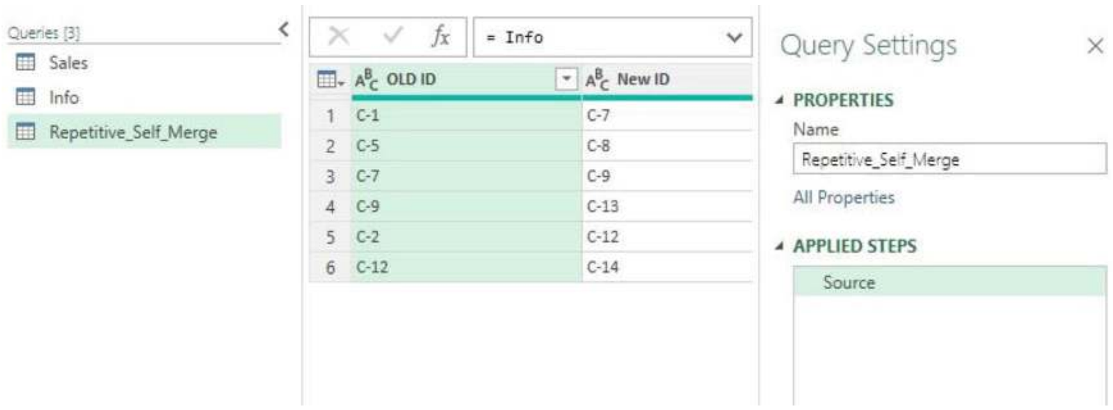
**Note** The data in this example is provided in an Excel file titled `07 Self-Merging.xlsx`.

The complexity of this problem lies within the Info table. If there were an additional column, say Last ID, that displayed the last ID for each customer (e.g., C-13 for all the IDs C-1, C-7, and C-9), you could easily solve this problem, but as there is no such column, you need to add it first and then use merging to solve the problem. Two different solutions based on merging and using the `List.Generate()` function are proposed to determine the last IDs.

## Solution 1: Based on Merging Logic

At first glance, one way to solve this problem is through recursion, where the Info table is repeatedly merged with itself multiple times, in each iteration, until it finds the last IDs for all customers. Create a new query called `Repetitive_Self_Merge` and write the following formula in its formula bar as the first step, as shown in Figure 7-46. This refers to the result of the Info query (at this step is exactly the same as the Info table).

```
= Info
```

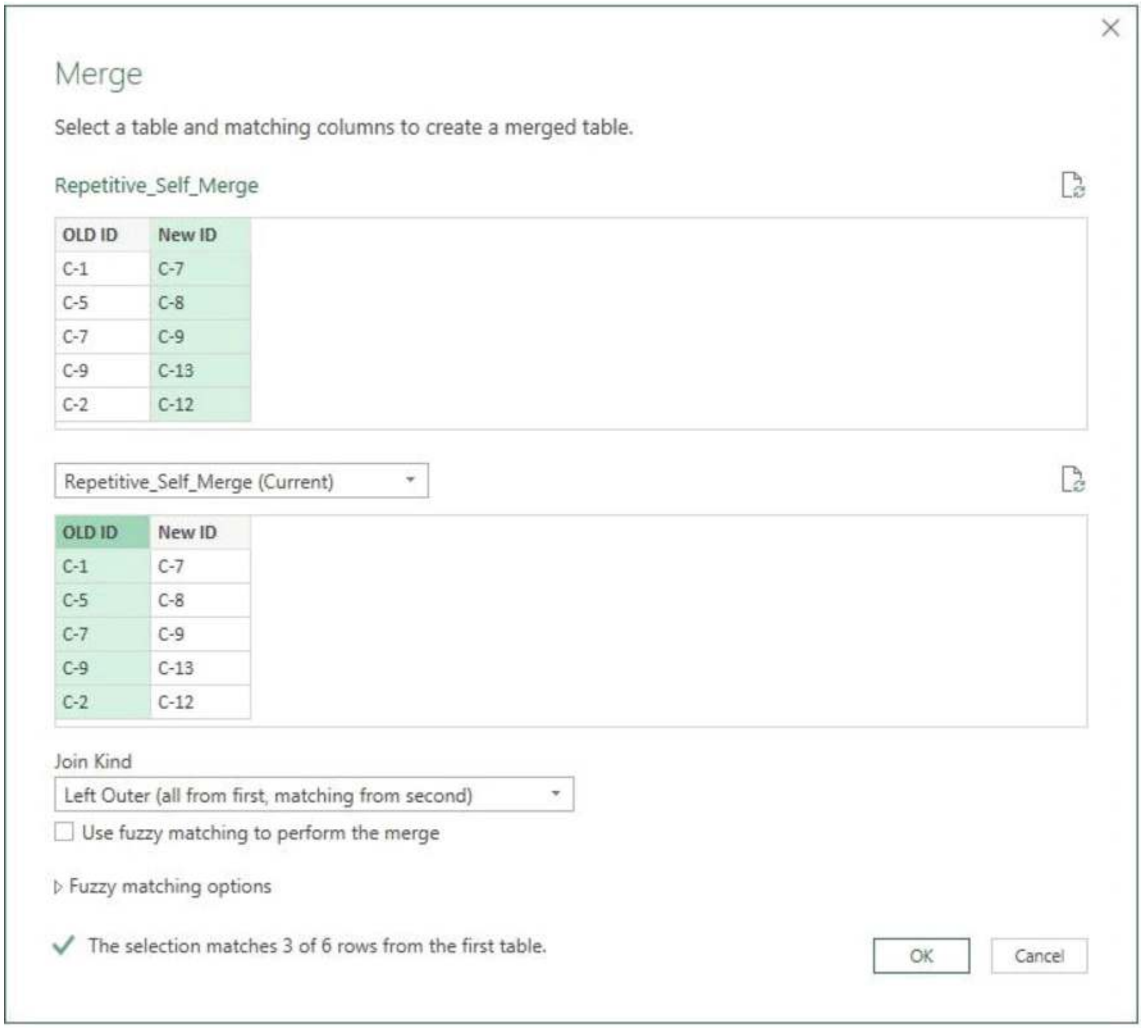


|  | OLD ID | New ID |
|---|---|---|
| 1 | C-1 | C-7 |
| 2 | C-5 | C-8 |
| 3 | C-7 | C-9 |
| 4 | C-9 | C-13 |
| 5 | C-2 | C-12 |
| 6 | C-12 | C-14 |

***Figure 7-46*** New query

Consider the first row in this table. Based on this row, the ID of customer C-1 is updated to C-7. To find its next update, you need to search for its last ID, which was presented on the New ID column (C-7) in the Old ID column across other rows. If you find C-7 in a row, the value in the New ID column of that row will provide the updated ID for this customer. If C-7 is not found, it indicates that this is the final ID for this customer. To achieve this, you need to recursively merge the table with itself to track the sequence of ID updates.

With the `Repetitive_Self_Merge` query selected, go to the Home tab and click the Merge Queries command. In the open window, select `Repetitive_Self_Merge` for the top and bottom tables. To extract the next ID, you need to search for values in the New ID column against the values in the Old ID column. So, in the top table, select the New ID column, and in the bottom table, select the Old ID column as the common columns, as shown in Figure 7-47. By clicking OK, you will get the result shown in Figure 7-48, which provides a table for rows where the IDs have changed again and a blank table for those rows where the IDs have not changed further.



Merge

Select a table and matching columns to create a merged table.

Repetitive_Self_Merge

| OLD ID | New ID |
|---|---|
| C-1 | C-7 |
| C-5 | C-8 |
| C-7 | C-9 |
| C-9 | C-13 |
| C-2 | C-12 |

Repetitive_Self_Merge (Current)

| OLD ID | New ID |
|---|---|
| C-1 | C-7 |
| C-5 | C-8 |
| C-7 | C-9 |
| C-9 | C-13 |
| C-2 | C-12 |

Join Kind

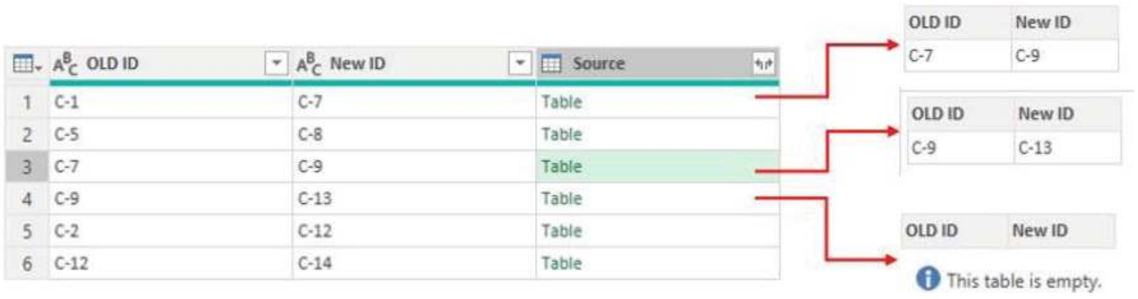
Left Outer (all from first, matching from second)

☐ Use fuzzy matching to perform the merge

▷ Fuzzy matching options

✓ The selection matches 3 of 6 rows from the first table.

*Figure 7-47* Merge settings



|  | OLD ID | New ID | Source |
|---|---|---|---|
| 1 | C-1 | C-7 | Table |
| 2 | C-5 | C-8 | Table |
| 3 | C-7 | C-9 | Table |
| 4 | C-9 | C-13 | Table |
| 5 | C-2 | C-12 | Table |
| 6 | C-12 | C-14 | Table |

| OLD ID | New ID |
|---|---|
| C-7 | C-9 |

| OLD ID | New ID |
|---|---|
| C-9 | C-13 |

| OLD ID | New ID |
|---|---|

This table is empty.

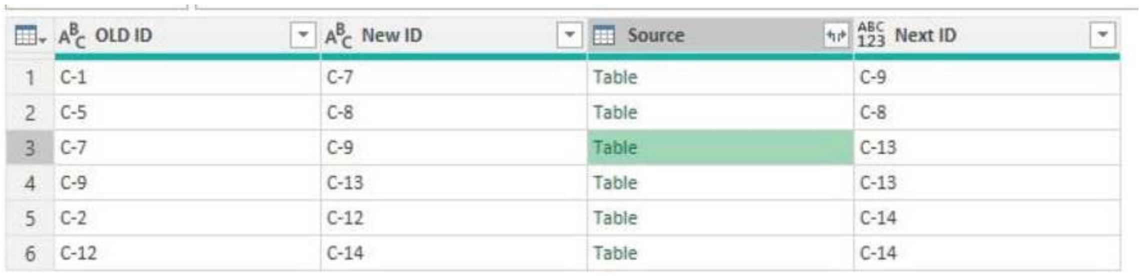
*Figure 7-48* Merge results

If the Source column contains an empty table (as in row 4), it means that the New ID in this row is the final ID for that customer. However, if the Source column contains a non-empty table, it does not guarantee that you've reached the last ID. Instead, it indicates that you've only found the next ID for that customer, and you will need to perform the self-merging process again to continue the sequence.

Add a new column called Next ID using the following formula in the Custom Column window:

```
= if Table.IsEmpty([Source]) then [New ID] else [Source][New ID]{0}
```

This column will show the value from the New ID column if the Source column is blank; otherwise, it will extract the value from the New ID column in the table is present in the Source column, and produces the result shown in Figure 7-49.



| | OLD ID | New ID | Source | Next ID |
|---|---|---|---|---|
| 1 | C-1 | C-7 | Table | C-9 |
| 2 | C-5 | C-8 | Table | C-8 |
| 3 | C-7 | C-9 | Table | C-13 |
| 4 | C-9 | C-13 | Table | C-13 |
| 5 | C-2 | C-12 | Table | C-14 |
| 6 | C-12 | C-14 | Table | C-14 |

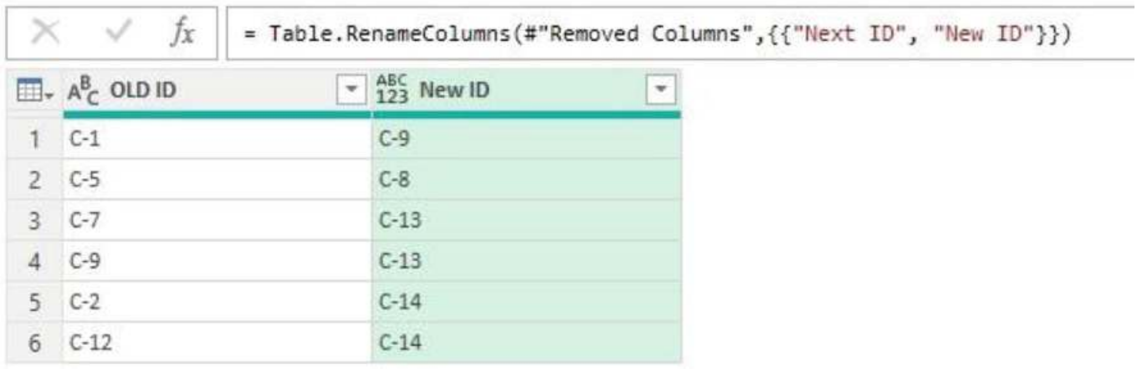
***Figure 7-49*** Merge results

In the first row of the resulting table, the customer ID was initially C-1, and its New ID became C-7, which was later changed to C-9 (as shown in the Next ID column). However, C-9 is not the final ID, as it is changed to C-13 next. Therefore, you need to repeat this self-merge process again.

The number of times the self-merging process needs to be repeated depends on the structure of the data. This process should continue until a stop condition is met. For example, the process can stop once all the tables in the merged column are blank, indicating that no further IDs need to be updated.

Since the number of times this process needs to be repeated is not always clear, you need to create a loop using a recursive function to repeat this process until reaching the last ID for all the customers. Since this process will be repeated multiple times, it’s helpful to convert the output table back to the same structure as the input table. This will ensure that the process can continue smoothly without having to adjust for changes in the table structure with each iteration.

In this example, the initial table contains only two columns: Old ID and New ID. To transform the resulting table into this structure, remove the New ID and Source columns, then rename the Next ID column to New ID. You will then have a table with the same column names as in the first step, as shown in Figure 7-50.

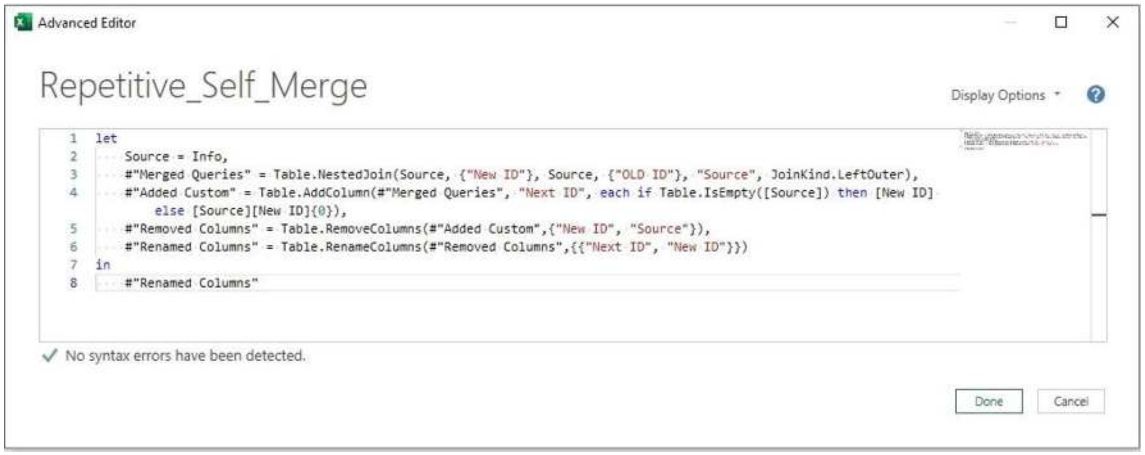


```
= Table.RenameColumns(#"Removed Columns",{{"Next ID", "New ID"}})
```

| | OLD ID | New ID |
|---|---|---|
| 1 | C-1 | C-9 |
| 2 | C-5 | C-8 |
| 3 | C-7 | C-13 |
| 4 | C-9 | C-13 |
| 5 | C-2 | C-14 |
| 6 | C-12 | C-14 |

***Figure 7-50*** Changing the table

Next, open the Advanced Editor, where the steps are shown in Figure 7-51.



Repetitive_Self_Merge

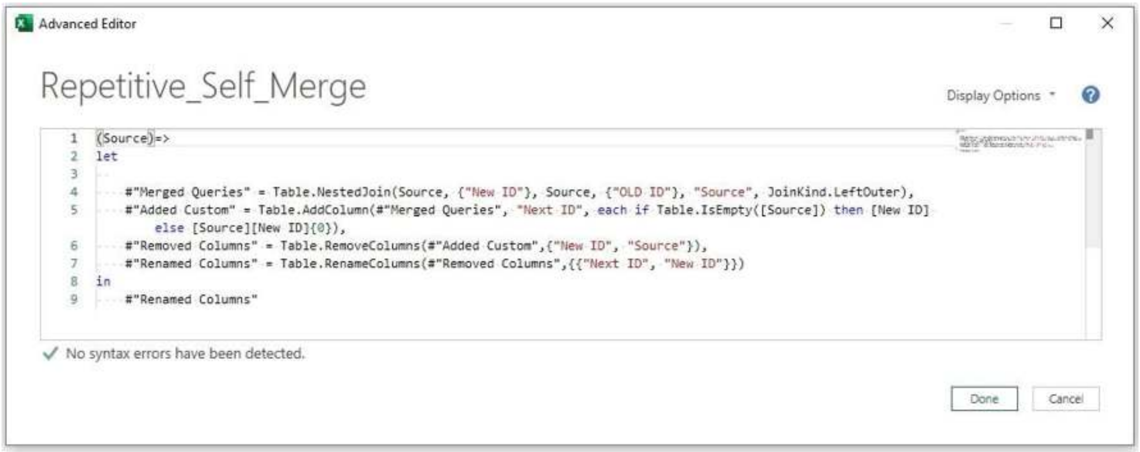
```
let
    Source = Info,
    #"Merged Queries" = Table.NestedJoin(Source, {"New ID"}, Source, {"OLD ID"}, "Source", JoinKind.LeftOuter),
    #"Added Custom" = Table.AddColumn(#"Merged Queries", "Next ID", each if Table.IsEmpty([Source]) then [New ID]
        else [Source][New ID]{0}),
    #"Removed Columns" = Table.RemoveColumns(#"Added Custom",{"New ID", "Source"}),
    #"Renamed Columns" = Table.RenameColumns(#"Removed Columns",{{"Next ID", "New ID"}})
in
    #"Renamed Columns"
```

✓ No syntax errors have been detected.

***Figure 7-51*** Advanced Editor

All the steps you followed up to now are presented here. In the first step, you defined the Source as the result of the Info query, and all subsequent steps were applied to this table. Instead of directly using this table, you can convert it into a parameter. By doing this, this query will be transformed into a function that takes a table as input, applies all the steps to it, and returns the resulting table.

To convert this query into a function and make it dynamic, you need to remove the first step (`Source = Info`) and define Source as an input parameter. You do this by entering `(Source)=>` before the `let` expression, as shown in Figure 7-52.



Repetitive_Self_Merge

```
(Source)=>
let

    #"Merged Queries" = Table.NestedJoin(Source, {"New ID"}, Source, {"OLD ID"}, "Source", JoinKind.LeftOuter),
    #"Added Custom" = Table.AddColumn(#"Merged Queries", "Next ID", each if Table.IsEmpty([Source]) then [New ID]
        else [Source][New ID]{0}),
    #"Removed Columns" = Table.RemoveColumns(#"Added Custom",{"New ID", "Source"}),
    #"Renamed Columns" = Table.RenameColumns(#"Removed Columns",{{"Next ID", "New ID"}})
in
    #"Renamed Columns"
```

✓ No syntax errors have been detected.

***Figure 7-52*** Converting the query into a function

The query has been converted into a function, as shown in Figure 7-53, so that it takes a table like Info and performs a self-merge on it once. To repeat this process until the last IDs for all the customers are found using a recursive cycle, you need to define a stop condition.

In this example, you reach the last IDs for all the customers when none of the text in the New ID column is present in the Old ID column. So, the condition can be written as follows (since the last step in the defined function is named `#"Renamed Columns"`, I use that for the table name):

```
= List.ContainsAny(#"Renamed Columns"[New ID],#"Renamed Columns" [OLD ID])
```

If the result of the previous formula is true, it means that there is at least one value in the New ID column that is also found in the Old ID column, so the cycle should be repeated. Otherwise, you have reached the final table, and it should be presented as the result.

In the function steps shown in Figure 7-52, after the `in` expression, the result of `#"Renamed Columns"` is currently returned. However, since you have now defined a stop condition, you need to modify this logic. You need to write it as, if the stop condition evaluates to true, it means you have not yet reached the final table and must apply self-merging again to `#"Renamed Columns"`. If the stop condition is false, the process is complete, and `#"Renamed Columns"` represents the final table.

To implement this logic, write the formula as follows:

```
if [stop condition] then Repetitive_Self_Merge(#"Renamed Columns") else
#"Renamed Columns"
```

The revised recursive custom function is defined as follows (see Figure 7-53):

```
(Source)=>
let

    #"Merged Queries" = Table.NestedJoin(Source, {"New ID"}, Source, {"OLD
ID"}, "Source", JoinKind.LeftOuter),
    #"Added Custom" = Table.AddColumn(#"Merged Queries", "Next ID", each if
Table.IsEmpty([Source]) then [New ID] else [Source][New ID]{0}),
    #"Removed Columns" = Table.RemoveColumns(#"Added Custom",{"New ID",
"Source"}),
    #"Renamed Columns" = Table.RenameColumns(#"Removed Columns",{{"Next
ID", "New ID"}})

in
    if  List.ContainsAny(#"Renamed Columns"[New ID],#"Renamed Columns" [OLD
ID]) then Repetitive_Self_Merge(#"Renamed Columns") else #"Renamed Columns"
```

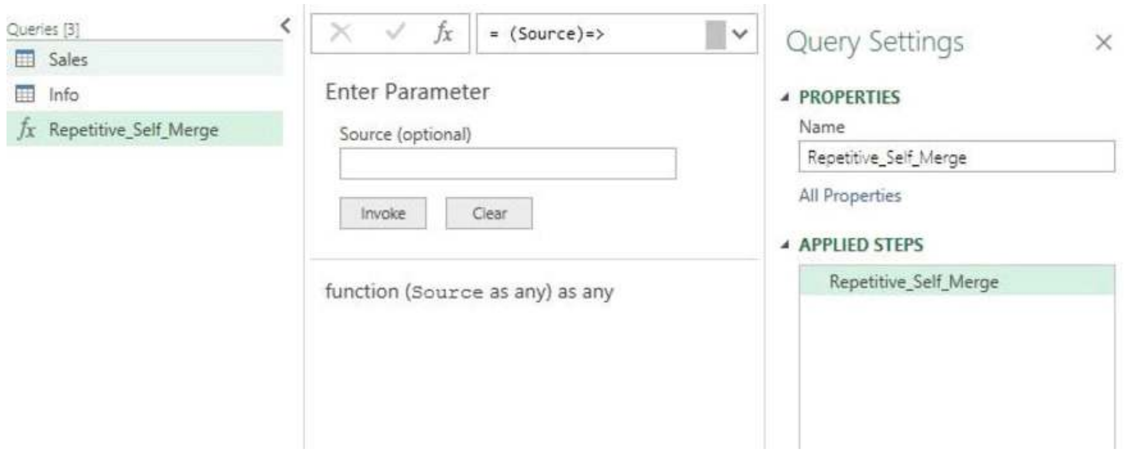
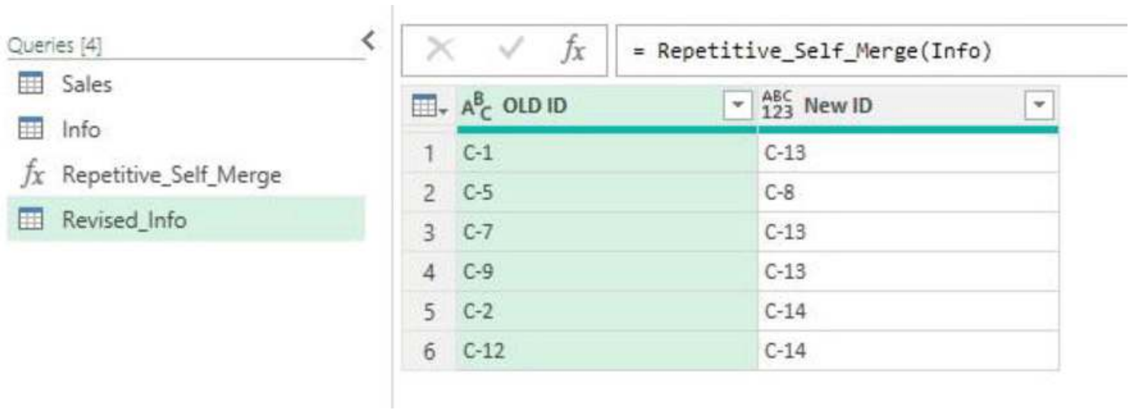


***Figure 7-53*** Defining the recursive function

By creating a new query named `Revised_Info` and using the following formula, you obtain the desired table. This table includes the latest IDs for customers who have undergone ID changes. This includes all the changed IDs and their last IDs for merging with the Sales table, as shown in Figure 7-54:

```
= Repetitive_Self_Merge(Info)
```

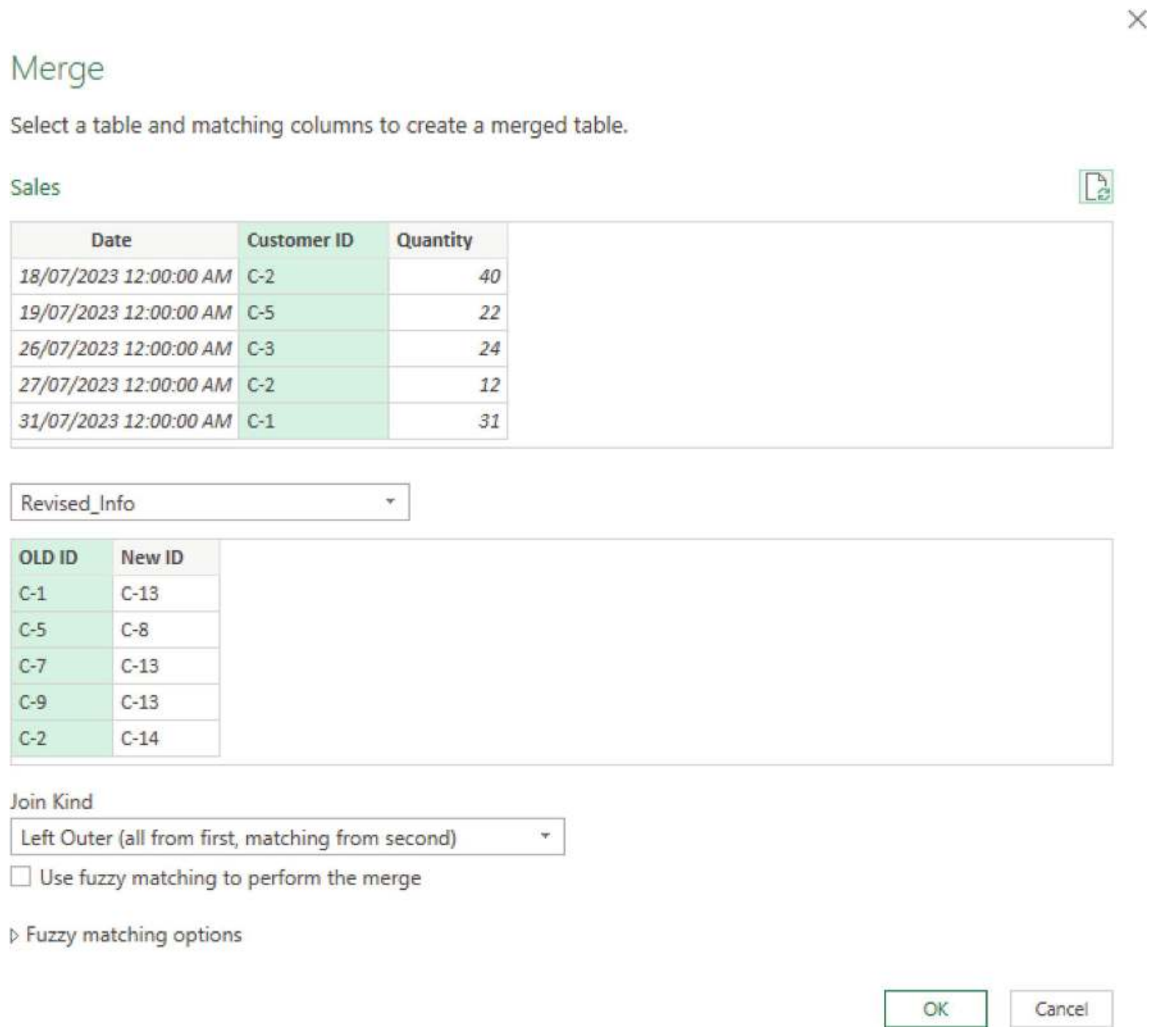


= Repetitive_Self_Merge(Info)

| | OLD ID | New ID |
|---|---|---|
| 1 | C-1 | C-13 |
| 2 | C-5 | C-8 |
| 3 | C-7 | C-13 |
| 4 | C-9 | C-13 |
| 5 | C-2 | C-14 |
| 6 | C-12 | C-14 |

***Figure 7-54*** Revised Info table

After reaching the last IDs for all the customers, select the Sales table and perform a merge with the Revised_Info table based on the settings shown in Figure 7-55. Then, expand the new column by selecting only New ID to achieve the result shown in Figure 7-56.


Merge
Select a table and matching columns to create a merged table.
Sales

| Date | Customer ID | Quantity |
|---|---|---|
| 18/07/2023 12:00:00 AM | C-2 | 40 |
| 19/07/2023 12:00:00 AM | C-5 | 22 |
| 26/07/2023 12:00:00 AM | C-3 | 24 |
| 27/07/2023 12:00:00 AM | C-2 | 12 |
| 31/07/2023 12:00:00 AM | C-1 | 31 |

Revised_Info

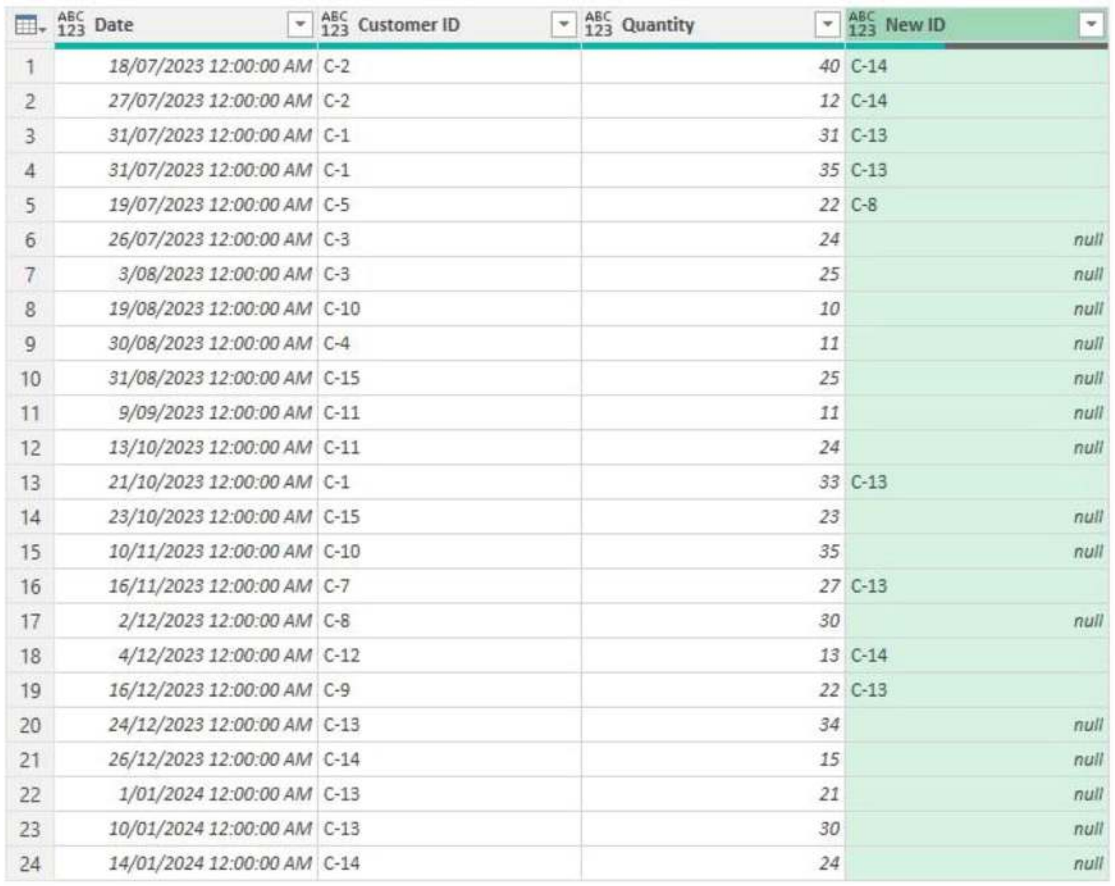
| OLD ID | New ID |
|---|---|
| C-1 | C-13 |
| C-5 | C-8 |
| C-7 | C-13 |
| C-9 | C-13 |
| C-2 | C-14 |

Join Kind: Left Outer (all from first, matching from second)

☐ Use fuzzy matching to perform the merge

Fuzzy matching options
OK
Cancel

***Figure 7-55*** Setting for merging



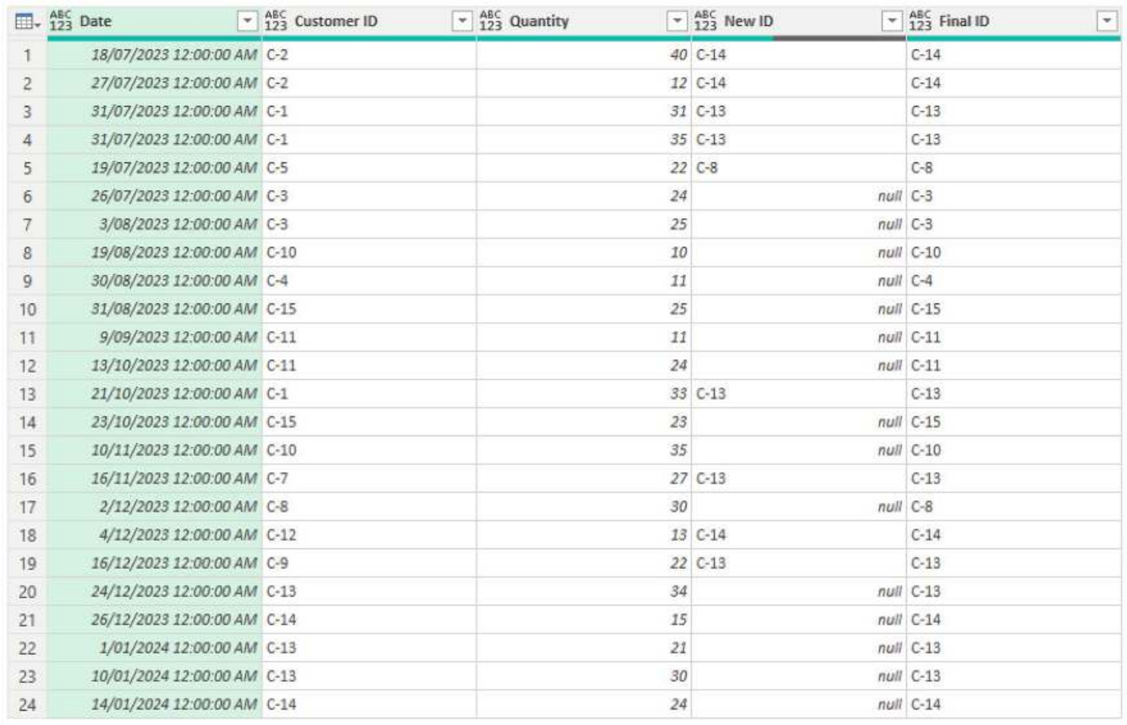
| | Date | Customer ID | Quantity | New ID |
|---|---|---|---|---|
| 1 | 18/07/2023 12:00:00 AM | C-2 | 40 | C-14 |
| 2 | 27/07/2023 12:00:00 AM | C-2 | 12 | C-14 |
| 3 | 31/07/2023 12:00:00 AM | C-1 | 31 | C-13 |
| 4 | 31/07/2023 12:00:00 AM | C-1 | 35 | C-13 |
| 5 | 19/07/2023 12:00:00 AM | C-5 | 22 | C-8 |
| 6 | 26/07/2023 12:00:00 AM | C-3 | 24 | null |
| 7 | 3/08/2023 12:00:00 AM | C-3 | 25 | null |
| 8 | 19/08/2023 12:00:00 AM | C-10 | 10 | null |
| 9 | 30/08/2023 12:00:00 AM | C-4 | 11 | null |
| 10 | 31/08/2023 12:00:00 AM | C-15 | 25 | null |
| 11 | 9/09/2023 12:00:00 AM | C-11 | 11 | null |
| 12 | 13/10/2023 12:00:00 AM | C-11 | 24 | null |
| 13 | 21/10/2023 12:00:00 AM | C-1 | 33 | C-13 |
| 14 | 23/10/2023 12:00:00 AM | C-15 | 23 | null |
| 15 | 10/11/2023 12:00:00 AM | C-10 | 35 | null |
| 16 | 16/11/2023 12:00:00 AM | C-7 | 27 | C-13 |
| 17 | 2/12/2023 12:00:00 AM | C-8 | 30 | null |
| 18 | 4/12/2023 12:00:00 AM | C-12 | 13 | C-14 |
| 19 | 16/12/2023 12:00:00 AM | C-9 | 22 | C-13 |
| 20 | 24/12/2023 12:00:00 AM | C-13 | 34 | null |
| 21 | 26/12/2023 12:00:00 AM | C-14 | 15 | null |
| 22 | 1/01/2024 12:00:00 AM | C-13 | 21 | null |
| 23 | 10/01/2024 12:00:00 AM | C-13 | 30 | null |
| 24 | 14/01/2024 12:00:00 AM | C-14 | 24 | null |

***Figure 7-56*** Result of merging

Since the Info table only includes customers who have experienced at least one ID change, some customers may have a null value in the ***New ID*** column. For these customers, you should use the value from the ***Customer ID*** column. Add a new column named Final ID using one of the following formulas to reach the result shown in Figure 7-57:

```
=if [New ID]=null then [Customer ID] else [New ID]
```

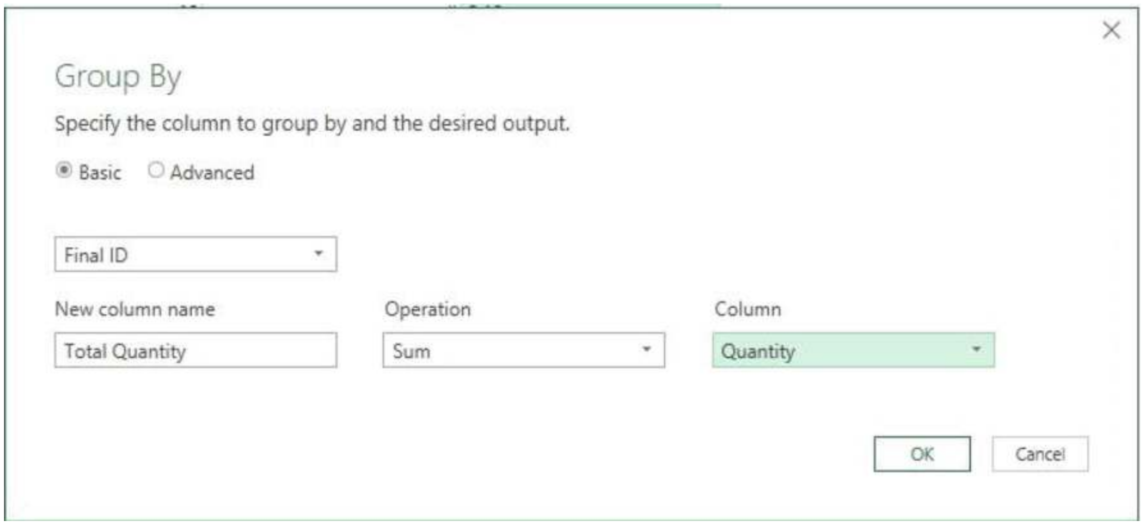
```
=[New ID]??[Customer ID]
```



| | Date | Customer ID | Quantity | New ID | Final ID |
|---|---|---|---|---|---|
| 1 | 18/07/2023 12:00:00 AM | C-2 | 40 | C-14 | C-14 |
| 2 | 27/07/2023 12:00:00 AM | C-2 | 12 | C-14 | C-14 |
| 3 | 31/07/2023 12:00:00 AM | C-1 | 31 | C-13 | C-13 |
| 4 | 31/07/2023 12:00:00 AM | C-1 | 35 | C-13 | C-13 |
| 5 | 19/07/2023 12:00:00 AM | C-5 | 22 | C-8 | C-8 |
| 6 | 26/07/2023 12:00:00 AM | C-3 | 24 | null | C-3 |
| 7 | 3/08/2023 12:00:00 AM | C-3 | 25 | null | C-3 |
| 8 | 19/08/2023 12:00:00 AM | C-10 | 10 | null | C-10 |
| 9 | 30/08/2023 12:00:00 AM | C-4 | 11 | null | C-4 |
| 10 | 31/08/2023 12:00:00 AM | C-15 | 25 | null | C-15 |
| 11 | 9/09/2023 12:00:00 AM | C-11 | 11 | null | C-11 |
| 12 | 13/10/2023 12:00:00 AM | C-11 | 24 | null | C-11 |
| 13 | 21/10/2023 12:00:00 AM | C-1 | 33 | C-13 | C-13 |
| 14 | 23/10/2023 12:00:00 AM | C-15 | 23 | null | C-15 |
| 15 | 10/11/2023 12:00:00 AM | C-10 | 35 | null | C-10 |
| 16 | 16/11/2023 12:00:00 AM | C-7 | 27 | C-13 | C-13 |
| 17 | 2/12/2023 12:00:00 AM | C-8 | 30 | null | C-8 |
| 18 | 4/12/2023 12:00:00 AM | C-12 | 13 | C-14 | C-14 |
| 19 | 16/12/2023 12:00:00 AM | C-9 | 22 | C-13 | C-13 |
| 20 | 24/12/2023 12:00:00 AM | C-13 | 34 | null | C-13 |
| 21 | 26/12/2023 12:00:00 AM | C-14 | 15 | null | C-14 |
| 22 | 1/01/2024 12:00:00 AM | C-13 | 21 | null | C-13 |
| 23 | 10/01/2024 12:00:00 AM | C-13 | 30 | null | C-13 |
| 24 | 14/01/2024 12:00:00 AM | C-14 | 24 | null | C-14 |

***Figure 7-57*** Calculating the final ID

You can use this new column to calculate the sales per customer. Select the Quantity column and change its type to number and then select the Group By command and applying the settings shown in Figure 7-58. Click OK to reach the result shown in Figure 7-59.



Group By

Specify the column to group by and the desired output.

[✓ Basic] Advanced

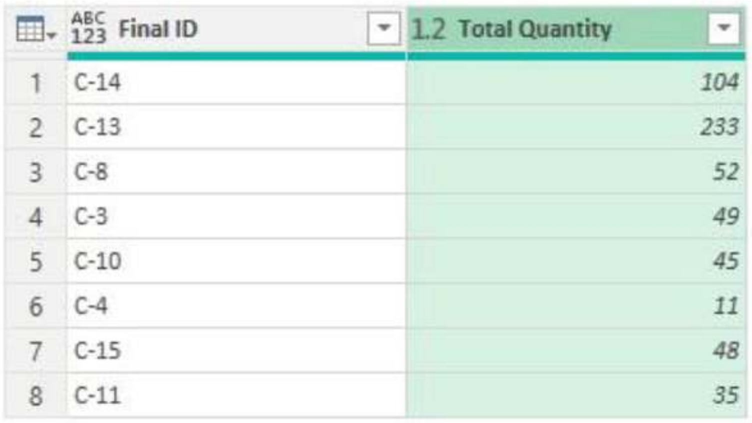
Final ID

New column name: Total Quantity

Operation: Sum

Column: Quantity

***Figure 7-58*** Setting for Group By



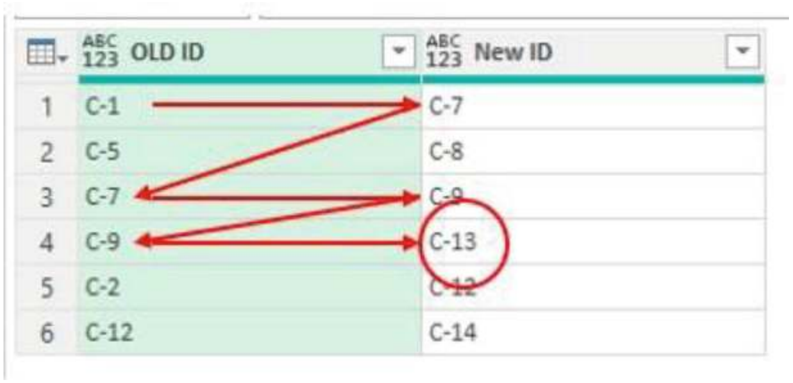
| | Final ID | Total Quantity |
|---|---|---|
| 1 | C-14 | 104 |
| 2 | C-13 | 233 |
| 3 | C-8 | 52 |
| 4 | C-3 | 49 |
| 5 | C-10 | 45 |
| 6 | C-4 | 11 |
| 7 | C-15 | 48 |
| 8 | C-11 | 35 |

***Figure 7-59*** Result of Group By

## Solution 2: Using the List.Generate() Function

The previous solution solves the problem, but for large-scale scenarios, it may be time-consuming due to repeated self-merging. This solution introduces an alternative that is more efficient compared to the previous approach.

To verify the logic of this solution, consider the customer with the ID C-1 as an example. You can use a formula to search for it in the Info table's Old ID column. If found, it chooses the corresponding New ID and repeats the search process using this new ID in the Old ID column until the last ID is found, as illustrated in Figure 7-60.



| | OLD ID | New ID |
|---|---|---|
| 1 | C-1 | C-7 |
| 2 | C-5 | C-8 |
| 3 | C-7 | C-9 |
| 4 | C-9 | C-13 |
| 5 | C-2 | C-12 |
| 6 | C-12 | C-14 |

***Figure 7-60*** Searching for the last ID of customer C-1

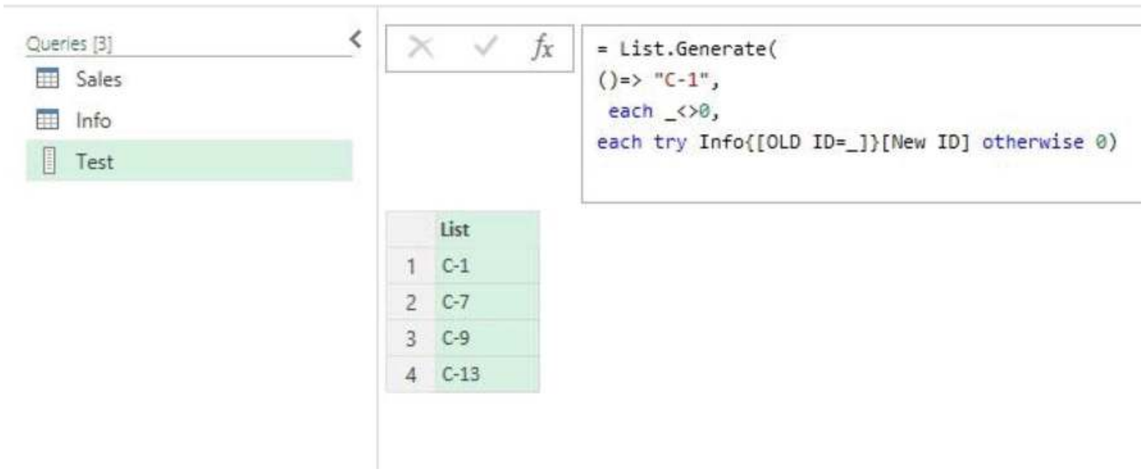
To perform this loop until the last ID of customers is found, you can use the `List.Generate()` function, (Chapter 9 explains this function and another way of defining a loop in Power Query.) To prepare the formula, create a new query called Test and write the following formula for customer ID C-1 to retrieve all the historical IDs of C-1. As shown in Figure 7-61, this formula produces all the historical IDs of the C-1 customer.

```
= List.Generate(
      ()=> "C-1",
      each _<>0,
      each try Info{[OLD ID=_]}[New ID] otherwise 0)
```

To clarify this formula, consider a variable named `x` (in the formula it is `_`, but since `x` is more easy to follow, let's assume the variable name is `x`), initially set to C-1 in the first argument. The second argument, which defines the stop condition, states that if `x` is not equal to `0`, the loop should continue; otherwise, the loop should stop. In the third argument, x is updated using the following formula, which means searching for the value of x in the Old ID column. If a matching row is found, the corresponding value in the New ID column on that row is assigned the new value of x; otherwise, x is set to 0. The stop condition is then checked again, and based on the result, the loop continues or terminates.

```
try Info{[OLD ID=_]}[New ID] otherwise 0
```

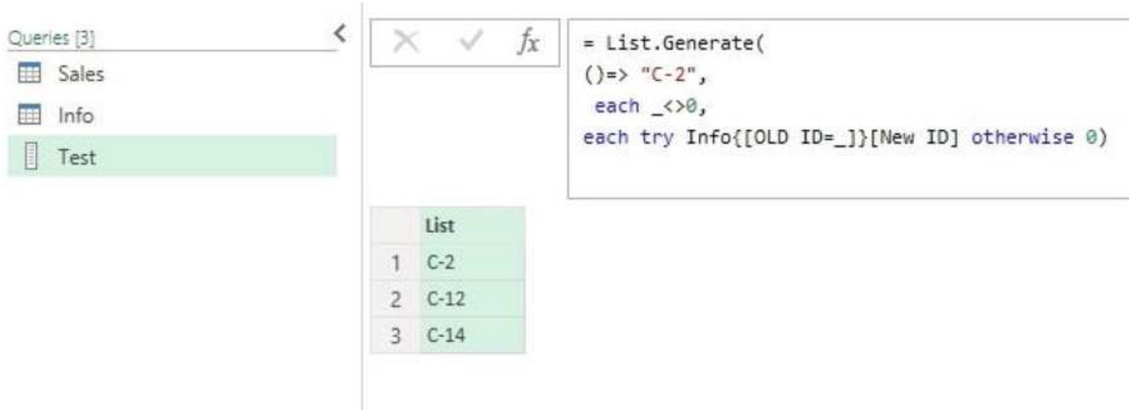
Changing C-1 to C-2 or C-3 in the first input of the previous formula will yield all the historical IDs of C-2 and C-3, as shown in Figure 7-62 and Figure 7-63.



```
= List.Generate(
()=> "C-1",
 each _<>0,
each try Info{[OLD ID=_]}[New ID] otherwise 0)
```

| | List |
|---|---|
| 1 | C-1 |
| 2 | C-7 |
| 3 | C-9 |
| 4 | C-13 |

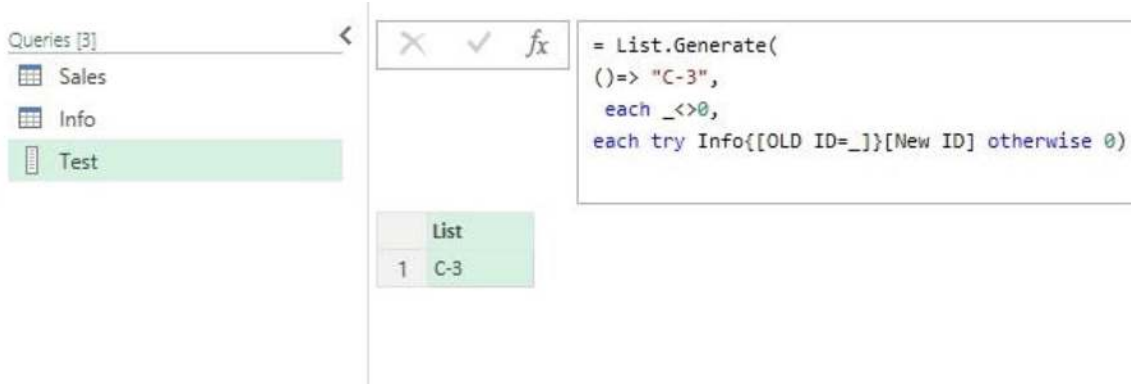
***Figure 7-61*** Result for the last ID of customer C-1



```
= List.Generate(
()=> "C-2",
 each _<>0,
each try Info{[OLD ID=_]}[New ID] otherwise 0)
```

| | List |
|---|---|
| 1 | C-2 |
| 2 | C-12 |
| 3 | C-14 |

***Figure 7-62*** The result for the last ID of customer C-2



```
= List.Generate(
()=> "C-3",
 each _<>0,
each try Info{[OLD ID=_]}[New ID] otherwise 0)
```

| | List |
|---|---|
| 1 | C-3 |

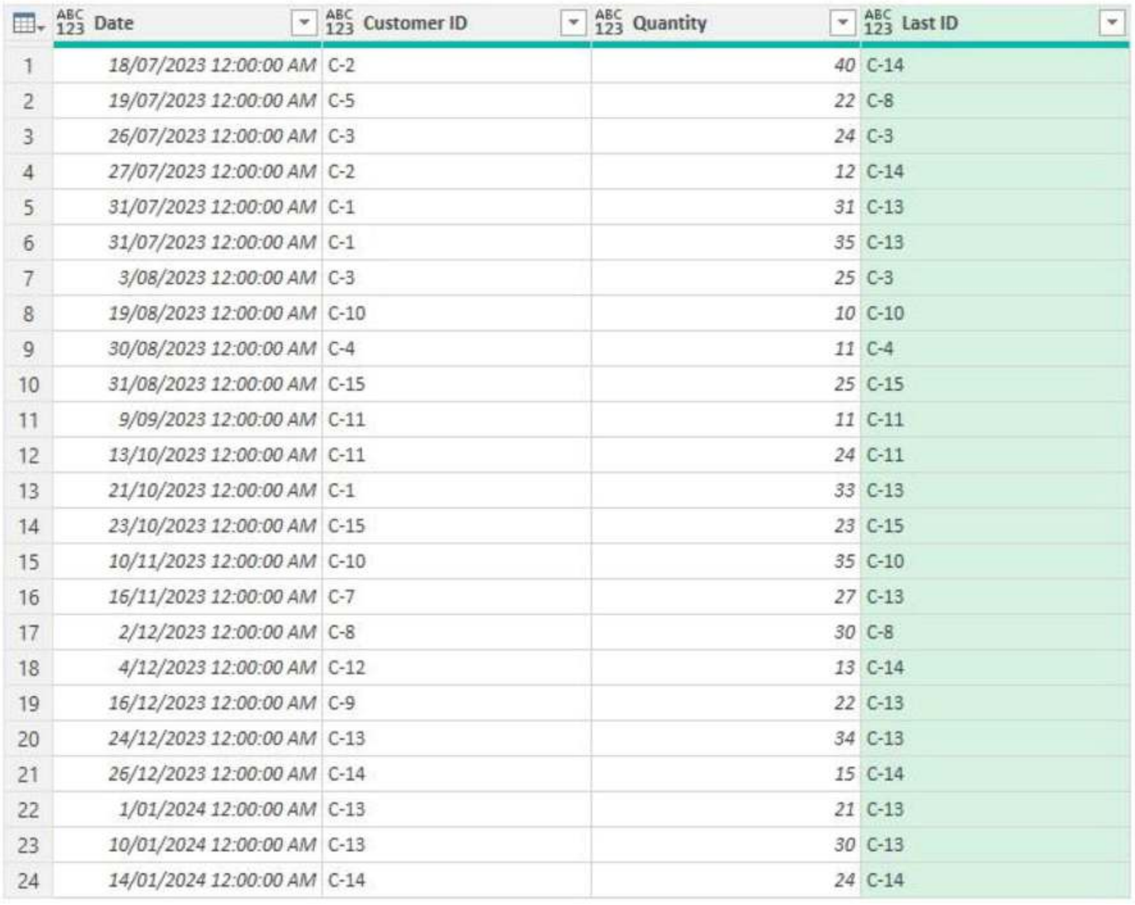
*Figure 7-63* The result for the last ID of customer C-3

Since this formula returns a list of all changes in the customer IDs, the last value in the list represents the final ID for that customer. Therefore, the following formula will yield the last ID for the customer with `ID = C-1`:

```
= List.Last(List.Generate(
      ()=> "C-1",
      each _<>0,
      each try Info{[OLD ID=_]}[New ID] otherwise 0))
```

Based on this explanation, go to the Sales table and add a new column named Last ID using the following formula. This will extract the last IDs for each customer, as shown in Figure 7-64, and these IDs can then be used for grouping the data, similar to the previous solution.

```
=List.Last(List.Generate(
      ()=> [Customer ID],
      each _<>0,
      each try Info{[OLD ID=_]}[New ID] otherwise 0))
```



| | Date | Customer ID | Quantity | Last ID |
|---|---|---|---|---|
| 1 | 18/07/2023 12:00:00 AM | C-2 | 40 | C-14 |
| 2 | 19/07/2023 12:00:00 AM | C-5 | 22 | C-8 |
| 3 | 26/07/2023 12:00:00 AM | C-3 | 24 | C-3 |
| 4 | 27/07/2023 12:00:00 AM | C-2 | 12 | C-14 |
| 5 | 31/07/2023 12:00:00 AM | C-1 | 31 | C-13 |
| 6 | 31/07/2023 12:00:00 AM | C-1 | 35 | C-13 |
| 7 | 3/08/2023 12:00:00 AM | C-3 | 25 | C-3 |
| 8 | 19/08/2023 12:00:00 AM | C-10 | 10 | C-10 |
| 9 | 30/08/2023 12:00:00 AM | C-4 | 11 | C-4 |
| 10 | 31/08/2023 12:00:00 AM | C-15 | 25 | C-15 |
| 11 | 9/09/2023 12:00:00 AM | C-11 | 11 | C-11 |
| 12 | 13/10/2023 12:00:00 AM | C-11 | 24 | C-11 |
| 13 | 21/10/2023 12:00:00 AM | C-1 | 33 | C-13 |
| 14 | 23/10/2023 12:00:00 AM | C-15 | 23 | C-15 |
| 15 | 10/11/2023 12:00:00 AM | C-10 | 35 | C-10 |
| 16 | 16/11/2023 12:00:00 AM | C-7 | 27 | C-13 |
| 17 | 2/12/2023 12:00:00 AM | C-8 | 30 | C-8 |
| 18 | 4/12/2023 12:00:00 AM | C-12 | 13 | C-14 |
| 19 | 16/12/2023 12:00:00 AM | C-9 | 22 | C-13 |
| 20 | 24/12/2023 12:00:00 AM | C-13 | 34 | C-13 |
| 21 | 26/12/2023 12:00:00 AM | C-14 | 15 | C-14 |
| 22 | 1/01/2024 12:00:00 AM | C-13 | 21 | C-13 |
| 23 | 10/01/2024 12:00:00 AM | C-13 | 30 | C-13 |
| 24 | 14/01/2024 12:00:00 AM | C-14 | 24 | C-14 |

*Figure 7-64* Extracting the last ID for customers

**Note**Although this solution is more efficient compared to the first approach, it can be slow in real-world scenarios, especially when dealing with a large Info table, as it queries the table multiple times. To improve performance, similar to the technique presented in Chapter 2, it is recommended that you introduce an intermediate step. In this step, apply `Table.Buffer(Info)` to cache the table, and then reference this buffered table in the formula to reduce redundant lookups.

## Summary

In this chapter, you learned how to manage multiple tables by either stacking them vertically (*appending*) or aligning them horizontally (*merging*), which are known as unite and joint in SQL. To append tables, you can use the `Table.Combine()` function, which takes two arguments—the first is a list of tables to be stacked, and the optional second argument specifies columns to include after appending, and it keeps the data types of the combined columns.

To merge tables, you use `Table.Join()` function to align two tables based on shared columns. This function supports various join types, such as inner and outer joins, to combine tables according to specific needs. Additionally, if the common columns are not exact matches, you can apply *fuzzy matching* to approximate and join similar values.

Your journey with Power Query continues! In the next chapter, you explore techniques for handling missing values in Power Query.

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# 8. Handling Missing Values

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During the data-cleaning process, you might have to deal with missing values, which arise from various reasons, including the data-collection process, human mistakes, and technical issues. For example, if you create a form for job applicants where they can enter their date of birth in various formats (e.g., year, year-month, year/month/day), you might encounter missing values during analysis because some parts of the information are not provided. In another scenario, if you store your data in Excel files by year and inadvertently remove the data for 2012, that data will become missing for future analysis. Alternatively, if you want to use a government index in your prediction model, but the value of that index was not reported for a specific period in the past, it will be treated as a missing value in your analysis.

There are different scenarios in which you might encounter missing values, and handling missing values is a critical step in the data-cleaning process because it ensures data integrity and accuracy. Properly addressing missing values significantly improves model performance and enhances the overall quality and usability of the data. High-quality data is essential for making informed decisions, and addressing missing values ensures that the dataset is both complete and accurate. This chapter explains how to handle missing values in several scenarios.

**Note** Missing values and zeros are often confused, but they are fundamentally different. Consider the process of collecting data via a questionnaire. After conducting five interviews, the decision is made to add a question asking participants how many children they have. For the individuals interviewed before this question was added, there is no data available on this field, meaning it is a missing value. This does not imply that these individuals have no children—it simply means the information wasn't collected. Therefore, you cannot enter a value of 0 for these individuals. However, for future interviews, if a participant answers 0, that is a valid response indicating they have no children, rather than a missing value.

## Filling Nulls with Previous Values

Table 8-1 shows the project progress reports at the end of the month for projects A and B. In some months, the progress is missing, indicated by a null value in the Actual Progress column (the cells in the Excel files are blank, which will be converted to null after loading them into Power Query). Replace the null values with the last reported progress from the previous month.

***Table 8-1*** Source: Monthly Project Progress

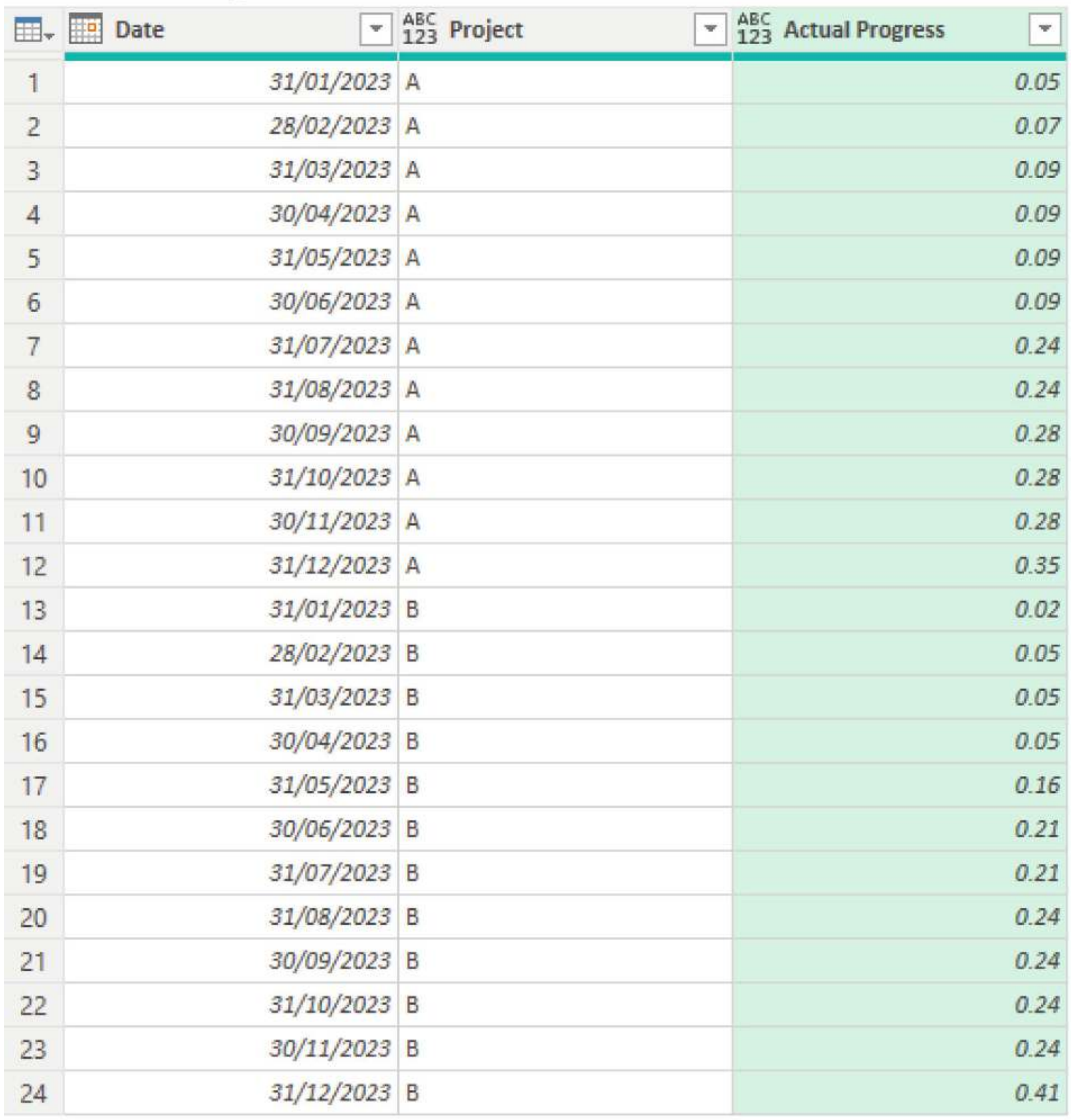
| Date | Project | Actual Progress |
|---|---|---|
| 31/01/2023 | A | 0.05 |
| 28/02/2023 | A | 0.07 |
| 31/03/2023 | A | 0.09 |
| 30/04/2023 | A | null |
| 31/05/2023 | A | null |
| 30/06/2023 | A | null |
| 31/07/2023 | A | 0.24 |
| 31/08/2023 | A | null |
| 30/09/2023 | A | 0.28 |
| 31/10/2023 | A | null |
| 30/11/2023 | A | null |
| 31/12/2023 | A | 0.35 |
| 31/01/2023 | B | 0.02 |
| 28/02/2023 | B | 0.05 |

| Date | Project | Actual Progress |
|---|---|---|
| 31/03/2023 | B | null |
| 30/04/2023 | B | null |
| 31/05/2023 | B | 0.16 |
| 30/06/2023 | B | 0.21 |
| 31/07/2023 | B | null |
| 31/08/2023 | B | 0.24 |
| 30/09/2023 | B | null |
| 31/10/2023 | B | null |
| 30/11/2023 | B | null |
| 31/12/2023 | B | 0.41 |

**Note** The data in this example is provided in an Excel file titled `01 Filling with Previous Values.xlsx`.

The rows are sorted for each project based on Date column, so to replace null values with the last reported progress from the previous month, you just need to replace the null values with the previous non-null value on that column. Select the Actual Progress column, then from the Transform tab, use the Fill command. Choose Fill Down to solve the problem and reach Figure 8-1 based on the following formula:

```
= Table.FillDown(Source,{"Actual Progress"})
```



| | Date | Project | Actual Progress |
|---|---|---|---|
| 1 | 31/01/2023 | A | 0.05 |
| 2 | 28/02/2023 | A | 0.07 |
| 3 | 31/03/2023 | A | 0.09 |
| 4 | 30/04/2023 | A | 0.09 |
| 5 | 31/05/2023 | A | 0.09 |
| 6 | 30/06/2023 | A | 0.09 |
| 7 | 31/07/2023 | A | 0.24 |
| 8 | 31/08/2023 | A | 0.24 |
| 9 | 30/09/2023 | A | 0.28 |
| 10 | 31/10/2023 | A | 0.28 |
| 11 | 30/11/2023 | A | 0.28 |
| 12 | 31/12/2023 | A | 0.35 |
| 13 | 31/01/2023 | B | 0.02 |
| 14 | 28/02/2023 | B | 0.05 |
| 15 | 31/03/2023 | B | 0.05 |
| 16 | 30/04/2023 | B | 0.05 |
| 17 | 31/05/2023 | B | 0.16 |
| 18 | 30/06/2023 | B | 0.21 |
| 19 | 31/07/2023 | B | 0.21 |
| 20 | 31/08/2023 | B | 0.24 |
| 21 | 30/09/2023 | B | 0.24 |
| 22 | 31/10/2023 | B | 0.24 |
| 23 | 30/11/2023 | B | 0.24 |
| 24 | 31/12/2023 | B | 0.41 |

***Figure 8-1*** The result of Fill Down

**Note** If you plan to load the result table into the data model, instead of filling null values with the previous value in Power Query before loading, you can remove the rows with null values and then use DAX to extract the last available values after loading the table into the data model.

## Handling Missing Rows

Similar to previous examples, the project progress reports at the end of the month for projects A and B are shown in the table called Source in Table 8-2. Some months are missing. Add the missing months to the table and then fill them with the last reported progress.

***Table 8-2*** Source: Monthly Project Progress

| Date | Project | Actual Progress |
|---|---|---|
| 31/01/2023 | A | 5% |
| 28/02/2023 | A | 7% |
| 31/03/2023 | A | 9% |
| 31/07/2023 | A | 24% |
| 30/09/2023 | A | 28% |
| 31/12/2023 | A | 35% |
| 31/01/2023 | B | 2% |
| 28/02/2023 | B | 5% |
| 31/05/2023 | B | 16% |
| 30/06/2023 | B | 21% |
| 31/08/2023 | B | 24% |
| 31/12/2023 | B | 41% |

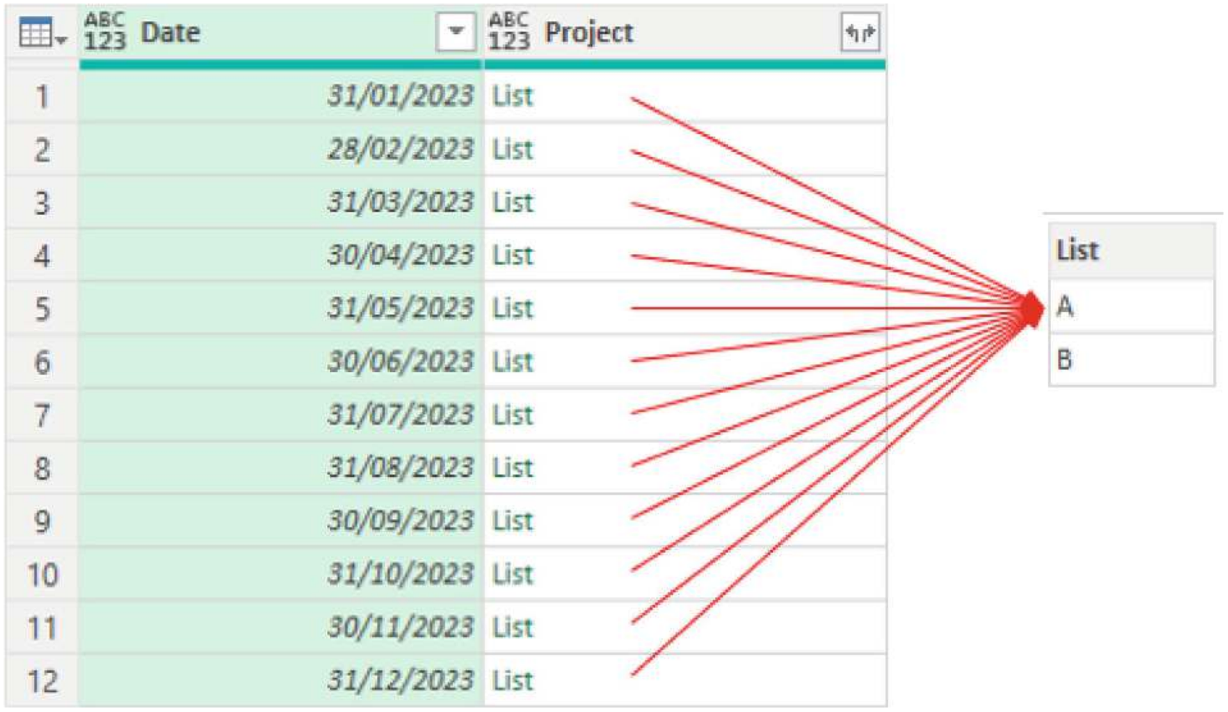
**Note** The data in this example is provided in an Excel file titled `02 Handling Entirely Missing Rows.xlsx`.

To solve this problem, two different solutions—one based on merging and the other on appending—are provided. In both solutions, you need a table including all relevant dates (in this example, the last days of each month in 2023) for both projects.

You can use the `Table.FromList()` function to generate this table efficiently (for more details on this function, see the Example 11 in Chapter 1). In the `AllRowsData` query, you can click the *fx* button next to the formula bar to create a new step and write the following formula in the formula bar:

```
=Table.FromList({1..12}, each
{Date.EndOfMonth(#date(2023,_,1)),  {"A","B"}},
{"Date","Project"})
```

This results in Figure 8-2.

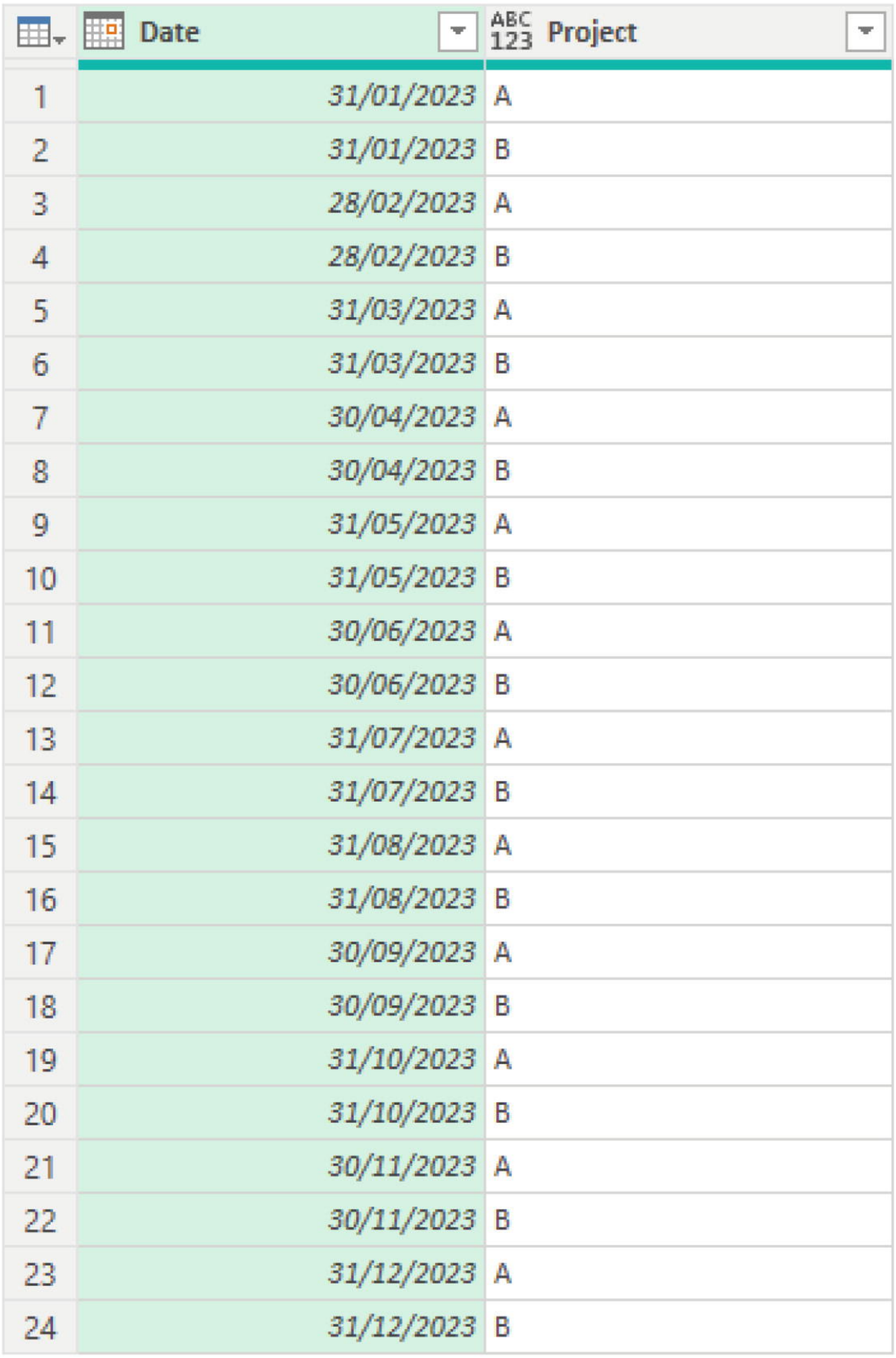


| | Date | Project |
|---|---|---|
| 1 | 31/01/2023 | List |
| 2 | 28/02/2023 | List |
| 3 | 31/03/2023 | List |
| 4 | 30/04/2023 | List |
| 5 | 31/05/2023 | List |
| 6 | 30/06/2023 | List |
| 7 | 31/07/2023 | List |
| 8 | 31/08/2023 | List |
| 9 | 30/09/2023 | List |
| 10 | 31/10/2023 | List |
| 11 | 30/11/2023 | List |
| 12 | 31/12/2023 | List |

| List |
|---|
| A |
| B |

*Figure 8-2* Result of using Table.FromList

Expanding the values in the Project column and changing the data type of the Date column will result in Figure 8-3.



| | Date | Project |
|---|---|---|
| 1 | 31/01/2023 | A |
| 2 | 31/01/2023 | B |
| 3 | 28/02/2023 | A |
| 4 | 28/02/2023 | B |
| 5 | 31/03/2023 | A |
| 6 | 31/03/2023 | B |
| 7 | 30/04/2023 | A |
| 8 | 30/04/2023 | B |
| 9 | 31/05/2023 | A |
| 10 | 31/05/2023 | B |
| 11 | 30/06/2023 | A |
| 12 | 30/06/2023 | B |
| 13 | 31/07/2023 | A |
| 14 | 31/07/2023 | B |
| 15 | 31/08/2023 | A |
| 16 | 31/08/2023 | B |
| 17 | 30/09/2023 | A |
| 18 | 30/09/2023 | B |
| 19 | 31/10/2023 | A |
| 20 | 31/10/2023 | B |
| 21 | 30/11/2023 | A |
| 22 | 30/11/2023 | B |
| 23 | 31/12/2023 | A |
| 24 | 31/12/2023 | B |

*Figure 8-3* The result of expanding the Project column

**Note** In this example, the following formula is used to create a table that includes all valid dates for two projects—A and B:

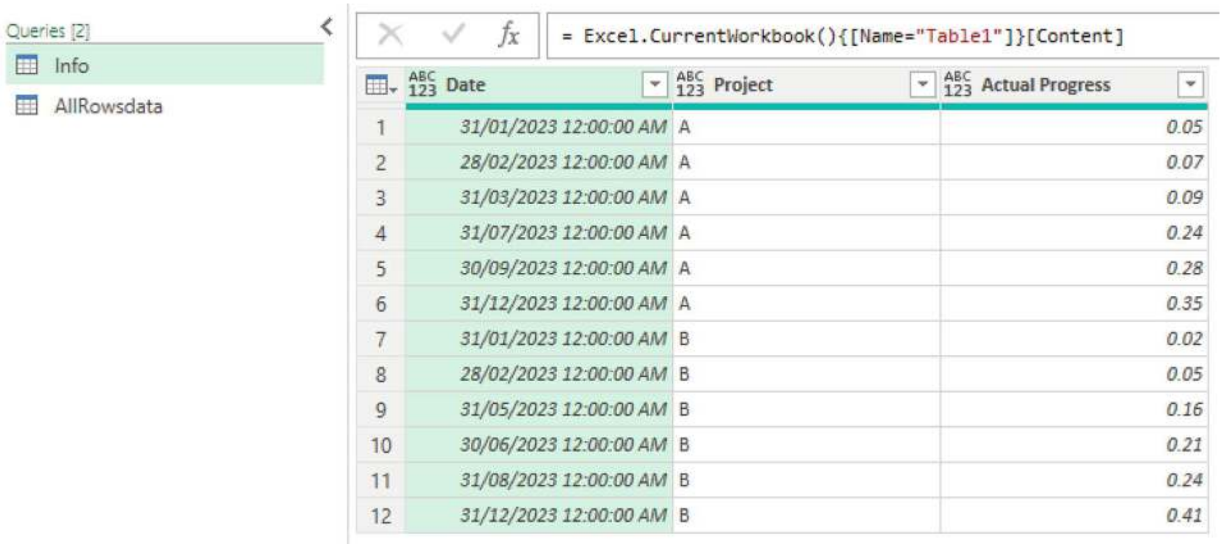
```
=Table.FromList({1..12}, each
{Date.EndOfMonth(#date(2023,_,1)),  {"A","B"}},
{"Date","Project"})
```

In practice, if you are working with multiple projects, instead of hardcoding `{"A", "B"}`, you can dynamically retrieve the list of projects using `List.Distinct(Info[Project])`. This ensures that all the project names from the `Info[Project]` column are included.

Additionally, if you need a wider range of dates—such as the last day of each month from 2023 to 2025—after changing the first argument from `{1..12}` to `{1..36}` (as you need 36 rows), you can use the following formula to generate the correct dates dynamically:

```
Date.EndOfMonth(Date.AddMonths(#date(2023,1,1),_
-1))
```

In the next step, load the Source table into the Power Query Editor as a query named `Info`, as Figure 8-4.

