

Wrangling + Exploring with Power BI

Overview

Students will practice converting available data into clean, structured data models.

Learning Objectives

In this lesson, students will:

- Differentiate between cleaning and modeling
- Load and connect data from multiple sources
- Relate SQL UNIONs and JOINs to Power BI *appends* and *merges*
- Perform analytical calculations with Power BI's *Data Analysis Expression* language (DAX)

Duration: 3 hours



Suggested Agenda - Wrangling+Exploring

Time		Activity	Topics
0:00–0:10	10 mins	<u>Opening</u>	Today's Agenda & Learning Objectives
0:10–0:15	5 mins	<u>Topic Introduction</u>	Intro to Data Wrangling
0:15–0:30	15 mins	<u>Topic Introduction</u>	Data Modeling
0:30–1:30	60 mins	<u>Guided Practice</u>	Deep Dive: The Power Query Editor
1:30–1:40	10 mins	<u>BREAK</u>	
1:40–2:10	30 mins	<u>Guided Practice</u>	Deep Dive: The Data Model
2:10–2:20	10 mins	<u>Independent Practice</u>	Data Model Activity
2:20–2:30	10 mins	<u>Guided Practice</u>	DAX Calculations
2:30–2:50	20 mins	<u>Independent Practice</u>	DAX Calculations Activity
2:50–3:00	10 mins	<u>Review & Wrap Up</u>	Reflection, Exit Tickets



Advanced Analytics

Hello, GAClient!

What Have We Learned So Far?

Last lesson we:

- agreed on components of good visual design
- articulated the difference between dashboards, reports, and analysis
- differentiated Power BI from other/similar BI platforms
- navigated the Power BI interface
- loaded data into Power BI, performed basic cleaning, and created reports
- saved a model and exported a report to PDF

Today's Agenda

Here's what we'll cover today:

- Intro to Data Wrangling
- Data Modeling in Power BI
 - Importing from multiple sources
 - Creating relationships
- The Power Query Editor
- Calculations in Power BI using DAX



Learning Objectives

After this lesson, you'll be able to:

- Load data from different file types (xlsx, txt)
- Clean and reshape data using the Power Query Editor
- Understand the difference between relational data models and the Power BI associative model
- Explain and apply joins between tables
- Create calculations in Power BI's
Data Analysis Expression language DAX





Computers Out:

Prepare for Class

Before we begin:

Please be prepared to access the following files for this lesson:

1. **Data_Wrangling.xlsx**
2. **Person.Address.txt**
3. **Person.StateProvince.txt**
4. **Person.CountryRegion.txt**
5. **Production.Product.txt**
6. **Sales.SalesOrderDetail.txt**
7. **Sales.SalesOrderHeader.txt**



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Wrangling + Exploring

Why Are We Doing This?

My data is very messy!

My data is all over the place

I want the latest data for my reports

I keep copying and pasting data everywhere

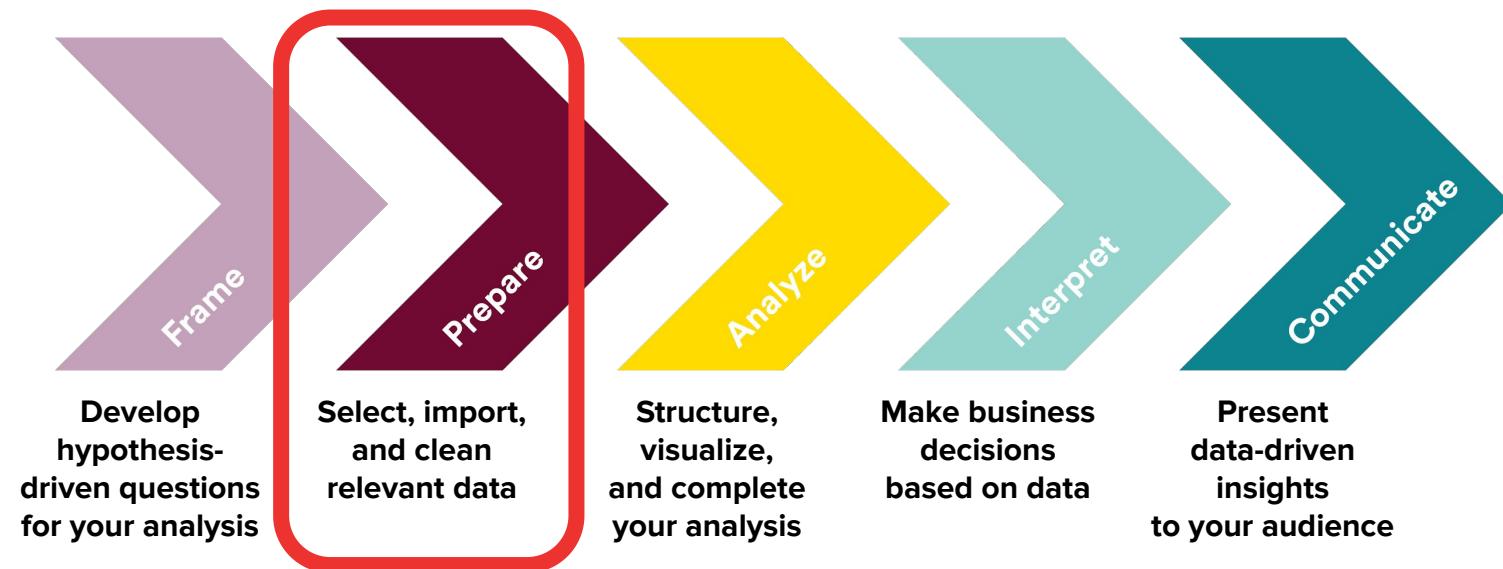
My data is in LOTS of different formats

I'm tired of VLOOKUPS & INDEX/MATCH

I have do the same thing every week

Data Journey

Once we've identified objective questions to ask of our data, it's time to select, clean and organize our data into a Data Model for analysis.



How does this lesson fit in?

Power BI Unit Overview

In this lesson we take a deep dive into selecting, loading, cleaning and preparing data for analysis.

	Lesson	Description
1	Why BI Tools?	Orient individuals to Power BI with an interactive session exploring pre-existing dashboards and the insights they reveal in Power BI. Evaluate what makes a dashboard/analysis effective or not from a communication and clarity perspective.
2	Wrangling + Exploring	Learn how to clean, join, and label data in Power BI in order to set it up for analysis. Then, begin exploring relationships between variables you've brought into an analysis to identify those with the most compelling insights.
3	Exploratory Data Analysis	Model and program relevant variables from exploration into dashboards in Power BI to make your dashboards live entities that others can explore. Begin introducing the concept of significance of findings in stats terms in order to identify the reliability of results.
4	Communicating Insights	Visualize datasets in Power BI to explore and communicate findings. Then, discuss how to use Power BI to share insights & templates.
5	Lab 2	Use Power BI to analyze sales data and answer prompts related to products, sales, and marketing.

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Intro to Data Wrangling

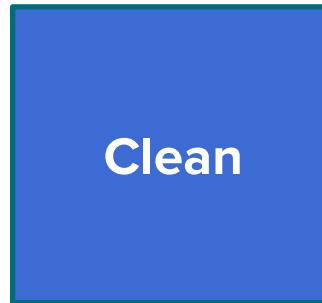
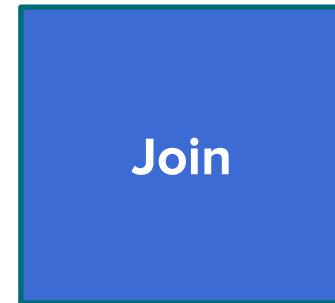


What is Data Wrangling?

- The process of acquiring, cleaning, joining and transforming data from multiple sources.
- Depending on enterprise, may also be referred to as data preparation.

Why?

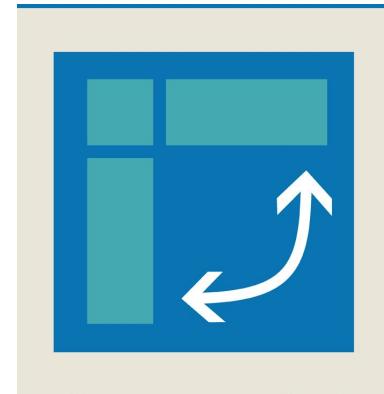
Identifying issues with data early in the analytic process allows more time to correct issues and prevents bad data from going into modelling.



What Is Reshaping?

We **reshape** data to ensure that:

- We have all the fields needed for analysis
 - we might combine data from different sources
- The data is in the correct format
 - we might convert data from wide to long

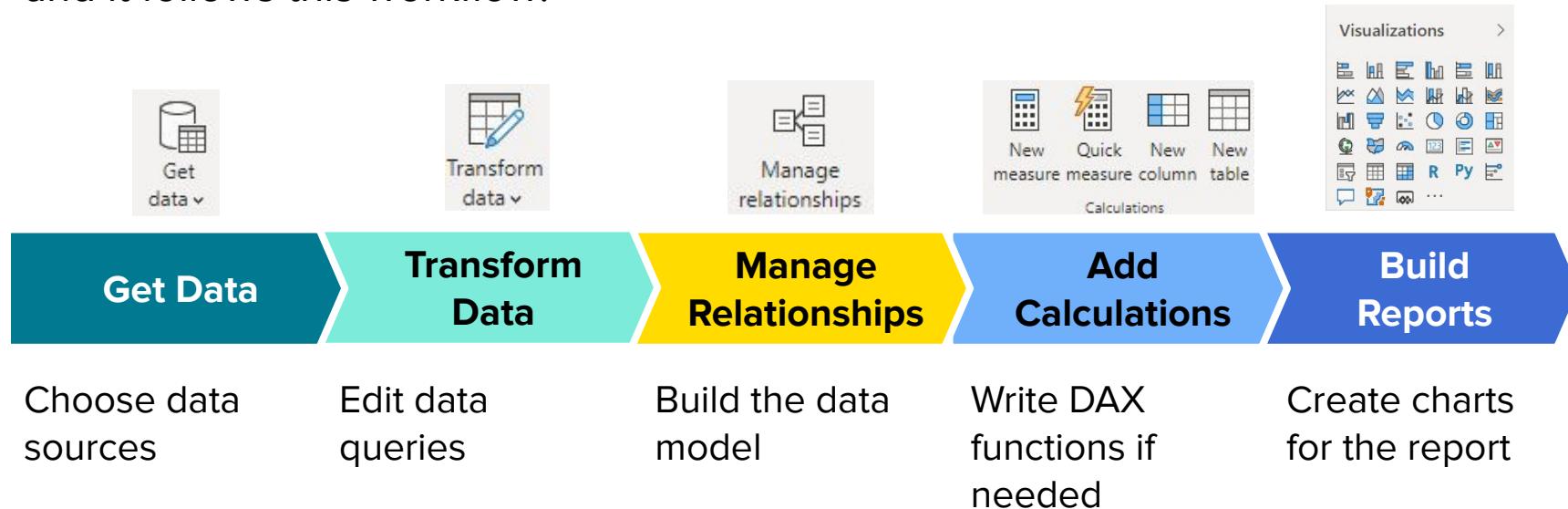


Reshaping data may mean:

- Adding calculated columns
- Appending / Merging data
- Pivoting columns

The Power BI Workflow

End to end data analysis can be achieved through Power BI and it follows this workflow:



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Data Modeling





Discussion:

Where's Your Data?

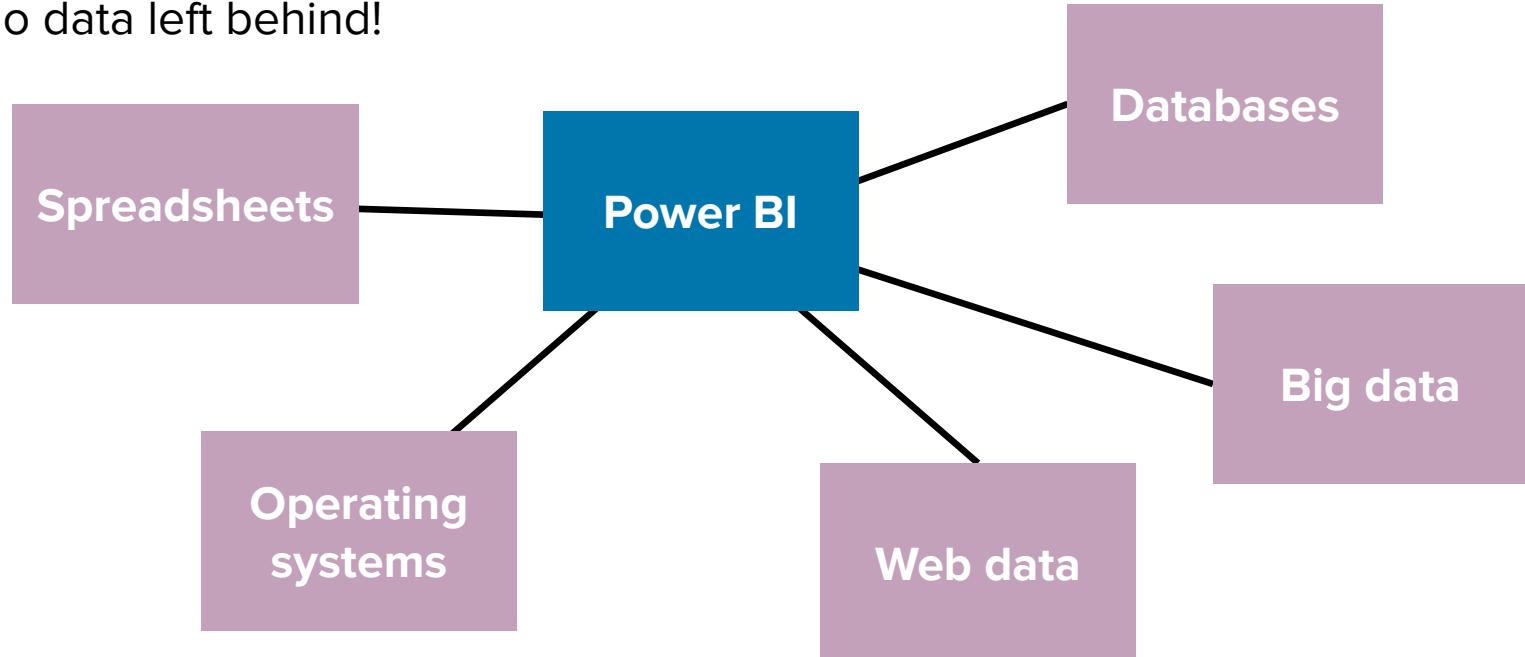
When you work with data, typically where does it come from?

What are your most commonly used data sources?



Connecting to Data

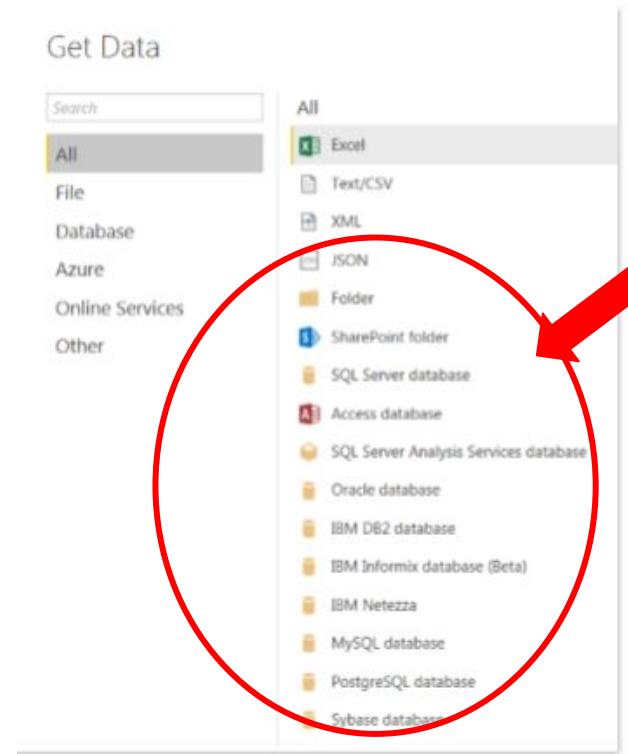
- Connect to **ALL** of your data from **ALL** of your sources.
- No data left behind!



Connecting to Data

Power BI can connect to:

- **Flat files & spreadsheets:**
csv, txt, xlsx, etc
- **Databases:**
SQL, Access, Oracle, IBM, Azure, etc
- **Online Services:** Sharepoint, GitHub, Dynamics 365, Google Analytics, Salesforce, Power BI Service, etc
- **many others:** Web feeds, R scripts, Spark, Hadoop, etc



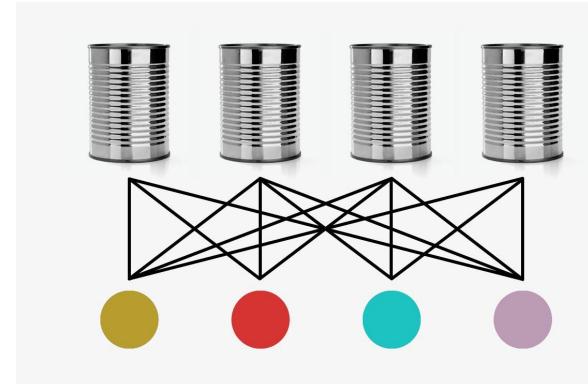
Power BI
can
connect to
many
different
sources of
data

Connected Data!

