



M 365 Excel Class Video 04: Data Analysis with Excel and Power BI Table of Contents:

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Define Data Analysis

Data Analysis = Convert raw data into useful information to gain insight and make decisions.

Synonyms: Data Analytics, Analytics, Business Intelligence, Data Science, Data Analysis

Goal: help make data-driven decisions, which tend to be more accurate & help to achieve goals more consistently

Examples:

1) Sales data in a table converted into a Monthly SalesRep Sales Report. What are top 3 sales amounts?

Q: If a bonus is given for the 3 biggest monthly sales amounts, who gets bonus? A: Chantel, Jo, Tyrone.

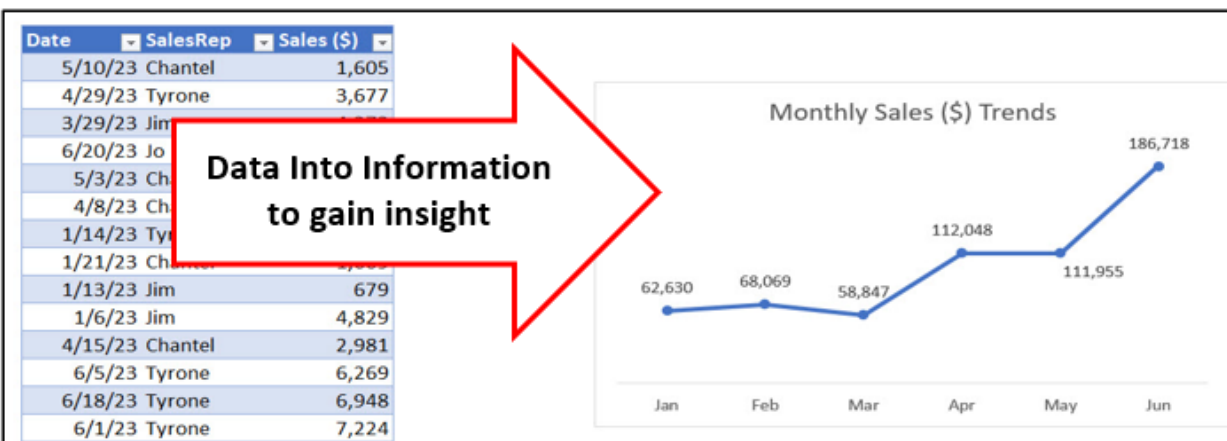
Date	SalesRep	Sales (\$)
1/5/23	Jim	1,645
1/6/23	Jim	4,829
1/8/23	Chantel	3,635
1/11/23	Chantel	2,712
1/13/23	Jim	
1/13/23	Tyrone	
1/14/23	Tyrone	
1/14/23	Jo	
1/14/23	Tyrone	
1/15/23	Chantel	3,361
1/15/23	Jo	458
1/15/23	Chantel	2,140
1/17/23	Jim	3,882
1/21/23	Chantel	1,609
1/21/23	Tyrone	3,223
1/22/23	Tyrone	99
1/22/23	Jo	1,616
1/23/23	Chantel	2,887

Data Into Information to make decisions

SalesRep	Month	Total Sales (\$)
Chantel	Jan	18,037
	Feb	19,794
	Mar	10,318
Chantel Total		48,149
Jim	Jan	16,072
	Feb	13,145
	Mar	13,509
Jim Total		42,726
Jo	Jan	9,467
	Feb	21,874
	Mar	16,247
Jo Total		47,588
Tyrone	Jan	19,054
	Feb	13,256
	Mar	18,773
Tyrone Total		51,082
Grand Total		189,545

2) Sales data in a Table converted into a Monthly Sales Trends Chart. What is the trend?

Q: What were sales trends over last six months? A: Mostly up.