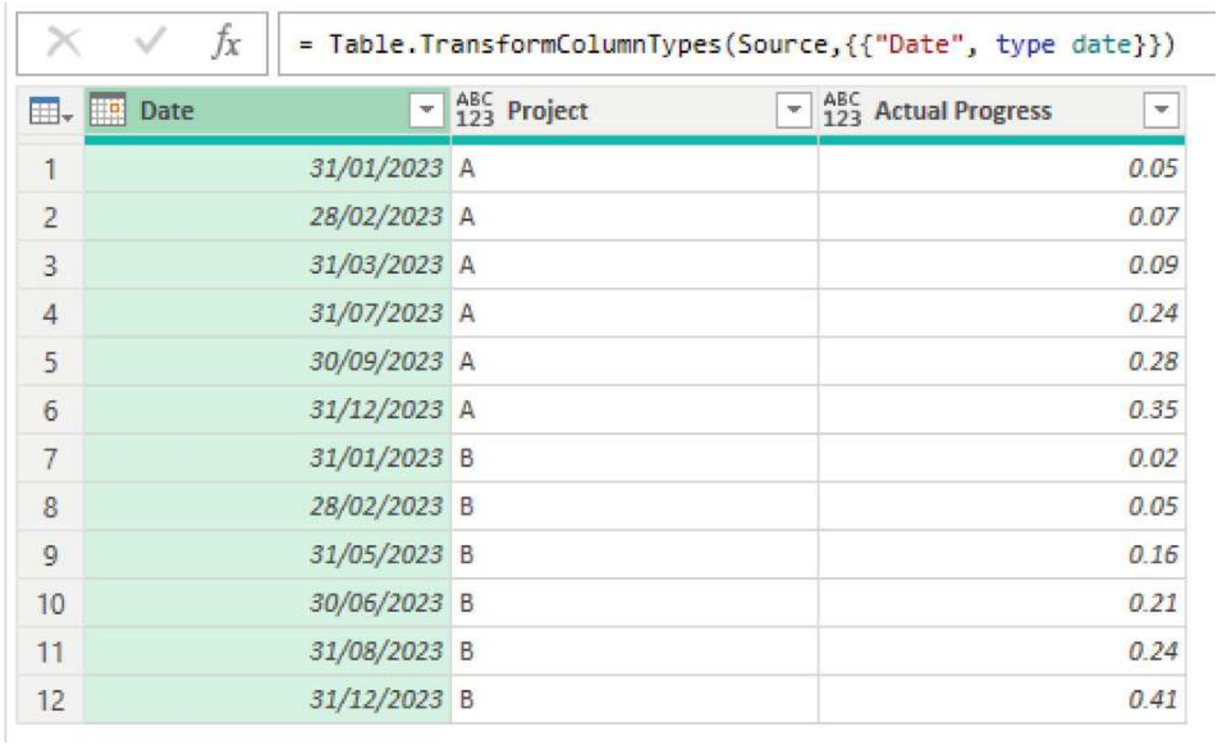


```
= Excel.CurrentWorkbook(){[Name="Table1"]}[Content]
```

| | Date | Project | Actual Progress |
|---|---|---|---|
| 1 | 31/01/2023 12:00:00 AM | A | 0.05 |
| 2 | 28/02/2023 12:00:00 AM | A | 0.07 |
| 3 | 31/03/2023 12:00:00 AM | A | 0.09 |
| 4 | 31/07/2023 12:00:00 AM | A | 0.24 |
| 5 | 30/09/2023 12:00:00 AM | A | 0.28 |
| 6 | 31/12/2023 12:00:00 AM | A | 0.35 |
| 7 | 31/01/2023 12:00:00 AM | B | 0.02 |
| 8 | 28/02/2023 12:00:00 AM | B | 0.05 |
| 9 | 31/05/2023 12:00:00 AM | B | 0.16 |
| 10 | 30/06/2023 12:00:00 AM | B | 0.21 |
| 11 | 31/08/2023 12:00:00 AM | B | 0.24 |
| 12 | 31/12/2023 12:00:00 AM | B | 0.41 |

***Figure 8-4*** Loading the source table

As shown, the Date column includes the date and time. Select this column and change its type to Date to obtain Figure 8-5.



```
= Table.TransformColumnTypes(Source,{{"Date", type date}})
```

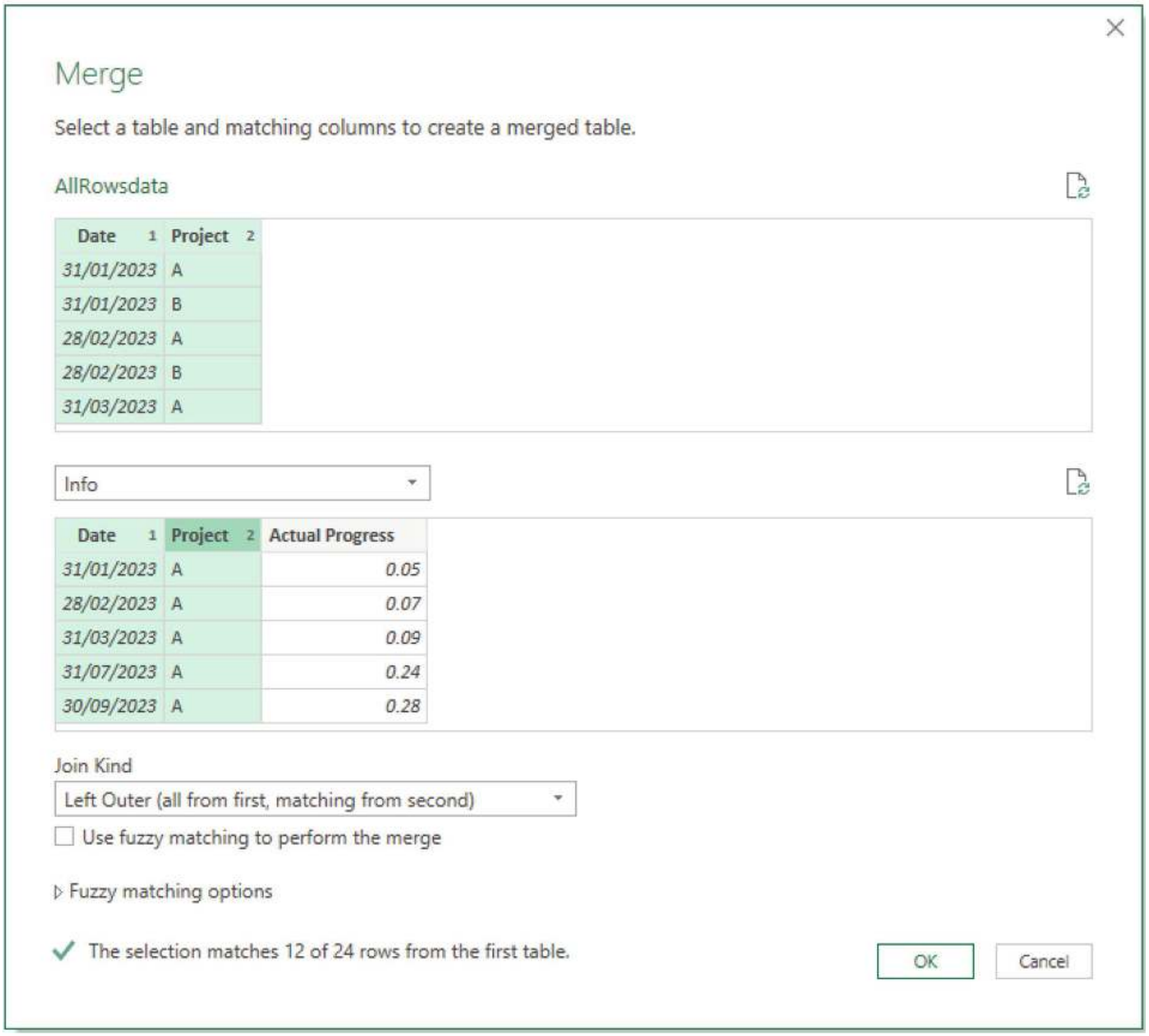
| | Date | Project | Actual Progress |
|---|---|---|---|
| 1 | 31/01/2023 | A | 0.05 |
| 2 | 28/02/2023 | A | 0.07 |
| 3 | 31/03/2023 | A | 0.09 |
| 4 | 31/07/2023 | A | 0.24 |
| 5 | 30/09/2023 | A | 0.28 |
| 6 | 31/12/2023 | A | 0.35 |
| 7 | 31/01/2023 | B | 0.02 |
| 8 | 28/02/2023 | B | 0.05 |
| 9 | 31/05/2023 | B | 0.16 |
| 10 | 30/06/2023 | B | 0.21 |
| 11 | 31/08/2023 | B | 0.24 |
| 12 | 31/12/2023 | B | 0.41 |

***Figure 8-5*** Converting the data type in the Dates column

You have two queries—`Info`, which contains reported progress for specific months, and `AllRowsData`, which includes all the dates for the projects but does not have any progress values. To generate a complete table that ensures valid progress values are available for all dates, you can use two different solutions—by merging and by appending the tables. These are presented in the following sections.

## Solution 1: Using the Merge Command

In this solution, select AllRowsData query, and from the Home tab, use the Merge Queries command. Select Merge Queries to open a new window for merging the queries. As shown in Figure 8-6, for the second table, select the `Info` query, and then in the tables, select the Date and Project columns by holding Ctrl. Then click OK to obtain Figure 8-7.



Merge

Select a table and matching columns to create a merged table.

AllRowsdata

| Date 1 | Project 2 |
|---|---|
| 31/01/2023 | A |
| 31/01/2023 | B |
| 28/02/2023 | A |
| 28/02/2023 | B |
| 31/03/2023 | A |

Info

| Date 1 | Project 2 | Actual Progress |
|---|---|---|
| 31/01/2023 | A | 0.05 |
| 28/02/2023 | A | 0.07 |
| 31/03/2023 | A | 0.09 |
| 31/07/2023 | A | 0.24 |
| 30/09/2023 | A | 0.28 |

Join Kind

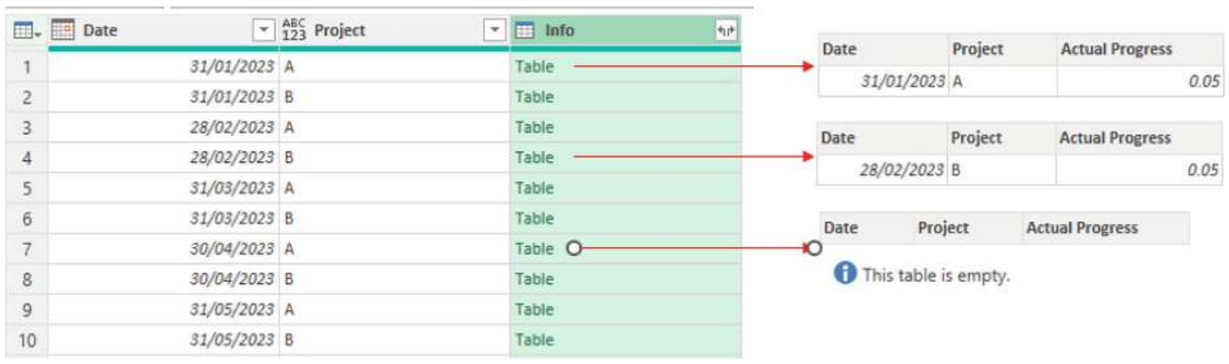
Left Outer (all from first, matching from second)

☐ Use fuzzy matching to perform the merge

▷ Fuzzy matching options

✓ The selection matches 12 of 24 rows from the first table.

***Figure 8-6*** Merging settings



| | Date | Project | Info |
|---|---|---|---|
| 1 | 31/01/2023 | A | Table |
| 2 | 31/01/2023 | B | Table |
| 3 | 28/02/2023 | A | Table |
| 4 | 28/02/2023 | B | Table |
| 5 | 31/03/2023 | A | Table |
| 6 | 31/03/2023 | B | Table |
| 7 | 30/04/2023 | A | Table |
| 8 | 30/04/2023 | B | Table |
| 9 | 31/05/2023 | A | Table |
| 10 | 31/05/2023 | B | Table |

| Date | Project | Actual Progress |
|---|---|---|
| 31/01/2023 | A | 0.05 |

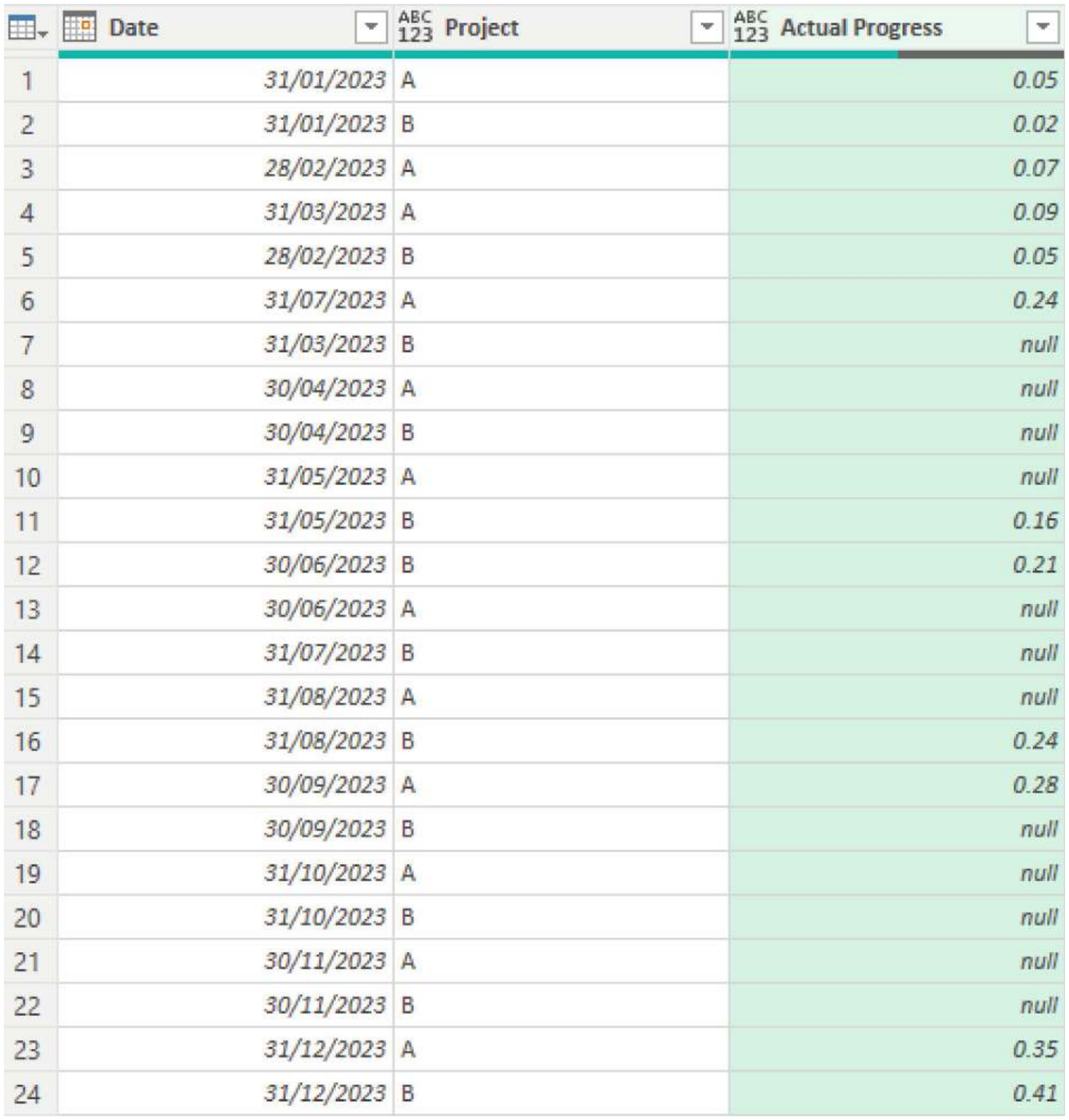
| Date | Project | Actual Progress |
|---|---|---|
| 28/02/2023 | B | 0.05 |

| Date | Project | Actual Progress |
|---|---|---|

This table is empty.

*Figure 8-7* The result of merging

In this next step, from the expand icon next to the new column called Info, select Actual Progress and expand it to obtain Figure 8-8.



| | Date | Project | Actual Progress |
|---|---|---|---|
| 1 | 31/01/2023 | A | 0.05 |
| 2 | 31/01/2023 | B | 0.02 |
| 3 | 28/02/2023 | A | 0.07 |
| 4 | 31/03/2023 | A | 0.09 |
| 5 | 28/02/2023 | B | 0.05 |
| 6 | 31/07/2023 | A | 0.24 |
| 7 | 31/03/2023 | B | null |
| 8 | 30/04/2023 | A | null |
| 9 | 30/04/2023 | B | null |
| 10 | 31/05/2023 | A | null |
| 11 | 31/05/2023 | B | 0.16 |
| 12 | 30/06/2023 | B | 0.21 |
| 13 | 30/06/2023 | A | null |
| 14 | 31/07/2023 | B | null |
| 15 | 31/08/2023 | A | null |
| 16 | 31/08/2023 | B | 0.24 |
| 17 | 30/09/2023 | A | 0.28 |
| 18 | 30/09/2023 | B | null |
| 19 | 31/10/2023 | A | null |
| 20 | 31/10/2023 | B | null |
| 21 | 30/11/2023 | A | null |
| 22 | 30/11/2023 | B | null |
| 23 | 31/12/2023 | A | 0.35 |
| 24 | 31/12/2023 | B | 0.41 |

***Figure 8-8*** Expanding the Actual Progress column

By using merge, the row orders might be changed, so sort the table initially based on the project name and then based on the Date column to reorder the rows. This way, you can use the Fill Down command. Then, as in the previous example, use the Fill Down function to replace null values with the last values from the previous rows.

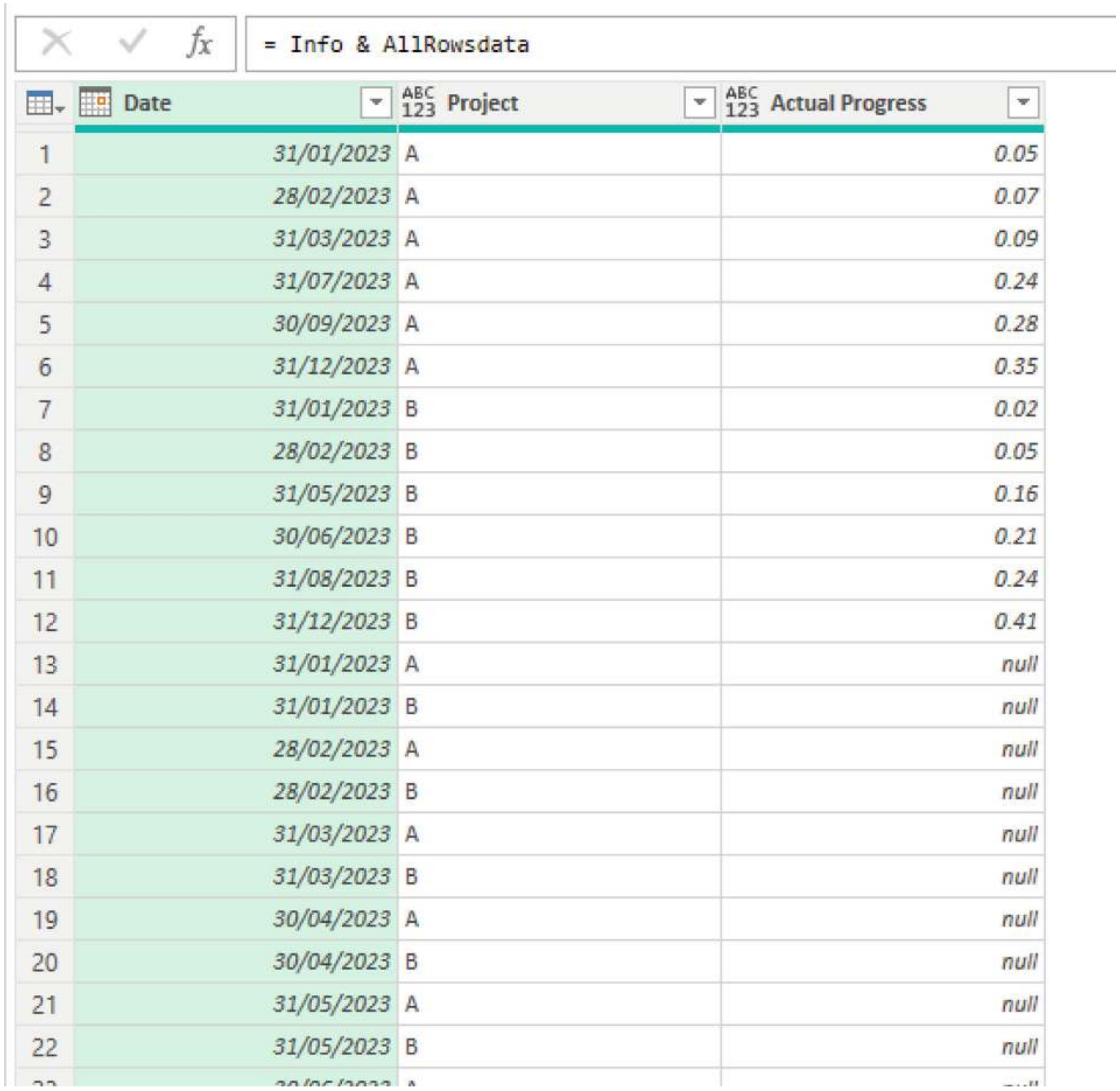
## Solution 2: Based on Appending the Queries

In the previous solution, you used merge to extract the progress values from the `Info` query into the `AllRowsData` query. Alternatively, you can solve this problem by stacking the tables on top of each other and then removing the rows from `AllRowsData` that already exist in the `Info` query with the same Date and Project name.

So, first create a blank query. Then, click the *fx* button next to the formula bar to create a new step. In the formula bar, use the following formula to append the results from both queries (since the tables have the same column names):

```
= Info & AllRowsdata
```

This will append the rows from the `Info` query to the `AllRowsData` query, as shown in Figure 8-9.



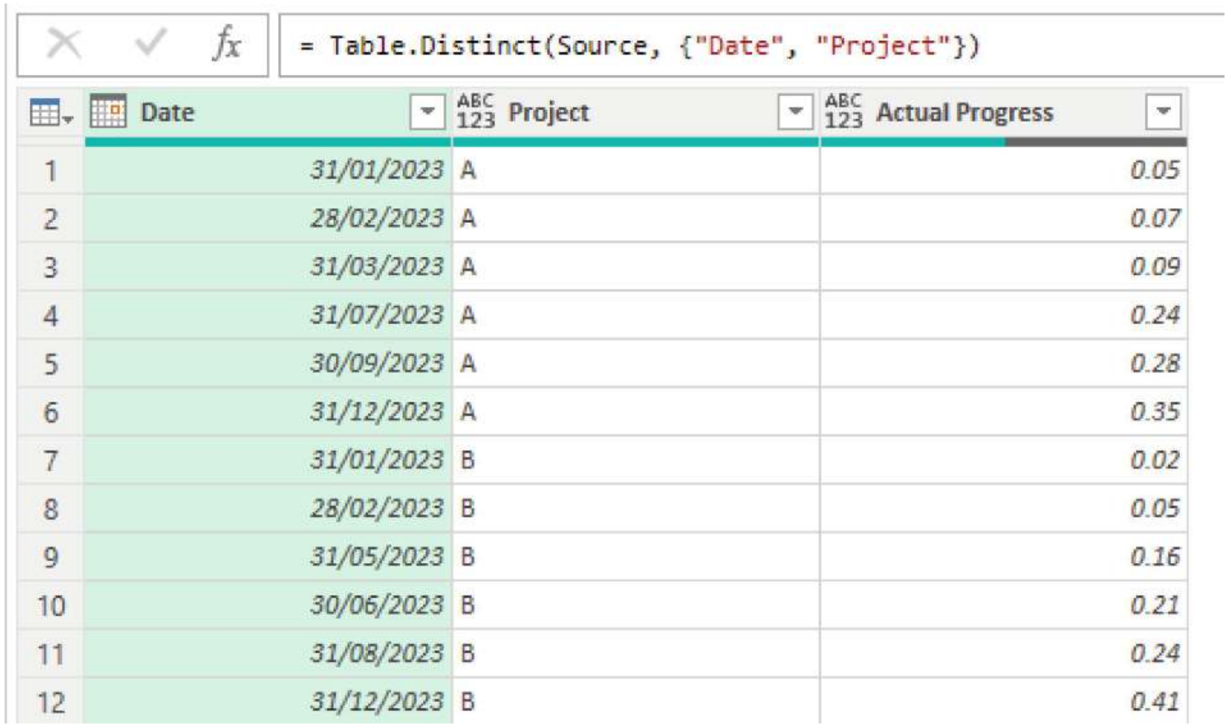
```
= Info & AllRowsdata
```

| | Date | Project | Actual Progress |
|---|---|---|---|
| 1 | 31/01/2023 | A | 0.05 |
| 2 | 28/02/2023 | A | 0.07 |
| 3 | 31/03/2023 | A | 0.09 |
| 4 | 31/07/2023 | A | 0.24 |
| 5 | 30/09/2023 | A | 0.28 |
| 6 | 31/12/2023 | A | 0.35 |
| 7 | 31/01/2023 | B | 0.02 |
| 8 | 28/02/2023 | B | 0.05 |
| 9 | 31/05/2023 | B | 0.16 |
| 10 | 30/06/2023 | B | 0.21 |
| 11 | 31/08/2023 | B | 0.24 |
| 12 | 31/12/2023 | B | 0.41 |
| 13 | 31/01/2023 | A | null |
| 14 | 31/01/2023 | B | null |
| 15 | 28/02/2023 | A | null |
| 16 | 28/02/2023 | B | null |
| 17 | 31/03/2023 | A | null |
| 18 | 31/03/2023 | B | null |
| 19 | 30/04/2023 | A | null |
| 20 | 30/04/2023 | B | null |
| 21 | 31/05/2023 | A | null |
| 22 | 31/05/2023 | B | null |

***Figure 8-9*** Combining the tables

Now, since the rows with actual progress are at the top and those with null values in the Actual Progress column are at the bottom, removing duplicates based on the Date and Project columns will eliminate the common rows with null values in Actual Progress (be careful when removing duplicates in more complex scenarios due to Power Query's execution order, as this can affect the results).

Select the Date and Project columns, right-click one of them, and choose Remove Duplicates to obtain Figure 8-10.



```
= Table.Distinct(Source, {"Date", "Project"})
```

| | Date | Project | Actual Progress |
|---|---|---|---|
| 1 | 31/01/2023 | A | 0.05 |
| 2 | 28/02/2023 | A | 0.07 |
| 3 | 31/03/2023 | A | 0.09 |
| 4 | 31/07/2023 | A | 0.24 |
| 5 | 30/09/2023 | A | 0.28 |
| 6 | 31/12/2023 | A | 0.35 |
| 7 | 31/01/2023 | B | 0.02 |
| 8 | 28/02/2023 | B | 0.05 |
| 9 | 31/05/2023 | B | 0.16 |
| 10 | 30/06/2023 | B | 0.21 |
| 11 | 31/08/2023 | B | 0.24 |
| 12 | 31/12/2023 | B | 0.41 |

***Figure 8-10*** Removing duplicates

Now sort the table in ascending order based on the Project column first, and then based on the Date column, and finally use the Fill Down command.

## Extracting Missing Values

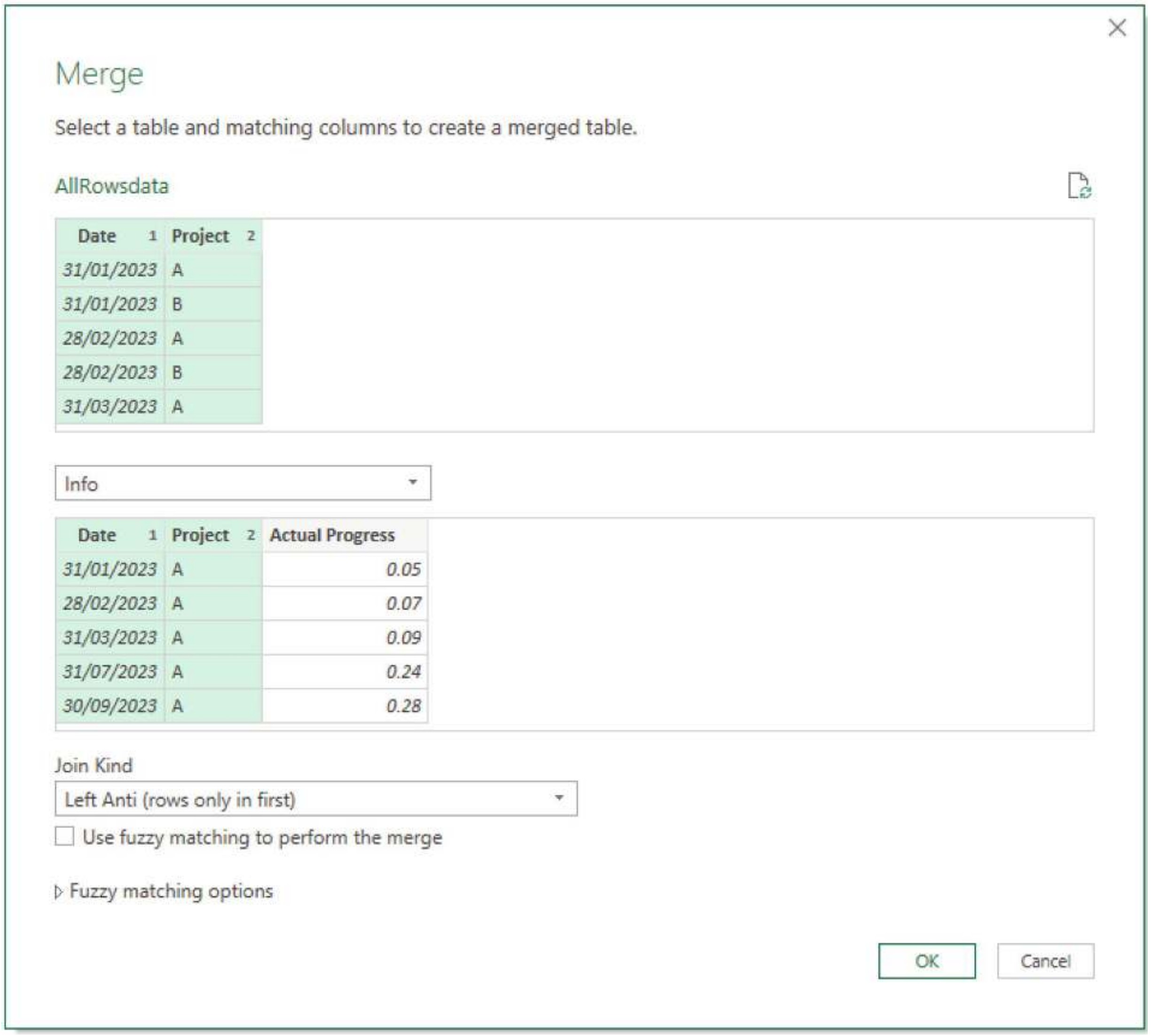
Consider the previous example and extract a list of dates with missing values for each project. Three different solutions—based on appending, merging, and grouping—are provided in this section.

### Solution 1: Based on Appending/Merging

Consider all the steps in the previous example that lead to the table shown in Figure 8-10. Selecting the rows with null values in the Actual Progress column will leave you with only the dates for the projects that haven't reported values.

### Solution 2: Using Merging

Consider the steps that lead to the queries shown in Figure 8-4. In this case, selecting the `AllRowsData` query and using the Merge command with the Left Anti Join kind, as shown in Figure 8-11, will result in the missing data, as demonstrated in Figure 8-12.



Merge

Select a table and matching columns to create a merged table.

AllRowsdata

| Date | Project |
|---|---|
| 31/01/2023 | A |
| 31/01/2023 | B |
| 28/02/2023 | A |
| 28/02/2023 | B |
| 31/03/2023 | A |

Info

| Date | Project | Actual Progress |
|---|---|---|
| 31/01/2023 | A | 0.05 |
| 28/02/2023 | A | 0.07 |
| 31/03/2023 | A | 0.09 |
| 31/07/2023 | A | 0.24 |
| 30/09/2023 | A | 0.28 |

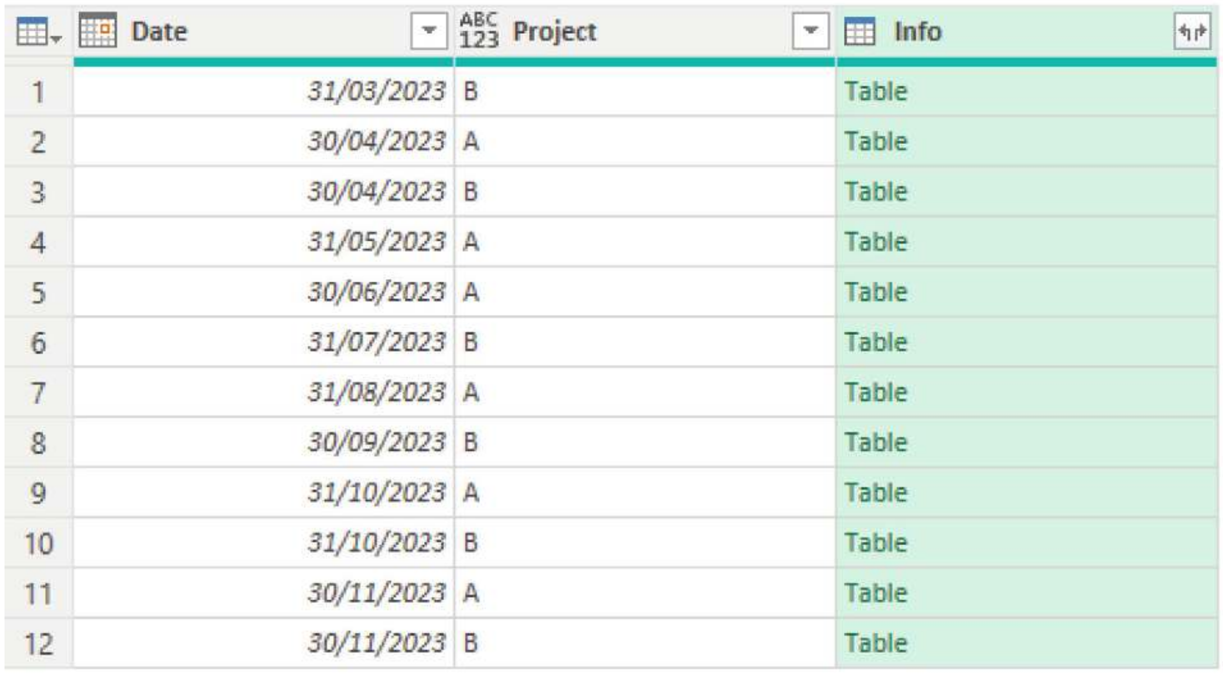
Join Kind

Left Anti (rows only in first)

☐ Use fuzzy matching to perform the merge

▷ Fuzzy matching options

***Figure 8-11*** Configuration for merging

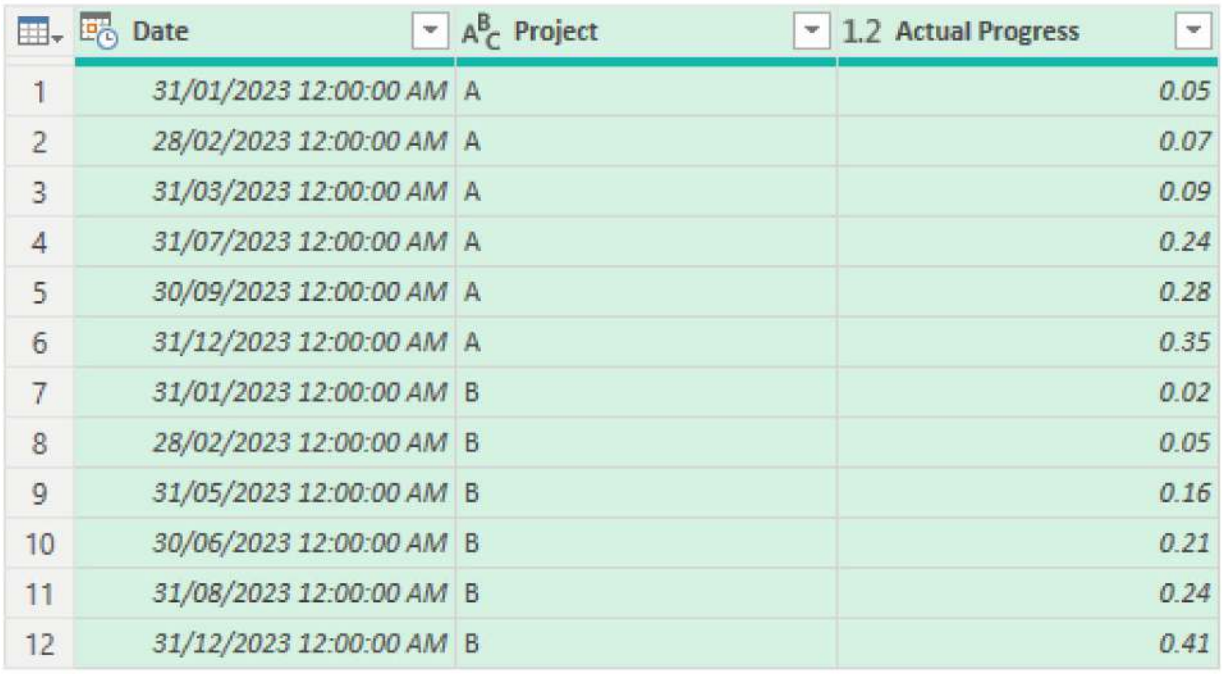


| | Date | Project | Info |
|---|---|---|---|
| 1 | 31/03/2023 | B | Table |
| 2 | 30/04/2023 | A | Table |
| 3 | 30/04/2023 | B | Table |
| 4 | 31/05/2023 | A | Table |
| 5 | 30/06/2023 | A | Table |
| 6 | 31/07/2023 | B | Table |
| 7 | 31/08/2023 | A | Table |
| 8 | 30/09/2023 | B | Table |
| 9 | 31/10/2023 | A | Table |
| 10 | 31/10/2023 | B | Table |
| 11 | 30/11/2023 | A | Table |
| 12 | 30/11/2023 | B | Table |

***Figure 8-12*** The result of merging

## Solution 3: Based on Grouping the Rows

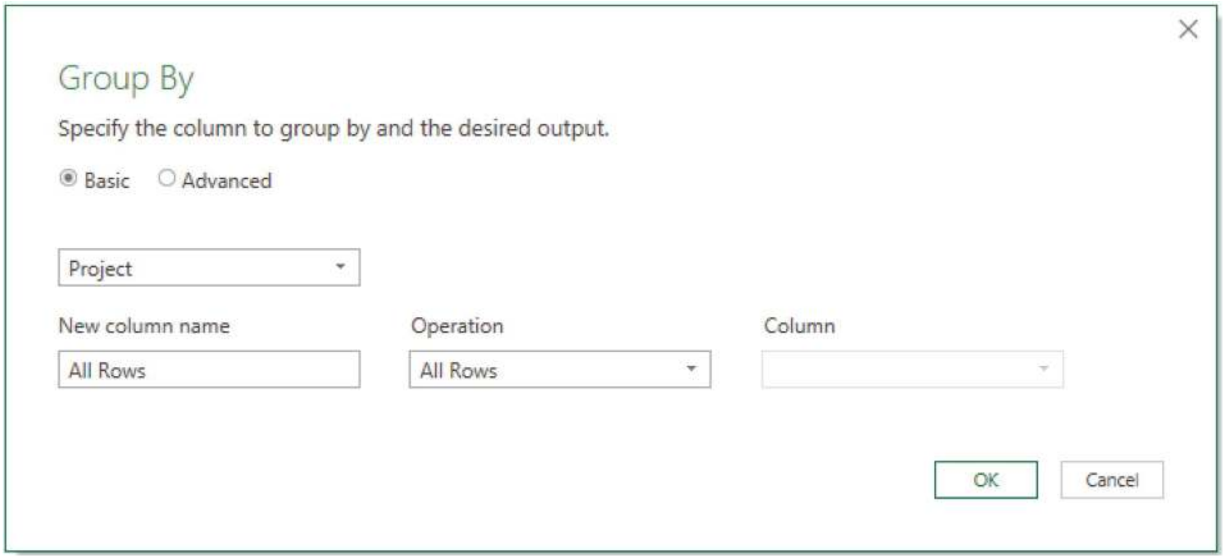
In this solution, the `Table.Group()` function extracts the list of reported dates, and then `List.Difference()` is applied to determine the missing dates. To achieve the table shown in Figure 8-13, load the data into Power Query and set the data types for the Date, Project, and Actual Progress columns as Date, Text, and Number, respectively.



| | Date | Project | Actual Progress |
|---|---|---|---|
| 1 | 31/01/2023 12:00:00 AM | A | 0.05 |
| 2 | 28/02/2023 12:00:00 AM | A | 0.07 |
| 3 | 31/03/2023 12:00:00 AM | A | 0.09 |
| 4 | 31/07/2023 12:00:00 AM | A | 0.24 |
| 5 | 30/09/2023 12:00:00 AM | A | 0.28 |
| 6 | 31/12/2023 12:00:00 AM | A | 0.35 |
| 7 | 31/01/2023 12:00:00 AM | B | 0.02 |
| 8 | 28/02/2023 12:00:00 AM | B | 0.05 |
| 9 | 31/05/2023 12:00:00 AM | B | 0.16 |
| 10 | 30/06/2023 12:00:00 AM | B | 0.21 |
| 11 | 31/08/2023 12:00:00 AM | B | 0.24 |
| 12 | 31/12/2023 12:00:00 AM | B | 0.41 |

***Figure 8-13*** Loading data into Power Query and changing their types

In the next step, select the Project column and use Group By. Select All Rows as the operation. The settings are provided in Figure 8-14. This will result in a table with a row for each project, as shown in Figure 8-15.



Group By

Specify the column to group by and the desired output.

[✓ Basic] Advanced

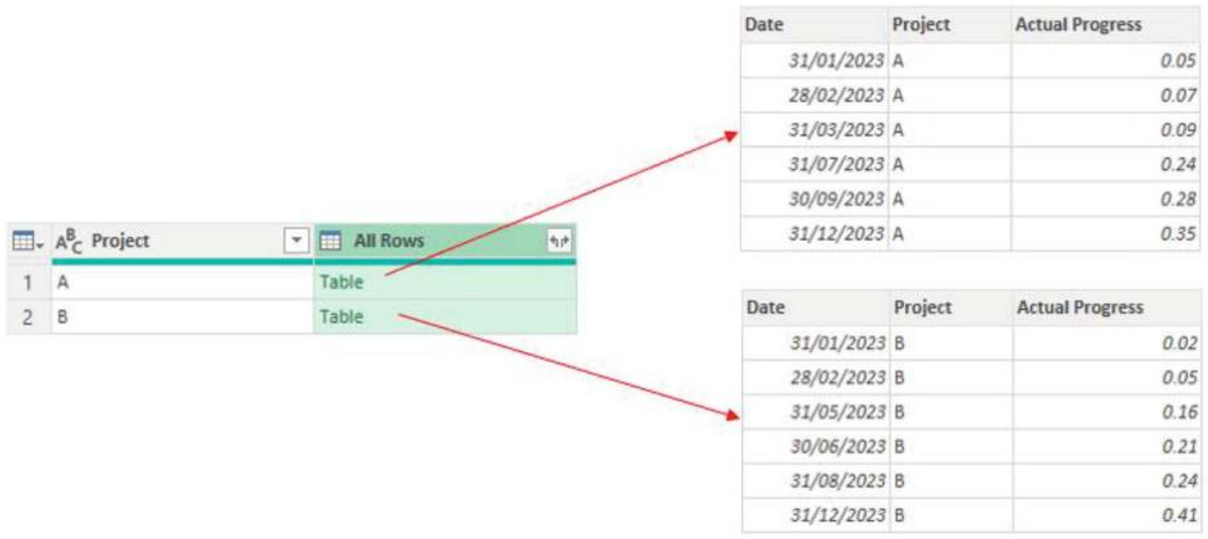
Project

New column name: All Rows

Operation: All Rows

Column:

***Figure 8-14*** Settings for grouping



| | Project | All Rows |
|---|---|---|
| 1 | A | Table |
| 2 | B | Table |

| Date | Project | Actual Progress |
|---|---|---|
| 31/01/2023 | A | 0.05 |
| 28/02/2023 | A | 0.07 |
| 31/03/2023 | A | 0.09 |
| 31/07/2023 | A | 0.24 |
| 30/09/2023 | A | 0.28 |
| 31/12/2023 | A | 0.35 |

| Date | Project | Actual Progress |
|---|---|---|
| 31/01/2023 | B | 0.02 |
| 28/02/2023 | B | 0.05 |
| 31/05/2023 | B | 0.16 |
| 30/06/2023 | B | 0.21 |
| 31/08/2023 | B | 0.24 |
| 31/12/2023 | B | 0.41 |

***Figure 8-15*** The result of grouping

In this example, since you are searching for the missing dates, you only need the Date values from all the columns presented in the tables in the All Rows column. This can be achieved by revising the formula. Consider the following formula, generated in the formula bar after grouping the rows based on the Project names.

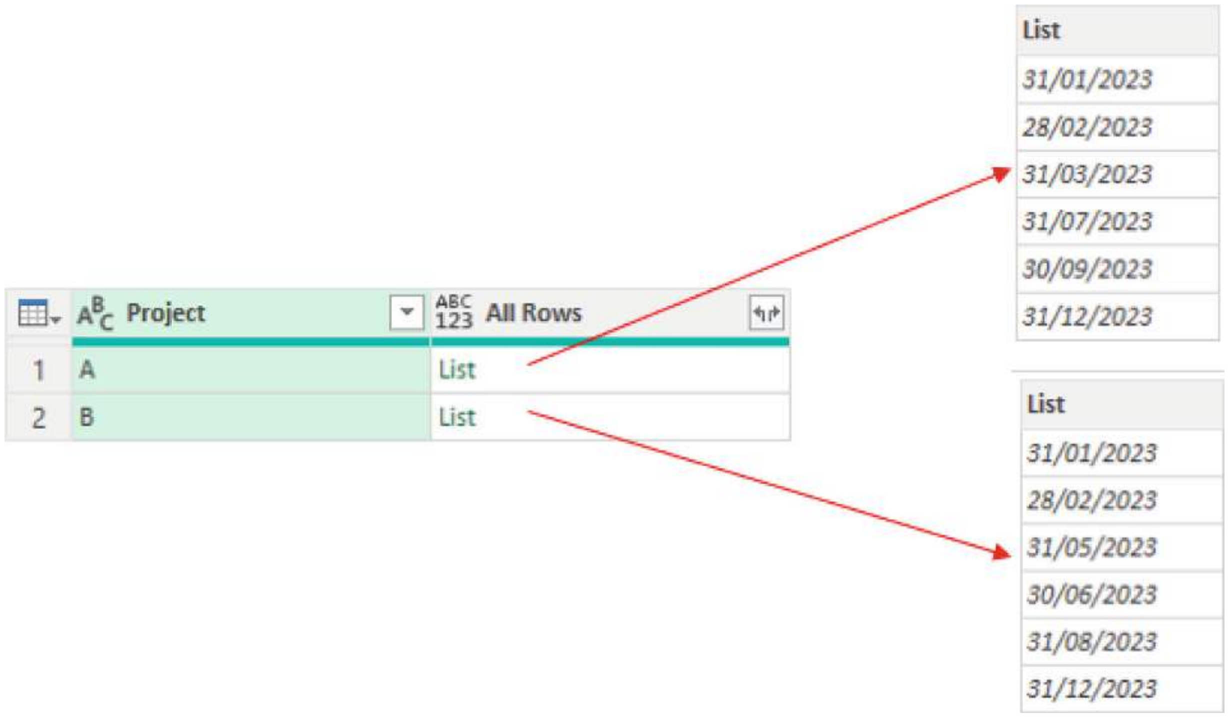
```
= Table.Group(#"Changed Type", {"Project"}, {{"All
Rows", each _, type table [Date=nullable date,
Project=nullable text, Actual Progress=nullable
number]}})
```

As mentioned in Chapter 6, this formula can be simplified as follows:

```
= Table.Group(#"Changed Type", {"Project"}, {{"All
Rows", each _}})
```

As explained in Chapter 6, in this formula, `each _` generates a table for each row. To extract the value from a specific column in the resulting tables, you can rewrite the formula as `each _[Column Names]`. By rewriting the previous formula as follows, the result will change as shown in Figure 8-16.

```
= Table.Group(Source, {"Project"}, {"All Rows",
each _[Date]})
```



| | Project | All Rows |
|---|---|---|
| 1 | A | List |
| 2 | B | List |

| List |
|---|
| 31/01/2023 |
| 28/02/2023 |
| 31/03/2023 |
| 31/07/2023 |
| 30/09/2023 |
| 31/12/2023 |

| List |
|---|
| 31/01/2023 |
| 28/02/2023 |
| 31/05/2023 |
| 30/06/2023 |
| 31/08/2023 |
| 31/12/2023 |

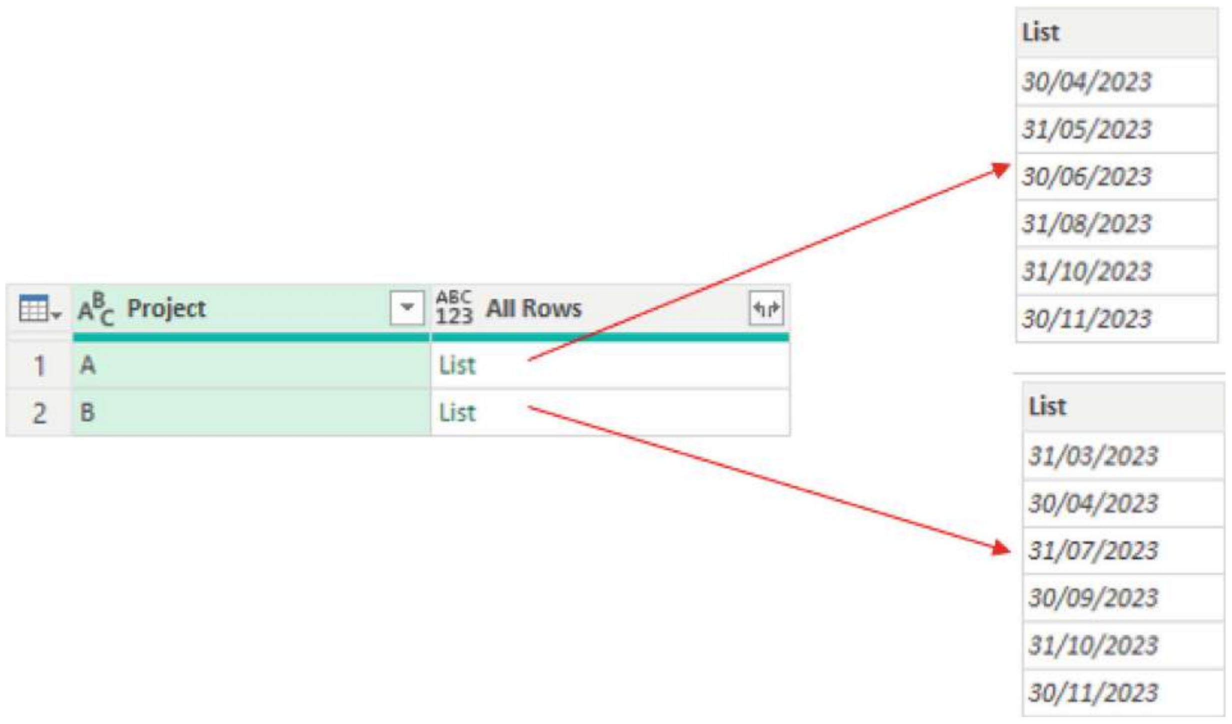
***Figure 8-16*** The result of the revised grouping

In the previous formula, `_[Date]` results in a list for each row (project), containing all the dates with reported values for Actual Progress. So, if you have a complete list of dates, you can use `List.Difference(alldates, _[Date])` to extract the missing dates. You can use several formulas, like the following one (for more dynamic formula, see the recommendation in the Example 2 in this chapter) to extract the list of dates at the end of each month in 2023:

```
List.Transform({1..12}, (X)=>
Date.EndOfMonth(#date(2023,X, 1)))
```

Rewriting the previous grouping formula as follows will present the list of missing dates for each project, as shown in Figure 8-17.

```
= Table.Group(#"Changed Type", {"Project"}, {{"All
Rows", each
List.Difference(List.Transform({1..12}, (X)=>
Date.EndOfMonth(#date(2023,X, 1))),_[Date])}})
```



|  | Project | All Rows |
|---|---|---|
| 1 | A | List |
| 2 | B | List |

| List |
|---|
| 30/04/2023 |
| 31/05/2023 |
| 30/06/2023 |
| 31/08/2023 |
| 31/10/2023 |
| 30/11/2023 |

| List |
|---|
| 31/03/2023 |
| 30/04/2023 |
| 31/07/2023 |
| 30/09/2023 |
| 31/10/2023 |
| 30/11/2023 |

***Figure 8-17*** Converting the dates to the number

By expanding the All Rows column, the problem is solved and all the missing dates per projects are extracted.

## Linear Interpolation for Missing Data

Consider the project progress reports at the end of each month for projects A and B, as shown in the Source table in Table 8-3. Fill in the missing values using linear interpolation between the known values before and after each missing period (after you load data into Power Query, the blank cells will be shown as null).

***Table 8-3*** Source Table: Project Progress

| Month | Project | Actual Progress |
|---|---|---|
| 1 | A | 0.05 |
| 2 | A | 0.07 |
| 3 | A | 0.09 |
| 4 | A |  |
| 5 | A |  |

| Month | Project | Actual Progress |
|---|---|---|
| 6 | A | |
| 7 | A | 0.24 |
| 8 | A | |
| 9 | A | 0.28 |
| 10 | A | |
| 11 | A | |
| 12 | A | 0.35 |
| 1 | B | 0.02 |
| 2 | B | 0.05 |
| 3 | B | |
| 4 | B | |
| 5 | B | 0.16 |
| 6 | B | 0.21 |
| 7 | B | |
| 8 | B | 0.24 |
| 9 | B | |
| 10 | B | |
| 11 | B | |
| 12 | B | 0.41 |

**Note** The data in this example is provided in an Excel file titled `04 Linear Interpolation for Missing Data.xlsx`.

Before addressing this problem, it's important to mention that interpolated values are not actual values; they provide an estimation that might be inaccurate. Treating both real and estimated values as the same in a table and later using them as input for other models, such as prediction models, can affect the results. In cases where null values are replaced by other values, it is recommended to distinguish them, for example, by adding a column that indicates which rows contain real values and which contain estimated values. This can be helpful for further analysis.

Interpolation is a method used to estimate unknown values that fall between known values in a dataset (for more detail, visit `www.johndcook.com/interpolator.html`). There are several models for interpolation, but in this example, you use linear interpolation, which assumes that the change between two known values is constant. The estimated value is found by drawing a straight line between two known values.

Generally, linear interpolation is calculated based on the following formula:

y=y1+(x−x1)*(y2−y1)/(x2−x1)

Where:

x1 , y1 are the coordinates of the first known data point.

x2, y2 are the coordinates of the second known data point.

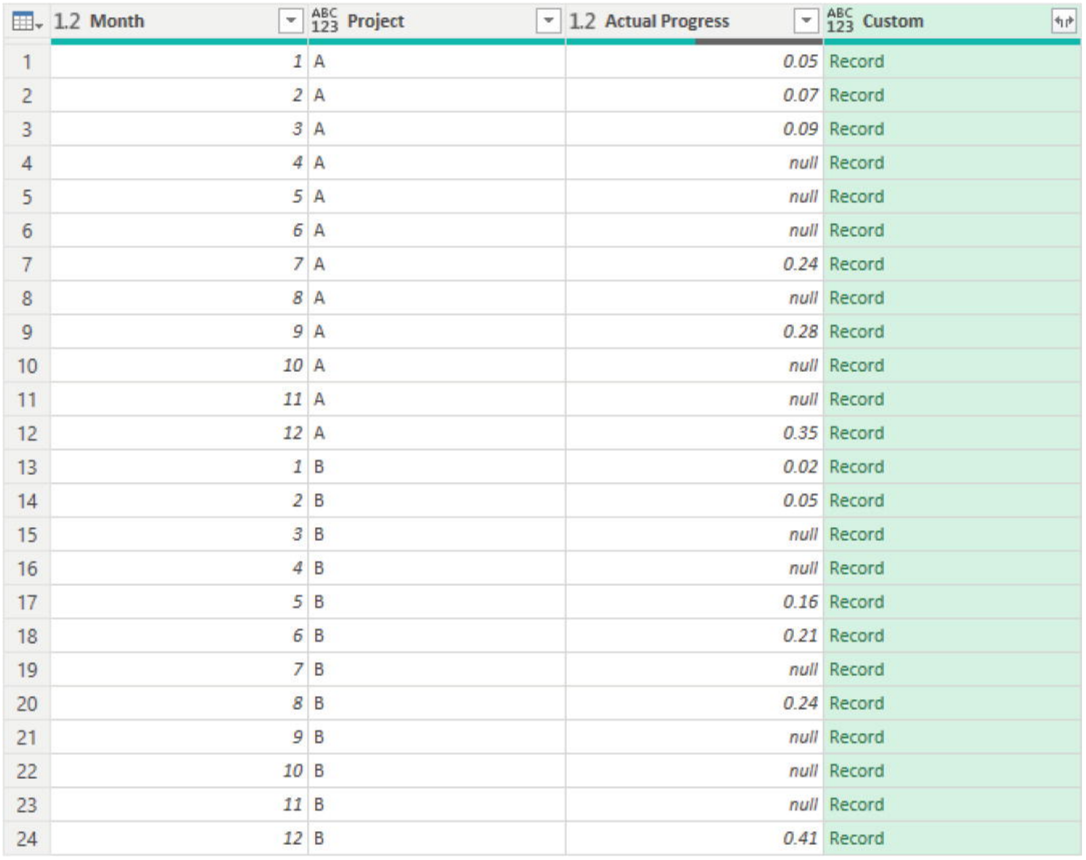
x is the value for which you want to estimate the corresponding y.

In this example, x comes from the column Month and y comes from the column Actual Progress. So for the project B in month 3, x=3, x1=2, y1= 0.05 , x2 =5, and y2=0.16. So y is 0.05+(3-2)*(0.16-0.05)/(5-2), which is equal to 0.867. To calculate each month, you need the month and the actual progress values from the nearest previous and next rows that contain known actual progress.

Based on the data structure (where data is sorted by month for each project and the first and last month of each project are not null), selecting the Actual Progress column and applying Fill Down will replace null values with the previous non-null actual progress values (y1). Similarly, using Fill Up will replace nulls with the next non-null actual progress values (y2). By creating a similar column for the month, you can extract x1 and x2 in the same way.

To solve this problem, load the data into Power Query and change the column types for Month and Actual Progress to Number. Next, extract the values of x1, y1, x2, and y2 for each row. Instead of adding four separate columns individually, use record definitions to define all the columns at once (as demonstrated in Example 4 of Chapter 2). To do this, go to the Add Column tab, select Custom Column, and enter the following formula in the open window. You'll get the result shown in Figure 8-18.

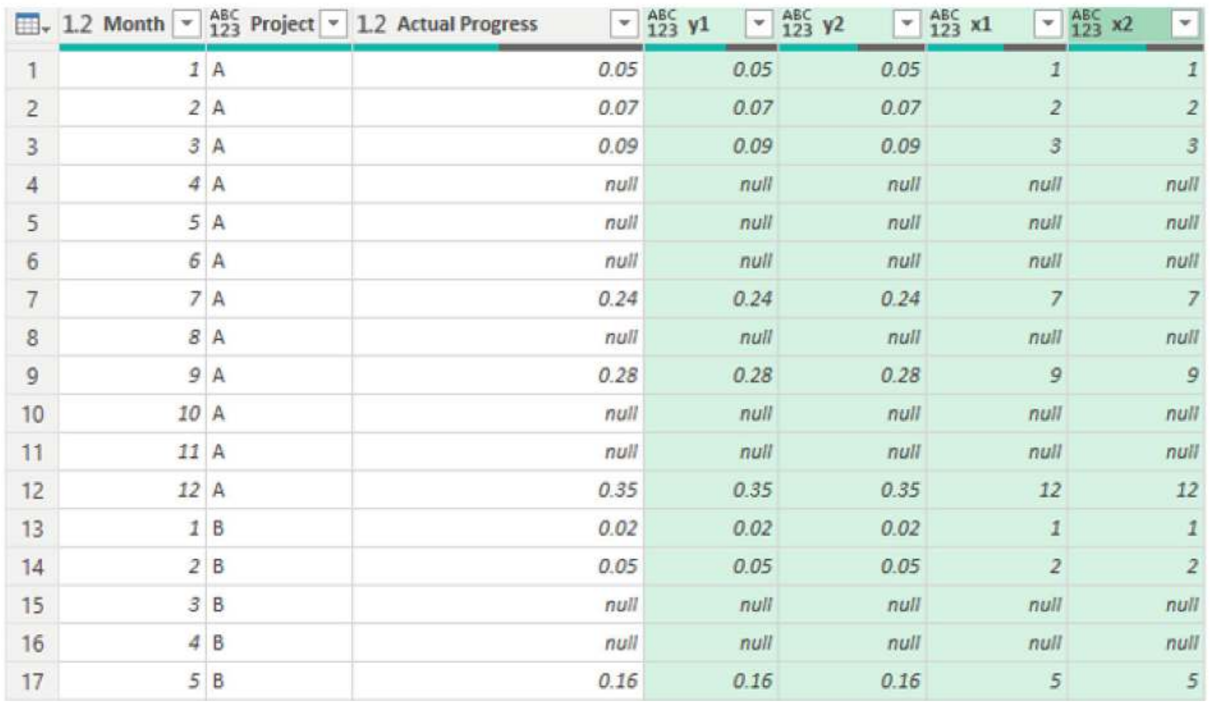
```
=[y1=[Actual Progress],y2=y1,x1=if [Actual
Progress] = null then null else [Month],x2=x1]
```



| | 1.2 Month | ABC 123 Project | 1.2 Actual Progress | ABC 123 Custom |
|---|---|---|---|---|
| 1 | 1 | A | 0.05 | Record |
| 2 | 2 | A | 0.07 | Record |
| 3 | 3 | A | 0.09 | Record |
| 4 | 4 | A | null | Record |
| 5 | 5 | A | null | Record |
| 6 | 6 | A | null | Record |
| 7 | 7 | A | 0.24 | Record |
| 8 | 8 | A | null | Record |
| 9 | 9 | A | 0.28 | Record |
| 10 | 10 | A | null | Record |
| 11 | 11 | A | null | Record |
| 12 | 12 | A | 0.35 | Record |
| 13 | 1 | B | 0.02 | Record |
| 14 | 2 | B | 0.05 | Record |
| 15 | 3 | B | null | Record |
| 16 | 4 | B | null | Record |
| 17 | 5 | B | 0.16 | Record |
| 18 | 6 | B | 0.21 | Record |
| 19 | 7 | B | null | Record |
| 20 | 8 | B | 0.24 | Record |
| 21 | 9 | B | null | Record |
| 22 | 10 | B | null | Record |
| 23 | 11 | B | null | Record |
| 24 | 12 | B | 0.41 | Record |

***Figure 8-18*** The result of adding custom column

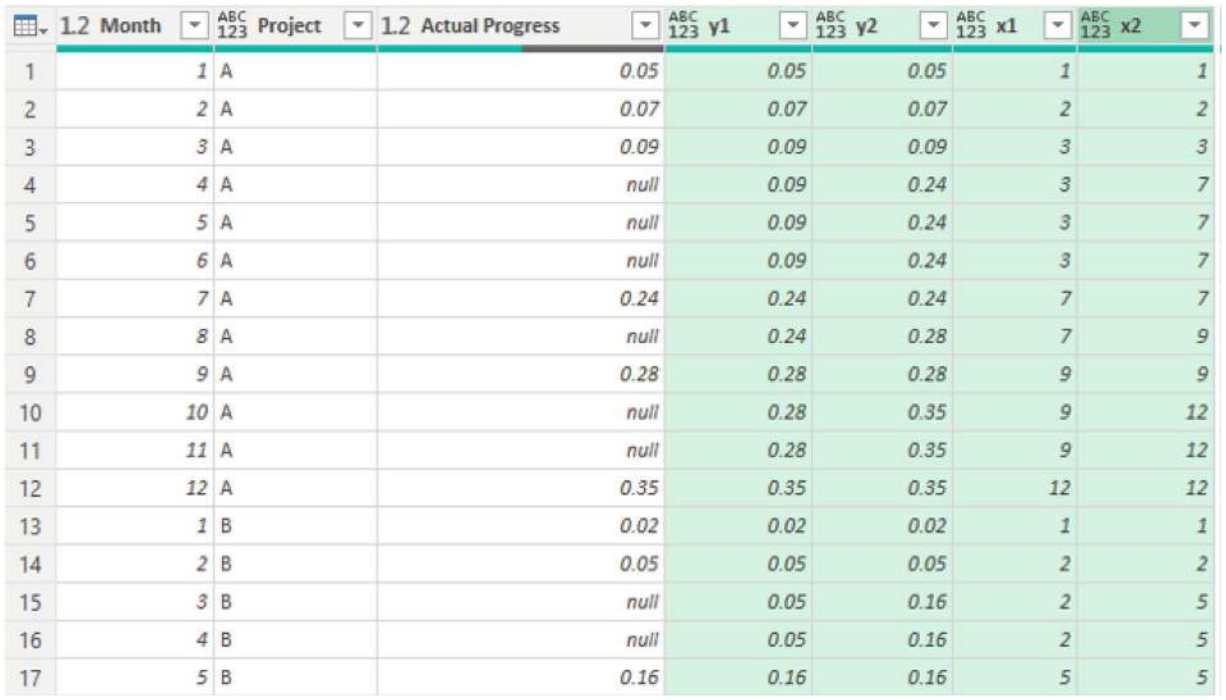
Expanding the custom column will result in the table shown in Figure 8-19.



| | 1.2 Month | ABC 123 Project | 1.2 Actual Progress | ABC 123 y1 | ABC 123 y2 | ABC 123 x1 | ABC 123 x2 |
|---|---|---|---|---|---|---|---|
| 1 | 1 | A | 0.05 | 0.05 | 0.05 | 1 | 1 |
| 2 | 2 | A | 0.07 | 0.07 | 0.07 | 2 | 2 |
| 3 | 3 | A | 0.09 | 0.09 | 0.09 | 3 | 3 |
| 4 | 4 | A | null | null | null | null | null |
| 5 | 5 | A | null | null | null | null | null |
| 6 | 6 | A | null | null | null | null | null |
| 7 | 7 | A | 0.24 | 0.24 | 0.24 | 7 | 7 |
| 8 | 8 | A | null | null | null | null | null |
| 9 | 9 | A | 0.28 | 0.28 | 0.28 | 9 | 9 |
| 10 | 10 | A | null | null | null | null | null |
| 11 | 11 | A | null | null | null | null | null |
| 12 | 12 | A | 0.35 | 0.35 | 0.35 | 12 | 12 |
| 13 | 1 | B | 0.02 | 0.02 | 0.02 | 1 | 1 |
| 14 | 2 | B | 0.05 | 0.05 | 0.05 | 2 | 2 |
| 15 | 3 | B | null | null | null | null | null |
| 16 | 4 | B | null | null | null | null | null |
| 17 | 5 | B | 0.16 | 0.16 | 0.16 | 5 | 5 |

***Figure 8-19*** The result of expanding the column

In the next step, select the y1 and x1 columns, then go to the Transform tab and apply the Fill Down command. Next, select the y2 and x2 columns and apply the Fill Up command. This will populate each row with the nearest previous and next known data for Month and Actual Progress, requiring for linear interpolation, as shown in Figure 8-20

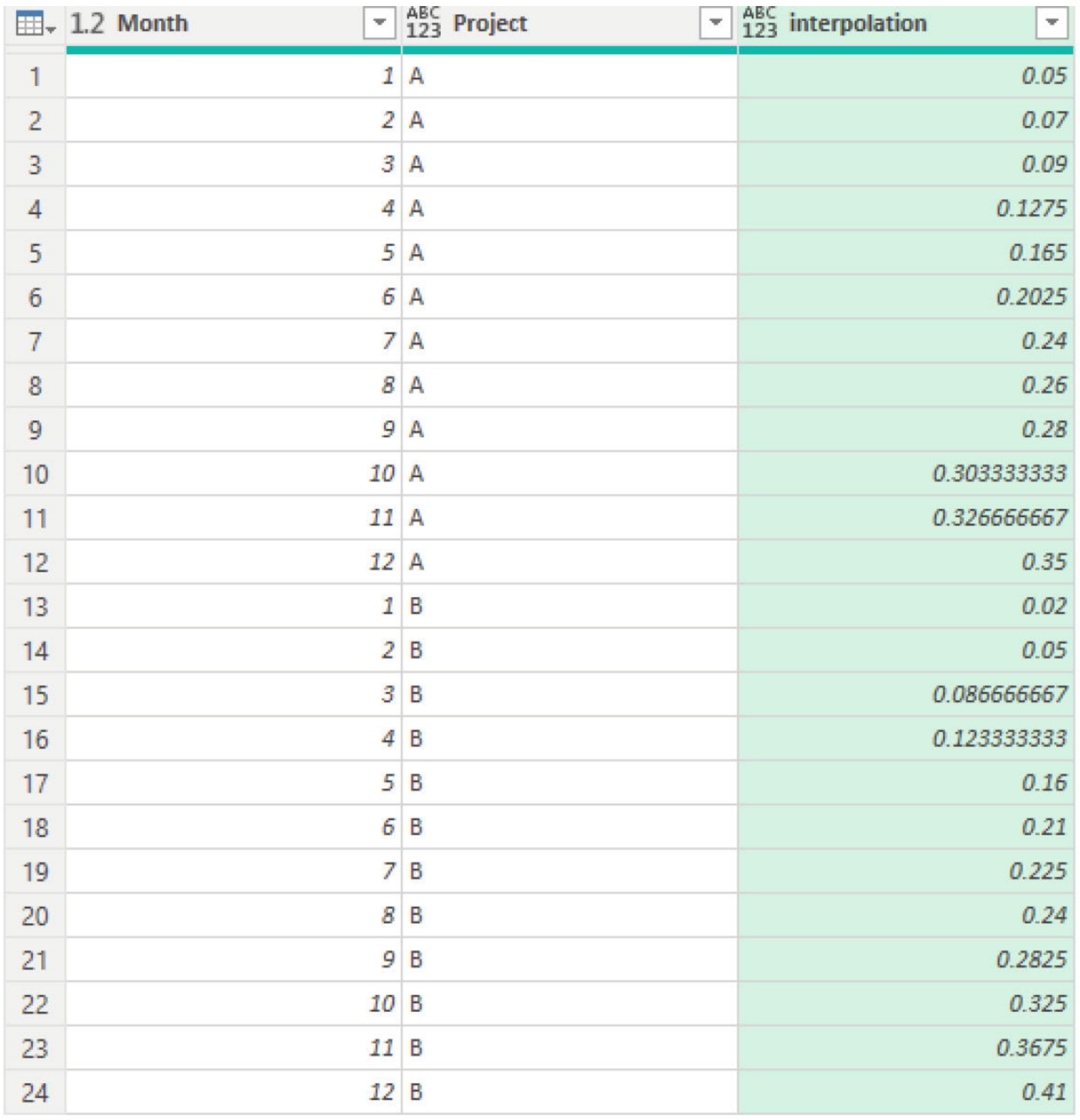


| | 1.2 Month | ABC 123 Project | 1.2 Actual Progress | ABC 123 y1 | ABC 123 y2 | ABC 123 x1 | ABC 123 x2 |
|---|---|---|---|---|---|---|---|
| 1 | 1 | A | 0.05 | 0.05 | 0.05 | 1 | 1 |
| 2 | 2 | A | 0.07 | 0.07 | 0.07 | 2 | 2 |
| 3 | 3 | A | 0.09 | 0.09 | 0.09 | 3 | 3 |
| 4 | 4 | A | null | 0.09 | 0.24 | 3 | 7 |
| 5 | 5 | A | null | 0.09 | 0.24 | 3 | 7 |
| 6 | 6 | A | null | 0.09 | 0.24 | 3 | 7 |
| 7 | 7 | A | 0.24 | 0.24 | 0.24 | 7 | 7 |
| 8 | 8 | A | null | 0.24 | 0.28 | 7 | 9 |
| 9 | 9 | A | 0.28 | 0.28 | 0.28 | 9 | 9 |
| 10 | 10 | A | null | 0.28 | 0.35 | 9 | 12 |
| 11 | 11 | A | null | 0.28 | 0.35 | 9 | 12 |
| 12 | 12 | A | 0.35 | 0.35 | 0.35 | 12 | 12 |
| 13 | 1 | B | 0.02 | 0.02 | 0.02 | 1 | 1 |
| 14 | 2 | B | 0.05 | 0.05 | 0.05 | 2 | 2 |
| 15 | 3 | B | null | 0.05 | 0.16 | 2 | 5 |
| 16 | 4 | B | null | 0.05 | 0.16 | 2 | 5 |
| 17 | 5 | B | 0.16 | 0.16 | 0.16 | 5 | 5 |

***Figure 8-20*** The result of applying Fill Down and Up over the columns

Now that all the required information for applying the interpolation formula is available for each row, add a Custom Column named Interpolation and enter the following formula in the Custom Column window. After clicking OK, remove any extra columns to obtain the final table, as shown in Figure 8-21.

```
=if [Actual Progress] = null then [y1]+([Month]-
[x1])*([y2]-[y1])/([x2]-[x1]) else [Actual
Progress]
```



| | 1.2 Month | ABC 123 Project | ABC 123 interpolation |
|---|---|---|---|
| 1 | 1 | A | 0.05 |
| 2 | 2 | A | 0.07 |
| 3 | 3 | A | 0.09 |
| 4 | 4 | A | 0.1275 |
| 5 | 5 | A | 0.165 |
| 6 | 6 | A | 0.2025 |
| 7 | 7 | A | 0.24 |
| 8 | 8 | A | 0.26 |
| 9 | 9 | A | 0.28 |
| 10 | 10 | A | 0.303333333 |
| 11 | 11 | A | 0.326666667 |
| 12 | 12 | A | 0.35 |
| 13 | 1 | B | 0.02 |
| 14 | 2 | B | 0.05 |
| 15 | 3 | B | 0.086666667 |
| 16 | 4 | B | 0.123333333 |
| 17 | 5 | B | 0.16 |
| 18 | 6 | B | 0.21 |
| 19 | 7 | B | 0.225 |
| 20 | 8 | B | 0.24 |
| 21 | 9 | B | 0.2825 |
| 22 | 10 | B | 0.325 |
| 23 | 11 | B | 0.3675 |
| 24 | 12 | B | 0.41 |

***Figure 8-21*** The final table

**Note** The presented solution is simple and efficient in terms of time. However, for those interested in exploring Power Query further, this problem can also be solved without using Fill Down and Fill Up and instead by utilizing the Filter function (which is not recommended). To do this, add a Custom Column and use the following formula:

```
= [
  Non_null_rows = Table.SelectRows(
    Source,
    (X) => X[Actual Progress] <> null and
X[Project] = [Project]
   ),
   Previous_Month =
Table.Last(Table.SelectRows(Non_null_rows, (X)
=> X[Month] <= [Month])),
  Next_Month =
Table.First(Table.SelectRows(Non_null_rows, (X)
=> X[Month] >= [Month])),
  Result = [Actual Progress]
    ?? (
      Previous_Month[Actual Progress]
        + ([Month] - Previous_Month[Month])
          * (Next_Month[Actual Progress] -
Previous_Month[Actual Progress])
          / (Next_Month[Month] -
Previous_Month[Month])
    )
][Result]
```

## K-Nearest Neighbors (K-NN) for Imputation

K-nearest neighbors (KNN) is a supervised machine learning algorithm used for classification and regression tasks, which you can use to handle missing values. In this example, the goal is to use this technique to replace the missing values.

In the Source table shown in Table 8-4, the values of each row are represented by x, y, and z, but some values are missing. Fill in the missing values using the K-NN method with K=2 by following this process:

1. Consider set P, which includes all rows without any missing values, and set S, which includes all rows with at least one missing value. For any row, like i, in set S (rows with missing values), calculate the

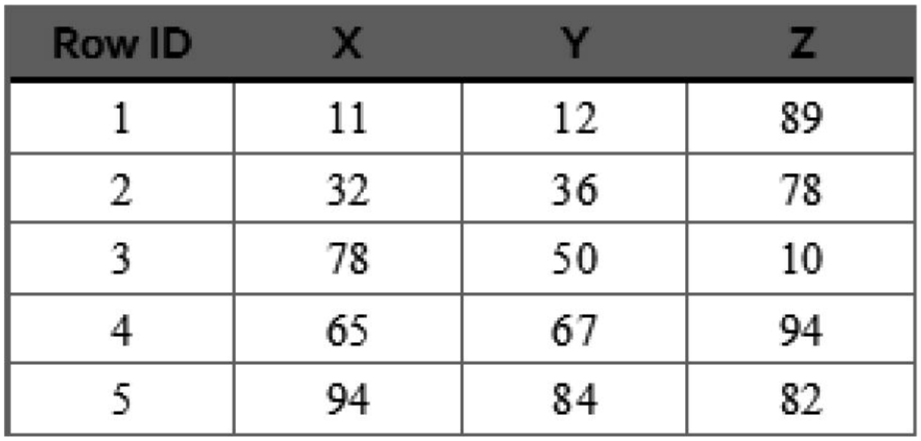
2. distance of that row from all rows in set S based on non-missing values. For example, if x in row i is missing, the distance is calculated using $(y_i-y_p)^2+(z_i-z_p)^2$, and if both x and y in the ith row are missing, the distance is calculated using $(z_i-z_p)^2$.
3. Select the two rows from set P with the smallest distances from the ith rows in set S and designate them as r1 and r2.
4. Replace the missing value in the ith row with the average of the corresponding values in r1 and r2.

***Table 8-4*** Source Table: Sample Data

| Row ID | X | Y | Z |
|---|---|---|---|
| 1 | 11 | 12 | 89 |
| 2 | 32 | 36 | 78 |
| 3 | 78 | 50 | 10 |
| 4 | 65 | 67 | 94 |
| 5 | 94 | 84 | 82 |
| 6 | 57 | 68 | |
| 7 | | 30 | 12 |
| 8 | 40 | | |
| 9 | 34 | | 10 |
| 10 | 10 | 70 | |

**Note** The data in this example is provided in an Excel file titled `05 K-Nearest Neighbors (K-NN) for Imputation.xlsx`.

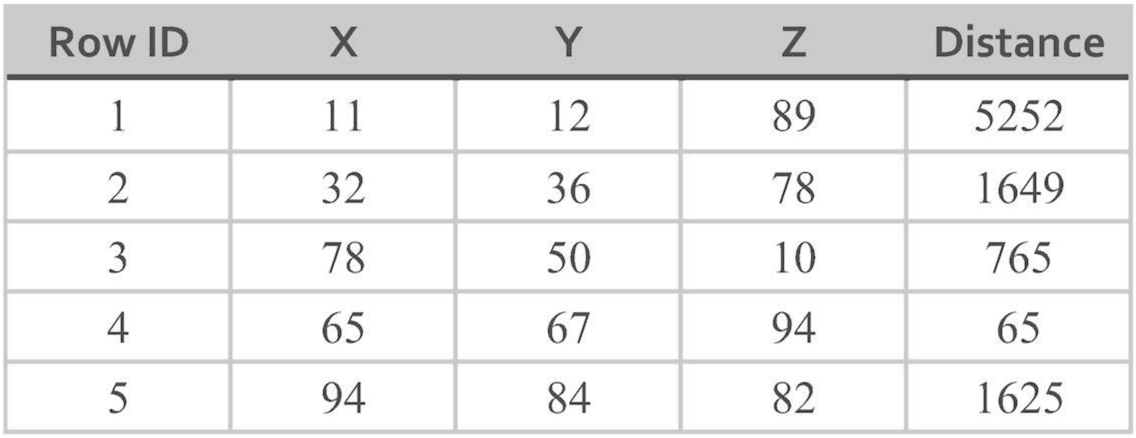
For example, consider the row ID=6 with x=57, y=68, and z=null (z is a missing value). To apply the KNN method and estimate the missing z value, you first need to extract the rows that have no missing values, as shown in Figure 8-22.



| Row ID | X | Y | Z |
|---|---|---|---|
| 1 | 11 | 12 | 89 |
| 2 | 32 | 36 | 78 |
| 3 | 78 | 50 | 10 |
| 4 | 65 | 67 | 94 |
| 5 | 94 | 84 | 82 |

***Figure 8-22*** Selecting the rows without a null value

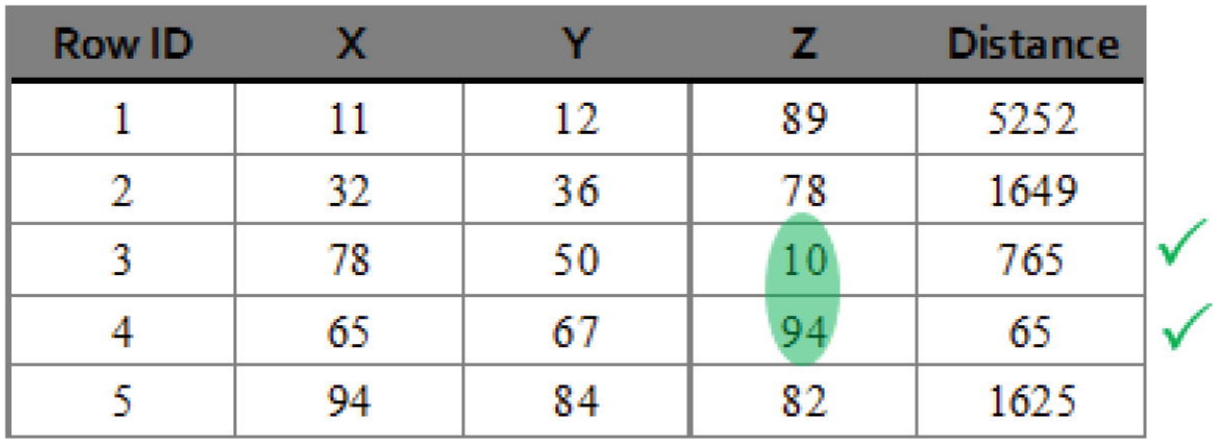
Next, calculate the distance between row ID=6 and every row in the table resulting from the previous step, using the values on Columns x and y. You do this using the $(x_i - x_6)^2 + (y_i - y_6)^2$ formula, as shown in Figure 8-23.



| Row ID | X | Y | Z | Distance |
|---|---|---|---|---|
| 1 | 11 | 12 | 89 | 5252 |
| 2 | 32 | 36 | 78 | 1649 |
| 3 | 78 | 50 | 10 | 765 |
| 4 | 65 | 67 | 94 | 65 |
| 5 | 94 | 84 | 82 | 1625 |

***Figure 8-23*** Calculating distances

In the final step, you identify the two nearest rows with the smallest distances and take the average of their z values. This average (average of 10 and 94) is then assigned as the estimated z value for row ID=6, as shown in Figure 8-24.



| Row ID | X | Y | Z | Distance | |
|---|---|---|---|---|---|
| 1 | 11 | 12 | 89 | 5252 | |
| 2 | 32 | 36 | 78 | 1649 | |
| 3 | 78 | 50 | 10 | 765 | ✓ |
| 4 | 65 | 67 | 94 | 65 | ✓ |
| 5 | 94 | 84 | 82 | 1625 | |

***Figure 8-24*** Extracting the nearest rows

> **Note** There are rare situations where applying such mathematical algorithms directly in Power Query is necessary. In most cases, it is easier to use Python or R within the Power BI version of Power Query (explained in Chapter 10). However, this example demonstrates that even advanced transformations can be performed with just a few steps in Power Query.