Once you have data, you can start building reports and dashboards.

Things to consider:

- Data types, granularity, relevant fields, stale data...
what needs wrangling? Too much or too little?
- Power BI can help in all of these areas, but input
should be clean going in, if possible.



Shaping Your Data

In the last lesson we loaded a single table that contained all of the data.

In practice this almost never happens!

And that's ok - we'll see that this is **not** an efficient way of working.

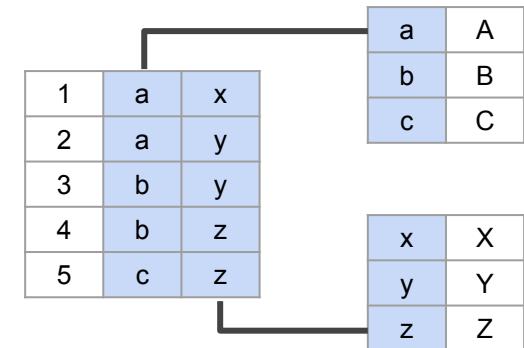
GOOD
single table

1	A	X
2	A	Y
3	B	Y
4	B	Z
5	C	Z

BETTER
merged tables

1	a	A	x	X
2	a	A	y	Y
3	b	B	y	Y
4	b	B	z	Z
5	c	C	z	Z

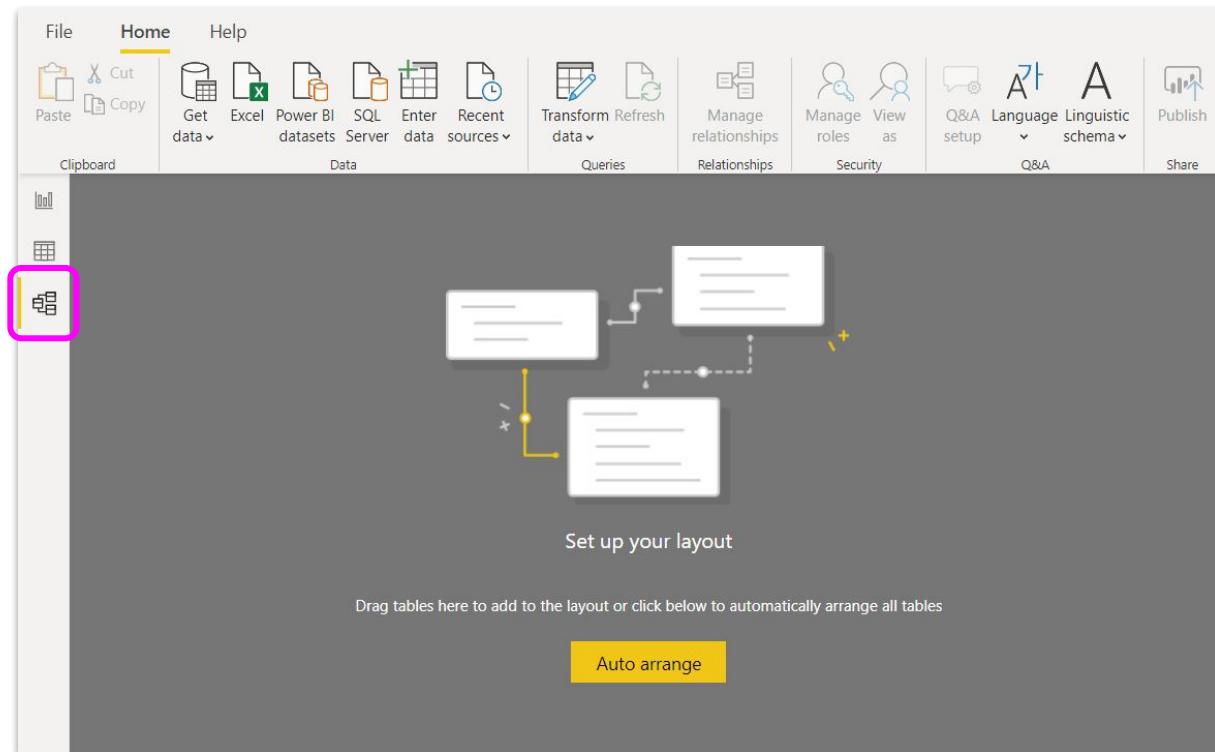
BEST
table relationships



Sneak Peek: Table Relationships

Remember, there are different **views** in Power BI.

This is the **Model view**.



“

Plan your work, and work your plan.

- Every coach ever



Prepare Your Data with a Plan

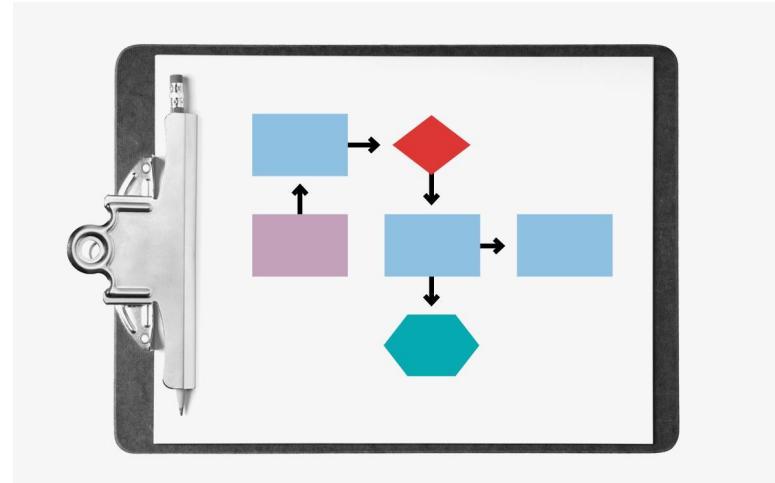
We'll get to table relationships in a bit.

First we'll explore **appending** and **merging** tables in the Query Editor.

This is similar to UNIONs and JOINs in SQL!

Query Editor:
collect all the pieces

Data Model:
assemble the project



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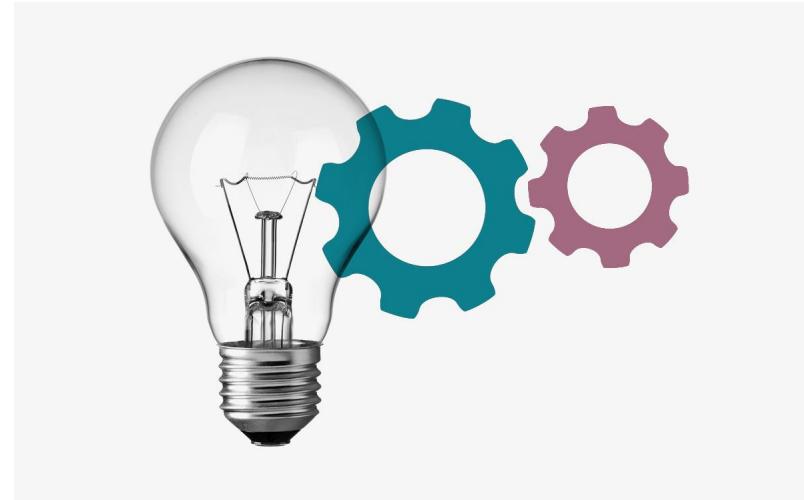
Deep Dive: The Power Query Editor



In This Section...

In this section we'll:

- Load data from a **spreadsheet**
- Explore the Query Editor interface
- Clean the spreadsheet data to make it useful for our Data Model
 - remove unwanted rows
 - promote column headers
 - set column data types
 - unpivot columns
- Append queries
- Merge queries



Deep Dive: The Query Editor

Guided Walkthrough: Loading a Spreadsheet

Loading Data from Spreadsheets

For this exercise we'll load data from **Data_Wrangling.xlsx**

AdventureWorks Budget Data																
2	Prepared By: BI Maverick															
3	AdventureWorks Confidential															
4	Category	Subcategory	ProductName	Jan, 2016	Feb, 2016	Mar, 2016	Apr, 2016	May, 2016	Jun, 2016	Jul, 2016	Aug, 2016	Sep, 2016	Oct, 2016	Nov, 2016	Dec, 2016	Grand Total
5	Accessories	Bike Racks	Hitch Rack - 4-Bike	\$17,699	\$14,275	\$9,009	\$4,313	\$18,498	\$14,601	\$7,700	\$11,647	\$2,955	\$3,940	\$14,520	\$8,365	\$172,522
6	Accessories	Bike Stands	All-Purpose Bike Stand	\$18,292	\$8,835	\$6,050	\$15,615	\$18,982	\$17,540	\$20,837	\$22,563	\$17,170	\$6,793	\$15,519	\$4,531	\$172,727
7	Accessories	Bottles and Cages	Water Bottle - 30 oz.	\$21,175	\$2,062	\$8,851	\$19,290	\$7,697	\$12,859	\$12,562	\$18,420	\$10,409	\$23,585	\$16,316	\$16,134	\$169,360
8	Accessories	Cleaners	Bike Wash - Dissolver	\$9,012	\$21,608	\$12,976	\$1,794	\$14,087	\$8,929	\$11,334	\$7,761	\$3,418	\$5,054	\$7,995	\$13,778	
9	Accessories	Fenders	Fender Set - Mountain	\$12,052	\$20,176	\$5,522	\$4,782	\$11,181	\$11,970	\$20,254	\$14,147	\$3,626	\$14,541	\$21,256	\$13,289	\$152,796
10	Accessories	Helmets	Sport-100 Helmet, Red	\$7,183	\$14,244	\$6,218	\$18,551	\$6,536	\$21,475	\$8,994	\$11,626	\$5,456	\$15,139	\$14,960	\$9,628	\$140,010
11	Accessories	Hydration Packs	Hydration Pack - 70 oz.	\$22,782	\$18,833	\$2,949	\$9,583	\$21,419	\$17,788	\$16,255	\$16,741	\$22,897	\$20,148	\$13,989	\$3,256	\$186,640
12	Accessories	Tires and Tubes	Patch Kit/8 Patches	\$16,659	\$22,140	\$4,488	\$11,112	\$11,550	\$4,064	\$14,097	\$15,525	\$3,516	\$13,827	\$21,464	\$19,079	\$157,521
13	SubTotal Accessories			\$124,854	\$122,173	\$52,897	\$96,222	\$97,657	\$114,384	\$109,628	\$122,008	\$73,790	\$101,391	\$123,078	\$82,277	\$1,220,354
14	Bikes	Mountain Bikes	Mountain-100 Silver, 38	\$271,886	\$141,318	\$175,939	\$133,138	\$220,621	\$121,034	\$280,020	\$256,339	\$293,100	\$255,309	\$119,503	\$213,836	\$2,482,043
15	Bikes	Road Bikes	Road-150 Red, 62	\$138,803	\$191,146	\$196,255	\$282,511	\$270,926	\$186,018	\$212,106	\$170,941	\$275,025	\$297,144	\$138,128	\$170,998	\$2,530,001
16	Bikes	Touring Bikes	Touring-2000 Blue, 60	\$254,390	\$104,319	\$248,799	\$295,111	\$299,234	\$113,172	\$221,146	\$243,851	\$249,822	\$142,915	\$136,337	\$295,713	\$2,604,809
17	SubTotal Bikes			\$665,079	\$436,783	\$620,993	\$710,760	\$790,781	\$420,224	\$713,272	\$671,131	\$817,947	\$695,368	\$393,968	\$680,547	\$7,616,853
18	Clothing	Caps	AWC Logo Cap	\$3,680	\$8,290	\$9,413	\$9,283	\$3,105	\$5,432	\$1,347	\$9,795	\$7,007	\$8,569	\$8,618	\$9,006	\$83,545
19	Clothing	Gloves	Half-Finger Gloves, S	\$2,285	\$1,683	\$4,188	\$6,117	\$7,755	\$2,753	\$4,508	\$9,232	\$4,766	\$4,126	\$8,463	\$6,564	\$62,440
20	Clothing	Jerseys	Long-Sleeve Logo Jersey, S	\$4,548	\$9,842	\$2,196	\$9,554	\$1,180	\$2,040	\$4,850	\$3,260	\$9,024	\$2,166	\$3,899	\$3,567	\$56,126
21	Clothing	Shorts	Men's Sports Shorts, S	\$5,009	\$571	\$9,273	\$8,290	\$1,560	\$4,885	\$1,847	\$1,585	\$2,255	\$1,103	\$7,578	\$703	\$44,658
22	Clothing	Socks	Mountain Bike Socks, M	\$9,089	\$1,542	\$8,855	\$4,386	\$3,626	\$2,275	\$5,820	\$8,002	\$1,551	\$5,842	\$8,635	\$6,443	\$66,066
23	Clothing	Vests	Classic Vest, S	\$2,921	\$8,886	\$2,744	\$5,151	\$6,130	\$8,495	\$6,458	\$5,937	\$9,116	\$8,671	\$3,246	\$1,440	\$69,195
24	SubTotal Clothing			\$27,531	\$30,814	\$36,669	\$42,781	\$23,356	\$25,880	\$24,830	\$37,811	\$33,719	\$30,477	\$40,439	\$27,723	\$382,030
25	Grand Total			\$817,464	\$589,770	\$710,559	\$849,763	\$911,794	\$560,488	\$847,730	\$830,945	\$925,456	\$827,236	\$557,485	\$790,547	\$9,219,237



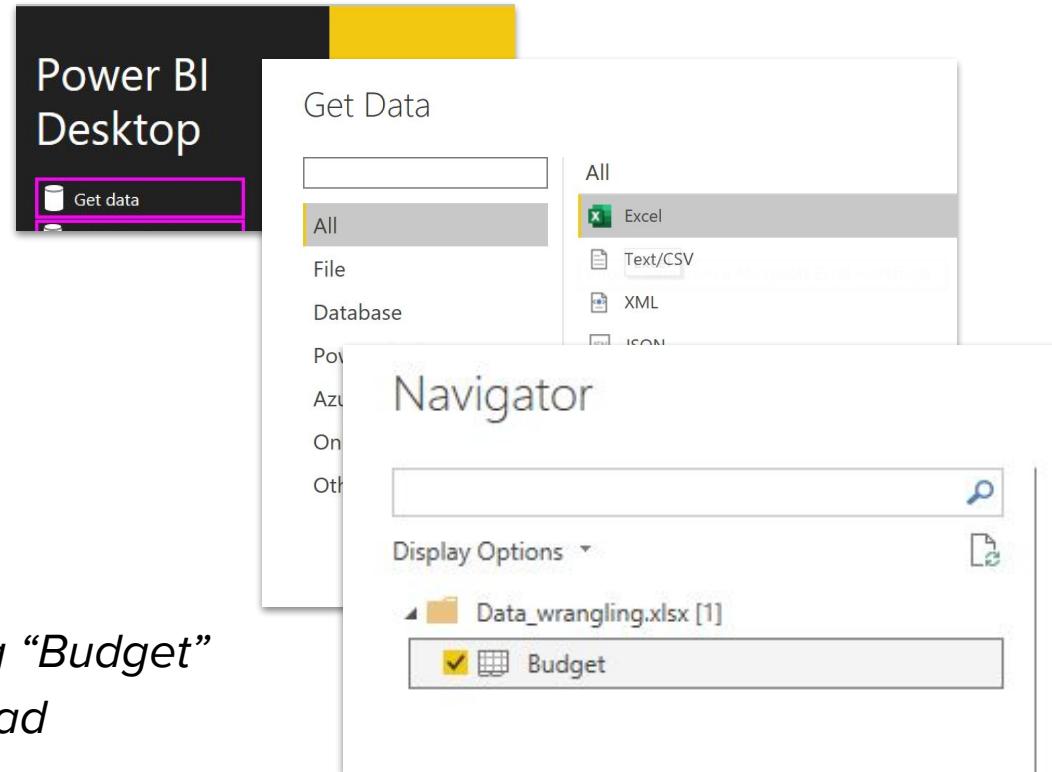
Guided Walk-Through:

Loading Data from Spreadsheets

Let's create a new query!

- From the startup menu, click **Get Data → Excel**
- Find **Data_Wrangling.xlsx** and click open
- In the **Navigator** pane, select sheet **Budget**

DO NOT click **Load** after selecting “Budget”
click **Transform Data** instead





Solo Exercise:

Cleaning Spreadsheet Data

5 minutes



Review the table and consider what issues would you face if you were to load the data as is?

Share your observations in the chat!