Define Table

Raw Data = data stored in its smallest form in a cell

Not Raw Data:

Date, Person, Sales
01/05/2023, Jim, \$1,645.01

Raw Data:

Date	Person	Sales
1/5/23	Jim	\$1,645.01

Proper Data Set = Data Set = Table

Table is made up of:

Field = column in table

Field Name = name at top of field that describes what data goes into field

Record = one row in table

Table requirements in Excel worksheet:

- 1) Field names in first row
- 2) Records of related data in subsequent rows
- 3) Empty cells or Excel Row/Column Headers, all the way around table

Date	Person	Sales
1/5/23	Jim	1,645
1/6/23	Jim	4,829
1/8/23	Chantel	3,635
1/11/23	Chantel	2,713
1/13/23	Jim	679
1/13/23	Tyrone	1,527
1/14/23	Tyrone	3,152

← Fields
← Records

Survey Data
Yes
Yes
No
Yes
No
No
No

← Fields
← Records

Delimiters and Text Files

1. Delimiter = character/s that separate bits of data
2. Delimited Table = Field Names and Data in Records separated by Delimiter
3. Text Files = files that can transport tables of data from one system to another, such as transporting database data to Power Query and then Excel.
4. Common Text Files:
 - .csv file = Comma Delimiter
 - .txt file = Tab Delimiter

Excel Table Feature

- 1) If you have a proper data set, you can convert your proper data set to an Excel Table by selecting one cell in the proper data set, click on the Table button in Table group in Insert Ribbon Tab, or just use keyboard: Ctrl + T.
- 2) The advantage to using the Excel Table feature is that when new rows or columns are added to the Excel Table, all objects, such as PivotTable, Charts, Formulas, or other features can be refreshed, and the new data will be incorporated into the object.
- 3) You can name your Excel Table: select one cell in Excel Table, click the Table Design Ribbon Tab, Properties group. You can NOT use spaces in the Table Name.
- 4) You can add new records to Excel Table by typing or pasting new data in the first row below the Excel Table.
- 5) Filter and Sort dropdown arrows at top of each field allow you to sort or filter the records in the Excel Table.
- 6) The Total Row can contain aggregate calculations such as sum or average. This total row automatically moves downward when new records are added to the table.
- 7) If new rows and columns are not added to Excel Table, you will need to change option settings for Excel Tables: File menu, Options button, Proofing tab on left, "AutoCorrect Options" button, check "Include new rows and columns in table".

Sort & Filter Features

- 1) Sort Feature
 - i. To sort means to organize the records in a table from smallest to biggest (A-Z, or ascending) or biggest to smallest (Z-A, or descending), based on a specified column.
 - ii. When you sort a column in a proper data set, the records in the table are sorted based on the order of the sorted column.
 - iii. If you have mixed data, an A to Z sort would sort in this order (top to bottom): Numbers, Text, FALSE, TRUE, Errors, Empty Cells
 1. Empty Cells are always sorted to the bottom whether you do **A to Z** or **Z to A**).
- 2) Filter Feature
 - i. To filter means to show only certain records, based on one or more conditions from one or more columns. Any type of logical test can be used to filter a table. Examples of Logical Tests:
 1. **AND Logical Test** = All Conditions must = TRUE. When you use two columns for a filter, you are performing an AND Logical Test.
 2. **OR Logical Test** = At least one condition must = TRUE. One or more conditions must = TRUE. When you use two conditions from a unique list on one column for a filter, you are performing an OR Logical Test.
 - ii. When you filter based on conditions, the matching records are shown, and the non-matching records are hidden.

FlashFill

- 1) If you have a one-time data cleaning task, and the pattern for extracting data is the same for every row in the table, then Flash Fill is the tool you want to use. However, if the pattern is not consistent in every row, then Flash Fill can be hard to use and may even give you incorrect results, especially if you have a large dataset where it is hard to determine whether a perceived pattern is the same in every row. When Flash Fill cleans data, the solution created does not automatically update if the source data changes, so Flash Fill is usually not a good tool for data analysis solutions that will later be updated with new data. Power Query and worksheet formulas are designed specifically for situations where you will get new data later and you need the solution to update. If there is a consistent pattern, you can clean data by typing example to right of column of data, then click FlashFill button or Ctrl + E.
- 2) The three rules for using FlashFill are:
 - i. You have a one-time data cleaning task that does not need to be repeated
 - ii. You will not get more data later and need the solution to update
 - iii. There is a simple pattern in the data that you can use to provide an example