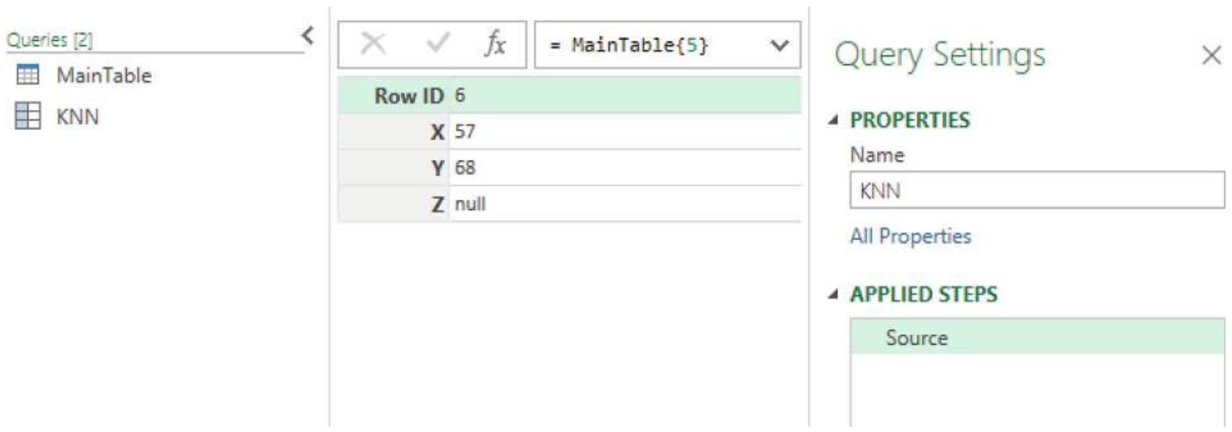
To solve this problem, first load the data into Power Query and rename the query `MainTable`, ensuring that all numerical columns (X, Y, and Z) are set to the number data type. If not, do this manually.

The table is now ready to apply the steps of KNN over it. Instead of solving the problem for all rows at once, you begin by applying the method to a single row with missing values—like the row related to Row ID=6. This allows you to construct a solution that can later be converted into a function applicable to all rows with missing values.

Create a new blank query, named KNN, where you simulate the process for a single row before generalizing it. To work on Row 6, extract its values using the following formula in the formula bar, which serves as a reference for subsequent calculations:

```
= MainTable{5}
```

If you follow these steps, you will reach two queries: `MainTable` and `KNN`. In the `KNN` query, the first step, named Source, extracts the details of the sixth row from `MainTable`, as shown in Figure 8-25.



```
= MainTable{5}
```

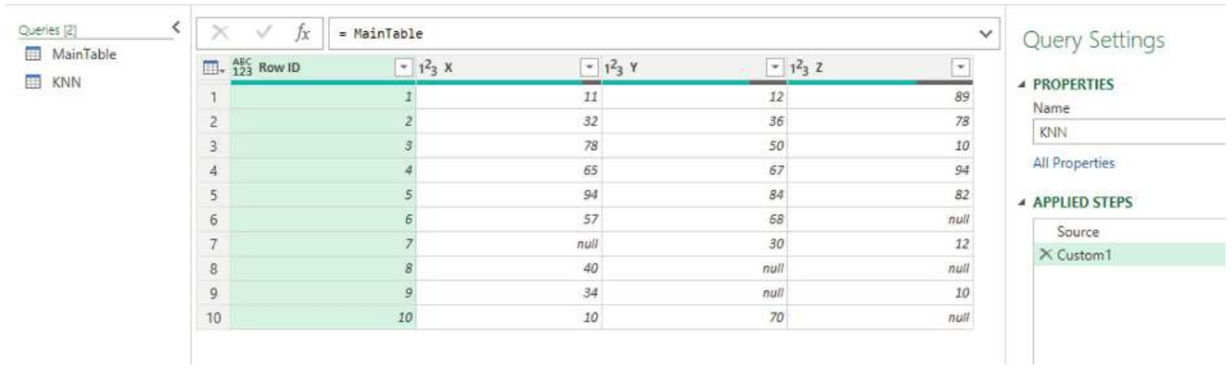
| | |
|---|---|
| Row ID | 6 |
| X | 57 |
| Y | 68 |
| Z | null |

Name: KNN

Applied steps: Source

*Figure 8-25* The result of referring to the sixth row in MainTable

In addition to the information in row 6, you need the entire dataset, which you'll later use to compute distances. So, in the `KNN` query, click the *fx* button to create a new step, which will be named `Custom1` by default. In the formula bar, enter = `MainTable`, which will load the full dataset into the `KNN` query, as shown in Figure 8-26.



```
= MainTable
```

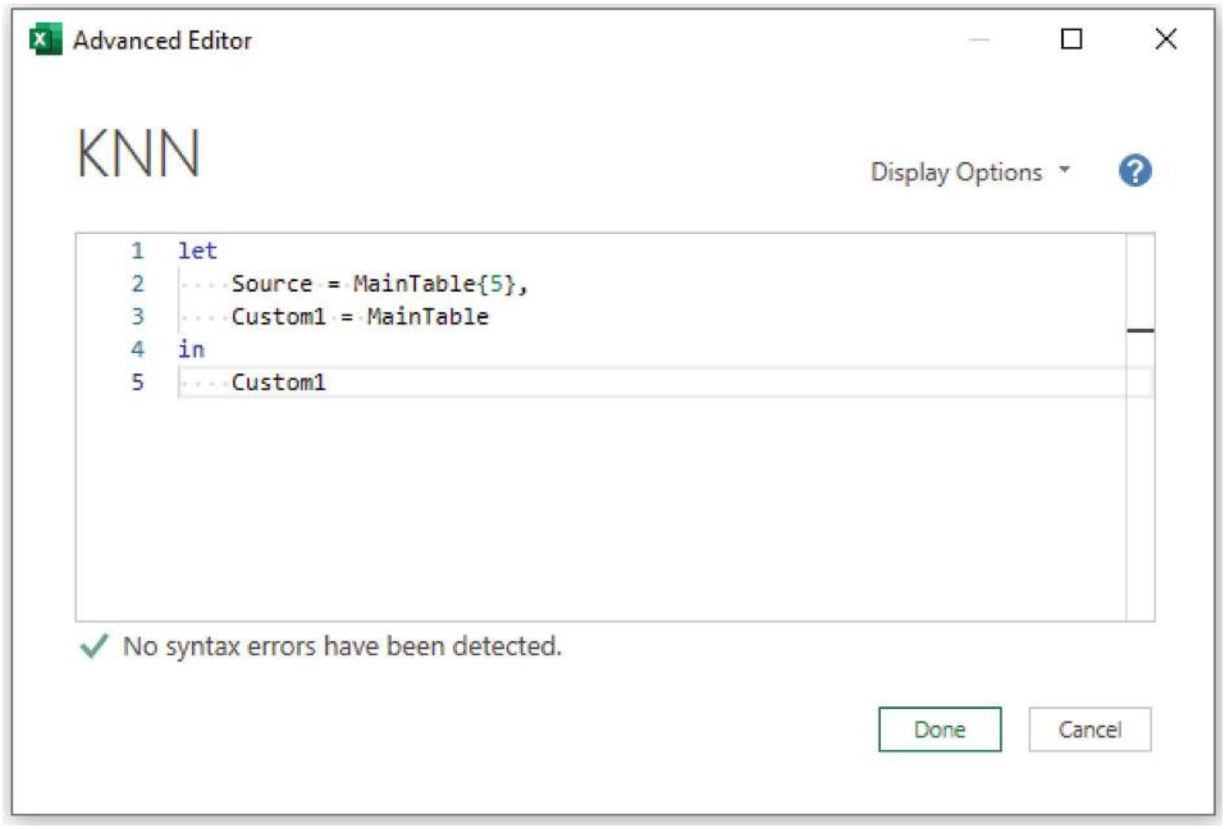
| | Row ID | X | Y | Z |
|---|---|---|---|---|
| 1 | 1 | 11 | 12 | 89 |
| 2 | 2 | 32 | 36 | 78 |
| 3 | 3 | 78 | 50 | 10 |
| 4 | 4 | 65 | 67 | 94 |
| 5 | 5 | 94 | 84 | 82 |
| 6 | 6 | 57 | 68 | null |
| 7 | 7 | null | 30 | 12 |
| 8 | 8 | 40 | null | null |
| 9 | 9 | 34 | null | 10 |
| 10 | 10 | 10 | 70 | null |

Name: KNN

Applied steps: Source, Custom1

*Figure 8-26* Result of referring to Maintable

Before proceeding with the solution, you'll refine the approach by renaming the steps for better clarity. To do this, navigate to the Home tab, select Advanced Editor, and review all the steps, as shown in Figure 8-27.

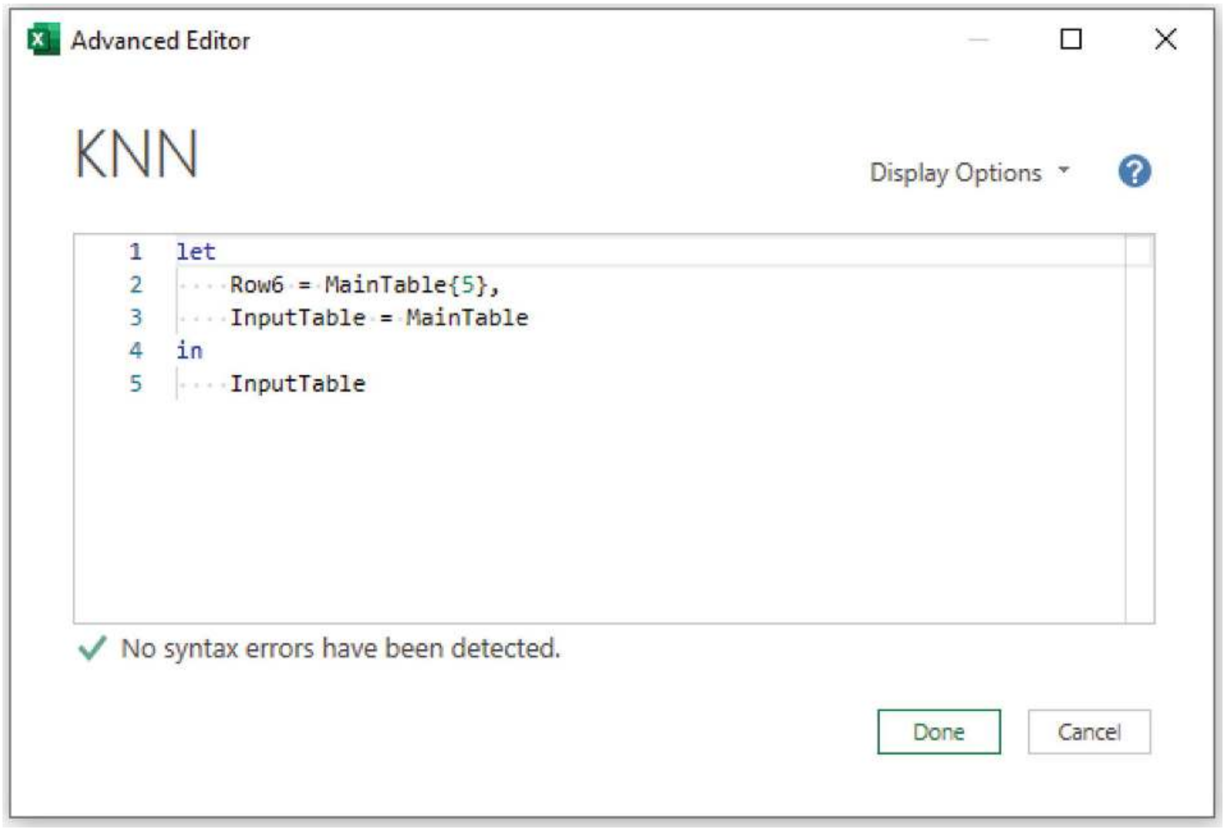


```
let
    Source = MainTable{5},
    Custom1 = MainTable
in
    Custom1
```

No syntax errors have been detected.

***Figure 8-27*** Query steps before changing

In the open window, rename `Source` to `Row6` and `Custom1` to `InputTable`, as shown in Figure 8-28.



```
let
    Row6 = MainTable{5},
    InputTable = MainTable
in
    InputTable
```

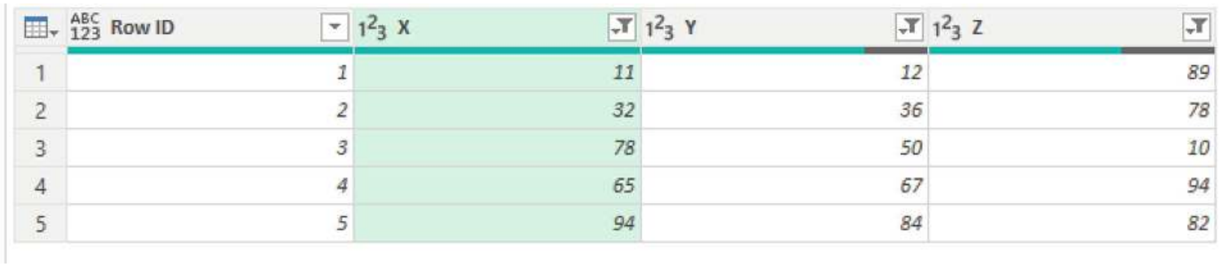
***Figure 8-28*** Query steps after changing

Now you can apply the KNN steps. The first step is to filter out rows that contain null values in any column. To achieve this, use the filter option next to a column, such as column X, and deselect the null values. This results in the following formula:

```
= Table.SelectRows(InputTable, each ([X] <> null))
```

Applying the same filter to other columns or rewriting the formula shown here will remove all rows that contain null values in any column. (If you are working with a large number of columns, refer to the technique presented in Example 1 of Chapter 3.) This process results in the table shown in Figure 8-29.

```
= Table.SelectRows(InputTable, each ([X] <> null)
and ([Y] <> null) and ([Z] <> null))
```



| | Row ID | X | Y | Z |
|---|---|---|---|---|
| 1 | 1 | 11 | 12 | 89 |
| 2 | 2 | 32 | 36 | 78 |
| 3 | 3 | 78 | 50 | 10 |
| 4 | 4 | 65 | 67 | 94 |
| 5 | 5 | 94 | 84 | 82 |

***Figure 8-29*** The result of selecting rows without null values

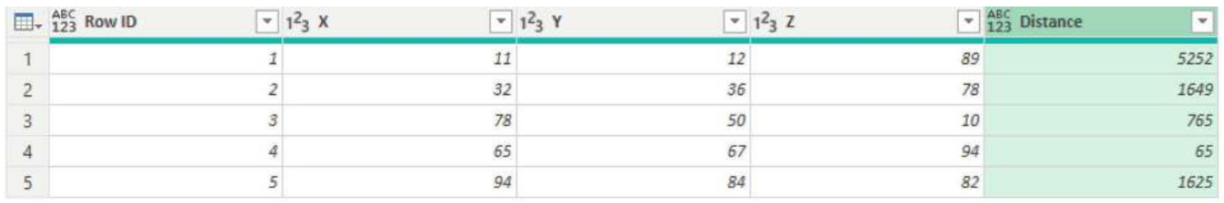
The next step involves computing the Euclidean distance between Row6 and rows in the filtered dataset. Since you know that Row6 has a missing value in column Z, you can use a formula to calculate the squared differences between corresponding values in the X and Y columns using the following formula in the Custom Column window.

```
=Number.Power(Row6[X]-[X],2)+Number.Power(Row6[Y]-
[Y],2)
```

The previous formula only works for rows where the missing value is in column Z. If it were applied to a row with a null value in column X, the term `Number.Power(Row6[X] - [X], 2)` would return null. Since any operation involving null results in null, the entire formula would also return null. To prevent this, you can modify the formula by using `Number.Power(Row6[X] - [X], 2) ?? 0`, which ensures that if the value in column X is null, it is replaced with 0.

Since any of columns X, Y, and Z may contain null values, you can use the following formula in a custom column to create a new column named Distance. This formula ensures that the Euclidean distance can be calculated for any row, even if some fields contain null values, resulting in the table shown in Figure 8-30.

```
(Number.Power(Row6[X]-[X],2)??0)+
(Number.Power(Row6[Y]-[Y],2)??0)+
(Number.Power(Row6[Z]-[Z],2)??0)
```

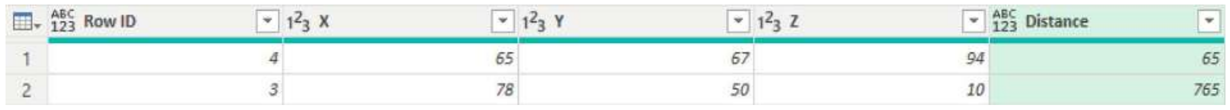


| | Row ID | X | Y | Z | Distance |
|---|---|---|---|---|---|
| 1 | 1 | 11 | 12 | 89 | 5252 |
| 2 | 2 | 32 | 36 | 78 | 1649 |
| 3 | 3 | 78 | 50 | 10 | 765 |
| 4 | 4 | 65 | 67 | 94 | 65 |
| 5 | 5 | 94 | 84 | 82 | 1625 |

***Figure 8-30*** The result of calculating distance

Once the distances are calculated, you can identify the two nearest neighbors using the `Table.MinN()` function, which extracts the rows with the smallest distance values to the selected row. After the previous step, click the f*x* button to create a new step named Custom1. Then `Table.MinN()` function, as shown here, to identify the two rows with the smallest distance. This will produce the desired result shown in Figure 8-31.

```
= Table.MinN(#"Added Custom","Distance",2)
```

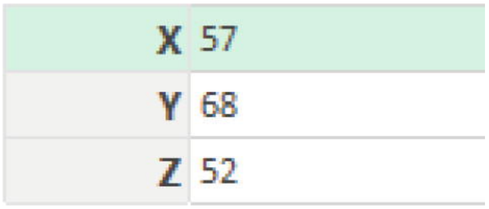


| | Row ID | X | Y | Z | Distance |
|---|---|---|---|---|---|
| 1 | 4 | 65 | 67 | 94 | 65 |
| 2 | 3 | 78 | 50 | 10 | 765 |

***Figure 8-31*** The result of selecting two nearest neigbours

Since you have identified the two nearest rows without any null values for Row6, you can now replace the null values in Row6. For each field in Row6, if a value except null is present, it should be used as is. Otherwise, it should be replaced with the average of that field from the two nearest rows. The following formula, entered in the formula bar, creates a record containing X, Y, and Z fields, where each field takes its value from Row6 if it is not null; otherwise, it uses the average value of that field from the nearest rows (see Figure 8-32):

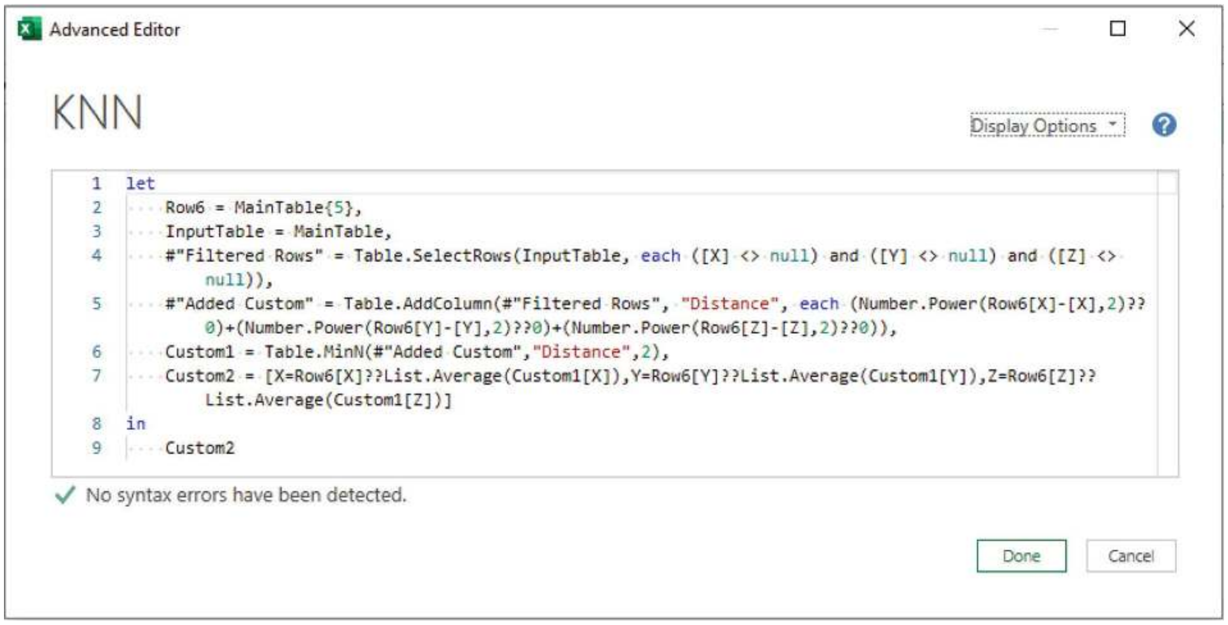
```
= [X=Row6[X]??List.Average(Custom1[X]),Y=Row6[Y]??
List.Average(Custom1[Y]),Z=Row6[Z]??
List.Average(Custom1[Z])]
```



| | |
|---|---|
| X | 57 |
| Y | 68 |
| Z | 52 |

***Figure 8-32*** The result of replacing the null values in Row6

At this point, the method successfully imputes the missing value for Row6. To generalize the approach, you can transform the query into a function with two arguments: the row containing a missing value and the full dataset. To convert the query to a function, from the Home tab, select the Advanced Editor command to see all the steps of the query, as shown in Figure 8-33.

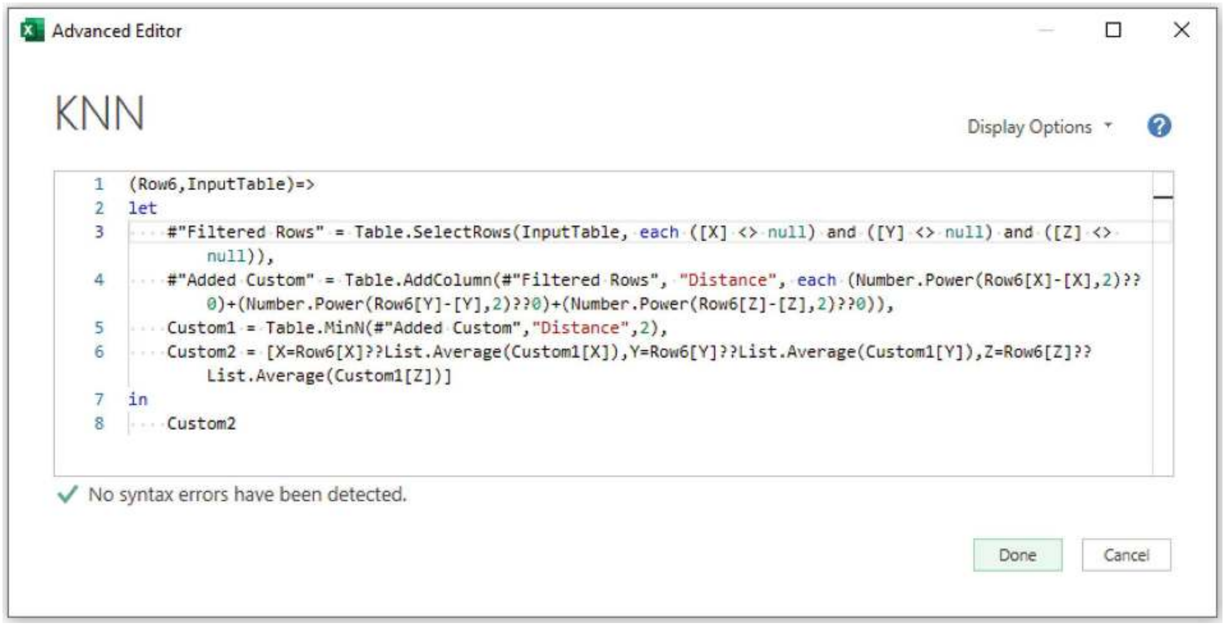


```
let
    Row6 = MainTable{5},
    InputTable = MainTable,
    #"Filtered Rows" = Table.SelectRows(InputTable, each ([X] <> null) and ([Y] <> null) and ([Z] <>
        null)),
    #"Added Custom" = Table.AddColumn(#"Filtered Rows", "Distance", each (Number.Power(Row6[X]-[X],2)??
        0)+(Number.Power(Row6[Y]-[Y],2)??0)+(Number.Power(Row6[Z]-[Z],2)??0)),
    Custom1 = Table.MinN(#"Added Custom","Distance",2),
    Custom2 = [X=Row6[X]??List.Average(Custom1[X]),Y=Row6[Y]??List.Average(Custom1[Y]),Z=Row6[Z]??
        List.Average(Custom1[Z])]
in
    Custom2
```

✓ No syntax errors have been detected.

***Figure 8-33*** Query steps before converting to a function

The first two steps, which define Row6 and the `InputTable` value, can be removed and instead passed as function arguments. To achieve this, define them at the beginning of the formula using `(Row6, InputTable) =>`, before the `let` expression, as shown in Figure 8-34.

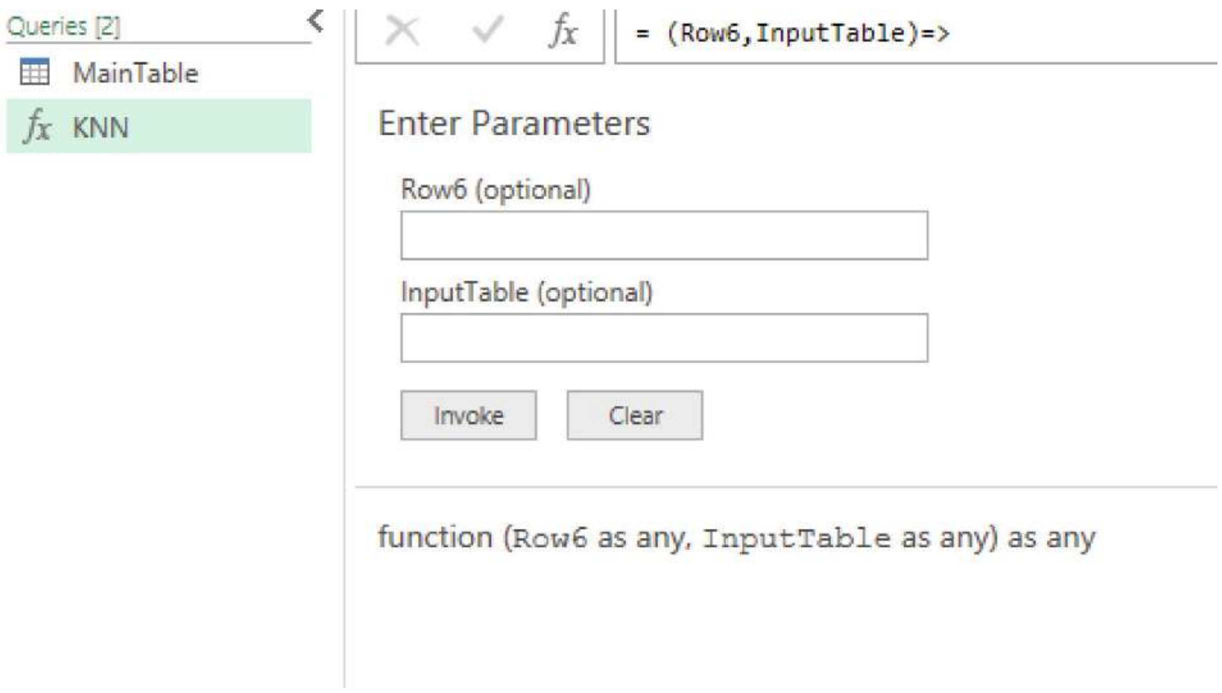


```
(Row6,InputTable)=>
let
    #"Filtered Rows" = Table.SelectRows(InputTable, each ([X] <> null) and ([Y] <> null) and ([Z] <>
        null)),
    #"Added Custom" = Table.AddColumn(#"Filtered Rows", "Distance", each (Number.Power(Row6[X]-[X],2)??
        0)+(Number.Power(Row6[Y]-[Y],2)??0)+(Number.Power(Row6[Z]-[Z],2)??0)),
    Custom1 = Table.MinN(#"Added Custom","Distance",2),
    Custom2 = [X=Row6[X]??List.Average(Custom1[X]),Y=Row6[Y]??List.Average(Custom1[Y]),Z=Row6[Z]??
        List.Average(Custom1[Z])]
in
    Custom2
```

No syntax errors have been detected.

***Figure 8-34*** Query steps after converting it into a function

By applying this step, the KNN query is converted into a function, as shown in Figure 8-35, which can be applied to other queries. This transformation allows you to apply the same logic to different rows or datasets, making the process more flexible and efficient.



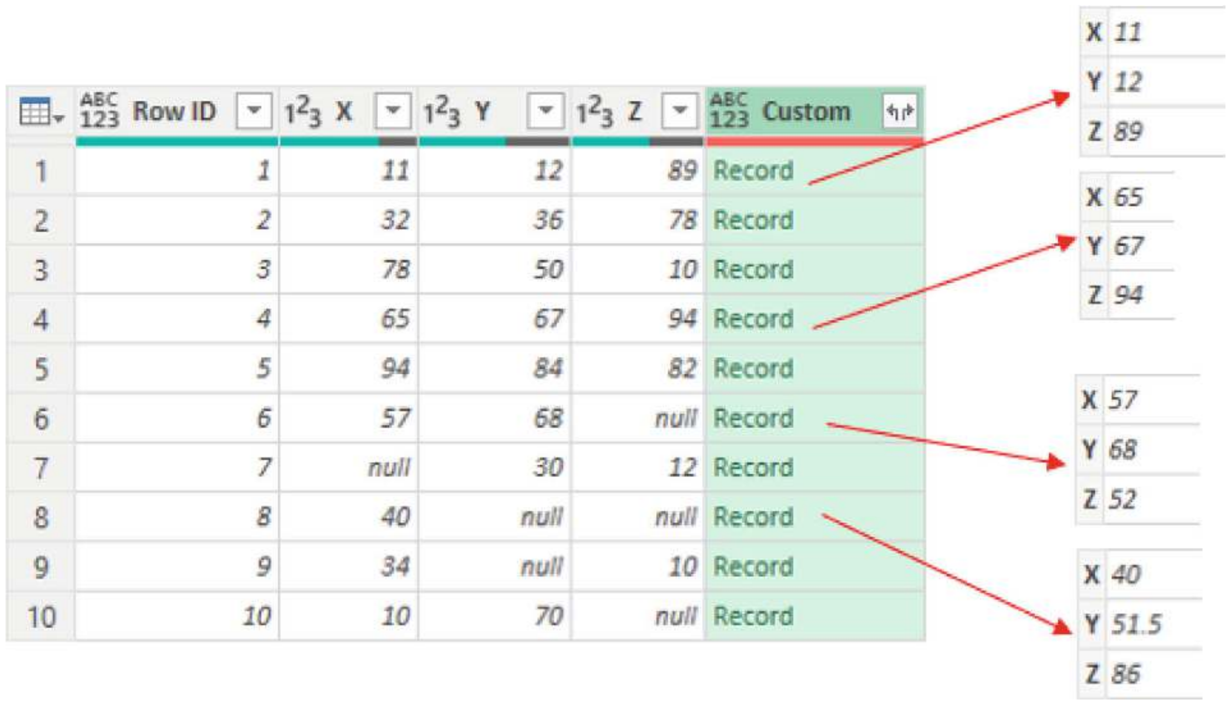
```
= (Row6,InputTable)=>
```

function (Row6 as any, InputTable as any) as any

***Figure 8-35*** The result of converting the query to a function

This function can then be applied across all rows of `MainTable` by adding a new custom column. To do this, go to `MainTable`, add a custom column, and use the following formula in the Custom Column window. This will apply the `KNN` function to each row, calculating the missing values based on the logic you defined earlier, and will return the updated table shown in Figure 8-36.

```
=KNN(_,#"Changed Type")
```



|  | Row ID | X | Y | Z | Custom |
|---|---|---|---|---|---|
| 1 | 1 | 11 | 12 | 89 | Record |
| 2 | 2 | 32 | 36 | 78 | Record |
| 3 | 3 | 78 | 50 | 10 | Record |
| 4 | 4 | 65 | 67 | 94 | Record |
| 5 | 5 | 94 | 84 | 82 | Record |
| 6 | 6 | 57 | 68 | null | Record |
| 7 | 7 | null | 30 | 12 | Record |
| 8 | 8 | 40 | null | null | Record |
| 9 | 9 | 34 | null | 10 | Record |
| 10 | 10 | 10 | 70 | null | Record |

|  |  |
|---|---|
| X | 11 |
| Y | 12 |
| Z | 89 |

|  |  |
|---|---|
| X | 65 |
| Y | 67 |
| Z | 94 |

|  |  |
|---|---|
| X | 57 |
| Y | 68 |
| Z | 52 |

|  |  |
|---|---|
| X | 40 |
| Y | 51.5 |
| Z | 86 |

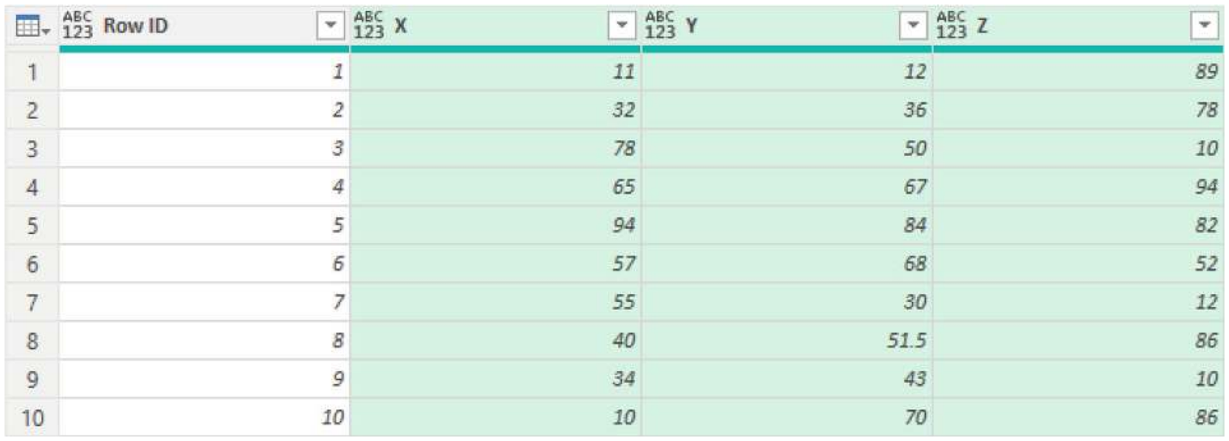
***Figure 8-36*** The result of applying KNN for the table

It is true that the previous formula solves the problem, but it executes all the steps of the `KNN` function for every row in the `MainTable`, even for those rows that do not have any null values. To optimize this, it would be better to revise the formula to apply the `KNN` function only for rows with null values. This can be achieved by checking if any of the fields (X, Y, or Z) in a row are null. If none of them are null, the row should be left unchanged. The revised formula would look like the following formula:

```
=if ([X]+[Y]+[Z])= null then KNN(_,#"Changed
Type") else _
```

This revised formula ensures that the `KNN` function is applied only to rows where one or more fields have a null value (if one of them is null, the result of `([X]+[Y]+[Z])` is null), reducing unnecessary calculations for rows with complete data.

In the final step, you need to remove the original X, Y, and Z columns from the table. After that, expand the custom column by selecting only the X, Y, and Z fields. This will replace the missing values in the original X, Y, and Z columns with the results from the `KNN` function, and you'll achieve the desired outcome, as shown in Figure 8-37.



| | Row ID | X | Y | Z |
|---|---|---|---|---|
| 1 | 1 | 11 | 12 | 89 |
| 2 | 2 | 32 | 36 | 78 |
| 3 | 3 | 78 | 50 | 10 |
| 4 | 4 | 65 | 67 | 94 |
| 5 | 5 | 94 | 84 | 82 |
| 6 | 6 | 57 | 68 | 52 |
| 7 | 7 | 55 | 30 | 12 |
| 8 | 8 | 40 | 51.5 | 86 |
| 9 | 9 | 34 | 43 | 10 |
| 10 | 10 | 10 | 70 | 86 |

***Figure 8-37*** The result of replacing null values in all the rows

## Summary

Missing values are an unavoidable aspect of the data-cleaning process. This chapter covered strategies for managing these gaps, such as replacing missing values with previous entries, applying linear interpolation, and using advanced methods like K-Nearest Neighbors (KNN). The chapter discussed scenarios in which replacing missing values can beneficial and where it can be detrimental, in terms of general business logic.

The next chapter introduces the important topic of looping in Power Query, which enables the automation of repetitive tasks across tables.

In Chapter 10, you explore how to integrate Python and R into Power Query. These tools are particularly useful for running machine learning models on data with complex scenarios, offering a more efficient and flexible approach compared to methods within Power Query.

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# 9. Looping in Power Query

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Loops are fundamental control structures in programming that enable code to run repeatedly based on specified conditions. They are essential for automating repetitive tasks, handling large datasets, and simplifying complex operations. The most commonly used loops include the `For-Each` loop, the `For-Next` loop, and the `Do-While` loop. Each type serves a specific purpose in different scenarios. (For more information, visit `www.tutorialspoint.com/computer_programming/computer_programming_loops.htm`).

## The For-Each Loop

A `For-Each` Loop is designed to iterate through each element in a collection, such as a list, array, or table, without requiring an explicit counter. This makes it particularly useful for working with datasets where the number of elements is unknown or may change dynamically. A `For-Each` loop retrieves elements one by one, ensuring a simple and readable approach to handling data.

For example, in Excel VBA, you can use a `For-Each` loop to iterate through various elements, such as all the cells in a selected range, all the sheets in a workbook, or all the shapes on a worksheet. This loop simplifies the process of performing actions on multiple objects efficiently.

## The For-Next Loop

A `For-Next` Loop executes a block of code a fixed number of times, using a counter variable that increments or decrements with each iteration. This loop is particularly useful when the number of iterations is predetermined. It allows control over the step size, meaning that you can iterate in different increments, such as by twos or fives, rather than the default step of one. This loop structure is commonly used in scenarios like filling an array, applying formulas to multiple cells, or processing datasets with a known number of elements.

For example, in Excel VBA, you can use a `For-Next` loop to insert values into cells A1 to A10 or apply changes across Sheet1 to Sheet10. This loop is ideal for executing a set of instructions a specific number of times.

## The Do-While Loop

A `Do-While` Loop executes a block of code as long as a specified condition remains true. Unlike a `For-Next` loop, the number of iterations is not fixed beforehand. Instead, it depends on the condition, which is evaluated before each iteration. If the condition is false from the start, the loop may not run at all. This makes `Do-While` loops useful for scenarios where an operation should continue until a certain condition is met, such as applying a change from the top rows until reaching an empty cell.

For example, in Excel VBA, you can use a `Do-While` loop to continuously add numbers to a column until a specific value is reached. This loop is useful when the number of iterations depends on a condition rather than a fixed count.

## Looping in Power Query

Although Power Query does not include looping functions like for, while, or do-while, it offers alternative functions to achieve similar results. Functions like `List.Transform()`, `List.TransformMany()`, `List.Accumulate()`, and `List.Generate()` enable iterative operations in Power Query. This chapter provides an in-depth exploration of these powerful functions, showcasing their applications in various scenarios.

## List.Transform()

`List.Transform()` is a versatile function for applying transformations to items in a list and has been used many previous examples (including Examples 4-1, 4-3, and 4-4). The syntax of `List.Transform()` is presented as follows:

```
List.Transform(
       list as list,
       transform as function) as list
```

This function takes two arguments:

- The first argument is in the type of `list` and includes the items that you want to transform.
- The second argument is in the type of `function` and defines the transformation function to be applied to the items in the list specified by the first argument.

In this function, the transformation function defined as its second argument will be applied to each item in the list specified as its first argument, and it will return a new list containing the transformed items.

In other words, the `List.Transform()` function in Power Query operates similarly to a `For-Each` Loop. As mentioned, a `For-Each` loop iterates through each item in a collection, processing them one by one. Similarly, `List.Transform()` applies a specified transformation to each item in a given list.

In this function, the collection of items is provided in the first argument as a list. The items in the list can be of any data type, including numbers, text, records, or even tables. The transformation function is then applied to all the items in the list, and the resulting transformed items are returned in a new list.

For the first example, consider a list of monthly incomes for four months: `{4200, 3871, 3910, 3800}`. You want to calculate the tax value, which is 10 percent of the income. To do this, you need to multiply each salary by 0.1, representing 10 percent of the amount.

This can be easily accomplished using the `List.Transform()` function in Power Query. In this case, the list of items is `{4200, 3871, 3910, 3800}` and the transformation function is defined as `each _ * 0.1`, where _ represents each item in the list.

You can type the following formula in the formula bar to apply the transformation to each item, resulting in `{420, 387.1, 391, 380}`.

```
=List.Transform({4200, 3871, 3910, 3800}, each _ * 0.1)
```

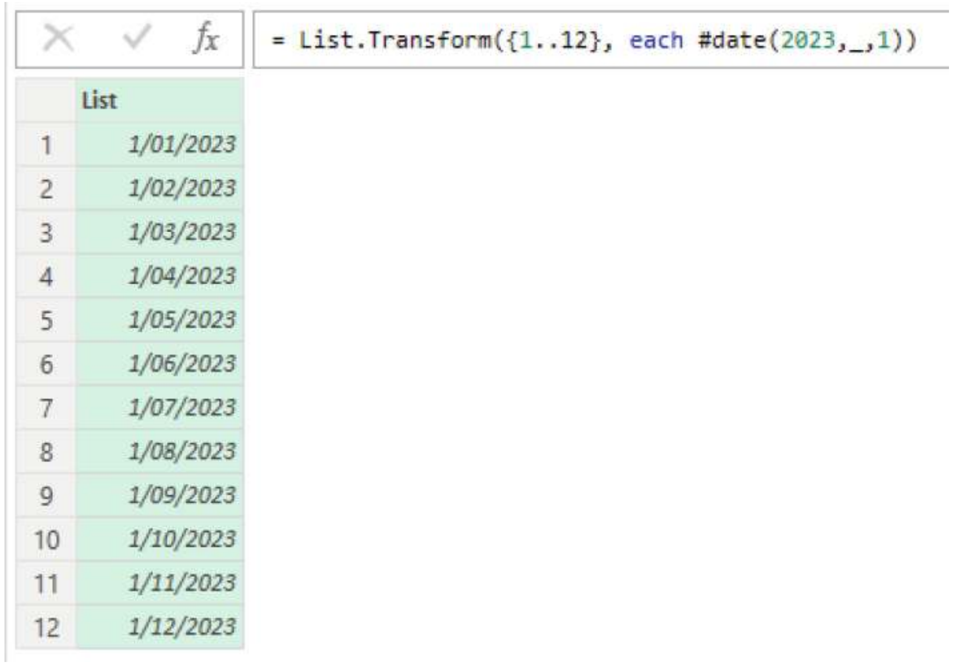
In the formula, you created a `For-`***Each*** loop that iterates over the items in the list `{420, 387.1, 391, 380}`. During each iteration, the transformation function (provided as the second argument) is applied to the selected item (in this case, the numbers representing the salary). The transformed value is then included in the final result. In the first iteration, _ is `4200`, and its transformed value is calculated as `4200 * 0.1`, resulting in `420`. In the second iteration, _ becomes `3871`, and its transformed value is `3871 * 0.1`, which equals `387.1`. This process continues for all the items in the defined list, applying the same transformation (`_ * 0.1`) to each item and producing the corresponding results for each iteration.

For the second example, say you want to extract the first day of each month in 2023. This can be done using the `List.Transform()` function as well.

In this case, you need to iterate over the month number, and in each iteration use the `#date()` function to extract the first date of that month. So, you define the month numbers as the list of items in the first input and use `each #date(2023, _, 1)` as the transformation function to transform any month number to its first date in 2023.

You can type the following formula in the formula bar, which results in Figure 9-1.

```
= List.Transform({1..12}, each #date(2023,_,1))
```



```
= List.Transform({1..12}, each #date(2023,_,1))
```

|  | List |
|---|---|
| 1 | 1/01/2023 |
| 2 | 1/02/2023 |
| 3 | 1/03/2023 |
| 4 | 1/04/2023 |
| 5 | 1/05/2023 |
| 6 | 1/06/2023 |
| 7 | 1/07/2023 |
| 8 | 1/08/2023 |
| 9 | 1/09/2023 |
| 10 | 1/10/2023 |
| 11 | 1/11/2023 |
| 12 | 1/12/2023 |

***Figure 9-1*** Extracting the first dates of months using List.Transform()

**Note** The `#date()` function in Power Query takes three arguments—year, month, and day—and returns the corresponding date based on the input values.

In another example, to extract the last day of each month in 2023, you can use similar logic but the last date of each month is not fixed like 31. So, in this case, you need to extract a day of each month and then use the `Date.EndOfMonth()` function to extract the last date of that month. This can be done by modifying the transformation function in the previous formula. and This results in Figure 9-2.

```
= List.Transform({1..12}, each Date.EndOfMonth(#date(2023,_,1)))
```

Alternatively, you can break the process into multiple steps using a record definition. In the first step, you extract the first date of each month, and in the second step, you apply `Date.EndOfMonth()` to extract the last date of that month. In this scenario, the transformation would look like this:

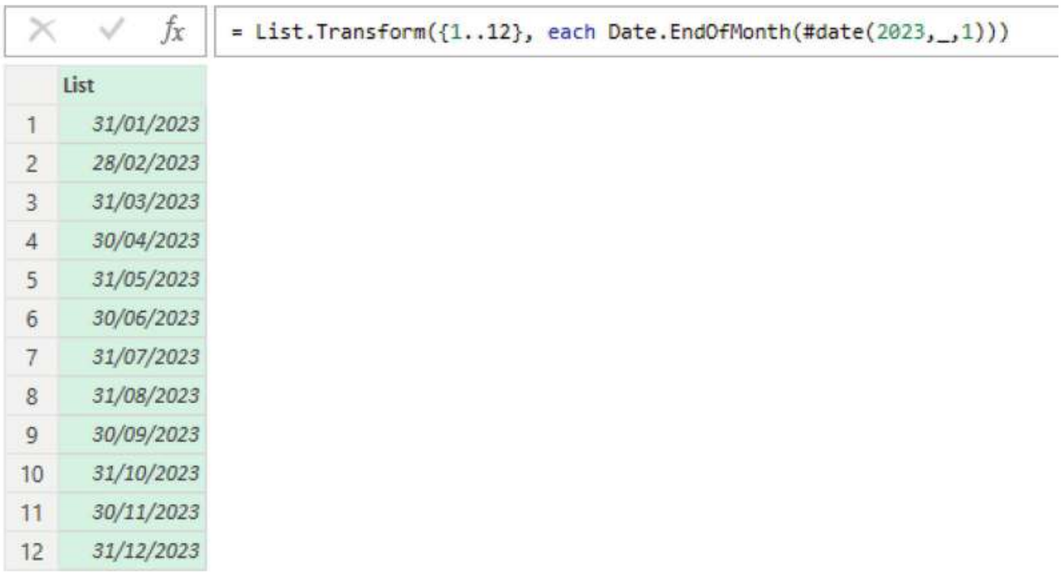
```
each [Step1=#date(2023,_,1), Step2=Date.EndOfMonth(Step1)]
```

However, this transformation will result in a record for each item, but you only need the value of `Step2` (the last date). To fix this, you simply select Step2, by adding `[Step2]` to the end of the transformation function and rewrite the formula as follows:

```
each [Step2 = Date.EndOfMonth(#date(2023, _, 1))][Step2]
```

The full formula in the formula bar looks like following, which results in Figure 9-2:

```
= List.Transform({1..12}, each [Step1=#date(2023,_,1),
Step2=Date.EndOfMonth(Step1)][Step2])
```



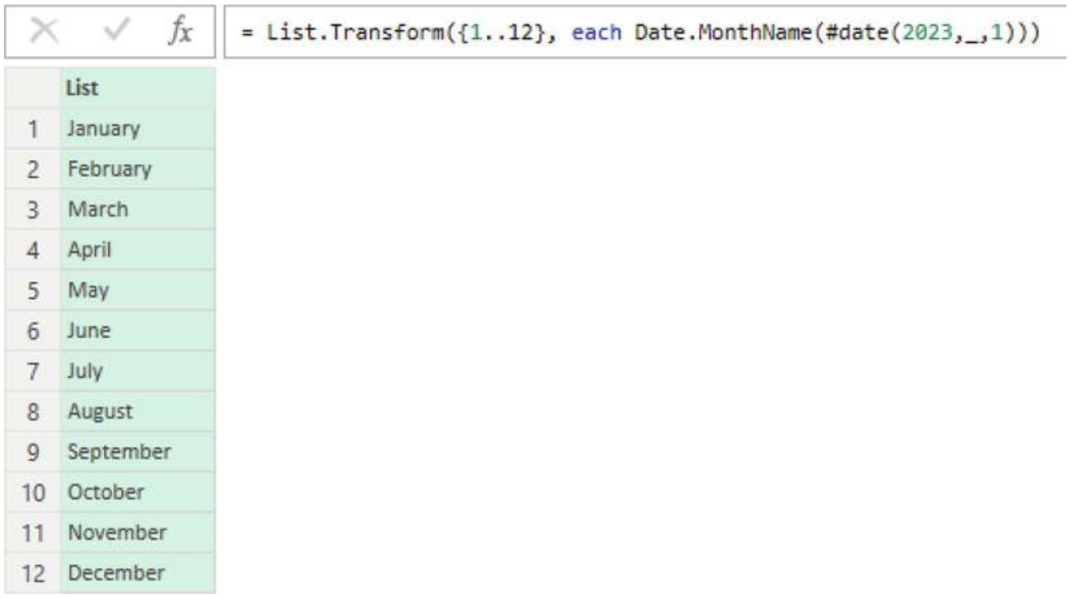
```
= List.Transform({1..12}, each Date.EndOfMonth(#date(2023,_,1)))
```

| | List |
|---|---|
| 1 | 31/01/2023 |
| 2 | 28/02/2023 |
| 3 | 31/03/2023 |
| 4 | 30/04/2023 |
| 5 | 31/05/2023 |
| 6 | 30/06/2023 |
| 7 | 31/07/2023 |
| 8 | 31/08/2023 |
| 9 | 30/09/2023 |
| 10 | 31/10/2023 |
| 11 | 30/11/2023 |
| 12 | 31/12/2023 |

***Figure 9-2*** Extracting the last dates of months using List.Transform()

Similarly, to extract the list of month names, you can type the following formula, which results in Figure 9-3.

```
= List.Transform({1..12}, each Date.MonthName(#date(2023,_,1)))
```



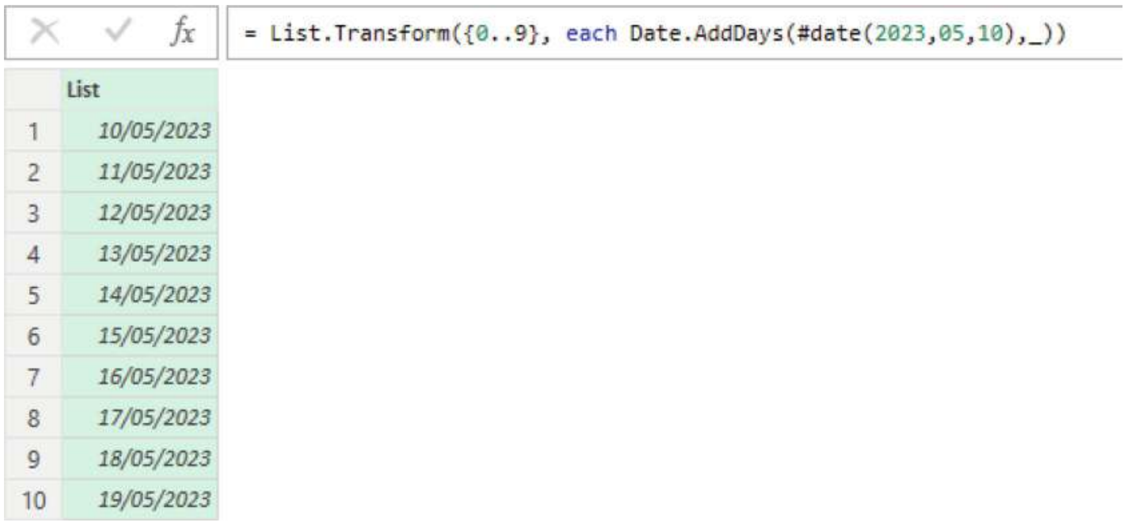
```
= List.Transform({1..12}, each Date.MonthName(#date(2023,_,1)))
```

| | List |
|---|---|
| 1 | January |
| 2 | February |
| 3 | March |
| 4 | April |
| 5 | May |
| 6 | June |
| 7 | July |
| 8 | August |
| 9 | September |
| 10 | October |
| 11 | November |
| 12 | December |

***Figure 9-3*** Extracting the name of months using List.Transform()

Additionally, to create a list of ten consecutive dates starting at `#date(2023, 05, 10)`, you can use the `List.Transform()` function with the `{0..9}` list. The transformation will add each value from this list (representing the number of days to be added) to the initial date `#date(2023, 05, 10)`. The formula can be written as follows and results in Figure 9-4:

```
= List.Transform({0..9}, each Date.AddDays(#date(2023,05,10),_))
```



```
= List.Transform({0..9}, each Date.AddDays(#date(2023,05,10),_))
```

| | List |
|---|---|
| 1 | 10/05/2023 |
| 2 | 11/05/2023 |
| 3 | 12/05/2023 |
| 4 | 13/05/2023 |
| 5 | 14/05/2023 |
| 6 | 15/05/2023 |
| 7 | 16/05/2023 |
| 8 | 17/05/2023 |
| 9 | 18/05/2023 |
| 10 | 19/05/2023 |

***Figure 9-4*** The range of dates using List.Transform()

In the previous examples, you used a list of numbers as the first argument of the `List.Transform()` function. However, it's important to note that this function can also be applied to other types of data, such as tables. In this case, a list of tables can be defined as the first argument. The transformation function will then be applied to each table separately, and the transformed tables will be presented in the resulting list. Each table in the list will undergo the specified transformation individually, and the output will be a list of the transformed tables.

For example, consider three tables—Table1, Table2, and Table3—shown in Figure 9-5. They contain sales data for each product in various regions over the spring months. These tables are loaded into Power Query and are named Table1, Table2, and Table3, respectively.

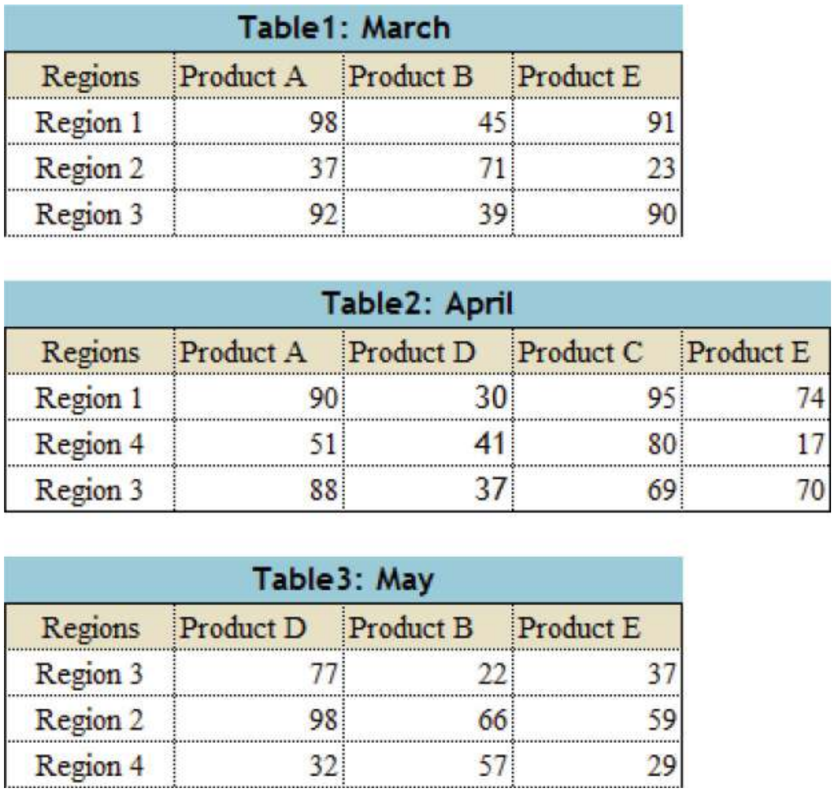


Table1: March

| Regions | Product A | Product B | Product E |
|---|---|---|---|
| Region 1 | 98 | 45 | 91 |
| Region 2 | 37 | 71 | 23 |
| Region 3 | 92 | 39 | 90 |

Table2: April

| Regions | Product A | Product D | Product C | Product E |
|---|---|---|---|---|
| Region 1 | 90 | 30 | 95 | 74 |
| Region 4 | 51 | 41 | 80 | 17 |
| Region 3 | 88 | 37 | 69 | 70 |

Table3: May

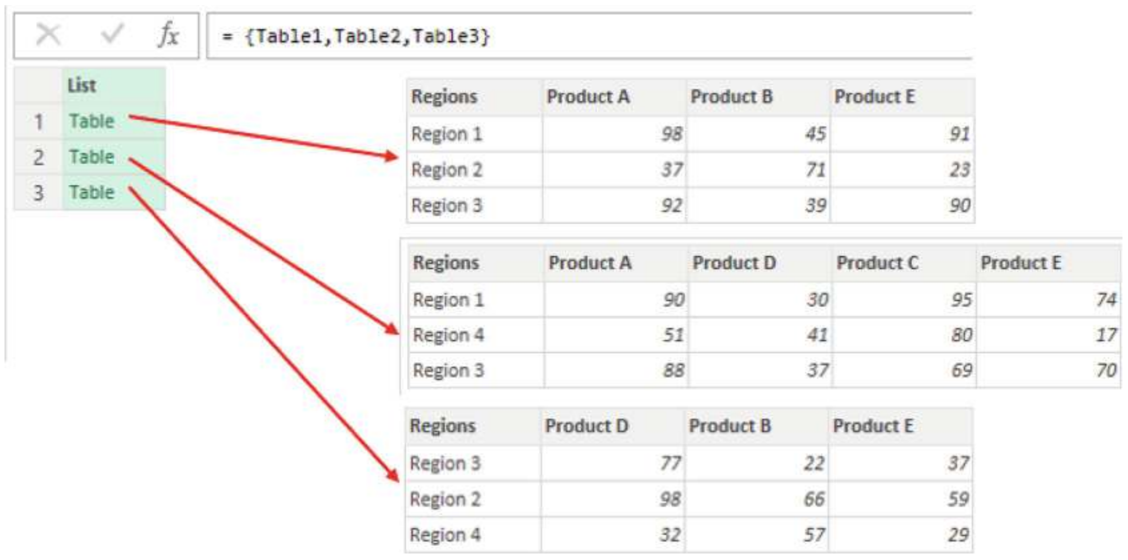
| Regions | Product D | Product B | Product E |
|---|---|---|---|
| Region 3 | 77 | 22 | 37 |
| Region 2 | 98 | 66 | 59 |
| Region 4 | 32 | 57 | 29 |

***Figure 9-5*** Loaded tables

Since the tables have different column names, directly combining them will not yield the desired result. However, combining the unpivoted version of the tables (where all columns except for Region are unpivoted) will produce better results. One approach is to unpivot each table separately and then combine them using the `Table.Combine()` function. Alternatively, you can use `List.Transform()` to create a loop over each table and apply the unpivot transformation for each table.

To do this, create a blank query and define the list by entering the following formula in the formula bar, which will result in Figure 9-6.

```
= {Table1,Table2,Table3}
```



= {Table1,Table2,Table3}

| | List |
|---|---|
| 1 | Table |
| 2 | Table |
| 3 | Table |

| Regions | Product A | Product B | Product E |
|---|---|---|---|
| Region 1 | 98 | 45 | 91 |
| Region 2 | 37 | 71 | 23 |
| Region 3 | 92 | 39 | 90 |

| Regions | Product A | Product D | Product C | Product E |
|---|---|---|---|---|
| Region 1 | 90 | 30 | 95 | 74 |
| Region 4 | 51 | 41 | 80 | 17 |
| Region 3 | 88 | 37 | 69 | 70 |

| Regions | Product D | Product B | Product E |
|---|---|---|---|
| Region 3 | 77 | 22 | 37 |
| Region 2 | 98 | 66 | 59 |
| Region 4 | 32 | 57 | 29 |

***Figure 9-6*** Creating a list of tables

In this case, the list of tables can be placed in the first argument of `List.Transform()`, and unpivoting transformation function can be defined to apply a transformation to any table in this list. Since the items in this list are of type `table`, using ***e***`ach _` in the second argument means that _ represents each table item in the list.

As explained in Chapter 4, to unpivot the columns in a table (let's call it _), excluding the Regions column, you can use the following formula:

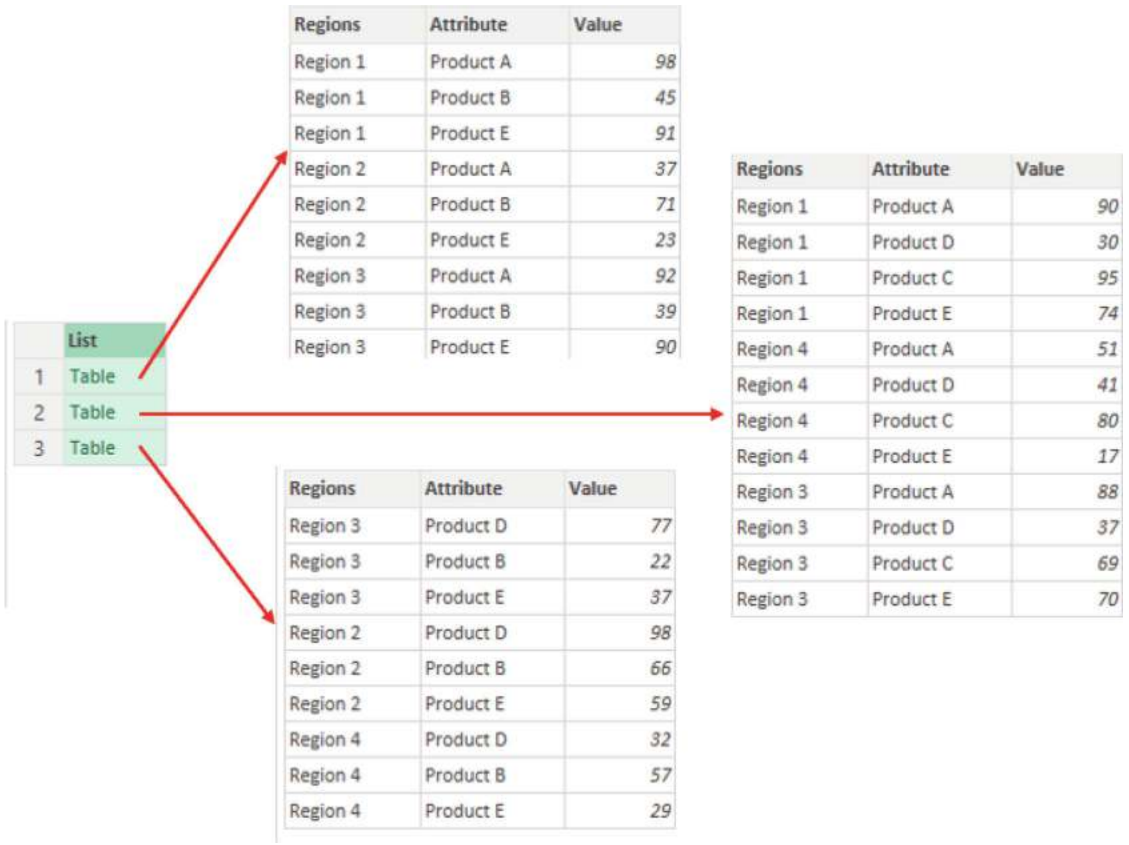
```
= Table.UnpivotOtherColumns(_, {"Regions"}, "Attribute", "Value")
```

So, the transformation function in this example can be defined as follows:

```
each  Table.UnpivotOtherColumns(_, {"Regions"}, "Attribute", "Value")
```

The full formula to unpivot each table in the list is as follows and it results in Figure 9-7.

```
= List.Transform({Table1,Table2,Table3},each  Table.UnpivotOtherColumns(_,
{"Regions"}, "Attribute", "Value"))
```



| | List |
|---|---|
| 1 | Table |
| 2 | Table |
| 3 | Table |

| Regions | Attribute | Value |
|---|---|---|
| Region 1 | Product A | 98 |
| Region 1 | Product B | 45 |
| Region 1 | Product E | 91 |
| Region 2 | Product A | 37 |
| Region 2 | Product B | 71 |
| Region 2 | Product E | 23 |
| Region 3 | Product A | 92 |
| Region 3 | Product B | 39 |
| Region 3 | Product E | 90 |

| Regions | Attribute | Value |
|---|---|---|
| Region 1 | Product A | 90 |
| Region 1 | Product D | 30 |
| Region 1 | Product C | 95 |
| Region 1 | Product E | 74 |
| Region 4 | Product A | 51 |
| Region 4 | Product D | 41 |
| Region 4 | Product C | 80 |
| Region 4 | Product E | 17 |
| Region 3 | Product A | 88 |
| Region 3 | Product D | 37 |
| Region 3 | Product C | 69 |
| Region 3 | Product E | 70 |

| Regions | Attribute | Value |
|---|---|---|
| Region 3 | Product D | 77 |
| Region 3 | Product B | 22 |
| Region 3 | Product E | 37 |
| Region 2 | Product D | 98 |
| Region 2 | Product B | 66 |
| Region 2 | Product E | 59 |
| Region 4 | Product D | 32 |
| Region 4 | Product B | 57 |
| Region 4 | Product E | 29 |

***Figure 9-7*** Transformed version of tables

Based on the examples presented, you can see that `List.Transform()` is a powerful function in Power Query that allows you to apply a `For-Each` loop over items of various types.

## List.TransformMany()

`List.TransformMany()` is an advanced version of `List.Transform()` and can be thought of as two nested `For-Each` loops. For example, in Excel, you might create a `For-Each` loop over the sheets, and inside that loop, define another `For-Each` loop over the cells in a specific range. Similarly, `List.TransformMany()` in Power Query allows you to create a `For-Each` loop over the items in a list. For each item in the list, it creates a nested `For-Each` loop for its sub-collections, applying transformations to each of the sub-items.

This function in Power Query comes with the following syntax:

```
List.TransformMany(
      list as list,
      collectionTransform as function,
      resultTransform as function) as list
```

The arguments of this function are as follows:

- The first argument defines the list of items for the first `For-Each` loop.
- The list of items for the second `For-Each` loop is defined in the second argument. This argument is different than the first one and should be in the type of `function`, which results in a list.
- The third argument is the transformation function that is applied to both items from the first and second lists. Since there are two lists, the transformation function must be a custom function with two arguments, such as `(L1, L2) => F(L1, L2)`, where `L1` comes from the first list (first argument) and `L2` comes from the second list (second argument).

This function returns a list containing the transformed items from both lists.

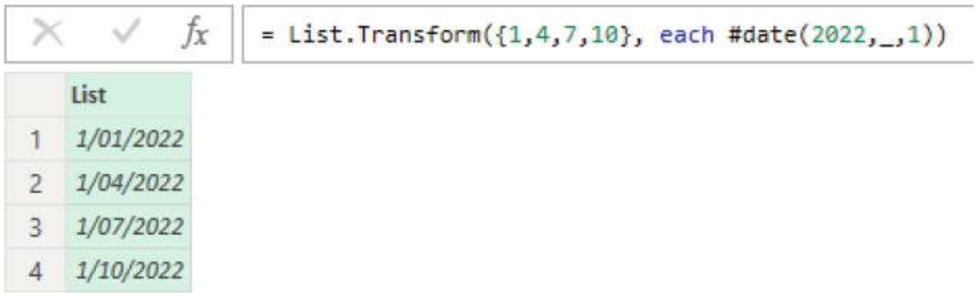
`List.TransformMany()` initially iterates over the items in the first list. For each item in the first list, it then iterates over the items in the second list and applies the transformation function to every combination of items from the first and second lists. This means that `List.TransformMany()` works like two nested `For-Each` loops. In contrast, `List.Transform()` creates a single `For-Each` loop over the items in a list only. Therefore, `List.TransformMany()` is similar to using two nested `List.Transform()` functions. This will become more clear in the following example.

In this example, you want to create the first date of each quarter in the years 2022 to 2025. You have two lists of items: one for the years `{2022..2025}`, and one for the first month of each quarter, `{1, 4, 7, 10}`.

Before solving this problem using `List.TransformMany()`, let's try to solve it by nested `List.Transform()`.

Initially, to extract the first date of each quarter in 2022, you can type the following formula, which results in Figure 9-8.

```
= List.Transform({1,4,7,10}, each #date(2022,_,1))
```



```
= List.Transform({1,4,7,10}, each #date(2022,_,1))
```

|  | List |
|---|---|
| 1 | 1/01/2022 |
| 2 | 1/04/2022 |
| 3 | 1/07/2022 |
| 4 | 1/10/2022 |

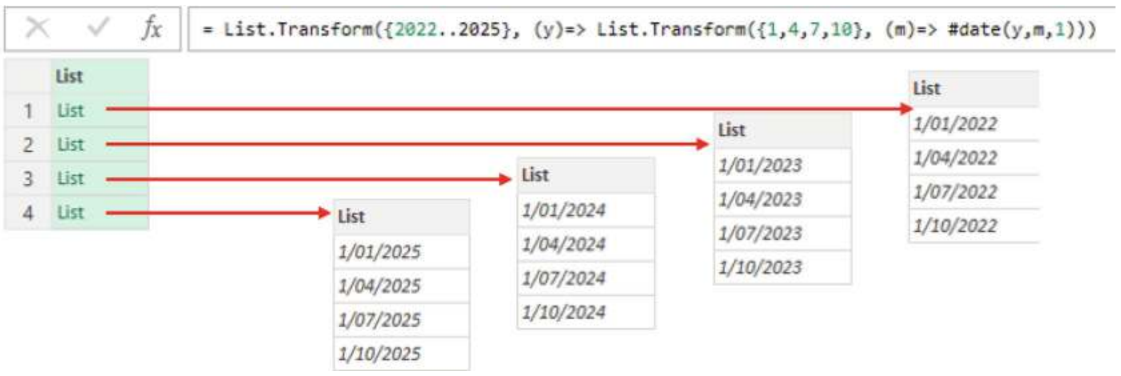
***Figure 9-8*** Extracting the first dates of the quarters using List.Transform()

In the previous formula, you created a loop to iterate over the months using each `#date(2022, _, 1)` as the transformation function. In the next step, you want to add another `List.Transform()` to iterate over the years. However, since you are nesting two `List.Transform()` functions, you cannot use `each _` for both loops (as it is not clear which _ came from the list of years and which one came from the list of months). So, you need to replace the `each _` logic in the previous formula with custom function logic and rewrite it as follows:

```
= List.Transform({1,4,7,10}, (m)=> #date(2022,m,1))
```

To create a loop over the years, you can define another `List.Transform({2022..2025}, (y) => f(y))`, where `y` iterates over the years. This allows you to create a nested loop using the following formula, which results in Figure 9-9.

```
= List.Transform({2022..2025}, (y)=> List.Transform({1,4,7,10}, (m)=>
#date(y,m,1)))
```


```
= List.Transform({2022..2025}, (y)=> List.Transform({1,4,7,10}, (m)=> #date(y,m,1)))
```

| | List |
|---|---|
| 1 | List |
| 2 | List |
| 3 | List |
| 4 | List |

| List |
|---|
| 1/01/2022 |
| 1/04/2022 |
| 1/07/2022 |
| 1/10/2022 |

| List |
|---|
| 1/01/2023 |
| 1/04/2023 |
| 1/07/2023 |
| 1/10/2023 |

| List |
|---|
| 1/01/2024 |
| 1/04/2024 |
| 1/07/2024 |
| 1/10/2024 |

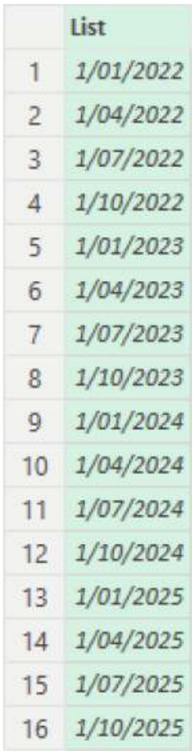
| List |
|---|
| 1/01/2025 |
| 1/04/2025 |
| 1/07/2025 |
| 1/10/2025 |

***Figure 9-9*** The result of a nested List.Transform()

In this case, `y` iterates over the items in the list of years. Initially, `y` becomes `2022`. In the transformation function, for `y = 2022`, `m` will iterate over the list of months. It starts with 1, then goes through 4, 7, and finally 10. For each value of `m` and `y=2022`, `#date(y, m, 1`***)*** will be calculated. So, for `y=2022`, a list of dates will be generated. Then, `y` will be updated to the next value in the list of years and become `2023`. Again, for this value of `y`, `m` will iterate over the months, and four new dates will be generated. This process continues until `y` iterates over all the years in the list.

To combine the results into a single list, you can wrap the formula inside the `List.Combine()` function, as shown in following formula, which results in Figure 9-10.

```
= List.Combine(List.Transform({2022..2025}, (y)=> List.Transform({1,4,7,10},
(m)=> #date(y,m,1))))
```



| | List |
|---|---|
| 1 | 1/01/2022 |
| 2 | 1/04/2022 |
| 3 | 1/07/2022 |
| 4 | 1/10/2022 |
| 5 | 1/01/2023 |
| 6 | 1/04/2023 |
| 7 | 1/07/2023 |
| 8 | 1/10/2023 |
| 9 | 1/01/2024 |
| 10 | 1/04/2024 |
| 11 | 1/07/2024 |
| 12 | 1/10/2024 |
| 13 | 1/01/2025 |
| 14 | 1/04/2025 |
| 15 | 1/07/2025 |
| 16 | 1/10/2025 |

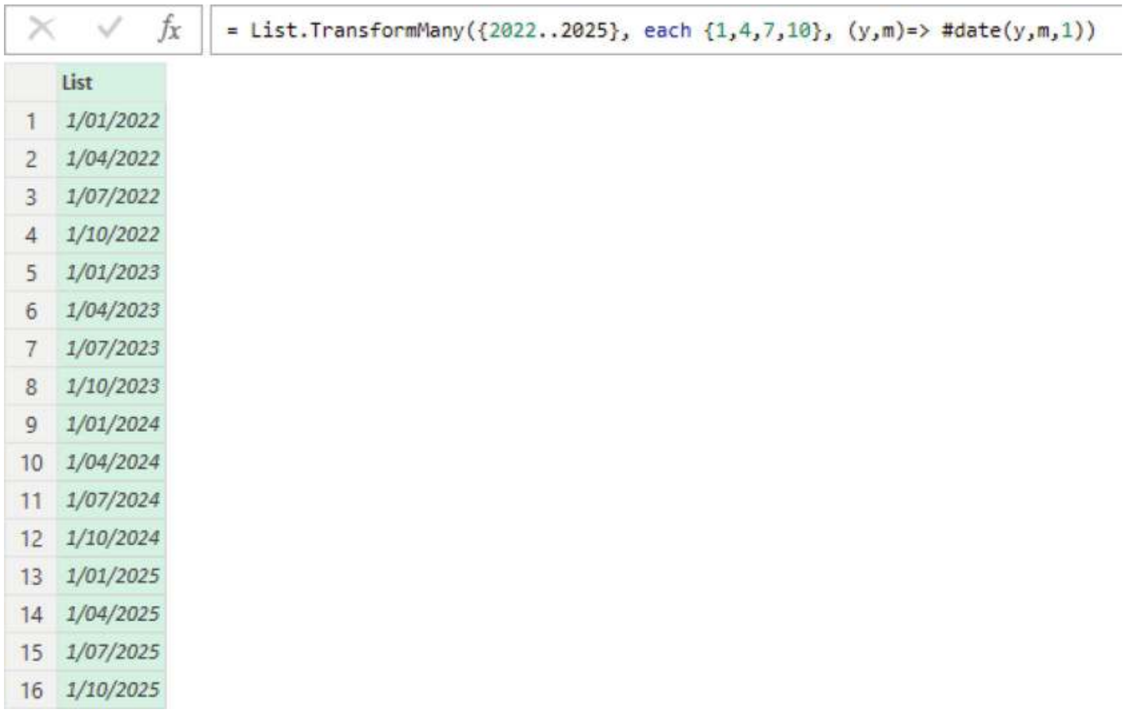
***Figure 9-10*** The result of combining the nested List.Transform()

Instead of using a nested `List.Transform()` and then wrapping it with `List.Combine()`, you can directly use `List.TransformMany()`. In this case, the list of years `{2022..2025}` will be placed in the first argument, and a function that generates the list of months, such as `{1, 4, 7, 10}`, will be placed in the second argument as `each {1, 4, 7, 10}`.

The transformation function can be defined as `(y, m) => f(y, m)`, where `y` iterates over the items in the first list (years) and `m` iterates over the items in the second list (months). So, the transformation function can be defined as `(y,m)=> #date(y,m,1)`.

The formula becomes as follows and using it in the formula bar results in Figure 9-11.

```
= List.TransformMany({2022..2025}, each {1,4,7,10}, (y,m)=> #date(y,m,1))
```



```
= List.TransformMany({2022..2025}, each {1,4,7,10}, (y,m)=> #date(y,m,1))
```

| | List |
|---|---|
| 1 | 1/01/2022 |
| 2 | 1/04/2022 |
| 3 | 1/07/2022 |
| 4 | 1/10/2022 |
| 5 | 1/01/2023 |
| 6 | 1/04/2023 |
| 7 | 1/07/2023 |
| 8 | 1/10/2023 |
| 9 | 1/01/2024 |
| 10 | 1/04/2024 |
| 11 | 1/07/2024 |
| 12 | 1/10/2024 |
| 13 | 1/01/2025 |
| 14 | 1/04/2025 |
| 15 | 1/07/2025 |
| 16 | 1/10/2025 |

***Figure 9-11*** The result of List.TransformMany()

In the presented solution, `y` will iterate over the items in the first list, `{2022..2025}`. For each selected value of `y`, the function in the second argument will be evaluated. In this case, the function is defined as `each {1,4,7,10}`, meaning that regardless of the value of `y`, it will always return the list `{1,4,7,10}`. For the selected `y=2022`, the second list will be generated as `{1,4,7,10}`, and `m` will start iterating over the items in this list. So:

- Iteration 1: `y=2022` and `m=1`, the transformation function produces `#date(2022, 1, 1)`.
- Iteration 2: `y=2022` and `m=4`, the transformation function produces `#date(2022, 4, 1)`.
- Iteration 3: `y=2022` and `m=7`, the transformation function produces `#date(2022, 7, 1)`.
- Iteration 4: `y=2022` and `m=10`, the transformation function produces `#date(2022, 10, 1)`.

At this iteration, `m` is iterated over all the items in the second list. Once `m` finishes iterating, `y` will be updated to the next item in the first list and become `2023`. The second argument will then be evaluated for this selected `y`, but since it is independent of the selected value of `y`, it will still result in `{1,4,7,10}`. `m` will then start iterating over these values again. So, the next iterations are as follows:

- Iteration 5: `y=2023` and `m=1`, the transformation function produces `#date(2023, 1, 1)`.
- Iteration 6: `y=2023` and `m=4`, the transformation function produces `#date(2023, 4, 1)`.
- Iteration 7: `y=2023` and `m=7`, the transformation function produces `#date(2023, 7, 1)`.
- Iteration 8: `y=2023` and `m=10`, the transformation function produces `#date(2023, 10, 1)`.

This process continues for each value of `y` in the `{2022..2025}` list.

In the presented solution, in the second argument of `List.TransformMany()`, you use a function such as `each {1,4,7,10}`, which means that for every item from the first list (every selected `y`), this function should be executed. The result of this function does not depend on the selected item in the first list (selected `y`), and it always returns `{1, 4, 7, 10}`. However, in practice, you may encounter situations where the second list needs to be defined dynamically based on the selected value in the first list.

Let's consider an example where you want to extract all the dates in 2023 using `List.TransformMany()`. The first list you should iterate over is the list of months `{1..12}`, and the second list is the list of days. However, the number of days varies in each month. For the first month (January), the list of days is `{1..31}` and for the second month (February), the list is `{1..28}`. Therefore, the second list is dependent on the value selected from the first list.