Untitled - Power Query Editor

File Home Transform Add Column View Tools Help

Close & Apply New Source Recent Sources Enter Data Data source settings Manage Parameters Refresh Preview Advanced Editor Properties Choose Columns Remove Columns Keep Rows Remove Rows Sort Split Column Group By Replace Values Data Type: Any Use First Row as Headers Combine

Queries [1]

Budget

	AdventureWorks Budget Data	Column2	Column3	ABC 123 Column4	ABC 123 Column5	ABC 123
1	Prepared By: BI Maverick		null	null	null	null
2	AdventureWorks Confidential		null	null	null	null
3	Category	Subcategory	ProductName	Jan, 2016	Feb, 2016	
4	Accessories	Bike Racks	Hitch Rack - 4-Bike	17699	14275	
5	Accessories	Bike Stands	All-Purpose Bike Stand	18292	8835	
6	Accessories	Bottles and Cages	Water Bottle - 30 oz.	21175	2062	
7	Accessories	Cleaners	Bike Wash - Dissolver	9012	21608	
8	Accessories	Fenders	Fender Set - Mountain	12052	20176	
9	Accessories	Helmets	Sport-100 Helmet, Red	7183	14244	
10	Accessories	Hydration Packs	Hydration Pack - 70 oz.	22782	18833	
11	Accessories	Tires and Tubes	Patch Kit/8 Patches	16659	22140	
12	SubTotal Accessories		null	124854	122173	
13	Bikes	Mountain Bikes	Mountain-100 Silver, 38	271886	141318	
14	Bikes	Road Bikes	Road-150 Red, 62	138803	191146	
15	Bikes	Touring Bikes	Touring-2000 Blue, 60	254390	104319	
16	SubTotal Bikes		null	665079	436783	
17	Clothing	Caps	AWC Logo Cap	3680	8290	
18	Clothing	Gloves	Half-Finger Gloves, S	2285	1683	
19	Clothing	Jerseys	Long-Sleeve Logo Jersey, S	4548	9842	
20	Clothing	Shorts	Men's Sports Shorts, S	5008	571	
21	Clothing	Socks	Mountain Bike Socks, M	9089	1542	
22	Clothing	Vests	Classic Vest, S	2921	8886	
23	SubTotal Clothing		null	27531	30814	
24	Grand Total		null	817464	589770	

16 COLUMNS, 24 ROWS Column profiling based on top 1000 rows PREVIEW DOWNLOADED AT 1:16 PM





Solo Exercise:

Cleaning Spreadsheet Data

desired column
headers

	Column2	Column3	Column4	Column5
1	Prepared By: BI Maverick	null	null	null
2	AdventureWorks Confidential	null	null	null
3	Category	Subcategory	ProductName	Jan, 2016
4	Accessories	Bike Racks	Hitch Rack - 4-BIKE	17699
5	Accessories	Bike Stands	All-Purpose Bike Stand	18292
6	Accessories	Bottles and Cages	Water Bottle - 30 oz.	21175
7	Accessories	Cleaners	Bike Wash - Dissolver	9012
8	Accessories	Fenders	Fender Set - Mountain	12052
9	Accessories	Helmets	Sport-100 Helmet, Red	7183
10	Accessories	Hydration Packs	Hydration Pack - 70 oz.	2278
11	Accessories	Tires and Tubes	Patch Kit/8 Patches	16659
12	SubTotal Accessories	null	null	124854
13	Bikes	Mountain Bikes	Mountain-100 Silver, 38	271810
14	Bikes	Road Bikes	Road-150 Red, 62	138803
15	Bikes	Touring Bikes	Touring-2000 Blue, 60	254390
16	SubTotal Bikes	null	null	665079
17	Clothing	Caps	AWC Logo Cap	3680
18	Clothing	Gloves	Half-Finger Gloves, S	1683
19	Clothing	Jerseys	Long-Sleeve Logo Jersey, S	9842
20	Clothing	Shorts	Men's Sports Shorts, S	5008
21	Clothing	Socks	Mountain Bike Socks, M	9089
22	Clothing	Vests	Classic Vest, S	2921
23	SubTotal Clothing	null	null	27531
24	Grand Total	null	null	817464

unwanted rows

Deep Dive: The Query Editor

Guided Walkthrough: The Query Editor Interface



The Power Query Editor

Can connect to a variety of local and remote data sources

Add as many queries as needed for the report

The screenshot shows the Microsoft Power Query Editor interface. The top navigation bar includes File, Home, Transform, Add Column, View, Tools, and Help. The Home tab is selected. Below the ribbon is a toolbar with icons for Close & Apply, New Source, Recent Sources, Enter Data, Data source settings, Manage Parameters, Refresh, Advanced Editor, Properties, and a preview pane. The main area is divided into three sections: Queries [5], Data Preview, and Query Settings.

Queries [5]: A tree view showing five groups of queries:

- AppendMerge [2]: Contains Append1 and Merge1.
- Other Queries [3]: Contains Budget, Person Address, and Person StateProvince.

Data Preview: Shows a table with 17 rows and 5 columns. The columns are Category, Subcategory, ProductName, Month, and Value. The data is as follows:

	Category	Subcategory	ProductName	Month	Value
1	Accessories	Bike Racks	Hitch Rack - 4-Bike	1/1/2016	
2	Accessories	Bike Racks	Hitch Rack - 4-Bike	2/1/2016	
3	Accessories	Bike Racks	Hitch Rack - 4-Bike	3/1/2016	
4	Accessories	Bike Racks	Hitch Rack - 4-Bike	4/1/2016	
5	Accessories	Bike Racks	Hitch Rack - 4-Bike	5/1/2016	
6	Accessories	Bike Racks	Hitch Rack - 4-Bike	6/1/2016	
7	Accessories	Bike Racks	Hitch Rack - 4-Bike	7/1/2016	
8	Accessories	Bike Racks	Hitch Rack - 4-Bike	8/1/2016	
9	Accessories	Bike Racks	Hitch Rack - 4-Bike	9/1/2016	
10	Accessories	Bike Racks	Hitch Rack - 4-Bike	10/1/2016	
11	Accessories	Bike Racks	Hitch Rack - 4-Bike	11/1/2016	
12	Accessories	Bike Racks	Hitch Rack - 4-Bike	12/1/2016	
13	Accessories	Bike Stands	All-Purpose Bike Stand	1/1/2016	
14	Accessories	Bike Stands	All-Purpose Bike Stand	2/1/2016	
15	Accessories	Bike Stands	All-Purpose Bike Stand	3/1/2016	
16	Accessories	Bike Stands	All-Purpose Bike Stand	4/1/2016	
17	Accessories	Bike Stands	All-Purpose Bike Stand	5/1/2016	

Query Settings: On the right, there are sections for Properties (Name: Budget) and Applied Steps (Source, Navigation, Removed Top Rows, Promoted Headers, Filtered Rows, Unpivoted Columns, Removed Columns, Changed Type, Renamed Columns).



The Power Query Editor

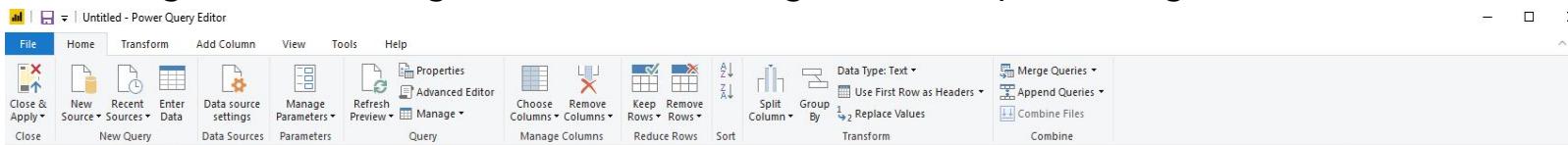
The screenshot shows the Microsoft Power Query Editor window. The ribbon at the top includes File, Home, Transform, Add Column, View, Tools, and Help. The Home tab is selected. The toolbar below has various icons for data source settings, parameters, refresh, properties, and manage. A red box highlights the 'Data source settings' icon. The main area displays a preview of a table with columns: Category, Subcategory, ProductName, Month, and Value. The preview shows 17 rows of data. To the right, the 'Query Settings' pane shows 'Properties' (Name: Budget) and an 'Applied Steps' list. The 'Applied Steps' list, also highlighted with a red box, includes: Source, Navigation, Removed Top Rows, Promoted Headers, Filtered Rows, Unpivoted Columns, Removed Columns, Changed Type, and Renamed Columns. At the bottom, it says 'PREVIEW DOWNLOADED AT 4:19 PM'.

Prepare and clean data as part of the data import without having to alter the source

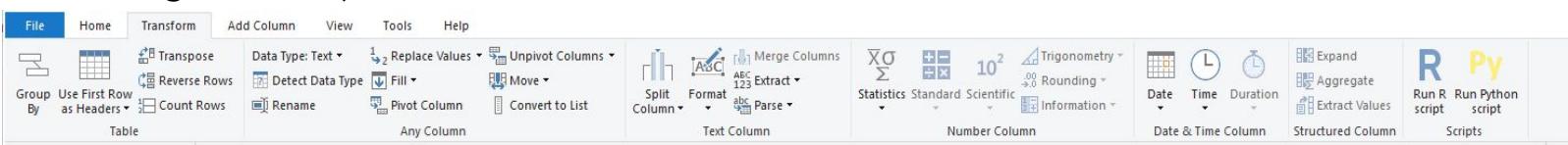
Keep track of every single step and edit them as needed without having to redo tasks

Query Editor Ribbons

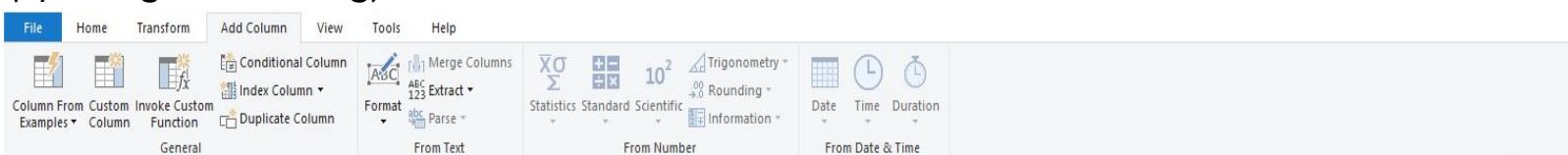
The **HOME** ribbon contains common table transformation tools such as *adding, duplicating, renaming and removing columns, removing rows and promoting header rows*



The **TRANSFORM** ribbon has tools to modify existing columns (*splitting/grouping, transposing, extracting text, etc*)



The **ADD COLUMN** ribbon contains tools to create new columns based on *text operations (splitting, formatting), calculations, statistics, etc.*



Deep Dive: The Query Editor

Guided Walkthrough: Cleaning Data:

- remove unwanted rows
- promote column headers



Guided Walk-Through:

Remove Unwanted Rows - Top Rows

First, think about what we want removed, and what we want as column headers.

1. **delete 3 rows**
2. **promote remaining row**
3. ***we already have a promote row step***

The screenshot shows the Power Query Editor interface with the 'Budget' query selected. The 'Applied Steps' pane on the right shows a 'Promoted Headers' step. The main grid displays data with the first three rows highlighted in red, and the fourth row highlighted in blue. The status bar at the bottom indicates '16 COLUMNS, 24 ROWS' and 'Column profiling based on top 1000 rows'.

	Category	Subcategory	ProductName	Jan, 2
1	Prepared By: BI Maverick		null	null
2	Adventureworks Confidential		null	null
3	Category	Subcategory	ProductName	Jan, 2
4	Accessories	Bike Racks	Hitch Rack - 4-Bike	
5	Accessories	Bike Stands	All-Purpose Bike Stand	
6	Accessories	Bottles and Cages	Water Bottle - 30 oz.	
7	Accessories	Cleaners	Bike Wash - Dissolver	
8	Accessories	Fenders	Fender Set - Mountain	
9	Accessories	Helmets	Sport-100 Helmet, Red	
10	Accessories	Hydration Packs	Hydration Pack - 70 oz.	
11	Accessories	Tubes and Tubes	Patch Kit/8 Patches	
12	SubTotal Accessories		null	null
13	Bikes	Mountain Bikes	Mountain-100 Silver, 38	
14	Bikes	Road Bikes	Road-150 Red, 62	
15				

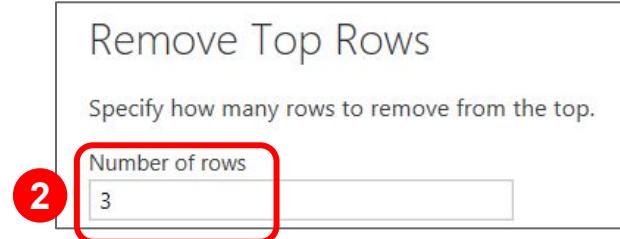
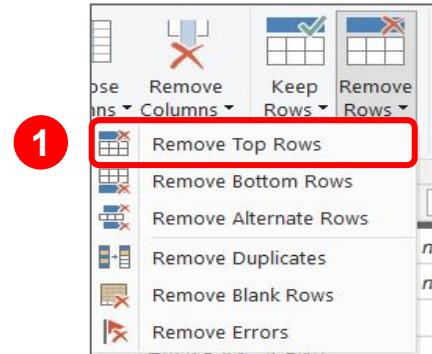


Guided Walk-Through:

Remove Unwanted Rows - Top Rows

Follow these steps in order - they'll make sense at the end.

1. Remove the top 3 rows



RESULT

This is not what we want yet, but we can fix it by changing APPLIED STEPS

The screenshot shows the Power Query Editor with the 'Budget' query selected. The first three rows have been removed, leaving 15 rows of data. The 'APPLIED STEPS' section on the right shows a step named 'Removed Top Rows'.

	A ^B Column1	A ^B Column2	A ^B Column3
1	Accessories	Bike Racks	Hitch Rack - 4-Bike
2	Accessories	Bike Stands	All-Purpose Bike Stand
3	Accessories	Bottles and Cages	Water Bottle - 30 oz.
4	Accessories	Cleaners	Bike Wash - Dissolver
5	Accessories	Fenders	Fender Set - Mountain
6	Accessories	Helmets	Sport-100 Helmet, Red
7	Accessories	Hydration Packs	Hydration Pack - 70 oz.
8	Accessories	Tires and Tubes	Patch Kit/8 Patches
9	SubTotal Accessories		null
10	Bikes	Mountain Bikes	Mountain-100 Silver, 38
11	Bikes	Road Bikes	Road-150 Red, 62
12	Bikes	Touring Bikes	Touring-2000 Blue, 60
13	SubTotal Bikes		null
14	Clothing	Caps	AWC Logo Cap
15			



Guided Walk-Through:

Remove Unwanted Rows - Top Rows

2. In **APPLIED STEPS**, click and drag Removed Top Rows **above** Promoted Headers

RESULT

Columns are now unnamed, and Row 1 contains headers

The screenshot shows the Power Query Editor interface with the following details:

- File** | Home | Transform | Add Column | View | Tools | Help
- Queries [1]
- Column Headers: ABC 123 Column1, ABC 123 Column2, ABC 123 Column3, ABC 123 Column4
- Data:

	Category	Subcategory	ProductName	Jan, 2016
1	Category	Subcategory	ProductName	Jan, 2016
2	Accessories	Bike Racks	Hitch Rack - 4-Bike	
3	Accessories	Bike Stands	All-Purpose Bike Stand	
4	Accessories	Bottles and Cages	Water Bottle - 30 oz.	
5	Accessories	Cleaners	Bike Wash - Dissolver	
6	Accessories	Fenders	Fender Set - Mountain	
7	Accessories	Helmets	Sport-100 Helmet, Red	
8	Accessories	Hydration Packs	Hydration Pack - 70 oz.	
9	Accessories	Tires and Tubes	Patch Kit/8 Patches	
10	SubTotal Accessories		null	null
11	Bikes	Mountain Bikes	Mountain-100 Silver, 38	
12	Bikes	Road Bikes	Road-150 Red, 62	
13	Bikes	Touring Bikes	Touring-2000 Blue, 60	
14	SubTotal Bikes		null	null
15				
- Transform ribbon: Close & Apply, New Source, Recent Sources, Enter Data, Data source settings, Manage Parameters, Refresh, Advanced Editor, Properties, Choose Columns, Remove Columns, Keep Rows, Remove Rows, Reduce Rows, Sort, Split Column, Group By, Replace Values, Use First Row as Headers, Combine.
- Query Settings pane: Name (Budget), All Properties.
- Applied Steps pane:
 - Removed Top Rows (highlighted with a red box and a red arrow pointing to it from the text above).
 - Promoted Headers
 - Changed Type
- Bottom status bar: 16 COLUMNS, 22 ROWS, Column profiling based on top 1000 rows.
- Bottom right: PREVIEW DOWNLOADED AT 7:11 PM.
- Bottom right corner: GA logo.



Guided Walk-Through:

Promote Column Headers (reuse existing step)

3. In **APPLIED STEPS**, click on Promoted Headers to perform this step

RESULT

Columns now contain the correct headers

The screenshot shows the Power Query Editor interface with the following details:

- File** tab is selected.
- Queries [1]** pane shows a single query named "Budget".
- Transform** ribbon tab is selected.
- APPLIED STEPS** pane on the right lists:
 - Source
 - Navigation
 - Removed Top Rows
 - Promoted Headers** (highlighted with a red box and a red arrow pointing to it with the text "click here")
 - Changed Type
- Preview** pane shows the data with the first row promoted to headers:

ABC 123	Category	ABC 123	Subcategory	ABC 123	ProductName	ABC 123	Jan, 2016
1	Accessories	Bike Racks	Hitch Rack - 4-Bike				
2	Accessories	Bike Stands	All-Purpose Bike Stand				
3	Accessories	Bottles and Cages	Water Bottle - 30 oz.				
4	Accessories	Cleaners	Bike Wash - Dissolver				
5	Accessories	Fenders	Fender Set - Mountain				
6	Accessories	Helmets	Sport-100 Helmet, Red				
7	Accessories	Hydration Packs	Hydration Pack - 70 oz.				
8	Accessories	Tires and Tubes	Patch Kit/8 Patches				
9	SubTotal Accessories			null		null	
10	Bikes	Mountain Bikes	Mountain-100 Silver, 38				
11	Bikes	Road Bikes	Road-150 Red, 62				
12	Bikes	Touring Bikes	Touring-2000 Blue, 60				
13	SubTotal Bikes			null		null	
14	Clothing	Caps	AWC Logo Cap				
15							
- Bottom status bar: 16 COLUMNS, 21 ROWS, Column profiling based on top 1000 rows, PREVIEW DOWNLOADED AT 7:11 PM.