Standard PivotTable Notes

- 2) What PivotTables do:
 - i. Create Summary Reports that contain calculations with Conditions or Criteria.
- 3) Summary of how to create PivotTable:
 - i. Click in one cell in Proper Data Set
 - ii. Insert Ribbon Tab, Tables group, PivotTable button.
 1. Keyboard = Alt, N, V, T.
 - iii. From Field List, drag field name to Rows area or Columns area or Filter area. These are the conditions/criteria for the calculation in the Values area of the PivotTable.
 1. Fields in the Rows area add a condition/criterion to the row
 2. Fields in the Columns area add a condition/criterion to the column
 3. Fields in the Filter area add a condition/criterion to the entire PivotTable.
 - iv. From Field List drag the field you would like to make a calculation on to values area.
 1. Number fields default to a SUM calculation (add numbers)
 2. Text fields default to a COUNTA calculation (count non-empty cells)
 - v. With a cell selected in the PivotTable, click on PivotTable Tools Design Ribbon Tab, go to the Layout group, click drop-down for Report Layout and then click on "Show in Tabular Form" or "Show in Outline Form". These Layouts shows the Field Names in your Report. To set the layout default for all PivotTable, click on File menu, Options button, in the Excel Options dialog box, click the Data tab on the left, click the Edit Default Layout button, then in Report Layout check box, select "Show in Tabular Form" or "Show in Outline Form".

- vi. To add Number Formatting to the Values area of the PivotTable, click in one cell in the Values area of the PivotTable, Right-click the cell and click on “Number Format...”, then in the Number Formatting dialog box select the Number Formatting that you would like and then click OK.
- vii. Slicers can be added to the PivotTable to add a condition/criterion to the entire PivotTable, similar to a field in the Filter area. To insert a Slicer into a PivotTable, click in one cell in the PivotTable Report, then go to the PivotTable Tools Analyze Ribbon Tab, then in the Filter Group, click the Insert Slicer button
- viii. If you want to change the summary calculation in the Values area, right-click the Values area in the PivotTable Report, point to one of these two options:
 - 1. “Summarize Values By” and then select an aggregate calculation such as “Average”, or “Max”, or “More Options”.
 - 2. “Show Values As” and then select a calculation such as “% of Column Total”, “Running Total”, “Difference From” or other calculations.
- ix. Standard PivotTable vs. Data Model PivotTable.
 - 1. A Standard PivotTable stores its data in the PivotTable cache. A Standard PivotTable is best when data is stored in one small table (less than about 50,000 rows of data) and you want simple calculations such as sum, averages, % of column totals or % of grand total.
 - 2. A Data Model PivotTable stores its data in the Power Pivot Data Model Columnar Database. A Data Model PivotTable is best when you have a large amount of data, you have multiple related tables, or you want to make calculations that a Standard PivotTable cannot easily make.
- x. Standard PivotTable Cached Data
 - 1. When you create a Standard PivotTable, Excel creates a copy of the source data and stores it in the Pivot Cache. The Pivot Cache is stored in Excel’s memory.
 - 2. This is why the PivotTable does not update when source data changes.
 - 3. If source data changes, you can right-click the PivotTable and click Refresh, or use the Refresh button in the Data Ribbon Tab.
 - 4. You can’t see Cached PivotTable Data, but that’s the data the PivotTable references when you build your PivotTable or change a Slicer selection or move rows/columns around.
 - 5. When we group dates in a PivotTable, the Pivot Cache is where this action takes place. The Pivot Cache save the action of grouping by dates so that when we use the date column in other places, the date column will remain grouped.
 - 6. When we use a Slicer or change the conditions and criteria in the PivotTable, these actions are interacting with the Pivot Cache of data, not the original source data.

Excel Charts

- 1) What do Charts do?
 - i. Visually portray quantitative data (number data).
 - ii. Give a quick impression of the number data.
 - iii. Create a picture that can communicate more quickly than just the numbers alone.
 - iv. Charts allow you to see patterns or trends that you may not be able to see if you are looking at just the number data.
 - v. Allows you to make relative comparisons more quickly than if you are using a table
- 2) Types of Charts
 - i. **Column:** Use to compare differences across categories. Height of column conveys number.
 - ii. **Bar:** Use to compare differences across categories. Length of bar conveys number.
 - iii. **Stacked Column/Bar:** Good for displaying crosstabulation, emphasis on horizontal axis categories.
 - iv. **Clustered Column/Bar:** Good for displaying crosstabulation, emphasis on legend categories.
 - v. **Line:** Use to show trend for a number variable over a category such as time.
 - vi. **X-Y Scatter:** Used to show relationship between two number variables (x and y).
- 3) Rules for Charts:
 - i. No Chart Junk.
 - ii. Eliminate all chart elements that do not help to communicate the message.
- 4) Formatting Charts:
 - i. You can add and remove chart elements by using the **Green +** on the right side of chart.
 - ii. To format a chart element, select element and use the keyboard Ctrl + 1 to open the Format Chart Element task pane.
- 5) Link Labels to Cells
 - i. Click on Chart Title, type an equal sign, click on cell with title, hit Enter.