**Note** While there may be more efficient solutions for generating a list of all dates in a year, I use this example simply to explore the capabilities of `List.TransformMany()`.

In this example, the first argument for the `List.TransformMany()` function is the list of months `{1..12}` representing each month in the year. The second argument requires a function that generates a list of days based on the selected month. For instance:

– If the first item (January) is selected, the list should be `{1..31}`.
– If the second item (February) is selected, the list should be `{1..28}`, and so on for the other months.

To achieve this, you can use `Date.DaysInMonth(#date(2023, _, 1))` in the second argument to get the number of days in the selected month. However, this results in a number (e.g., 31 for January or 28 for February), but you need a value in the type of `list` in this argument. To create this list, you can define the second argument as follows:

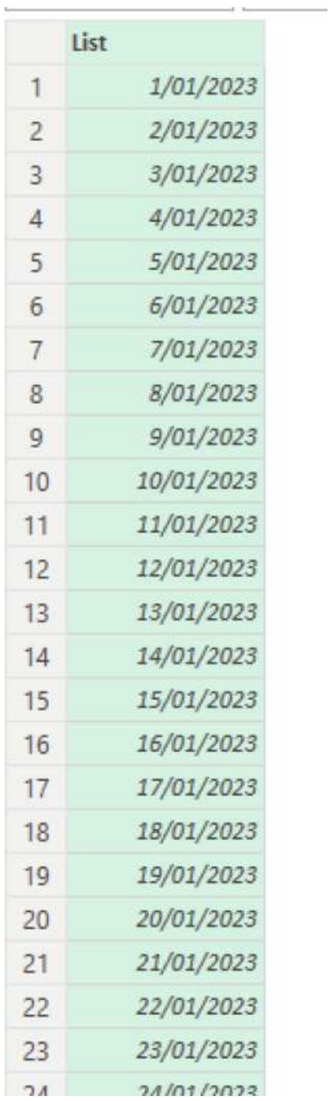
```
each {1..Date.DaysInMonth(#date(2023,_,1))}
```

In this case, the selected item from the first list is represented by _. If `_ = 1`, that means the selected month is January, so the second argument will result in `{1..31}` (the number of days in January). If `_ = 2`, this means the selected month is February, and the second argument will result in `{1..28}` (the number of days in February).

This dynamic selection based on the month number will ensure that the correct number of days is generated for each month in the second argument.

After defining the first two arguments, the third argument can be defined as `(m, d) => #date(2023, m, d)`, where `m` iterates over the items in the first list (the months) and `d` iterates over the items in the second list (the days in each month). With this setup, writing the following formula in the formula bar will generate a list of all the dates in 2023, as shown in Figure 9-12.

```
= List.TransformMany({1..12}, each {1..Date.DaysInMonth(#date(2023,_,1))},
(m,d)=> #date(2023,m,d))
```



| | List |
|---|---|
| 1 | 1/01/2023 |
| 2 | 2/01/2023 |
| 3 | 3/01/2023 |
| 4 | 4/01/2023 |
| 5 | 5/01/2023 |
| 6 | 6/01/2023 |
| 7 | 7/01/2023 |
| 8 | 8/01/2023 |
| 9 | 9/01/2023 |
| 10 | 10/01/2023 |
| 11 | 11/01/2023 |
| 12 | 12/01/2023 |
| 13 | 13/01/2023 |
| 14 | 14/01/2023 |
| 15 | 15/01/2023 |
| 16 | 16/01/2023 |
| 17 | 17/01/2023 |
| 18 | 18/01/2023 |
| 19 | 19/01/2023 |
| 20 | 20/01/2023 |
| 21 | 21/01/2023 |
| 22 | 22/01/2023 |
| 23 | 23/01/2023 |
| 24 | 24/01/2023 |

***Figure 9-12*** Extracting dates in a year using List.TransformMany()

## List.Accumulate()

`List.Accumulate()` is another function in Power Query that's used to perform a `For-Each` loop, similar to `List.Transform()`. However, the key difference is that, while `List.Transform()` produces separate, independent results for each iteration, `List.Accumulate()` allows you to aggregate (or combine) the results in different ways during the iteration.

Like other list functions, `List.Accumulate()` doesn't have a built-in graphical interface and must be written manually. It uses the following syntax:

```
List.Accumulate(list as list, seed as any, accumulator as function) as any
```

As proposed by its syntax, this function receives three arguments:

- Similar to `List.Transform()`, the first argument in `List.Accumulate()` is a list, which contains the items that you want to iterate over.
- With `List.Accumulate()`, the results of each iteration are combined into a defined variable, starting with an initial value. This initial value, known as the *seed*, is defined in the second argument of the function. The seed can be a number, record, list, or even a table.

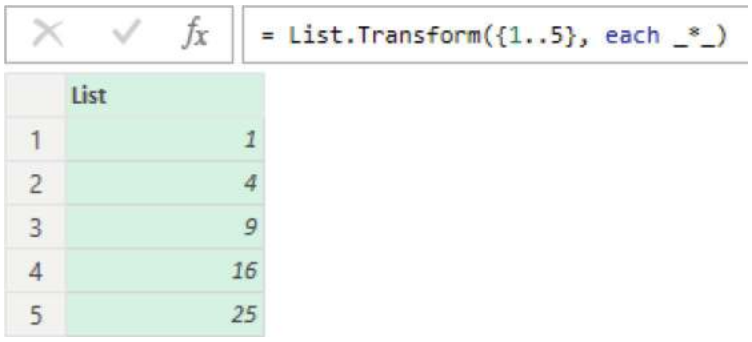
– The third argument is an accumulator, which is a custom function that takes two inputs, typically written as (s, c) => f(s, c). Here, s represents the state, and c represents the current value. This accumulator function is applied to each iteration to determine how the results of iterations should be combined. In the first iteration, s starts with the seed value, and c is the first item in the list (from the first argument). The function f(s, c) is evaluated and updates s with the result. For each subsequent iteration, s is replaced with the updated value from the previous iteration, and c becomes the next item in the list. This process continues until c has iterated over all the items in the list, and the final value of f(s, c) is returned as the result.

This function can produce any type of value, but in most cases, the result will have the same type as the seed (the second argument). This is because the seed value defines the starting type for the accumulation process, and the accumulator function (f(s, c)) ensures that the state (s) is updated in a way that maintains this type consistency throughout the iterations.

As presented, List.Accumulate() and List.Transform() both perform a For-Each loop over the items in the list defined in their first argument. The difference is that in List.Transform(), the result of each iteration is independent, while in List.Accumulate(), the results of each iteration can be combined. To explore this difference, calculate the sum of the squares of values from 1 to 5 using both functions.

Using List.Transform(), you can define the list of numbers as {1..5}, iterate over them, and calculate the square of each number (see Figure 9-13):

```
=List.Transform({1..5}, each _*_)
```



```
= List.Transform({1..5}, each _*_)
```

| | List |
|---|---|
| 1 | 1 |
| 2 | 4 |
| 3 | 9 |
| 4 | 16 |
| 5 | 25 |

***Figure 9-13*** Extracting the square of 1 to 5 using List.Transform()

In the formula, a For-Each loop is defined over the items in the {1..5} list, and then the transformation function each _ * _ is applied to each item independently. To sum the transformed values, you need to use List.Sum() to calculate the sum of the squares of the numbers. The formula would be rewritten as following:

```
=List.Sum(List.Transform({1..5}, each _*_))
```

Using List.Accumulate(), you can combine (in this case, sum) the results of iterations. You do not need to transform the values first and then use List.Sum() to calculate the sum of transformed values.

To use List.Accumulate() in this example, you want to iterate over the {1..5} list, so the first argument is {1..5}. You aim to sum the results of the iterations, and this sum will be stored in a variable. The initial value of this variable is defined in the second argument (the *seed*). So, the initial value of the variable can be defined as 0.

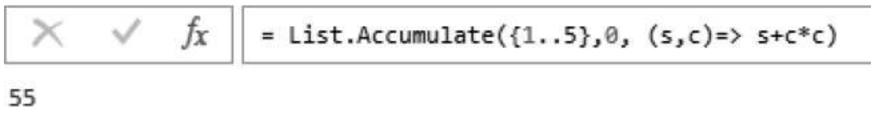
You now define the accumulator function as (s, c) => f(s, c). Here:

– s represents the accumulated value, starting at 0.
– c is the current item in the {1..5} list.

For each iteration, you want to add the square of the current item (c * c) to the accumulated value s. The f(s, c) function is defined as s + c * c. This ensures that, for each iteration, the square of the current value of c will be added to s.

Using the following formula in the formula bar, you can solve the problem, as shown in Figure 9-14.

```
= List.Accumulate({1..5},0, (s,c)=> s+c*c)
```



```
= List.Accumulate({1..5},0, (s,c)=> s+c*c)
```

```
55
```

***Figure 9-14*** Extracting the square of 1 to 5 using List.Accumulate()

In this formula, the initial value of the seed is 0, so the accumulator function starts with s = 0. The variable c iterates over the items in the {1..5} list, and in each iteration, the function (s, c) => s + c * c is applied.

- In the first iteration, s is 0 and c is 1 (the first item in the list). The function calculates 0 + 1 * 1 = 1, so the value of s becomes 1. This updated value of s is then used in the next iteration.
- In the second iteration, s is 1 and c is 2 (the second item in the list). The function calculates 1 + 2 * 2 = 5, so the value of s becomes 5.
- In the third iteration, s is 5 and c is 3. The function calculates 5 + 3 * 3 = 14, so s becomes 14.
- In the fourth iteration, s is 14, and c is 4. The function calculates 14 + 4 * 4 = 30, updating s to 30.
- Finally, in the fifth iteration, s is 30 and c is 5. The function calculates 30 + 5 * 5 = 55, giving the final value of s as 55.

At the end of all iterations, the final result of the List.Accumulate() function is 55. This process is summarized in Table 9-1.

***Table 9-1*** Iterations

| Iteration Number | s | c | s+c*c |
|---|---|---|---|
| 1 | 0 | 1 | 1 |
| 2 | 1 | 2 | 1+2*2=5 |
| 3 | 5 | 3 | 5+3*3=14 |
| 4 | 14 | 4 | 14+4*4=30 |
| 5 | 30 | 5 | 30+5*5=55 |

**Note** In the previous example, if you want to save the result of each iteration separately, you can use the List.Accumulate() function with a different seed and accumulator function. In this case, the initial value of the seed should be defined as a blank list {}, and in each iteration, a new item (the result of transforming items in the list in the first argument) should be added to it.

To achieve this, instead of summing the result of c * c with s, you convert the result of c * c into a list and combine it with s, which is now a list. This can be done using the accumulator function (s, c) => s & { c * c }. The operator & is used to append the result of each iteration to the accumulated list s.

You can use this formula:

```
= List.Accumulate({1..5},{}, (s,c)=> s & {c*c})
```

It is true that List.Accumulate() iterates over the item in the list entered in its first argument, like a For-Each loop, but it can also be used to simulate a For-Next loop. For example, say you have a variable x equal to 2 and you want to repeatedly square it for five iterations. In other words, you want to calculate x = x * x repeatedly for five steps.

You can accomplish this using List.Accumulate() by defining a list with five elements (e.g., {1..5}), which will act as the counter for the loop. The initial value of x is set as the seed, so the seed will be 2. Then, the transformation function (s, c) => f(s, c) can be defined as (s, c) => s * s, where `s` is the current value of `x`, and `c` iterates through the list (though in this case `c` is not being used, as you are just repeating the operation).

You can type the following formula in the formula bar to solve this problem:

```
= List.Accumulate({1..5},2, (s,c)=> s*s)
```

This formula will start with `s = 2` (the seed value), and in each iteration, `s` will be squared. It passes five iterations as presented here:

Iteration 1: `s = 2`, so `s * s = 2 * 2 = 4`
Iteration 2: `s = 4`, so `s * s = 4 * 4 = 16`
Iteration 3: `s = 16`, so `s * s = 16 * 16 = 256`
Iteration 4: `s = 256`, so `s * s = 256 * 256 = 65536`
Iteration 5: `s = 65536`, so `s * s = 65536 * 65536 = 4294967296`

The result of five iterations is `4294967296`.

## List.Generate()

`List.Generate()` is another function in Power Query used to create loops. Unlike the previous functions (`List.Transform()` and `List.Accumulate()`), which iterate over a fixed set of items, `List.Generate()` allows you to create a `Do-While` loop. This means the loop will continue to iterate until a specified condition is met. If you are unsure about the number of iterations, you can use this function to define a stop condition.

The function syntax is:

```
List.Generate(
      initial as function,
      condition as function,
      next as function,
      optional selector as nullable function) as list
```

This function takes four arguments, all of which are functions, with the following specific applications:

– The first argument, called `initial`, defines the starting value or state of the loop. It is a function with no input variables, and it is defined as `()=>`. For example, `()=>0` sets the initial value to `0`.
– The second argument, called `condition`, is a function with one input parameter, which is the result from the previous iteration. This function is evaluated to determine whether the loop should continue or stop. The condition returns `true` to continue the loop and `false` to stop it. For example, `each _ < 5` means the loop continues if the result of the previous iteration is less than five; otherwise, the loop stops, and the result is returned.
– The third argument, called `next`, is a function with one input parameter. It receives the result from the previous iteration and updates it based on the defined logic. For example, `each _ + 1` adds one to the result of the previous iteration for the next iteration.
– The fourth argument, called `selector`, is optional. If provided, it applies a transformation or selection process to the final output of each iteration. If it's not provided, the current value of the iteration is used. This function determines what is added to the resulting list.

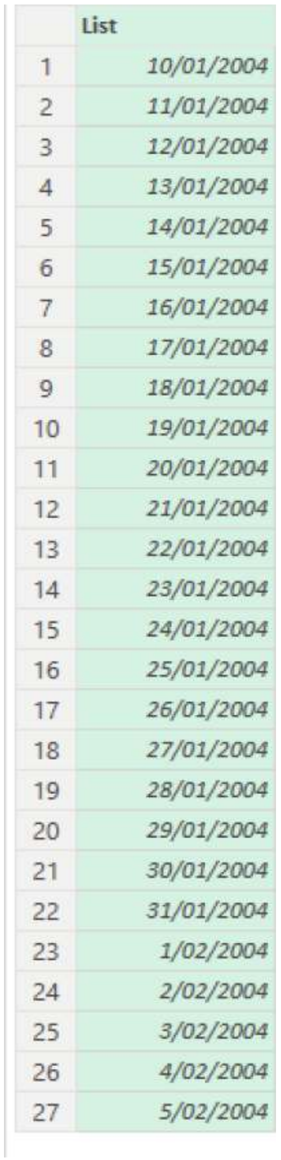
To demonstrate how to use `List.Generate()`, in the first example, you'll use it to extract all the dates between two specific dates, such as `#date(2004, 1, 10)` and `#date(2004, 2, 05)`. Follow these steps:

– In this case, the loop should start at `#date(2004, 1, 10)`, so the first argument will be `()=> #date(2004, 1, 10)`.
– The loop should continue until you reach a date larger than `#date(2004, 2, 05)`. So, the second argument (the condition) will be `each _ <= #date(2004, 2, 05)`.
– In each iteration, you need to calculate the next date by adding one day to the current date. This can be done using the `Date.AddDays()` function, so the third argument will be `each Date.AddDays(_,`

```
1).
```

The formula can be written as follows, and this will generate the list of dates shown in Figure 9-15:

```
= List.Generate(()=> #date(2004, 1, 10),each _ <= #date(2004, 2, 05) , each
Date.AddDays(_,1))
```



| | List |
|---|---|
| 1 | 10/01/2004 |
| 2 | 11/01/2004 |
| 3 | 12/01/2004 |
| 4 | 13/01/2004 |
| 5 | 14/01/2004 |
| 6 | 15/01/2004 |
| 7 | 16/01/2004 |
| 8 | 17/01/2004 |
| 9 | 18/01/2004 |
| 10 | 19/01/2004 |
| 11 | 20/01/2004 |
| 12 | 21/01/2004 |
| 13 | 22/01/2004 |
| 14 | 23/01/2004 |
| 15 | 24/01/2004 |
| 16 | 25/01/2004 |
| 17 | 26/01/2004 |
| 18 | 27/01/2004 |
| 19 | 28/01/2004 |
| 20 | 29/01/2004 |
| 21 | 30/01/2004 |
| 22 | 31/01/2004 |
| 23 | 1/02/2004 |
| 24 | 2/02/2004 |
| 25 | 3/02/2004 |
| 26 | 4/02/2004 |
| 27 | 5/02/2004 |

***Figure 9-15*** Extracting dates using List.Generate()

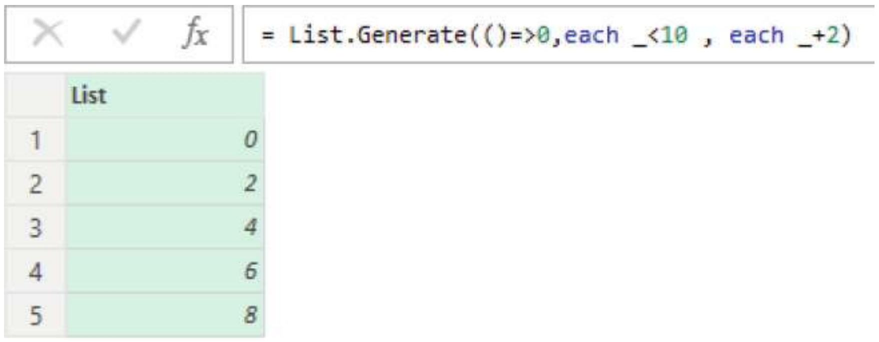
**Note** In the previous solution, instead of using `Date.AddDays()`, you can use other functions like `Date.AddWeeks()`, `Date.AddMonths()`, `Date.AddQuarters()`, and `Date.AddYears()` to generate a date list with different levels of granularity. For example, using `Date.AddWeeks(_,1)` will create a list of dates increasing by one week, while `Date.AddMonths(_,1)` will generate a list of dates increasing by one month.

As another example, say you want to extract all even numbers starting at 0 but less than 10 using `List.Generate()`. The parameters for this function are as follows:

- Initial value: Since you start at `0`, the first argument is `()=>0`.
- Condition: The loop should continue as long as the value remains less than 10, so the second argument is `each _ < 10`.
- Next value: In each iteration, you need to generate the next even number by adding two to the previous value, so the third argument is `each _ + 2`.

The formula can be written as follows, and it results in a list of even numbers from 0 to 8, as shown in Figure 9-16:

```
=List.Generate(()=>0,each _<10 , each _+2)
```



```
= List.Generate(()=>0,each _<10 , each _+2)
```

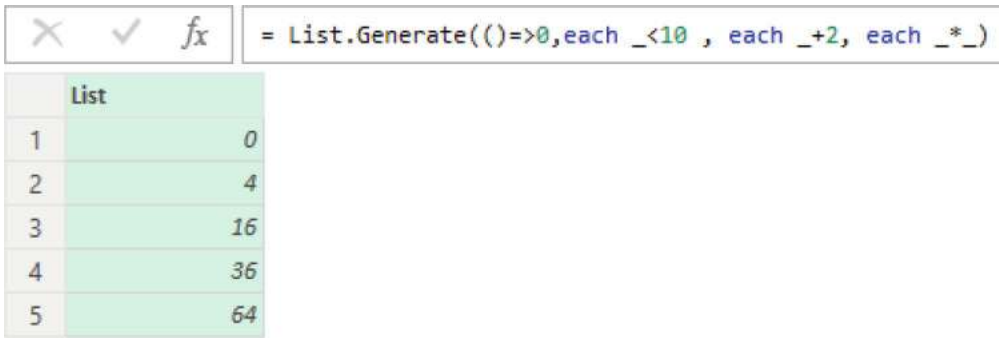
|   | List |
|---|---|
| 1 | 0 |
| 2 | 2 |
| 3 | 4 |
| 4 | 6 |
| 5 | 8 |

***Figure 9-16*** Extracting even numbers less than 10 using List.Generate()

In the previous example, if you wanted to extract the square values of even numbers less than 10, you could use the fourth argument (selector) in the previous formula. You define it as `each _ * _`, which means that after applying the loop, instead of displaying the iteration results directly, show their squares as the final output.

The revised formula is as follows, and it results in a list of squared even numbers as shown in Figure 9-17:

```
= List.Generate(()=>0,each _<10 , each _+2, each _*_)
```



```
= List.Generate(()=>0,each _<10 , each _+2, each _*_)
```

|   | List |
|---|---|
| 1 | 0 |
| 2 | 4 |
| 3 | 16 |
| 4 | 36 |
| 5 | 64 |

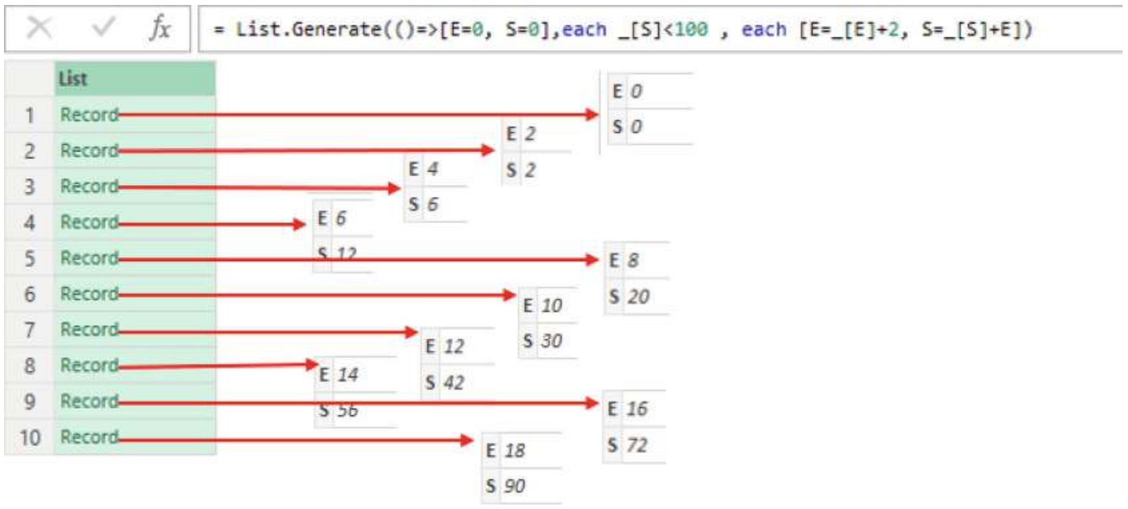
***Figure 9-17*** Extracting the square of even numbers less than 10 using List.Generate()

Again using the previous example, say you wanted to generate a list of even numbers starting at `0` and continuing until the sum of the extracted values reaches `100`. To achieve this, you need to track two values simultaneously—the current even number, (call it `E`) and the cumulative sum of the previous even numbers (call it `S`). Thus, you would define the arguments as follows:

- The initial value should be a record containing both `E` and `S`, defined as `()=> [E=0, S=0]`.
- The stop condition is based on `S`, because the loop should continue as long as `S` is less than `100`. The second argument is therefore `each _[S] < 100`.
- The iteration step updates both values: `E` increases by `2`, and `S` is updated by adding the new `E`. This is expressed as `each [E = _[E] + 2, S = _[S] + _[E]]`.

Using these parameters, the formula can be written as follows, and it results in a list including the records, as shown in Figure 9-18.

```
= List.Generate(()=>[E=0, S=0],each _[S]<100 , each [E=_[E]+2, S=_[S]+E])
```

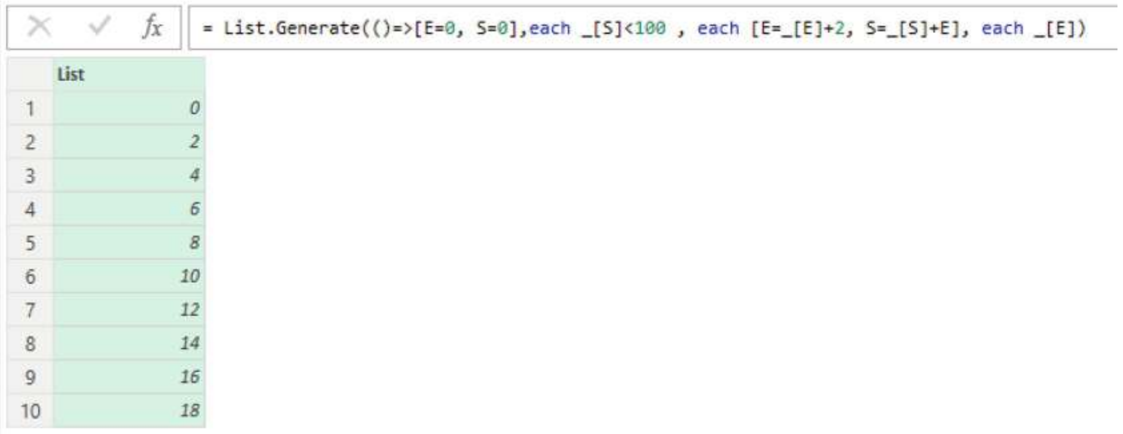

= List.Generate(()=>[E=0, S=0],each _[S]<100 , each [E=_[E]+2, S=_[S]+E])

| | List |
|---|---|
| 1 | Record |
| 2 | Record |
| 3 | Record |
| 4 | Record |
| 5 | Record |
| 6 | Record |
| 7 | Record |
| 8 | Record |
| 9 | Record |
| 10 | Record |

***Figure 9-18*** Extracting even numbers with a sum less than 100 using List.Generate()

Since you only need the even numbers as output, and the sum (`S`) is used only for the stop condition, and you can utilize the fourth argument (selector) of `List.Generate()` to return only the `E` values. This simplifies the formula as follows, which results in Figure 9-19.

```
= List.Generate(()=>[E=0, S=0],each _[S]<100 , each [E=_[E]+2, S=_[S]+E],
each _[E])
```


= List.Generate(()=>[E=0, S=0],each _[S]<100 , each [E=_[E]+2, S=_[S]+E], each _[E])

| | List |
|---|---|
| 1 | 0 |
| 2 | 2 |
| 3 | 4 |
| 4 | 6 |
| 5 | 8 |
| 6 | 10 |
| 7 | 12 |
| 8 | 14 |
| 9 | 16 |
| 10 | 18 |

***Figure 9-19*** Extracting the even numbers using List.Generate()

The remainder of this chapter explores all the hidden features of these remarkable functions.

## Running Totals by List.Accumulate()

Calculate the running total for items in the Source list `{1, 10, 50, 100, 150}` using the `List.Accumulate()` function.

You can solve this problem using `List.Accumulate()` in different ways, and two possible solutions are provided here. In both solutions, based on the question, the result of the formula should be in the type of list equal to {1, 11, 61, 161, 311}. Therefore, it is better to use an item in the type of list in the second argument of List.Accumulate().

## Solution 1: Based on the For-Each Loop

In this first solution, you use a For-Each loop approach, where the Source list is directly used as the first argument of List.Accumulate(). The seed is initialized as {0}, and in each iteration, a new item is added to the seed. This new item is calculated as the sum of the current item from the Source list and the last item in the seed. So, in the iterations seed is updated as follows:

- Iteration 1: The seed becomes {0, 0 + 1} → {0, 1}
- Iteration 2: It becomes {0, 1, 1 + 10} → {0, 1, 11}
- Iteration 3: It becomes {0, 1, 11, 11 + 50} → {0, 1, 11, 61}

This process continues for the remaining items in the Source list.

In the formula, the first argument is the Source list and the second argument (seed) is {0}. Now it is time to define the accumulator function in the form (s, c) => f(s, c). To determine f(s, c), consider the first iteration:

- s represents the current state and is {0}
- c is the first element of the Source list, which is 1
- f(s, c) should produce {0, 1}

The result of f(s, c) is equal to adding a new item (1) to the s, and this new item is calculated as the sum of the last item in s (0) and the value of c (1). So, in general, the formula is f(s, c) is s & {List.Last(s) + c}, which ensures that each new value is derived from the sum of the last item in s and the current item c. Using this approach, the formula to solve this problem is as follows. Using this formula in the formula bar results in {0, 1, 11, 61, 161, 311}:

```
= List.Accumulate(Source,{0},(s,c)=>s & {List.Last(s)+c})
```

To remove the first item in the result {0, 1, 11, 61, 161, 311}, the formula can be modified using the List.Skip() function. This function removes the first item from the resulting list, ensuring that the final output starts with the desired values. By applying this change, the final result becomes {1, 11, 61, 161, 311}.

```
= List.Skip(List.Accumulate(Source,{0},(s,c)=>s & {List.Last(s)+c}))
```

While the previous formula solves the problem, it initially adds 0 to the list by defining the seed as {0}, and removes it later using the List.Skip() function. Instead of this approach, you can redefine the seed as an empty list {} from the beginning. However, doing so introduces a challenge: in the first iteration, List.Last(s) returns null since s is empty, causing all subsequent calculations to also result in null.

To handle this, you can replace null with 0 using List.Last(s) ?? 0 or using the second argument in the List.Last() function as List.Last(s,0). This ensures that when s is empty, List.Last() returns 0 instead of null, preventing errors in the calculations. By applying this adjustment and writing the formula as follows in the formula bar, you achieve the same final result without needing to add and later remove an extra value.

```
= List.Accumulate(Source,{},(s,c)=>s & {List.Last(s,0)+c})
```

In this formula, during each iteration, the last value of s (which represents the accumulated value from the previous iteration) is retrieved using List.Last(s,0), then added to c (the next value in the Source list). The result is then converted to a list and appended to s. Since the initial value of s is {}, using List.Last(s) will return null in the first iteration, while using List.Last(s,0) returns 0 instead of null.

The iterations of this formula are detailed in Table 9-2.

***Table 9-2*** Iterations of List.Accumulate

| iteration | s | c | List.Last(s)??0 | {List.Last(s,0)+c} | s&{List.Last(s,0)+c} |
|---|---|---|---|---|---|
| 1 | {} | 1 | 0 | {1} | {1} |
| 2 | {1} | 10 | 1 | {11} | {1,11} |
| 3 | {1,11} | 50 | 11 | {61} | {1,11,61] |
| 4 | {1,11,61] | 100 | 61 | {161} | {1,11,61,161} |
| 5 | {1,11,61,161} | 150 | 161 | {311} | {1,11,61,161,311} |

## Solution 2: Based on the For-Next Loop

In this second scenario, you use a `For-Next` loop approach. Here, the iterator is `c`, and for each value of `c`, you calculate the sum of the first `c` items in the Source list. For example, if `c` is equal to `3` (the third iteration), you extract the sum of the first three items, such as `List.Sum({1, 10, 50})`, which is equal to `List.Sum(List.FirstN(Source,c))`.

Since the Source list contains five items, the counter should start at 1 and end at 5, meaning the first input is `{1..5}`. The second input should match the type of the result, so it is initialized as an empty list `{}`.

For the accumulator function `(s, c) => f(s, c)`, in each iteration, you concatenate the list `s` with the sum of the first `c` items from the Source list. This can be expressed as `s & {List.Sum(List.FirstN(Source, c))}`.

The whole formula can be written as follows:

```
= List.Accumulate({1..5},{},(s,c)=>s&{List.Sum(List.FirstN(Source,c+1))})
```

Since the dimension of the Source might vary in different examples, instead of hardcoded values, the first argument can be rewritten using `List.Positions(Source)`, which results in `{0..4}`. Because the replaced list starts at `0`, in the revised formula, `c` should be replaced with `c+1` in the accumulator argument, and the revised formula will be:

```
= List.Accumulate(List.Positions(Source),{},(s,c)=>s&
{List.Sum(List.FirstN(Source,c+1))})
```

Table 9-3 illustrates the result of this formula across different iterations.

***Table 9-3*** Iterations of List.Accumulate

| iteration | s | c | List.FirstN(Source,c+1) | {List.Sum(....)} | s&{List.Sum(....)} |
|---|---|---|---|---|---|
| 1 | {} | 0 | {1} | {1} | {1} |
| 2 | {1} | 1 | {1,10} | {11} | {1,11} |
| 3 | {1,11} | 2 | {1,10,50} | {61} | {1,11,61] |
| 4 | {1,11,61] | 3 | {1,10,50,100} | {161} | {1,11,61,161} |
| 5 | {1,11,61,161} | 4 | {1,10,50,100,150} | {311} | {1,11,61,161,311} |

**Note** For those familiar with VBA, in the second solution, `c` acts as a counter ranging from 0 to 4, similar to `For c = 1 To 4`. In contrast, in the first solution, `c` represents the elements within the Source list, analogous to `For c In Range` in VBA.

**Efficiency Tip** Let's evaluate the performance of the formula proposed in Solution 1. For a list with 4,000 items, the first solution (without using `List.Buffer()`) takes 137 seconds to execute, which is too long. However, applying `List.Buffer()` to the source list (e.g., `Source = List.Buffer({1..4000})`) outside of the `List.Accumulate()` arguments does not significantly impact execution time, as the Source list is just used once in the first argument of the formula and is not directly part of the accumulator function (third argument).

In contrast, using `List.Buffer()` in the third argument of `List.Accumulate()`, and then rewriting the formula as follows, reduces the execution time to under one second.

```
= List.Accumulate(Source,{},(s,c)=>List.Buffer(s & {List.Last(s,0)+c}))
```

On the other hand, Solution 2, without using `List.Buffer()`, outperformed solution 1, but as the Source list is called several times in the accumulator functions in this solution, using `List.Buffer()` for the source list can improve its execution time.

---

## Running Totals by List.Generate()

Calculate the running total using `List.Generate` from the Source list `{1, 10, 50, 100, 150}`.

You can solve this problem by creating a loop using `List.Generate()`. Two different solutions—a basic one and an efficient one—are provided using the `List.Generate()` function.

### Solution 1: Basic Option

In this approach, in the `List.Generate()`, the counter starts at `1`, so the first argument of `List.Generate()` is defined as `()=>1`. In each iteration, the counter is incremented by one, making the third argument `each _ + 1`. Since the source list contains five items, the loop should runs five times. Therefore, the second argument of the function can be defined as `each _ <= 5` or more dynamically as `each _ <= List.Count(Source)`.

Using these arguments inside the `List.Generate()` function will create a loop starting at `1` and ending at `5`, resulting in `{1, 2, 3, 4, 5}`.

```
= List.Generate(
      ()=>1,
      each _<=List.Count(Source),
      each _+1)
```

In this example, instead of returning the value of `i` in each iteration, you want to extract the sum of the first `i` items in the Source list. To achieve this, you need to convert `i` into the sum of the first `i` items from the Source list. This can be done by using `List.Sum(List.FirstN(Source, _))` as the fourth argument of the `List.Generate()` function. By applying this modification and rewriting the formula as follows, you get the result as `{1, 11, 61, 161, 311}`.

```
= List.Generate(
      ()=>1,
      each _<=List.Count(Source),
      each _+1,
      each List.Sum(List.FirstN(Source, _)))
```

### Solution 2: Efficient Option

The previous solution solves the problem, but it is not the most efficient approach for handling large datasets. As shown, in each iteration, the cumulative sum is calculated separately from scratch. For example, in the 1,000th iteration, the sum of the first 1,000 items in the list is computed, even though the sum of the first 999 items was already determined in the previous iteration. This redundant recalculation increases computational cost significantly.

Instead of recomputing the sum each time, you can optimize the approach by using the previously calculated sum to determine the next value, reducing unnecessary calculations and improving performance.

In this solution, each iteration requires two values: `C`, which represents the iteration index (counter), and `M`, which represents the sum of the first `C` items in the source list. To save the information of `C` and `M` into each iteration, you can use a record with two fields called `C` and `M`.

The initial value of `C` is `1`, and in each iteration, `C` is incremented by one. The initial value of `M` is `Source{0}`, and in each iteration, `M` is updated by adding the `Cth` item from the source list to its previous value.

Based on these initial values, the first argument of `List.Generate()` is defined as follows:

```
()=>[C=1, M=Source{0}]
```

As in the previous solution, the number of iterations is limited to `List.Count(Source)`. However, since `C` and `M` are both maintained in each iteration, the second argument is defined as follows:

```
each [C] <= List.Count(Source)
```

Additionally, as `C` is incremented by one and `M` is updated by adding `Source{[C]}`, the third argument is defined as follows:

```
each [C=[C]+1, M=[M] + Source{[C]}]
```

By inserting these arguments into `List.Generate()`, the final formula will produce the result shown in Figure 9-20.

```
= List.Generate(
      ()=>[C=1,M=Source{0}],
      each [C]<=List.Count(Source),
      each [C=[C]+1,M=[M]+Source{[C]}])
```

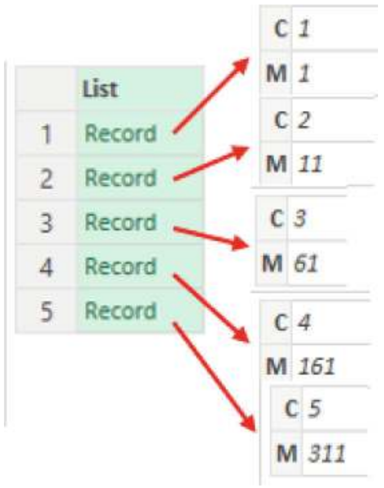


***Figure 9-20*** The result of List.Generate()

In the formula used here, the `C` and `M` values are both maintained and updated during each iteration. The result of this formula is a list containing records, with each record having two fields: `C` and `M`.

Since you are interested in extracting the values of `M` from the output, you can use the fourth argument of the `List.Generate()` function to select the `M` value from each record. This can be done by referring to `[M]` in the fourth argument.

To update the formula, which extracts only the `M` values from the result, the formula can be rewritten as follows. This will result in the output `{1, 11, 61, 161, 311}`, as expected.

```
= List.Generate(
      ()=>[C=1,M=Source{0}],
      each [C]<=List.Count(Source),
      each [C=[C]+1,M=[M]+Source{[C]}],
      each [M])
```

In this formula, as shown in the third argument of the `List.Generate()` function, the value of `M` is updated by adding `Source{[C]}` to the previous value of `M`. This approach eliminates the need to recalculate the sum of the first `C` items from the Source list for each iteration.

Instead of calculating the sum from scratch in each iteration, the formula efficiently builds the cumulative sum by adding the current item from the Source list to the running total. This significantly improves performance, especially for larger datasets, since only the new item in each iteration is added to the previous cumulative sum.

**Note** Instead of using a record to store the values of `C` and `M` in the previous solution, you can use a list with two items. The first item will represent `C`, and the second item will represent `M`. This approach simplifies the structure. The formula can be rewritten as follows, yielding the same result.

```
= List.Generate(
      ()=>{1,Source{0}},
      each _{0}<=List.Count(Source),
      each {_{0}+1,_{1}+Source{_{0}}},
      each _{1})
```

## Calculating the Running Total by List.Transform()

Calculate the running total using `List.Transform()` from the Source list `{1, 10, 50, 100, 150}`.

Besides using `List.Accumulate()` and `List.Generate()`, this problem can also be solved with the `List.Transform()` function. In this case, for each item in the list defined in the first argument, the transformation function will be applied.

If you define the first argument as `{1..5}`, the transformation function should replace each number `n` in this list with the sum of the first *n* items in the Source list. For this, you can use `each List.Sum(List.FirstN(Source, _))` as a transformation function, where the underscore _ represents the current item in the list.

Using the following formula in the formula bar will solve the problem:

```
= List.Transform(List.Positions(Source), each List.Sum(List.FirstN(Source,
_+1)))
```

In the previous formula, the first argument is hardcoded as `{1..5}`, which can be replaced with `List.Positions(Source)` to dynamically handle the position of each item in the list. The formula can be rewritten as follows:

```
= List.Transform(List.Positions(Source), each List.Sum(List.FirstN(Source,
_+1)))
```

## Generating the Fibonacci Sequence by List.Accumulate()

Calculate the first ten terms of the Fibonacci sequence using `List.Accumulate()`.

**Note** for more information about the Fibonacci sequence, visit this page: `www.mathsisfun.com/numbers/fibonacci-sequence.html`.

In the Fibonacci sequence, the initial values are $x_0$ =0 and $x_1$ =1. Each subsequent term is the sum of the two preceding terms: So $x_2=x_0+x_1=1$ and $x_3=x_2+x_1=2$ and so on, where $x_n=x_{n-1}+x_{n-2}$.

Since you are looking for the first ten numbers in the Fibonacci sequence in the form of a list, it is convenient to define the seed as a list, and as you know the first two numbers in the sequence, you can define the seed as `{0, 1}`. In the process of using `List.Accumulate()` to solve this problem, starting with the initial values `{0, 1}` as the seed, you calculate the next Fibonacci number in each iteration and update the seed accordingly.

In the Fibonacci sequence, each number is the sum of the two preceding numbers. Therefore, the next number can be calculated using `List.Sum(List.LastN(s, 2))`, where `s` represents the current state.

To continue the process, this value should be added to the list of previous numbers. Thus, the accumulator function can be written as follows.

```
(s,c)=>s&{List.Sum(List.LastN(s,2))}
```

On the other hand, with each run of the accumulator, a new number in the sequence is calculated and added. Since the seed includes the first two items of the sequence, to extract the first ten numbers, you need to iterate this process ten times. Therefore, the first argument can be any list with a length of eight, such as `{1..8}`. The whole formula to solve this problem is as follows. It results in `{0,1,1,2,3,5,8,13,34}`.

```
= List.Accumulate(
      {1..8},
      {0,1},
      (x,y)=>x&{List.Sum(List.LastN(x,2))})
```

Table 9-4 illustrates the values of `x` and `y` during different iterations of this formula.

***Table 9-4*** Iterations of List.Accumulate for the Fibonacci Series

| iteration | s | c | List.LastN(s,2) | List.Sum(....) | s& {List.Sum(..)} |
|---|---|---|---|---|---|
| 1 | {0,1} | 1 | {0,1} | 1 | {0,1,1} |
| 2 | {0,1,1} | 2 | {1,1} | 2 | {0,1,1,2} |
| 3 | {0,1,1,2} | 3 | {1,2} | 3 | {0,1,1,2,3} |
| 4 | {0,1,1,2,3} | 4 | {2,3} | 5 | {0,1,1,2,3,5} |
| 5 | {0,1,1,2,3,5} | 5 | {3,5} | 6 | {0,1,1,2,3,5,8} |
| 6 | {0,1,1,2,3,5,8} | 6 | {5,8} | 13 | {0,1,1,2,3,5,8,13} |
| 7 | {0,1,1,2,3,5,8,13} | 7 | {8,13} | 13 | {0,1,1,2,3,5,8,13} |
| 8 | {0,1,1,2,3,5,8,13} | 8 | {8,13} | 34 | {0,1,1,2,3,5,8,13,34} |

## Generating the Fibonacci Sequence with List.Generate

Calculate the first ten terms of the Fibonacci series using `List.Generate`.

The Fibonacci sequence has been previously created using `List.Accumulate()`, but here, to better understand the arguments in the `List.Generate()` function, you will solve this problem using `List.Generate()`.

This problem can be solved using `List.Generate()` in various ways, but an efficient approach is to keep track of the last two values in the series and use them to generate the next value by simply adding them together. In each iteration, you need `C` (the counter), `Xn_2` (the second-to-last value in the series), and `Xn_1` (the last value in the series).

To start, you set the initial value of `C` to `1`, which indicates the first iteration. For `Xn_2`, you start with `0`, which is the first value in the series, and for `Xn_1`, you start with `1`, which is the second value in the series. These initial values are set using the first argument of `List.Generate()`, as follows:

```
()=>[C=1,Xn_2=0,Xn_1=1]
```

The number of iterations should be repeated ten times, so the second argument of the function will define the stopping condition. This ensures that the iteration stops after ten iterations. The condition is simply `[C] <= 10`.

In each iteration, the counter `C` is incremented by one, while `Xn_2` is updated to the previous value of `Xn_1` (since the value of `Xn_1` in the next iteration corresponds to the value of `Xn-2`), and `Xn_1` is updated by adding the current values of `Xn_1` and `Xn_2`. This logic is defined in the third argument of `List.Generate()`:

```
each [C=[C]+1,xn_2=[xn_1],xn_1=[xn_1]+[xn_2]]
```

Combining all the parts, you can type the formula in the formula bar as follows. This results in Figure 9-21.

```
= List.Generate(()=>[C=0,xn_2=0,xn_1=1],each [C]<10,each [C=[C]+1,xn_2=
[xn_1],xn_1=[xn_1]+[xn_2]])
```

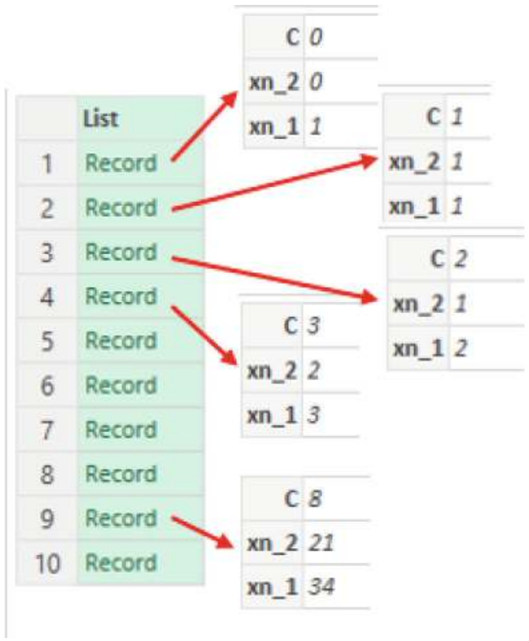


***Figure 9-21*** The result of List.Generate() for the Fibonacci sequence

In the presented result, all the values of C, Xn_2, and Xn_1 are presented in the result in the type of record. If you want to extract only the values of Xn_2 from the result to get the Fibonacci sequence from the initial item, you can use the fourth argument of List.Generate(). This argument specifies what you want to return in each iteration. The formula can then be rewritten as follows and results in {1, 1, 2, 3, 5, 8, 13, 21, 34, 55}:

```
= List.Generate(()=>[C=0,xn_2=0,xn_1=1], each [C]<10, each [C=[C]+1,xn_2=
[xn_1],xn_1=[xn_1]+[xn_2]], each [xn_2])
```

**Note** In addition to the previously presented solution, you can use another variation with List.Generate(), as shown here.

In this variation, instead of defining separate fields for Xn_2 and Xn_1, you can combine them into a single field called X, which will store them as a list. The first item in the list will represent Xn_2, and the second item will represent Xn_1.

This variation simplifies the logic by grouping these two values together in a list. As a result, the formula can be rewritten as follows:

```
= List.Generate(
      ()=>[C=0,x={0,1}],
      each [C]<10,
      each [C=[C]+1,x={List.Last([x]),List.Sum([x])}],
      each List.First([x]))
```

## Implementing Sumproduct

The SUMPRODUCT function in Excel is a versatile and powerful function that multiplies corresponding components in given arrays or ranges and then sums the results. Calculate the SUMPRODUCT of two lists S1={1,3,5,2,7} and S2={0,1,2,1,1} in Power Query using List.Accumulate() and List.Transform().

## Solution 1: Using List.Transform()

The List.Transform() function alone cannot solve the entire problem; it only handles the part of multiplying corresponding items from the two lists and provides a list of the multiplication results. To obtain the final SUMPRODUCT, you need to use List.Sum() to sum the results of the multiplication.

To handle the multiplication part, you can use the index {0..4} as the first argument in the List.Transform() function, since you have five items in the lists. In the second argument, you can use the expression each S1{_} * S2{_} to calculate the product of the corresponding items from S1 and S2. The following formula can be rewritten in the formula bar:

```
= List.Transform({0..4}, each S1{_}*S2{_})
```

This formula results in the {0, 3, 10, 2, 7} list. To get the final result of SUMPRODUCT, you apply List.Sum() to the result of List.Transform(), which will give the final result, 25.

```
= List.Sum(List.Transform({0..4}, each S1{_}*S2{_}))
```

Alternatively, you can approach the solution in a different way. Instead of using indexes, you can create a list of sublists, where each sublist contains the corresponding values from S1 and S2, such as {{1, 0}, {3, 1}, {5, 2}, {2, 1}, {7, 1}}. Using this list in the first argument of List.Transform() can help you apply the multiplication of corresponding items, by using each _{0}*_{1} as a transformation function in the second argument of List.Transform().

You can use List.Zip({S1, S2}) to create this list of corresponding pairs. Then, you can use List.Transform() with the transformation function each _{0} * _{1} to calculate the product of each pair. The formula for this approach is as follows:

```
= List.Transform(List.Zip({S1, S2}), each _{0} * _{1})
```

This will give the same intermediate list {0, 3, 10, 2, 7}, and to get the final result, you apply List.Sum():

```
= List.Sum(List.Transform(List.Zip({S1, S2}), each _{0} * _{1}))
```

This approach also results in the final SUMPRODUCT value of 25.

## Solution 2: Using List.Accumulate()

Using List.Accumulate(), you can solve this problem directly without the need for another function like List.Sum(). In this case, similar to the first variation provided earlier, you can use {0..4} (since you have five items in the lists) as the first argument of List.Accumulate(), with the seed value set to 0. Then, in each iteration, you add the result of multiplying the corresponding items in S1 and S2 to the accumulated value using the accumulator function (s, c) => s + S1{c} * S2{c}.

You can type the following formula in the formula bar to solve the problem:

```
= List.Accumulate (List.Positions(S1), 0,(x,y)=> x+S1{y}*S2{y})
```

Table 9-5 summarizes the iterations of the proposed code.

***Table 9-5*** Iterations of List.Accumulate()

| iteration | s | c | S1{c}*S2{c} | s+ S1{c}*S2{c} |
|---|---|---|---|---|
| 1 | 0 | 0 | 1*0 | 0 |

| iteration | s | c | S1{c}*S2{c} | s+ S1{c}*S2{c} |
|---|---|---|---|---|
| 2 | 0 | 1 | 3*1 | 3 |
| 3 | 3 | 2 | 5*2 | 13 |
| 4 | 13 | 3 | 2*1 | 15 |
| 5 | 15 | 4 | 7*1 | 22 |

Although the previous formula solves the problem, it can lead to incorrect results if the two lists have different lengths. Specifically, if the shorter list is used to create the first input, the formula will produce incorrect results instead of throwing an error. To handle this situation more robustly, it's recommended you use the second variation based on `List.Zip()` and then use the following formula.

```
= List.Accumulate (List.Zip({S1,S2}), 0,(s,c)=> s+c{0}*c{1})
```

In this case, if one list is shorter than the other, the zipped version will pair corresponding elements, and for the shorter list, `null` will be used for the missing values. After multiplying the corresponding numbers, the presence of `null` will result in a `null` value being generated. This will cause the final result of the formula to be `null`.

## Applying Transformation Over the Columns

The data collected from a questionnaire is provided in the Source table, as shown in Table 9-6. To normalize the table, divide the values of each column by the sum of the values in that column.

***Table 9-6*** Comparison Matrix

| Criteria 1 | Criteria 2 | Criteria 3 | Criteria 4 | Criteria 5 | Criteria 6 |
|---|---|---|---|---|---|
| 36 | 78 | 11 | 83 | 93 | 63 |
| 79 | 21 | 54 | 89 | 18 | 71 |
| 58 | 75 | 85 | 33 | 44 | 67 |
| 72 | 12 | 56 | 54 | 81 | 59 |
| 11 | 54 | 27 | 42 | 91 | 29 |
| 18 | 33 | 20 | 10 | 97 | 19 |

**Note** The data in this example is provided in an Excel file titled `07 Apply Transformation Over the Columns.xlsx`.

Two different solutions using `List.Accumulate()` and `List.Transform()` are presented here, but before starting the solutions, you need to know how to change the values of a column once.

To divide all the values of a column like Criteria 1 by a specific number, initially select that column. Then, from the Transform tab, in the Number Column section, choose Standard and then the Divide command, as shown in Figure 9-22.

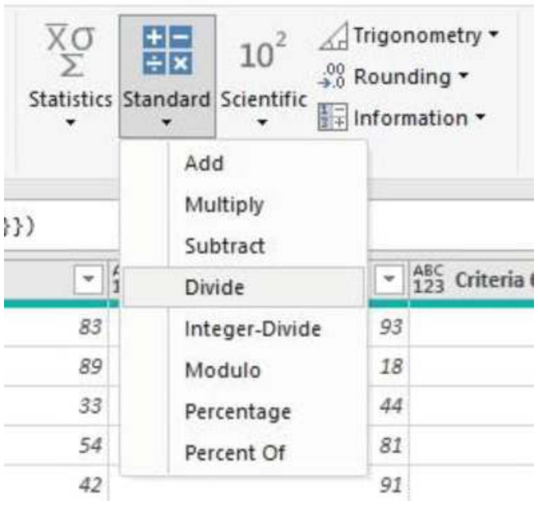


*Figure 9-22* Transforming a table column

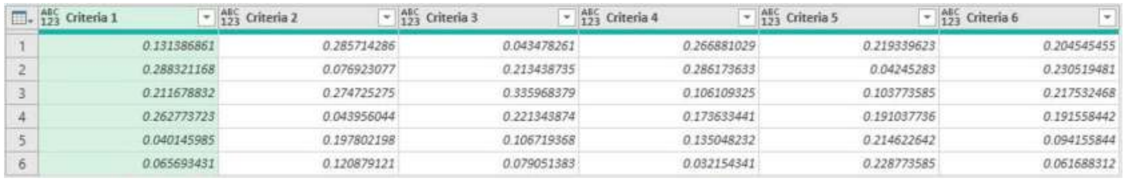
In the dialog box that appears, enter a value such as 100, so each value in the Criteria 1 column is divided by 100, using the generated formula in the formula bar as follows:

```
= Table.TransformColumns(Source, {{"Criteria 1", each _ / 100, type
number}})
```

In this formula, 100 can be replaced with `List.Sum(Source[Criteria 1])` or `List.Sum(Table.Column(Source,"Criteria 1")`, to divide each value of the Criteria 1 column by the sum of the values on that column.

To normalize all the columns, the same process can be applied to other columns, or the previous formula can be rewritten as follows, resulting in the table where all the columns are normalized, shown in Figure 9-23:

```
= Table.TransformColumns(Source, {
      {"Criteria 1", each _ / List.Sum(Table.Column(Source,"Criteria 1"))},
      {"Criteria 2", each _ / List.Sum(Table.Column(Source,"Criteria 2"))},
      {"Criteria 3", each _ / List.Sum(Table.Column(Source,"Criteria 3"))},
      {"Criteria 4", each _ / List.Sum(Table.Column(Source,"Criteria 4"))},
      {"Criteria 5", each _ / List.Sum(Table.Column(Source,"Criteria 5"))},
      {"Criteria 6", each _ / List.Sum(Table.Column(Source,"Criteria 6"))}
})
```



| | Criteria 1 | Criteria 2 | Criteria 3 | Criteria 4 | Criteria 5 | Criteria 6 |
|---|---|---|---|---|---|---|
| 1 | 0.131386861 | 0.285714286 | 0.043478261 | 0.266881029 | 0.219339623 | 0.204545455 |
| 2 | 0.288321168 | 0.076923077 | 0.213438735 | 0.286173633 | 0.04245283 | 0.230519481 |
| 3 | 0.211678832 | 0.274725275 | 0.335968379 | 0.106109325 | 0.103773585 | 0.217532468 |
| 4 | 0.262773723 | 0.043956044 | 0.221343874 | 0.173633441 | 0.191037736 | 0.191558442 |
| 5 | 0.040145985 | 0.197802198 | 0.106719368 | 0.135048232 | 0.214622642 | 0.094155844 |
| 6 | 0.065693431 | 0.120879121 | 0.079051383 | 0.032154341 | 0.228773585 | 0.061688312 |

*Figure 9-23* Normalization result

The previous formula is not dynamic, and it will result in an error if the column names change. It will not be applied to any newly added columns. Additionally, when dealing with a table that has many columns, instead of applying the previous formula, you can use `List.Accumulate()` and `List.Transform()` to normalize the entire table by iterating through the columns in a loop.

## Solution 1: Using List.Accumulate()

As presented, you can use the following formula to apply the transformation on a column (Criteria 1).

```
=Table.TransformColumns(Source, {{"Criteria 1", each _ /
List.Sum(Table.Column(Source,"Criteria 1"))}})
```

Using `List.Accumulate()`, you can create a `For-Each` loop to apply this transformation to all columns in the source table. In this case, the first argument of `List.Accumulate()` is a list containing all the column names, and the seed is the source table. In the third argument, you use the transformation formula, meaning that for each column name, this transformation will be applied to the corresponding column. The formula can be written as follows:

```
List.Accumulate(
      {"Criteria 1","Criteria 2","Criteria 3","Criteria 4","Criteria
5","Criteria 6"}, Source, (s,c)=>Table.TransformColumns(s, {c,
      each _/List.Sum(Table.Column(s,c))}
))
```

In this formula:

- Initially, `s` is the source table, and `c` represents the name of the first column.
- For the column represented by `c`, `Table.TransformColumns()` is applied to normalize the value of that column, by dividing each value by the sum of values on that column.
- The result of this iteration becomes the `s` for the next iteration and `c` will be updated to the name of the next column.
- Then, this process continues until all specified columns in the first argument are normalized, producing a table where all the columns have been normalized.

In the previous formula, the column named are defined manually. The formula can indeed be more dynamic by replacing the first input with `Table.ColumnNames(Source)`. This way, you can dynamically apply the normalization to all columns in any table:

```
= List.Accumulate(
      Table.ColumnNames(Source), Source, (s,c)=>Table.TransformColumns(s,
      {c, each _/List.Sum(Table.Column(s,c))}
))
```

## Solution 2: Using List.Transform()

The previous formula solves the problem, but it is not the most efficient approach, as the column transformations are applied separately in each iteration. Instead, you can use `List.Transform()` to apply all the transformations at once in a single formula.

Consider the following hardcoded formula for transforming the columns from Criteria 1 to Criteria 6:

```
= Table.TransformColumns(Source, {
      {"Criteria 1", each _ / List.Sum(Table.Column(Source,"Criteria 1"))},
      {"Criteria 2", each _ / List.Sum(Table.Column(Source,"Criteria 2"))},
      {"Criteria 3", each _ / List.Sum(Table.Column(Source,"Criteria 3"))},
      {"Criteria 4", each _ / List.Sum(Table.Column(Source,"Criteria 4"))},
      {"Criteria 5", each _ / List.Sum(Table.Column(Source,"Criteria 5"))},
      {"Criteria 6", each _ / List.Sum(Table.Column(Source,"Criteria 6"))}
})
```

In the previous formula, the second argument is a list containing several sublists, one sublist for each column transformation. Each sublist consists of two parts (the third part, which determines the result type, is omitted for simplicity). The first part is the column name, and the second part is a function that applies the transformation to the values of the specified column.

In this solution, you want to use `List.Transform()` to generate the second argument of `Table.TransformColumns()`. Since `Table.ColumnNames(Source)` returns a list of all the column names from the source table, you can use the following formula to create sublists containing the column name as the first argument and the number `1` as the second argument, as shown in Figure 9-24.

```
=List.Transform( Table.ColumnNames(Source), (x)=> {x,  1})
```

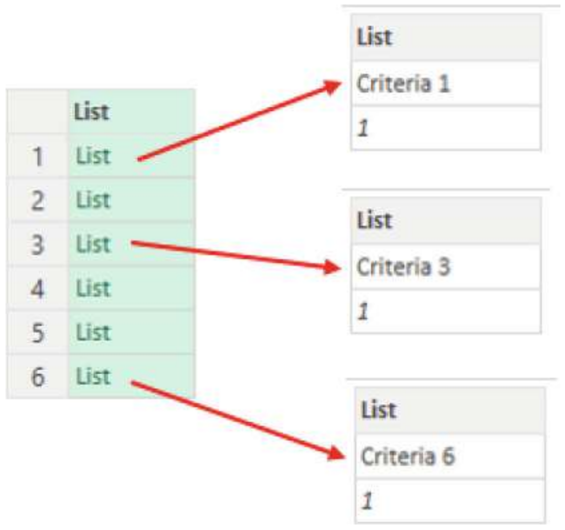


***Figure 9-24*** The first step of creating the sublists

At this point, the second argument of the sublists is the number `1`. However, you need to use a function instead. To convert the second item in the sublists to a function, you can modify the formula. Replace the `1` with a function, as shown in Figure 9-25.

```
=List.Transform( Table.ColumnNames(Source), (x)=> {x,  each 1})
```

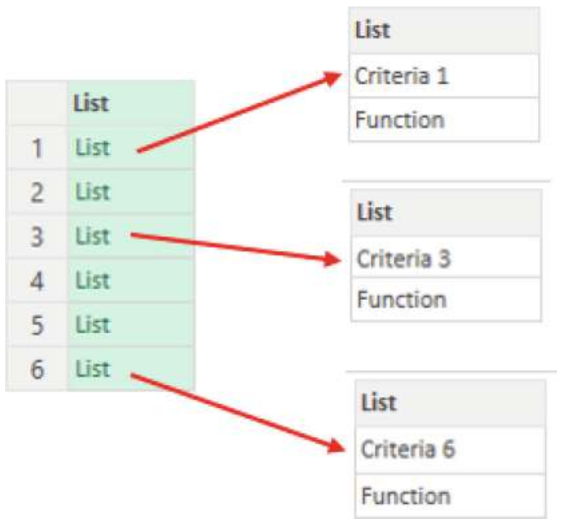
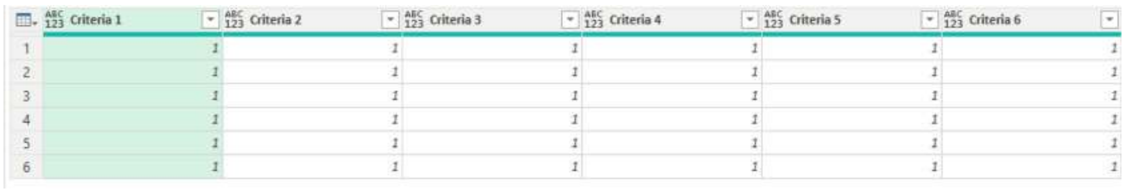


***Figure 9-25*** Creating the sublists in the right format

As presented, the result of the previous formula is a list containing several sublists, where the first item in each sublist is a column name and the second item is a function. As the result is in the right format, you can use this formula as the second argument in the `Table.TransformColumns()` function, using the following formula.

```
= Table.TransformColumns(Source,
List.Transform(Table.ColumnNames(Source), (x)=> {x,   each 1 })  )
```

In this case, the transformation function is defined as `each 1`, which converts all the values in the columns to the number `1`, as shown in Figure 9-26.



| | Criteria 1 | Criteria 2 | Criteria 3 | Criteria 4 | Criteria 5 | Criteria 6 |
|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4 | 1 | 1 | 1 | 1 | 1 | 1 |
| 5 | 1 | 1 | 1 | 1 | 1 | 1 |
| 6 | 1 | 1 | 1 | 1 | 1 | 1 |

***Figure 9-26*** Replacing all the values of a table with 1

Instead of applying `each 1` to all values, you can use the previously defined transformation function and rewrite the formula as follows to achieve the desired normalized table.

```
= Table.TransformColumns(
    Source,
    List.Transform(
      Table.ColumnNames(Source),
      (x)=> {x,   each _/List.Sum(Table.Column(Source, x)) }
    )
  )
```

## Adding Multiple Columns Simultaneously

The actual cost in 2023 for different departments is provided in the Source table in Table 9-7. Define the budget columns for each department in three different scenarios, with increasing cost rates equal to 3, 7, and 10 percent.

***Table 9-7*** Department Cost

| Department | Cost 2023 |
|---|---|
| Sales | 30,462.00 |
| Marketing | 40,289.00 |
| Purchase | 47,141.00 |
| Finance | 23,826.00 |
| HR | 40,415.00 |
| Production | 10,371.00 |
| Technical Support | 37,704.00 |
| CRM | 34,269.00 |

**Note** The data in this example is provided in an Excel file titled `08 Adding Multiple Columns Simultaneously .xlsx`.

In Example 4 of Chapter 2, you learned how to use record definitions to add multiple columns at once. However, in this case, since the columns follow a specific pattern, you can use the functions to generate the required record and then expand it.

Following the approach from Example 4 in Chapter 2, applying the following formula in the Custom Column window and then expanding the resulting column will solve the problem.

```
=[#"by 3%"=[Cost 2023]*1.03,
#"by 5%"=[Cost 2023]*1.05,
#"by 7%"=[Cost 2023]*1.07
]
```

To create this record in the rest of this section, three solutions based on `List.Transform()` and `List.Accumulate()` are provided.

### Solution 1: Using List.Transform()

In this example, three different scenarios are defined. To represent them dynamically, you use the `{3,5,7}` list as the first input for `List.Transform()`. Then you will use a transformation function, converting each item into a record with a specific field name and value. To create a record, you'll use the `Record.AddField()` function, which takes three arguments: the base record (which, in this case, can be an empty record), the field name, and the field value.

For instance, using `=Record.AddField([], "X", 1)` in the formula bar results in a `[X=1]` record. Applying this as the transformation function in `List.Transform()`, using the following formula in the formula bar, produces a list of three records, each identical to `[X=1]`:

```
=List.Transform({3,5,7},(i)=> Record.AddField([],"X",1))
```

Instead of using `X` as the field name, you can dynamically generate field names by concatenating By with `Text.From(i)`, making each record's field name unique. So the revised formula is presented as follows, which results in Figure 9-27:

```
=List.Transform({3,5,7},(i)=> Record.AddField([],"By "&Text.From(i) &
"%" ,1))
```

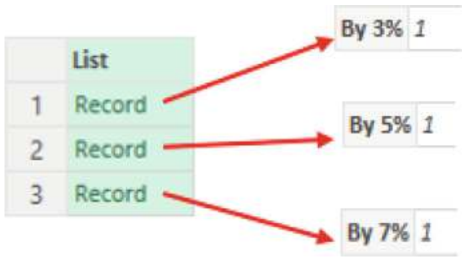
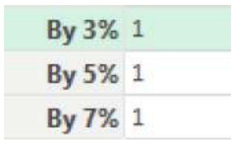


***Figure 9-27*** The result of modifying the field names

The previous formula generates three single-field records within a list. To combine them into a single record with three fields, you can use the `Record.Combine()` function. By passing the previous formula as its input, you obtain the record shown in Figure 9-28:

```
= Record.Combine(List.Transform({3,5,7},(i)=> Record.AddField([],"By
"&Text.From(i) & "%" ,1)))
```



| | |
|---|---|
| By 3% | 1 |
| By 5% | 1 |
| By 7% | 1 |

***Figure 9-28*** The result of combining the records

Returning to the main problem, adding a custom column with the previous formula results in the same record (with tree fields) for all rows. Now that you have structured the records correctly, you need to replace the placeholder value `1` with the percentage-based calculation using the Cost in 2023 column. The percentages originate from the list used in `List.Transform()`, indexed by *i*. Since *i* is in the type of `number`, to convert it to percentages, it should be divided 100.

The values for different growth rates, for example, a 3 percent increase in Cost in 2023, is reached by multiplying the cost by 1.03, which translates to `[Cost 2023] * (1 + i / 100)`.

Thus, the revised formula for the Custom Column window is as follows:

```
=Record.Combine(List.Transform({3,5,7},(i)=> Record.AddField([],"By
"&Text.From(i) & "%" ,[Cost 2023]*(1+i/100))))
```

After applying this formula and expanding the newly created column, you can obtain the final result.

### Solution 2: Using List.Accumulate(), Variation 1

This solution follows the same logic as presented in Solution 1. However, since `List.Accumulate` provides an accumulator function, you do not need to transform the values into records and then combine them using `Record.Combine()`. Instead, you can add fields to the record one by one.

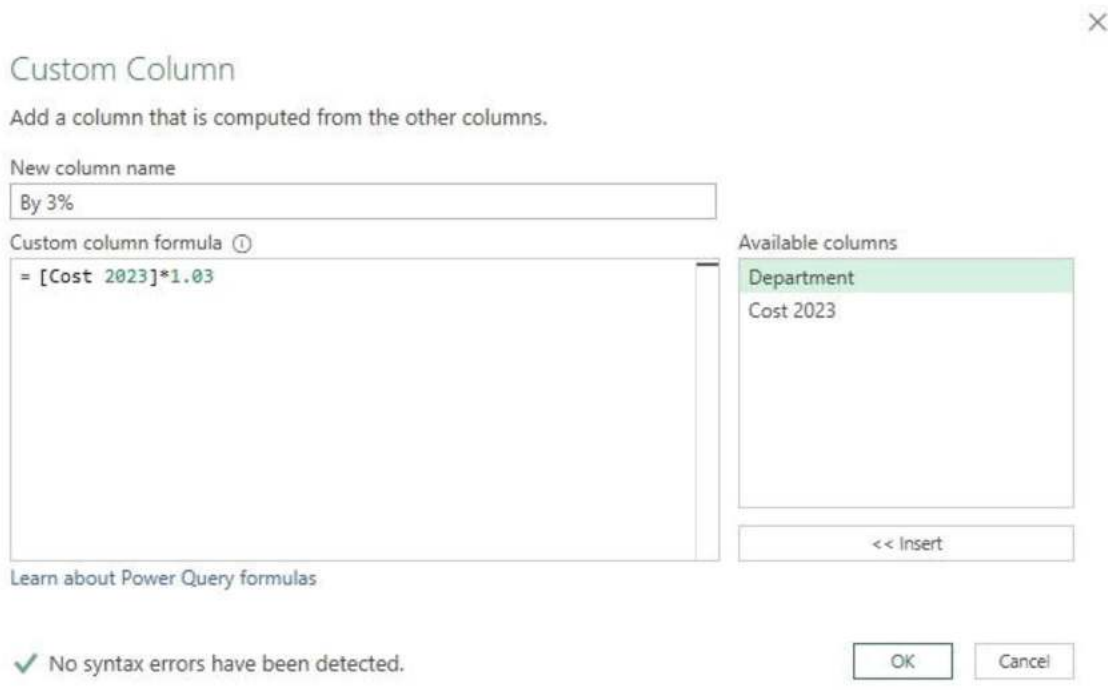
Here, the seed is considered a blank record, and the first argument remains the same as in `List.Transform()`. When you use `Record.AddField()` in the third argument of `List.Accumulate`, new fields are added to the existing record iteratively. Therefore, the following formula can also be used to solve this problem.

```
List.Accumulate({3,5,7},[],(s,c)=> Record.AddField(s,"By "&Text.From(c) &
"%" ,[Cost 2023]*(1+c/100)))
```

### Solution 3: Using List.Accumulate(), Variation 2

Besides the first two solutions, which involved adding a column using a record, this problem can also be solved by adding each column separately within a loop using `List.Accumulate()`. In this approach, the seed is the Source table, and with each iteration, a new column is added to it.

Before starting the solution, recall the formula for adding a column to a table. In Power Query, you can add a new column by selecting the Custom Column command from the Add Column tab and configuring the settings shown in Figure 9-29 to create a new column named By 3%.


Custom Column

Add a column that is computed from the other columns.

New column name: By 3%

Custom column formula:

```
= [Cost 2023]*1.03
```

Available columns: Department, Cost 2023

<< Insert
Learn about Power Query formulas
No syntax errors have been detected.
OK
Cancel

***Figure 9-29*** Adding a column

The formula bar will generate the following expression to create a new column named By 3%, which you will use later to add the columns:

```
= Table.AddColumn(Source, "By 3%", each [Cost 2023]*1.03)
```

To solve this problem with new logic, you need to loop through the values `{3, 5, 7}` and, in each iteration, add a new column to the source table by multiplying the Cost 2023 column by a specific percentage. So, the `{3, 5, 7}` list serves as the first argument of `List.Accumulate()`, and in each iteration, you apply modifications to the Source table, so the Source table is used as the second argument.

To update the table during each iteration, you need to define a function called `(s, c) => f(s, c)`, where:

– `s` represents the table at the current step.
– `c` is a value from the `{3, 5, 7}` list.

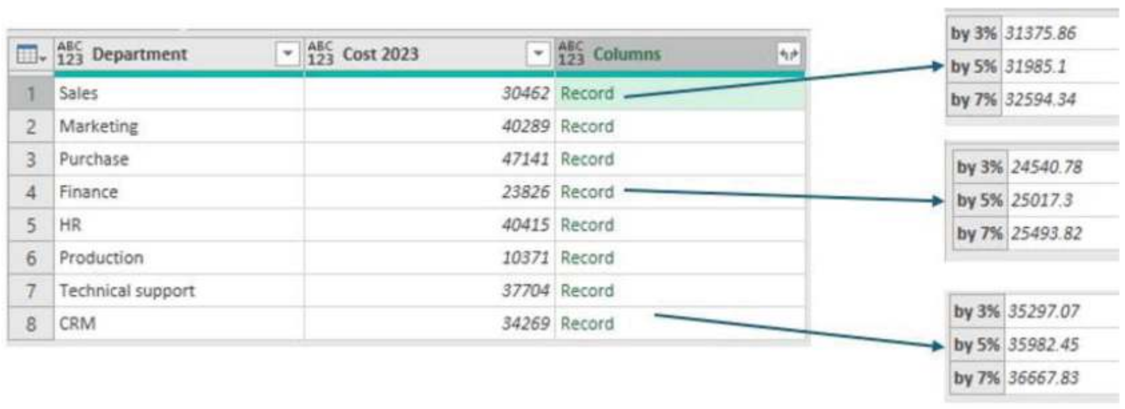
Using the formula for adding a column, the original table (Source) should be replaced with `s`, and the multiplication factor 1.03 should be replaced with `(1 + c / 100)`. Additionally, the column name should dynamically reflect the percentage, so By 3% is replaced with `"By " & Text.From(c) & "%"`.

Thus, the function inside `List.Accumulate()` becomes:

```
(s,c)=>Table.AddColumn(s, "By "&Text.From(c) & "%", each [Cost 2023]*
(1+c/100))
```

And the complete formula for solving this problem is as follows (see Figure 9-30):

```
= List.Accumulate(
      {3,5,7},
      Source,
      (s,c)=>Table.AddColumn(s, "By "&Text.From(c) & "%", each [Cost 2023]*
(1+c/100)))
```



| | Department | Cost 2023 | Columns |
|---|---|---|---|
| 1 | Sales | 30462 | Record |
| 2 | Marketing | 40289 | Record |
| 3 | Purchase | 47141 | Record |
| 4 | Finance | 23826 | Record |
| 5 | HR | 40415 | Record |
| 6 | Production | 10371 | Record |
| 7 | Technical support | 37704 | Record |
| 8 | CRM | 34269 | Record |

| | |
|---|---|
| by 3% | 31375.86 |
| by 5% | 31985.1 |
| by 7% | 32594.34 |

| | |
|---|---|
| by 3% | 24540.78 |
| by 5% | 25017.3 |
| by 7% | 25493.82 |

| | |
|---|---|
| by 3% | 35297.07 |
| by 5% | 35982.45 |
| by 7% | 36667.83 |

***Figure 9-30*** The result of Group By

**Note** This problem can be also solved using the splitting function as follows:

```
= Table.SplitColumn(Source, "Cost 2023", each List.Transform({0,3,5,7},
(i)=> _*(1+i/100)))
```

In this case, you need to rename the column names after modification. The revised version that will define the column names is as follows:

```
= Table.SplitColumn(Source, "Cost 2023", each List.Transform({0,3,5,7},
(i)=> _*(1+i/100)),{"Cost 2023"}& List.Transform({3,5,7},(i)=> "By
"&Text.From(i) & "%" ))
```

## Handling the Sequences

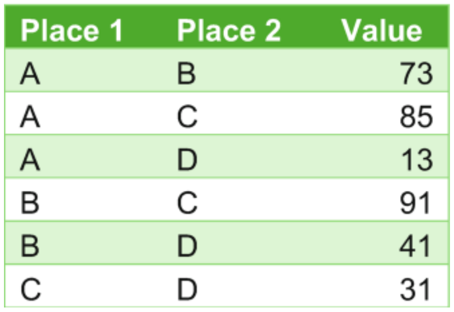
Consider a company with four branches in four different locations. The distances between the branches are provided in the Distance table, as in Table 9-8. (The distance from Branch X to Branch Y is the same as the distance from Branch Y to Branch X.) The historical trips of staff between these branches on different dates are presented in the Travel table, as shown in Table 9-9. To calculate staff commissions, the distance traveled is required. So, add a new column to the Source table to calculate the distance traveled for each row.

*Table 9-9* Travel: Travel History

| Date | Staff ID | Path |
|---|---|---|
| 6/04/2024 | s-2 | C,B |
| 12/04/2024 | s-2 | D,C |
| 12/04/2024 | s-3 | D,C,D |
| 15/04/2024 | s-3 | A,C,B,A,B,A,C |
| 16/04/2024 | s-1 | A,B |
| 21/04/2024 | s-1 | A,C,B,A |
| 21/04/2024 | s-3 | A,B,C,A,B,A |
| 22/04/2024 | s-2 | A,B,C,D |
| 26/04/2024 | s-1 | A,B |
| 28/04/2024 | s-2 | A,B |
| 29/04/2024 | s-1 | A,C |
| 30/04/2024 | s-1 | A,B,C |

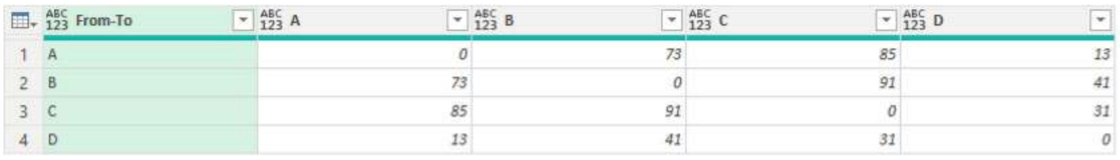
**Note** The data in this example is provided in an Excel file titled `09 List.Accumulate with Memory Handling.xlsx`.

*Table 9-8* Distance: Distance Matrix



| Place 1 | Place 2 | Value |
|---|---|---|
| A | B | 73 |
| A | C | 85 |
| A | D | 13 |
| B | C | 91 |
| B | D | 41 |
| C | D | 31 |

**Note** If the distances are stored in the format shown in Figure 9-31, right-click the first column and select Unpivot Other Columns to convert the data into the format used in this example.



|  | From-To | A | B | C | D |
|---|---|---|---|---|---|
| 1 | A | 0 | 73 | 85 | 13 |
| 2 | B | 73 | 0 | 91 | 41 |
| 3 | C | 85 | 91 | 0 | 31 |
| 4 | D | 13 | 41 | 31 | 0 |

*Figure 9-31* Another format of the Distance table

To solve this problem, first load both tables into Power Query by different queries. Then, rename the first query to Distance and the second to Travel.

As explained in Chapter 3, to retrieve the distance between two branches (e.g., A to B), filter the Distance table where `Place 1` is `A` and `Place 2` is `B`. Then, extract the value from the Distance column using the following formula:

```
= Table.SelectRows(Distance, each ([Place 1] = "A") and ([Place 2] = "B"))
[Distance]{0}
```

This formula can be rewritten using the function notation `(x) =>` as follows. As presented in the Chapter 3, this modification is required, as this formula will later be used in another formula with an `each _` definition.

```
= Table.SelectRows(Distance, (x)=> (x[Place 1] = "A") and (x[Place 2] =
"B"))[Distance]{0}
```

For the reverse case (calculating the distance from B to A), while the result should be the same, filtering `Place 1` for `B` and `Place 2` for `A` returns a blank table. As you know, the distances from A to B and from B to A are the same, and the Distance table just includes one way. To handle both cases, you need to use an `or` condition in the formula and rewrite it as follows:

```
= Table.SelectRows(Distance, (x)=> (x[Place 1] = "A" and x[Place 2] = "B")
or (x[Place 1] = "B" and x[Place 2] = "A"))[Distance]{0}
```

Now that you have a formula to extract the distance between two branches, let's apply it to solve the problem.

In the Travel table, the Path column contains branch sequences in text format (e.g., `"A,C,B,A,B,A,C"`). To work with these values as separate entries, you add a Custom Column using the `Text.Split()` function. Add a custom column called Path List to the Travel table using the following formula in the Custom Column window:

```
= Text.Split([Path],",")
```

This converts each path from text into a list of visited branches. So for the first row, the value for path column is `C,B` and the result of path list become `{"C", "B"}`. For the fourth row, the value of the Path column is `"A,C,B,A,B,A,C"`, and the Path list becomes `{"A", "C", "B", "A", "B", "A", "C"}`. Based on this new column, in the rest of this section, three different solutions based on `List.Transform()` and `List.Accumulate()` are presented.

## Solution 1: Using List.Transform()

Before solving the problem for all rows, first consider the value in the Path List column for the fourth row, which is `{"A", "C", "B", "A", "B", "A", "C"}`. You'll calculate the total distance for this journey first, then extend the solution to all rows. Let's name this list `ListX`.

In this list, the sequence of branches visited during the journey is provided. However, you need to break it down into individual trips, each with a starting and ending branch. In other words, instead of representing the journey as `{"A", "C", "B", "A", "B", "A", "C"}`, it would be more useful to structure it as `{{"A", "C"}, {"C", "B"}, {"B", "A"}, {"A", "B"}, {"B", "A"}, {"A", "C"}}`. This format clearly shows each leg of the journey—for example, the first trip is from A to C, the second is from C to B, and so on.

To generate the revised list, you need to create sublists where each element at index *i* in `ListX` is paired with the element at index *i+1*. This means that for each *i* (starting at 0 and including all valid indexes of `ListX`), you extract `ListX{i}` and `ListX{i+1}` and place them together in a sublist as `{ListX{i}, ListX{i+1}}`.

To achieve this transformation, you can use the `List.Transform()` function over the `{0..6}` range, applying the transformation to convert `ListX` into the desired format by the following formula:

```
= List.Transform({0..6},(i)=> {ListX{i},ListX{i+1}})
```

In the previous formula, the `{0..6}` range can be replaced with `List.Positions(ListX)` to make the transformation more dynamic. However, before making this change, let's analyze what happens when `i = 6`.

If you apply the transformation function at `i = 6`, it results in `{ListX{6}, ListX{7}}`, but since there is no element at index 7, an error occurs. To prevent this issue, you can either:

– Use the range `{0..5}` instead of `{0..6}`, thus ensuring that `ListX{i+1}` always exists.
– Use the range `{1..6}` and modify the transformation function to `{ListX{i-1}, ListX{i}}`, effectively shifting the indexing logic.