Guided Walk-Through:

Delete Unwanted Steps

4. In **APPLIED STEPS**, click on Changed Type.

What happened? Click the X to remove this step.

The screenshot shows the Power Query Editor interface with the following details:

- File, Home, Transform, Add Column, View, Tools, Help** tabs are visible at the top.
- Queries [1]** pane on the left shows a single query named **Budget**.
- Table View** pane displays data with columns: Category, Subcategory, ProductName, and Jan, 2016.
- Query Settings** pane on the right shows properties for the query, including Name (Budget) and All Properties.
- APPLIED STEPS** pane on the right lists steps:
 - Source
 - Navigation
 - Removed Top Rows
 - Promoted Headers
 - Changed Type** (highlighted with a red arrow and the text "click here")
- Bottom status bar: 16 COLUMNS, 21 ROWS, Column profiling based on top 1000 rows, PREVIEW DOWNLOADED AT 7:11 PM.

Deep Dive: The Query Editor

Guided Walkthrough: Cleaning Data:

- filter rows
- detect data type



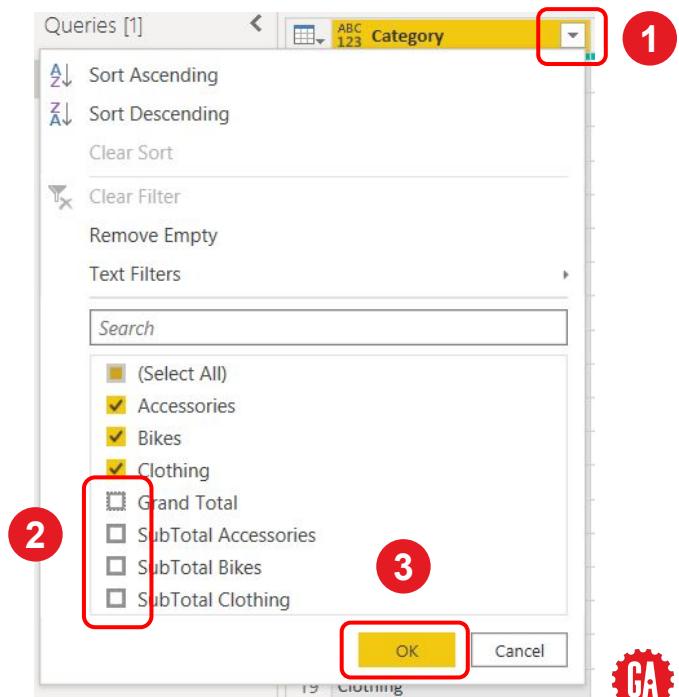
Guided Walk-Through:

Remove Unwanted Rows - Filter Rows

To remove rows in the middle of a table we have a couple of options.

OPTION A: Select all the rows we want filtered:

1. In the Categories column header click the down-arrow to open the filter menu
2. deselect unwanted values
3. hit OK





Guided Walk-Through:

Remove Unwanted Rows - Filter Rows

To remove rows in the middle of a table we have a couple of options.

OPTION B: Filter by a specific property:

1. Open the filter menu
 2. Click *Text Filters*
 3. Click *Does Not Contain*
 4. Type Total
 5. Hit OK

Queries [1] < ABC 123 Category

A Sort Ascending
Z Sort Descending
Clear Sort
Clear Filter
Remove Empty
Text Filters 2

Search

(Select All)
 Accessories
 Bikes
 Clothing
 Grand Total
 SubTotal Accessories
 SubTotal Bikes
 SubTotal Clothing

ABC 123 Category

Bike Racks
Bike Stands
Bottles and Cages
Cleaners
Fenders
Helmets

1

Equals...
Does Not Equal...
Begins With...
Does Not Begin With...
Ends With...
Does Not End With...
Contains...
Does Not Contain... 3

Shorts
Socks
Vests

OK Cancel



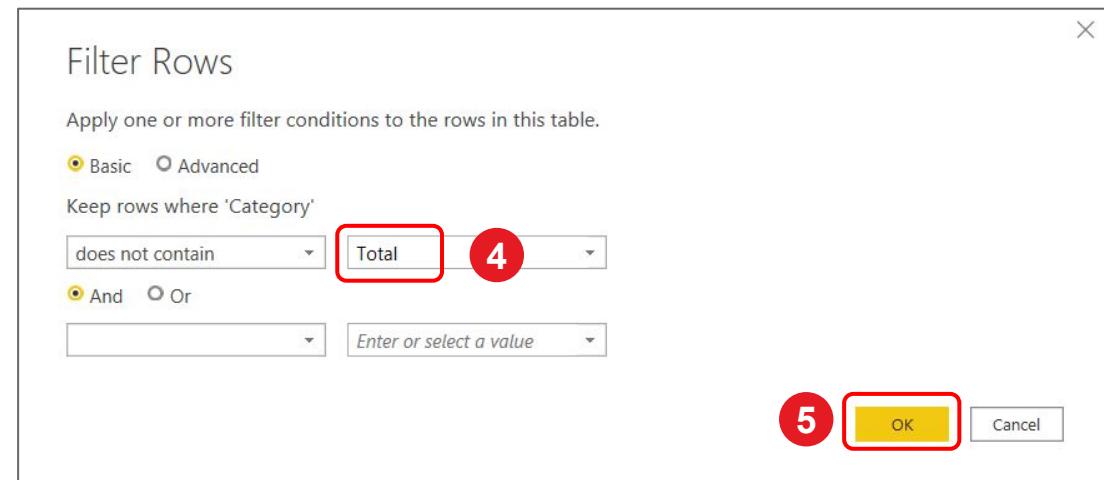
Guided Walk-Through:

Remove Unwanted Rows - Filter Rows

To remove rows in the middle of a table we have a couple of options.

OPTION B: Filter by a specific property:

1. Open the filter menu
2. Click *Text Filters*
3. Click *Does Not Contain*
4. Type Total
5. Hit OK





Guided Walk-Through:

Cleaning Data - Detect Data Type

A good next step is to use **Detect Data Type** to change columns from "All" to "Text", "Whole Number", etc.

1. Open the Transform ribbon and select all columns
2. Click *Detect Data Type*

Notice how the columns have changed.

Category	Subcategory	ProductName	Date
Accessories	Bike Racks	Hitch Rack - 4-Bike	1769
Accessories	Bike Stands	All-Purpose Bike Stand	1829
Accessories	Bottles and Cages	Water Bottle - 30 oz.	2117
Accessories	Cleaners	Bike Wash - Dissolver	901
Accessories	Fenders	Fender Set - Mountain	1205
Accessories	Helmets	Sport-100 Helmet, Red	718
Accessories	Hydration Packs	Hydration Pack - 70 oz.	2278
Accessories	Tires and Tubes	Patch Kit/8 Patches	1665
Bikes	Mountain Bikes	Mountain-100 Silver, 38	27188
Bikes	Road Bikes	Road-150 Red, 62	13880
Bikes	Touring Bikes	Touring-2000 Blue, 60	25439
Clothing	Caps	AWC Logo Cap	368

Deep Dive: The Query Editor

Guided Walkthrough: Reshaping Data:

- pivot / unpivot



Solo Exercise:

Are We Done?

This is what the resulting data should look like. ...so we're done, right???
Unfortunately not.

Can you say why **importing data in the current format might be problematic?**

	Category	Subcategory	ProductName	Jan, 2016	Feb, 2016	Mar, 2016
1	Accessories	Bike Racks	Hitch Rack - 4-Bike	17699	14275	9009
2	Accessories	Bike Stands	All-Purpose Bike Stand	18292	8835	6050
3	Accessories	Bottles and Cages	Water Bottle - 30 oz.	21175	2062	8851
4	Accessories	Cleaners	Bike Wash - Dissolver	9012	21608	9810
5	Accessories	Fenders	Fender Set - Mountain	12052	20176	5522
6	Accessories	Helmets	Sport-100 Helmet, Red	7183	14244	6218
7	Accessories	Hydration Packs	Hydration Pack - 70 oz.	22782	18833	2949
8	Accessories	Tires and Tubes	Patch Kit/8 Patches	16659	22140	4488
9	Bikes	Mountain Bikes	Mountain-100 Silver, 38	271886	141318	175939
10	Bikes	Road Bikes	Road-150 Red, 62	138803	191146	196255



Solo Exercise:

Are We Done?

Right now **each month has its own column**.

It would be better to have a "Month" column and a "Value" Column.

We can get there by **Unpivoting Columns**

	Category	Subcategory	ProductName	Jan, 2016	Feb, 2016	Mar, 2016
1	Accessories	Bike Racks	Hitch Rack - 4-Bike	17699	14275	9009
2	Accessories	Bike Stands	All-Purpose Bike Stand	18292	8835	6050
3	Accessories	Bottles and Cages	Water Bottle - 30 oz.	21175	2062	8851
4	Accessories	Cleaners	Bike Wash - Dissolver	9012	21608	9810
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8	Accessories	Tires and Tubes	Patch Kit/8 Patches	16659	22140	4488
9	Bikes	Mountain Bikes	Mountain-100 Silver, 38	271886	141318	175939
10	Bikes	Road Bikes	Road-150 Red, 62	138803	191146	196255



Guided Walk-Through:

Reshaping Data - Unpivoting Columns

First we want to select the columns to unpivot.

Select all the date columns, but **not** the Grand Total column.

Then click **Unpivot Columns**

The screenshot shows the Power BI ribbon with the 'Transform' tab selected. The 'Unpivot Columns' button in the 'Text Column' group is highlighted with a red box. Below the ribbon is a table named 'Budget' with six rows of data. The columns are labeled 'Sep, 2016', 'Oct, 2016', 'Nov, 2016', 'Dec, 2016', and 'Grand Total'. The data shows monthly values for six categories.

	Sep, 2016	Oct, 2016	Nov, 2016	Dec, 2016	Grand Total
1	647	2955	3940	14520	8365
2	563	17170	6793	15519	4531
3	420	10409	23585	16316	16134
4	334	7761	3418	5054	7995
5	147	3626	14541	21256	13289
6	626	5456	15139	14960	9628



Guided Walk-Through:

Reshaping Data - Unpivoting Columns

The result should look like this:

Screenshot of the Power BI Transform ribbon showing the 'Unpivot Columns' tool selected.

The data table displays a list of products categorized by Category, Subcategory, and ProductName, grouped by Month and Year, with corresponding Grand Total values.

	Category	Subcategory	ProductName	Grand Total	Attribute	Value
1	Accessories	Bike Racks	Hitch Rack - 4-Bike	127522	Jan, 2016	17699
2	Accessories	Bike Racks	Hitch Rack - 4-Bike	127522	Feb, 2016	14275
3	Accessories	Bike Racks	Hitch Rack - 4-Bike	127522	Mar, 2016	9009
4	Accessories	Bike Racks	Hitch Rack - 4-Bike	127522	Apr, 2016	4313
5	Accessories	Bike Racks	Hitch Rack - 4-Bike	127522	May, 2016	18498
6	Accessories	Bike Racks	Hitch Rack - 4-Bike	127522	Jun, 2016	14601
7	Accessories	Bike Racks	Hitch Rack - 4-Bike	127522	Jul, 2016	7700
8	Accessories	Bike Racks	Hitch Rack - 4-Bike	127522	Aug, 2016	11647
9	Accessories	Bike Racks	Hitch Rack - 4-Bike	127522	Sep, 2016	2955
10	Accessories	Bike Racks	Hitch Rack - 4-Bike	127522	Oct, 2016	3940
11	Accessories	Bike Racks	Hitch Rack - 4-Bike	127522	Nov, 2016	14520
12	Accessories	Bike Racks	Hitch Rack - 4-Bike	127522	Dec, 2016	8365
13	Accessories	Bike Stands	All-Purpose Bike Stand	172727	Jan, 2016	18292
14	Accessories	Bike Stands	All-Purpose Bike Stand	172727	Feb, 2016	8835
	All Products	All Products	All Products	122727	All Products	6020

M Query Language

Well done! Without even knowing it you've been using the M query language!

All the APPLIED STEPS are recorded in M.

You can see it in the **Advanced Editor**.

The screenshot shows the Power Query Editor interface. The main window is titled "Advanced Editor" and contains the M code for a query named "Budget". The code is highlighted with a pink rectangle. To the right of the editor is the "Applied Steps" pane, which also has a pink rectangle around it. The pane lists several steps: Source, Navigation, Removed Top Rows, Promoted Headers, Filtered Rows, Removed Columns, Unpivoted Columns, Changed Type, and Renamed Columns. The "Renamed Columns" step is currently selected. A pink arrow points from the bottom of the "Applied Steps" pane towards the "Renamed Columns" step. The top menu bar of the Power Query Editor is visible, showing various options like Add Column, View, Tools, and Help. The "Advanced Editor" button in the toolbar is also highlighted with a pink rectangle.

```
let
    Source = Excel.Workbook(File.Contents("C:\Users\debum\OneDrive\Desktop\Power BI Datasets\Lesson 2 data\Data_wrangling.xlsx"), null, true),
    Budget_Sheet = Source[[Item="Budget", Kind="Sheet"]][Data],
    #"Removed Top Rows" = Table.Skip(Budget_Sheet, 3),
    #"Promoted Headers" = Table.PromoteHeaders(#"Removed Top Rows", [PromoteAllScalars=true]),
    #"Filtered Rows" = Table.SelectRows(#"Promoted Headers", each not Text.Contains([Category], "Total")),
    #"Removed Columns" = Table.RemoveColumns(#"Filtered Rows", {"Grand Total"}),
    #"Unpivoted Columns" = Table.UnpivotOtherColumns(#"Removed Columns", {"Category", "Subcategory", "ProductName"}, "Attribute", "Value"),
    #"Changed Type" = Table.TransformColumnTypes(#"Unpivoted Columns", {{"Category", type text}, {"Subcategory", type text}, {"ProductName", type text}, {"Attribute", type text}, {"Value", type number}},
    in
    #"Renamed Columns"
```



Guided Walk-Through:

Cleaning Data - Final Steps

Let's do some housekeeping.

1. Remove the Grand Total column
2. Set the Attribute column type to Date
3. Change the Attribute column name to Month

We're done!

Hit
Close &
Apply

The screenshot shows the Power BI desktop interface with the 'Budget' query editor open. The 'File' tab is highlighted with a yellow box. Three red circles with numbers 1, 2, and 3 point to specific actions: circle 1 points to the 'Close & Apply' button in the ribbon; circle 2 points to the 'Remove Columns' button in the ribbon; and circle 3 points to the 'Month' column header in the table. To the right, the 'APPLIED STEPS' pane lists several steps, with 'Renamed Columns' highlighted in yellow. A blue circle highlights the 'APPLIED STEPS' pane.

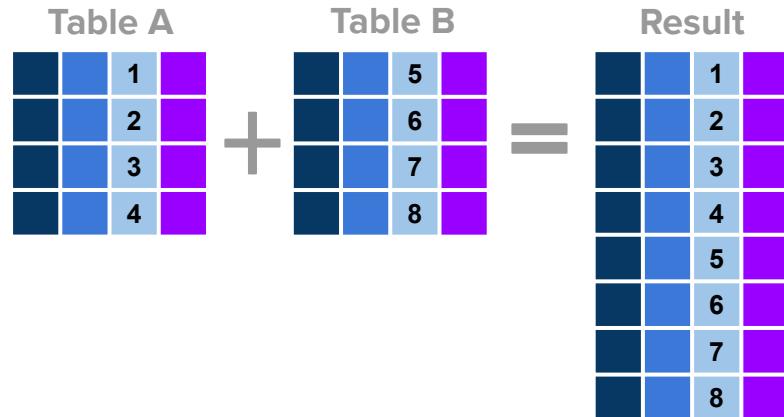
Category	Subcategory	ProductName	Month	Value
Accessories	Bike Racks	Hitch Rack - 4-Bike	1/1/2016	17699
Accessories	Bike Racks	Hitch Rack - 4-Bike	2/1/2016	14275
Accessories	Bike Racks	Hitch Rack - 4-Bike	3/1/2016	9009
Accessories	Bike Racks	Hitch Rack - 4-Bike	4/1/2016	4313
Accessories	Bike Racks	Hitch Rack - 4-Bike	5/1/2016	18498
Accessories	Bike Racks	Hitch Rack - 4-Bike	6/1/2016	14601
Accessories	Bike Racks	Hitch Rack - 4-Bike	7/1/2016	7700
Accessories	Bike Racks	Hitch Rack - 4-Bike	8/1/2016	11647
Accessories	Bike Racks	Hitch Rack - 4-Bike	9/1/2016	2955
Accessories	Bike Racks	Hitch Rack - 4-Bike	10/1/2016	3940
Accessories	Bike Racks	Hitch Rack - 4-Bike	11/1/2016	14520
Accessories	Bike Racks	Hitch Rack - 4-Bike	12/1/2016	8365
Accessories	Bike Stands	All-Purpose Bike Stand	1/1/2016	18292
Accessories	Bike Stands	All-Purpose Bike Stand	2/1/2016	8835
Accessories	Bike Stands	All-Purpose Bike Stand	3/1/2016	6050
Accessories	Bike Stands	All-Purpose Bike Stand	4/1/2016	15615

Deep Dive: The Query Editor

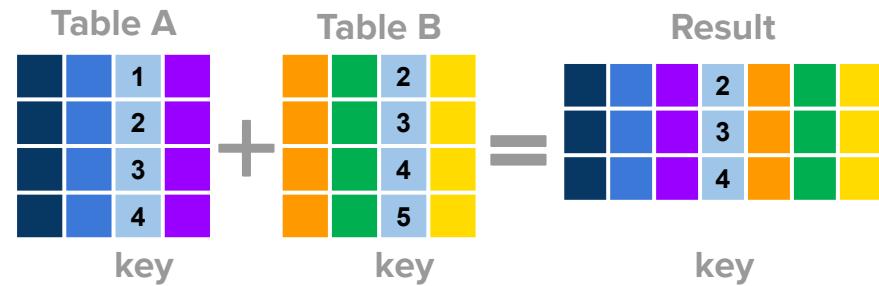
A Quick Review: **UNIONs and JOINS**

Quick Review: SQL UNIONs & JOINS

A **UNION** stacks rows of *similar* data to extend the dataset.