Data Modeling

- 1) Data modeling involves getting the source data into the correct form so that you can easily create reports, visuals, and other useful information.
- 2) Examples:
 - ii. Using the XLOOKUP function to add columns to a single flat table which you can use with the Standard PivotTable.
 - iii. Using Power Query to convert 12 test files into one table.

Dashboards:

- 1) One location where we can present useful information & metrics for making decisions.
- 2) Information is presented in a neat and organized manner.
- 3) Dashboards may contain: tables, charts, visualizations, data validation, pictures, other visualizations of data.
- 4) Dashboards can be created on an Excel Worksheet, a Power BI Page or in a sharable location in a workspace at Power BI Online.
- 5) When new data arrives, the dashboard can be refreshed.
- 6) Just like a dashboard in a car, a dashboard should present information that is required for making good decisions.

Fact Table, Dimension Table, Primary Key, Foreign Key, Relationships

Fact table: A fact table contains the data that you want to summarize or measure (such as sales amounts or units sold). Examples of fact tables are tables that store sales transactions, tables that store baseball data for baseball games, tables that store customer clicks at a website, and tables that store observations from an experiment. The facts are the measurements of activities, such as the amount of a sale, the number of balls and strikes in a baseball game, the start and end times for someone who visits a website, and the temperature size in an experiment. Fact tables can sometimes be very large; they may contain 100,000 rows, 1 million rows, or even 100 million rows or more.

Dimension table: A dimension table contains a field with a unique list of entities (such as product IDs) with attributes in subsequent fields for conditional calculations (such as product names) or lookup items (such as product prices). Dimension tables are also called lookup tables. The term dimension table is used in data analysis to refer to a lookup table. Remember from Chapter 14 that a lookup table always has a unique list of items in the first column of the table (the primary key); it is the same with dimension tables. For example, a product dimension table has a unique identifier, usually in the first column, such as product name or product ID; an employee dimension table has a unique identifier in the first column, such as employee ID or employee name. Dimension tables are usually much smaller than fact tables.

A field with a unique list of entities, called a **primary key**, is used to ensure that there are no duplicate records in the dimension table. When a primary key from a dimension table is used in a fact table, from the point of view of the fact table, it is a **foreign key**.

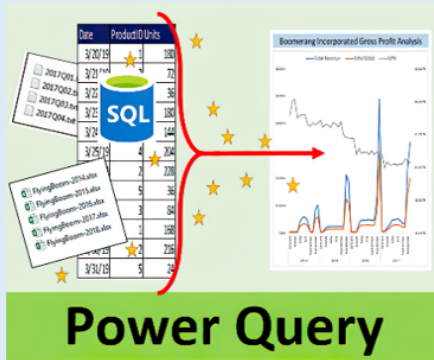
In the Data Model in Power Pivot and Power BI Desktop you can connect a primary key and a foreign key in a **one-to-many relationship**, where the one-side is the primary key and the many side is the foreign key. When you have multiple tables in a Data Model, a one-to-many relationship can replace the XLOOKUP function that you would use in the Worksheet. The advantage of using a one-to-many relationship is that it: 1) allow you to use multiple tables in a Data Model PivotTable Field List, 2) use DAX lookup functions like RELATED and 3) allows filters to flow from the dimension table to the fact table during the DAX Filter Context Process.