Thus, you can use either of the following formulas to dynamically transform `ListX` into the required format, as shown in Figure 9-32.

```
= List.Transform(List.RemoveLastN(List.Positions(ListX),1),(i)=>
{ListX{i},ListX{i+1}})
```

```
= List.Transform(List.Skip(List.Positions(ListX)),(i)=> {ListX{i-
1},ListX{i}})
```

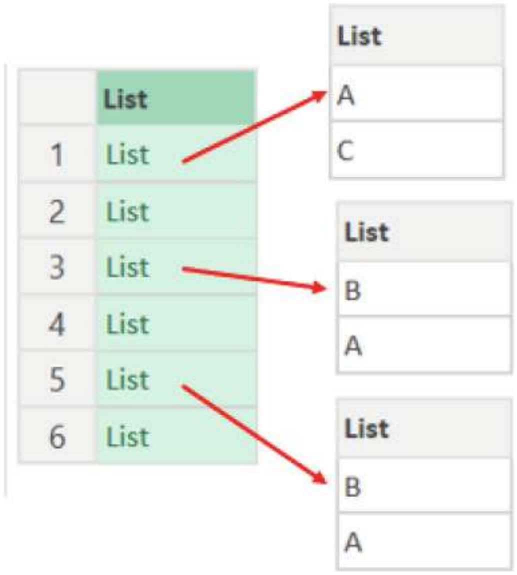


***Figure 9-32*** The result of transforming ListX

In this case, the formula results in a list of sublists, where each sublist contains two items:

– The first item represents the departure branch for each sub-trip.
– The second item represents the destination branch for each sub-trip.

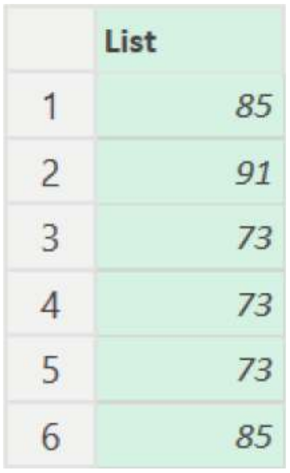
Instead of keeping them as separate values, you can directly use these two branches in the formula you developed for extracting the distance between two branches as follows:

```
=Table.SelectRows(Distance, (x)=> (x[Place 1] = "A" and x[Place 2] = "B") or
(x[Place 1] = "B" and x[Place 2] = "A"))[Distance]{0}
```

To do this, replace `A` in the formula with `ListX{i-1}` (the departure branch) and `B` with `ListX{i}` (the destination branch), ensuring that the transformation dynamically computes the distances for each leg of the journey.

The revised formula is as follows, which results in Figure 9-33.

```
=List.Transform(
  List.Skip(List.Positions(ListX)),
  (i) =>
    Table.SelectRows(
      Distance,
      (x) => (x[Place 1] = ListX{i - 1} and x[Place 2] = ListX{i})
        or (x[Place 1] = ListX{i} and x[Place 2] = ListX{i - 1})
    )[Distance]{0}
)
```



| | List |
|---|---|
| 1 | 85 |
| 2 | 91 |
| 3 | 73 |
| 4 | 73 |
| 5 | 73 |
| 6 | 85 |

***Figure 9-33*** Distance of the travel legs

In this case, `85` represents the distance traveled from `A` to `C`, and `91` represents the distance from `C` to the next branch, and the same for other numbers.

To calculate the total traveled distance, you can use `List.Sum()` to sum up all the individual distances.

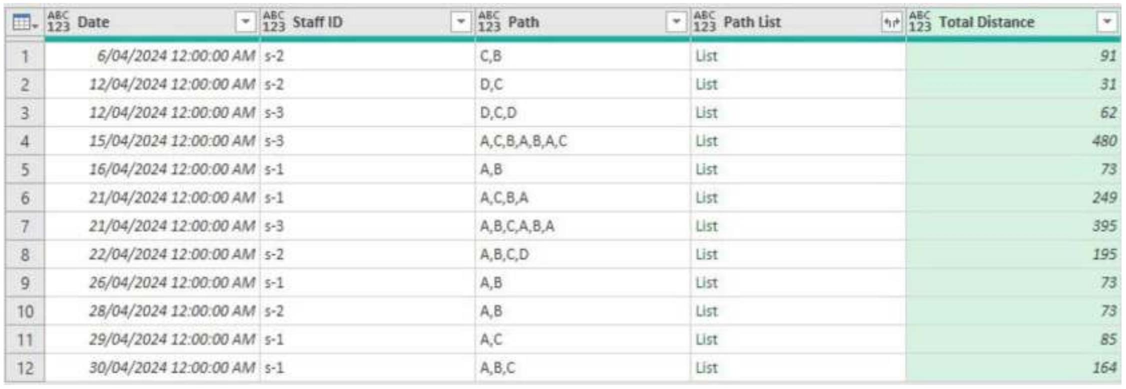
Thus, the formula can be rewritten as follows to dynamically compute the total distance for the entire journey in `ListX`:

```
= List.Sum(
  List.Transform(
    List.Skip(List.Positions(ListX)),
    (i) =>
      Table.SelectRows(
        Distance,
        (x) => (x[Place 1] = ListX{i - 1} and x[Place 2] = ListX{i})
          or (x[Place 1] = ListX{i} and x[Place 2] = ListX{i - 1})
      )[Distance]{0}
  )
)
```

This formula can be applied to all rows in the Travel table. So, after adding the Path List column, you introduce another column called Distance. Then, you use the previously developed formula in the Custom Column window, by replacing `ListX` with `[Path List]`, as shown here:

```
= List.Sum(
  List.Transform(
    List.Skip(List.Positions([Path List])),
    (i) =>
      Table.SelectRows(
        Distance,
        (x) => (x[Place 1] = [Path List]{i - 1} and x[Place 2] = [Path List]
{i}) or (x[Place 1] = [Path List]{i} and x[Place 2] =
        [Path List]{i - 1})
      )[Distance]{0}
  )
)
```

This transformation dynamically computes the total travel distance for each row, resulting in the final table displayed in Figure 9-34.



| | Date | Staff ID | Path | Path List | Total Distance |
|---|---|---|---|---|---|
| 1 | 6/04/2024 12:00:00 AM | s-2 | C,B | List | 91 |
| 2 | 12/04/2024 12:00:00 AM | s-2 | D,C | List | 31 |
| 3 | 12/04/2024 12:00:00 AM | s-3 | D,C,D | List | 62 |
| 4 | 15/04/2024 12:00:00 AM | s-3 | A,C,B,A,B,A,C | List | 480 |
| 5 | 16/04/2024 12:00:00 AM | s-1 | A,B | List | 73 |
| 6 | 21/04/2024 12:00:00 AM | s-1 | A,C,B,A | List | 249 |
| 7 | 21/04/2024 12:00:00 AM | s-3 | A,B,C,A,B,A | List | 395 |
| 8 | 22/04/2024 12:00:00 AM | s-2 | A,B,C,D | List | 195 |
| 9 | 26/04/2024 12:00:00 AM | s-1 | A,B | List | 73 |
| 10 | 28/04/2024 12:00:00 AM | s-2 | A,B | List | 73 |
| 11 | 29/04/2024 12:00:00 AM | s-1 | A,C | List | 85 |
| 12 | 30/04/2024 12:00:00 AM | s-1 | A,B,C | List | 164 |

***Figure 9-34*** List.Accumulate

## Solution 2: Using List.Accumulate(), Variation 1

`List.Accumulate()` can also be used to solve this problem. However, since it utilizes an accumulator function instead of a transformation function, you can define an initial seed value of `0` and create a loop where, in each iteration, the distance of the next leg of the journey is calculated and added to the accumulated value.

The first argument of this function remains the same as the first input of `List.Transform()`. The second argument is set to `0` (the initial seed value). In the third argument, instead of using `(i) => f(i)`, you can modify it to `(s, i) => s + f(i)`, meaning that in each iteration, the function calculates the distance using `f(i)` and adds it to the accumulated sum `s`.

The revised formula is as follows. You can use this in the Custom Column window for the table after adding the Path List column to solve the problem efficiently.

```
= List.Accumulate(
  List.Skip(List.Positions([Path List])),
  0,
  (s, i) =>
    s
      + Table.SelectRows(
        Distance,
        (x) => (x[Place 1] = [Path List]{i - 1} and x[Place 2] = [Path List]
{i}) or (x[Place 1] = [Path List]{i} and x[Place 2] =
        [Path List]{i - 1})
      )[Distance]{0}
)
```

To maintain consistency with the notation, replace `i` with `c` and rewrite the formula as follows:

```
= List.Accumulate(
  List.Skip(List.Positions([Path List])),
  0,
  (s, c) =>
    s
      + Table.SelectRows(
        Distance,
        (x) => (x[Place 1] = [Path List]{c - 1} and x[Place 2] = [Path List]
{c}) or (x[Place 1] = [Path List]{c} and x[Place 2] =
        [Path List]{c - 1})
      )[Distance]{0}
)
```

## Solution 3: Using List.Accumulate(), Variation 2

As in the previous solutions, instead of solving the entire problem at once, let's first consider ListX and solve the problem for this specific case. Once you derive the correct formula, you can generalize it and apply it to all rows in the dataset. By focusing on ListX first, you can verify that the logic works correctly before extending it to the entire table.

In the previous solution, you initially calculated the Path List in a helper column, then used indexes to convert the sequence of trips into a list of sublists, where each sublist represented a departure and destination pair for a leg of the journey. You then applied this list to the distance calculation formula.

In this approach, however, you aim to solve the problem without using a helper column. Instead of relying on indexes (e.g., List.Skip(List.Positions(ListX)), which results in {1..6}), you will work directly with the trip sequence {"A","C","B","A","B","A","C"}.

If you use this list as the first input in List.Accumulate(), each iteration will pass only a single branch to the accumulator function. However, you need two branches in each step (departure and destination) to compute the distance.

To illustrate, consider the following formula:

```
=List.Accumulate(ListX, seed, (s,c)=>f(s,c))
```

Here, c represents only one city at a time, which is insufficient for calculating distances.

To address this issue, you modify the seed to store not just the accumulated distance but also the previous branch. Instead of defining the seed as a single number (starting at 0), you define it as a record with two fields:

- D: The total accumulated distance (initially set to 0).
- P: The previously visited branch (initially set to ListX{0}, the starting branch of the trip).

Since the first element of ListX is stored in P, you replace ListX in the first argument of List.Accumulate() with List.Skip(ListX) to exclude the first branch from iteration. Thus, the revised formula becomes:

```
=List.Accumulate(List.Skip(ListX), [D=0,P=ListX{0}], (s,c)=>f(s,c))
```

Which is equal to the following formula:

```
=List.Accumulate({"C","B","A","B","A","C"}, [D=0,P="A"], (s,c)=>f(s,c))
```

To define the (s, c) => f(s, c) function, let's analyze the first iteration:

- s starts as [D = 0, P = "A"]
- c is C

In this step, the departure branch comes from s[P] (which is A), and the destination branch is c (which is C).

Thus, you can update the value of D (total accumulated distance) using the same formula from the previous solution with small modifications as follows.

- Instead of using ListX{c–1}, you use s[P] as the departure branch.
- Instead of using ListX{c}, you use c as the destination branch.
- Instead of using s directly, you update only s[D] (the accumulated distance).

With these adjustments, the formula for updating D becomes:

```
D=s[D]+Table.SelectRows(Distance, (x)=> (x[Place 1] = s[P] and x[Place 2]
=c) or (x[Place 1] = c and x[Place 2] = s[P]))[Distance]{0}))
```

Besides updating D, the value of P in the seed should also be updated to store the departure branch for the next iteration. This value is exactly the same as c, meaning that for P, the update formula is P = c.

Thus, the accumulator function can be defined as follows:

```
(s, c) => [
  D = s[D]
    + Table.SelectRows(
      Distance,
      (x) => (x[Place 1] = s[P] and x[Place 2] = c) or (x[Place 1] = c and
x[Place 2] = s[P])
    )[Distance]{0},
  P = c
]
```

Using the following formula, you can extract the total traveled distance for `ListX`:

```
=List.Accumulate(
  List.Skip(ListX),
  [D = 0, P = ListX{0}],
  (s, c) => [
    D = s[D]
      + Table.SelectRows(
        Distance,
        (x) => (x[Place 1] = s[P] and x[Place 2] = c) or (x[Place 1] = c and
x[Place 2] = s[P])
      )[Distance]{0},
    P = c
  ]
)
```

However, since the seed value in this example is a record, the formula returns a record as well. Since you only need the value of the `D` field (which represents the traveled distance), you can extract it by appending `[D]` to the end of the formula as follows. This ensures that the result is just the total traveled distance for `ListX`.

```
=List.Accumulate(
  List.Skip(ListX),
  [D = 0, P = ListX{0}],
  (s, c) => [
    D = s[D]
      + Table.SelectRows(
        Distance,
        (x) => (x[Place 1] = s[P] and x[Place 2] = c) or (x[Place 1] = c and
x[Place 2] = s[P])
      )[Distance]{0},
    P = c
  ]
)[D]
```

Before applying this formula to all rows, you can refine it further. Instead of setting the seed as `[D=0, P=ListX{0}]` and using `List.Skip(ListX)` as the first argument, you can define the seed as `[D=0, P=""]` and use `ListX` directly in the first argument.

However, this change introduces an issue: in the first iteration, since `P=""`, the filtering table for `P=""` returns an error. To handle this, you need to modify the accumulator function by adding an `if` condition. This condition checks if `s[P] is ""`, and assigns a `0` instead of causing an error. Otherwise, the function proceeds with the distance calculation as follows:

```
(s, c) => [
  D = s[D]
    + (
      if s[P] = "" then
```

```
        0
      else
        Table.SelectRows(
          Distance,
          (x) => (x[Place 1] = s[P] and x[Place 2] = c) or (x[Place 1] = c
and x[Place 2] = s[P])
        )[Distance]{0}
    ),
  P = c
]
```

The whole formula is as follows:

```
=List.Accumulate(
  ListX,
  [D = 0, P = ""],
  (s, c) => [
    D = s[D]
      + (
        if s[P] = "" then
          0
        else
          Table.SelectRows(
            Distance,
            (x) => (x[Place 1] = s[P] and x[Place 2] = c) or (x[Place 1] = c
and x[Place 2] = s[P])
          )[Distance]{0}
      ),
    P = c
  ]
)[D]
```

This formula can be applied directly in the Custom Column window of the Travel table, even before adding the Path List column. Simply replace `ListX` with `Text.Split([Path], ",")` as follows, to dynamically generate the list from the Path column.

```
=List.Accumulate(
  Text.Split([Path], ","),
  [D = 0, P = ""],
  (s, c) => [
    D = s[D]
      + (
        if s[P] = "" then
          0
        else
          Table.SelectRows(
            Distance,
            (x) => (x[Place 1] = s[P] and x[Place 2] = c) or (x[Place 1] = c
and x[Place 2] = s[P])
          )[Distance]{0}
      ),
    P = c
  ]
)[D]
```

## Implementing Stepped Tax Calculations

Given the tax rates in Table 9-10 and the income values in Table 9-11, add a new column to the people's income table to calculate the tax for each person using stepped tax logic.

***Table 9-10*** Tax_Rates: TaxRates

| From | To | Tax Rate |
|---|---|---|
| $0 | $18,200 | 0% |
| $18,201 | $45,000 | 19% |
| $45,001 | $120,000 | 33% |
| $120,001 | $180,000 | 37% |
| $180,001 | Over | 45% |

***Table 9-11*** People_Income: People Incomes

| Person ID | Income |
|---|---|
| A | 199,920 |
| B | 26,068 |
| C | 106,439 |
| D | 28,521 |
| E | 142,566 |

**Note** In stepped tax logic, different tax rates apply to various segments of income. For instance, based on the Tax_Rates table, individuals with an income less than $18,200 are taxed at 0%. For incomes exceeding $18,200, different rates apply to different income ranges: 0% for the first $18,200, 19% for the portion from $18,201 to $45,000, 33% for the portion from $45,001 to $120,000, and 37% for the amount above $120,000. For example, the tax calculation for a person with an income of $142,566 (person `E`) is as follows:

```
=0*(18200-0)+0.19*(45000-18201)+0.33*(120000-45001)+0.37*(142566-120001)
```

**Note** The data in this example is provided in an Excel file titled `10 Implementing Stepped Tax Calculations.xlsx`.

To solve this problem in Power Query, load both tables into separate queries named `Tax_Rates` and `People_Income`. Then, you can address the problem using any of the following three solutions.

### Solution 1: Using a Nested if

In the first solution, select the `People_Income` query and change the type of column Income to `number`. Then, from the Add Column tab, add a Custom Column called Tax. Then use the following nested `if` formula in the Custom Column window to add a new column for calculating the tax:

```
=if [Income]<18201
      then 0
else if [Income]<45001
      then 0.19*([Income]-18201)
else if [Income]<120001
      then 0.19*(45000-18201)+0.325*([Income]-45001)
else if [Income]<180001
      then 0.19*(45000-18201)+0.325*(120000-45001)+0.37*([Income]-120001)
else 0.19*(45000-18201)+0.325*(120000-45001)+0.37*(180000-120001)+0.45*
([Income]-180001)
```

The previous formula can be simplified by calculating the results of the arithmetic operations as follows:

```
=if [Income]<18201
      then 0
else if [Income]<45001
      then 0.19*([Income]-18201)
else if [Income]<120001
      then 5091.81+0.325*([Income]-45001)
else if [Income]<180001
      then 5091.81+24374.675+0.37*([Income]-120001)
else 5091.81+24374.675+22199.63+0.45*([Income]-180001)
```

## Solution 2: Using List.Transform()

The first solution was not dynamic as it hardcoded the tax rate information. Additionally, using a nested `if` statement might work for a Tax_Rates table with only a few rows (e.g., up to four), but as the table grows, the formula becomes too long and difficult to manage.

A better approach is to use `List.Transform()` to calculate the applied tax for each row of the Tax_Rates table dynamically. However, since the tax rate information is stored in a table, you need to convert it into a list format that `List.Transform()` can process.

To achieve this conversion, you can use the `Table.ToRows()` function, which transforms the Tax_Rates table into a list where each row is represented as a sublist. The following formula in the formula bar performs this transformation, as shown in Figure 9-35.

```
= Table.ToRows(Tax_Rates)
```

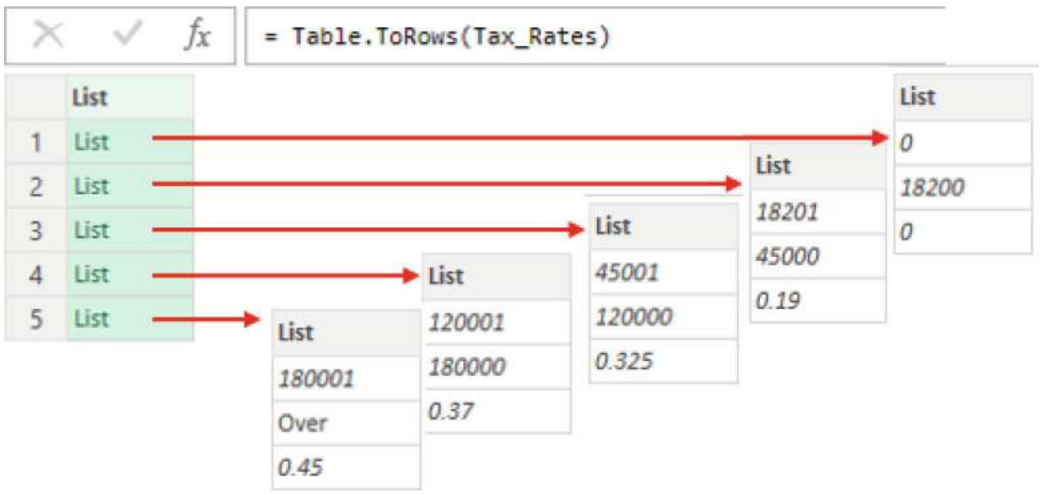


*Figure 9-35* The result of Table.ToRows()

You can use the result of the `Table.ToRows(Tax_Rates)` formula as the first input of `List.Transform()` to calculate the tax amount applied at each tax bracket.

Instead of calculating the tax for all individuals at once, first compute the tax for Person A, whose income is 199,920, with the following formula:

```
=List.Transform(Table.ToRows(Tax_Rates),(x)=>f(x))
```

To determine `f(x)`, consider an example tax bracket from the transformed Tax_Rates table, related to the second row of the table as `{18201, 45000, 0.19}`:

- `18201`: Lower bound of the tax bracket, which is equal to `x{0}`.
- `45000`: Upper bound of the tax bracket, which is equal to `x{0}`.
- `0.19`: Tax rate for this bracket, which is equal to `x{0}`.

So, the tax calculation logic for this bracket is:

- If `income < 18201`, the tax for this bracket is `0`.
- If `income > 45000`, the tax for this bracket is `(45000 - 18201) * 0.19`.
- If `18201 ≤ income ≤ 45000`, the tax for this bracket is `(income - 18201) * 0.19`.

Which simplifies to:

```
if income<18201 then 0 else (List.Min({Income,45000})-18201)*0.19
```

And is further refactored using `List.Max()` to ensure non-negative values:

```
List.Max({0,(List.Min({Income,45000})-18201)*0.19})
```

In the transformation function, you replace the static values with the corresponding list elements:

- 45000 → x{1} (upper bound)
- 18201 → x{0} (lower bound)
- 0.19 → x{2} (tax rate)
- Income → 199,920 (for Person A)

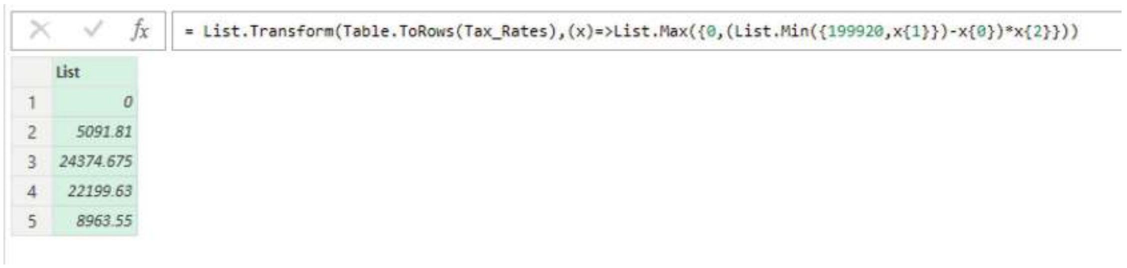
Thus, the transformation function becomes:

```
(x)=>List.Max({0,(List.Min({199920,x{1}})-x{0})*x{2}})
```

Finally, the complete formula that calculates the tax at each tax level for Person A is:

```
= List.Transform(Table.ToRows(Tax_Rates),(x)=>List.Max({0,
(List.Min({199920,x{1}})-x{0})*x{2}}))
```

This will return a list of tax amounts for each tax bracket, which can be summed up to determine the total tax payable, as shown in Figure 9-36.



```
= List.Transform(Table.ToRows(Tax_Rates),(x)=>List.Max({0,(List.Min({199920,x{1}})-x{0})*x{2}}))
```

| | List |
|---|---|
| 1 | 0 |
| 2 | 5091.81 |
| 3 | 24374.675 |
| 4 | 22199.63 |
| 5 | 8963.55 |

***Figure 9-36*** Calculating the tax for each level

**Note** In the Tax_Rates table, the last value in the To column is a text value called Over, instead of a numeric value. Interestingly, the formula still works correctly because `List.Min({199920, "Over"})` returns `199,920`, treating the text as a higher value. However, this behavior might not always be reliable in similar cases, so caution is advised.

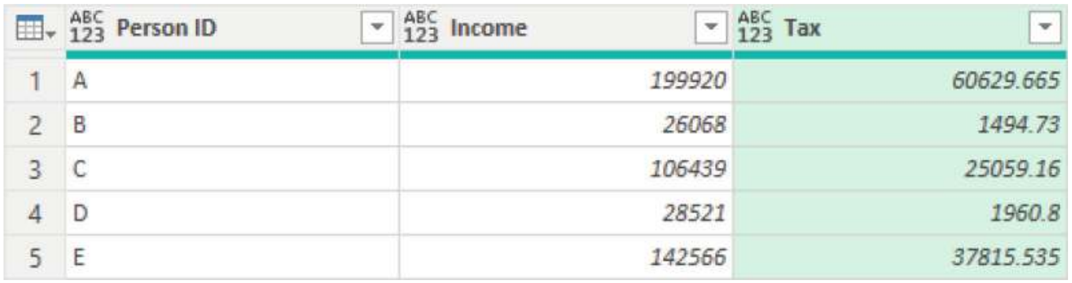
To get the total tax amount for Person A, you sum the tax amounts for each bracket using `List.Sum()`.The revised formula is as follows:

```
= List.Sum(
  List.Transform(
    Table.ToRows(Tax_Rates),
    (x) => List.Max({0, (List.Min({199920, x{1}}) - x{0}) * x{2}})
  )
)
```

This formula applies the tax calculation logic to each bracket and sums the results to determine the total tax payable for Person A.

To calculate the tax for all individuals, select the People Income table and add a Custom Column named Tax using the revised formula (replacing the hardcoded income value (199,920) with the [Income] column reference). This will solve the problem and results in Figure 9-37.

```
= List.Sum(
  List.Transform(
    Table.ToRows(Tax_Rates),
    (x) => List.Max({0, (List.Min({[Income], x{1}}) - x{0}) * x{2}})
  )
)
```



| | Person ID | Income | Tax |
|---|---|---|---|
| 1 | A | 199920 | 60629.665 |
| 2 | B | 26068 | 1494.73 |
| 3 | C | 106439 | 25059.16 |
| 4 | D | 28521 | 1960.8 |
| 5 | E | 142566 | 37815.535 |

***Figure 9-37*** Adding a Tax column

## Solution 3: Using List.Accumulate()

In addition to using `List.Transform()`, you can also use `List.Accumulate()` to solve this problem, following a similar logic. However, the key difference is that with `List.Accumulate()`, you don't need to calculate the tax for each bracket separately and then sum the results. Instead, you can accumulate the tax directly from the initial tax bracket and, for each subsequent bracket, add the tax calculated for that bracket to the total accumulated tax.

For the third input as an accumulator function, you can use the transformation function in `List.Transform()` with some modification. In `List.Transform()`, you used `(x) => f(x)`, where `f(x)` calculates the tax for each bracket. In `List.Accumulate()`, the accumulator function is written as `(s, x) => s + f(x)`, where `s` represents the accumulated tax, `x` is the current tax bracket, and `f(x)` is used in `List.Transform()`.

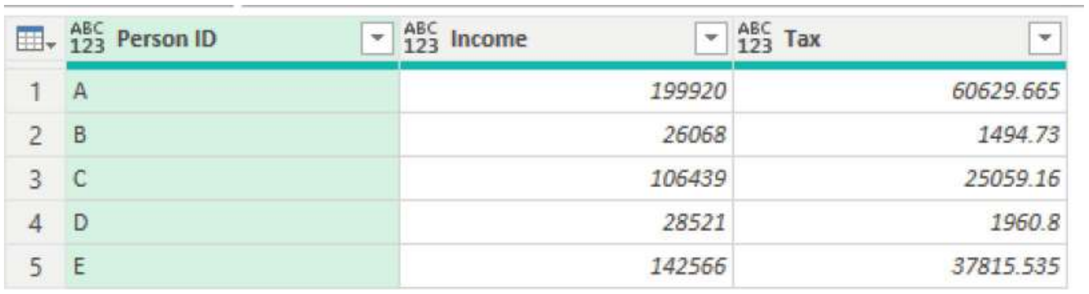
The formula is as follows:

```
= List.Accumulate(
  Table.ToRows(Tax_Rates),
  0,
  (s, x) => s + List.Max({0, (List.Min({[Income], x{1}}) - x{0}) * x{2}})
)
```

Using consistent notation, you can replace `x` with `c` in the accumulator function. The revised formula becomes:

```
= List.Accumulate(
  Table.ToRows(Tax_Rates),
  0,
  (s, c) => s + List.Max({0, (List.Min({[Income], c{1}}) - c{0}) * c{2}})
)
```

This formula can be used in the Custom Column window for the People Income table to calculate the tax of each person, as shown in Figure 9-38.



| | Person ID | Income | Tax |
|---|---|---|---|
| 1 | A | 199920 | 60629.665 |
| 2 | B | 26068 | 1494.73 |
| 3 | C | 106439 | 25059.16 |
| 4 | D | 28521 | 1960.8 |
| 5 | E | 142566 | 37815.535 |

***Figure 9-38*** Adding a Tax column using List.Accumulate()

## Changing Data Granularity

The power consumption data of a house recorded every 30 minutes for different dates is listed in the Source table, as shown in Table 9-12. Convert this data into hourly energy consumption by merging every two columns and summing their values. For example, in the results table, the values in columns `E_0000` and `E_0030` for each row should be summed and presented in a single column named `E_0000`.

***Table 9-12*** Source: Power Consumption

| Date | E_0000 | E_0030 | E_0100 | E_0130 | E_0200 | E_0230 | E_0300 | E_0330 |
|---|---|---|---|---|---|---|---|---|
| 1/04/2012 | 426 | 396 | 340 | 392 | 348 | 378 | 362 | 356 |
| 2/04/2012 | 1872 | 1920 | 1620 | 304 | 230 | 268 | 198 | 248 |
| 3/04/2012 | 766 | 528 | 320 | 474 | 384 | 338 | 326 | 356 |
| 4/04/2012 | 696 | 546 | 408 | 390 | 362 | 384 | 186 | 198 |
| 5/04/2012 | 632 | 490 | 506 | 330 | 364 | 308 | 352 | 318 |
| 6/04/2012 | 734 | 802 | 716 | 246 | 166 | 244 | 202 | 244 |
| 7/04/2012 | 220 | 234 | 170 | 234 | 172 | 228 | 182 | 184 |
| 8/04/2012 | 1094 | 870 | 1720 | 1338 | 534 | 498 | 484 | 528 |
| 9/04/2012 | 834 | 682 | 686 | 664 | 682 | 588 | 516 | 556 |
| 10/04/2012 | 378 | 358 | 304 | 302 | 354 | 304 | 304 | 350 |

**Note** The data in this example is provided in an Excel file titled `11 Changing Data Granularity.xlsx`.

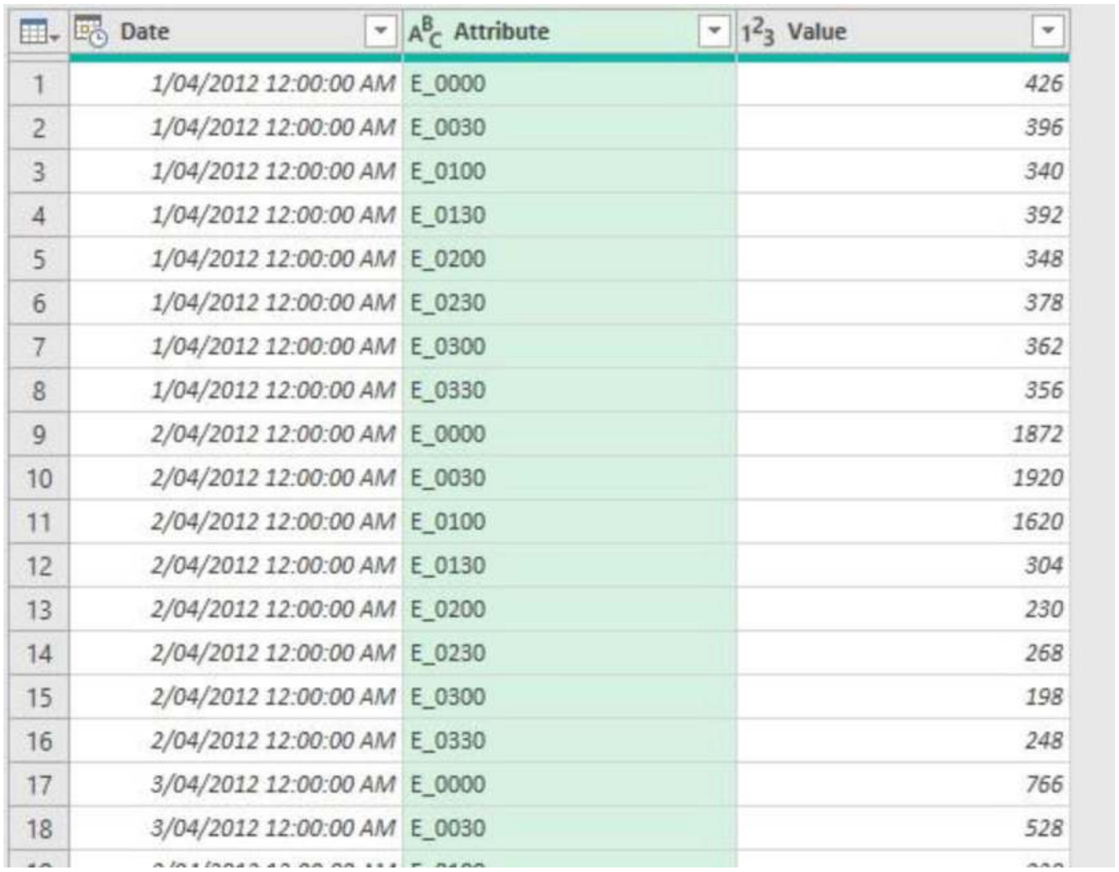
You can use several approaches to solve this problem, and this section explains four different solutions. The first approach is suitable for cases where the column naming follows a specific logic (like this example), while the other solutions are more general and based on unpivoting the `List.Transform()` and `List.Accumulate()` functions. Before talking about the solutions, select all the columns that start with `E` and change their types into `Number`.

**Note** As mentioned, the first proposed solution relies on a specific column name pattern, meaning that even small changes to column names could lead to unintended results. Therefore, in practice, it is recommended to use more dynamic approaches, such as those presented in Solutions 2 and 3.

### Solution 1: Column Name-Based Approach

By looking more closely at the column names, it becomes clear that any pair of columns that should be merged share the same first four characters. By extracting these first four characters, you can identify and group columns with the same prefix. However, this operation cannot be directly applied to columns, as it is impossible to have multiple columns with identical names. Instead, you need to transform the data structure so that these names are represented in rows.

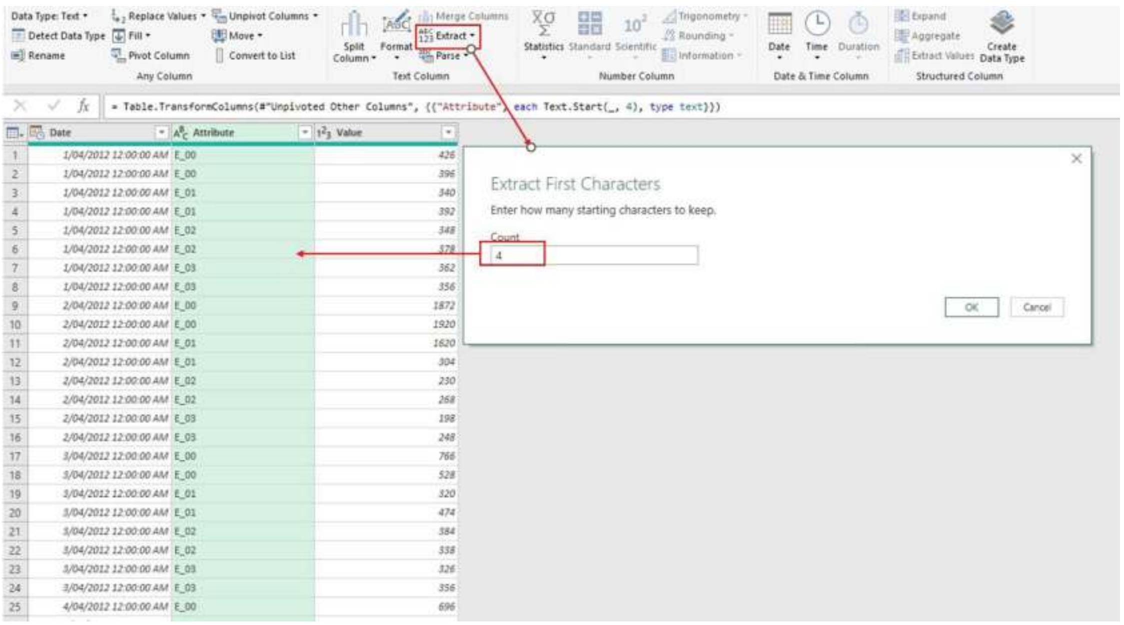
Right-click the Date column and select Unpivot Other Columns to transform the table, as shown in Figure 9-39.



| | Date | Attribute | Value |
|---|---|---|---|
| 1 | 1/04/2012 12:00:00 AM | E_0000 | 426 |
| 2 | 1/04/2012 12:00:00 AM | E_0030 | 396 |
| 3 | 1/04/2012 12:00:00 AM | E_0100 | 340 |
| 4 | 1/04/2012 12:00:00 AM | E_0130 | 392 |
| 5 | 1/04/2012 12:00:00 AM | E_0200 | 348 |
| 6 | 1/04/2012 12:00:00 AM | E_0230 | 378 |
| 7 | 1/04/2012 12:00:00 AM | E_0300 | 362 |
| 8 | 1/04/2012 12:00:00 AM | E_0330 | 356 |
| 9 | 2/04/2012 12:00:00 AM | E_0000 | 1872 |
| 10 | 2/04/2012 12:00:00 AM | E_0030 | 1920 |
| 11 | 2/04/2012 12:00:00 AM | E_0100 | 1620 |
| 12 | 2/04/2012 12:00:00 AM | E_0130 | 304 |
| 13 | 2/04/2012 12:00:00 AM | E_0200 | 230 |
| 14 | 2/04/2012 12:00:00 AM | E_0230 | 268 |
| 15 | 2/04/2012 12:00:00 AM | E_0300 | 198 |
| 16 | 2/04/2012 12:00:00 AM | E_0330 | 248 |
| 17 | 3/04/2012 12:00:00 AM | E_0000 | 766 |
| 18 | 3/04/2012 12:00:00 AM | E_0030 | 528 |

***Figure 9-39*** Unpivoting columns.

Then, select the Attribute column. From the Transform tab, under the Text Column section, choose Extract and then First Characters. In the open window, select four characters to get the result shown in Figure 9-40.



```
= Table.TransformColumns(#"Unpivoted Other Columns", {{"Attribute", each Text.Start(_, 4), type text}})
```

Extract First Characters

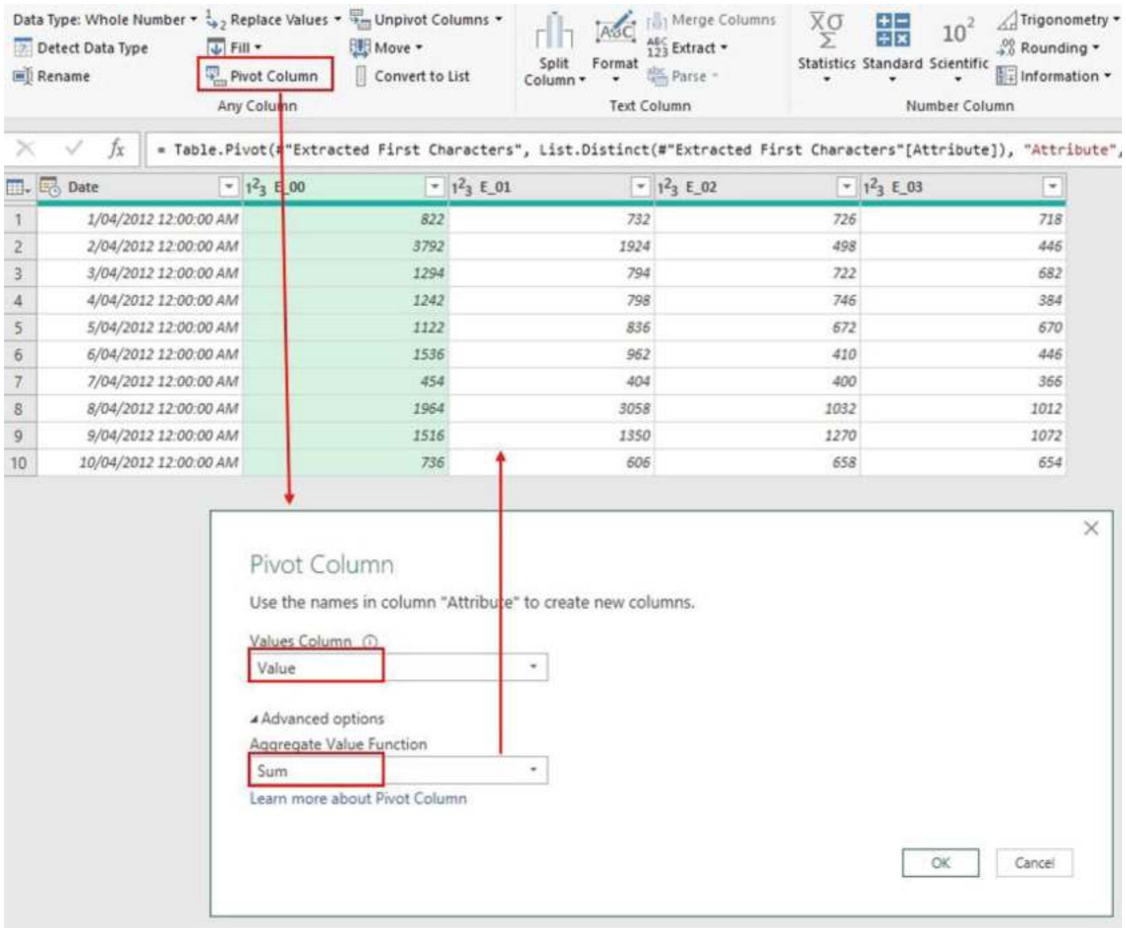
Enter how many starting characters to keep.

Count: 4

| | Date | Attribute | Value |
|---|---|---|---|
| 1 | 1/04/2012 12:00:00 AM | E_00 | 426 |
| 2 | 1/04/2012 12:00:00 AM | E_00 | 396 |
| 3 | 1/04/2012 12:00:00 AM | E_01 | 340 |
| 4 | 1/04/2012 12:00:00 AM | E_01 | 392 |
| 5 | 1/04/2012 12:00:00 AM | E_02 | 348 |
| 6 | 1/04/2012 12:00:00 AM | E_02 | 378 |
| 7 | 1/04/2012 12:00:00 AM | E_03 | 362 |
| 8 | 1/04/2012 12:00:00 AM | E_03 | 356 |
| 9 | 2/04/2012 12:00:00 AM | E_00 | 1872 |
| 10 | 2/04/2012 12:00:00 AM | E_00 | 1920 |
| 11 | 2/04/2012 12:00:00 AM | E_01 | 1620 |
| 12 | 2/04/2012 12:00:00 AM | E_01 | 304 |
| 13 | 2/04/2012 12:00:00 AM | E_02 | 230 |
| 14 | 2/04/2012 12:00:00 AM | E_02 | 268 |
| 15 | 2/04/2012 12:00:00 AM | E_03 | 198 |
| 16 | 2/04/2012 12:00:00 AM | E_03 | 248 |
| 17 | 3/04/2012 12:00:00 AM | E_00 | 766 |
| 18 | 3/04/2012 12:00:00 AM | E_00 | 528 |
| 19 | 3/04/2012 12:00:00 AM | E_01 | 320 |
| 20 | 3/04/2012 12:00:00 AM | E_01 | 474 |
| 21 | 3/04/2012 12:00:00 AM | E_02 | 384 |
| 22 | 3/04/2012 12:00:00 AM | E_02 | 338 |
| 23 | 3/04/2012 12:00:00 AM | E_03 | 326 |
| 24 | 3/04/2012 12:00:00 AM | E_03 | 356 |
| 25 | 4/04/2012 12:00:00 AM | E_00 | 696 |

***Figure 9-40*** Select the first four characters

In the result table, the values on the Attribute column for every two rows are the same. Select the Attribute column. From the Transform tab, choose Pivot Column. In the Pivot Column window, set Value as the Value column, and in the Advanced tab, select Sum as the aggregation method to produce the final table shown in Figure 9-41.



```
= Table.Pivot(#"Extracted First Characters", List.Distinct(#"Extracted First Characters"[Attribute]), "Attribute",
```

|  | Date | E_00 | E_01 | E_02 | E_03 |
|---|---|---|---|---|---|
| 1 | 1/04/2012 12:00:00 AM | 822 | 732 | 726 | 718 |
| 2 | 2/04/2012 12:00:00 AM | 3792 | 1924 | 498 | 446 |
| 3 | 3/04/2012 12:00:00 AM | 1294 | 794 | 722 | 682 |
| 4 | 4/04/2012 12:00:00 AM | 1242 | 798 | 746 | 384 |
| 5 | 5/04/2012 12:00:00 AM | 1122 | 836 | 672 | 670 |
| 6 | 6/04/2012 12:00:00 AM | 1536 | 962 | 410 | 446 |
| 7 | 7/04/2012 12:00:00 AM | 454 | 404 | 400 | 366 |
| 8 | 8/04/2012 12:00:00 AM | 1964 | 3058 | 1032 | 1012 |
| 9 | 9/04/2012 12:00:00 AM | 1516 | 1350 | 1270 | 1072 |
| 10 | 10/04/2012 12:00:00 AM | 736 | 606 | 658 | 654 |

Pivot Column

Use the names in column "Attribute" to create new columns.

Values Column: Value

Advanced options

Aggregate Value Function: Sum

*Figure 9-41* The result of pivoting

This method works well if the column naming is consistent and follows a specific pattern.

**Note** This approach works, and the output data is pivoted—making it human-readable, which is good. However, for machine processing and BI, unpivoted data is generally preferred (i.e., a structure with three columns: Date, Time, and Consumption). Additionally, creating a table with hundreds of columns is considered poor practice for data analysts, as it can lead to column limits and significant performance slowdowns when processing large datasets.

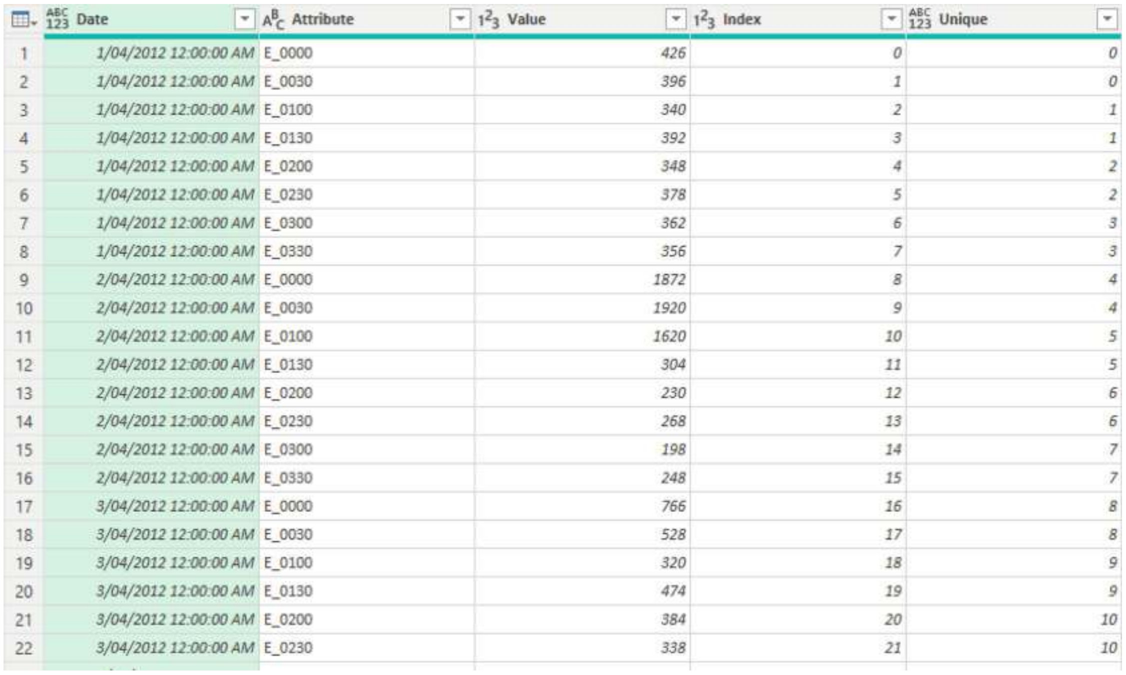
## Solution 2: Using the Unpivoting Column

The previous solution works when the column names follow a specific pattern. However, this solution is based on unpivoted columns. Consider the unpivoted table shown in Figure 9-39.

If there is no specific pattern in the column names, in the next step, you can use the group command to combine every two rows together. For grouping, you need a column with a unique value for every pair of rows.

To create this new column, add an Index column starting at `0`. Then, add a custom column named Unique using the following formula in the Custom Column window, to generate a unique value for every other row, as shown in Figure 9-42.

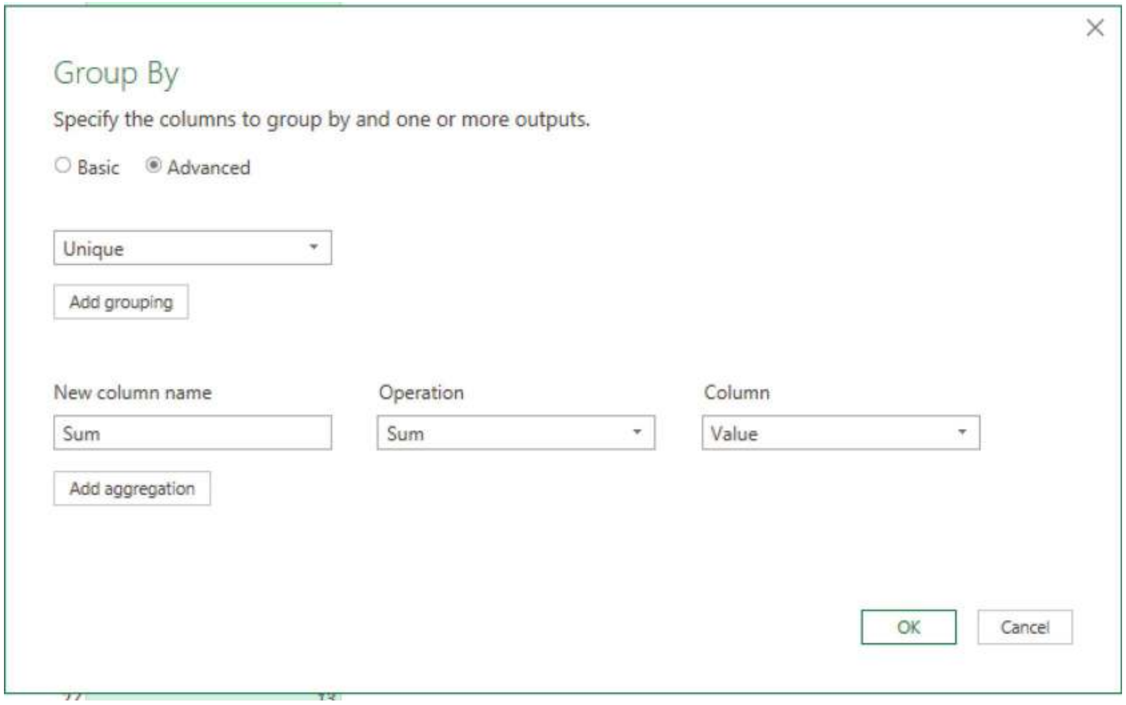
```
=Number.IntegerDivide([Index], 2)
```



| | Date | Attribute | Value | Index | Unique |
|---|---|---|---|---|---|
| 1 | 1/04/2012 12:00:00 AM | E_0000 | 426 | 0 | 0 |
| 2 | 1/04/2012 12:00:00 AM | E_0030 | 396 | 1 | 0 |
| 3 | 1/04/2012 12:00:00 AM | E_0100 | 340 | 2 | 1 |
| 4 | 1/04/2012 12:00:00 AM | E_0130 | 392 | 3 | 1 |
| 5 | 1/04/2012 12:00:00 AM | E_0200 | 348 | 4 | 2 |
| 6 | 1/04/2012 12:00:00 AM | E_0230 | 378 | 5 | 2 |
| 7 | 1/04/2012 12:00:00 AM | E_0300 | 362 | 6 | 3 |
| 8 | 1/04/2012 12:00:00 AM | E_0330 | 356 | 7 | 3 |
| 9 | 2/04/2012 12:00:00 AM | E_0000 | 1872 | 8 | 4 |
| 10 | 2/04/2012 12:00:00 AM | E_0030 | 1920 | 9 | 4 |
| 11 | 2/04/2012 12:00:00 AM | E_0100 | 1620 | 10 | 5 |
| 12 | 2/04/2012 12:00:00 AM | E_0130 | 304 | 11 | 5 |
| 13 | 2/04/2012 12:00:00 AM | E_0200 | 230 | 12 | 6 |
| 14 | 2/04/2012 12:00:00 AM | E_0230 | 268 | 13 | 6 |
| 15 | 2/04/2012 12:00:00 AM | E_0300 | 198 | 14 | 7 |
| 16 | 2/04/2012 12:00:00 AM | E_0330 | 248 | 15 | 7 |
| 17 | 3/04/2012 12:00:00 AM | E_0000 | 766 | 16 | 8 |
| 18 | 3/04/2012 12:00:00 AM | E_0030 | 528 | 17 | 8 |
| 19 | 3/04/2012 12:00:00 AM | E_0100 | 320 | 18 | 9 |
| 20 | 3/04/2012 12:00:00 AM | E_0130 | 474 | 19 | 9 |
| 21 | 3/04/2012 12:00:00 AM | E_0200 | 384 | 20 | 10 |
| 22 | 3/04/2012 12:00:00 AM | E_0230 | 338 | 21 | 10 |

***Figure 9-42*** Adding the Unique column

Next, right-click the Unique column and select the Group By command, using the settings shown in Figure 9-43.



Group By

Specify the columns to group by and one or more outputs.

Basic [✓ Advanced]

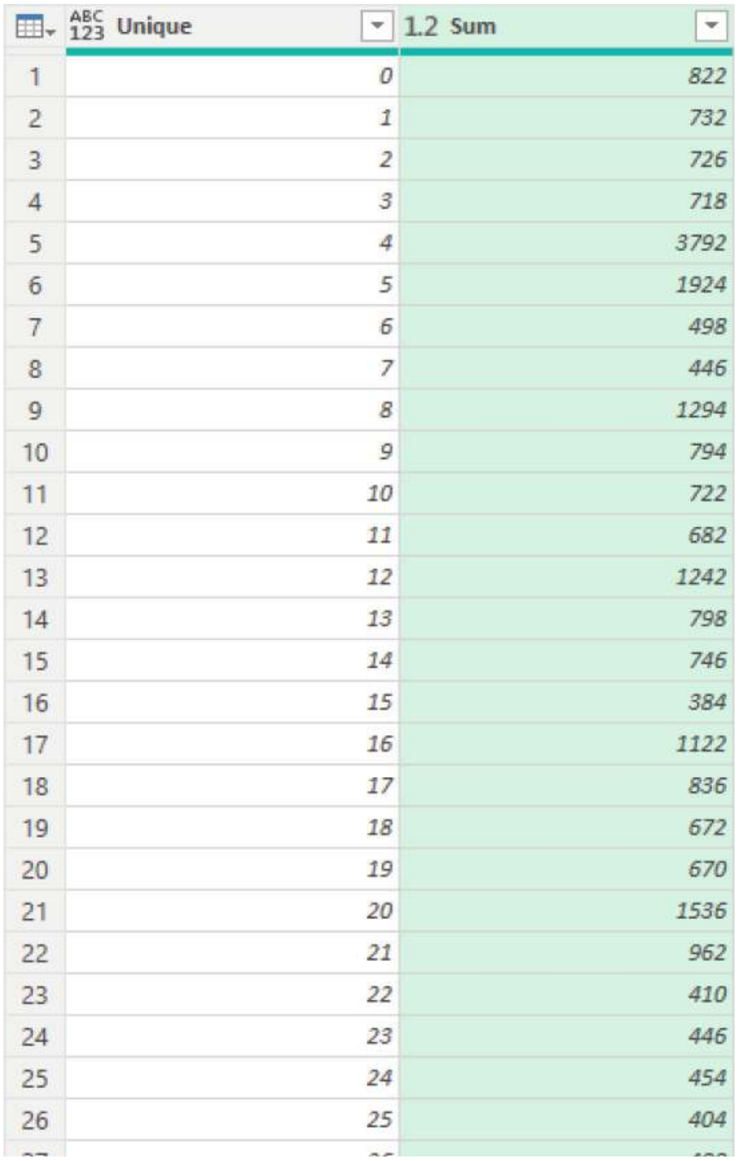
Unique

| New column name | Operation | Column |
|---|---|---|
| Sum | Sum | Value |

***Figure 9-43*** Settings for the grouping

Clicking OK will result in Figure 9-44 and generate the following formula in the formula bar:

```
= Table.Group(#"Added Custom", {"Unique"}, {{"Sum", each List.Sum([Value]),
type number}})
```

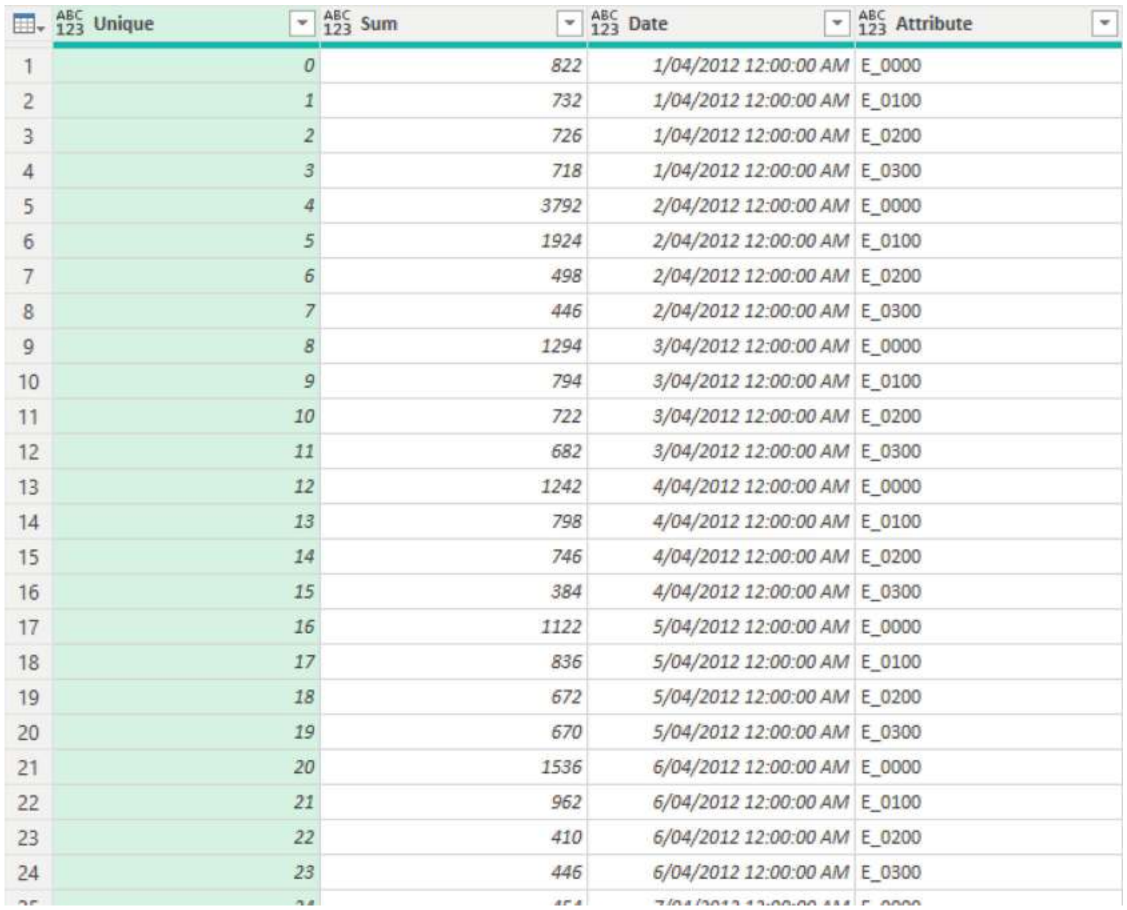


| | Unique | Sum |
|---|---|---|
| 1 | 0 | 822 |
| 2 | 1 | 732 |
| 3 | 2 | 726 |
| 4 | 3 | 718 |
| 5 | 4 | 3792 |
| 6 | 5 | 1924 |
| 7 | 6 | 498 |
| 8 | 7 | 446 |
| 9 | 8 | 1294 |
| 10 | 9 | 794 |
| 11 | 10 | 722 |
| 12 | 11 | 682 |
| 13 | 12 | 1242 |
| 14 | 13 | 798 |
| 15 | 14 | 746 |
| 16 | 15 | 384 |
| 17 | 16 | 1122 |
| 18 | 17 | 836 |
| 19 | 18 | 672 |
| 20 | 19 | 670 |
| 21 | 20 | 1536 |
| 22 | 21 | 962 |
| 23 | 22 | 410 |
| 24 | 23 | 446 |
| 25 | 24 | 454 |
| 26 | 25 | 404 |

***Figure 9-44*** The result of grouping

As presented in Chapter 6, to extract the Date value and the column name value, rewrite the previous formula as follows, which results in Figure 9-45.

```
= Table.Group(
  #"Added Custom",
  {"Unique"},
  {{"Sum", each List.Sum([Value])}, {"Date", each _[Date]{0}}, {"Attribute",
each _[Attribute]{0}}}
)
```



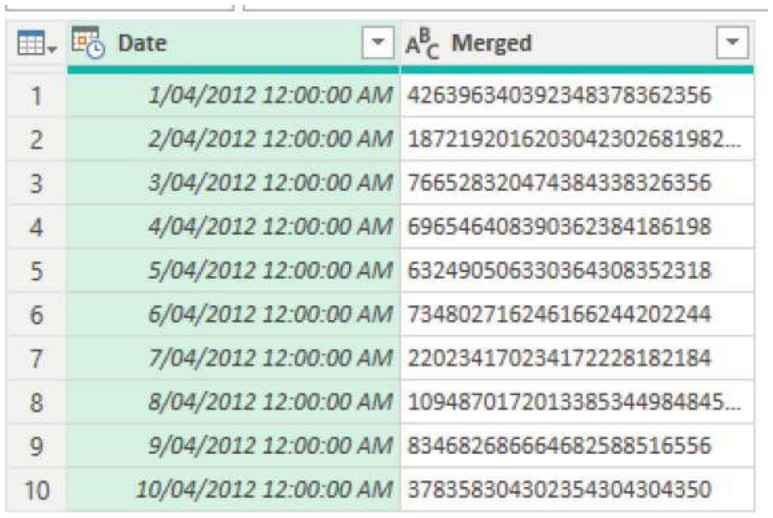
| | Unique | Sum | Date | Attribute |
|---|---|---|---|---|
| 1 | 0 | 822 | 1/04/2012 12:00:00 AM | E_0000 |
| 2 | 1 | 732 | 1/04/2012 12:00:00 AM | E_0100 |
| 3 | 2 | 726 | 1/04/2012 12:00:00 AM | E_0200 |
| 4 | 3 | 718 | 1/04/2012 12:00:00 AM | E_0300 |
| 5 | 4 | 3792 | 2/04/2012 12:00:00 AM | E_0000 |
| 6 | 5 | 1924 | 2/04/2012 12:00:00 AM | E_0100 |
| 7 | 6 | 498 | 2/04/2012 12:00:00 AM | E_0200 |
| 8 | 7 | 446 | 2/04/2012 12:00:00 AM | E_0300 |
| 9 | 8 | 1294 | 3/04/2012 12:00:00 AM | E_0000 |
| 10 | 9 | 794 | 3/04/2012 12:00:00 AM | E_0100 |
| 11 | 10 | 722 | 3/04/2012 12:00:00 AM | E_0200 |
| 12 | 11 | 682 | 3/04/2012 12:00:00 AM | E_0300 |
| 13 | 12 | 1242 | 4/04/2012 12:00:00 AM | E_0000 |
| 14 | 13 | 798 | 4/04/2012 12:00:00 AM | E_0100 |
| 15 | 14 | 746 | 4/04/2012 12:00:00 AM | E_0200 |
| 16 | 15 | 384 | 4/04/2012 12:00:00 AM | E_0300 |
| 17 | 16 | 1122 | 5/04/2012 12:00:00 AM | E_0000 |
| 18 | 17 | 836 | 5/04/2012 12:00:00 AM | E_0100 |
| 19 | 18 | 672 | 5/04/2012 12:00:00 AM | E_0200 |
| 20 | 19 | 670 | 5/04/2012 12:00:00 AM | E_0300 |
| 21 | 20 | 1536 | 6/04/2012 12:00:00 AM | E_0000 |
| 22 | 21 | 962 | 6/04/2012 12:00:00 AM | E_0100 |
| 23 | 22 | 410 | 6/04/2012 12:00:00 AM | E_0200 |
| 24 | 23 | 446 | 6/04/2012 12:00:00 AM | E_0300 |

***Figure 9-45*** The result of revised grouping

In the next step, remove the Unique column. Then, similar to the previous solution, select the Attribute column and apply the Pivot command to solve the problem. This will rearrange the data by turning the unique values from the Attribute column into new columns, resulting in the desired output.

## Solution 3: Using List.Transform()

Besides what was presented in Solutions 1 and 2, the `List.Transform()` function can also be used to solve this problem. In this approach, after changing the column types to numbers, you can select all the columns that need to be merged (all except the first one), right-click one of them, and choose Merge Columns. In the dialog box that appears, select None as the separator and click OK. This will concatenate the values, as shown in Figure 9-46.



| | Date | Merged |
|---|---|---|
| 1 | 1/04/2012 12:00:00 AM | 426396340392348378362356 |
| 2 | 2/04/2012 12:00:00 AM | 1872192016203042302681982... |
| 3 | 3/04/2012 12:00:00 AM | 766528320474384338326356 |
| 4 | 4/04/2012 12:00:00 AM | 696546408390362384186198 |
| 5 | 5/04/2012 12:00:00 AM | 632490506330364308352318 |
| 6 | 6/04/2012 12:00:00 AM | 734802716246166244202244 |
| 7 | 7/04/2012 12:00:00 AM | 220234170234172228182184 |
| 8 | 8/04/2012 12:00:00 AM | 1094870172013385344984845... |
| 9 | 9/04/2012 12:00:00 AM | 834682686664682588516556 |
| 10 | 10/04/2012 12:00:00 AM | 378358304302354304304350 |

***Figure 9-46*** Combining the columns

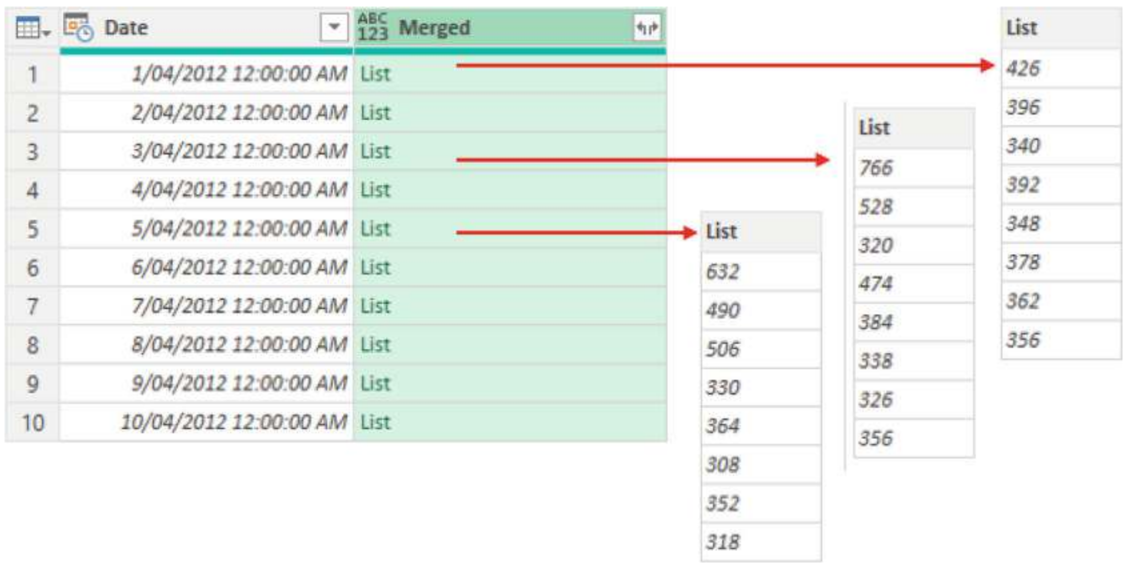
The generated formula in the formula bar will be as follows:

```
= Table.CombineColumns(
  Table.TransformColumnTypes(
    #"Changed Type",
    {
      {"E_0000", type text},
      {"E_0030", type text},
      {"E_0100", type text},
      {"E_0130", type text},
      {"E_0200", type text},
      {"E_0230", type text},
      {"E_0300", type text},
      {"E_0330", type text}
    },
    "en-AU"
  ),
  {"E_0000", "E_0030", "E_0100", "E_0130", "E_0200", "E_0230", "E_0300",
"E_0330"},
  Combiner.CombineTextByDelimiter("", QuoteStyle.None),
  "Merged"
)
```

As what was presented in Example 9 in Chapter 4, you can replace the first argument called `Table.TransformColumnTypes(...)` with the name of the previous step, such as `#"Changed Type"`. Additionally, replace the combiner in the fourth argument `Combiner.CombineTextByDelimiter("", QuoteStyle.None)` with `each _` and rewrite the formula as follows:

```
=Table.CombineColumns(
  #"Changed Type",
  {"E_0000", "E_0030", "E_0100", "E_0130", "E_0200", "E_0230", "E_0300",
"E_0330"},
  each _,
  "Merged"
)
```

This formula will present all the values of the merged column into a list, as shown in Figure 9-47.



| | Date | Merged |
|---|---|---|
| 1 | 1/04/2012 12:00:00 AM | List |
| 2 | 2/04/2012 12:00:00 AM | List |
| 3 | 3/04/2012 12:00:00 AM | List |
| 4 | 4/04/2012 12:00:00 AM | List |
| 5 | 5/04/2012 12:00:00 AM | List |
| 6 | 6/04/2012 12:00:00 AM | List |
| 7 | 7/04/2012 12:00:00 AM | List |
| 8 | 8/04/2012 12:00:00 AM | List |
| 9 | 9/04/2012 12:00:00 AM | List |
| 10 | 10/04/2012 12:00:00 AM | List |

| List |
|---|
| 632 |
| 490 |
| 506 |
| 330 |
| 364 |
| 308 |
| 352 |
| 318 |

| List |
|---|
| 766 |
| 528 |
| 320 |
| 474 |
| 384 |
| 338 |
| 326 |
| 356 |

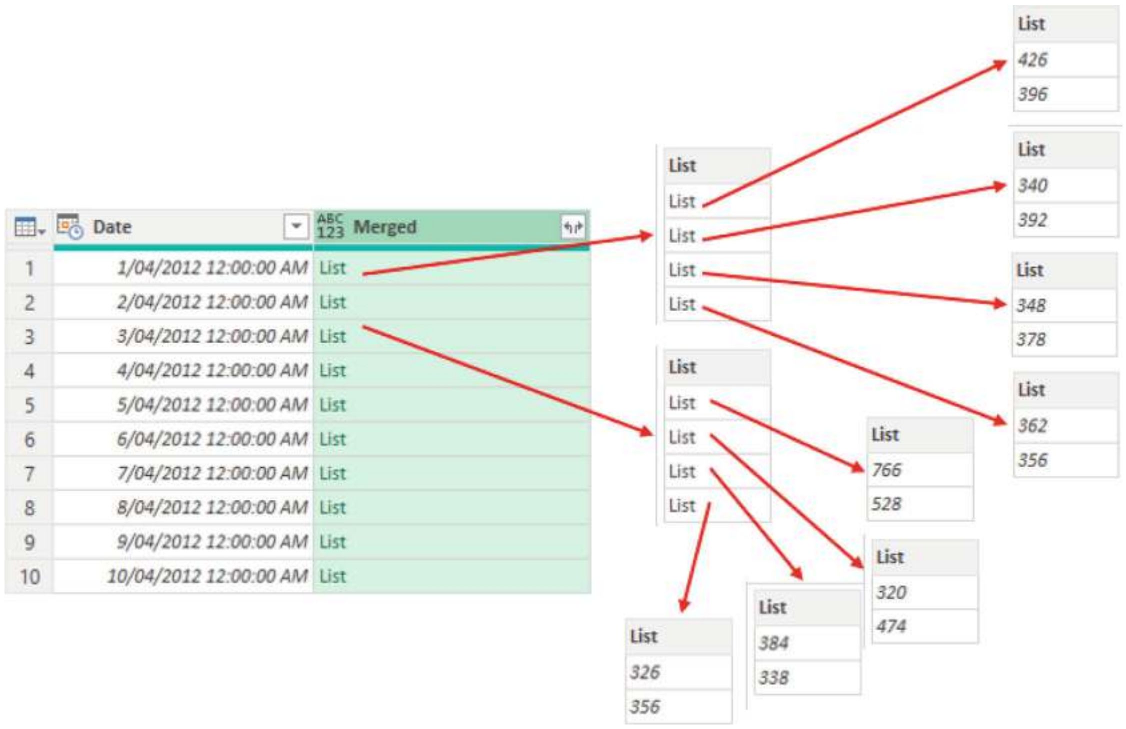
| List |
|---|
| 426 |
| 396 |
| 340 |
| 392 |
| 348 |
| 378 |
| 362 |
| 356 |

***Figure 9-47*** Combining the column after the revised formula

To make the solution more dynamic without changing the result, you can replace the second argument with `List.Skip(Table.ColumnNames(#"Changed Type"))` and rewrite the formula as follows:

```
= Table.CombineColumns(
  #"Changed Type",
  {"E_0000", "E_0030", "E_0100", "E_0130", "E_0200", "E_0230", "E_0300",
"E_0330"},
  each _,
  "Merged"
)
```

Here, the result of `each _` is a list that includes the values of the row. Replacing `each _` with `each List.Split(_,2)` will change the result and provide every two values in a sublist, as shown in Figure 9-48.



| | Date | Merged |
|---|---|---|
| 1 | 1/04/2012 12:00:00 AM | List |
| 2 | 2/04/2012 12:00:00 AM | List |
| 3 | 3/04/2012 12:00:00 AM | List |
| 4 | 4/04/2012 12:00:00 AM | List |
| 5 | 5/04/2012 12:00:00 AM | List |
| 6 | 6/04/2012 12:00:00 AM | List |
| 7 | 7/04/2012 12:00:00 AM | List |
| 8 | 8/04/2012 12:00:00 AM | List |
| 9 | 9/04/2012 12:00:00 AM | List |
| 10 | 10/04/2012 12:00:00 AM | List |

| List |
|---|
| List |
| List |
| List |
| List |

| List |
|---|
| 426 |
| 396 |

| List |
|---|
| 340 |
| 392 |

| List |
|---|
| 348 |
| 378 |

| List |
|---|
| 362 |
| 356 |

| List |
|---|
| List |
| List |
| List |
| List |

| List |
|---|
| 766 |
| 528 |

| List |
|---|
| 320 |
| 474 |

| List |
|---|
| 384 |
| 338 |

| List |
|---|
| 326 |
| 356 |

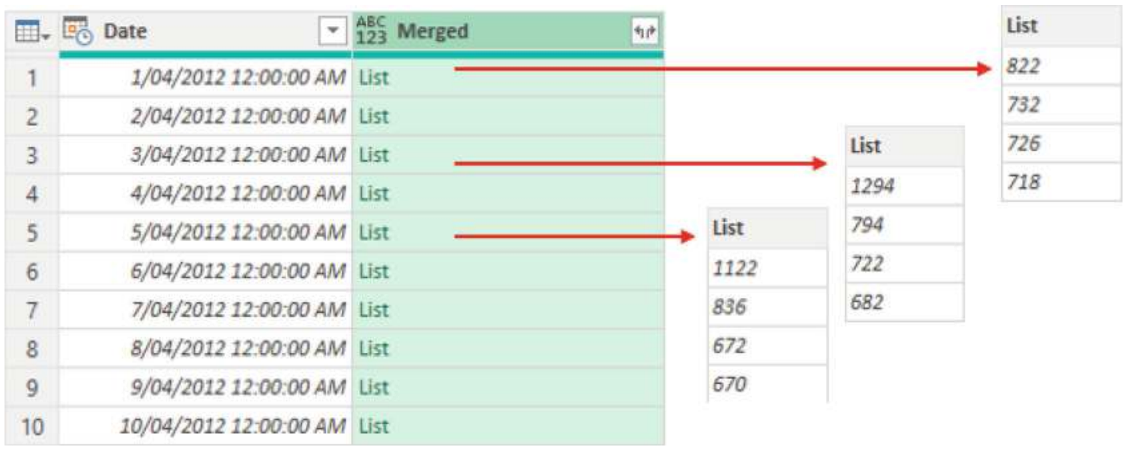
***Figure 9-48*** The result of using List.Split()

So each _ for the first row results in `{426,396,340,392,348,378,362,356}`, and `each List.Split(_,2)` will change the result to `{{426,396},{340,392},{348,378},{362,356}}`.

Here, you can use `List.Transform()` to replace each sublist with the sum of its values. Using `each List.Transform(List.Split(_,2), (x)=>List.Sum(x))` means replace each sublist by the sum of the values in it.

Revising the formula as shown here will result in Figure 9-49.

```
= Table.CombineColumns(
  #"Changed Type",
  List.Skip(Table.ColumnNames(#"Changed Type")),
  each List.Transform(List.Split(_, 2), (x) => List.Sum(x)),
  "Merged"
)
```



| | Date | Merged |
|---|---|---|
| 1 | 1/04/2012 12:00:00 AM | List |
| 2 | 2/04/2012 12:00:00 AM | List |
| 3 | 3/04/2012 12:00:00 AM | List |
| 4 | 4/04/2012 12:00:00 AM | List |
| 5 | 5/04/2012 12:00:00 AM | List |
| 6 | 6/04/2012 12:00:00 AM | List |
| 7 | 7/04/2012 12:00:00 AM | List |
| 8 | 8/04/2012 12:00:00 AM | List |
| 9 | 9/04/2012 12:00:00 AM | List |
| 10 | 10/04/2012 12:00:00 AM | List |

| List |
|---|
| 822 |
| 732 |
| 726 |
| 718 |

| List |
|---|
| 1294 |
| 794 |
| 722 |
| 682 |

| List |
|---|
| 1122 |
| 836 |
| 672 |
| 670 |

***Figure 9-49*** The result of adding List.Transform()

The splitting command can be applied to the Merged column in the result table to separate the values into individual columns. However, it is often more efficient to first convert the list values into records with meaningful names, and then expand the new column to include these records.

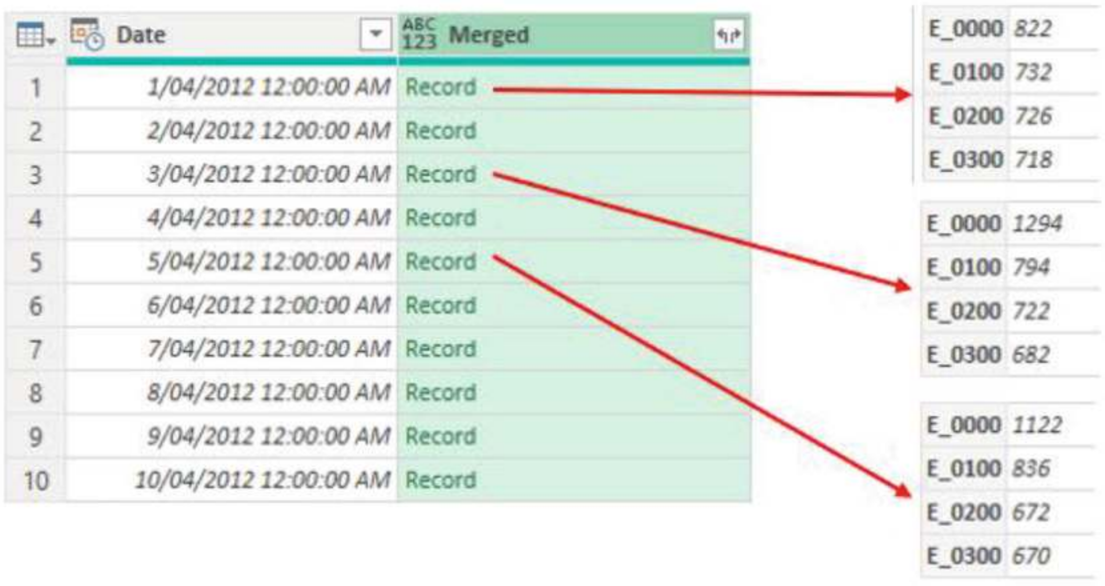
To achieve this, you can use the `Record.FromList()` function, which takes two arguments: the list of values and the corresponding field names. The list of values is already generated using `List.Transform()`, as demonstrated earlier. For the field names, instead of manually specifying a list like `{"E_0000", "E_0100", "E_0200", "E_0300"}`, you can dynamically generate the names.

To do this, you can use `List.Skip(Table.ColumnNames(#"Changed Type"))` to get all the column names (e.g., `{"E_0000"`, `"E_0030"`, `"E_0100"`, `"E_0130"`, `"E_0200"`, `"E_0230"`, `"E_0300"`, and `"E_0330"}`). Then, you use `List.Alternate()` to select every other item in this list, resulting in the desired field names, such as `{"E_0000", "E_0100", "E_0200", "E_0300"}`.

```
List.Alternate(List.Skip(Table.ColumnNames(#"Changed Type")),1,1,1)
```

The revised formula is as follows and results in Figure 9-50:

```
= Table.CombineColumns(
  #"Changed Type",
  List.Skip(Table.ColumnNames(#"Changed Type")),
  each Record.FromList(
    List.Transform(List.Split(_, 2), (x) => List.Sum(x)),
    List.Alternate(List.Skip(Table.ColumnNames(#"Changed Type")), 1, 1, 1)
  ),
  "Merged"
)
```



| | Date | Merged |
|---|---|---|
| 1 | 1/04/2012 12:00:00 AM | Record |
| 2 | 2/04/2012 12:00:00 AM | Record |
| 3 | 3/04/2012 12:00:00 AM | Record |
| 4 | 4/04/2012 12:00:00 AM | Record |
| 5 | 5/04/2012 12:00:00 AM | Record |
| 6 | 6/04/2012 12:00:00 AM | Record |
| 7 | 7/04/2012 12:00:00 AM | Record |
| 8 | 8/04/2012 12:00:00 AM | Record |
| 9 | 9/04/2012 12:00:00 AM | Record |
| 10 | 10/04/2012 12:00:00 AM | Record |

| | |
|---|---|
| E_0000 | 822 |
| E_0100 | 732 |
| E_0200 | 726 |
| E_0300 | 718 |

| | |
|---|---|
| E_0000 | 1294 |
| E_0100 | 794 |
| E_0200 | 722 |
| E_0300 | 682 |

| | |
|---|---|
| E_0000 | 1122 |
| E_0100 | 836 |
| E_0200 | 672 |
| E_0300 | 670 |

***Figure 9-50*** Converting the items to a record

By expanding the Merged column, you solve the problem.