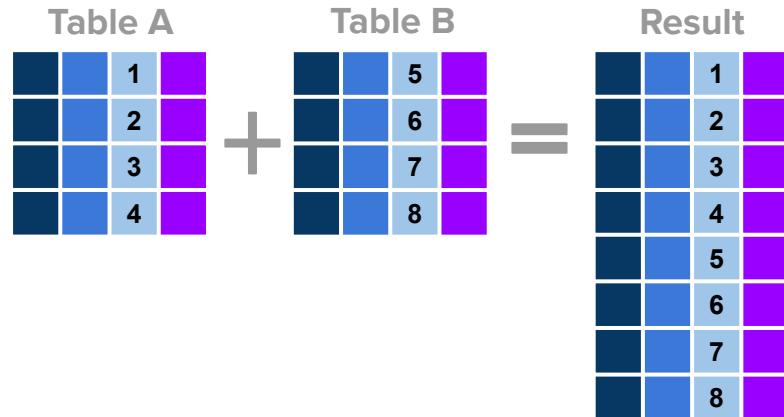


A **JOIN** combines tables using common unique identifiers (keys) to enrich the dataset.

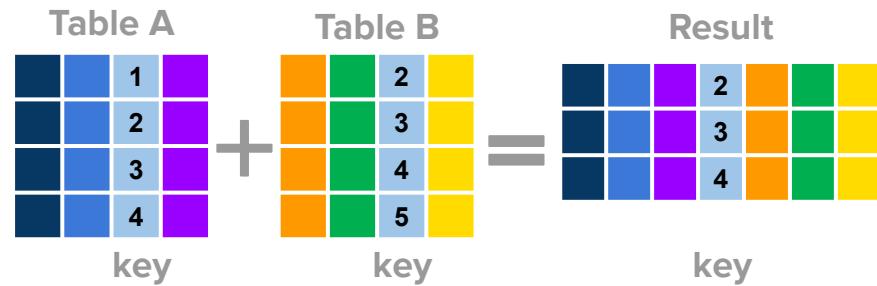


Power BI UNIONs & JOINS

In Power BI this is called
appending queries.

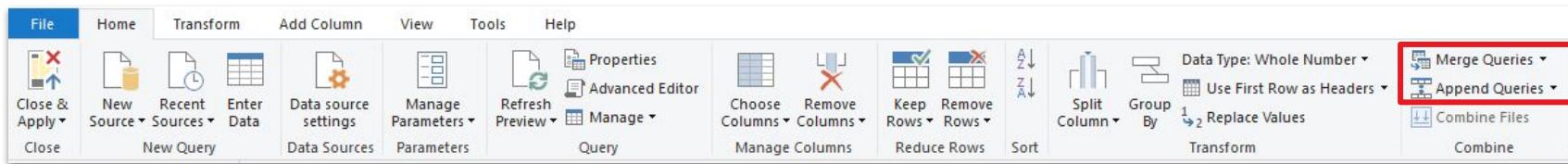


In Power BI this is called
merging queries.



Power BI UNIONs & JOINS

We can perform unions and joins inside Power BI
by **merging** and **appending** queries.



Use these sparingly!

We might get the same result more efficiently with Data Model **table relationships**.

Deep Dive: The Query Editor

Guided Walkthrough: Append Queries

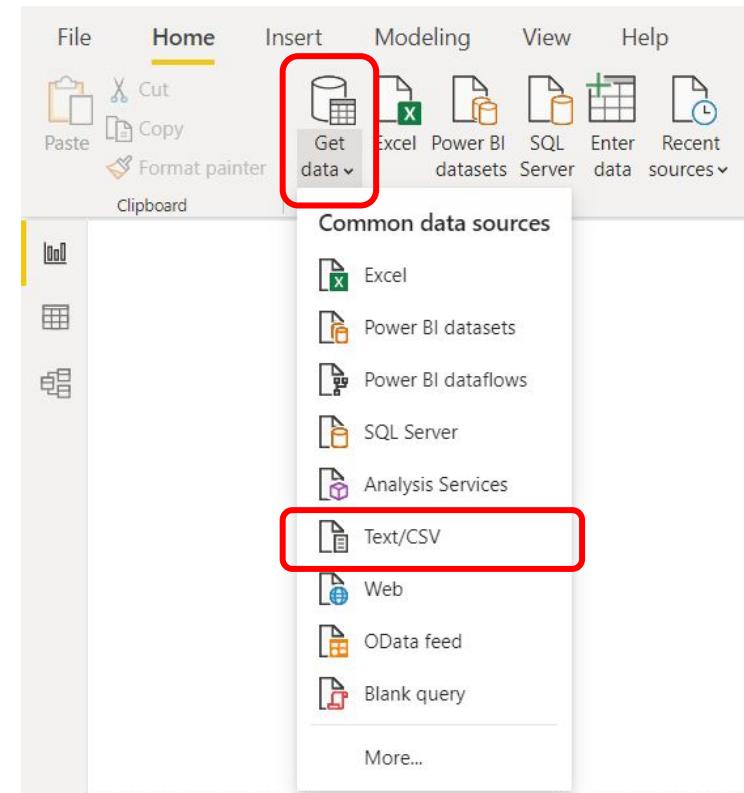




Guided Walk-Through: Query Setup

1. Load **Person.Address.txt** into the Query Editor
2. Remove the **rowguid** and **ModifiedDate** columns

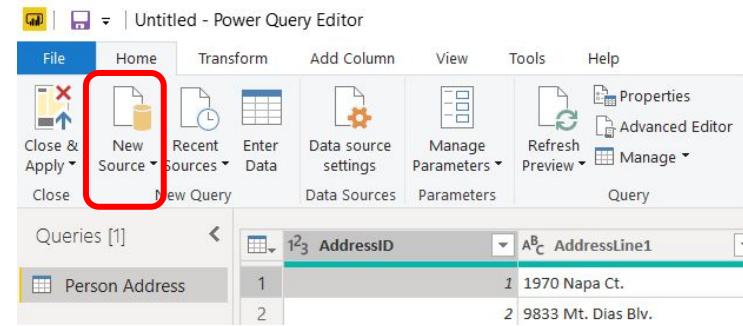
From the Data Model:





Guided Walk-Through: Query Setup

1. Click New Source in the Home ribbon
and load **Person.StateProvince.txt**
2. Remove the **rowguid** and
ModifiedDate columns



The screenshot shows the Microsoft Power Query Editor interface. The ribbon at the top has several tabs: File, Home (which is selected and highlighted in blue), Transform, Add Column, View, Tools, and Help. Under the Home tab, there are several icons: Close & Apply (with a red circle around it), New Source (also with a red circle around it), Recent Sources, Enter Data, Data source settings, Manage Parameters, Refresh Preview, and Manage. Below the ribbon, the 'Queries [1]' section shows a single query named 'Person Address'. The data preview pane shows two rows of data with columns 'AddressID' and 'AddressLine1'. The first row has AddressID 1 and AddressLine1 '1970 Napa Ct.'. The second row has AddressID 2 and AddressLine1 '9833 Mt. Dias Blv.'



Guided Walk-Through: Append Queries

With **Person.StateProvince** selected, click *Append Queries as New*

The screenshot shows the Power Query Editor interface. The ribbon menu is visible with options like File, Home, Transform, Add Column, View, Tools, and Help. The Home tab is selected. In the center, there's a preview grid showing data from the 'Person StateProvince' query, which contains 181 rows. A red box labeled '1' highlights the 'Person StateProvince...' query in the 'Queries [2]' list. A blue box labeled '181 rows' points to the row count in the bottom left of the preview grid. A blue oval encircles the bottom-left corner of the preview grid. On the right side, the 'Query Settings' pane is open, showing the 'Name' field set to 'Person StateProvince'. Below it, the 'APPLIED STEPS' pane shows 'Source' and 'Promoted Headers'. The top right of the ribbon has a red box labeled '2' over the 'Append Queries as New' button, which is also highlighted with a red border.

181 rows

1

2

	StateProvinceID	Name
1	1	Alberta
2	2	Alaska
3	3	Alabama
4	4	Arkansas
5	5	American Samoa
6	6	Arizona
7	7	British Columbia
8	8	Bayern
9	9	California



Guided Walk-Through: Append Queries

Enter **Person.StateProvince** in the lower box and hit OK

Append

Concatenate rows from two tables into a single table.

Two tables Three or more tables

Primary table

Person StateProvince

Table to append to the primary table

Person StateProvince

OK Cancel



Guided Walk-Through: Append Queries

Notice we have a new query with twice as many rows.

This resulted in a new table **Append1** that can be used in the data model.

The screenshot shows the Power Query Editor interface. The 'File' tab is selected. In the 'Queries [3]' pane, three queries are listed: 'Person Address', 'Person StateProvin...', and 'Append1'. The 'Append1' query is highlighted with a red box. A blue box labeled '362 rows' points to the bottom-left corner of the preview area. The preview area shows a table with columns 'StateProvinceID' and 'Name'. The data includes rows for Alberta, Alaska, Alabama, Arkansas, American Samoa, Arizona, British Columbia, Bayern, and California. The 'Query Settings' pane on the right shows the 'Name' field set to 'Append1'. The 'Applied Steps' pane shows a single step named 'Source'.

StateProvinceID	Name
1	Alberta
2	Alaska
3	Alabama
4	Arkansas
5	American Samoa
6	Arizona
7	British Columbia
8	Bayern
9	California

Deep Dive: The Query Editor

Guided Walkthrough: Merge Queries





Guided Walk-Through: Merge Queries

In the Home ribbon select **Person Address** and click *Merge Queries as New*

The screenshot shows the Microsoft Power Query Editor interface. The ribbon at the top has 'Home' selected. On the far right of the ribbon, there is a dropdown menu labeled 'Merge Queries' with two options: 'Merge Queries' and 'Merge Queries as New'. A red circle with the number '2' is drawn around the 'Merge Queries as New' option. In the main area, the 'Queries [3]' pane on the left shows three items: 'Person Address' (selected and highlighted with a red box), 'Person StateProv', and 'Append1'. The main table view shows columns for 'AddressID', 'AddressLine1', 'AddressLine2', and 'City', with data for addresses in Bothell. The 'Query Settings' pane on the right shows the query is named 'Person Address'.

AddressID	AddressLine1	AddressLine2	City
1	1970 Napa Ct.		Bothell
2	9833 Mt. Dias Blv.		Bothell
3	7484 Roundtree Drive		Bothell
4	9539 Glenside Dr		Bothell
5	1226 Shoe St.		Bothell
6	1399 Firestone Drive		Bothell
7	5672 Hale Dr.		Bothell
8	6387 Scenic Avenue		Bothell



Guided Walk-Through: Merge Queries

Enter **Person.StateProvince**
in the lower box, select
StateProvinceID in both tables
and hit OK

Merge

Select tables and matching columns to create a merged table.

Person Address

AddressID	AddressLine1	AddressLine2	City	StateProvinceID	PostalCode
1	1970 Napa Ct.		Bothell	79	98011
2	9833 Mt. Dias Blv.		Bothell	79	98011
3	7484 Roundtree Drive		Bothell	79	98011
4	9539 Glenside Dr		Bothell	79	98011
5	1226 Shoe St.		Bothell	79	98011

1 Person StateProvince

StateProvinceID	Name
1	Alberta
2	Alaska
3	Alabama
4	Arkansas
5	American Samoa

2

Join Kind

Left Outer (all from first, matching from second)

Use fuzzy matching to perform the merge

> Fuzzy matching options

✓ The selection matches 19614 of 19614 rows from the first table.

3 OK Cancel



Guided Walk-Through: Merge Queries

Now we can select which columns from **Person.StateProvince** we want merged.
Click the expand button:

The screenshot shows the Power Query Editor interface with the following details:

- File** tab selected.
- Home** tab selected.
- Transform** tab available.
- Add Column**, **View**, **Tools**, and **Help** tabs available.
- Icons**: Close & Apply, New Source, Recent Sources, Enter Data, Data source settings, Manage Parameters, Refresh Preview, Properties, Advanced Editor, Manage, Choose Columns, Remove Columns, Keep Rows, Remove Rows, Sort, Split Column, Group By, Data Type: Whole Number, Use First Row as Headers, Merge Queries, Append Queries, Combine Files, and Combine.
- Queries [4]** pane on the left shows: Person Address, Person StateProvin..., Append1, and Merge1 (selected).
- Table View** pane shows a table with 7 columns and 9 rows. The columns are: City, StateProvinceID, PostalCode, and Person StateProvince. The last column is a table itself. The 9th row has a red box around its expand button.
- Query Settings** pane on the right shows:
 - PROPERTIES**: Name = Merge1.
 - APPLIED STEPS**: Source.
- Bottom Status Bar**: 7 COLUMNS, 999+ ROWS, Column profiling based on top 1000 rows, PREVIEW DOWNLOADED AT 1:41 PM.



Guided Walk-Through: Merge Queries

Clear all but **Name**, uncheck *Use original column name as prefix*, and hit OK

The screenshot shows the Power Query Editor interface with the 'Merge' step selected in the 'Queries [4]' list. The main area displays a preview of the 'City' and 'StateProvinceID' tables joined on the 'City' column. A red box highlights the 'Merge' step in the list.

The 'Transform' ribbon tab is selected. In the 'Transform' group, the 'Merge Queries' button is highlighted.

The 'Merge' dialog box is open on the right side:

- Step 1:** Under 'Search Columns to Expand', the 'Expand' radio button is selected. The 'Name' checkbox is checked (highlighted by a red box). Other options like 'Select All Columns' and 'StateProvinceID' are unchecked.
- Step 2:** The 'Use original column name as prefix' checkbox is unchecked (highlighted by a red box).
- Step 3:** The 'OK' button is highlighted by a red box.

On the far right, the 'Query Settings' pane shows the 'Name' field set to 'Merge1'. The 'APPLIED STEPS' pane shows the 'Source' step.



Guided Walk-Through: Merge Queries

Now we have a **Merge1** query where every address includes a StateProvince Name.

The screenshot shows the Microsoft Power Query Editor interface with the title bar "Untitled - Power Query Editor". The ribbon menu includes File, Home, Transform, Add Column, View, Tools, and Help. The Home tab is selected, showing various icons for file operations like Close & Apply, New Source, Refresh, and Data. The Transform tab is also visible. On the right side, there are buttons for Merge Queries, Append Queries, and Combine Files. The main area displays a table titled "Queries [4]" containing data for "Merge1". The table has columns: City, StateProvinceID, PostalCode, and Name. All rows show "Bothell" in the City column, "79" in the StateProvinceID column, "98011" in the PostalCode column, and "Washington" in the Name column. The "Merge1" query is highlighted in the list. The bottom status bar indicates "7 COLUMNS, 999+ ROWS" and "Column profiling based on top 1000 rows". To the right of the table, the "Query Settings" pane is open, showing "Name: Merge1" under "PROPERTIES" and "Expanded Person StatePro..." under "APPLIED STEPS". A preview message at the bottom right says "PREVIEW DOWNLOADED AT 1:46 PM".

	City	StateProvinceID	PostalCode	Name
1	Bothell	79	98011	Washington
2	Bothell	79	98011	Washington
3	Bothell	79	98011	Washington
4	Bothell	79	98011	Washington
5	Bothell	79	98011	Washington
6	Bothell	79	98011	Washington
7	Bothell	79	98011	Washington
8	Bothell	79	98011	Washington
9				

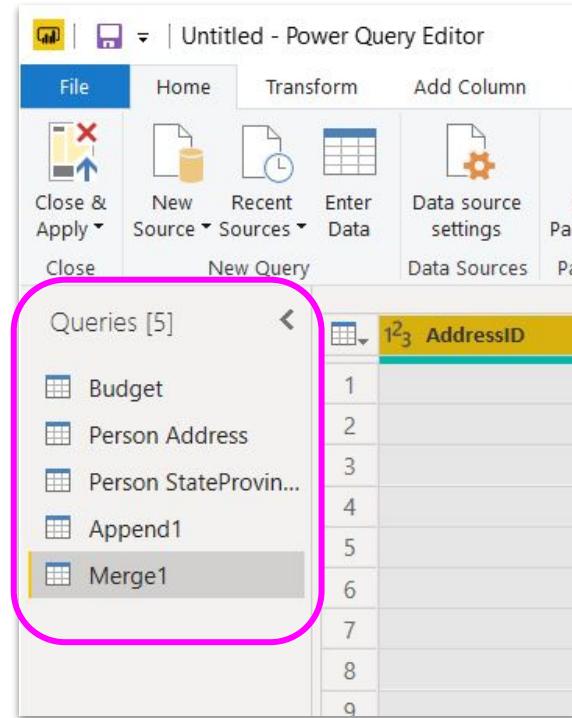
Deep Dive: The Query Editor

Guided Walkthrough: Query Groups



Query Groups

If your query list starts to get messy,
query groups can help organize your queries.