**Note** In this solution, you first combine the columns, and the values of selected columns are provided in the list using `each _` as a combiner. However, when you add a custom column and using _ as the formula in the Custom Column window, all the values of that row will be presented as a list. Using `List.Skip(_)` will exclude the value from the first column, and then you can apply the same solution as before in the Custom Column window to solve the problem.

## Solution 4: Using List.Accumulate()

Besides the solution presented earlier, where all columns are combined at once, you can use `List.Accumulate()` to combine every two columns in separate iterations. To achieve this, let's first combine two sample columns and extract the formula for combining them in Power Query.

After converting the values of columns into number, select the `E_0000` and `E_0030` columns, right-click one of them, and choose Merge Columns. However, as shown in Figure 9-51, you cannot select `Sum` as a merging operation, so like the previous solution, select None as the separator and click OK.

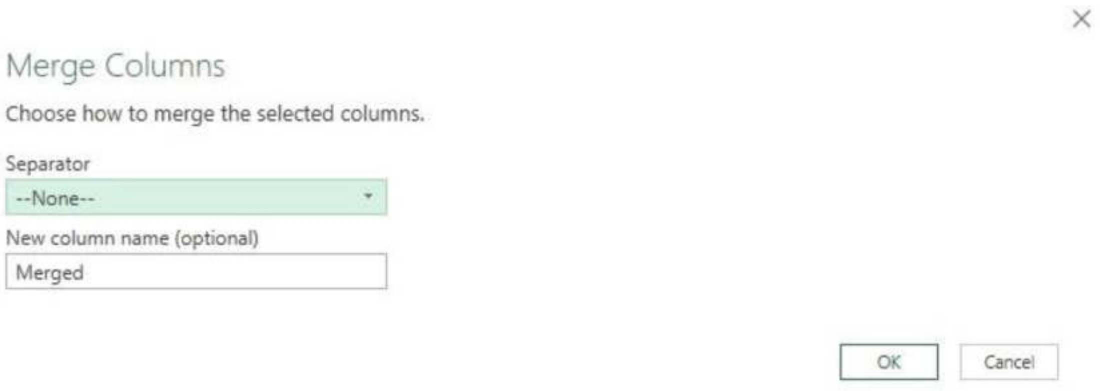
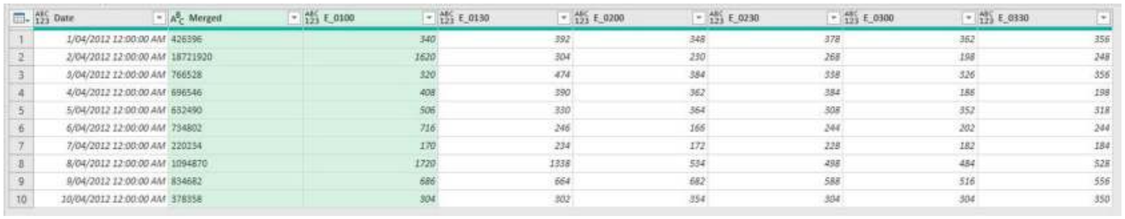

Merge Columns
Choose how to merge the selected columns.
Separator
--None--
New column name (optional)
Merged
OK
Cancel

***Figure 9-51*** Merge setting

This action concatenates the values of the selected columns and presents the result in a new column called Merged, as demonstrated in Figure 9-52 and based on the following formula generated in the formula bar.

```
= Table.CombineColumns(
      Table.TransformColumnTypes(#"Changed Type", {{"E_0000", type text},
{"E_0030", type text}}, "en-AU"),
      {"E_0000", "E_0030"},
      Combiner.CombineTextByDelimiter("", QuoteStyle.None),
      "Merged")
```



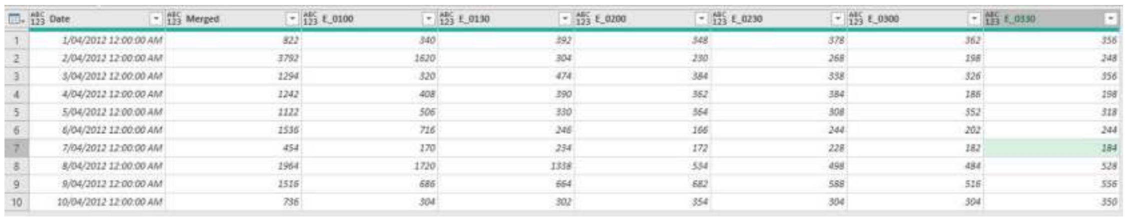
| | Date | Merged | E_0100 | E_0130 | E_0200 | E_0230 | E_0300 | E_0330 |
|---|---|---|---|---|---|---|---|---|
| 1 | 1/04/2012 12:00:00 AM | 426396 | 340 | 392 | 348 | 378 | 362 | 356 |
| 2 | 2/04/2012 12:00:00 AM | 18721920 | 1620 | 304 | 230 | 268 | 198 | 248 |
| 3 | 3/04/2012 12:00:00 AM | 766528 | 320 | 474 | 384 | 338 | 326 | 356 |
| 4 | 4/04/2012 12:00:00 AM | 696546 | 408 | 390 | 362 | 384 | 186 | 198 |
| 5 | 5/04/2012 12:00:00 AM | 632490 | 506 | 330 | 364 | 308 | 352 | 318 |
| 6 | 6/04/2012 12:00:00 AM | 734802 | 716 | 246 | 166 | 244 | 202 | 244 |
| 7 | 7/04/2012 12:00:00 AM | 220234 | 170 | 234 | 172 | 228 | 182 | 184 |
| 8 | 8/04/2012 12:00:00 AM | 1094870 | 1720 | 1338 | 534 | 498 | 484 | 528 |
| 9 | 9/04/2012 12:00:00 AM | 834682 | 686 | 664 | 682 | 588 | 516 | 556 |
| 10 | 10/04/2012 12:00:00 AM | 378358 | 304 | 302 | 354 | 304 | 304 | 350 |

***Figure 9-52*** The result of merge

Since the selected columns are of type `number` and the merging logic specified in the third argument is `Combiner.CombineTextByDelimiter`, the initial step involves converting the column types to `text` using `Table.TransformColumnTypes`. After that, the values are combined.

However, in this example, the values need to be summed rather than concatenated. Therefore, the step to convert the values type to `text` is unnecessary, and the formula can be modified to directly summing the values, as shown here and resulting in Figure 9-53.

```
= Table.CombineColumns(
      #"Changed Type",
      {"E_0000", "E_0030"},
      List.Sum,
      "Merged")
```



| | Date | Merged | E_0100 | E_0130 | E_0200 | E_0230 | E_0300 | E_0330 |
|---|---|---|---|---|---|---|---|---|
| 1 | 1/04/2012 12:00:00 AM | 822 | 340 | 392 | 348 | 378 | 362 | 356 |
| 2 | 2/04/2012 12:00:00 AM | 3792 | 1620 | 304 | 230 | 268 | 198 | 248 |
| 3 | 3/04/2012 12:00:00 AM | 1294 | 320 | 474 | 384 | 338 | 326 | 356 |
| 4 | 4/04/2012 12:00:00 AM | 1242 | 408 | 390 | 362 | 384 | 186 | 198 |
| 5 | 5/04/2012 12:00:00 AM | 1122 | 506 | 330 | 364 | 308 | 352 | 318 |
| 6 | 6/04/2012 12:00:00 AM | 1536 | 716 | 246 | 166 | 244 | 202 | 244 |
| 7 | 7/04/2012 12:00:00 AM | 454 | 170 | 234 | 172 | 228 | 182 | 184 |
| 8 | 8/04/2012 12:00:00 AM | 1964 | 1720 | 1338 | 534 | 498 | 484 | 528 |
| 9 | 9/04/2012 12:00:00 AM | 1516 | 686 | 664 | 682 | 588 | 516 | 556 |
| 10 | 10/04/2012 12:00:00 AM | 736 | 304 | 302 | 354 | 304 | 304 | 350 |

***Figure 9-53*** The result of the revised formula

This formula summed the values from the `E_0000` and E_0030 columns by summing their values and placing the result in a new column named Merged, which the column name can and will be changed by modifying the fourth argument in the formula.

To solve this problem, you need to apply a similar action for other pairs of columns as `{"E_0100", "E_0130"}`, `{"E_0200", "E_0230"}`, and `{ "E_0300", "E_0330"}`. To automate the process, you can identify the pairs of columns that need to be merged as sublists of a min list, and repeat the merging process for each pair of column names.

Use the following formula in the formula bar to extract all column names as `{"Date","E_0000", "E_0030", "E_0100", "E_0130", "E_0200", "E_0230", "E_0300", "E_0330"}`:

```
=Table.ColumnNames(Source)
```

Since the Date column should not be processed, you need to filter it out from the to-be-processed-columns. Because the date column is the first one, `List.Skip()` will do the job. Rewrite the formula as follows:

```
=List.Skip(Table.ColumnNames(Source))
```

In the next step, to convert the list of column names for merging into several sublists for the pair of columns, you can use the `List.Split()` function with the page of 2 (second argument). So, rewrite the formula as shown here, which results in pairs like `{{"E_0000", "E_0030"}, {"E_0100", "E_0130"}, {"E_0200", "E_0230"}, {"E_0300", "E_0330"}}`:

```
= List.Split(
      List.Skip(Table.ColumnNames(Source)),
      2)
```

The previous formula results in the `{{"E_0000", "E_0030"}, {"E_0100", "E_0130"}, {"E_0200", "E_0230"}, {"E_0300", "E_0330"}}` list, which you can use as the first argument of `List.Accumulate()`.

In each iteration of `List.Accumulate()`, two columns from the main table should be combined, so `#"Changed Type"` (the name of last step) serves as the initial table (seed) in the second argument.

To create the accumulator function, such as `(s,c) => f(s,c)`, where `s` is the table and `c` is the pair of column names, you can use the formula for combining two columns, which was presented earlier in this section, and is shown here:

```
= Table.CombineColumns(
      #"Changed Type",
      {"E_0000", "E_0030"},
      List.Sum,
      "Merged")
```

In this case, `#"Changed Type"` can be replaced with `s`, `{"E_0000", "E_0030"}` can be replaced with `c`, and `"Merged"` can be replaced with `c{0}` to represent the meaningful name after merging. The accumulator formula becomes:

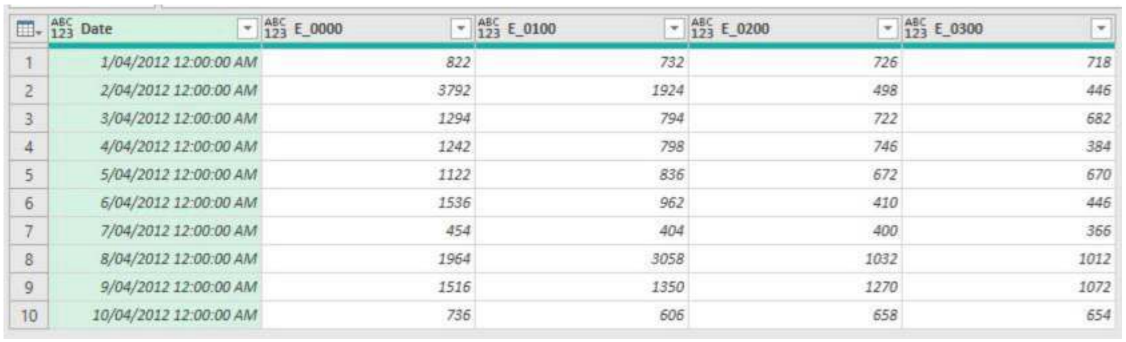
```
(s,c)=> Table.CombineColumns(s,c,List.Sum,c{0})
```

The entire formula for `List.Accumulate()` can be written as flows:

```
= List.Accumulate(
      List.Split(List.Skip(Table.ColumnNames(Source)),2),
      #"Changed Type",
       (s,c)=>Table.CombineColumns(s,c,List.Sum,c{0})
)
```

Writing this formula in the formula bar will iterate through each pair of columns, combine them, and assign a meaningful name to the merged column, updating the table with each iteration.

This will generate the final table, where every pair of columns in the Source table are merged, as shown in Figure 9-54.



| | Date | E_0000 | E_0100 | E_0200 | E_0300 |
|---|---|---|---|---|---|
| 1 | 1/04/2012 12:00:00 AM | 822 | 732 | 726 | 718 |
| 2 | 2/04/2012 12:00:00 AM | 3792 | 1924 | 498 | 446 |
| 3 | 3/04/2012 12:00:00 AM | 1294 | 794 | 722 | 682 |
| 4 | 4/04/2012 12:00:00 AM | 1242 | 798 | 746 | 384 |
| 5 | 5/04/2012 12:00:00 AM | 1122 | 836 | 672 | 670 |
| 6 | 6/04/2012 12:00:00 AM | 1536 | 962 | 410 | 446 |
| 7 | 7/04/2012 12:00:00 AM | 454 | 404 | 400 | 366 |
| 8 | 8/04/2012 12:00:00 AM | 1964 | 3058 | 1032 | 1012 |
| 9 | 9/04/2012 12:00:00 AM | 1516 | 1350 | 1270 | 1072 |
| 10 | 10/04/2012 12:00:00 AM | 736 | 606 | 658 | 654 |

***Figure 9-54*** The final table

**Efficiency Tips** Four different solutions are provided for this problem. To evaluate their performance, a table with 10,000 rows and 101 columns was used. The execution times for the four solutions were measured as 6.9 seconds, 34 seconds, 3.1 seconds, and 0.6 seconds, respectively.

## Product Combinations

Imagine a store with products defined by the set `S = {"A","B","C","D","E"}`. Generate all possible combinations of products in a customer's basket, ignoring the order of the products.

The expected solution for this problem is:

```
{"A","B","C","D","E","AB","AC","AD","AE","BC","BD","BE","CD","
CE","DE","ABC","ABD","ABE","
ACD","ACE","ADE","BCD","BCE","BDE","CDE","ABCD","ABCE","ABDE","ACDE","BCDE","
```

To solve this problem, you can use a combination of the `List.Accumulate()` and `List.Transform()` functions, as shown in the following formula:

```
= List.Accumulate({"A".."E"}, {""},(s,c)=>s&List.Transform(s,each _&c))
```

To discover the logic behind this formula, the result of different elements in this formula for the first three iterations is illustrated in Table 9-13. It begins with an initial list `{""}`. In each iteration, it adds all possible combinations of the new product to each previously selected product in the list, thereby building the complete set of combinations.

***Table 9-13*** Source: Solutions

| iteration | s | c | List.Transform(s,each _&c) | s&List.Transform(s,each _&c) |
|---|---|---|---|---|
| 1 | {""} | "A" | "A" | {"","A"} |

| iteration | s | c | List.Transform(s,each _&c) | s&List.Transform(s,each _&c) |
|---|---|---|---|---|
| 2 | {"","A"} | "B" | {"B","AB"} | {"","A","B","AB"} |
| 3 | {"","A","B","AB"} | "C" | {"C","AC","BC","ABC"} | {"","A","B","AB","C","AC","BC","ABC"} |
| ... | | | | |

To remove the initial empty string from the result list, the formula can be adjusted as follows, which results in Figure 9-55:

```
=List.Skip(List.Accumulate({"A".."E"}, {""},(s,c)=>s&List.Transform(s,each
_&c)))
```

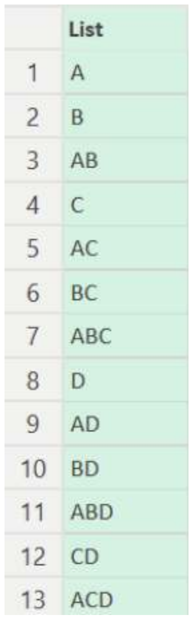

| | List |
|---|---|
| 1 | A |
| 2 | B |
| 3 | AB |
| 4 | C |
| 5 | AC |
| 6 | BC |
| 7 | ABC |
| 8 | D |
| 9 | AD |
| 10 | BD |
| 11 | ABD |
| 12 | CD |
| 13 | ACD |

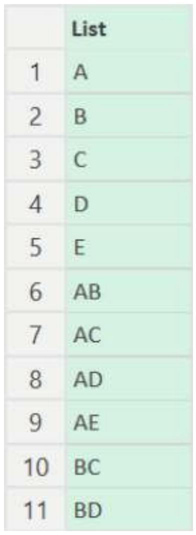
***Figure 9-55*** All the product combinations

To sort the result list based on the number of characters, you can place the formula inside the `List.Sort()` function and use `Text.Length()` to define the sorting logic by the following formula:

```
= List.Sort(List.Skip(List.Accumulate({"A".."E"}, {""},
(a,b)=>a&List.Transform(a,each _&b))), Text.Length)
```

To sort items with the same length in ascending order, in addition to sorting by `Text.Length`, you can apply a secondary sorting logic as follows, resulting in Figure 9-56:

```
= List.Sort(List.Skip(List.Accumulate({"A".."E"}, {""},
(a,b)=>a&List.Transform(a,each _&b))), {Text.Length,each _})
```



|  | List |
|---|---|
| 1 | A |
| 2 | B |
| 3 | C |
| 4 | D |
| 5 | E |
| 6 | AB |
| 7 | AC |
| 8 | AD |
| 9 | AE |
| 10 | BC |
| 11 | BD |

***Figure 9-56*** Sorting the product combinations

**Note** In the previous formula, product names are combined into a single text string. To create combinations as lists instead, perhaps to use the result for other application, the formula can be rewritten as follows:

```
= List.Skip(List.Accumulate({"A".."E"}, {{}},
(a,b)=>a&List.Transform(a,each _&{b})))
```

## Working with Set Combinations (Cartesian Product)

Consider a company that produces three products—A, B, and C—using two formulations—Eco and Pro—with two colors—Black and Blue—and in three sizes—X, XL, and XXL. Generate the names of all possible product combinations, such as “A Pro Black XXL”.

**Note** This full combination is known as a cartesian product.

Three different solutions based on combining the table column, using `List.Accumulate()` to expand the columns, and using a combination of `List.Accumulate()` and `List.TransformMany()` are provided for this problem, as outlined in this section.

### Solution 1: Merging the Table Columns

The first solution involves creating a table with one row and four columns, where each column contains a list of specific product features. Expanding these lists will generate all possible combinations of the features.

To create a table with all possible product combinations, use the following formula to generate the results shown in Figure 9-57.

```
= #table(
       {"Name","Formulation","Colour","Size"},
       {
                  {{"A","B","C"},{"Eco","Pro"},{"Black","Blue"},
{"X","XL","XXL"}}
       })
```

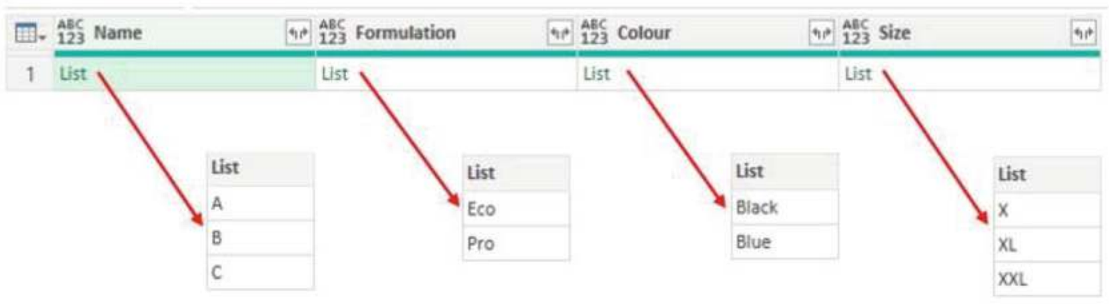


***Figure 9-57*** The #table function

> **Note** `#table` is a function in Power Query used to create a table, with the syntax:
>
> `#table(columns as any, rows as any) as any`
> In the simplest form, as used in this example, the column names are provided as a list in the first argument, and the row data is entered as sublists within a general list in the second argument.

In the next step, expanding the Name column into new rows results in Figure 9-58.

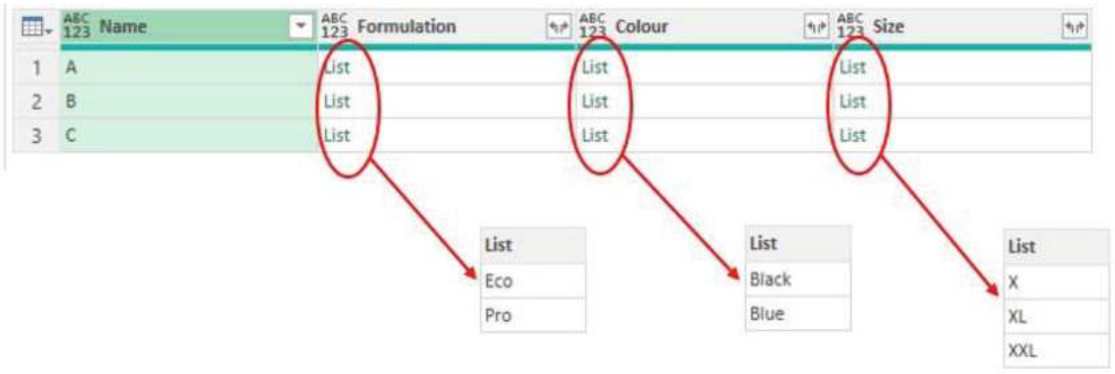
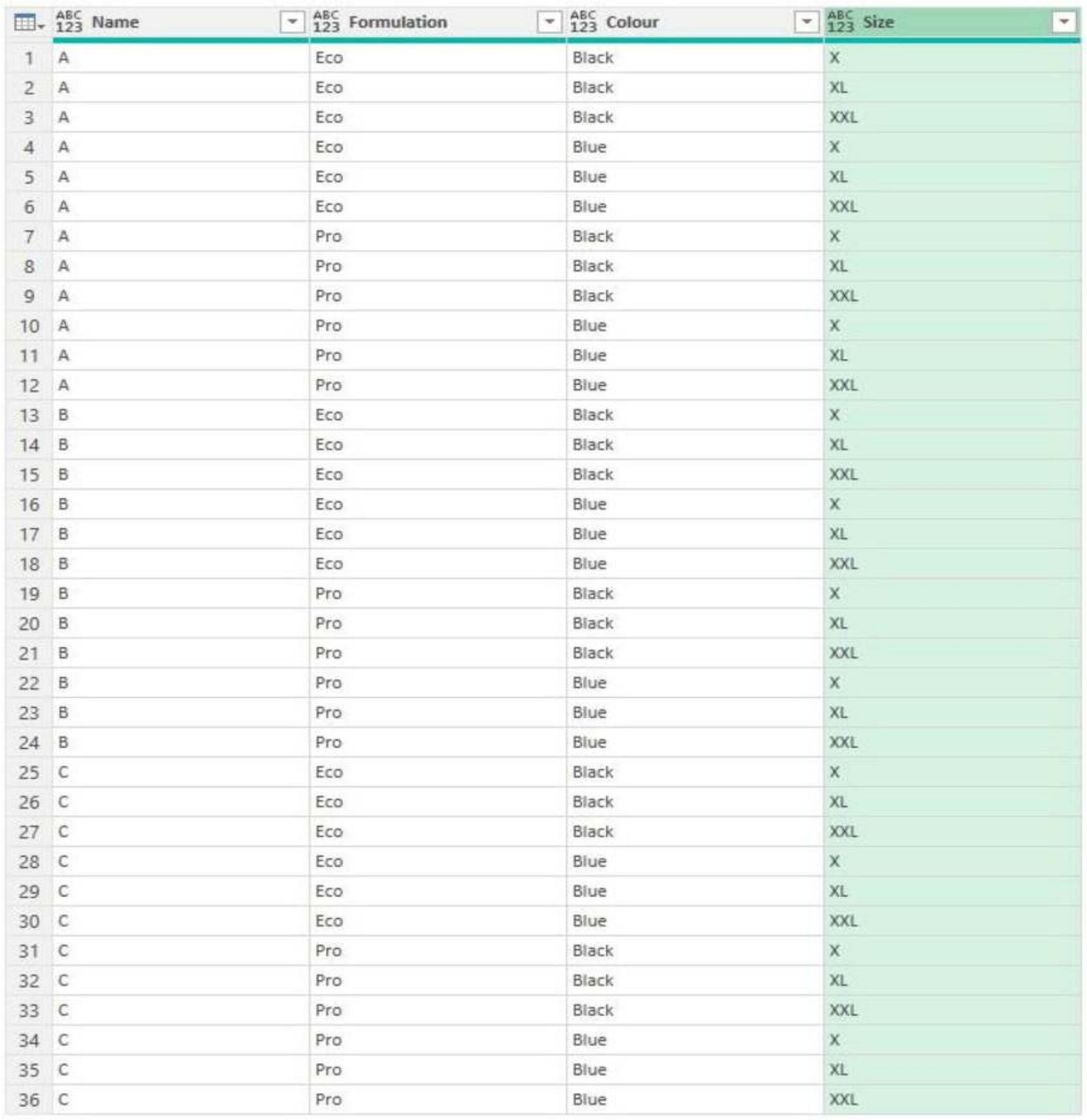


***Figure 9-58*** Expanding the Name column

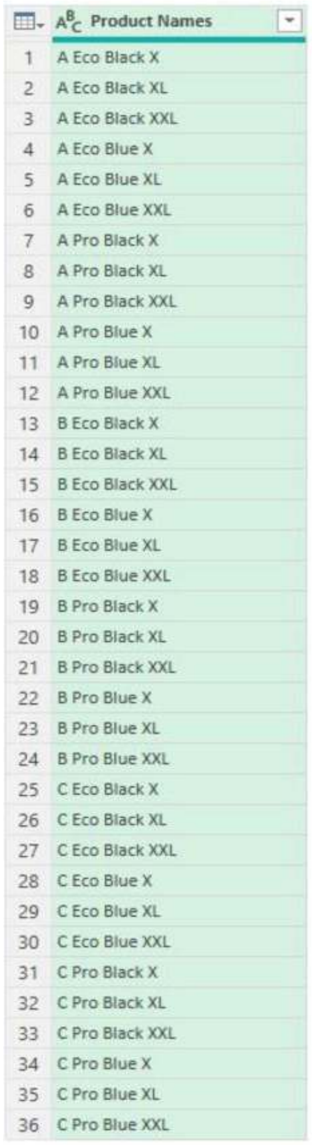
Expanding all the other columns will result in Figure 9-59.



| | Name | Formulation | Colour | Size |
|---|---|---|---|---|
| 1 | A | Eco | Black | X |
| 2 | A | Eco | Black | XL |
| 3 | A | Eco | Black | XXL |
| 4 | A | Eco | Blue | X |
| 5 | A | Eco | Blue | XL |
| 6 | A | Eco | Blue | XXL |
| 7 | A | Pro | Black | X |
| 8 | A | Pro | Black | XL |
| 9 | A | Pro | Black | XXL |
| 10 | A | Pro | Blue | X |
| 11 | A | Pro | Blue | XL |
| 12 | A | Pro | Blue | XXL |
| 13 | B | Eco | Black | X |
| 14 | B | Eco | Black | XL |
| 15 | B | Eco | Black | XXL |
| 16 | B | Eco | Blue | X |
| 17 | B | Eco | Blue | XL |
| 18 | B | Eco | Blue | XXL |
| 19 | B | Pro | Black | X |
| 20 | B | Pro | Black | XL |
| 21 | B | Pro | Black | XXL |
| 22 | B | Pro | Blue | X |
| 23 | B | Pro | Blue | XL |
| 24 | B | Pro | Blue | XXL |
| 25 | C | Eco | Black | X |
| 26 | C | Eco | Black | XL |
| 27 | C | Eco | Black | XXL |
| 28 | C | Eco | Blue | X |
| 29 | C | Eco | Blue | XL |
| 30 | C | Eco | Blue | XXL |
| 31 | C | Pro | Black | X |
| 32 | C | Pro | Black | XL |
| 33 | C | Pro | Black | XXL |
| 34 | C | Pro | Blue | X |
| 35 | C | Pro | Blue | XL |
| 36 | C | Pro | Blue | XXL |

***Figure 9-59*** Expanding all the columns

In this next step, select all the columns (the selection order is important), right-click one of them, choose Merge Columns, select space as the separator, enter the new column name as Product Names, and click OK. Figure 9-60 shows the final table.



| | Product Names |
|---|---|
| 1 | A Eco Black X |
| 2 | A Eco Black XL |
| 3 | A Eco Black XXL |
| 4 | A Eco Blue X |
| 5 | A Eco Blue XL |
| 6 | A Eco Blue XXL |
| 7 | A Pro Black X |
| 8 | A Pro Black XL |
| 9 | A Pro Black XXL |
| 10 | A Pro Blue X |
| 11 | A Pro Blue XL |
| 12 | A Pro Blue XXL |
| 13 | B Eco Black X |
| 14 | B Eco Black XL |
| 15 | B Eco Black XXL |
| 16 | B Eco Blue X |
| 17 | B Eco Blue XL |
| 18 | B Eco Blue XXL |
| 19 | B Pro Black X |
| 20 | B Pro Black XL |
| 21 | B Pro Black XXL |
| 22 | B Pro Blue X |
| 23 | B Pro Blue XL |
| 24 | B Pro Blue XXL |
| 25 | C Eco Black X |
| 26 | C Eco Black XL |
| 27 | C Eco Black XXL |
| 28 | C Eco Blue X |
| 29 | C Eco Blue XL |
| 30 | C Eco Blue XXL |
| 31 | C Pro Black X |
| 32 | C Pro Black XL |
| 33 | C Pro Black XXL |
| 34 | C Pro Blue X |
| 35 | C Pro Blue XL |
| 36 | C Pro Blue XXL |

***Figure 9-60*** The result of merging

## Solution 2: Based on List.Accumulate()

In the previous solution, where all the columns were expanded manually, this task can be automated using `List.Accumulate()`.

After applying all the steps in the previous solution, select the Advanced Editor to see the steps, as follows :

```
let
    Source = #table({"Name","Formulation","Colour","Size"},{{{"A","B","C"},
{"Eco","Pro"},{"Black","Blue"},{"X","XL","XXL"}}}),
    #"Expanded Name" = Table.ExpandListColumn(Source, "Name"),
    #"Expanded Formulation" = Table.ExpandListColumn(#"Expanded Name",
"Formulation"),
    #"Expanded Colour" = Table.ExpandListColumn(#"Expanded Formulation",
"Colour"),
    #"Expanded Size" = Table.ExpandListColumn(#"Expanded Colour", "Size"),
    #"Merged Columns" = Table.CombineColumns(#"Expanded Size",{"Name", 
"Formulation", "Colour", "Size"},Combiner.CombineTextByDelimiter(" ", 
QuoteStyle.None),"Product Names")
in
    #"Merged Columns"
```

In this code, the expansion of columns is applied in four steps, each over a different column name using the `Table.ExpandListColumn()` function. However, by defining the column names as a list in the first argument of `List.Accumulate()` and considering the source table as the seed, the expansion can be performed through a loop over the column names, making the process more efficient and dynamic. So, by using `List.Accumulate()`, the code can be rewritten as follows:

```
let
    ColNames={"Name","Formulation","Colour","Size"},
    Source =List.Accumulate(
        ColNames,
        #table(ColNames,{{{"A","B","C"},{"Eco","Pro"},{"Black","Blue"},
{"X","XL","XXL"}}}),
         (x,y)=>Table.ExpandListColumn(x, y)),
    #"Merged Columns" = Table.CombineColumns(
        Source,ColNames,
        Combiner.CombineTextByDelimiter(" ", QuoteStyle.None),
        "Product Names")
in
    #"Merged Columns"
```

## Solution 3: Combining List.Accumulate() and List.TransformMany()

In this solution, a combination of `List.Accumulate()` and `List.TransformMany()` is used to solve the problem.

Before addressing the problem for all product features (Name, Formulation, Color, and Size), let's first focus on just the Name and Color features and explore how to generate their Cartesian combination. This will help simplify the process and establish the method for handling the full set of product features later.

In this case, you need two nested loops: one for iterating over all the Names and the other for iterating over the Colors, and as a function, you can concatenate the name and colors of all iterations. This can be achieved using the `List.TransformMany()` function.

To do this:

– The first list (Names) will be placed as the first argument.
– The second list (Colours) will be placed as the second argument.
– A concatenation function will be applied to combine each Name with every Colour, creating the desired combinations.

You can use the following formula:

```
= List.TransformMany(
      {"A","B","C"},
      each {"Black","Blue"},
      (Product,Colour)=>Product &" - "& Colour)
```

In this example, `{"A", "B", "C"}` is the list of product names in the initial argument, and `each {"Black", "Blue"}` is a function in the second argument. This function specifies that for each product, you should consider the list `{"Black", "Blue"}` list of colors. The third argument is also a function as `(Product, Colour) => Product & " - " & Colours`. This function combines each product with each color to generate the final strings.

For each product in `{"A", "B", "C"}`, the `each {"Black", "Blue"}` function generates the list of colors `{"Black", "Blue"}`, and the third argument function `(Product, Colour) => Product`

`& " - " & Colour` then combines each product with each color.

So, the output is a list, combining all products with colors as follows: `{"A - Black","A - Blue","B - Black","B - Blue","C - Black","C - Blue"}`.

`List.TransformMany()` can combine two lists, but in this case, you are dealing with four lists: Product Name, Formulation, Color, and Size. To handle all four lists and generate all possible combinations, you can use `List.Accumulate()` in combination with `List.TransformMany()`.

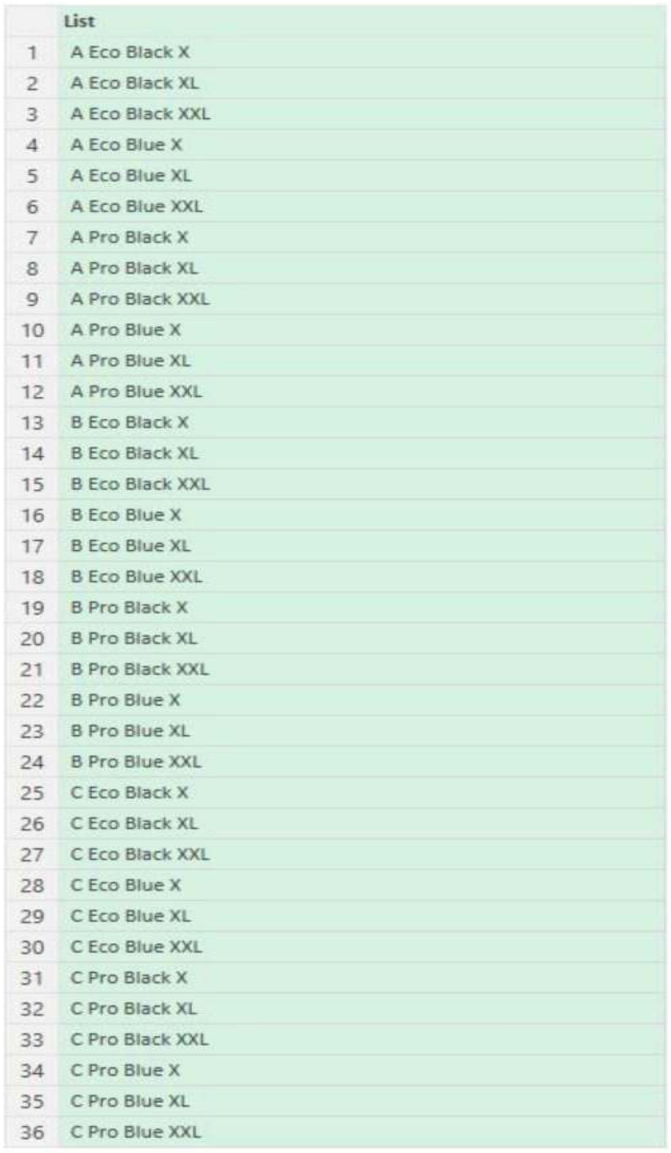
Here's how this combination works:

- Each of the four lists (Name, Formulation, Color, and Size) is provided as a sublist within the first argument of `List.Accumulate()`.
- At the beginning, a list with one blank item is considered the seed, as `{""}`.
- In each iteration, a sublist of the first argument and the seed are passed to `List.TransformMany()`.
- `List.TransformMany()` combines this sublist with the seed value (which is equal to all the combinations generated so far) and provides the new combination as a new seed.

The formula for solving this problem is as follows:

```
= List.Accumulate(
      {{"A","B","C"},{"Eco","Pro"},{"Black","Blue"},{"X","XL","XXL"}},
      {""}, (s, c) => List.TransformMany(s, each  c, (L1, L2) =>
       L1 & " "& L2))
```

You can use this formula in the formula bar; it results in Figure 9-61.



| | List |
|---|---|
| 1 | A Eco Black X |
| 2 | A Eco Black XL |
| 3 | A Eco Black XXL |
| 4 | A Eco Blue X |
| 5 | A Eco Blue XL |
| 6 | A Eco Blue XXL |
| 7 | A Pro Black X |
| 8 | A Pro Black XL |
| 9 | A Pro Black XXL |
| 10 | A Pro Blue X |
| 11 | A Pro Blue XL |
| 12 | A Pro Blue XXL |
| 13 | B Eco Black X |
| 14 | B Eco Black XL |
| 15 | B Eco Black XXL |
| 16 | B Eco Blue X |
| 17 | B Eco Blue XL |
| 18 | B Eco Blue XXL |
| 19 | B Pro Black X |
| 20 | B Pro Black XL |
| 21 | B Pro Black XXL |
| 22 | B Pro Blue X |
| 23 | B Pro Blue XL |
| 24 | B Pro Blue XXL |
| 25 | C Eco Black X |
| 26 | C Eco Black XL |
| 27 | C Eco Black XXL |
| 28 | C Eco Blue X |
| 29 | C Eco Blue XL |
| 30 | C Eco Blue XXL |
| 31 | C Pro Black X |
| 32 | C Pro Black XL |
| 33 | C Pro Black XXL |
| 34 | C Pro Blue X |
| 35 | C Pro Blue XL |
| 36 | C Pro Blue XXL |

***Figure 9-61*** The result of List.Accumulate and List.TransformMany

Let's examine how this formula operates. Initially, `s` (state) in `List.Accumulate()` is `{" "}`, and `c` (current) is `{"A", "B", "C"}`. By substituting `s` and `c` into `List.TransformMany()`, the function becomes:

```
=List.TransformMany(
      {""},
      each {"A","B","C"},
      (L1, L2) => a & " "& b)
```

In the third argument of this formula, `L1` is `""` and `L2` is `{"A", "B", "C"}`, resulting in a list that combines `L1` with each item in `L2`, which yields `{"A", "B", "C"}`.

In the subsequent step, where `s` is `{"A", "B", "C"}` (the result of the previous aggregator) and `c` is `{"Eco", "Pro"}`, substituting `s` and `c` into `List.TransformMany()` results in the following formula:

```
=List.TransformMany(
      {"A","B","C"},
      each {"Eco","Pro"},
      (L1, L2) => L1 & " "& L2)
```

This formula produces `{"A Eco", "A Pro", "B Eco", "B Pro", "C Eco", "C Pro"}`.

In the next iteration, where `s` is `{"A Eco", "A Pro", "B Eco", "B Pro", "C Eco", "C Pro"}` and `c` is `{"Black", "Blue"}`, substituting `s` and `c` into `List.TransformMany()` results in the following formula:

```
=List.TransformMany(
      {"A Eco","A Pro" "B Eco","B Pro" "C Eco","C Pro"},
      each {"Black","Blue"},
      (L1, L2) => L1 & " "& L2)
```

And results in this list: `{"A Eco Black", "A Pro Black", "B Eco Black", "B Pro Black", "C Eco Black", "C Pro Black", "A Eco Blue", "A Pro Blue", "B Eco Blue", "B Pro Blue", "C Eco Blue", "C Pro Blue"}`.

The same process is then repeated in the next iterations for the sizes and provides a list including all the combinations of product names.

---

## Summary

This chapter introduced looping concepts in Power Query, covering how to implement `For-Next`, `For-Each`, and `Do-While` loops. Since Power Query lacks a user interface for loops, they are executed through M-code functions like `List.Transform()`, `List.TransformMany()`, `List.Accumulate()`, and `List.Generate()`.

`List.Transform()` works like a `For-Each` loop and applies a transformation function to each item in a list. It iterates through the list and returns a new list with the transformed values. On the other hand, `List.TransformMany()` is an advanced version of `List.Transform()`. It functions similarly to having two nested `List.Transform()` calls, providing two levels of iteration (nested loops). This allows you to apply a transformation to one list, and within each transformation, you can apply another transformation to another list or to nested items, making it ideal for handling more complex combinations or multi-level operations.

`List.Accumulate()` is a more flexible function because it allows you to carry forward the result of each iteration into the next iteration. This means that you can build upon the results from previous steps as you move through the list. It operates by taking an initial value (the seed) and applying a function iteratively to each item in the list, accumulating the result. This feature makes it ideal for scenarios when you need to maintain state or accumulate value for performing complex transformations that require previous results to influence the next steps.

Similarly, `List.Generate()` is a powerful function for loops in Power Query. It accepts four function-type arguments: the initial value, a condition defining when the loop continues, a "next" function to update the value per iteration, and an optional selector for transforming or selecting each iteration's output.

The next chapter explores external integrations with Power Query, including the use of R, Python, and JavaScript.

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# 10. Leveraging Scripting and External Integrations in Power Query

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This chapter addresses additional common challenges in Power Query and demonstrates solutions using APIs and scripting with R, Python, and JavaScript.

## Using a Regex Function Based on JavaScript in Power Query

Consider the Source table, which contains a single column called Text, as shown in Table 10-1. Extract all emails, dates, numbers, and times from the text.

***Table 10-1*** Source: Text

| Text |
|---|
| On 2023-05-14, John Doe (john.doe@example.com) received an email from his colleague, Jane Smith (jane_smith@workplace.org). The email mentioned a meeting scheduled for 2024-07-20 at 2:30 PM. During the meeting, they planned to discuss the budget, which had a preliminary figure of $150,000. Jane also mentioned that the project's milestones needed to be reviewed by the end of the fiscal year on 2024-12-31. John replied with a confirmation: "Let's meet @ 2:30 PM sharp and make sure we cover all agenda items." He also added: "Please cc to mark.spencer@department.gov and finance@office.com for their input." |
| John had a note in his calendar to call the supplier at +1-800-555-1234 and inquire about the order #987654321. Meanwhile, the team was informed via the internal messaging system that the server maintenance would be conducted on 2024-08-15 @ 10:00 PM. The project management tool also sent automatic reminders to everyone involved, highlighting the importance of completing their tasks by the specified deadlines. |

**Note** The general idea of this solution came from the website of TheBICCOUNTANT, written by Microsoft MVP Imke Feldmann. See `https://www.thebiccountant.com/2018/04/25/regex-in-power-bi-and-power-query-in-excel-with-java-script/`.

To address such problems, most software uses Regular Expression (*regex* or *regexp*) functions to extract sequences of characters that match a specific search pattern. Unfortunately, Power Query does not natively support regex functions. While Power BI users can utilize regex through Python or R scripts, this code is not yet supported directly within Power Query inside Excel.

If you are an Excel user, the good news is that you can use JavaScript within Power Query to achieve regex functionality, using the `Web.Page()` function in Power Query, which allows you to execute JavaScript code.

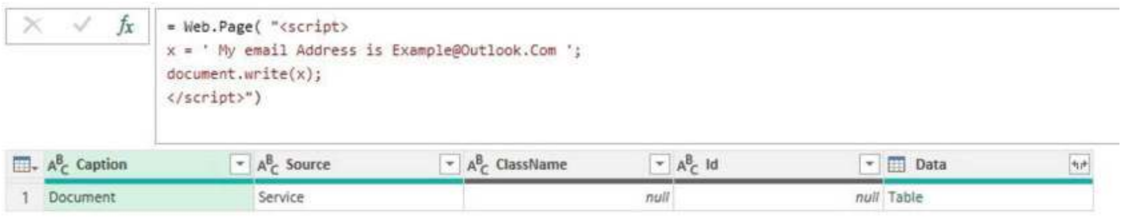
**Note** To learn more about regex, check out this website: `https://regex101.com/`.

Here is a simple JavaScript example that defines a variable `x` and provides it as a result value:

```
x = ' My email Address is Example@Outlook.Com';
document.write(x);
```

To use this JavaScript code within Power Query, you can embed it using the `Web.Page()` function. The Power Query formula for this looks like the following and results in Figure 10-1.

```
= Web.Page( "<script>
x = ' My email Address is Example@Outlook.Com ';
document.write(x);
</script>")
```



```
= Web.Page( "<script>
x = ' My email Address is Example@Outlook.Com ';
document.write(x);
</script>")
```

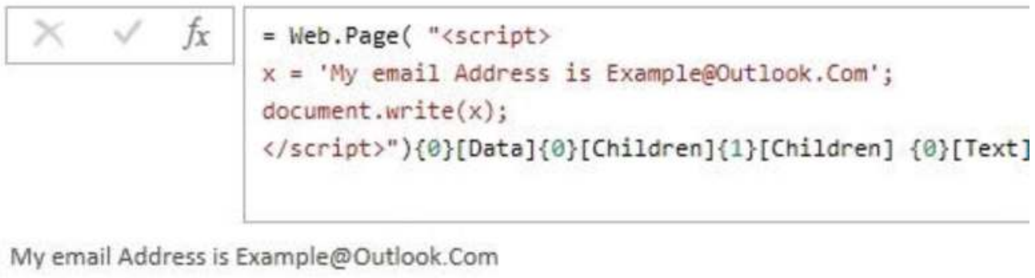
|  | Caption | Source | ClassName | Id | Data |
|---|---|---|---|---|---|
| 1 | Document | Service | null | null | Table |

*Figure 10-1* Example of JaveScript code processed by Power Query

To achieve the desired result, you need to navigate through the first row under the Data column. The navigation path is started by appending `{0}[Data]` to the previous formula. However, this navigation alone is not sufficient, and further steps are required. The final result is obtained after the following navigation: `{0}[Data]{0}[Children]{1}[Children]{0}[Text]`.

Rewriting the formula as follows will result in a table where the output matches the text contained in variable `x`, as shown in Figure 10-2:

```
= Web.Page( "<script>
x = 'My email Address is Example@Outlook.Com';
document.write(x);
</script>"){0}[Data]{0}[Children]{1}[Children] {0}[Text]
```



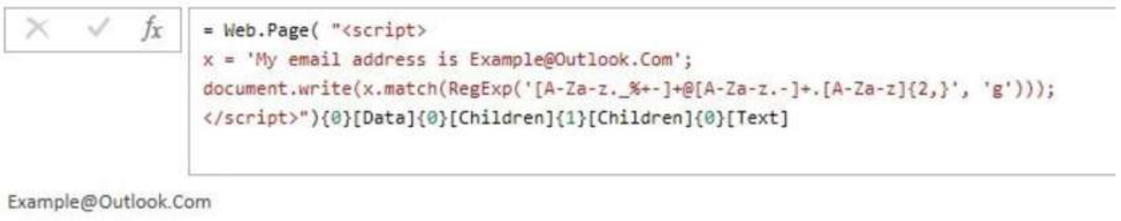
```
= Web.Page( "<script>
x = 'My email Address is Example@Outlook.Com';
document.write(x);
</script>"){0}[Data]{0}[Children]{1}[Children] {0}[Text]
```

My email Address is Example@Outlook.Com

*Figure 10-2* Result of the x variable (bottom), addressed in Web.Page() output hierarchy (top)

To extract only the email addresses from the text, you can modify the JavaScript code within the `Web.Page()` function to focus solely on extracting emails. Here's the revised formula, which results in Figure 10-3.

```
= Web.Page( "<script>
x = 'My email address is Example@Outlook.Com';
document.write(x.match(RegExp('^ [A-Za-z._%+-]+@[A-Za-z]+.[A-Za-z]{2,}$',
'g')));
</script>"){0}[Data]{0}[Children]{1}[Children]{0}[Text]
```



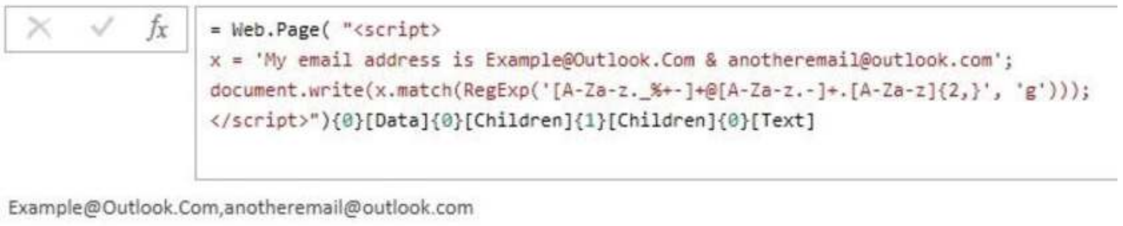
```
= Web.Page( "<script>
x = 'My email address is Example@Outlook.Com';
document.write(x.match(RegExp('[A-Za-z._%+-]+@[A-Za-z.-]+.[A-Za-z]{2,}', 'g')));
</script>"){0}[Data]{0}[Children]{1}[Children]{0}[Text]
```

```
Example@Outlook.Com
```

***Figure 10-3*** Regexp that extracts an email address from some text, wrapped in Power Query code

By changing the value of the variable `x` to include two email addresses, the formula will return both email addresses, as shown in Figure 10-4.

```
= Web.Page( "<script>
x = 'My email address is Example@Outlook.Com & anotheremail@outlook.com';
document.write(x.match(RegExp('^ [A-Za-z._%+-]+@[A-Za-z]+.[A-Za-z]{2,}$',
'g')));
</script>"){0}[Data]{0}[Children]{1}[Children]{0}[Text]
```



```
= Web.Page( "<script>
x = 'My email address is Example@Outlook.Com & anotheremail@outlook.com';
document.write(x.match(RegExp('[A-Za-z._%+-]+@[A-Za-z.-]+.[A-Za-z]{2,}', 'g')));
</script>"){0}[Data]{0}[Children]{1}[Children]{0}[Text]
```

```
Example@Outlook.Com,anotheremail@outlook.com
```

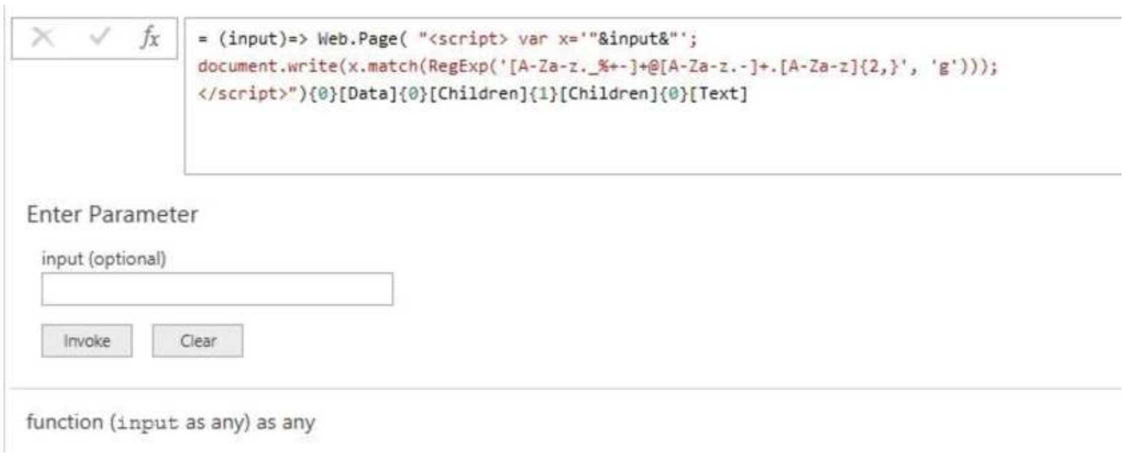
***Figure 10-4*** Extracting all the email address

This formula can be converted into a custom function in Power Query by defining an input parameter. Here's how you can rewrite the formula to include an input parameter, as shown in Figure 10-5:

```
= (input)=> Web.Page( "<script> var x='"&input&"';
document.write(x.match(RegExp('^ [A-Za-z._%+-]+@[A-Za-z]+.[A-Za-z]{2,}$',
'g')));
</script>"){0}[Data]{0}[Children]{1}[Children]{0}[Text]
```

Using a single line of text, such as "My email address is Example@Outlook.Com & anotheremail@outlook.com," works with the proposed function. However, it does not handle multiline text or text that includes single quotes (`'`). To address these issues, you can modify the formula to replace line breaks (which usually appear as `#(lf)` in Power Query and are equal to `Character.FromNumber(10)`, but other line breaks can also appear in the text) and single quotes with spaces. Here's the updated formula:

```
= (input)=> Web.Page(
        "<script> var x='"
        & Text.Replace(Text.Replace(input,"#(lf)"," "),"'"," ") &
        "'; document.write( x.match(RegExp('^ [A-Za-z._%+-]+@[A-Za-z]+.[A-
Za-z]{2,}$', 'g')));
</script>"){0}[Data]{0}[Children]{1}[Children]{0}[Text]
```



```
= (input)=> Web.Page( "<script> var x='"&input&"';
document.write(x.match(RegExp('[A-Za-z._%+-]+@[A-Za-z.-]+.[A-Za-z]{2,}', 'g')));
</script>"){0}[Data]{0}[Children]{1}[Children]{0}[Text]
```

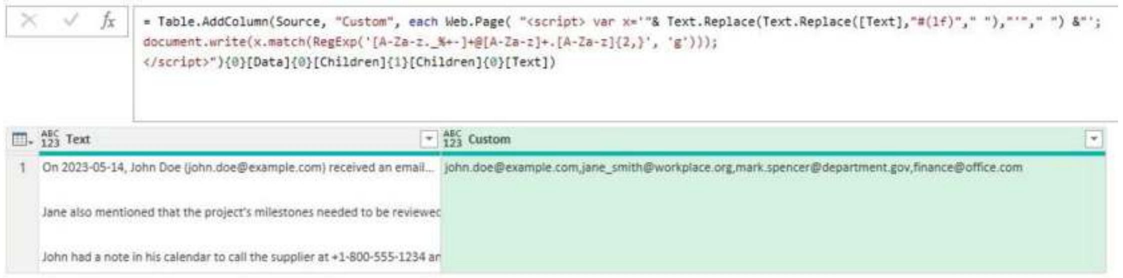
function (input as any) as any

*Figure 10-5* Converting the formula into function

The defined custom function takes a text input and returns all the email addresses found within that text. You can use this function to extract emails from the text in Table 10-1.

For the example with a single-row table, you can use `Source[Text]{0}` as the input for the custom function. (As long as it does not exceed Power Query's ability to handle approximately 30,000 ASCII characters per cell.) Alternatively, you can add a new column to the Source table using the following formula, which results in Figure 10-6:

```
=Web.Page( "<script> var x='"
        & Text.Replace(Text.Replace([Text],"#(lf)"," "),"'"," ")  &
        "'; document.write(x.match(RegExp('^ [A-Za-z._%+-]+@[A-Za-z]+.[A-Za-
z]{2,}$', 'g')));
</script>"){0}[Data]{0}[Children]{1}[Children]{0}[Text]
```



```
= Table.AddColumn(Source, "Custom", each Web.Page( "<script> var x='"& Text.Replace(Text.Replace([Text],"#(lf)"," "),"'"," ") &"';
document.write(x.match(RegExp('[A-Za-z._%+-]+@[A-Za-z]+.[A-Za-z]{2,}', 'g')));
</script>"){0}[Data]{0}[Children]{1}[Children]{0}[Text])
```

| | Text | Custom |
|---|---|---|
| 1 | On 2023-05-14, John Doe (john.doe@example.com) received an email... Jane also mentioned that the project's milestones needed to be reviewec John had a note in his calendar to call the supplier at +1-800-555-1234 ar | john.doe@example.com,jane_smith@workplace.org,mark.spencer@department.gov,finance@office.com |

*Figure 10-6* Extracting the emails of text

This formula adds a new column named Emails to the Source table, displaying the extracted email addresses.

In this example, the pattern `'^ [A-Za-z._%+-]+@[A-Za-z]+\\.[A-Za-z]{2,}$'` defines common email formats. Here's a breakdown of the pattern:

- `^` and `$` are used to mark the beginning and end of the pattern, ensuring that the entire string conforms to the format.
- `[A-Za-z._%+-]+@` matches the local part of the email address, which includes any uppercase or lowercase letters, as well as the `.`, `_`, `%`, `+`, and – characters. In practical scenarios, numbers can also be included.
- `@[A-Za-z]+\\.` specifies that after the `@` character, there should be one or more uppercase or lowercase letters followed by a dot.
- `\\.[A-Za-z]{2,}$` indicates that after the dot, there must be at least two uppercase or lowercase letters, representing the domain suffix.

This pattern ensures that the string matches the typical structure of email addresses.

You can use such functions to extract text with regular formats by replacing the relevant part of the formula with the appropriate regex pattern for each data type, as shown in Table 10-2.

***Table 10-2*** Regex Pattern Examples

| Purpose | Pattern |
|---|---|
| Email | ^[A-Za-z0-9._%+-]+@[A-Za-z0-9.-]+\.[A-Za-z]{2,}$ |
| Date | ^(?:19\|20)\d\d-(?:0[1-9]\|1[0-2])-(?:0[1-9]\|[12][0-9]\|3[01])$ |
| Number | ^\d+(?:\.\d+)?$ |
| Time | ^(1[0-2]\|0?[1-9]):[0-5][0-9] (AM\|PM)$ |
| ZIP Code | ^\d{5}(?:[-\s]\d{4})?$ |
| File Extension | ^.+\.(jpg\|jpeg\|png\|gif\|pdf)$ |

## Integrating Python with Power Query

Consider the Source table, which contains several sentences, as shown in Table 10-3. Extract the names of cities and countries from each row.

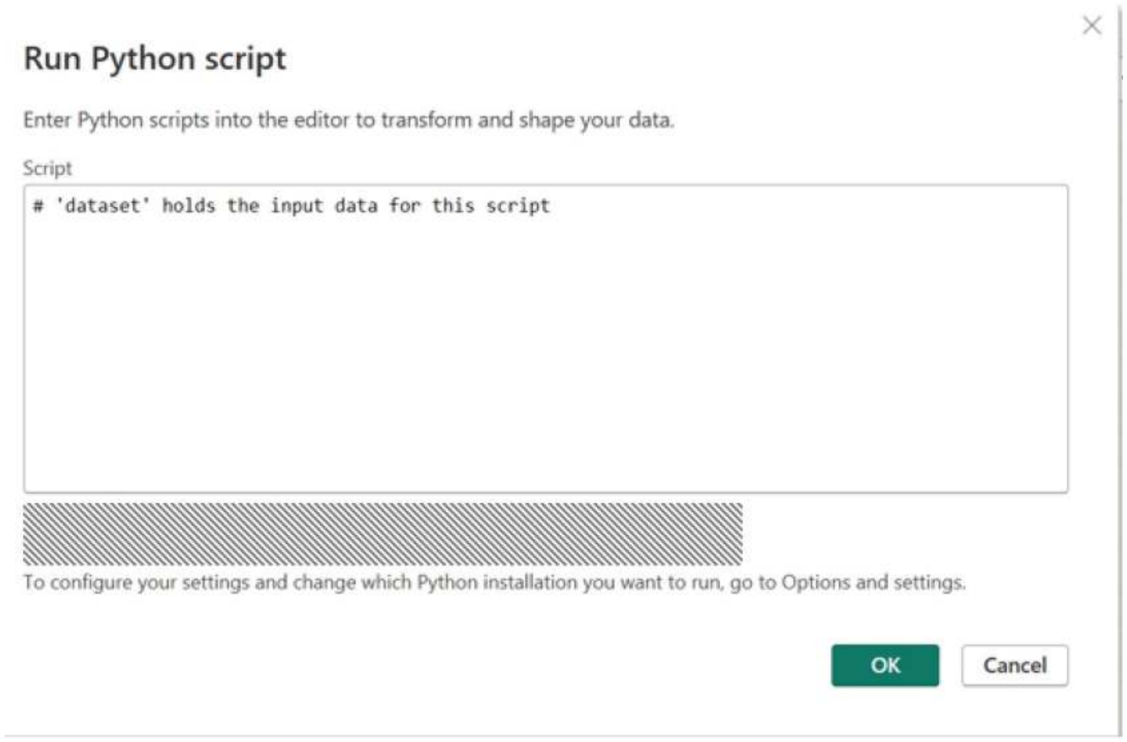
***Table 10-3*** Source: Texts

| Sentences |
|---|
| Tokyo is the capital of Japan. |
| Sydney is a major city in Australia. |
| Berlin is the capital of Germany. |
| New York is located in the United States. |
| Paris is known as the city of love in France. |
| Rio de Janeiro is a famous city in Brazil. |
| Toronto is a large city in Canada. |
| Moscow is the capital of Russia. |

Solving this problem without using an API or additional tools in Power Query is quite challenging. Therefore, this example uses Python to address it. At the time of writing this book, Python is not available in Power Query for Excel, but you can use Power BI to tackle this issue.

To use Python in Power Query, you need to complete some setup, including installing Python and the required libraries (such as `pandas` and `spacy`), and configuring Python scripting options in Power Query, as explained at `https://learn.microsoft.com/en-us/power-bi/connect-data/desktop-python-in-query-editor`.

Before tackling the main problem, let's explore a smaller example and see how to use Python in Power Query. Select the Source table, then from the Transform tab, select Run Python Script to open the window for entering Python script, as illustrated in Figure 10-7.


Run Python script
Enter Python scripts into the editor to transform and shape your data.
Script
OK
Cancel

```
# 'dataset' holds the input data for this script
```

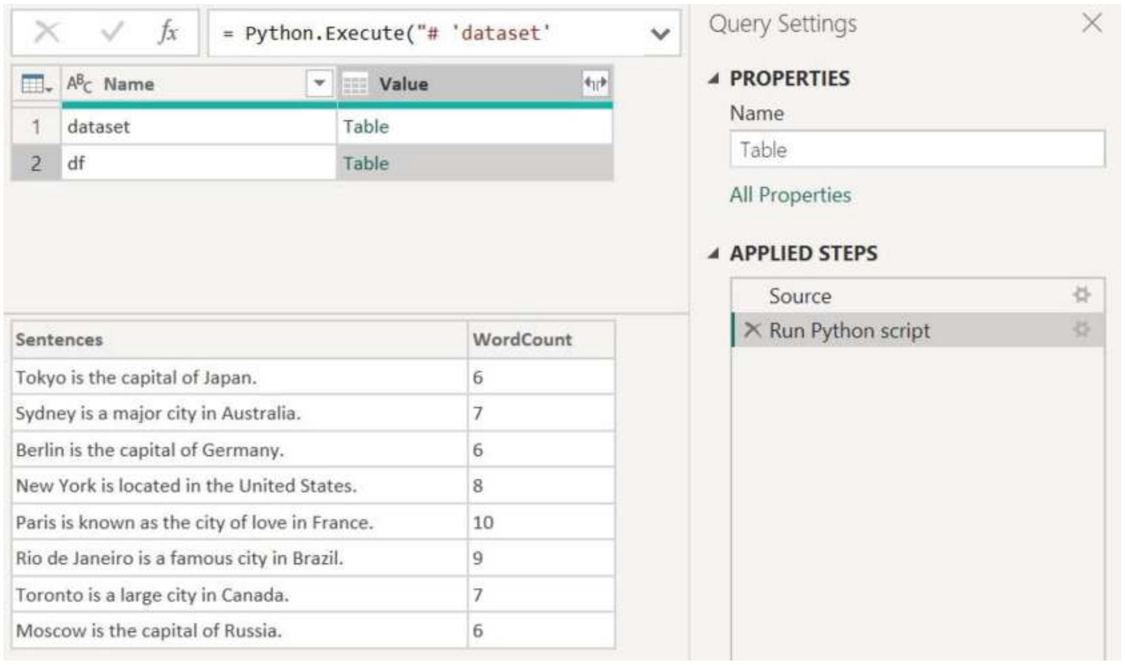
To configure your settings and change which Python installation you want to run, go to Options and settings.

***Figure 10-7*** The Run Python script dialog box in Power Query, a place for entering Python code

The first line of the open window states, `# 'dataset' holds the input data for this script`. This means you can refer to the result of the previous step of Power Query in the Python script using the name `dataset` (which can be changed by modifying the script).

Consider the following script. The first line imports the `pandas` library. The second line converts the Source table (referred to as `dataset`) into a structured data format in Python, named `df`. The last line adds a new column to the `df`, called `WordCount`, by applying the `len` function to the `text.split()` version of the text. Enter the following script in the open window and click OK, which will result in Figure 10-8.

```
import pandas as pd
df = pd.DataFrame(dataset)
df['WordCount'] = df['Sentences'].apply(lambda text: len(text.split()))
```



| | Name | Value |
|---|---|---|
| 1 | dataset | Table |
| 2 | df | Table |

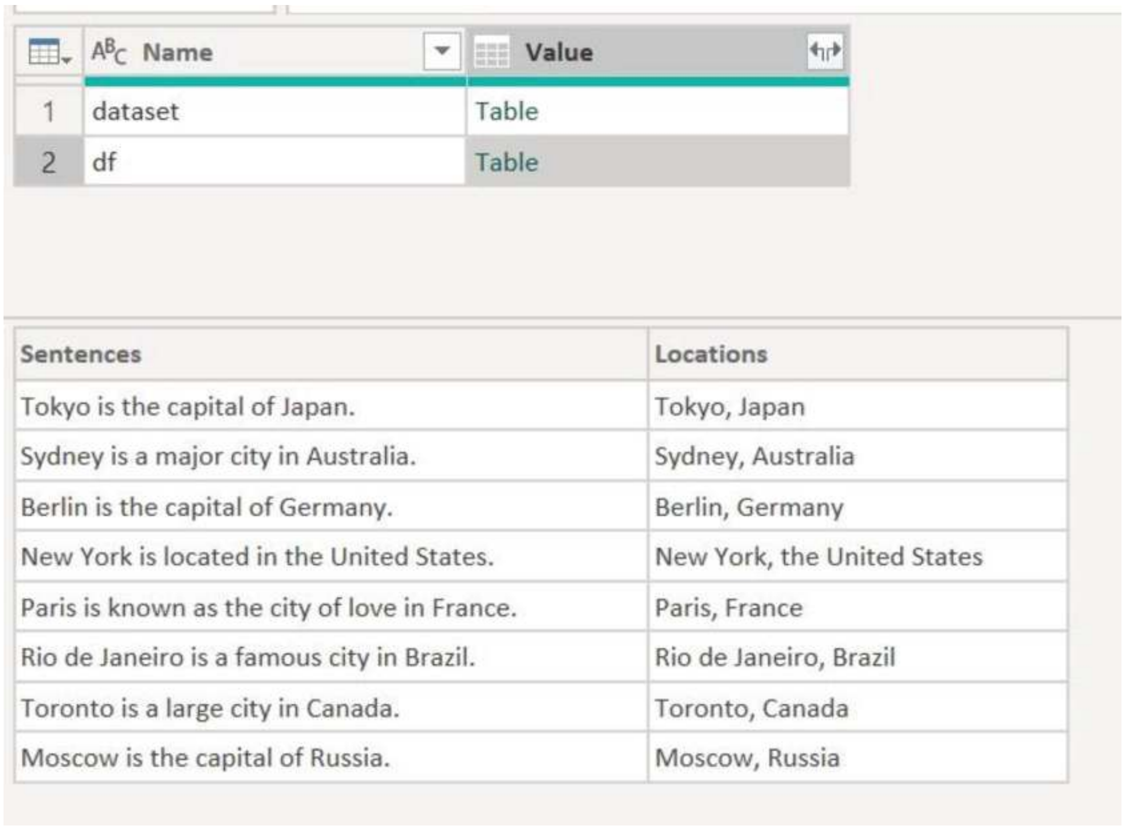
| Sentences | WordCount |
|---|---|
| Tokyo is the capital of Japan. | 6 |
| Sydney is a major city in Australia. | 7 |
| Berlin is the capital of Germany. | 6 |
| New York is located in the United States. | 8 |
| Paris is known as the city of love in France. | 10 |
| Rio de Janeiro is a famous city in Brazil. | 9 |
| Toronto is a large city in Canada. | 7 |
| Moscow is the capital of Russia. | 6 |

***Figure 10-8*** The result of Python code that counts words in a sentence

The result of this script is a table with two columns, named Name and Value. In this table, the Value column for the row with the name `dataset` is identical to the Source table. However, the table where the value is `df` represents the result of executing the Python code on the Source table. The code adds a new column called WordCount to the Source table, which displays the number of words in each row.

Now, let's update the Python script with the following script, which will result in Figure 10-9.

```
import pandas as pd
import spacy
nlp = spacy.load('en_core_web_sm')
df = pd.DataFrame(dataset)
df['Locations'] = df['Sentences'].apply(lambda text: ', '.join([ent.text for
ent in nlp(text).ents if ent.label_ in ['GPE']]))
```

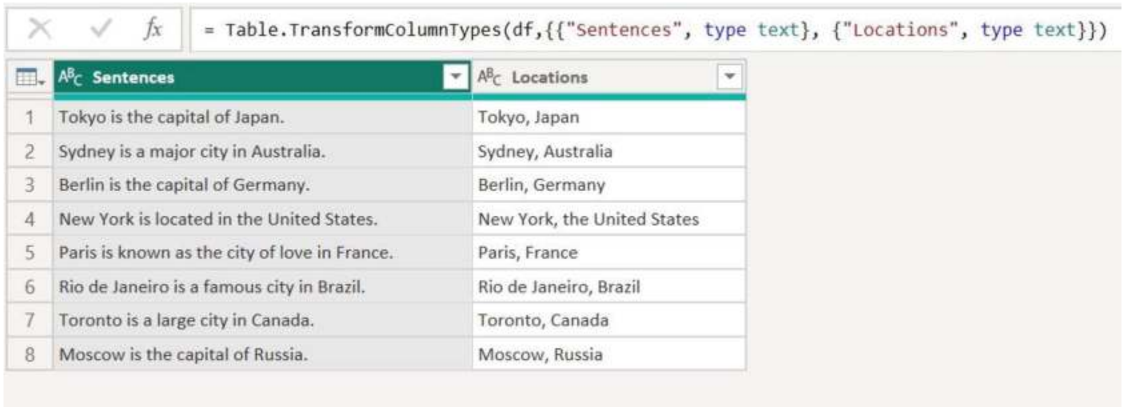


| | Name | Value |
|---|---|---|
| 1 | dataset | Table |
| 2 | df | Table |

| Sentences | Locations |
|---|---|
| Tokyo is the capital of Japan. | Tokyo, Japan |
| Sydney is a major city in Australia. | Sydney, Australia |
| Berlin is the capital of Germany. | Berlin, Germany |
| New York is located in the United States. | New York, the United States |
| Paris is known as the city of love in France. | Paris, France |
| Rio de Janeiro is a famous city in Brazil. | Rio de Janeiro, Brazil |
| Toronto is a large city in Canada. | Toronto, Canada |
| Moscow is the capital of Russia. | Moscow, Russia |

***Figure 10-9*** The result of Python-based extraction of geopolitical entities (city name, country name) by extracting the city names from text

In this script, the `spacy` library is used to extract labels related to `GPE` (geopolitical entities), which include cities, countries, and states from the sentences (to use this code, make sure the `spacy` library is installed). The output is a table with two columns and two rows. By selecting the table in the row with the name `df`, you can view the desired result, which is shown in Figure 10-10.



```
= Table.TransformColumnTypes(df,{{"Sentences", type text}, {"Locations", type text}})
```

| | Sentences | Locations |
|---|---|---|
| 1 | Tokyo is the capital of Japan. | Tokyo, Japan |
| 2 | Sydney is a major city in Australia. | Sydney, Australia |
| 3 | Berlin is the capital of Germany. | Berlin, Germany |
| 4 | New York is located in the United States. | New York, the United States |
| 5 | Paris is known as the city of love in France. | Paris, France |
| 6 | Rio de Janeiro is a famous city in Brazil. | Rio de Janeiro, Brazil |
| 7 | Toronto is a large city in Canada. | Toronto, Canada |
| 8 | Moscow is the capital of Russia. | Moscow, Russia |

***Figure 10-10*** The final results

**Note** When working with Power Query, it is important to note that you can leverage external tools like R, Python, and JavaScript multiple times within a single query. For instance, you can access external data via Power Query, preprocess it using Python, join the result with other data in Power Query, apply post-processing in Python, and finally utilize the output from Python in an R statistical package for further analysis.

## Integrating R with Power Query

Consider the Source table, which includes X and Y values, as shown in Table 10-4. Some values in the Y column are missing. Use the rows with complete Y values and create a regression model based on the selected data. Apply it over the rows with missing Ys and define new values for the missing Ys.

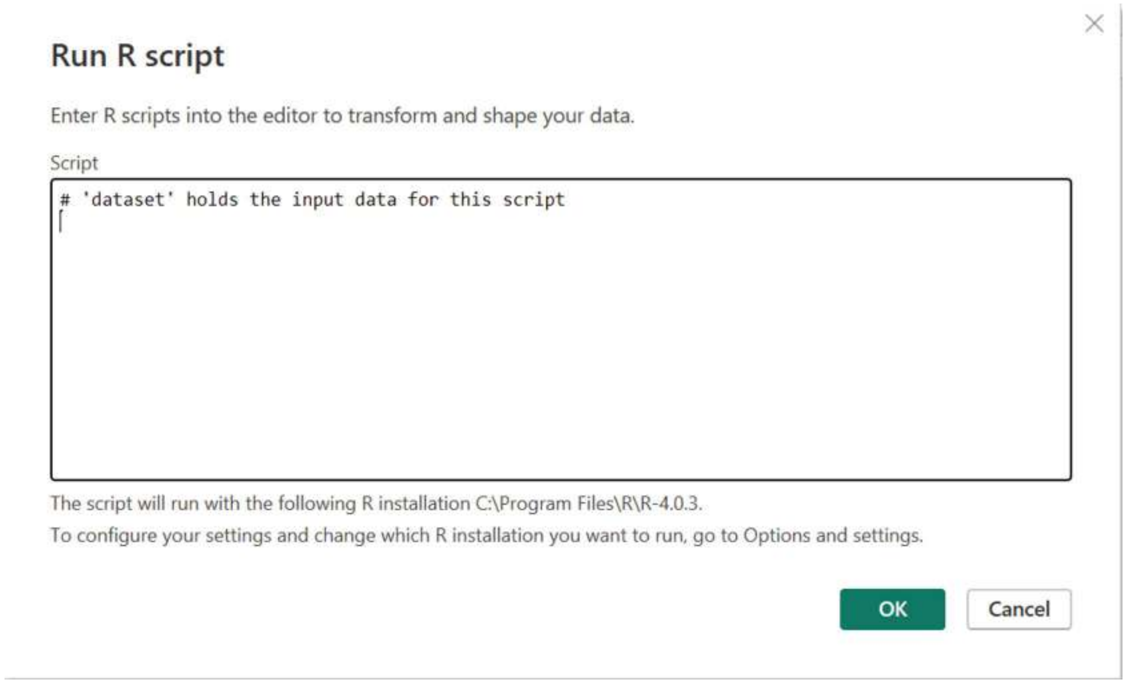
***Table 10-4*** Source: Parameters

| X | Y |
|---|---|
| 126 | 73 |
| 150 | 85 |
| 210 | |
| 420 | 229 |
| 500 | |
| 810 | 430 |
| 900 | 500 |

This problem can be addressed in various ways, but this example demonstrates how to use R scripts in Power Query to solve it.

Like Python, R can be utilized in Power Query within Power BI as of the time of writing this book. This requires some setup, which is outlined in `https://learn.microsoft.com/en-us/power-bi/connect-data/desktop-r-in-query-editor`.

In this example, after loading the data into Power Query, go to the Transform tab and select Run R Script to open a new window for entering R code, as shown in Figure 10-11 (at this time R can be applied to Power Query in Power BI, but not in the Excel version).


Run R script

Enter R scripts into the editor to transform and shape your data.

Script

```
# 'dataset' holds the input data for this script
```

The script will run with the following R installation C:\Program Files\R\R-4.0.3.

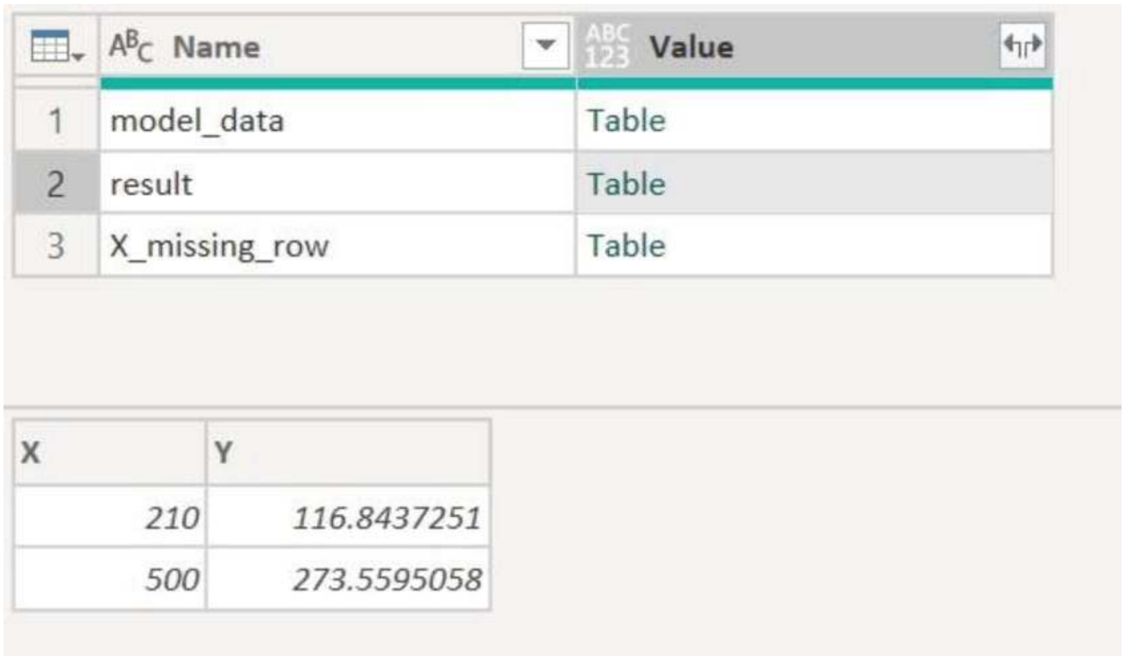
To configure your settings and change which R installation you want to run, go to Options and settings.

***Figure 10-11*** The Run R Script dialog box, a place for writing R scripts

As with Python, the last table is referred to as the `dataset`. Enter the following script into the Run R Script window and click OK, which will result in Figure 10-12.

```
dataset <- dataset
model_data <- na.omit(dataset)
```

```
model <- lm(Y ~ X, data = model_data)
X_missing_row <- dataset[is.na(dataset$Y), "X", drop = FALSE]
predictions <- predict(model, X_missing_row)
result <- cbind(X_missing_row , Y = predictions)
```



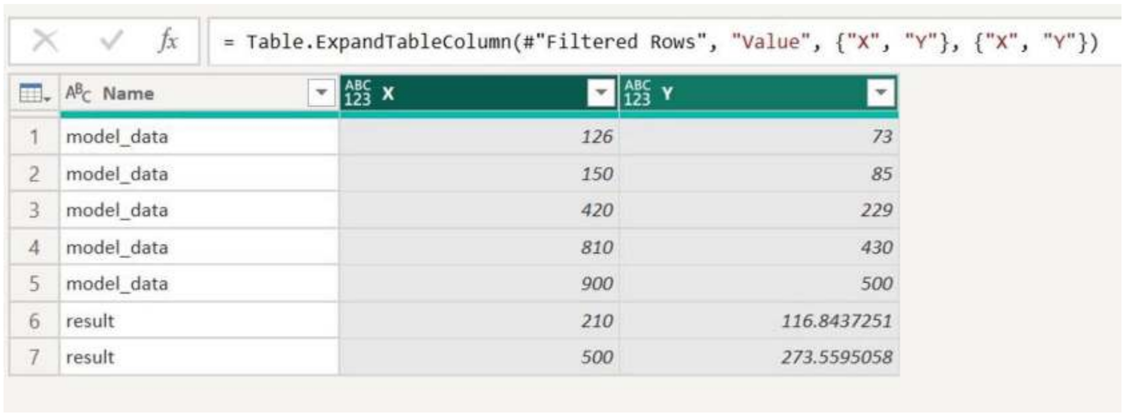
| | Name | Value |
|---|---|---|
| 1 | model_data | Table |
| 2 | result | Table |
| 3 | X_missing_row | Table |

| X | Y |
|---|---|
| 210 | 116.8437251 |
| 500 | 273.5595058 |

*Figure 10-12* The result of running the R script that fits missing data points (using linear interpolation) to the data input

In this script, the second line filters out rows with blank values in the Y column, and the remaining data is used in the third line to determine the regression model. Rows with missing Y values are extracted into a vector named X_missing_row. In the fifth line, the predicted Y values for these X values are calculated based on the regression model, and in the final line, the X and Y values are combined.

The output of running the R script in this example is a table that includes three variables: mode_data, result, and X_missing_row. You only need the data from mode_data and result, so filter out the rows related to X_missing_row using the filter command in Power Query. Expanding the tables in the Value column in the last row of the resulting table will yield the rows for missing the Ys (which came from the result step) and the other rows (which came from the model_data step). This is shown in Figure 10-13.



```
= Table.ExpandTableColumn(#"Filtered Rows", "Value", {"X", "Y"}, {"X", "Y"})
```

| | Name | X | Y |
|---|---|---|---|
| 1 | model_data | 126 | 73 |
| 2 | model_data | 150 | 85 |
| 3 | model_data | 420 | 229 |
| 4 | model_data | 810 | 430 |
| 5 | model_data | 900 | 500 |
| 6 | result | 210 | 116.8437251 |
| 7 | result | 500 | 273.5595058 |

*Figure 10-13* The result of expanding the column value

By removing the Name column, the program replaces the missing values with the predicted regression values.

## Translating Text Using the Google Translate API

Consider the Source table shown in Table 10-5, which contains customer comments for an online shop in various languages. Use Power Query to translate these comments into English.

***Table 10-5*** Source: Customer Comments

| Customer ID | Comments |
|---|---|
| C-094 | The product is great, but the delivery was too slow |
| C-052 | No estoy satisfecho con la calidad del producto |
| C-055 | 商品の品質は素晴らしいです。 |
| C-065 | El producto es bueno, pero la caja llegó dañada |
| C-091 | Je ne suis pas content du service après-vente |
| C-069 | خیلی راضی هستم، دقیقاً همان چیزی است که نیاز داشتم |
| C-094 | The product didn't meet my expectations |
| C-069 | محصول خوب است، اما قیمت کمی بالاست |

In Power Query, you can use APIs to modify tables. This example uses the Google Translate API for translation. To use this API frequently, you'll need to log in to the Google Cloud Platform, activate the Google Cloud Translation API, and create an API key for use in Power Query. This example uses the free version of the API, which has some limitations.

**Note** It is crucial to be well aware of the potential risks of sending data to third parties through API calls. This issue is not specific to Power Query, but rather pertains to data security, and for such situations, consider your company policies.

The free version can be accessed using the following URL format, where parameters are indicated with `XXX`:

```
https://translate.googleapis.com/translate_a/single?
client=gtx&sl=XXX&tl=XXX&dt=t&q=XXX
```

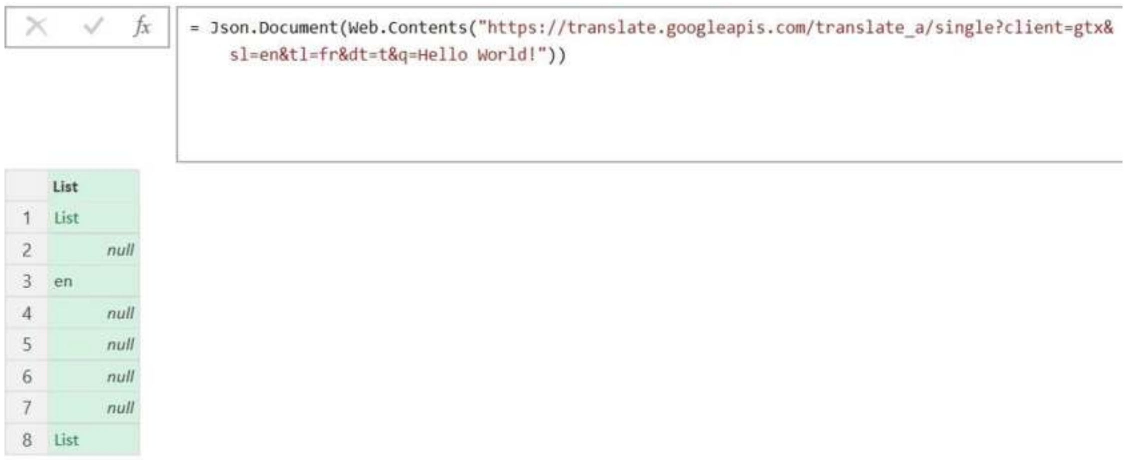
There are three parameters for using this API, called `sl`, `tl`, and `q`. Here, `sl` specifies the source language, `tl` specifies the target language, both in ISO codes, and `q` is the text to be translated.

For instance, to translate "`Hello World!`" from English to French, you would use the parameters `sl=en, tl=fr`, and `q=Hello World!` So, the URL would be:

```
https://translate.googleapis.com/translate_a/single?
client=gtx&sl=en&tl=fr&dt=t&q=Hello World!
```

In Power Query, you can use the `Web.Contents()` function to apply APIs. Since the result will be in JSON format, use `Json.Document()` function to process JSON output to Power Query-friendly data structure. So, to translate "`Hello World!`" into French, you use the following formula in the formula bar, which results in Figure 10-14.

```
= Json.Document(
      Web.Contents(
      "https://translate.googleapis.com/translate_a/single?
client=gtx&sl=en&tl=fr&dt=t&q=Hello World!"))
```



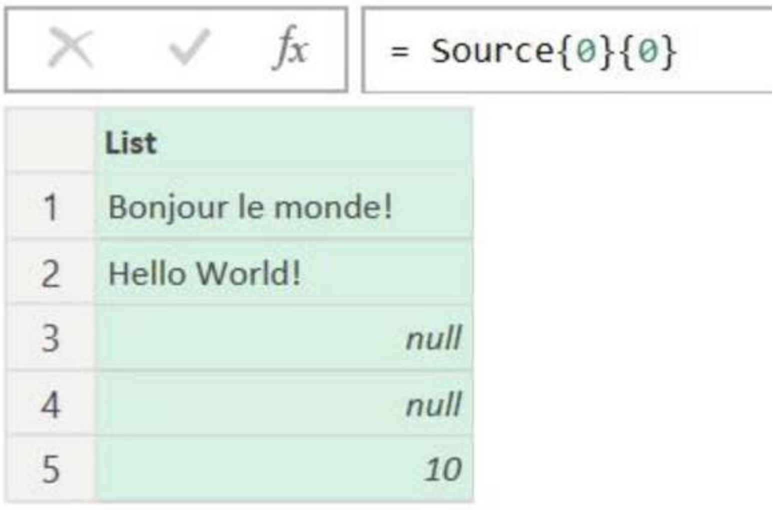
```
= Json.Document(Web.Contents("https://translate.googleapis.com/translate_a/single?client=gtx&
    sl=en&tl=fr&dt=t&q=Hello World!"))
```

|   | List |
|---|---|
| 1 | List |
| 2 | null |
| 3 | en |
| 4 | null |
| 5 | null |
| 6 | null |
| 7 | null |
| 8 | List |

***Figure 10-14*** The result of calling the API

Given the result from the previous formula as Source, the following formula will extract the translated text by navigating over the result list, as shown in Figure 10-15.

```
= Source{0}{0}
```



```
= Source{0}{0}
```

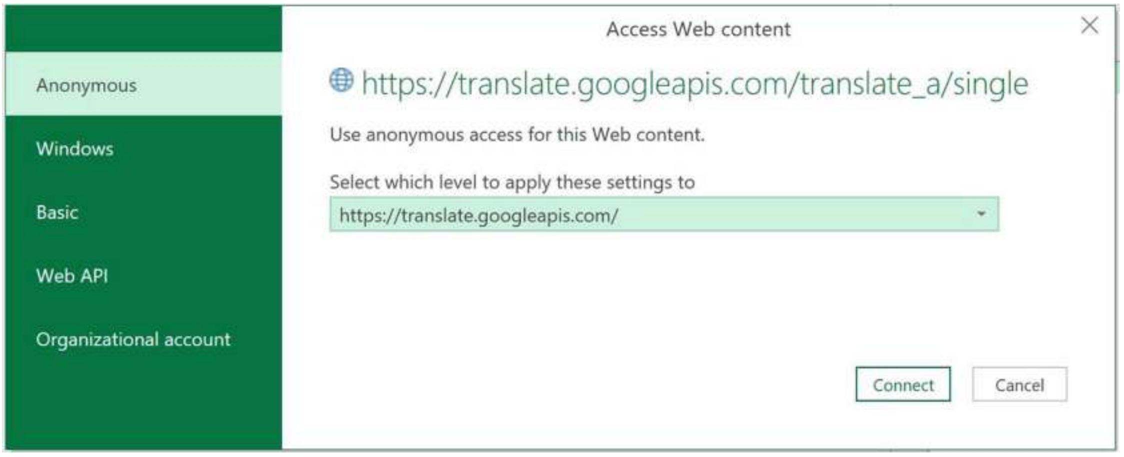
|   | List |
|---|---|
| 1 | Bonjour le monde! |
| 2 | Hello World! |
| 3 | null |
| 4 | null |
| 5 | 10 |

***Figure 10-15*** The result of calling the API

To directly get the translated text, use the following formula:

```
= Json.Document(
      Web.Contents(
      "https://translate.googleapis.com/translate_a/single?
client=gtx&sl=en&tl=fr&dt=t&q=Hello World!")){0}{0}{0}
```

If you encounter any credential warnings during this process, such as the one shown in Figure 10-16, edit the credentials and connect, as shown in Figure 10-17.



Access Web content

Anonymous | Windows | Basic | Web API | Organizational account

https://translate.googleapis.com/translate_a/single

Use anonymous access for this Web content.

Select which level to apply these settings to

https://translate.googleapis.com/

***Figure 10-16*** The Access Web Content window

Please specify how to connect.

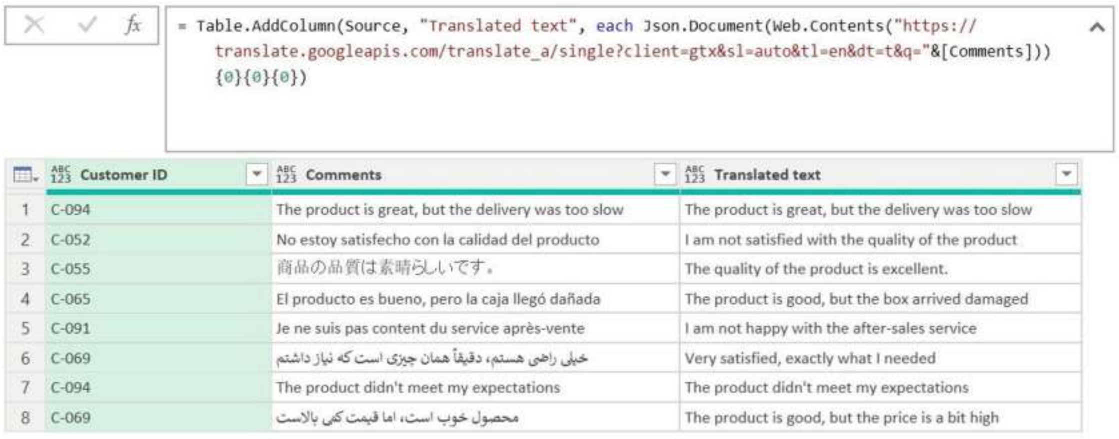
***Figure 10-17*** Credentials warning from the first connection to a source

Returning to the original problem, if you have a table with text in various languages and the source languages are not predefined, you can set `sl` to `auto-detect` so it can determine the language.

Based on this explanation, let's return to the main problem. Add a new column to the Source table named Translated Text and use the following formula to solve the problem and get the translated text.

```
=Json.Document(Web.Contents("https://translate.googleapis.com/translate_a/sin
client=gtx&sl=auto&tl=en&dt=t&q="&[Comments])){0}{0}{0}
```

This formula will populate the new column with the auto-translated text, as shown in Figure 10-18.



```
= Table.AddColumn(Source, "Translated text", each Json.Document(Web.Contents("https://
    translate.googleapis.com/translate_a/single?client=gtx&sl=auto&tl=en&dt=t&q="&[Comments]))
    {0}{0}{0})
```

| | Customer ID | Comments | Translated text |
|---|---|---|---|
| 1 | C-094 | The product is great, but the delivery was too slow | The product is great, but the delivery was too slow |
| 2 | C-052 | No estoy satisfecho con la calidad del producto | I am not satisfied with the quality of the product |
| 3 | C-055 | 商品の品質は素晴らしいです。 | The quality of the product is excellent. |
| 4 | C-065 | El producto es bueno, pero la caja llegó dañada | The product is good, but the box arrived damaged |
| 5 | C-091 | Je ne suis pas content du service après-vente | I am not happy with the after-sales service |
| 6 | C-069 | خیلی راضی هستم، دقیقاً همان چیزی است که نیاز داشتم | Very satisfied, exactly what I needed |
| 7 | C-094 | The product didn't meet my expectations | The product didn't meet my expectations |
| 8 | C-069 | محصول خوب است، اما قیمت کمی بالاست | The product is good, but the price is a bit high |

***Figure 10-18*** The result of auto-translated text (the input language is automatically detected)

In this problem, rather than adding a new column, you can directly apply the translation to the existing Comments column using the `Table.TransformColumns()` function. If you are a seasoned Power Query user, you can add a new transformation step directly, where you'll transform the column (`Source[Comments]`) using Google API translation. However, I recommend using a "lazy dev" approach, where you call an arbitrary transformation on the column of your choice and then adapt the automatically generated Power Query code to run the auto-translation.

To see this function setting, right-click the Comments column and choose a transformation option, such as converting text to uppercase. In this example, using the uppercase transformation will result in the following formula in the formula bar:

```
= Table.TransformColumns(Source,{{"Comments", Text.Upper, type text}})
```

This formula applies the `Text.Upper()` function as the transformation function over all the values in this column.

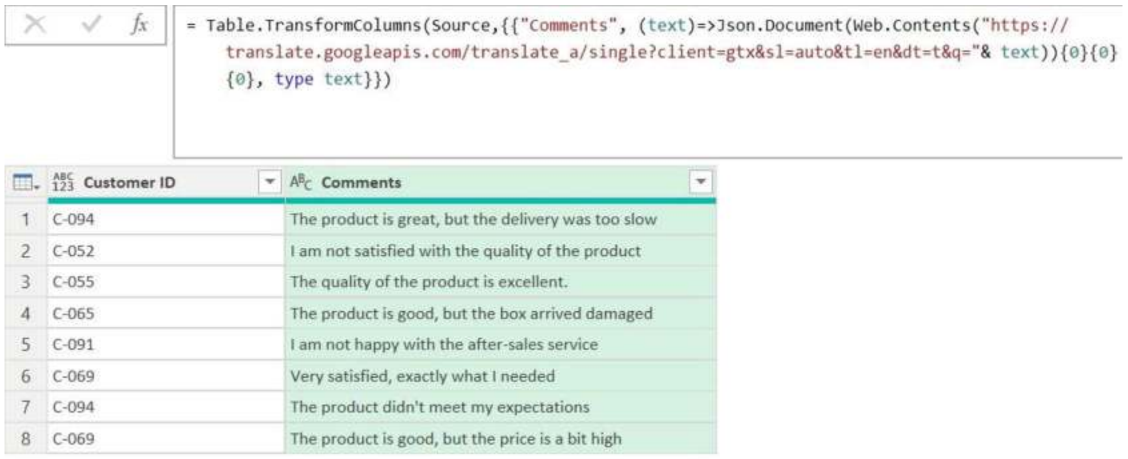
Instead of changing the text to uppercase, you want to translate the text. You can achieve this by creating a custom function for translation and applying it to the Comments column. To convert the translation formula into a function with one input parameter named `text`, use the following formula:

```
(text)=>Json.Document(Web.Contents("https://translate.googleapis.com/translate
client=gtx&sl=auto&tl=en&dt=t&q="& text)){0}{0}{0}
```

Now replace `Text.Upper` with this translation function in the `Table.TransformColumns()` formula. The updated formula will look like this:

```
= Table.TransformColumns(
      Source,
      {{"Comments",
      (text)=>Json.Document(
                              Web.Contents(
"https://translate.googleapis.com/translate_a/single?
client=gtx&sl=auto&tl=en&dt=t&q="& text)){0}{0}{0}, type text}})
```

This formula will directly translate the text in the Comments column and provide the translated result, as shown in Figure 10-19.



```
= Table.TransformColumns(Source,{{"Comments", (text)=>Json.Document(Web.Contents("https://
    translate.googleapis.com/translate_a/single?client=gtx&sl=auto&tl=en&dt=t&q="& text)){0}{0}
    {0}, type text}})
```

| | Customer ID | Comments |
|---|---|---|
| 1 | C-094 | The product is great, but the delivery was too slow |
| 2 | C-052 | I am not satisfied with the quality of the product |
| 3 | C-055 | The quality of the product is excellent. |
| 4 | C-065 | The product is good, but the box arrived damaged |
| 5 | C-091 | I am not happy with the after-sales service |
| 6 | C-069 | Very satisfied, exactly what I needed |
| 7 | C-094 | The product didn't meet my expectations |
| 8 | C-069 | The product is good, but the price is a bit high |

***Figure 10-19*** The result of the translation

## Automating Query Export to CSV Files

Add a query step to export the results from the previous step into a CSV file.

For Power BI users, solving this task is straightforward with the use of R and Python scripts. To save the previous query results to a file named `test` in the `C:/other/` directory as a TXT or CSV file, you can use the following R scripts in the Power BI version of Power Query:

```
write.table(dataset, "C:/other/test.txt", sep = "\t", row.names = FALSE,
quote = FALSE)

write.table(dataset, "C:/other/test.csv", sep = "\t", row.names = FALSE,
quote = FALSE)
```

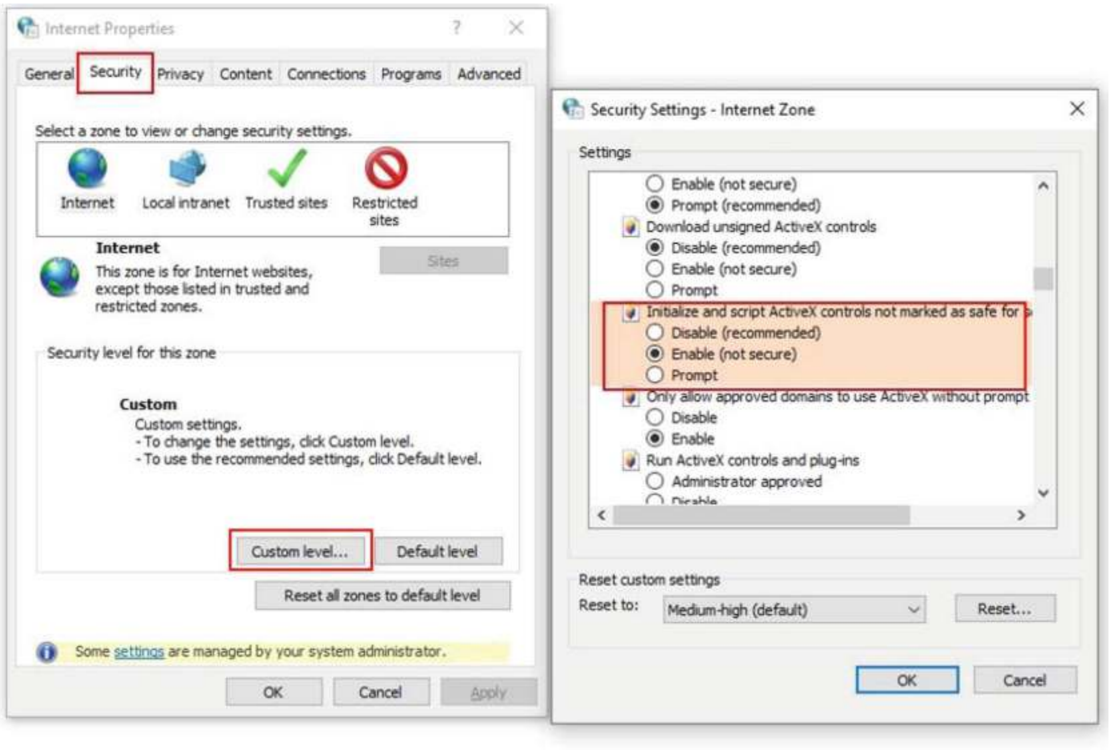
Alternatively, to achieve the same result using a Python script, you can use the following scripts:

```
import pandas as pd
data = pd.DataFrame(dataset)
data.to_csv('C:/other/test.csv', index=False)

import pandas as pd
data = pd.DataFrame(dataset)
data.to_csv('C:/other/test.txt', index=False)
```

For Excel users, who cannot use Python or R scripts (as of the time this book was written), JavaScript must be utilized instead. However, this requires changing ActiveX control settings, which can involve certain risks (it is not recommended and in most of companies can be changed by IT only). Proceed with these changes only if necessary for saving the data as a CSV file.

The process of enabling ActiveX controls might be different in different versions of Windows. In Windows 10, go to the Internet Options settings, navigate to the Security tab and select Custom Level. In the Security Settings, locate "Initialize and Script ActiveX Controls Not Marked As Safe..." and set it to Enable, as shown in Figure 10-20.



Internet Properties

General | Security | Privacy | Content | Connections | Programs | Advanced

Select a zone to view or change security settings.

Internet | Local intranet | Trusted sites | Restricted sites

**Internet**
This zone is for Internet websites, except those listed in trusted and restricted zones.

Security level for this zone

**Custom**
Custom settings.
- To change the settings, click Custom level.
- To use the recommended settings, click Default level.

Custom level... | Default level

Reset all zones to default level

Some settings are managed by your system administrator.

OK | Cancel | Apply

Security Settings - Internet Zone

Settings

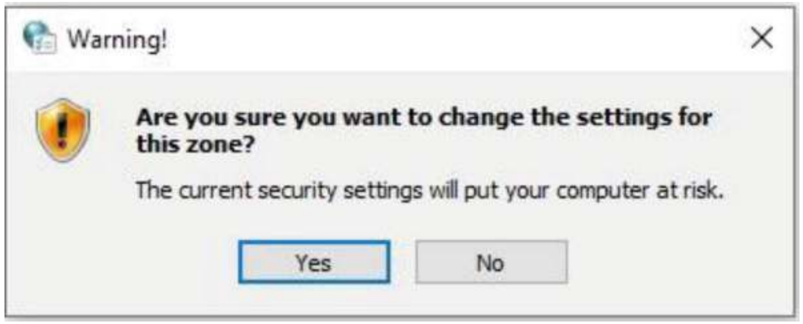
- Enable (not secure)
- [✓ Prompt (recommended)]
- Download unsigned ActiveX controls
  - [✓ Disable (recommended)]
  - Enable (not secure)
  - Prompt
- Initialize and script ActiveX controls not marked as safe for
  - Disable (recommended)
  - [✓ Enable (not secure)]
  - Prompt
- Only allow approved domains to use ActiveX without prompt
  - Disable
  - [✓ Enable]
- Run ActiveX controls and plug-ins
  - Administrator approved
  - Disable

Reset custom settings
Reset to: Medium-high (default) | Reset...

OK | Cancel

*Figure 10-20* ActiveX-specific security settings

After applying these settings, a warning window like Figure 10-21 will appear. Click Yes.



Warning!

**Are you sure you want to change the settings for this zone?**

The current security settings will put your computer at risk.

Yes | No

*Figure 10-21* Warning alarms

Once the initial settings are configured, you need to convert the Power Query table to JSON before saving it in a CSV file. Assuming the previous step of Power Query is named `dataset`, use the following formula to convert it to the JSON format. Create a new step, rename it `JSON`, and type the following formula in the formula bar.

```
    =
Text.FromBinary(Json.FromValue(Table.ToRows(Table.DemoteHeaders(dataset)))),
```

Next, use the following formula to export the JSON table to a CSV file.

```
    Export = Web.Page("<script>
                            var fso=new
ActiveXObject('Scripting.FileSystemObject');
                            var
f1=fso.CreateTextFile('C:/other/test.csv',true);
                            var arr="&Json&";
                            f1.WriteLine(arr.join('\n'));
                            f1.WriteBlankLines(1);
                            f1.Close();
                    </script>")
```

## Summary

This chapter explored how to run Python, JavaScript, and R scripts within Power Query to extend its functionality. Using Python and the `spacy` library, you extracted city names from text data, while R was employed to predict and replace missing values through regression. JavaScript enabled you to use regular expressions (regex) to extract email addresses from text. Additionally, you learned how to export the output of a Power Query step as a CSV file. Beyond these scripting techniques, you also integrated Google Translate APIs to automatically translate text from various languages into English.

The next chapter explains the techniques related to error handling in Power Query.

O. Motamedisedeh, *96 Common Challenges in Power Query*
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# 11. Error-Handling Strategies

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Dealing with errors is an inseparable part of the data-cleaning process, and Power Query provides several functions to handle them. Errors in Power Query can be categorized into two groups: step-level errors and cell-level errors.

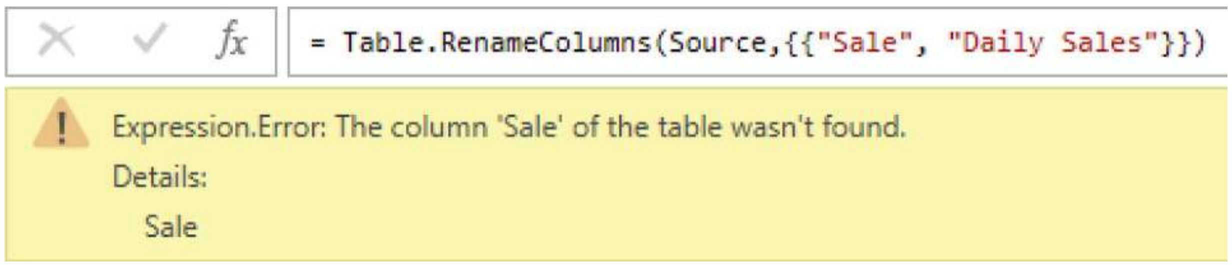
A common cause of step-level errors is referencing a column, table, data source or a query that does not exist. For example, consider the Source table in Table 11-1.

***Table 11-1*** Source: Historical sales value

| Date | Sales |
|---|---|
| 4/07/2024 | 21 |
| 7/07/2024 | 10 |
| 12/07/2024 | X |
| 15/07/2024 | 22 |
| 21/07/2024 | 7 |

If a Power Query developer addresses the Sales column by the wrong name (e.g., Sale or sales, because Power Query is case-sensitive), like in the following formula, it leads to error, as shown in Figure 11-1:

```
= Table.RenameColumns(Source,{{"Sale", "Daily Sales"}})
```



```
= Table.RenameColumns(Source,{{"Sale", "Daily Sales"}})
```

Expression.Error: The column 'Sale' of the table wasn't found.
Details:
Sale

***Figure 11-1*** Step-level error example

A step-level error prevents the query from loading and consists of three parts:

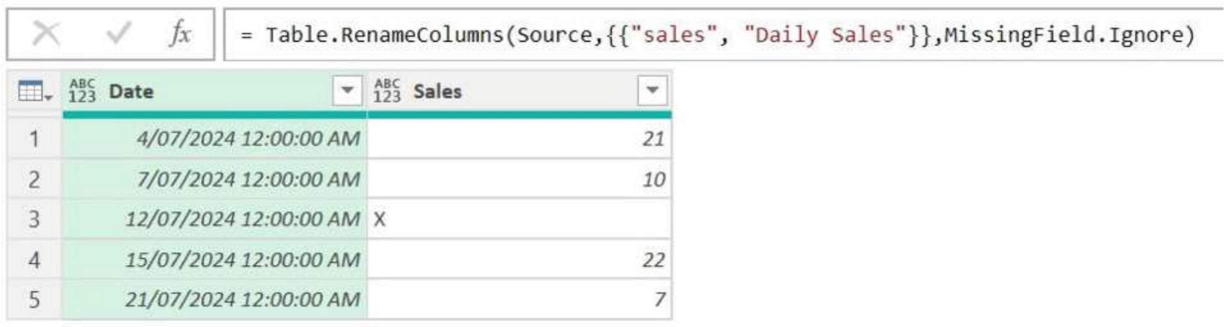
– Reason for the error (the part before the colon)
– Message (the part after the colon on the first line)
– Details (the section following the message)

Given the variety of situations that can lead to step-level errors, there is no universal solution for handling all of them. However, most of the time, step-level errors are caused by hardcoding or mismatched column names, so be mindful of these situations.

In the case of mismatch column names, you can use `MissingField.Error` (or value 1) and `MissingField.UseNull` (or value 2) as an additional argument in some functions to prevent errors.

The previous formula leads to an error, and rewriting it using `MissingField.UseNull`, as shown in the next formula, results in Figure 11-2. This says that if there is a column called sale, rename it Daily Sale. Otherwise, ignore it.

```
= Table.RenameColumns(Source,{{"sales", "Daily
Sales"}},MissingField.Ignore)
```



```
= Table.RenameColumns(Source,{{"sales", "Daily Sales"}},MissingField.Ignore)
```

| | Date | Sales |
|---|---|---|
| 1 | 4/07/2024 12:00:00 AM | 21 |
| 2 | 7/07/2024 12:00:00 AM | 10 |
| 3 | 12/07/2024 12:00:00 AM | X |
| 4 | 15/07/2024 12:00:00 AM | 22 |
| 5 | 21/07/2024 12:00:00 AM | 7 |

***Figure 11-2*** Using MissingField.Ignore

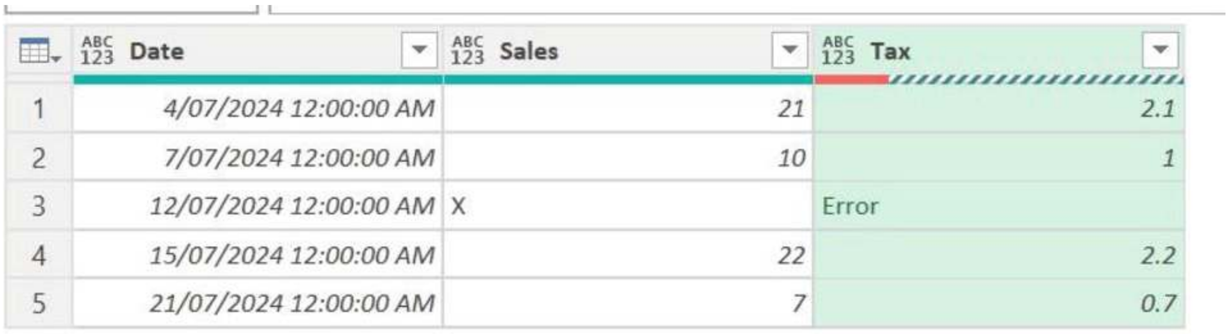
The `MissingField.Ignore` argument can also be used to rename and remove columns, including:

- `Record.RemoveFields()`
- `Record.RenameFields()`
- `Record.ReorderFields()`
- `Record.SelectFields()`
- `Record.TransformFields()`
- `Table.FromRecords()`
- `Table.RemoveColumns()`

- `Table.RenameColumns()`
- `Table.ReorderColumns()`
- `Table.SelectColumns()`
- `Table.TransformColumns()`

Cell-level errors typically occur due to a data type mismatch. For instance, consider the Source table from the earlier example. To add a new column for calculating tax equal to 10 percent of sales, add a Custom column using the following formula in the Custom Column window Since the value in the third row is non-numeric (`x`), the result for that row in the new column will be an error, as shown in Figure 11-3:

```
= 0.1*[Sales]
```

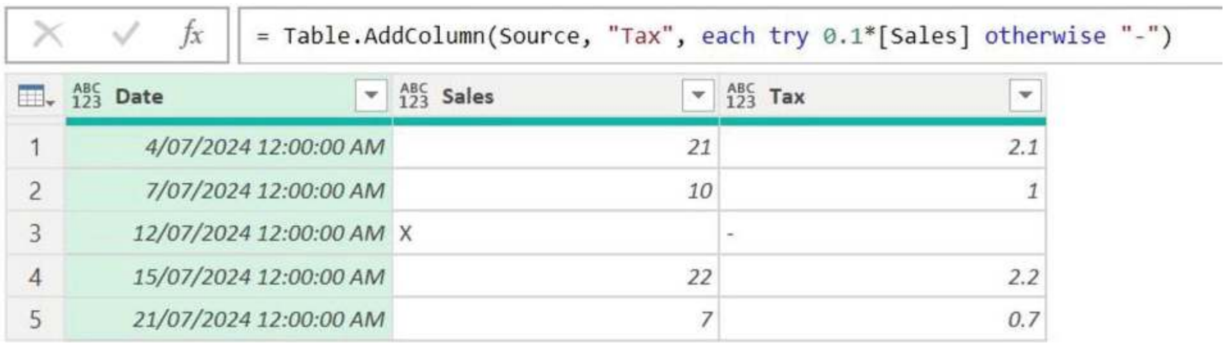


| | Date | Sales | Tax |
|---|---|---|---|
| 1 | 4/07/2024 12:00:00 AM | 21 | 2.1 |
| 2 | 7/07/2024 12:00:00 AM | 10 | 1 |
| 3 | 12/07/2024 12:00:00 AM | X | Error |
| 4 | 15/07/2024 12:00:00 AM | 22 | 2.2 |
| 5 | 21/07/2024 12:00:00 AM | 7 | 0.7 |

***Figure 11-3*** Cell-level error

In such conditions, you can use the `try-otherwise` function to handle errors. By rewriting the formula in the Custom Column window as shown here, the error for non-numeric values will be replaced with a placeholder value, resulting in Figure 11-4:

```
= try 0.1*[Sales] otherwise "-"
```



```
= Table.AddColumn(Source, "Tax", each try 0.1*[Sales] otherwise "-")
```

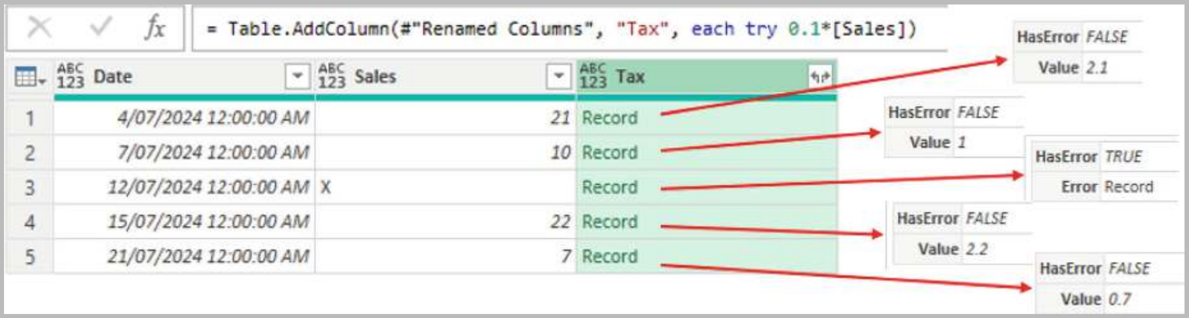
| | Date | Sales | Tax |
|---|---|---|---|
| 1 | 4/07/2024 12:00:00 AM | 21 | 2.1 |
| 2 | 7/07/2024 12:00:00 AM | 10 | 1 |
| 3 | 12/07/2024 12:00:00 AM | X | - |
| 4 | 15/07/2024 12:00:00 AM | 22 | 2.2 |
| 5 | 21/07/2024 12:00:00 AM | 7 | 0.7 |

***Figure 11-4*** Using try-otherwise

**Note** This example uses a placeholder to replace the errors, but this approach is not recommended. Using non-numerical placeholder values (such as “N/A”, “-”, or “Missing”) in numerical columns can lead to several issues in data processing and reporting, including:

- **Calculation errors:** In some cases, functions expecting numerical inputs (e.g., aggregations, arithmetic operations) will fail or produce incorrect results if non-numeric placeholders are present.
- **Performance overhead:** Additional transformations (e.g., replacing placeholders, handling errors) might be required in the later steps or after loading data into the Data Model.
- **Visualization problems:** BI tools like Power BI might struggle with mixed data types, affecting sorting, filtering, and chart rendering.

**Note** In the Custom Column window, this example used the `try 0.1 * [Sales] otherwise "-"` formula. However, using just `try 0.1 * [Sales]` changes the results, as shown in Figure 11-5.



```
= Table.AddColumn(#"Renamed Columns", "Tax", each try 0.1*[Sales])
```

|  | Date | Sales | Tax |
|---|---|---|---|
| 1 | 4/07/2024 12:00:00 AM | 21 | Record |
| 2 | 7/07/2024 12:00:00 AM | 10 | Record |
| 3 | 12/07/2024 12:00:00 AM | X | Record |
| 4 | 15/07/2024 12:00:00 AM | 22 | Record |
| 5 | 21/07/2024 12:00:00 AM | 7 | Record |

| | |
|---|---|
| HasError | FALSE |
| Value | 2.1 |

| | |
|---|---|
| HasError | FALSE |
| Value | 1 |

| | |
|---|---|
| HasError | TRUE |
| Error | Record |

| | |
|---|---|
| HasError | FALSE |
| Value | 2.2 |

| | |
|---|---|
| HasError | FALSE |
| Value | 0.7 |

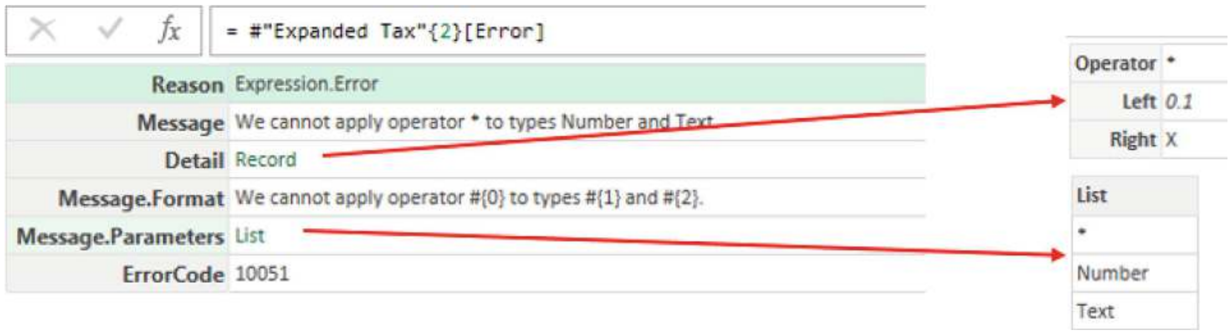
*Figure 11-5* Result of using try 0.1 * [Sales]

As demonstrated, this formula returns a record with two fields:

– The `HasError` field, which is present in all rows.
– A second field, which is either `Value` (for rows where `0.1 * [Sales]` does not result in an error) or `Error` (for rows where `0.1 * [Sales]` results in an error).

For rows where `0.1 * [Sales]` does not result in an error, `HasError` is `false`, and the `Value` field contains the calculated result of `0.1 * [Sales]`. But, for rows where `0.1 * [Sales]` does result in an error, `HasError` is `true`, and the `Error` field is a record containing details about the error.

If you drill down into the `Error` record for the third row (which causes an error), you can view the error details, as shown in Figure 11-6.



```
= #"Expanded Tax"{2}[Error]
```

| | |
|---|---|
| Reason | Expression.Error |
| Message | We cannot apply operator * to types Number and Text |
| Detail | Record |
| Message.Format | We cannot apply operator #{0} to types #{1} and #{2}. |
| Message.Parameters | List |
| ErrorCode | 10051 |

| | |
|---|---|
| Operator | * |
| Left | 0.1 |
| Right | X |

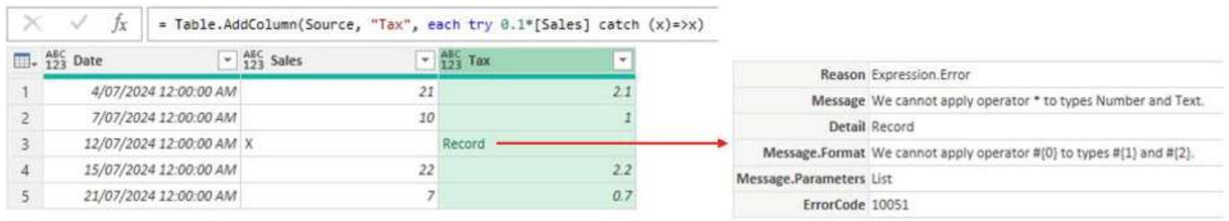
| List |
|---|
| * |
| Number |
| Text |

***Figure 11-6*** Values of the Error field

Besides using the `try-otherwise` combination, you can also use `try-catch`. In this approach, the expression after the `try` keyword is evaluated and returned as the result. However, if it results in an error, the value of the `Error` field is passed as input to the function defined after the `catch` keyword.

So, in the previous example, if you use the following formula to calculate the tax, it will result in Figure 11-7.

```
=try 0.1*[Sales] catch (x)=>x
```



```
= Table.AddColumn(Source, "Tax", each try 0.1*[Sales] catch (x)=>x)
```

| | Date | Sales | Tax |
|---|---|---|---|
| 1 | 4/07/2024 12:00:00 AM | 21 | 2.1 |
| 2 | 7/07/2024 12:00:00 AM | 10 | 1 |
| 3 | 12/07/2024 12:00:00 AM | X | Record |
| 4 | 15/07/2024 12:00:00 AM | 22 | 2.2 |
| 5 | 21/07/2024 12:00:00 AM | 7 | 0.7 |

| | |
|---|---|
| Reason | Expression.Error |
| Message | We cannot apply operator * to types Number and Text. |
| Detail | Record |
| Message.Format | We cannot apply operator #{0} to types #{1} and #{2}. |
| Message.Parameters | List |
| ErrorCode | 10051 |

***Figure 11-7*** Using try-catch

**Note** While the `try` keyword can be useful for handling errors by converting them into alternative results, it might come to your mind to use it for all the formulas to reach error-free results. But this would significantly impact query performance, especially when working with large datasets.

To demonstrate the performance impact, I expanded the Source table to 1 million rows and tested three different scenarios. In each case, I added a column to calculate the tax value and then summed all the tax amounts:

Scenario 1: The Sales column contains some text values, and I added a Tax column using the following formula:

```
= try 0.1*[Sales] otherwise "-"
```

Scenario 2: The same table of scenario 1 was used, but instead of "-", I replaced errors with `null` using the following formula:

```
= try 0.1*[Sales] otherwise null
```

Scenario 3: The Sales column contained only numeric values, so I used the following formula:

```
= try 0.1*[Sales] otherwise null
```

The results showed a significant performance difference. Execution time for the different scenarios were as follows:

```
Scenario 1: 27 seconds

Scenario 2: 18 seconds

Scenario 3: 3 seconds
```

As you can see, using `try-otherwise` increases processing time considerably.

In real-world scenarios, where tables contain millions of records, it is crucial to remove rows with errors and to determine the reasons for cell-level errors in queries. However, for the purpose of this chapter and to enhance readability, small tables are used in the rest of this chapter.

## Removing Rows with Errors

Consider the Source table, which includes historical sales transactions, as shown in Table 11-2. Calculate the average daily sales for each row (without cleaning the data) and remove the rows with errors from the resulting table.

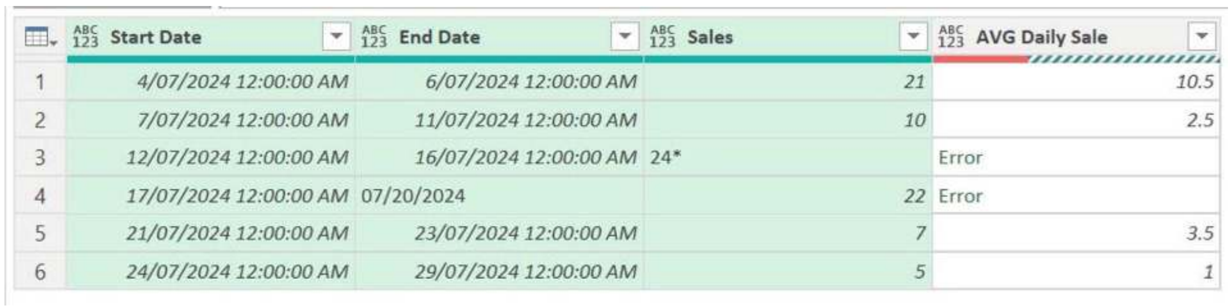
***Table 11-2*** Source: Historical Sales Value

| Start Date | End Date | Sales |
|---|---|---|
| 4/07/2024 12:00:00 AM | 6/07/2024 12:00:00 AM | 21 |
| 7/07/2024 12:00:00 AM | 11/07/2024 12:00:00 AM | 10 |
| 12/07/2024 12:00:00 AM | 16/07/2024 12:00:00 AM | 24* |
| 17/07/2024 12:00:00 AM | 07/20/2024 | 22 |

| Start Date | End Date | Sales |
|---|---|---|
| 21/07/2024 12:00:00 AM | 23/07/2024 12:00:00 AM | 7 |
| 24/07/2024 12:00:00 AM | 29/07/2024 12:00:00 AM | 5 |

To calculate the daily sales without cleaning the data, you can add a new column to the Source table named AVG Daily Sale using the following formula in the Custom Column window. This results in Figure 11-8:

```
=[Sales]/Number.From([End Date]-[Start Date])
```

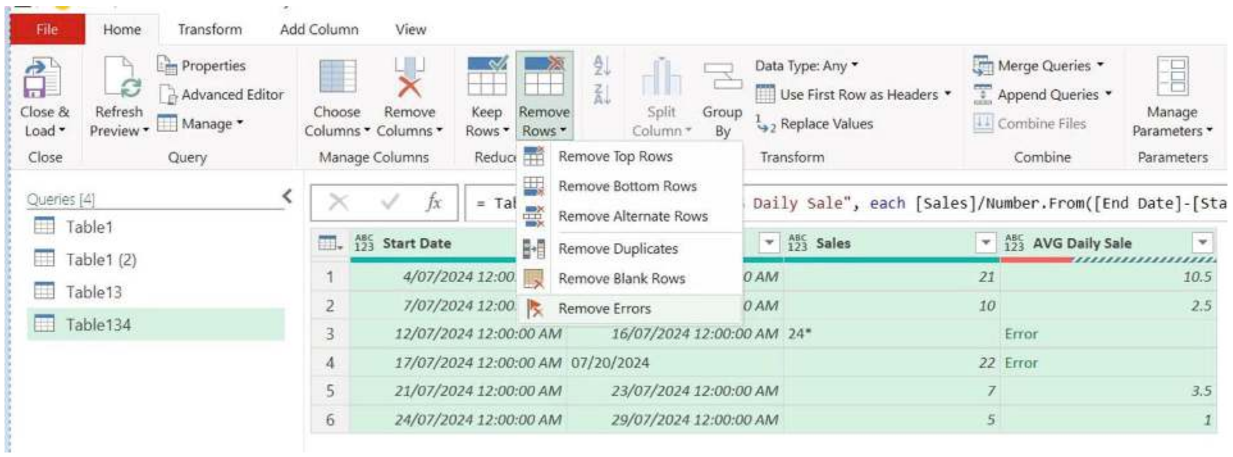


| | Start Date | End Date | Sales | AVG Daily Sale |
|---|---|---|---|---|
| 1 | 4/07/2024 12:00:00 AM | 6/07/2024 12:00:00 AM | 21 | 10.5 |
| 2 | 7/07/2024 12:00:00 AM | 11/07/2024 12:00:00 AM | 10 | 2.5 |
| 3 | 12/07/2024 12:00:00 AM | 16/07/2024 12:00:00 AM | 24* | Error |
| 4 | 17/07/2024 12:00:00 AM | 07/20/2024 | 22 | Error |
| 5 | 21/07/2024 12:00:00 AM | 23/07/2024 12:00:00 AM | 7 | 3.5 |
| 6 | 24/07/2024 12:00:00 AM | 29/07/2024 12:00:00 AM | 5 | 1 |

***Figure 11-8*** Result of daily sales

In this case, the defined formula results in errors in rows 3 and 4. In row 3, the sales value is entered as `24*`, which is not a number. Since the formula attempts to divide this value by the duration, it results in an error. On the other hand, in row 4, the value in the Start Date column is in the format of `DD/MM/yyyy hh:mm:ss` and the value in the End Date column is in the format of `MM/DD/YY`. Because these values are entered in different formats, subtracting `[Start Date]` from `[End Date]` causes an error in this row.

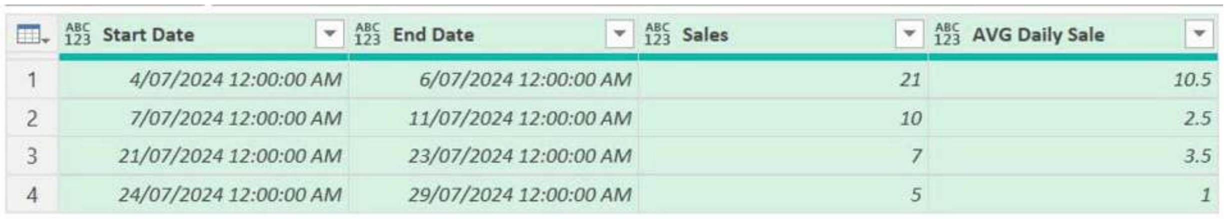
To remove rows with errors from the resulting table, select all columns in the table, then as shown in Figure 11-9, go to the Home tab. Under the Reduce Rows section, click the Remove Rows command, then select Remove Errors to produce Figure 11-10.



```
= Tal  Daily Sale", each [Sales]/Number.From([End Date]-[Sta
```

|  | Start Date |  | Sales | AVG Daily Sale |
|---|---|---|---|---|
| 1 | 4/07/2024 12:00 | 0 AM | 21 | 10.5 |
| 2 | 7/07/2024 12:00 | 0 AM | 10 | 2.5 |
| 3 | 12/07/2024 12:00:00 AM | 16/07/2024 12:00:00 AM | 24* | Error |
| 4 | 17/07/2024 12:00:00 AM | 07/20/2024 | 22 | Error |
| 5 | 21/07/2024 12:00:00 AM | 23/07/2024 12:00:00 AM | 7 | 3.5 |
| 6 | 24/07/2024 12:00:00 AM | 29/07/2024 12:00:00 AM | 5 | 1 |

***Figure 11-9*** Removing errors



|  | Start Date | End Date | Sales | AVG Daily Sale |
|---|---|---|---|---|
| 1 | 4/07/2024 12:00:00 AM | 6/07/2024 12:00:00 AM | 21 | 10.5 |
| 2 | 7/07/2024 12:00:00 AM | 11/07/2024 12:00:00 AM | 10 | 2.5 |
| 3 | 21/07/2024 12:00:00 AM | 23/07/2024 12:00:00 AM | 7 | 3.5 |
| 4 | 24/07/2024 12:00:00 AM | 29/07/2024 12:00:00 AM | 5 | 1 |

***Figure 11-10*** The result of removing the errors

The final step removes all the rows containing errors in any column, which generates the following formula:

```
= Table.RemoveRowsWithErrors(#"Added Custom", {"Start
Date", "End Date", "Sales", "AVG Daily Sale"})
```

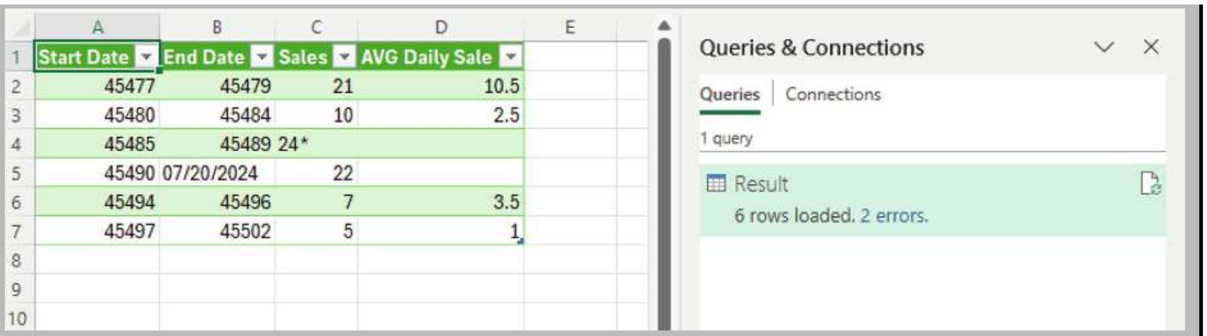
In this example, you can simplify the formula by omitting the list of column names to check for errors in all the columns and rewrite it as following :

```
= Table.RemoveRowsWithErrors(#"Added Custom")
```

## Extracting the Causes of Errors

In the previous example, instead of removing the rows with errors, extract all the rows with errors and identify the causes of those errors.

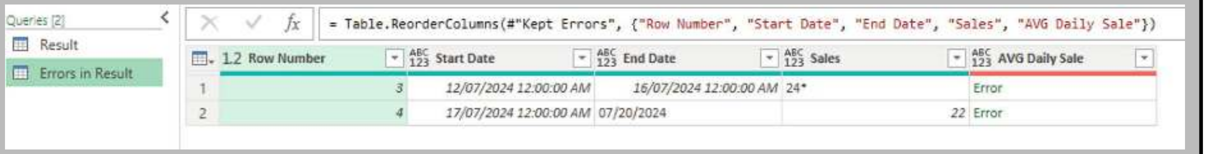
**Note** In the previous example, after adding the Custom column, if you load the data (with the errors) into Excel (or Power BI), you may notice that the resulting table contains two errors, as shown in Figure 11-11.



|  | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | Start Date | End Date | Sales | AVG Daily Sale |  |
| 2 | 45477 | 45479 | 21 | 10.5 |  |
| 3 | 45480 | 45484 | 10 | 2.5 |  |
| 4 | 45485 | 45489 | 24* |  |  |
| 5 | 45490 | 07/20/2024 | 22 |  |  |
| 6 | 45494 | 45496 | 7 | 3.5 |  |
| 7 | 45497 | 45502 | 5 | 1 |  |
| 8 |  |  |  |  |  |
| 9 |  |  |  |  |  |
| 10 |  |  |  |  |  |

*Figure 11-11* Loading a table with an error in Power Query

If you click the error message text, a query will be generated, which will display the rows that cause the errors, as shown in Figure 11-12.

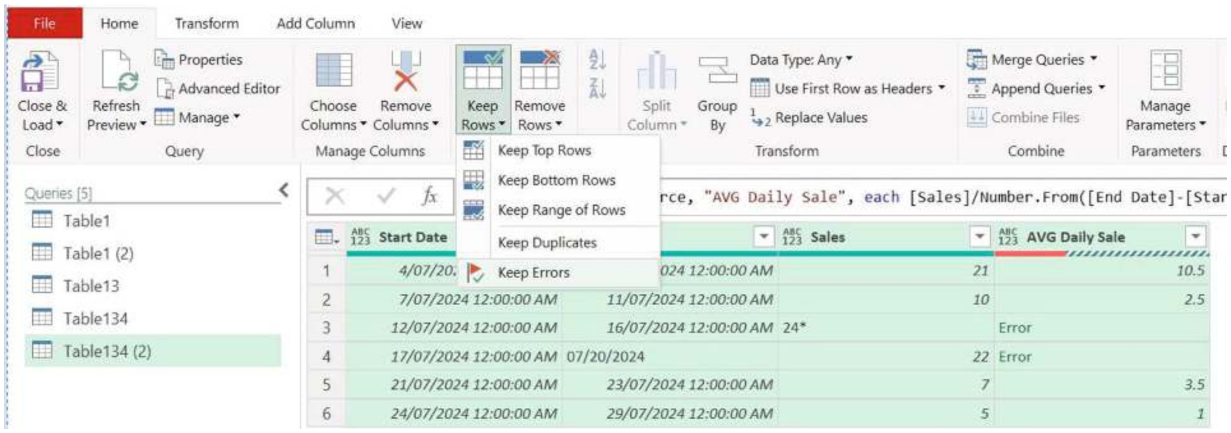


```
= Table.ReorderColumns(#"Kept Errors", {"Row Number", "Start Date", "End Date", "Sales", "AVG Daily Sale"})
```

|  | Row Number | Start Date | End Date | Sales | AVG Daily Sale |
|---|---|---|---|---|---|
| 1 | 3 | 12/07/2024 12:00:00 AM | 16/07/2024 12:00:00 AM | 24* | Error |
| 2 | 4 | 17/07/2024 12:00:00 AM | 07/20/2024 | 22 | Error |

*Figure 11-12* Automatically generated query showing the error

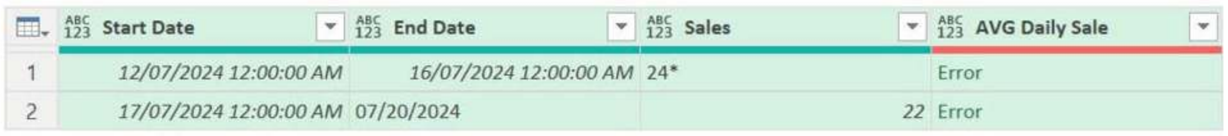
In the previous example, after adding the AVG Daily Sale column, instead of removing errors, you can extract rows with errors and identify their causes. To do this, you would select all the columns. (Although in this example, the errors are caused by the AVG Daily Sale column, so instead of selecting all the columns, you can select this column only.) Go to the Home tab, under the Reduce Rows section, click Keep Rows and select Keep Errors, as shown in Figure 11-13. This will result in all the rows with an error value in any of selected columns being shown, as in Figure 11-14.



```
rce, "AVG Daily Sale", each [Sales]/Number.From([End Date]-[Star
```

|  | Start Date |  | Sales | AVG Daily Sale |
|---|---|---|---|---|
| 1 | 4/07/20. | 024 12:00:00 AM | 21 | 10.5 |
| 2 | 7/07/2024 12:00:00 AM | 11/07/2024 12:00:00 AM | 10 | 2.5 |
| 3 | 12/07/2024 12:00:00 AM | 16/07/2024 12:00:00 AM | 24* | Error |
| 4 | 17/07/2024 12:00:00 AM | 07/20/2024 | 22 | Error |
| 5 | 21/07/2024 12:00:00 AM | 23/07/2024 12:00:00 AM | 7 | 3.5 |
| 6 | 24/07/2024 12:00:00 AM | 29/07/2024 12:00:00 AM | 5 | 1 |

*Figure 11-13* Using the Keep Error command

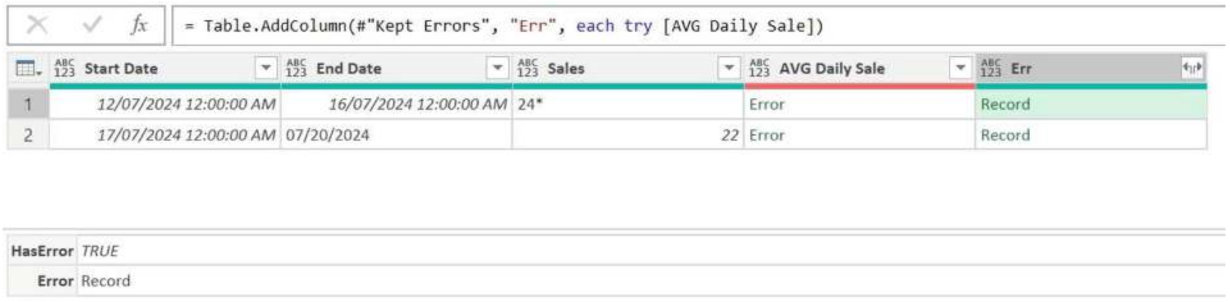


| | Start Date | End Date | Sales | AVG Daily Sale |
|---|---|---|---|---|
| 1 | 12/07/2024 12:00:00 AM | 16/07/2024 12:00:00 AM | 24* | Error |
| 2 | 17/07/2024 12:00:00 AM | 07/20/2024 | 22 | Error |

***Figure 11-14*** The result of using Keep Errors

After extracting the rows with errors, you can extract the cause of the errors. In the next step, add a new column named Err using the following formula, resulting in Figure 11-15:

```
=try [AVG Daily Sale]
```



```
= Table.AddColumn(#"Kept Errors", "Err", each try [AVG Daily Sale])
```

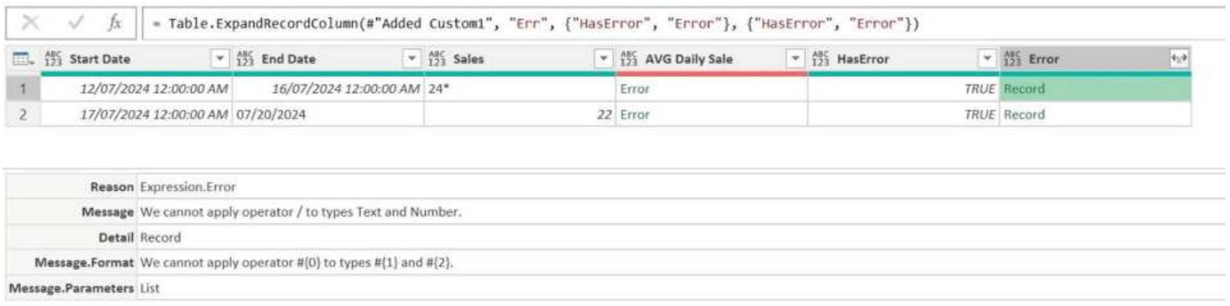
| | Start Date | End Date | Sales | AVG Daily Sale | Err |
|---|---|---|---|---|---|
| 1 | 12/07/2024 12:00:00 AM | 16/07/2024 12:00:00 AM | 24* | Error | Record |
| 2 | 17/07/2024 12:00:00 AM | 07/20/2024 | 22 | Error | Record |

| | |
|---|---|
| HasError | TRUE |
| Error | Record |

***Figure 11-15*** Results of try

The formula used for each row results in a value of type `record`, which contains information about the cause of the error. This record has two fields: `HasError` and `Error`. The `HasError` field is set to `true` if the expression following `try` leads to an error; otherwise, it is set to `false`. If `HasError` is `true`, the details of the error are stored in the `Error` field within the record.

To extract the information about the errors, expand the Err column. You'll see the table shown in Figure 11-16.



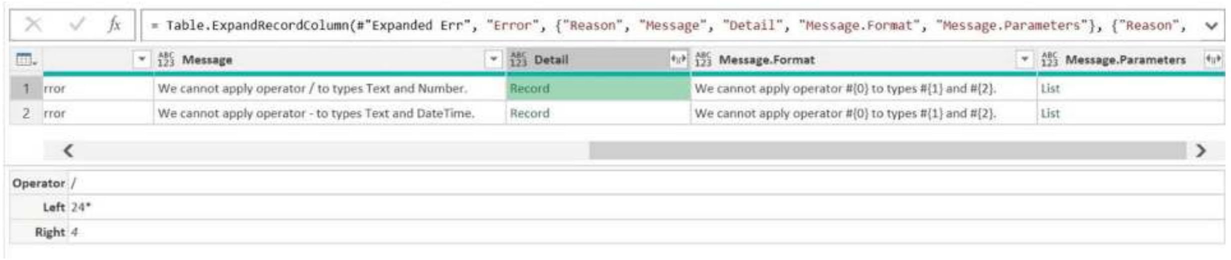
```
= Table.ExpandRecordColumn(#"Added Custom1", "Err", {"HasError", "Error"}, {"HasError", "Error"})
```

| | Start Date | End Date | Sales | AVG Daily Sale | HasError | Error |
|---|---|---|---|---|---|---|
| 1 | 12/07/2024 12:00:00 AM | 16/07/2024 12:00:00 AM | 24* | Error | TRUE | Record |
| 2 | 17/07/2024 12:00:00 AM | 07/20/2024 | 22 | Error | TRUE | Record |

| | |
|---|---|
| Reason | Expression.Error |
| Message | We cannot apply operator / to types Text and Number. |
| Detail | Record |
| Message.Format | We cannot apply operator #{0} to types #{1} and #{2}. |
| Message.Parameters | List |

***Figure 11-16*** Results of expanding the Err column

The values in the Error column are of type `record` and contain several fields related to the error. Expanding this column will result in the table shown in Figure 11-17.



```
= Table.ExpandRecordColumn(#"Expanded Err", "Error", {"Reason", "Message", "Detail", "Message.Format", "Message.Parameters"}, {"Reason",
```

| | | Message | Detail | Message.Format | Message.Parameters |
|---|---|---|---|---|---|
| 1 | rror | We cannot apply operator / to types Text and Number. | Record | We cannot apply operator #{0} to types #{1} and #{2}. | List |
| 2 | rror | We cannot apply operator - to types Text and DateTime. | Record | We cannot apply operator #{0} to types #{1} and #{2}. | List |

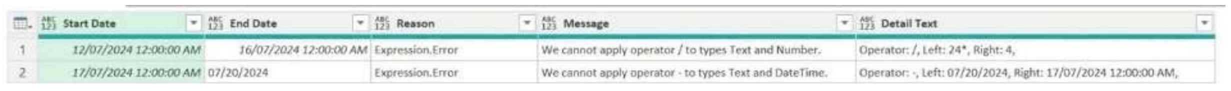
| | |
|---|---|
| Operator | / |
| Left | 24* |
| Right | 4 |

*Figure 11-17* Expanding the Error column and extracting the error message

Over the expanded fields, the Detail column is in the type `record`. To extract its values and convert them to text, you need to add a new Custom Column called Detailed Text. Do this using the following formula in the Custom Column window:

```
=Text.Combine(List.Transform(Record.FieldNames([Detail]),
(x)=> x &": " & Text.From(Record.Field([Detail],x))))
```

Finally, by removing all columns except Start Date, End Date, Reason, Message, and Detail Text, you will obtain Figure 11-18.



| | Start Date | End Date | Reason | Message | Detail Text |
|---|---|---|---|---|---|
| 1 | 12/07/2024 12:00:00 AM | 16/07/2024 12:00:00 AM | Expression.Error | We cannot apply operator / to types Text and Number. | Operator: /, Left: 24*, Right: 4, |
| 2 | 17/07/2024 12:00:00 AM | 07/20/2024 | Expression.Error | We cannot apply operator - to types Text and DateTime. | Operator: -, Left: 07/20/2024, Right: 17/07/2024 12:00:00 AM, |

*Figure 11-18* The result of extracting rows

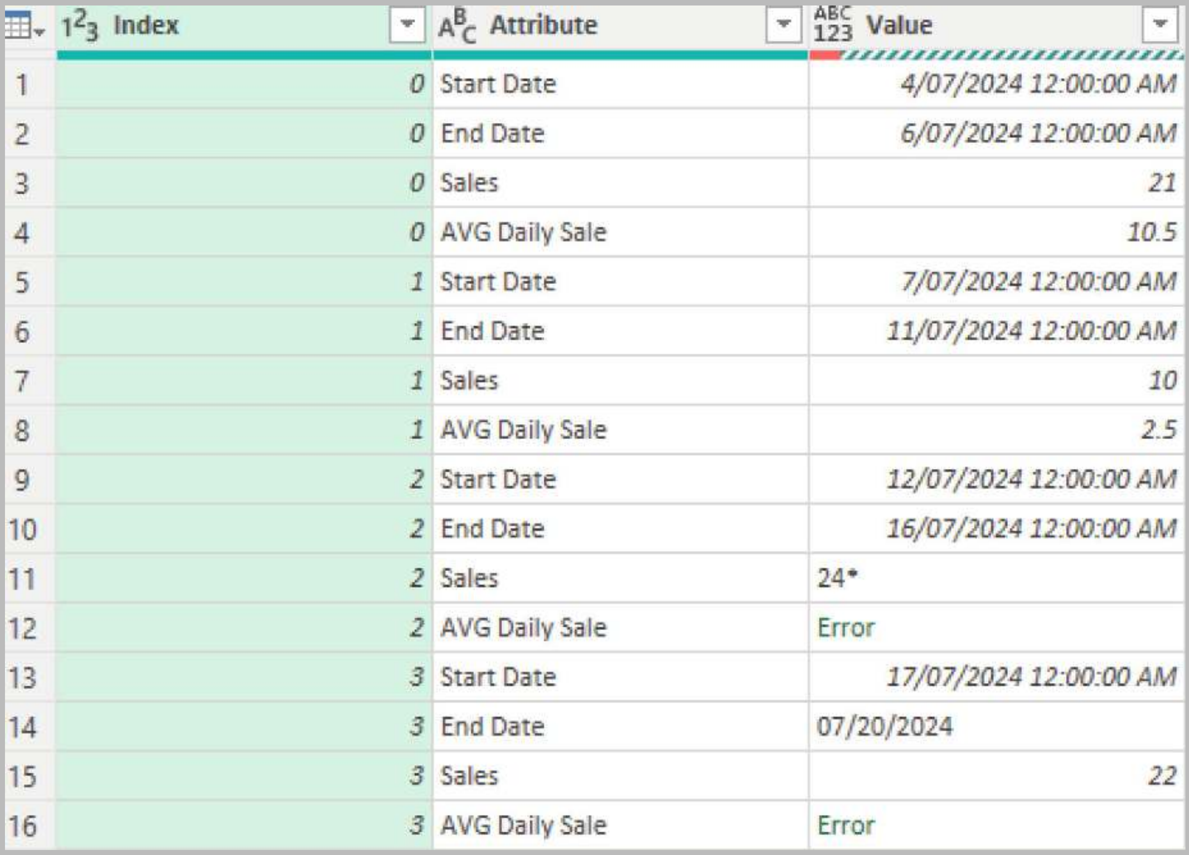
**Note** In this example, adding a custom column introduces errors in some rows, so all the errors appear in a single column. However, in practice, errors may occur in multiple columns.

To extract the cause of errors across different columns for multiple rows, follow these steps before removing the rows without errors:

1. Add an Index column to your table.
2. Right-click the newly added column and select Unpivot Other Columns.

   Applying this step leads to a table with three columns related to the index value (representing the origin row), column titles, and row values.

   Applying these steps in the example presented in this section results in the table shown in Figure 11-19.



|  | Index | Attribute | Value |
|---|---|---|---|
| 1 | 0 | Start Date | 4/07/2024 12:00:00 AM |
| 2 | 0 | End Date | 6/07/2024 12:00:00 AM |
| 3 | 0 | Sales | 21 |
| 4 | 0 | AVG Daily Sale | 10.5 |
| 5 | 1 | Start Date | 7/07/2024 12:00:00 AM |
| 6 | 1 | End Date | 11/07/2024 12:00:00 AM |
| 7 | 1 | Sales | 10 |
| 8 | 1 | AVG Daily Sale | 2.5 |
| 9 | 2 | Start Date | 12/07/2024 12:00:00 AM |
| 10 | 2 | End Date | 16/07/2024 12:00:00 AM |
| 11 | 2 | Sales | 24* |
| 12 | 2 | AVG Daily Sale | Error |
| 13 | 3 | Start Date | 17/07/2024 12:00:00 AM |
| 14 | 3 | End Date | 07/20/2024 |
| 15 | 3 | Sales | 22 |
| 16 | 3 | AVG Daily Sale | Error |

***Figure 11-19*** Result of unpivoting columns

In the transformed table, the errors are now on a column, and you can continue with the steps presented in this example. If, in the final table, the Index column is not useful for tracking the original rows, you can merge the final result table with the original table (before unpivoting) using the Index column as a key. This will extract all the information of the row represented by each index.

## Summary

This chapter explained that, during the data-cleaning process, certain actions can lead to errors in Power Query. These errors fall into two categories: step-level errors and cell-level errors. Step-level errors stop the entire query from running, whereas cell-level errors allow the query to complete, although some cells may display errors.

As presented, to handle cell-level errors, you can use the `try-otherwise` function to catch errors and replace them with appropriate values. For step-level errors, it’s best to avoid hardcoded values and take advantage of functions that allow flexibility, such as those that can ignore mismatched column names or define the column names dynamically.

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# 12. Custom Functions

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Despite Power Query offering over 700 built-in functions, there are instances where creating custom functions is necessary. There were many situations in the previous chapters where you used custom functions, such as using the fifth argument of `Table.Group()` in Chapter 6, Example 7 in Chapter 7, Example 5 in Chapter 8, and using the third arguments of `List.Accumulate()` and `List.Generate()` in Chapter 9. In this chapter, you learn more about custom functions in Power Query.

When you think about custom functions, it doesn't necessarily mean you need to put in a lot of effort to create a complex function. There are many scenarios—such as filtering, splitting a column, or combining columns—where simply applying a command through the UI automatically generates a custom function in the formula of that command. For example, consider the historical sales transactions in the Source table shown in Table 12-1.

***Table 12-1*** Source: Historical Sales Value

| Date | Customer ID | Quantity |
|---|---|---|
| 18/07/2023 | C-2 | 40 |
| 31/07/2023 | C-3 | 31 |
| 31/07/2023 | C-3 | 35 |
| 3/08/2023 | C-3 | 25 |
| 30/08/2023 | C-2 | 11 |
| 31/08/2023 | C-3 | 25 |
| 3/09/2023 | C-1 | 36 |
| 8/09/2023 | C-3 | 28 |
| 14/09/2023 | C-1 | 12 |
| 2/10/2023 | C-1 | 34 |
| 2/10/2023 | C-1 | 25 |
| 21/10/2023 | C-1 | 33 |
| 23/10/2023 | C-3 | 23 |
| 10/11/2023 | C-2 | 35 |

| Date | Customer ID | Quantity |
|---|---|---|
| 26/12/2023 | C-3 | 15 |
| 1/01/2024 | C-2 | 21 |
| 10/01/2024 | C-2 | 30 |
| 14/01/2024 | C-3 | 24 |
| 26/02/2024 | C-2 | 23 |
| 28/02/2024 | C-3 | 10 |
| 1/03/2024 | C-2 | 15 |
| 12/04/2024 | C-3 | 37 |
| 27/04/2024 | C-3 | 18 |

If you select the Customer ID column and filter for C-2, the following formula will be generated to filter the rows of the table related to Customer ID equal to C-2:

```
= Table.SelectRows(Source, each ([Customer ID] = "C-2"))
```

Examining the syntax of the `Table.SelectRows()` function on the Microsoft website (`https://learn.microsoft.com/en-us/powerquery-m/table-selectrows`), presented as the following, reveals that its second argument is a condition, and it is in the type of `function`.

```
Table.SelectRows(table as table, condition as function) as
table
```

So, in the generated formula, `each ([Customer ID] = "C-2")` is a (custom) function used within the `Table.SelectRows()` function.

As you know, every function in Power Query has its own characteristics, defined for a specific purpose. Some functions accept arguments of type `number`, while others take arguments of type `table`, `list`, `record`, `date`, `text`, or other data types. Additionally, some functions require a single argument, while others accept multiple arguments, and there are also functions like `DateTime.LocalNow()` that do not require any arguments at all. In Power Query, function arguments can be optional or mandatory.

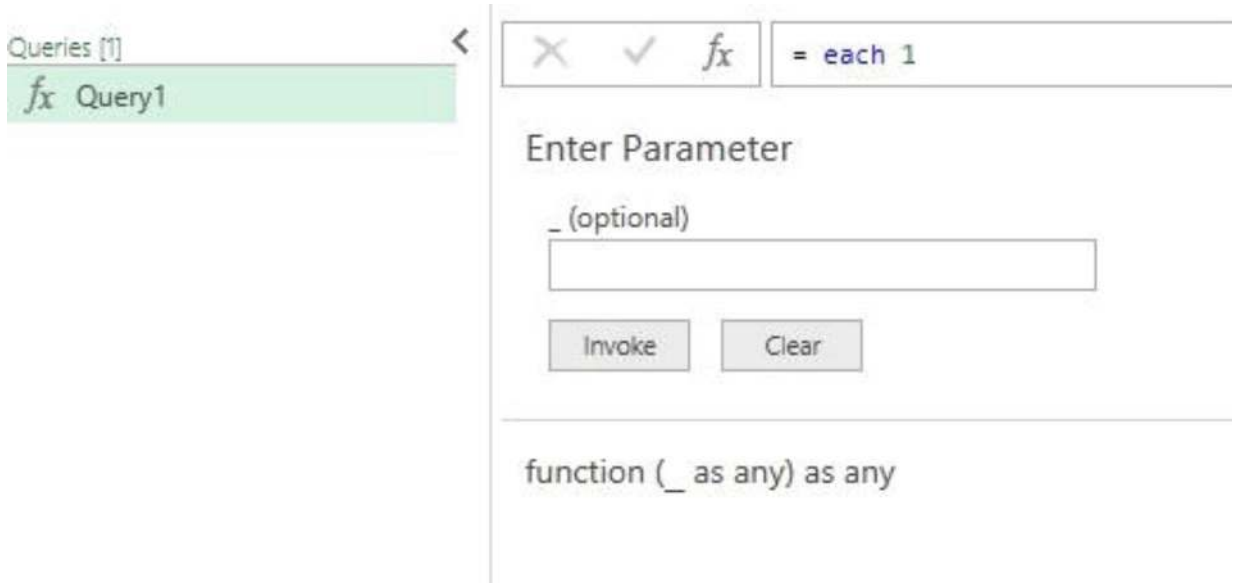
Similarly, custom functions in Power Query follow the same principles. They are designed for a specific purpose, and depending on that purpose, they may take no arguments, a single argument, or multiple arguments of different types.

At this point, the question arises: If `each ([Customer ID] = "C-2")` is a custom function tailored for the second argument of the `Table.SelectRows()` function in this example, what is its argument? How many arguments does it have, and what should the argument type be? Additionally, how can you address its argument?

Some of these questions have been answered implicitly when using the formulas in the previous chapters. However, this chapter discusses these issues in greater depth. To address these questions, you first need to explore custom functions in Power Query. Then the chapter will return to these questions and answer them.

Let’s build a basic custom function. Go the Power Query Editor and create a blank query. Then type the following formula in the formula bar, which results in Figure 12-1.

```
= each 1
```



function (_ as any) as any

*Figure 12-1* Creating a basic custom function

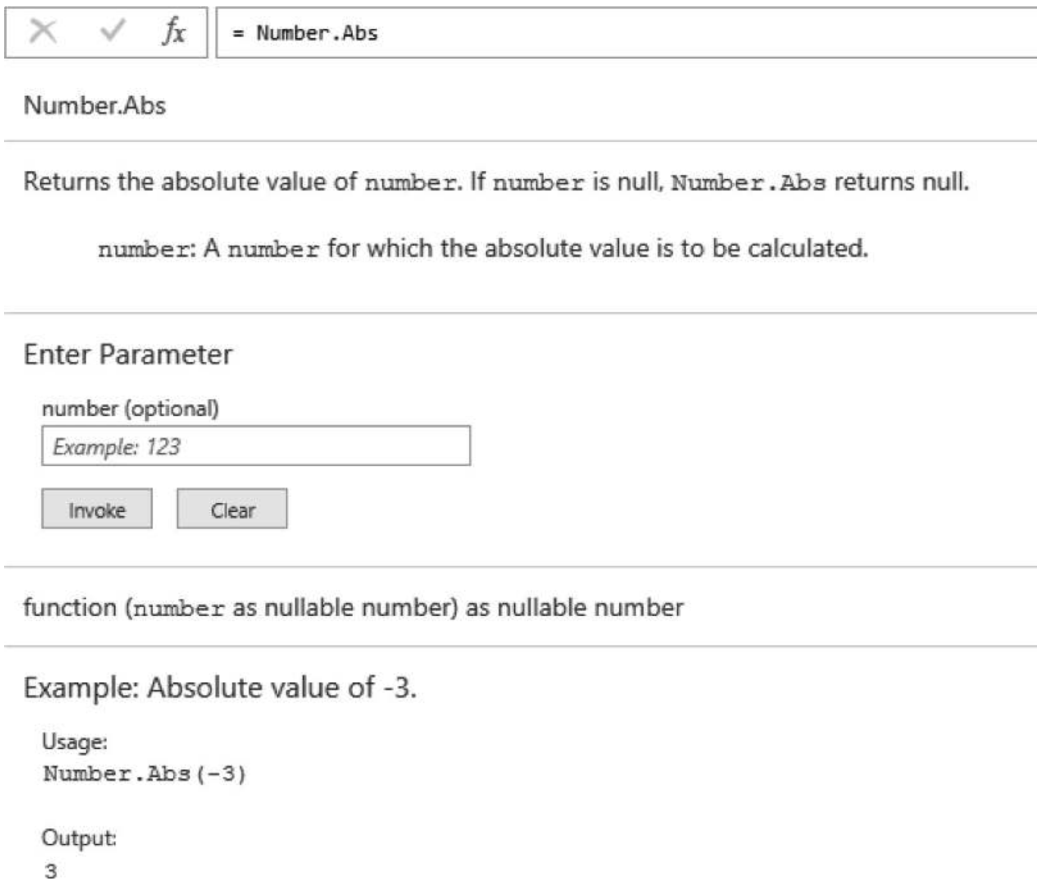
As shown, after you press Enter, the query icon changes from a standard query icon to a function icon, indicated by the *fx* symbol next to the function name (in this example, the name of the function is `Query1`). Additionally, the details of the created function are displayed in the preview window.

In the Enter Parameter section, there is a box where you can write a value as the input of the defined function. You can then see the function's result for the entered value by clicking the Invoke button. Above this box, the parameter name is highlighted as an underscore (_) followed by "`(optional)`". This indicates that the name of this argument in the defined function is _ and this argument for the defined function is optional.

**Note** `Number.Abs()` is a predefined Power Query function. If you open a blank query and write the following formula (without closing the parentheses and entering any input) in the formula bar, and click OK, it results in Figure 12-2. This is similar to the result when you write `=each 1` in the formula bar, but

`Number.Abs()` is a predefined function. More detailed documentation for this function is provided.

```
= Number.Abs
```



= Number.Abs

Number.Abs

Returns the absolute value of `number`. If `number` is null, `Number.Abs` returns null.

`number`: A `number` for which the absolute value is to be calculated.

Enter Parameter

number (optional)

function (`number` as nullable number) as nullable number

Example: Absolute value of -3.

Usage:

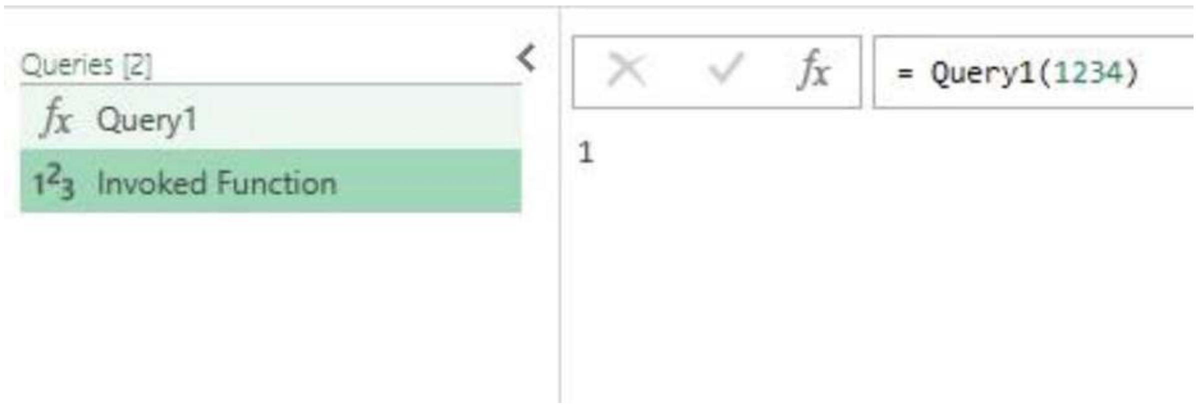
```
Number.Abs(-3)
```

Output:

```
3
```

***Figure 12-2*** Documentation of Number.Abs()

To check the result of the defined function, over different inputs, insert `1234` in the function box shown in Figure 12-1 and click Invoke. This generates a new query, which presents the result of a defined function for the value `1234`, as shown in Figure 12-3 (see the formula bar).



```
= Query1(1234)
```

```
1
```

*Figure 12-3* The result of invoking a function

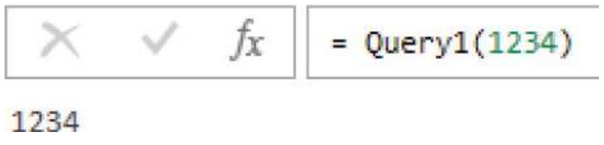
If you change the input value, even if you do not enter a value as input and invoke the function again, it results in 1, as shown in Figure 12-3.