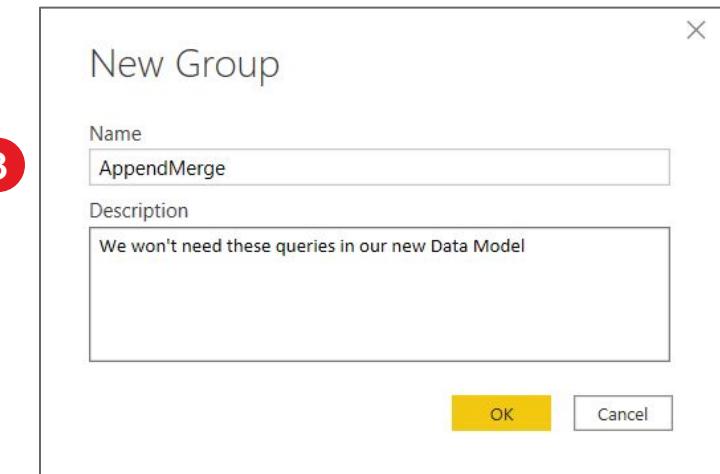


Guided Walk-Through: Query Groups

1. Select the queries to group.
2. Right-click > Move To Group > New Group

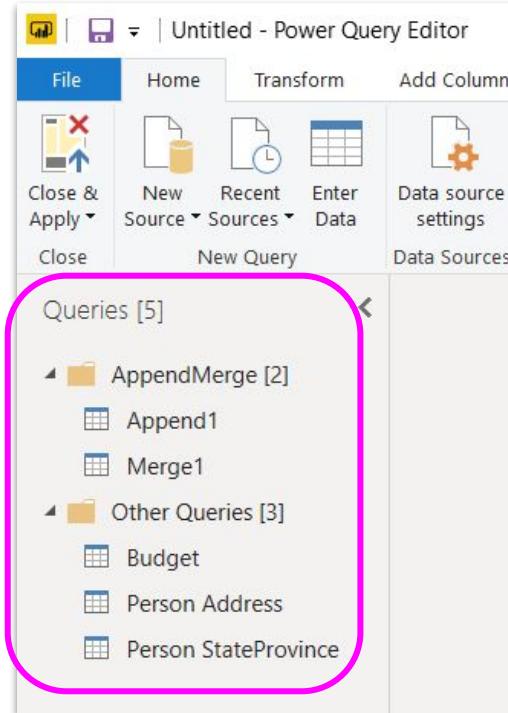
The screenshot shows the Power BI Query Editor interface. On the left, the 'Queries [5]' pane lists five queries: Budget, Person Address, Person StateProv..., Append1, and Merge1. The 'Append1' and 'Merge1' queries are highlighted with a red box and numbered '1'. A context menu is open over these two queries, with the 'Move To Group' option highlighted and numbered '2'. The 'New Group...' option from the same menu is also highlighted with a red box and numbered '2'. On the right, a table preview shows columns 'AddressID' and 'Address' with several rows of data.

3. Name the new group and add a description



Query Groups

- Queries are now grouped into folders.
- We can click & drag queries between groups.
- As we get more advanced, we'll discard query groups that were stepping stones to our desired query.



So Far We've...

- Introduced data modeling
- Loaded a spreadsheet
- Manipulated APPLIED STEPS to clean rows, set column headers
- Reviewed UNIONs and JOINs
- Performed their Power BI counterparts: *append* and *merge*

Up Next...

- Working in the Data Model with *table relationships*
- Performing sophisticated calculations with DAX

Stretch Break



Advanced Analytics

Deep Dive: The Data Model

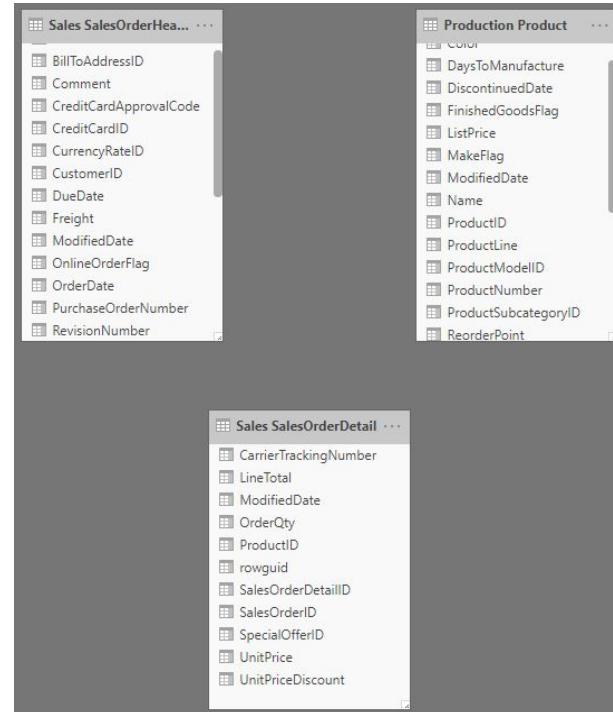


What is a Data Model?

By connecting to data sources,
we gain access to the data.

However, this is not a data *model* as
we don't know how tables interact.

This IS NOT a data model

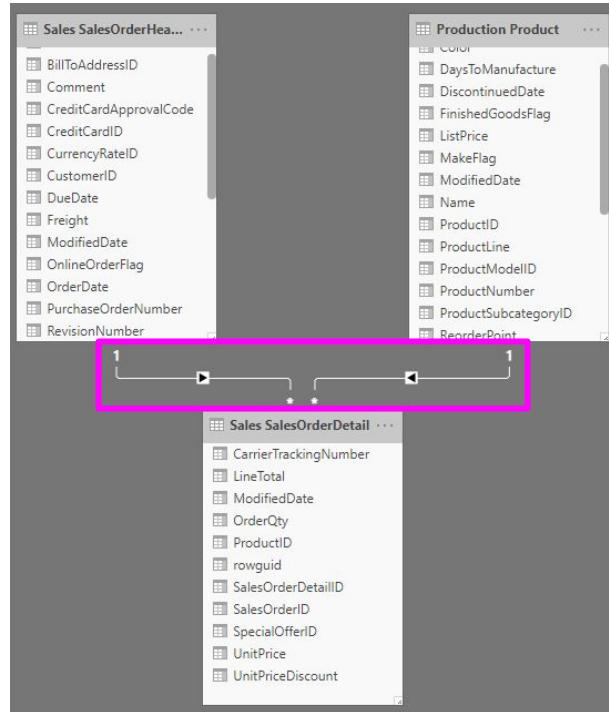


What is a Data Model?

A data model has established **relationships** across the data.

These are shown by the connection lines between the tables.

This **IS** a data model



Relationships in Power BI

Autodetect during load

When loading datasets, Power BI looks at column names to determine if there are any *potential* relationships between tables.

- ✓ If there are, those relationships are created automatically - but it does not mean they are correct. **Always check!**

- ✗ If Power BI Desktop can't determine with a high level of confidence there's a match, it doesn't create the relationship.

Deep Dive: The Data Model

First Steps: Fetch Some Data



Guided Walk-Through:

Load Data Directly Into the Data Model

Load these 3 files:

Production.Product

Sales.SalesOrderDetail

Sales.SalesOrderHeader

The screenshot shows the Microsoft Power BI desktop application's ribbon. The 'Home' tab is selected. In the 'Get data' section of the ribbon, a dropdown menu is open, listing various data sources. The 'Text/CSV' option is highlighted with a red box and the number '1'. At the bottom of the ribbon, there are three buttons: 'Load' (highlighted with a red box and the number '3'), 'Transform Data', and 'Cancel'.

Name
DemoSalesOrderHeader
Person.Address
Person.ContactType
Person.CountryRegion
Person.Person
Person.StateProvince
Production.Product
Production.ProductCategory
Production.ProductSubcategory
Sales.Customer
Sales.SalesOrderDetail
Sales.SalesOrderHeader
Sales.SalesPerson
Sales.SalesTerritory
Sales.Store

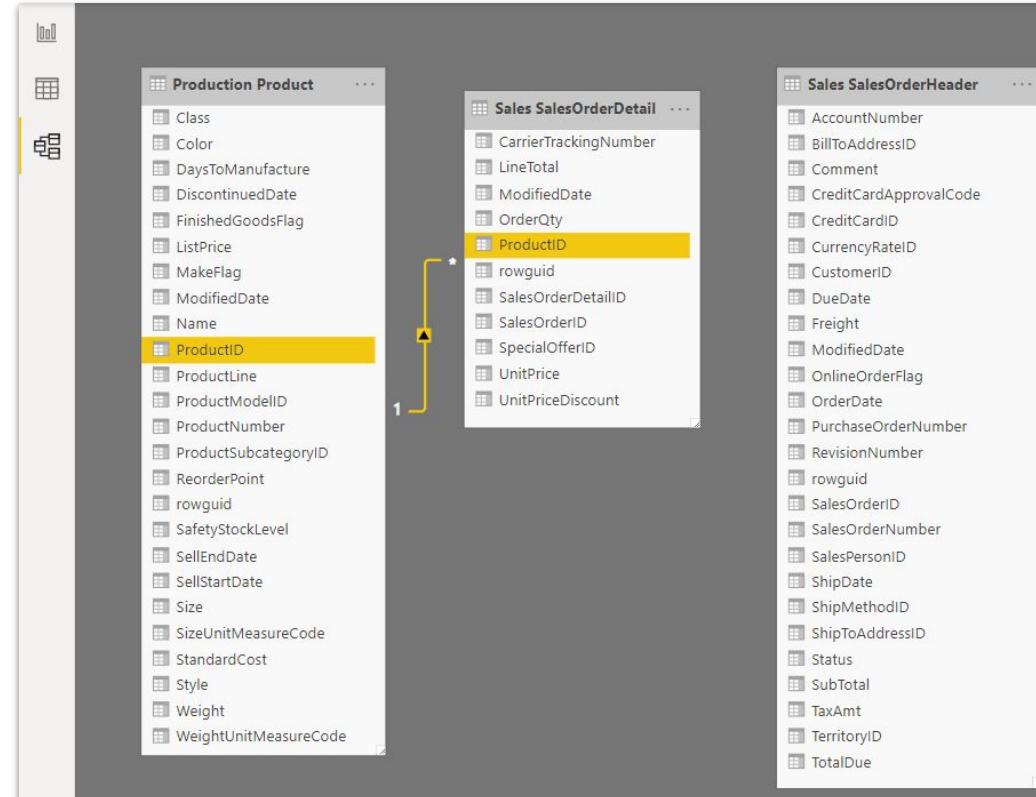


Guided Walk-Through:

Power BI Autodetects Relationships

Open the **Model view**

Power BI automatically detected the relationship between Production.Product and Sales.SalesOrderDetail but not between Detail and Sales.SalesOrderHeader.

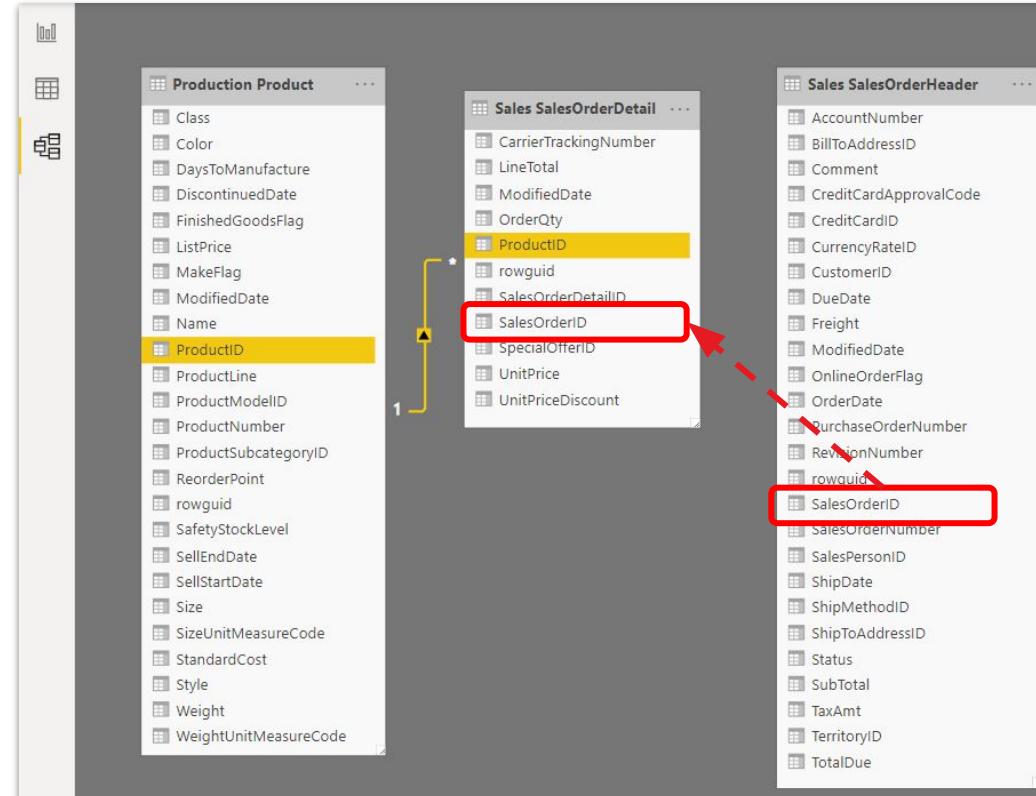




Guided Walk-Through:

Power BI Lets You Assign Relationships

Click & drag the
SalesOrderID field from
SalesOrderHeader to
SalesOrderDetail.

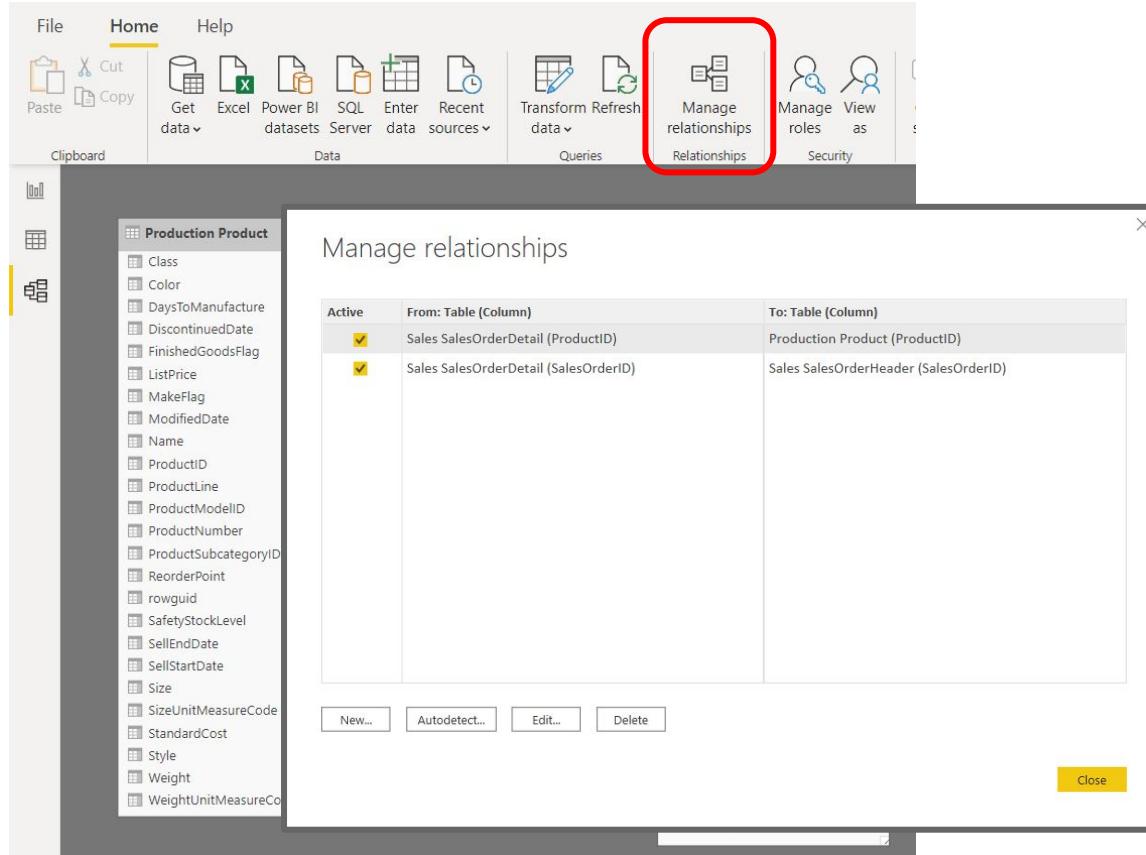




Guided Walk-Through:

Power BI Lets You Assign Relationships

Alternatively:



The screenshot shows the Power BI desktop interface. The ribbon menu is visible at the top, with the 'Home' tab selected. A red box highlights the 'Manage relationships' button in the 'Relationships' section of the ribbon. Below the ribbon, a 'Manage relationships' dialog box is open. On the left side of the dialog, there's a list of columns for the 'Production Product' table. The 'ProductID' column is currently selected. The main area of the dialog shows two active relationships:

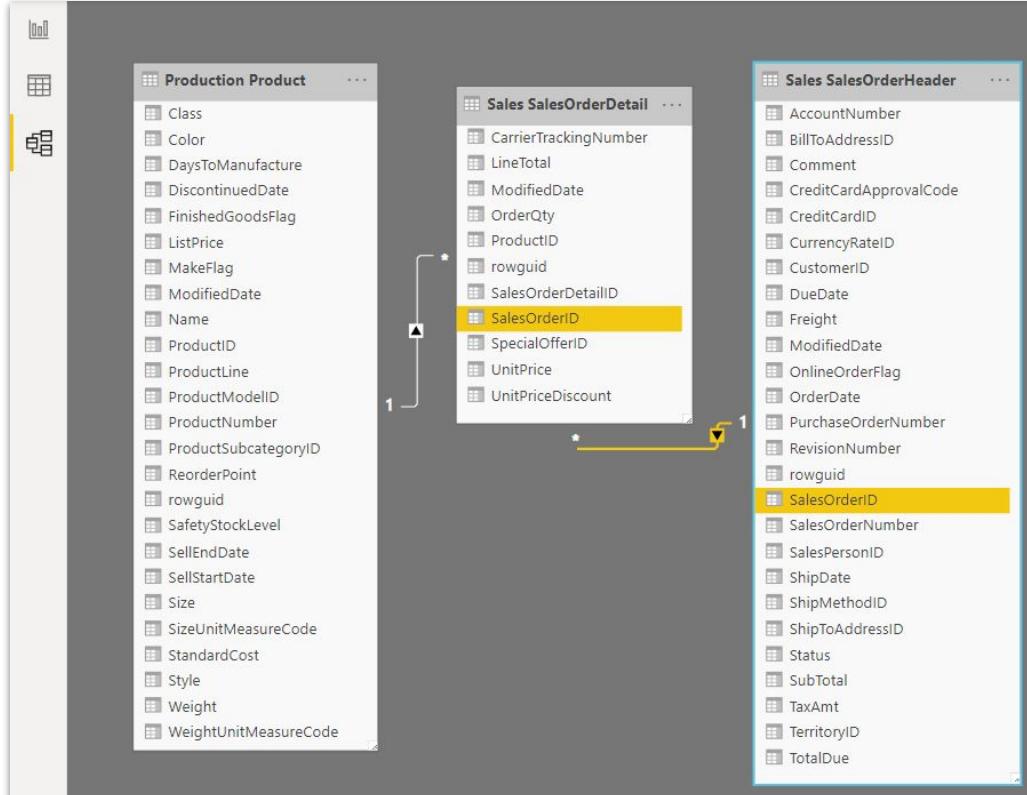
Active	From: Table (Column)	To: Table (Column)
<input checked="" type="checkbox"/>	Sales SalesOrderDetail (ProductID)	Production Product (ProductID)
<input checked="" type="checkbox"/>	Sales SalesOrderDetail (SalesorderId)	Sales SalesOrderHeader (SalesorderId)

At the bottom of the dialog, there are buttons for 'New...', 'Autodetect...', 'Edit...', 'Delete...', and 'Close'.



Guided Walk-Through: Table Relationships

Now we've related
all three tables.



Deep Dive: The Data Model

Next Steps:

Leverage Table Relationships



What Does Our Data Look Like?

31,465

Sales Orders

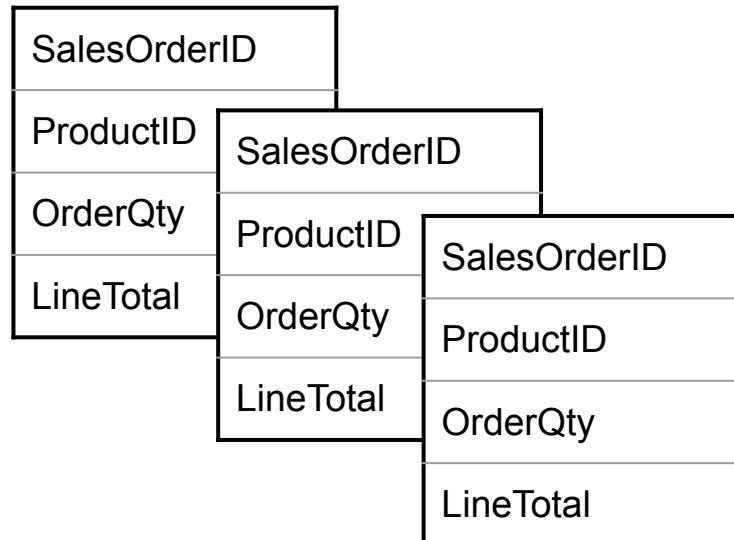
(Headers)

SalesOrderID
Line Item
Line Item
Line Item
TotalDue

121,317

Line Items

(Details)



504

Products

ProductID
Name
Color



Discussion:

Products Sold by Color

We want a table that shows the **number of products sold by color**.

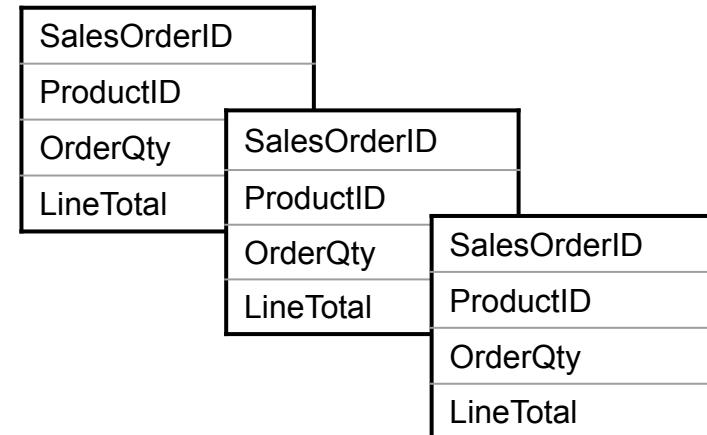


What two fields should we use?

Sales Orders
(Headers)

SalesOrderID
Line Item
Line Item
Line Item
TotalDue

Line Items
(Details)



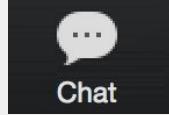
Products

ProductID
Name
Color



Discussion:

Products Sold by Color



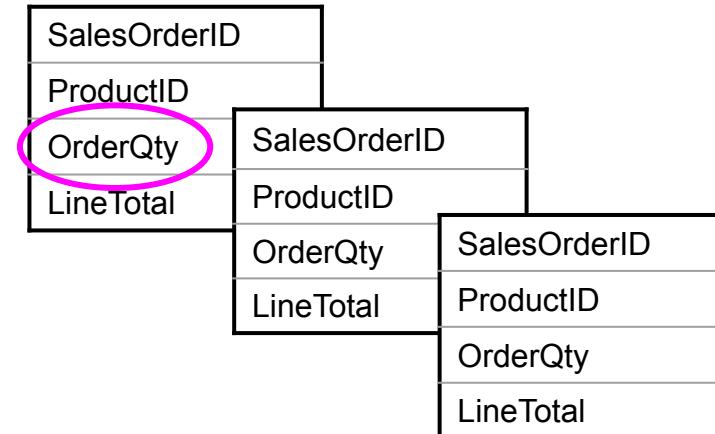
We want a table that shows the **number of products sold by color**.

What two fields should we use?

Sales Orders
(Headers)

SalesOrderID
Line Item
Line Item
Line Item
TotalDue

Line Items
(Details)



Products

ProductID
Name
Color



Guided Walk-Through:

Leverage Table Relationships

Time to use table relationships!

Create a table visualization which displays the number of products sold by color.

Drag **Color** from Product and
OrderQty from SalesOrderDetail
onto *Values*.

The screenshot shows the Power BI Fields pane. At the top, there are sections for 'Visualizations' and 'Fields'. Below 'Visualizations' is a grid of icons representing different chart types. One icon, a grid, is highlighted with a red box. In the 'Fields' section, there is a search bar labeled 'Search'. Below it, the 'Sales SalesOrderDetail' table is expanded, showing its fields: CarrierTrackingNumber, LineTotal, ModifiedDate, OrderQty, ProductID, rowguid, SalesOrderDetailID, and SalesorderId. The 'OrderQty' field is selected, indicated by a checked checkbox and a yellow circle with a checkmark. A red dashed arrow points from the highlighted grid icon in the Visualizations section down to the selected 'OrderQty' field in the Fields section.



Guided Walk-Through:

Leverage Table Relationships

Click on the *OrderQty* column header to sort descending.

The result should look like this:

Feel free to add different fields!

Color	OrderQty
Black	81937
	48289
Yellow	32556
Red	29229
Multi	25073
Silver	25023
Blue	23659
White	5217
Silver/Black	3931
Total	274914

Deep Dive: The Data Model

Create & Edit Relationships



Guided Walk-Through:

Edit an Existing Relationship

In the Report view, create a Table,
select **Sales.SalesOrderDetail** and
add the following:

Sales.SalesOrderDetail [SalesOrderID]

Sales.SalesOrderDetail [OrderQty]

Sales.SalesOrderDetail [ProductID]

Sales.SalesOrderDetail [UnitPrice]

Production.Product [StandardCost]

What happened?

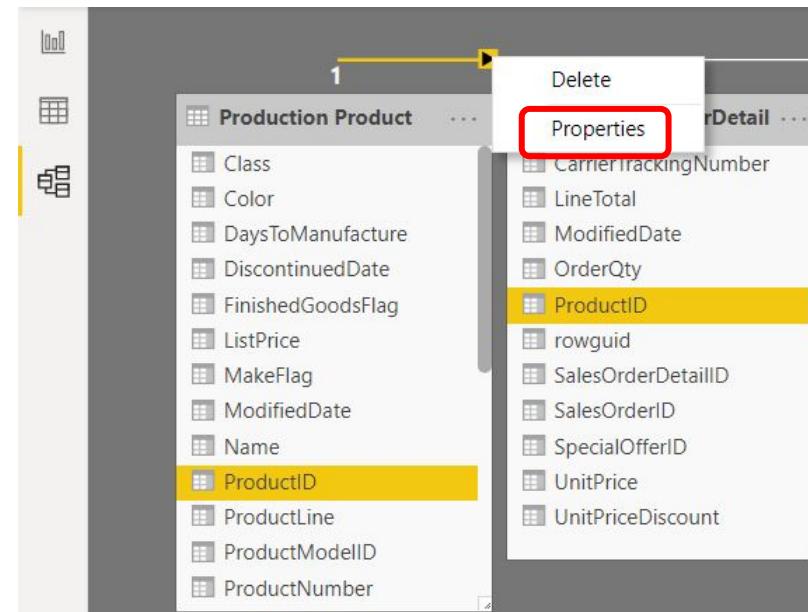
SalesOrderID	OrderQty	ProductID	UnitPrice	StandardCost
43659	6	709	5.70	130,335.89
43659	4	711	20.19	130,335.89
43659	2	712	5.19	130,335.89
43659	3	714	28.84	130,335.89
43659	1	716	28.84	130,335.89
43659	1	771	2,039.99	130,335.89
43659	1	772	2,039.99	130,335.89
43659	2	773	2,039.99	130,335.89
43659	1	774	2,039.99	130,335.89
43659	1	776	2,024.99	130,335.89
43659	3	777	2,024.99	130,335.89
43659	1	778	2,024.99	130,335.89
43660	1	758	874.79	130,335.89
43660	1	762	419.46	130,335.89
43661	5	708	20.19	130,335.89
43661	2	711	20.19	130,335.89
43661	4	712	5.19	130,335.89
43661	4	715	28.84	130,335.89
Total	274914		56,423,747.61	130,335.89



Guided Walk-Through:

Edit an Existing Relationship

Click on Model view and right-click on the connection between Production.Product and Sales.SalesOrderDetail. Select *Properties*.





Guided Walk-Through: Edit an Existing Relationship

Edit relationship

Select tables and columns that are related.

Sales SalesOrderDetail

SalesOrderID	SalesOrderDetailID	CarrierTrackingNumber	OrderQty	ProductID	SpecialOfferID	UnitPrice
51178	37753		1	870	1	
51180	37760		1	870	1	
51191	37790		1	870	1	

Production Product

ProductID	Name	ProductNumber	MakeFlag	FinishedGoodsFlag	Color	SafetyStockLevel	Rec
1	Adjustable Race	AR-5381	<i>False</i>	<i>False</i>		1000	
2	Bearing Ball	BA-8327	<i>False</i>	<i>False</i>		1000	
323	Crown Race	CR-9981	<i>False</i>	<i>False</i>		1000	

Cardinality

Many to one (*:1)

Make this relationship active

Assume referential integrity

Cross filter direction

Single

Both

OK Cancel

Open *Cross filter direction*,
select Both, then hit OK





Guided Walk-Through:

Edit an Existing Relationship

Now return to the Report view
to see the result.

SalesOrderID	OrderQty	ProductID	UnitPrice	StandardCost
43659	6	709	5.70	3.40
43659	4	711	20.19	13.09
43659	2	712	5.19	6.92
43659	3	714	28.84	38.49
43659	1	716	28.84	38.49
43659	1	771	2,039.99	1,912.15
43659	1	772	2,039.99	1,912.15
43659	2	773	2,039.99	1,912.15
43659	1	774	2,039.99	1,912.15
43659	1	776	2,024.99	1,898.09
43659	3	777	2,024.99	1,898.09
43659	1	778	2,024.99	1,898.09
43660	1	758	874.79	884.71
43660	1	762	419.46	486.71
43661	5	708	20.19	13.09
43661	2	711	20.19	13.09
43661	4	712	5.19	6.92
43661	4	715	28.84	38.49
Total	274914		56,423,747.61	130,335.89

Relationships in Power BI

Create a relationship manually

When creating these, think about:

1. Cardinality:

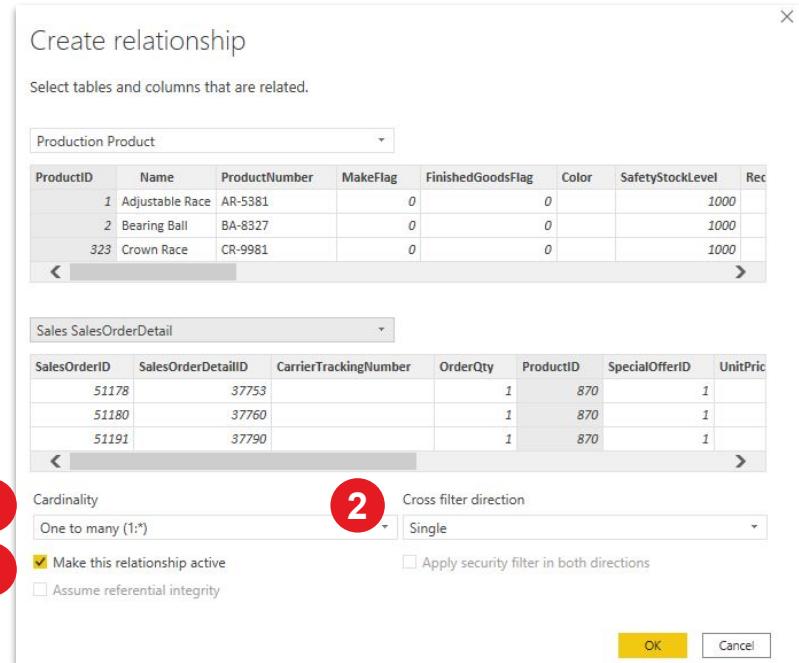
How unique are the values?

2. Cross filtering:

How should fields affect each other?

3. Active relationship:

Which relationship to enforce if there are multiple?



[Here is a great video](#) explaining these options in detail as an additional resource.

Cardinality

One to One (1:1)

Each value can only occur once in each table being connected.

ID	ID
1	1
2	2
3	3

One to Many (1:*)

Many to One (*:1)

Only one of the tables needs to have unique values.

ID	ID
1	1
2	1
3	1
1	2
2	2
3	3

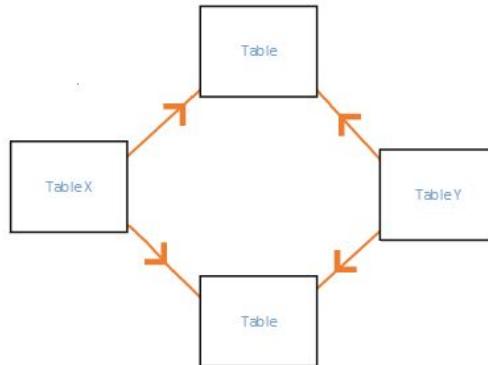
Many to Many (*:*)

Removes requirements for unique values in tables.