In this case, you've defined a function with one optional argument. Regardless of the input type or value entered, the function will always return 1 in all cases.

In the defined function, the result of invoking does not relate to the input parameter. Now let’s define a custom function whose result depends on the input value. Write the following formula in the formula bar of a blank query.

```
= each _
```

In this case, entering the number `1234` as the input for the defined custom function will lead to `1234` as the result, as shown in Figure 12-4.



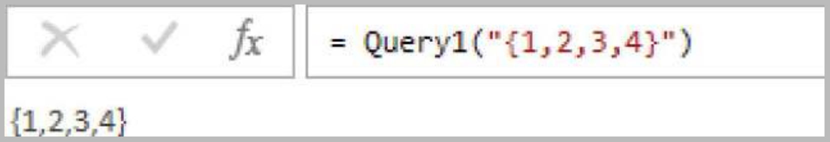
```
= Query1(1234)
```

```
1234
```

*Figure 12-4* The result of invoking 1234 in the custom function

When you're trying to invoke the function with other inputs, you will notice that it returns the same value as whatever you input. For example, entering `2` as the input will result in `2`, and entering a list such as `{1,2,3}` will result in the same list as output.

**Note** Entering `{1,2,3,4}` in the input box and invoking it will result in the text `"{1,2,3,4}"`, as shown in Figure 12-5. This is because, after invoking the function, the input value is treated as text, not as a list.

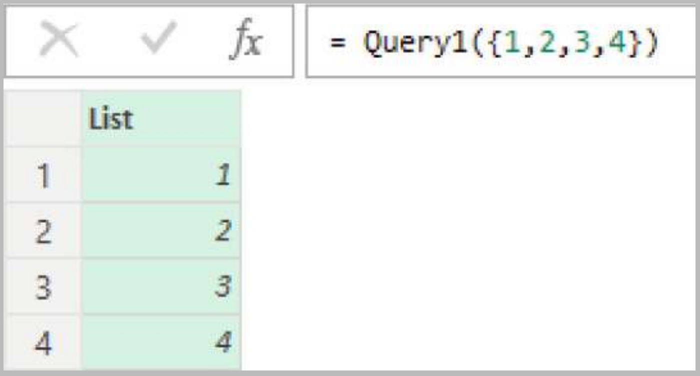


```
= Query1("{1,2,3,4}")
```

```
{1,2,3,4}
```

***Figure 12-5*** The result of invoking {1,2,3,4}

Revising the input value in the formula bar and removing the text sign will change the result into a list, as shown in Figure 12-6.



```
= Query1({1,2,3,4})
```

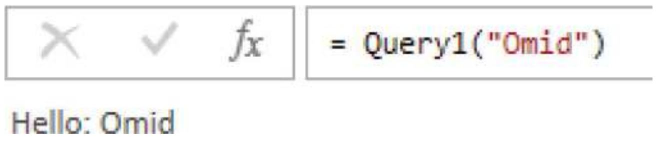
|   | List |
|---|---|
| 1 | 1 |
| 2 | 2 |
| 3 | 3 |
| 4 | 4 |

***Figure 12-6*** The result of revised formula after invoking {1,2,3,4}

In the previous step, the defined function simply returned the exact input value. Now, it's time to create a custom function that performs some modifications on the input value. Create a blank query and write the following formula in the formula bar:

```
= each "Hello: " & _
```

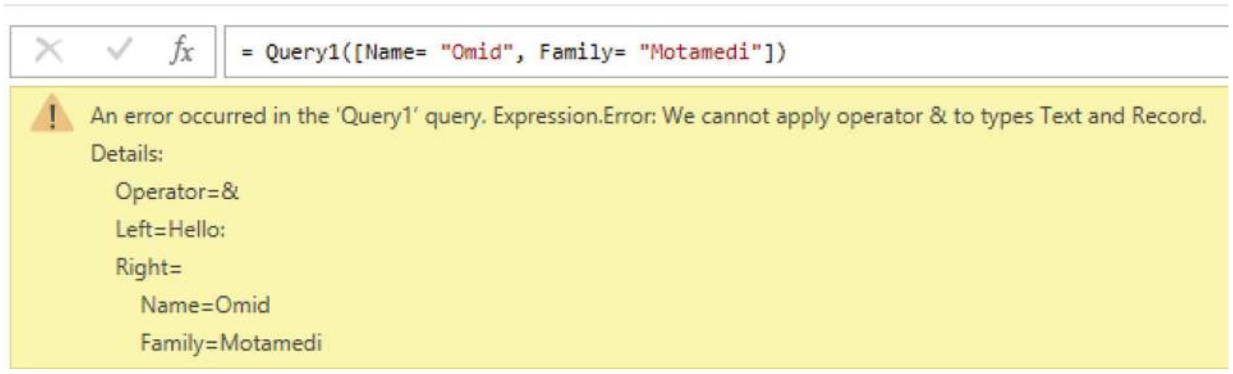
In this case, if you invoke the function after entering a name like Omid in the parameter box, the result will be `Hello: Omid`, as shown in Figure 12-7. But if you invoke the function for the input record like `[Name= "Omid", Family= "Motamedi"]`, an error is returned, as shown in Figure 12-8. This is because the `&` operation cannot be used to concatenate the text (`"Hello"`) shown a record (`[Name= "Omid", Family= "Motamedi"]`).



```
= Query1("Omid")
```

Hello: Omid

***Figure 12-7*** Invoking the custom function for Omid



```
= Query1([Name= "Omid", Family= "Motamedi"])
```

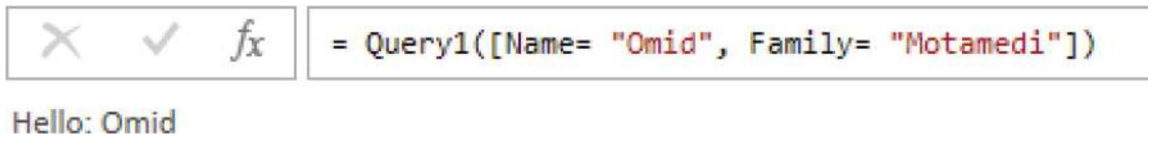
```
An error occurred in the 'Query1' query. Expression.Error: We cannot apply operator & to types Text and Record.
Details:
    Operator=&
    Left=Hello:
    Right=
        Name=Omid
        Family=Motamedi
```

***Figure 12-8*** Invoking the custom function for a record

To define a custom function that extracts the Name field from a record and concatenates Hello to it, you need to use this formula:

```
= each "Hello: " & _[Name]
```

Now you can use `[Name= "Omid", Family= "Motamedi"]` as the input value of the defined function, which results in Figure 12-9.



```
= Query1([Name= "Omid", Family= "Motamedi"])
```

```
Hello: Omid
```

***Figure 12-9*** Invoking the revised custom function for a record

You can try to revise the function by removing the underscore and rewriting it as follows:

```
= each "Hello: " & [Name]
```

Unexpectedly, the result of invoking this function for the record does not change. It seems that when you use the `each _` expression to define a custom function, if the input value is of type `record`, the underscore can be omitted, and Power Query automatically knows how to handle it.

Based on the defined custom functions you've seen so far, this list sums up what you have learned about the `each _` expression:

- You can use `each` to define a custom function.
- When using `each` to define a custom function, you can define up to one optional argument for the function.
- If `each` is used to create a custom function, the argument is represented with the underscore (_).
- When creating a custom function to handle data of type `record`, the underscore can be omitted without affecting the result.

Based on this explanation, let's return to the initial example of this section, where `each ([Customer ID] = "C-2")` was used as a custom function within the `Table.SelectRows()` function. Based on the `Table.SelectRows()` logic, the defined custom function in its second argument will be evaluated for all the rows separately. If the custom function returns `true` for a row, it will remain in the final result after filtering. Otherwise, that row will be removed.

The custom function will be evaluated for each row separately, and in Power Query, each single row in the evaluation process is considered as type `record`. Therefore, the input of the defined custom function is in type `record`. Based on these tips, when you define a custom function using `each _` logic for the case with input parameter in type `record`, the underscore can be omitted without affecting the results.

In another words, the whole version of the custom function in this example is `each (_[Customer ID] = "C-2")`, whereby the underscore is removed. In this custom function, for `each row each _[Customer ID]` extracts the value of the Customer ID of that row, and `each _[Customer ID] = "C-2"` returns `true` if the value of Customer ID is C-2 and `false` otherwise.

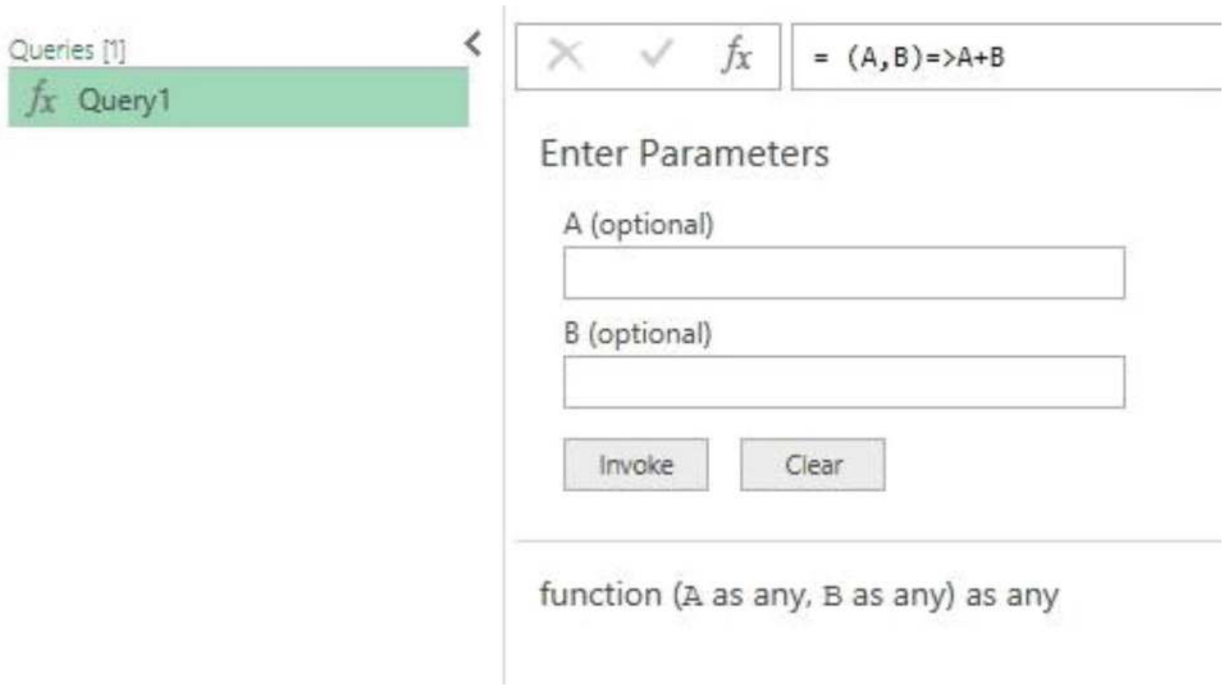
For instance, consider the first row of the Source table as a record `[Date=18/07/2023, Customer ID="C-2", Quantity=40]`. Using `each _` will result in the same record. Using `each _[Customer ID]` will return `C-2`, and `each _[Customer ID] = "C-2"` will return `true`, so this row will be presented in the final table.

Despite all the advantages of using the `each _` expression to create a custom function, it has a limitation—it can only be used when your custom function requires just one argument. There are situations, such as when defining the fifth argument of the `Table.Group()` function, where you need to create a custom function with multiple arguments. In such situations, you need to use the general definition of the custom function, as shown here:

```
(input 1, input 2,….., input n) => calculation logic
```

In this definition, the function is indicated by the => sign, with inputs defined before it and the calculation logic defined after. For example, the following formula defines a custom function that receives two inputs, called `A` and `B`, as shown in Figure 12-10, and results in the sum of inputs.

```
=(A,B)=>A+B
```



```
= (A,B)=>A+B
```

Enter Parameters

A (optional)

B (optional)

function (A as any, B as any) as any

*Figure 12-10* Custom function with two inputs

Given this general definition, you can say that the `each _` syntax presented at the beginning of this chapter is a shorthand version for defining a custom function with a single input argument named _. So, all the previous custom functions defined with `each _` in this section can be rewritten using this general definition, as provided in Table 12-2.

*Table 12-2* Comparing each _ and the General Definition of the Custom Function

| each | => |
|---|---|
| `= each 1` | `()=> 1` |
| `=each _` | `(A)=>A` |
| `=each "Hello: " & _` | `(A)=> "Hello: " & A` |
| `= each "Hello: " & _[Name]` | `(A)=> "Hello: " & A[Name]` |
| `= each "Hello: " & [Name]` | `(A)=> "Hello: " & A[Name]` |

Besides what's mentioned in the introduction of this chapter, in the custom functions, you can define the type of input parameters as well as the type of result, and define optional parameters. Additionally, custom functions can perform multi-step calculations, which you explore further later in this chapter.

## Implementing Sumproduct as a Custom Function

Define the `Sumproduct` function in Power Query, which receives two lists as input and returns the sum of the products of the corresponding items in both lists (similar to the Sumproduct function in Excel, but here it's applied to just two inputs).

To define a Sumproduct function in Power Query, create a blank query. Name it Sumproduct and use the following formula to define the function that leads to Figure 12-11, assuming the lists have the same length.

```
(L1 as list ,L2 as list) as number =>
      List.Sum(
                   List.Transform(List.Positions(L1), each
L1{ _ } * L2{ _ })
                          )
```

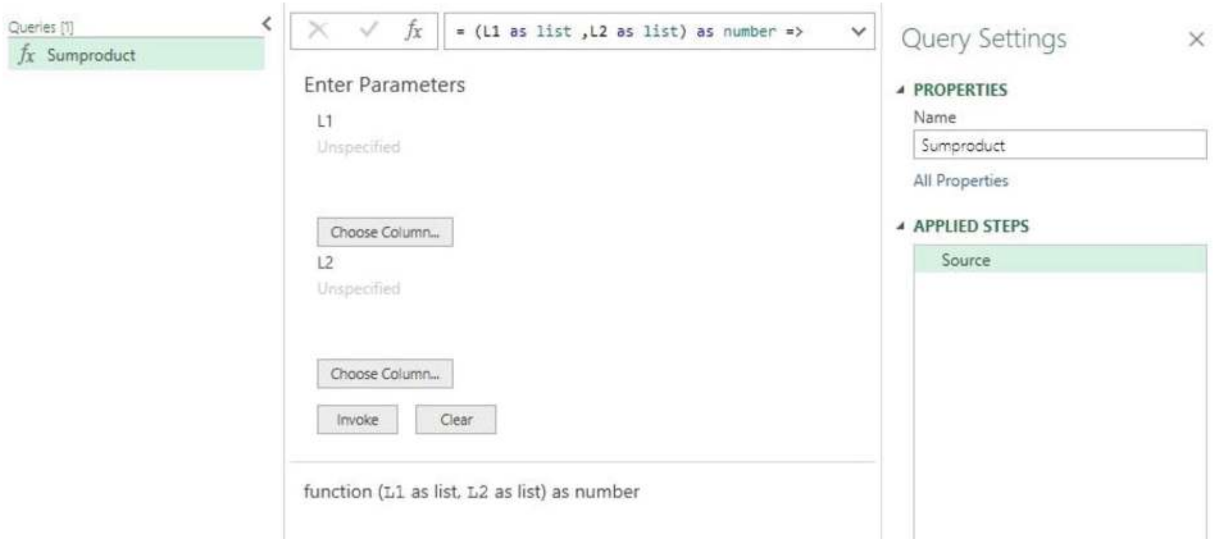

Queries [1]
Sumproduct
= (L1 as list ,L2 as list) as number =>
Enter Parameters
L1
Unspecified
Choose Column...
L2
Unspecified
Choose Column...
Invoke
Clear
function (L1 as list, L2 as list) as number
Query Settings
PROPERTIES
Name
Sumproduct
All Properties
APPLIED STEPS
Source

***Figure 12-11*** Defining Sumproduct

In this function, the input parameters L1 and L2 are defined as type lists. (When using the function in the Power Query UI, you need to select a column from a table as input, as the parameter type should be set to list.) The function's output type is specified as a number, just by entering a number after the list of input parameters.

The defined function can be written on a single line, but for better readability, it can be broken into several steps using records, as the following:

```
(L1 as list ,L2 as list) as number =>
      [
      Step1=List.Positions(L1),
      Step2=List.Transform(Step1, each L1{_} * L2{_}),
      Step3=List.Sum(Step2)
      ][Step3]
```

You can also use the let expression, as shown in the following formula, where the Power Query snippets are identical in output:

```
(L1 as list ,L2 as list) as number => let
      Step1=List.Positions(L1),
      Step2=List.Transform(Step1, each L1{_} *L2{_}),
      Step3=List.Sum(Step2)
      in
      Step3
```

To understand this custom function, consider the example where `L1 = {1,0,4}` and `L2 = {4,5,6}`. Here's the breakdown:

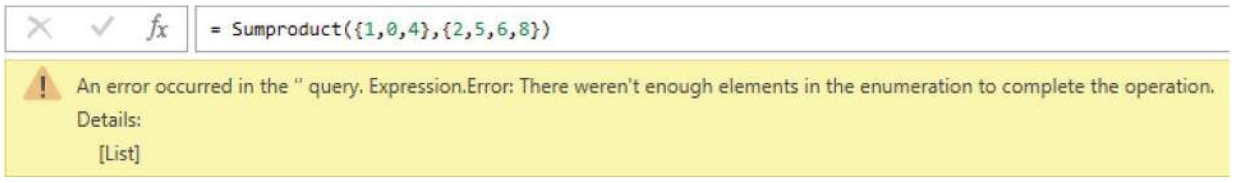
Step 1: `List.Positions({1,0,4})` returns `{0,1,2}`.
Step 2: `List.Transform({0,1,2}, each L1{_} * L2{_})` calculates the products of corresponding elements: `{L1{0} * L2{0},L1{1} * L2{1}, L1{2} * L2{2}}`, resulting in `{1*4, 0*5, 4*6} = {4,0,24}`.
Step 3: All the items in the list from the previous step are summed and the result is presented as the final result of defined custom function.

If you create a new blank query and use the `Sumproduct({1,0,4}, {2,5,6})` formula, the function will calculate the `Sumproduct` of these two lists, resulting in `28`. Similarly, if you use `Sumproduct({1,0,4},{2,5,6,8})`, you will reach the same result. While the lists have different lengths, the function should ideally result in an error.

Since in the defined function, the dimension is determined by `L1` (using `List.Positions()`), the function does not consider the extra elements in `L2` and presents the same result as `Sumproduct({1,0,4},{2,5,6})`. To address this issue, the function can be modified to use the list with the largest dimension for calculations as follows.

```
(L1 as list ,L2 as list) as number => let
      Step1={0..
(List.Max({List.Count(L1),List.Count(L2)})-1)},
      Step2=List.Transform(Step1, each L1{_} *L2{_}),
      Step3=List.Sum(Step2)
      in
      Step3
```

In the revised version, using the `=Sumproduct({1,0,4},{2,5,6,8})` formula in a blank query will result in an error, as shown in Figure 12-12. However, the error message provided is not very helpful or meaningful. It doesn't give clear information about the cause of the issue.



```
= Sumproduct({1,0,4},{2,5,6,8})
```

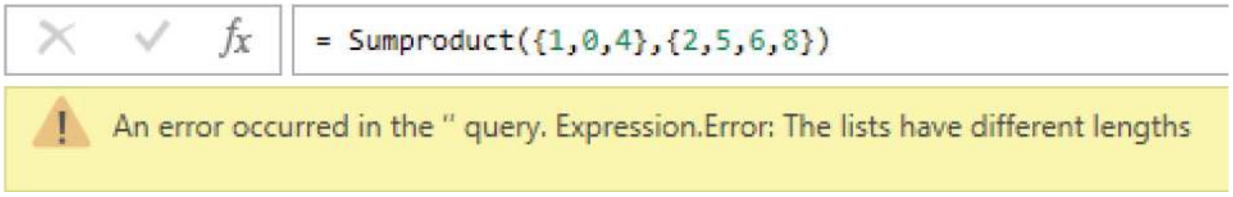
An error occurred in the '' query. Expression.Error: There weren't enough elements in the enumeration to complete the operation.
Details:
[List]

***Figure 12-12*** The result of using =Sumproduct({1,0,4},{2,5,6,8})

To provide a more meaningful error when entering lists of different lengths, the formula can be revised by modifying the term after the expression:

```
(L1 as list ,L2 as list) as number =>
let
      Step1={0..
(List.Max({List.Count(L1),List.Count(L2)})-1)},
      Step2=List.Transform(Step1, each L1{_} *L2{_}),
      Step3=List.Sum(Step2)
In
      if List.Count(L1) <> List.Count(L2) then error "The
lists have different lengths" else Step3
```

Now, instead of the generic error, if the lengths of the lists do not match, the formula will return a more descriptive error, as shown in Figure 12-13.



```
= Sumproduct({1,0,4},{2,5,6,8})
```

An error occurred in the '' query. Expression.Error: The lists have different lengths

***Figure 12-13*** The result of revised formula for =Sumproduct({1,0,4},{2,5,6,8})

## Documenting Custom Functions

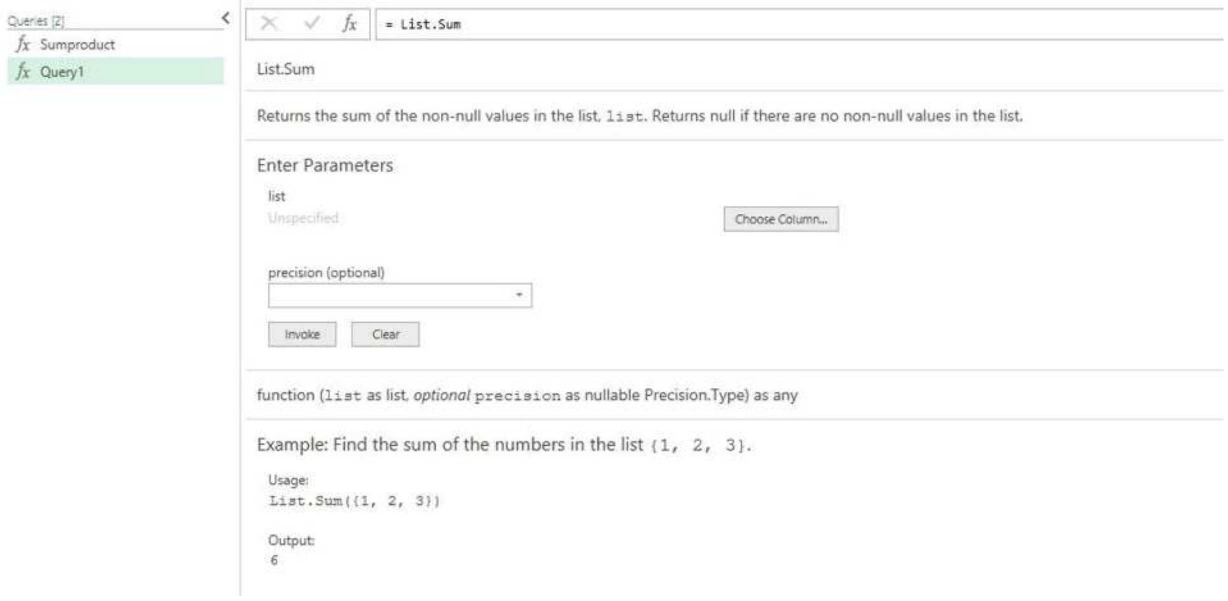
Consider the previous custom function and define its documentation.

First, let's review what function documentation looks like and why it's important to add it to your custom functions, which you and your colleagues use frequently.

Documentation provides important information about the function, including its input parameters, calculation logic, expected results, examples of how to use it, and more. Without documentation, if you share a custom function with others, you will need to explain its application, parameters, and how to use it verbally (e.g., in an email or a meeting). However, if you create documentation that explains the function's characteristics, this documentation will always be available with the function, allowing users to refer to it whenever they need more information. It also helps you in the future when you revisit the function and need to modify it.

Therefore, it's best to add documentation to your most frequently used custom functions.

All predefined Power Query functions have their own documentation as well. To see the function documentation, create a blank query and write a predefined function like `List.Sum` without parentheses in the formula bar. Press Enter to display the documentation, as shown in Figure 12-14.



```
= List.Sum
```

List.Sum

Returns the sum of the non-null values in the list, `list`. Returns null if there are no non-null values in the list.

function (`list` as list, *optional* `precision` as nullable Precision.Type) as any

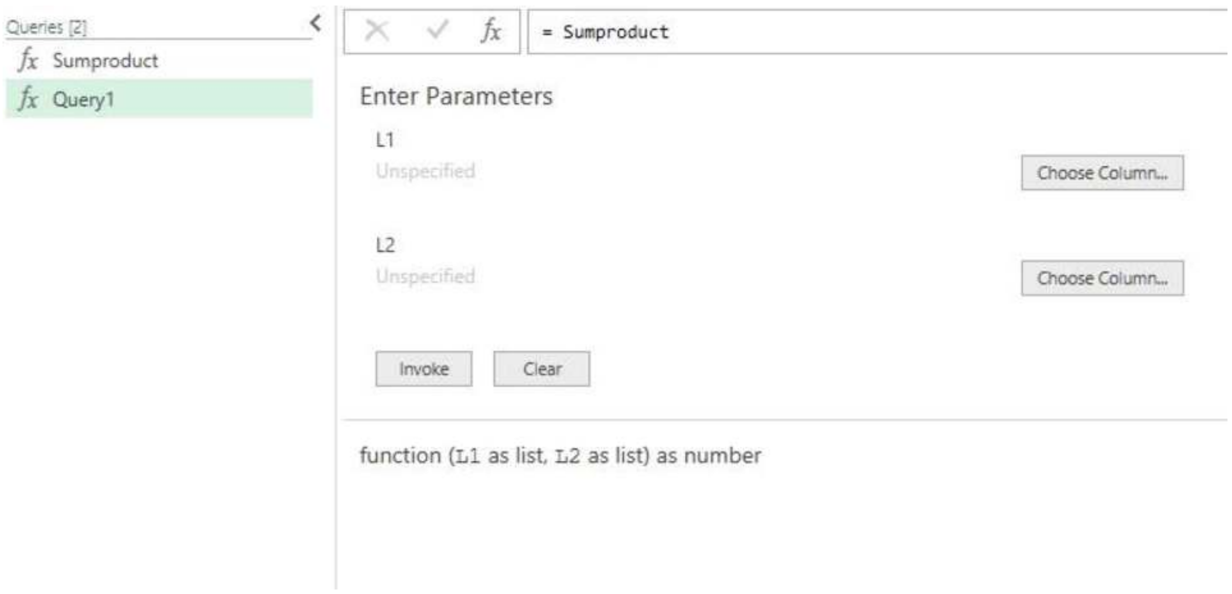
Example: Find the sum of the numbers in the list `{1, 2, 3}`.

Usage:
```
List.Sum({1, 2, 3})
```

Output:
```
6
```

***Figure 12-14*** Documentiont for List.Sum

As presented, the documentation of this function includes several sections, such as the function's name, its description, its parameters, and examples of how to use it. Writing the custom-defined `Sumproduct` function in the formula bar results in showing its documentation, as shown in Figure 12-15.



Enter Parameters

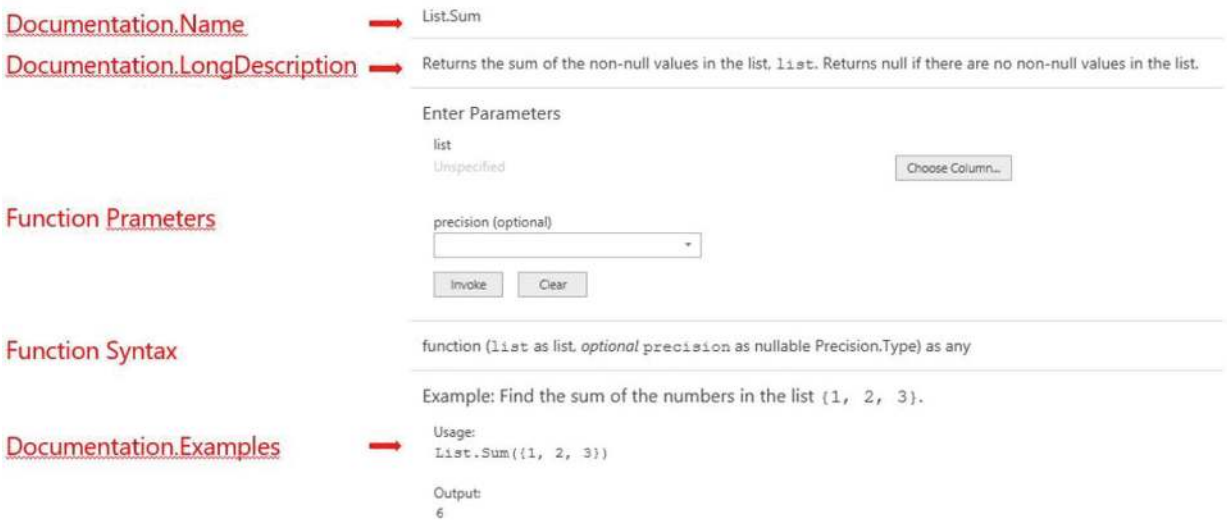
L1
Unspecified

L2
Unspecified

function (L1 as list, L2 as list) as number

*Figure 12-15* Documentation for Sumproduct

By comparing the documentation of `List.Sum` and `Sumproduct`, it is clear that the documentation on `List.Sum` is more detailed. The names of the different sections are shown in Figure 12-16.



List.Sum

Returns the sum of the non-null values in the list, `list`. Returns null if there are no non-null values in the list.

Enter Parameters

list
Unspecified

precision (optional)

function (`list` as list, *optional* `precision` as nullable Precision.Type) as any

Example: Find the sum of the numbers in the list `{1, 2, 3}`.

Usage:
```
List.Sum({1, 2, 3})
```

Output:
```
6
```

*Figure 12-16* Names of function documentation sections

The documentation sections you see in `List.Sum` can be added to any custom function within a record, with predefined field names. The most commonly used fields in the record for defining a function documentation are `Documentation.Name, Documentation.LongDescription`, and `Documentation.Examples`.

**Note** There are more fields for documentation. You can check them out at `https://learn.microsoft.com/en-us/power-query/handling-documentation`.

The first step in documenting a custom function, after creating it, is to create a record that includes the mentioned fields for the documentation. In this record, the `Documentation.Name` and `Documentation.LongDescription` fields are commonly used in type `text`, and the `Documentation.Examples` field is in the type `list`, including several sub-records, each for one example. This includes the Description, Code, and Result fields.

In the following snippet, you can see a record including the required fields for documentation:

```
[
    Documentation.Name = "Sumproduct",
     Documentation.LongDescription = "This function received
two list as inputs and returned the sum of the products of
corresponding items into lists",
    Documentation.Examples = {
     [Description = "Considering the case which list 1 and 2
are {1,2,3} and {1,2,3}", Code = "Sumproduct({1,2,3},
{1,2,3})", Result = "14"],
     [Description = "Considering the case which list 1 and 2
are {1,0,4} and {4,5,6}", Code = "Sumproduct({1,0,4},
{4,5,6})", Result = "28"]
    }
  ]
```

After defining the documentation fields, you can add them to your custom function. Consider the custom function defined in the previous example, as follows.

```
(L1 as list ,L2 as list) as number =>
let
      Step1={0..
(List.Max({List.Count(L1),List.Count(L2)})-1)},
      Step2=List.Transform(Step1, each L1{_} *L2{_}),
      Step3=List.Sum(Step2)
In
      if List.Count(L1) <> List.Count(L2) then error "The
lists have different lengths" else Step3
```

All these steps are required to execute the defined custom function, and you cannot add the documentation record within the steps needed to execute the function. The documentation should be added at the same level as defining the function. In other words, they should both be defined in the same `let` expression.

So, without changing the result, the previous formula can be rewritten as follows. This defines the step name as `Sumproduct` for the custom function and places it in a `let` expression:

```
let
    Sumproduct=(L1 as list ,L2 as list) as number =>
    let
        Step1={0..
(List.Max({List.Count(L1),List.Count(L2)})-1)},
        Step2=List.Transform(Step1, each L1{_} *L2{_}),
        Step3=List.Sum(Step2)
    in
    Step3

in
Sumproduct
```

Now you have a `let` block with one step, `Sumproduct`. You can add another step to it, called `Doc`, as shown here:

```
let
    Sumproduct=(L1 as list ,L2 as list) as number =>
    let
        Step1={0..
(List.Max({List.Count(L1),List.Count(L2)})-1)},
        Step2=List.Transform(Step1, each L1{_} *L2{_}),
        Step3=List.Sum(Step2)
    in
    Step3,

  Doc = [
    Documentation.Name = "Sumproduct",
     Documentation.LongDescription = "This function received
two list as inputs and returned the sum of the products of
corresponding items into lists",
    Documentation.Examples = {
     [Description = "Considering the case which list 1 and 2
are {1,2,3} and {1,2,3}", Code = "Sumproduct({1,2,3},
{1,2,3})", Result = "14"],
     [Description = "Considering the case which list 1 and 2
are {1,0,4} and {4,5,6}", Code = "Sumproduct({1,0,4},
{4,5,6})", Result = "28"]
```

```
    }
  ]

in
  Sumproduct
```

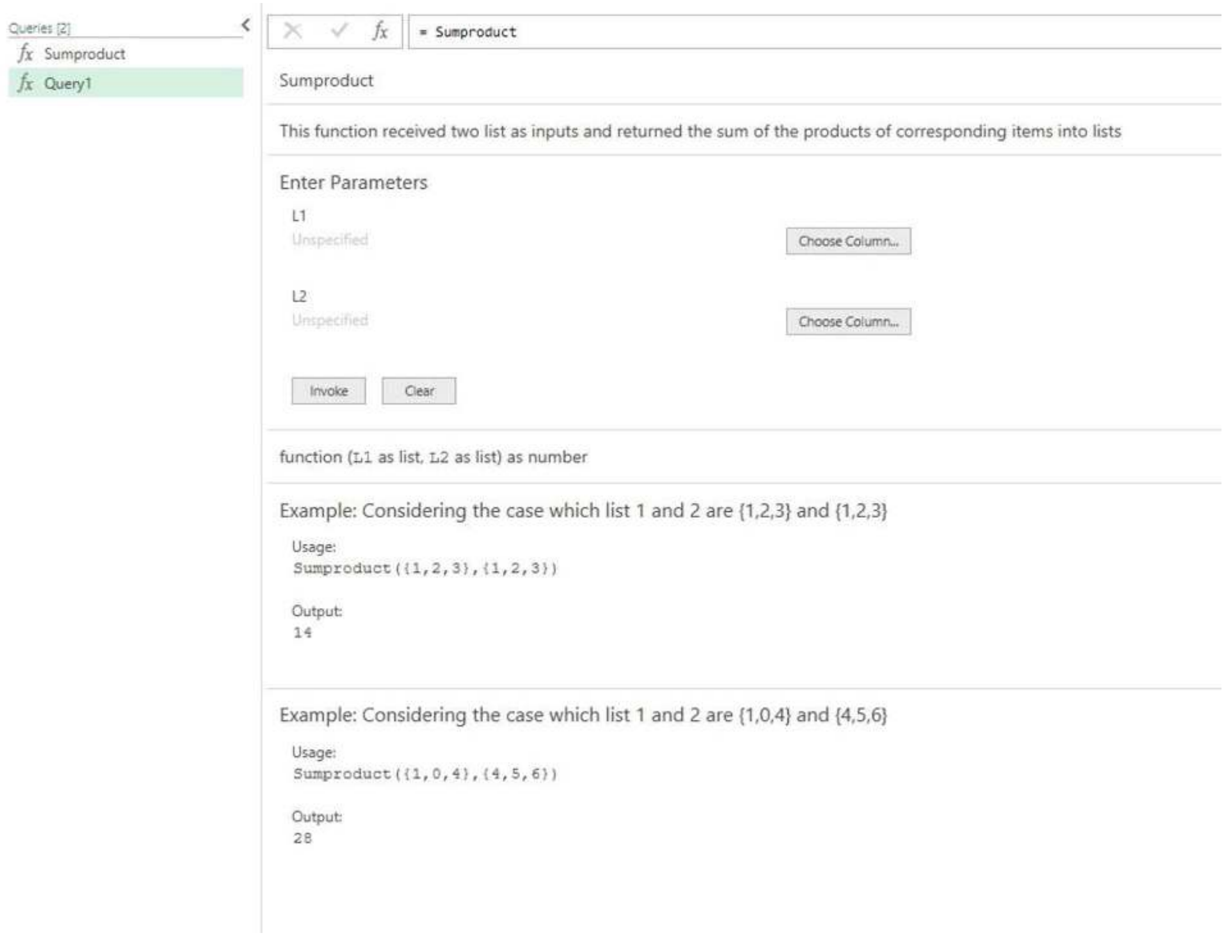
Based on the previous modification, the result does not change, as the defined documentation has not been applied to the custom function yet. To apply this documentation, the `Sumproduct` after `in` should be replaced with the following formula.

```
Value.ReplaceType(Sumproduct,
Value.ReplaceMetadata(Value.Type(Sumproduct), Doc))
```

The entire formula, including the custom function and its documentation, is as follows:

```
let
    Sumproduct=(L1 as list ,L2 as list) as number =>
    let
        Step1={0..
(List.Max({List.Count(L1),List.Count(L2)})-1)},
        Step2=List.Transform(Step1, each L1{_} *L2{_}),
        Step3=List.Sum(Step2)
    in
    Step3,

  Doc = [
    Documentation.Name = "Sumproduct",
     Documentation.LongDescription = "This function received
two list as inputs and returned the sum of the products of
corresponding items into lists",
    Documentation.Examples = {
      [Description = "Considering the case which list 1 and
2 are {1,2,3} and {1,2,3}", Code = "Sumproduct({1,2,3},
{1,2,3})", Result = "14"],
      [Description = "Considering the case which list 1 and
2 are {1,0,4} and {4,5,6}", Code = "Sumproduct({1,0,4},
{4,5,6})", Result = "28"]
    }
  ]

in
  Value.ReplaceType(Sumproduct,
Value.ReplaceMetadata(Value.Type(Sumproduct), Doc))
```

This change is reflected in the function's documentation, as shown in the example in Figure 12-17.



Queries [2]

*fx* Sumproduct

*fx* Query1

```
= Sumproduct
```

Sumproduct

This function received two list as inputs and returned the sum of the products of corresponding items into lists

Enter Parameters

L1

Unspecified

L2

Unspecified

function (L1 as list, L2 as list) as number

Example: Considering the case which list 1 and 2 are {1,2,3} and {1,2,3}

Usage:

```
Sumproduct({1,2,3},{1,2,3})
```

Output:

```
14
```

Example: Considering the case which list 1 and 2 are {1,0,4} and {4,5,6}

Usage:

```
Sumproduct({1,0,4},{4,5,6})
```

Output:

```
28
```

***Figure 12-17*** The result of the revised documentation for Sumproduct

**Note** In the documentation, instead of using Power Query's special characters, you should use JavaScript tags. For instance, if you want to insert a line break, you should use `<br>` instead of `#(lf)`.

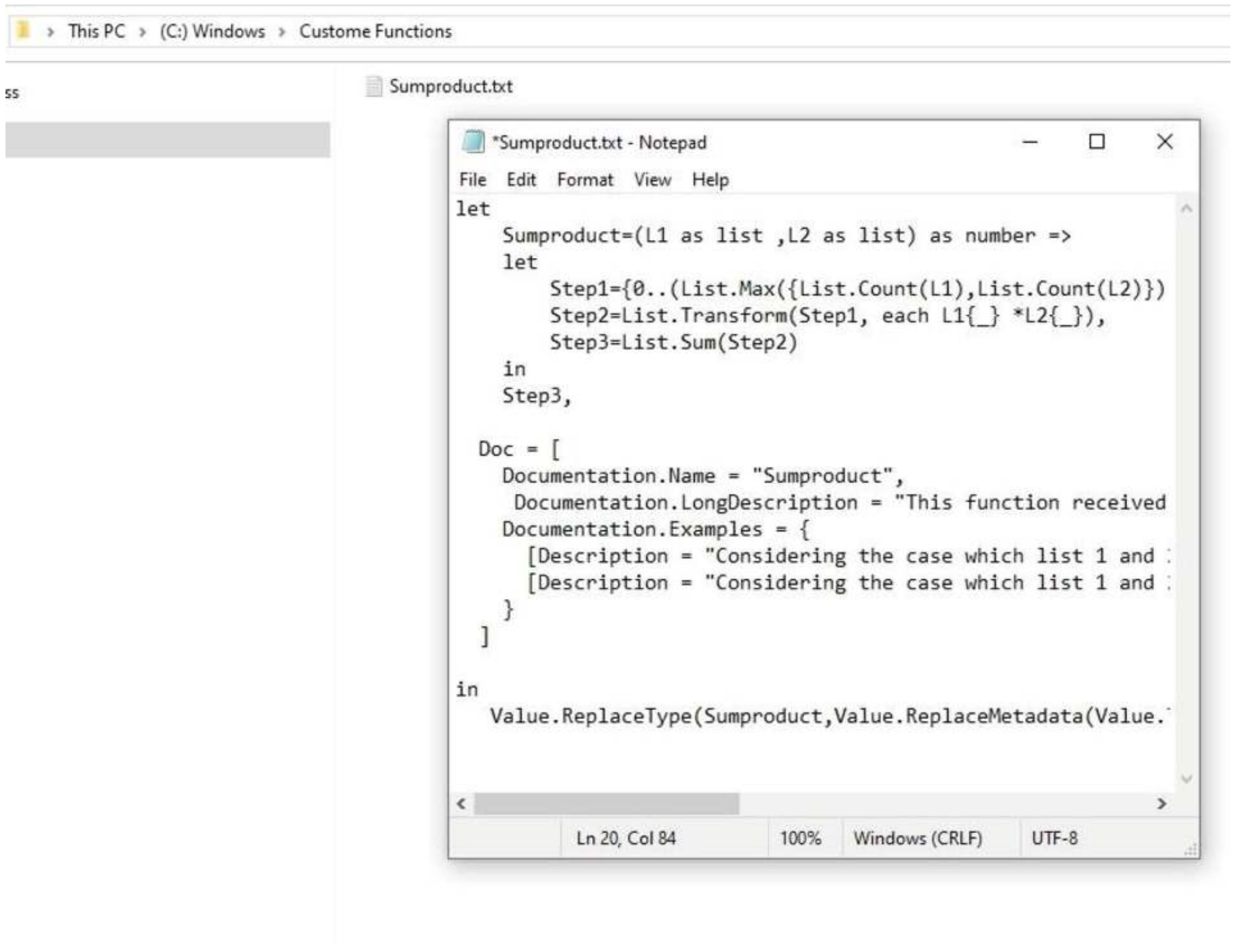
## Sharing Custom Functions Across Files

How can you share these custom functions across multiple files?

To use a custom function in another file, you typically need to copy and paste the code and redefine the function in the new file. However, this approach can become cumbersome, especially if you have multiple custom functions that you use frequently in different files. In this case, you should be aware of which functions are used within each function, and if you apply modifications to a function, you need to ensure that the same modifications are applied consistently across all files where that function is used.

A more practical approach is to save the function code in a text file and share this file between Power Query instances. In this scenario, any changes made to the shared text file will automatically be applied to the files where this function is used, during the next refresh.

To manage multiple custom functions, save each custom function in a separate text file, naming the file according to the function. For example, save the `Sumproduct` custom function as `Sumproduct.txt`, as shown in Figure 12-18.

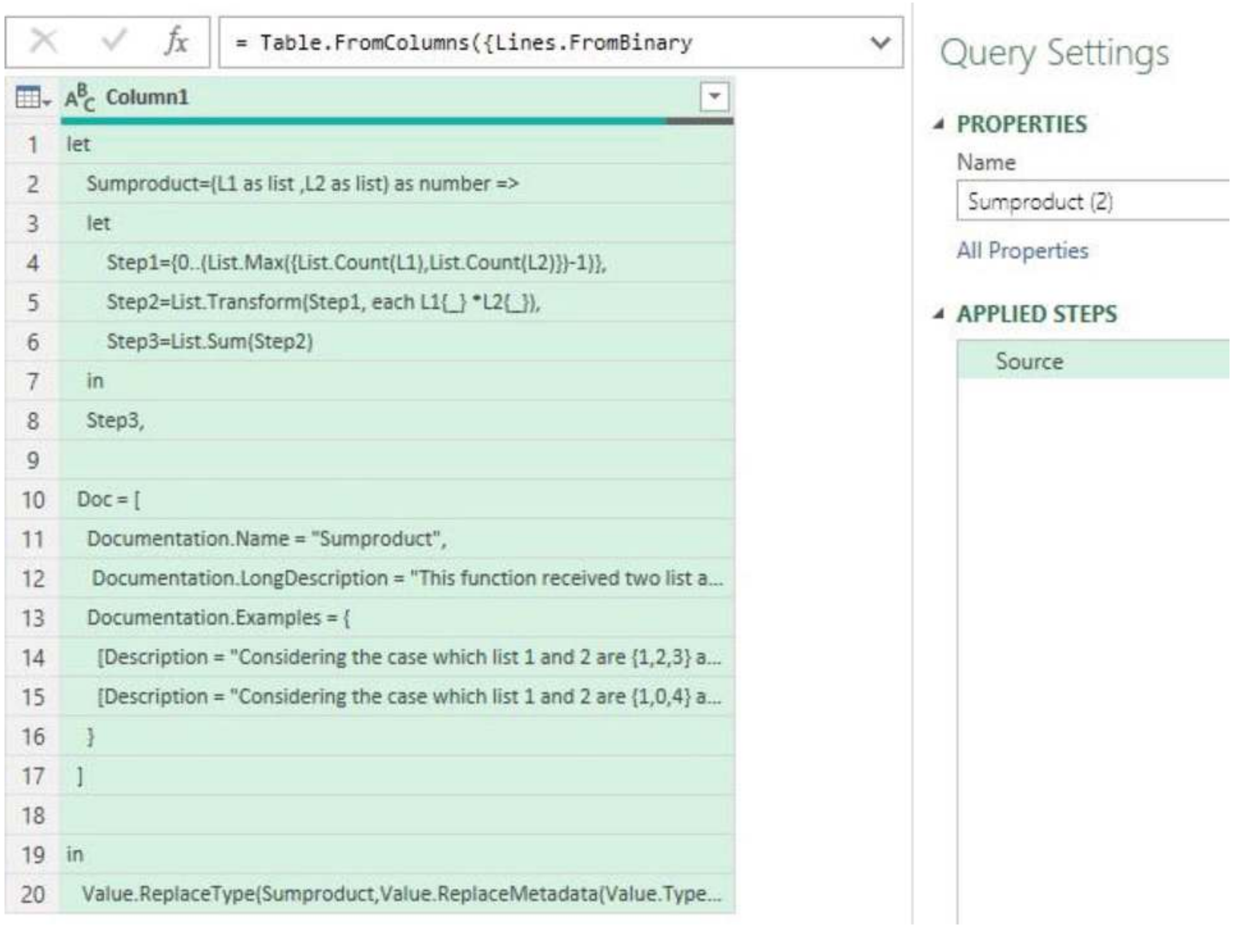

This PC › (C:) Windows › Custome Functions
Sumproduct.txt
*Sumproduct.txt - Notepad
File Edit Format View Help
Ln 20, Col 84
100%
Windows (CRLF)
UTF-8

```
let
    Sumproduct=(L1 as list ,L2 as list) as number =>
    let
        Step1={0..(List.Max({List.Count(L1),List.Count(L2)})
        Step2=List.Transform(Step1, each L1{_} *L2{_}),
        Step3=List.Sum(Step2)
    in
    Step3,

  Doc = [
    Documentation.Name = "Sumproduct",
     Documentation.LongDescription = "This function received
    Documentation.Examples = {
      [Description = "Considering the case which list 1 and
      [Description = "Considering the case which list 1 and
    }
  ]

in
   Value.ReplaceType(Sumproduct,Value.ReplaceMetadata(Value.
```

***Figure 12-18*** Saving a custom function as a text file

Then import the text file into Power Query using the following code or using the From Text command, which leads to Figure 12-19.

```
=
Table.FromColumns({Lines.FromBinary(File.Contents("C:\Custome
Functions\Sumproduct.txt"), null, null, 1252)})
```



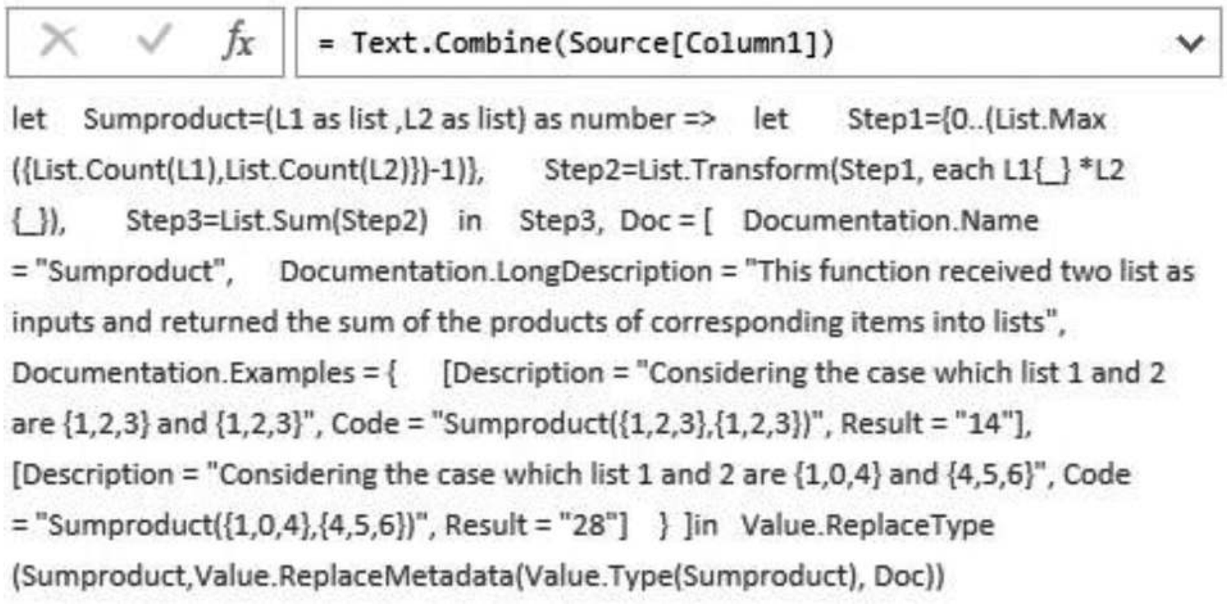
```
= Table.FromColumns({Lines.FromBinary
```

```
Column1
let
  Sumproduct=(L1 as list ,L2 as list) as number =>
  let
    Step1={0..(List.Max({List.Count(L1),List.Count(L2)})-1)},
    Step2=List.Transform(Step1, each L1{_} *L2{_}),
    Step3=List.Sum(Step2)
  in
  Step3,

 Doc = [
  Documentation.Name = "Sumproduct",
   Documentation.LongDescription = "This function received two list a...
  Documentation.Examples = {
    [Description = "Considering the case which list 1 and 2 are {1,2,3} a...
    [Description = "Considering the case which list 1 and 2 are {1,0,4} a...
  }
 ]

in
 Value.ReplaceType(Sumproduct,Value.ReplaceMetadata(Value.Type...
```

***Figure 12-19*** Loading the text file into Power Query

In the next step, use the following formula to merge all the text lines into one continuous text value, as shown in Figure 12-20.

```
= Text.Combine(Source[Column1])
```

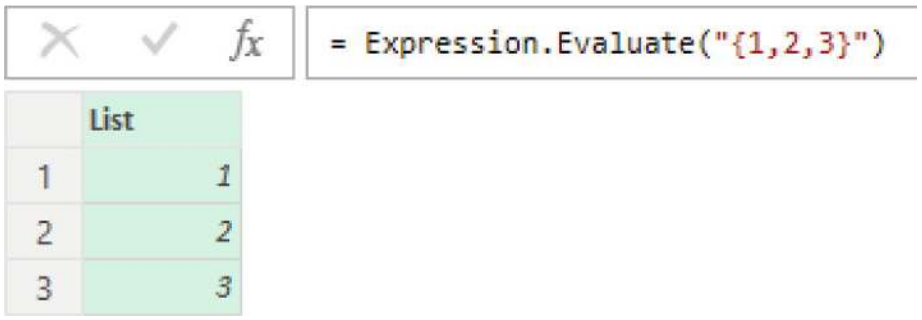


```
= Text.Combine(Source[Column1])
```

```
let    Sumproduct=(L1 as list ,L2 as list) as number =>    let        Step1={0..(List.Max
({List.Count(L1),List.Count(L2)})-1)},        Step2=List.Transform(Step1, each L1{_} *L2
{_}),        Step3=List.Sum(Step2)    in        Step3,  Doc = [    Documentation.Name
= "Sumproduct",    Documentation.LongDescription = "This function received two list as
inputs and returned the sum of the products of corresponding items into lists",
Documentation.Examples = {    [Description = "Considering the case which list 1 and 2
are {1,2,3} and {1,2,3}", Code = "Sumproduct({1,2,3},{1,2,3})", Result = "14"],
[Description = "Considering the case which list 1 and 2 are {1,0,4} and {4,5,6}", Code
= "Sumproduct({1,0,4},{4,5,6})", Result = "28"]    } ]in    Value.ReplaceType
(Sumproduct,Value.ReplaceMetadata(Value.Type(Sumproduct), Doc))
```

***Figure 12-20*** The result of Text.Combine

The result of `Text.Combine()` is in type `text`. To convert it into an executable function, you can use `Expression.Evaluate()`. It converts text into a Power Query formula. For example, `"1+1"` is text, and entering `="1+1"` in the formula bar results in text equal to `"1+1"`. However, using `=Expression.Evaluate("1+1")` in the formula bar—which means to convert `"1+1"` from text to the formula `=1+1`—returns `2`. Similarly, `Expression.Evaluate("{1,2,3}")` returns a `{1,2,3}` list, as shown in Figure 12-22. The result of `Expression.Evaluate("List.Sum({1,2,3})")` is shown in Figure 12-21.



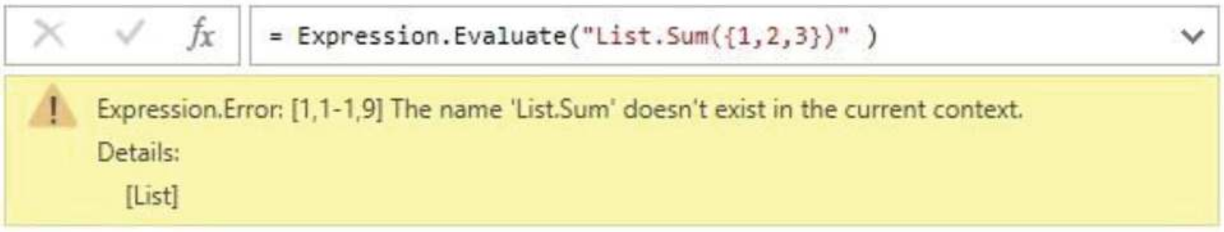
```
= Expression.Evaluate("{1,2,3}")
```

| | List |
|---|---|
| 1 | 1 |
| 2 | 2 |
| 3 | 3 |

***Figure 12-21*** The result of Expression.Evaluate("{1,2,3}" )

This function is straightforward for simple expressions. However, when dealing with functions in text, such as `"List.Sum({1,2,3})"`, directly using `=Expression.Evaluate("List.Sum({1,2,3}")` in the formula bar will result in an error, as shown in Figure 12-22. To resolve this, you need to specify `#shared` as the evaluation environment in the second argument of this function, like so:

```
=Expression.Evaluate("List.Sum({1,2,3})",#shared )
```



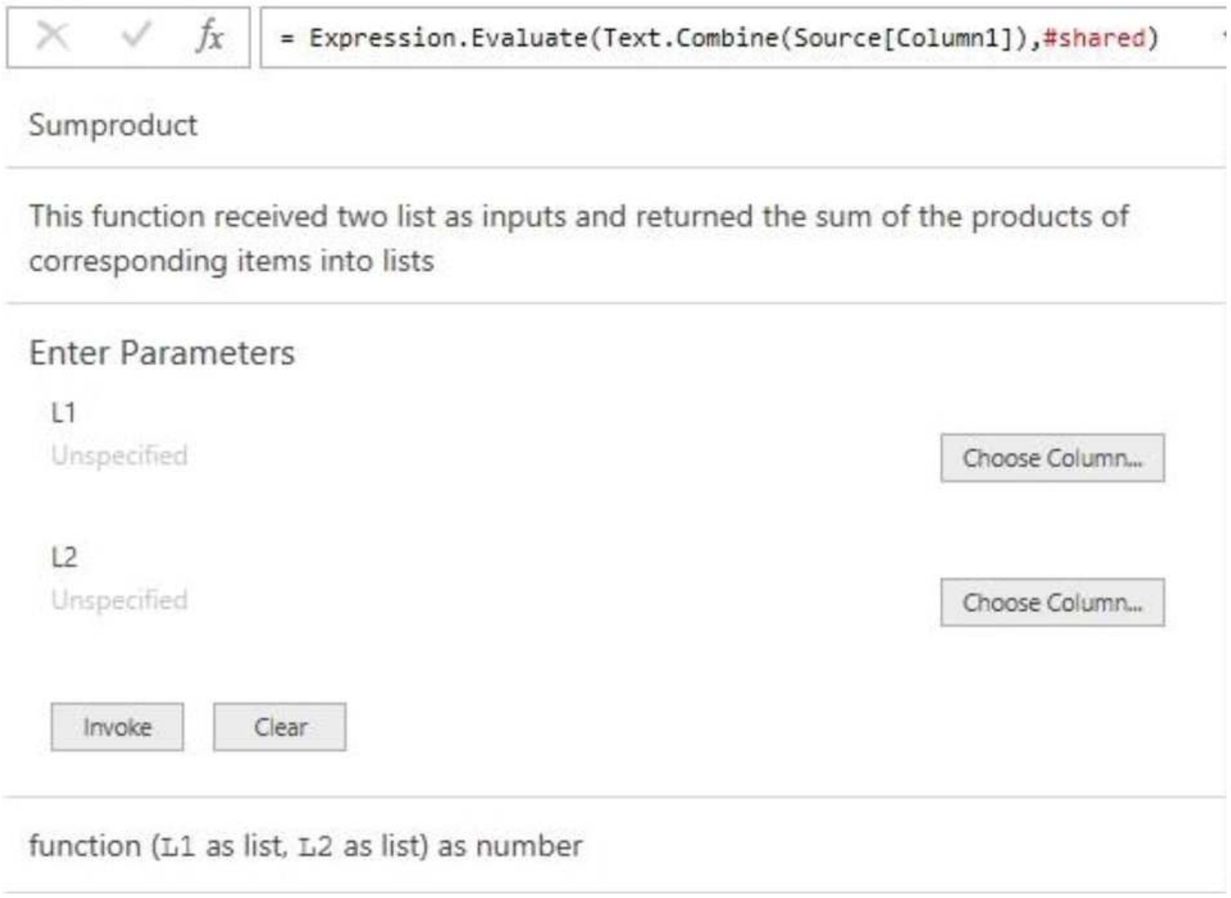
```
= Expression.Evaluate("List.Sum({1,2,3})" )
```

Expression.Error: [1,1-1,9] The name 'List.Sum' doesn't exist in the current context.
Details:
[List]

*Figure 12-22* The result of Expression.Evaluate("List.Sum({1,2,3})" )

Based on this explanation, `=Text.Combine(Source[Column1])` results in the custom function in type `text`, so the following formula will convert this text into the executable functions shown in Figure 12-23.

```
= Expression.Evaluate(Text.Combine(Source[Column1]),#shared)
```



```
= Expression.Evaluate(Text.Combine(Source[Column1]),#shared)
```

Sumproduct

This function received two list as inputs and returned the sum of the products of corresponding items into lists

Enter Parameters

L1
Unspecified

L2
Unspecified

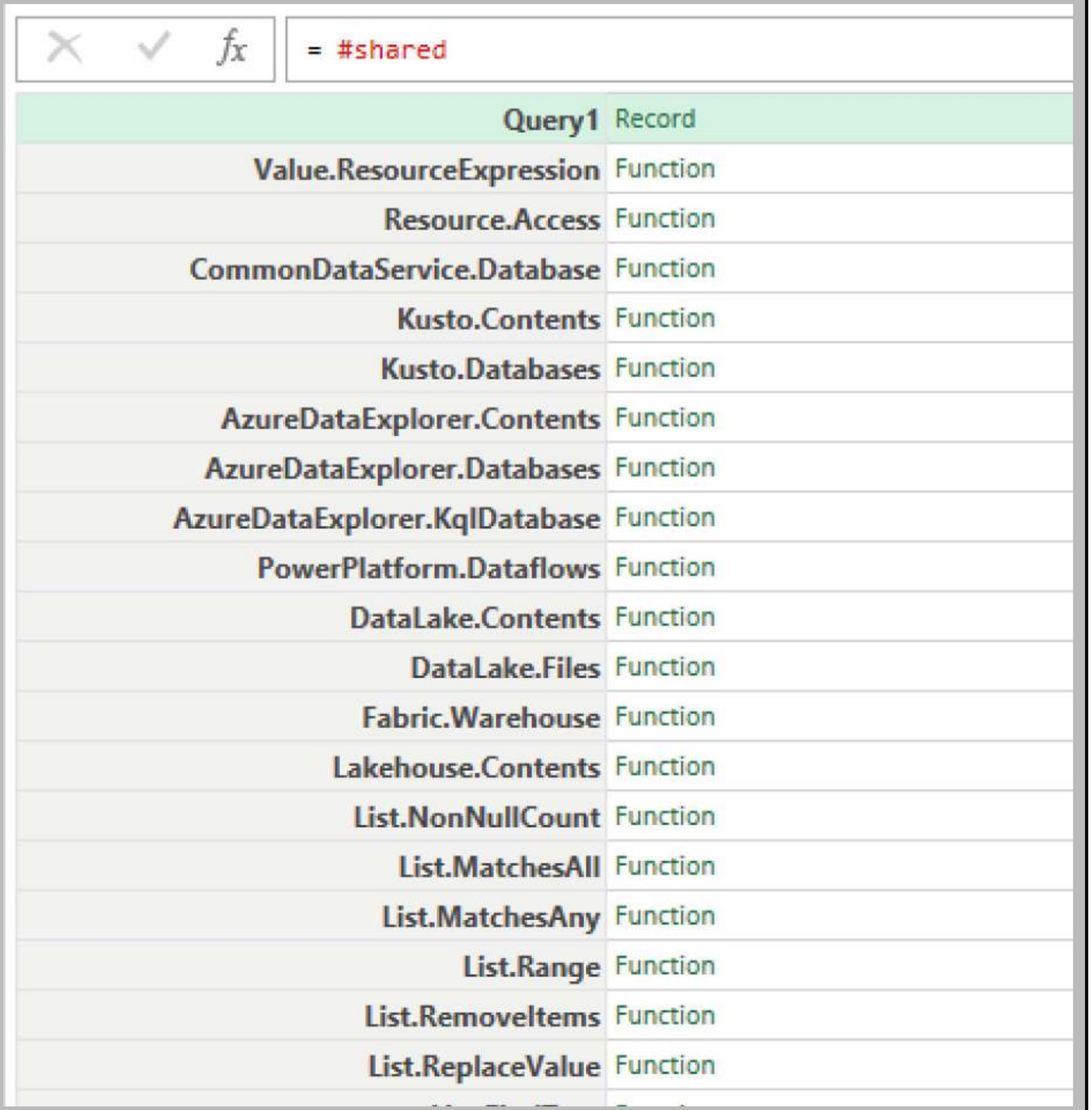
function (L1 as list, L2 as list) as number

*Figure 12-23* The result of using Expression.Evaluate

The result of this query is a defined custom function (`Sumproduct`), which you can use in other queries.

**Note** In Power Query (M language), `#shared` is a special keyword used to refer to a collection of all shared objects, such as functions, queries, and values that are globally available within the current Power Query environment.

`#shared` is essentially a special record that contains references to all functions, queries, and variables that are defined and made available in the Power Query environment. When you type `=#shared` in the formula bar, it returns a list of shared elements in the current workbook or query, as shown in Figure 12-24.



```
= #shared
```

| | |
|---|---|
| Query1 | Record |
| Value.ResourceExpression | Function |
| Resource.Access | Function |
| CommonDataService.Database | Function |
| Kusto.Contents | Function |
| Kusto.Databases | Function |
| AzureDataExplorer.Contents | Function |
| AzureDataExplorer.Databases | Function |
| AzureDataExplorer.KqlDatabase | Function |
| PowerPlatform.Dataflows | Function |
| DataLake.Contents | Function |
| DataLake.Files | Function |
| Fabric.Warehouse | Function |
| Lakehouse.Contents | Function |
| List.NonNullCount | Function |
| List.MatchesAll | Function |
| List.MatchesAny | Function |
| List.Range | Function |
| List.RemoveItems | Function |
| List.ReplaceValue | Function |

***Figure 12-24*** The result of #shared

## Creating Recursive Functions

Create a custom function that takes a number `n` as input and returns the first *n* values in the Fibonacci sequence (In the previous chapter, the Fibonacci sequence was calculated using various methods, and here, you define a custom function for it, by using basic operations.)

The general term for extracting the nth value in the Fibonacci series is $a_n=a_{n-1}+a_{n-2}$ with initial values $a_0=a_1=1$. So, calculate the fourth value in this series, presented by $a_4$, n=4. So, $a_4=a_3+a_2$. To find $a_3$, use $a_3= a_2+a_1$. To find $a_2$, use $a_2=a_1+a_0$. As mentioned, $a_0=a_1=1$, so $a_4=a_3+a_2=((a_1+a_0)+a_1)+(a_1+a_0)$. So, in this series, to extract the nth value, you need the (n-1)th and (n-2)th values, and this chain will continue to reach n=0 or n=1.

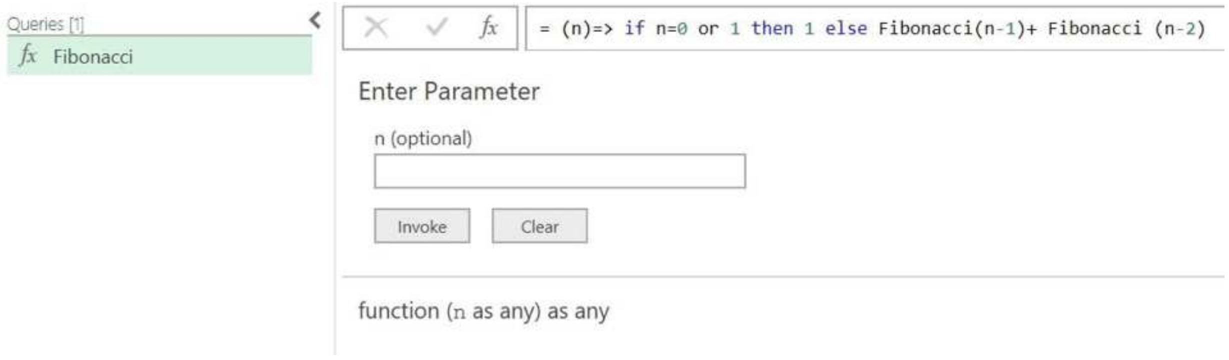
In other words, if you named the function to calculate the nth value of this series as Fibonacci, to calculate `Fibonacci(n)`, initially, you need to calculate `Fibonacci(n-1)` and **Fibonacci(n-2)** first, which for `Fibonacci(n-1)`, the values of `Fibonacci(n-2)` and `Fibonacci(n-3)` are required and for the calculation of `Fibonacci(n -2)`, the values of `Fibonacci(n-3)` and `Fibonacci(n-4)` are required.

For this function, you can say that if n=1 or n=2, then `Fibonacci(n)` is equal to 1 for other values of n. `Fibonacci(n)` is equal to `Fibonacci(n-1)+Fibonacci(n-2)`. So in M language, you can say:

```
Fibonacci (n)= if n=0 or n=1  then 1 else Fibonacci(n-1)+
Fibonacci (n-2)
```

To change this into a custom function to compute the nth value of Fibonacci series in Power Query, create a new blank query and name it `Fibonacci`. Then in the formula bar, write the following formula, which results in Figure 12-25.

```
(n)=> if n=0 or 1 then n=1 else Fibonacci(n-1)+ Fibonacci
(n-2)
```



```
= (n)=> if n=0 or 1 then 1 else Fibonacci(n-1)+ Fibonacci (n-2)
```

function (n as any) as any

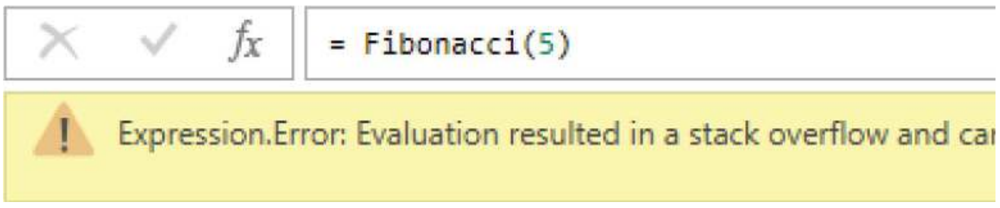
***Figure 12-25*** The defined custom function

In the defined function, entering `n` as 2, 3, and 4, yields the results 2, 3, and 5, respectively.

In this defined custom function, the function is named `Fibonacci`, and within its formula, you call the `Fibonacci` function again. This means that during execution, the function may call itself depending on the scenario. Such functions that call themselves as part of their execution are known as *recursive functions*.

> **Note** It is recommended to avoid using recursive functions whenever possible, as they are often time-consuming.
>
> The stop condition (also called the base case) is a crucial part of a recursive function. It is a specific condition that halts the recursion and prevents the function from calling itself indefinitely. In a recursive function, the function calls itself repeatedly. If an appropriate stop condition is not defined, the function will continue calling itself, leading to an *infinite loop,* which consumes all available computer memory and results in a stack overflow memory error.

In the defined function, the based cases are `n=0` or `n=1`. In such cases, the function does not recall itself and the recursion will stop. If you remove the base case and write the custom function as `(n)=> Fibonacci(n-1)+ Fibonacci (n-2)`, invoking the function for any value, such as `5`, results in a stack overflow error message, as shown in Figure 12-26.



```
= Fibonacci(5)
```

```
Expression.Error: Evaluation resulted in a stack overflow and ca
```

*Figure 12-26* Stack overflow error message

## Using Optional Input Parameters

Create a custom function with two arguments—`salary` and `tax rate`—to calculate the tax based on multiplying salary by the tax rate. If a tax rate is not provided, assume a default rate of 10 percent.

In this question, you are asked to create a custom function with an optional argument, similar to many predefined functions in Power Query. For example, Chapter 6 explains that the fourth and fifth arguments of the `Table.Group()` function are optional. By default, `Table.Group()` applies global grouping, but you can modify the grouping logic by using the fourth arguments.

The same concept applies to this function. The tax rate is generally set at 10 percent. However, if you want to use a different tax rate, you can specify a custom value using the function's second argument.

In Power Query custom functions, optional parameters can be defined using the `optional` keyword before the parameter name. So, the parameters for this custom function can be defined as follows, which means `taxRate` is optional:

```
(salary as number, optional taxRate as number) as number =>
```

In this case, you cannot simply use the `salary * taxRate` formula because `taxRate` is an optional argument and might not be provided by the user. If the user does not enter a value, `taxRate` will be `null`, causing the entire formula to return `null`.

To handle this, you need to assign a default value (e.g., 10 percent) when `taxRate` is `null`, ensuring that the calculation works correctly even if the user does not specify a value. So, instead of using `taxRate` directly, you can use `taxRate ?? 0.1`. This means that if `taxRate` has a value, it will be used; otherwise, if it is `null`, it will be replaced with 0.1 (which represents the default 10 percent tax rate). This ensures that the calculation works correctly even when the user does not provide a value for `taxRate`.

The revised formula is as follows.

```
(salary as number, optional taxRate as number) as number =>
salary *(taxRate ??0.1)
```

You can define a custom function with multiple optional arguments, as shown in this example. This approach allows you to create a function with three arguments, where two of them are optional. However, an important rule must be followed in defining an optional argument: all optional parameters must come after the required ones.

## Summary

Power Query provides a wide range of built-in functions, but there are situations where custom functions are necessary to meet specific needs. In this chapter, you learned how to define custom functions using the `each _` syntax or by creating a general function structure like `(x) => ....` You also explored how to specify parameter types and return types by appending the `type` keyword, and how to define optional parameters and add documentation to functions, making them more versatile and user-friendly.

# Appendix A

Power Query offers a versatile toolkit for data transformation, and as with any powerful tool, there are multiple ways to tackle challenges. For each challenge presented in this book, you can explore a wide range of potential solution, enhancing your understanding of Power Query's capabilities. While this book provides comprehensive solutions for each challenge, you can also explore other approaches for some of the challenges through Table A-1.

To find solutions to these challenges, simply append the challenge number from the "No" column to the following URL:

```
https://www.OmidBI.com/ch
```

For example, to access the solution for the challenge titled "Adding Multiple Columns at Once," append the challenge number 20 to the URL, as so:

```
https://www.OmidBI.com/ch20
```

***Table A-1*** Other Solutions for These Challenges

| Section | Title | No. |
|---|---|---|
| 2.4. | Adding Multiple Columns at Once | 20 |
| 2.6. | Extracting Data from Price List Table | 87 |
| 3.3. | Filtering Across Multiple Columns, Part 3 | 67 |
| 3.6. | Filtering Based on Sequence | 42 |
| 3.7. | Using Random Selection | 93 |
| 3.8. | Using Advanced Filtering Criteria | 36 |
| 4.3. | Splitting Text by Position | 45 |
| 4.4. | Extracting Text Between Parentheses | 27 |
| 4.5. | Extracting Email Addresses | 71 |
| 4.6. | Using a Multiline Splitter | 64 |
| 4.7. | Splitting Text by Changing Character Type, Part 1 | 63 |
| 4.8. | Splitting Text by Changing Character Type, Part 2 | 73 |
| 4.10. | Merging Instead of Adding a Column | 8 |
| 5.1. | Managing Product IDs | 39 |
| 5.2. | Value Repeated in Several Columns | 11 |

| Section | Title | No. |
|---|---|---|
| 5.3. | Removing Blank Columns | 79 |
| 5.4. | Transforming Columns, Part 1 | 41 |
| 5.5. | Transforming Columns, Part 2 | 31 |
| 5.6. | Transforming Columns, Part 3 | 32 |
| 6.3. | Matching Items in Groups | 55 |
| 6.4. | Identifying All-Season Products | 14 |
| 6.11. | Transformations Within Table.Group() | 16 |
| 7.1. | Combining Tables | 44 |
| 7.2. | Calculating Weighted Averages | 23 |
| 7.6. | Conditional Merging | 69 |
| 7.7. | Self-Merging | 61 |
| 8.2. | Handling Missing Rows | 54 |
| 8.4. | Linear Interpolation for Missing Data | 62 |
| 8.5. | K-Nearest Neighbors for Imputation | 86 |
| 9.4. | Generating the Fibonacci Sequence by List.Accumulate() | 72 |
| 9.7. | Applying Transformation Over the Columns | 12 |
| 9.10. | Implementing Stepped Tax Calculations | 58 |
| 9.11. | Changing Data Granularity | 59 |

To further broaden your expertise, I provide links to some other challenges on my website, with solutions. See Table A-2.

***Table A-2*** Complementary Challenges

| Chapter | Topic | Challenge Title | No. |
|---|---|---|---|
| 2 | Referencing | Last Inventory | 95 |
| 2 | Referencing | Compare Rows | 102 |
| 3 | Sorting and Filtering | Sort Table Columns | 43 |
| 3 | Sorting and Filtering | Custom Ranking | 85 |
| 3 | Sorting and Filtering | Top Products | 96 |
| 3 | Sorting and Filtering | Random Selection Part 2 | 99 |
| 3 | Sorting and Filtering | Custom Rank | 106 |
| 3 | Sorting and Filtering | Custom Rank | 112 |

| Chapter | Topic | Challenge Title | No. |
|---|---|---|---|
| 4 | Column Splitting and Merging | Custom Splitter 3 | 83 |
| 4 | Column Splitting and Merging | Data Cleaning | 98 |
| 4 | Column Splitting and Merging | Column Splitting | 136 |
| 4 | Column Splitting and Merging | Column Splitting | 146 |
| 5 | Pivoting and Unpivoting Tables | Transformation | 15 |
| 5 | Pivoting and Unpivoting Tables | Transformation | 21 |
| 5 | Pivoting and Unpivoting Tables | Transformation | 48 |
| 5 | Pivoting and Unpivoting Tables | Transformation | 65 |
| 5 | Pivoting and Unpivoting Tables | Merged Cells | 66 |
| 5 | Pivoting and Unpivoting Tables | Normal Distribution | 84 |
| 5 | Pivoting and Unpivoting Tables | Table Transformation | 122 |
| 5 | Pivoting and Unpivoting Tables | Transformation | 126 |
| 5 | Pivoting and Unpivoting Tables | Table Transformation | 131 |
| 5 | Pivoting and Unpivoting Tables | Table Transformation | 137 |
| 5 | Pivoting and Unpivoting Tables | Table Transformation | 142 |
| 5 | Pivoting and Unpivoting Tables | Table Transformation | 147 |
| 6 | Grouping Rows with `Table.Group` | Number Grouping | 46 |
| 6 | Grouping Rows with `Table.Group` | Custom Grouping | 109 |
| 6 | Grouping Rows with `Table.Group` | Custom Grouping | 119 |
| 6 | Grouping Rows with `Table.Group` | Custom Grouping | 123 |
| 6 | Grouping Rows with `Table.Group` | Custom Grouping | 129 |
| 6 | Grouping Rows with `Table.Group` | Custom Grouping | 133 |
| 6 | Grouping Rows with `Table.Group` | Custom Grouping | 139 |
| 6 | Grouping Rows with `Table.Group` | Custom Grouping | 143 |
| 7 | Merging and Appending Tables | Match Payments | 60 |
| 7 | Merging and Appending Tables | Matching Tables | 107 |
| 7 | Merging and Appending Tables | Reconciliation | 110 |
| 7 | Merging and Appending Tables | Merge | 114 |
| 7 | Merging and Appending Tables | Payment Durations | 120 |
| 8 | Handling Missing Values | Find Missing Numbers | 52 |
| 8 | Handling Missing Values | Linear Interpolation | 97 |

| Chapter | Topic | Challenge Title | No. |
|---|---|---|---|
| 8 | Handling Missing Values | Custom Average | 103 |
| 9 | Looping in Power Query | Calculate Spending Time | 26 |
| 9 | Looping in Power Query | Identifying Customers Staple Products | 29 |
| 9 | Looping in Power Query | Risk Analysis | 30 |
| 9 | Looping in Power Query | Noise Removing | 33 |
| 9 | Looping in Power Query | Connected People | 37 |
| 9 | Looping in Power Query | Cross-Selling | 40 |
| 9 | Looping in Power Query | Assignment Problem Part 1 | 49 |
| 9 | Looping in Power Query | Assignment Problem Part 2 | 50 |
| 9 | Looping in Power Query | Purchasing Together | 51 |
| 9 | Looping in Power Query | Coin Change Problem | 70 |
| 9 | Looping in Power Query | Fibonacci Sequence | 72 |
| 9 | Looping in Power Query | Manage Duplicate Values | 100 |
| 9 | Looping in Power Query | Subsets | 101 |
| 9 | Looping in Power Query | Merge | 124 |
| 9 | Looping in Power Query | FIFO | 130 |
| 9 | Looping in Power Query | Golden Period | 140 |
| 10 | Leveraging Scripting and External Integrations in Power Query | Cluster Values | 28 |
| - | Other | Customer Return Cycle | 34 |
| - | Other | Up and Down Grades | 35 |
| - | Other | Duration Since Last Visit | 38 |
| - | Other | Multiple Text Replaces | 47 |
| - | Other | OEIS Sequence | 53 |
| - | Other | Process Efficiency | 56 |
| - | Other | Fuzzy Numbers Calculation | 57 |
| - | Other | Simulation | 104 |
| - | Other | Character Repetition | 105 |
| - | Other | AVG Cooperation Time | 108 |
| - | Other | Increased SALES | 111 |
| - | Other | Manage Duplicate Values | 113 |

| Chapter | Topic | Challenge Title | No. |
|---|---|---|---|
| - | Other | Multi Replacement | 115 |
| - | Other | Remove Rows and Columns | 116 |
| - | Other | Add Index Column | 117 |
| - | Other | DSO | 118 |
| - | Other | Power | 121 |
| - | Other | Pad Middle | 125 |
| - | Other | Add Index Column | 127 |
| - | Other | Cartesian Product | 128 |
| - | Other | Merge | 132 |
| - | Other | Final Week of the Month | 134 |
| - | Other | Identify the Pattern | 135 |
| - | Other | Periodic Sales Summary | 138 |
| - | Other | Fill Up and Down | 141 |
| - | Other | First Transaction in Each Month | 144 |
| - | Other | Length of Pattern | 145 |
| - | Other | Filter Dates | 148 |

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