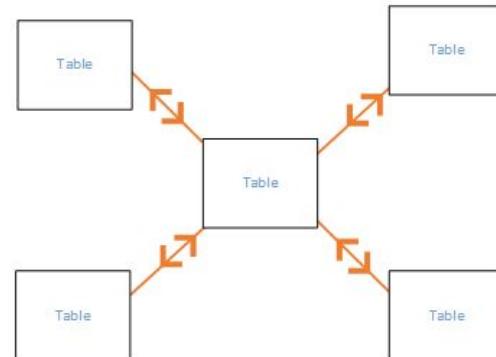
ID	ID
1	1
2	1
3	1
1	2
2	2
3	3

Cross Filtering

Single: Filtering flows one way only and affects the table where multiple values are being aggregated (default setting).



Both: Both tables can filter each other. This setting works well with a single table that has a number of lookup tables that surround it but no further connections (otherwise it creates a circular reference).

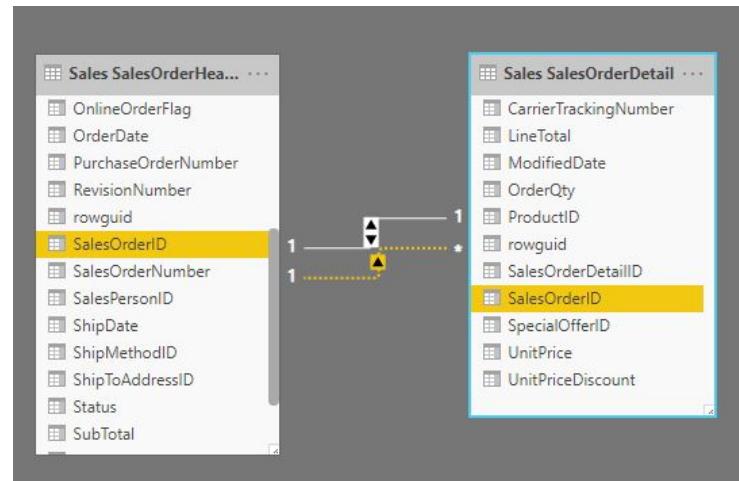


Deep Dive: The Data Model

Active Relationships

Active Relationships

In cases where there is more than one relationship between two tables, you can choose which to keep active or not (**inactive** relationships are represented by **dotted lines**).





Solo Exercise:

Recreate Sales by Country

10 minutes



In the first lesson we loaded **DemoSalesOrderHeader.txt** and built a map visualization showing Sales by Country shipped to.

See if you can do the same thing from source tables!

Use these tables:

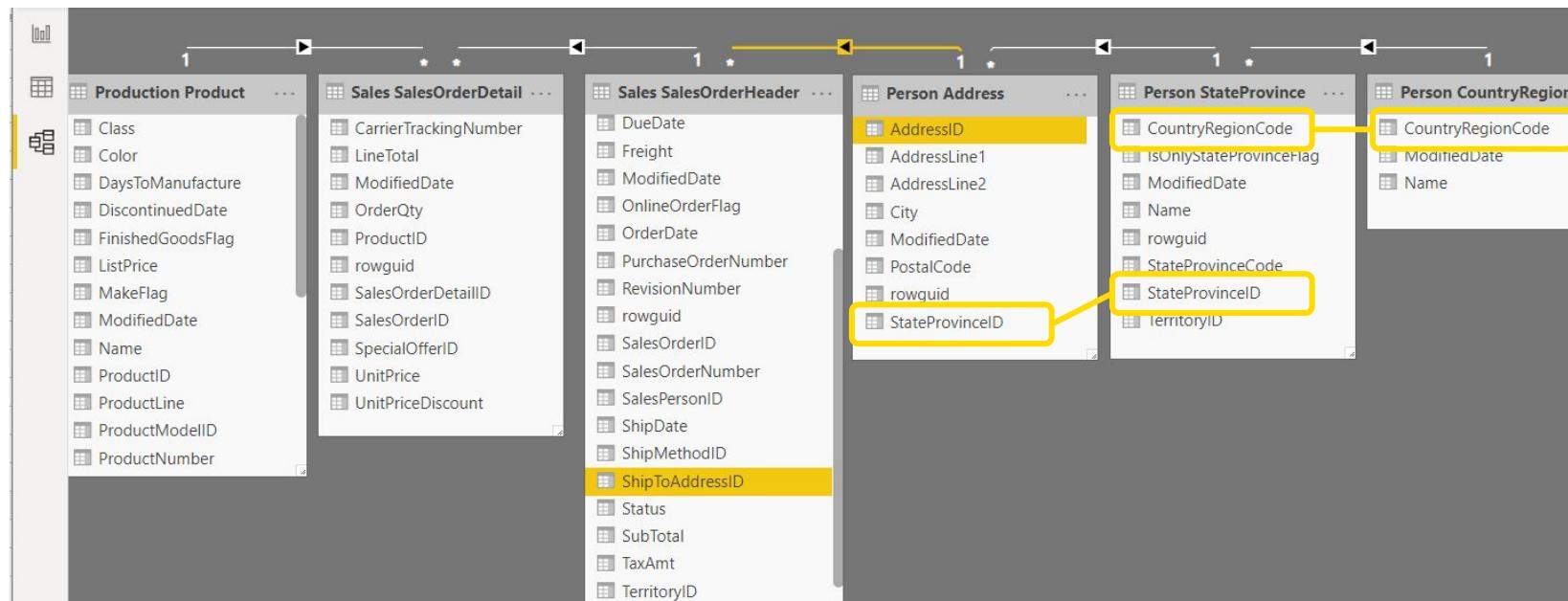
- **Sales.SalesOrderHeader.txt**
- **Person.Address.txt**
- **Person.StateProvince.txt**
- **Person.CountryRegion.txt**



Solo Exercise:

Recreate Sales by Country - Solution

To build the model, link tables as shown:





Solo Exercise:

Recreate Sales by Country - Solution

To recreate the graphic, add Person.CountryRegion **Name** to *Location*, and Sales.SalesOrderHeader **SubTotal** to *Size*.

The screenshot shows the Power BI desktop interface. On the left is a world map visualization titled "SubTotal by Name". The Fields pane on the right lists various fields categorized under "Visualizations" and "Fields". Two specific fields are highlighted with pink boxes: "Name" under "Location" and "SubTotal" under "Size".

Visualizations

- SubTotal by Name

Fields

- Filters
- Visualizations
- Fields

Location

- Name

Size

- SubTotal

Advanced Analytics

DAX Calculations in Power BI

Creating Measures & Columns

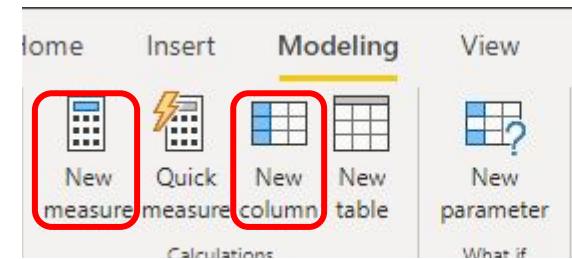


DAX

After loading and modeling the data, you can **add fields** using Power BI's *Data Analytics Expressions* language: **DAX**.

There are two types of calculations:

- **Column**: Returns a value for each row
- **Measure**: Returns a single aggregate value



BI tools are often described as “Visual SQL” as most of the functionality found in SQL also exists within BI tools but for visualization purposes (your SQL knowledge will come in handy here!)

Measures

Measures can take many forms:

- most recent stock price
- max / min value
- rolling average
- computed ratios



DAX Functions

DAX is written much like Excel and most functions are available such as:

Numerical

- SUM
- AVERAGE
- COUNT
- COUNTA
- MIN
- MAX

String

- CONCATENATE
- LEFT
- RIGHT
- SEARCH
- REPLACE

Date

- DATE
- HOUR
- WEEKDAY

Boolean

- ISERROR
- ISBLANK

Logical

- IF
- IFERROR
- AND
- OR

Note: The full documentation is found [here](#).





Guided Walk-Through:

Create a New Measure

Let's calculate the overall **Tax Rate** as the TaxAmt sum over the SubTotal sum.

In the Data view, select Sales.SalesOrderHeader and click **New measure**

The screenshot shows the Power BI Data View interface. The top navigation bar includes File, Home, Help, and Table tools. The Table tools tab is selected, showing options like Mark as date table, Manage relationships, New measure (which is highlighted with a red box), Quick measure, New measure column, and New table. A tooltip for the New measure button says "Write a DAX expression that calculates a value from your data." On the left, there's a sidebar with a grid icon (highlighted with a yellow box) and a table icon. The main area displays a table of Sales Order data with columns: SalesOrderID, RevisionNumber, OrderDate, DueDate, ShipDate, Status, and OnlineOrder. To the right, a Fields pane lists various tables and columns, with Sales SalesOrder... and Sales SalesOrder... AccountNumber highlighted with a pink box.

SalesOrderID	RevisionNumber	OrderDate	DueDate	ShipDate	Status	OnlineOrder
43702	8	6/1/2011 12:00:00 AM	6/13/2011 12:00:00 AM	6/8/2011 12:00:00 AM	5	
43706	8	6/2/2011 12:00:00 AM	6/14/2011 12:00:00 AM	6/9/2011 12:00:00 AM	5	
43707	8	6/2/2011 12:00:00 AM	6/14/2011 12:00:00 AM	6/9/2011 12:00:00 AM	5	
43713	8	6/4/2011 12:00:00 AM	6/16/2011 12:00:00 AM	6/11/2011 12:00:00 AM	5	
43719	8	6/5/2011 12:00:00 AM	6/17/2011 12:00:00 AM	6/12/2011 12:00:00 AM	5	
43728	8	6/8/2011 12:00:00 AM	6/20/2011 12:00:00 AM	6/15/2011 12:00:00 AM	5	
43747	8	6/13/2011 12:00:00 AM	6/25/2011 12:00:00 AM	6/20/2011 12:00:00 AM	5	
43755	8	6/14/2011 12:00:00 AM	6/26/2011 12:00:00 AM	6/21/2011 12:00:00 AM	5	
43758	8	6/15/2011 12:00:00 AM	6/27/2011 12:00:00 AM	6/22/2011 12:00:00 AM	5	
43762	8	6/16/2011 12:00:00 AM	6/28/2011 12:00:00 AM	6/23/2011 12:00:00 AM	5	
43784	8	6/21/2011 12:00:00 AM	7/3/2011 12:00:00 AM	6/28/2011 12:00:00 AM	5	



Guided Walk-Through:

Create a New Measure

In the formula area, rename "Measure" to "Tax Rate" and complete the formula as follows:

```
Tax Rate = SUM('Sales SalesOrderHeader'[TaxAmt]) /  
          SUM('Sales SalesOrderHeader'[SubTotal])
```

The screenshot shows the Microsoft Power BI ribbon with the 'Measure tools' tab selected. The formula bar at the bottom displays the measure definition:

```
1 Tax Rate = SUM('Sales SalesOrderHeader'[TaxAmt])/SUM('Sales SalesOrderHeader'[SubTotal])
```



Guided Walk-Through:

Create a New Measure

Note that **Tax Rate** shows up under Fields - but not as a new column.

The screenshot shows a Power BI Fields pane on the right side of a data view. The data view displays a table with columns: SubTotal, TaxAmt, Freight, TotalDue, and Col. The Fields pane lists various measures: Status, SubTotal, Tax Rate (which is circled in pink), TaxAmt, TerritoryID, and TotalDue.

SubTotal	TaxAmt	Freight	TotalDue	Col
3578.27	286.2616	89.4568	3953.9884	
3578.27	286.2616	89.4568	3953.9884	
3578.27	286.2616	89.4568	3953.9884	
3578.27	286.2616	89.4568	3953.9884	
3578.27	286.2616	89.4568	3953.9884	
3578.27	286.2616	89.4568	3953.9884	
3578.27	286.2616	89.4568	3953.9884	
3578.27	286.2616	89.4568	3953.9884	
3578.27	286.2616	89.4568	3953.9884	



Guided Walk-Through:

Using Measures in Reports

In Report view, click **Card** and drag Tax Rate into Fields.

The screenshot shows the Power BI Report view interface. On the left, there is a Card visualization displaying the value "0.09" and the text "Tax Rate". In the center, the "Visualizations" pane is open, showing various visualization icons. To the right, the "Fields" pane is open, listing fields from a data source. The field "Tax Rate" is selected, indicated by a red box and a checkmark. A red dashed arrow points from the "Tax Rate" field in the Fields pane to the "Tax Rate" card in the report area.

Visualizations

Fields

Search

Tax Rate

Drill through

SalesPersonID
ShipDate
ShipMethodID
ShipToAddress...
Status
SubTotal
TaxAmt
TerritoryID
TotalDue



Guided Walk-Through:

Using Measures in Reports

Next, click **Matrix**, drag TerritoryID into *Rows*, and SalesOrderID, TaxAmt, SubTotal & Tax Rate into *Values*.

TerritoryID	Count of SalesOrderID	TaxAmt	SubTotal	Tax Rate
1	4594	1,506,070.64	16,084,942.55	0.09
2	352	671,112.49	6,939,374.48	0.10
3	385	765,173.52	7,909,009.01	0.10
4	6224	2,259,797.98	24,184,609.60	0.09
5	486	765,290.89	7,879,655.07	0.10
6	4067	1,556,692.30	16,355,770.46	0.10
7	2672	661,480.87	7,251,555.65	0.09
8	2623	430,028.13	4,915,407.60	0.09
9	6843	883,078.05	10,655,335.96	0.08
10	3219	688,249.60	7,670,721.04	0.09
Total	31465	10,186,974.46	109,846,381.40	0.09

measures can be computed across groups

The screenshot shows a Power BI Matrix visualization on the left and the Fields pane on the right. In the Matrix, TerritoryID is in Rows, SalesOrderID is in Values, and TaxAmt, SubTotal, and Tax Rate are also in Values. A blue arrow points from the Matrix visualization to the 'Values' section of the Fields pane. The Fields pane lists various fields with checkboxes: TerritoryID (selected), SalesOrderID (selected), TaxAmt (selected), SubTotal (selected), Tax Rate (selected), and others like Count of SalesOrderID, DueDate, and TotalDue. Two sections are highlighted with pink boxes: 'Rows' (containing TerritoryID) and 'Values' (containing SalesOrderID, TaxAmt, SubTotal, and Tax Rate). A red box highlights the SalesOrderID field in the Fields pane.



Guided Walk-Through:

Create a New Column

1. Still in the Report view, create a new **Table**
2. In the Fields area select **Production.Product**
3. In the Table tools ribbon, click **New Column**

The screenshot shows the Power BI Report view interface. The ribbon is visible at the top with the 'Table tools' tab selected. A callout box with the number '3' highlights the 'New column' button in the ribbon's 'Data / Drill' section. Another callout box with the number '1' highlights the 'Production Product' table in the 'Fields' pane on the right. A third callout box with the number '2' highlights the 'New column' button in the 'Values' section of the 'Fields' pane.

File Home Insert Modeling View Help Format Data / Drill Table tools

Name Production Product

Structure

Calendars

Rela

Mark as date table ▾ Manage relationships

New table New measure New column New table

Write a DAX expression that creates a new column in the selected table and calculates values for each row.

Visualizations > Fields >

Search

Add data fields here

Filters on this visual

Filters on this page

Add data fields here

1

2

Production Product

Class

Color



Guided Walk-Through:

Create a New Column

1. In the formula area enter

```
WeightUnit =  
CONCATENATE('Production Product'[Weight],  
'Production Product'[WeightUnitMeasureCode])
```

1. Drag the new **WeightUnit** column onto the table.

WeightUnit
1000G
1050G
149G
14LB
15LB
168G
16LB
170G
17LB
185G
189G



Solo Exercise:

20 minutes



Calculate the Overall Gross Margin

Using the **Sales.SalesOrderDetail** and **Production.Product** tables, create columns and measures to derive the overall **Gross Margin** as the difference between UnitPrice and StandardCost across all orders in SalesOrderDetail. Remember to account for quantity sold!

HINT: Use the RELATED function!



Solo Exercise:

Gross Margin - Solution

1. Add a new column to SalesOrderDetail called **UnitCost**:

```
UnitCost = RELATED('Production Product'[StandardCost])
```

1. Add a new column to SalesOrderDetail called **Margin**:

```
Margin = 'Sales SalesOrderDetail'[OrderQty] *  
        ('Sales SalesOrderDetail'[UnitPrice] - *  
         'Sales SalesOrderDetail'[UnitCost])
```

1. Add a new measure to SalesOrderDetail called **GrossMargin**:

```
GrossMargin = SUM('Sales SalesOrderDetail'[Margin])
```

RESULT: \$9.90M

* There's another way to derive
Margin that results in \$9.37M

Advanced Analytics

Let's Review!



What Did We Just Cover?

In this lesson, we:

- **Loaded data** from multiple sources
- **Cleaned and reshaped data** using the Power Query Editor
- **Merged and appended** data
- **Created and managed relationships** between tables
- **Calculated new fields** using DAX



Finish That Sentence

What are your biggest takeaways from today?



“Something that really got me thinking is...”

“The best thing I got out of today is...”

“I discovered...”

“I still want to learn about...”

“I was surprised that...”

Ask Me Anything!



**Don't Forget Your
Exit Tickets!**



A Few Good References

[DAX Function Reference](#)



See you next time!

Thank you!