Power Query

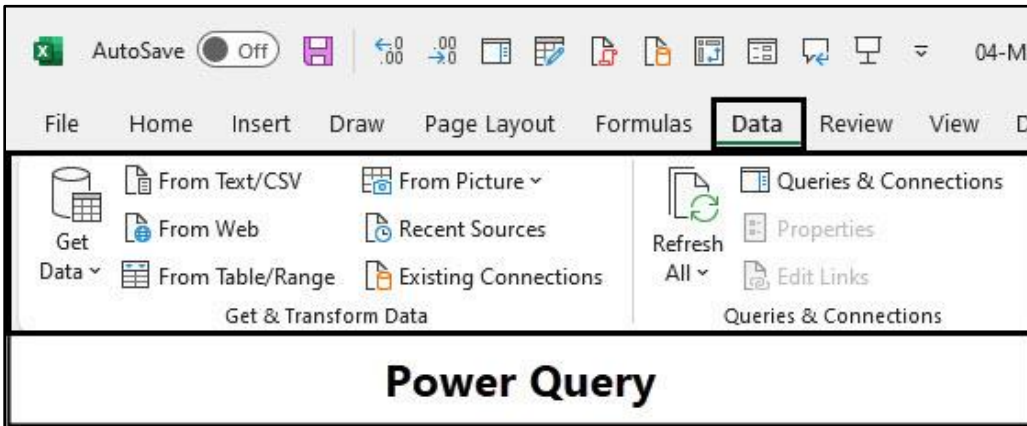
Power Query is greatest Excel tool invented since the PivotTable!

Power Query does these things:

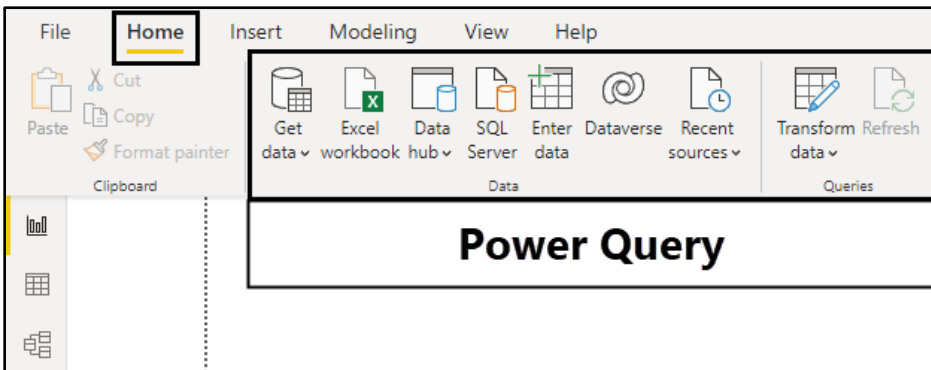
- 1) Import data from outside Excel: text files, other Excel files, databases
- 2) Clean Data like split first and last names into different columns or extract date from a data-time
- 3) Transform data like remove unwanted columns, calculate new columns or combine multiple tables into one table
- 4) Load data to the Worksheet, PivotTable Cache or the Data Model
- 5) Power Query, the import, clean, transform and load data tool, is in both **Excel & Power BI Desktop**



Power Query is in the Data tab in the Excel Ribbon:



Power Query is in the Home tab in the Power BI Desktop Ribbon:



Notes about Power Query from my book The Only App That Matters on next six pages:

Power Query

Power Query was first introduced in Excel in 2013, exactly 20 years after the PivotTable was invented. And as it turns out, Power Query is the greatest invention in Excel since the PivotTable. When you have to deal with data, Power Query is a dream tool that can do everything. In Excel 365, most data analysis projects start with Power Query, which is a perfect tool for all the data preparation you need to do before you use a PivotTable to create summary reports with conditional calculations.

Power Query can connect to data sources such as text files, databases, websites, other Excel files, and XML files. It can also bring data into the Power Query Editor window, which is an interface you can use to invoke commands to import, clean, transform, and manipulate data. Finally, Power Query can load data to locations such as the worksheet, the PivotTable cache, or the Data Model in the Excel app; and to the Data Model in the Power BI Desktop app. Power Query can also perform many other tasks that involve data, such as financial and statistical calculations that are not related to reporting, visualizations, and dashboards.

When you use the Power Query user interface to do things like import data, add a data type, or combine multiple tables, behind the scenes Power Query records every step for you so that you can go back and see previous steps or even go back and edit previous steps in the query. Power Query records these steps using a case-sensitive, function-based formula programming language called *M code*, where M stands for *data mashup*. There are more than 700 functions in the M code language, but none of them are identical to Excel worksheet functions. Luckily, most of the time you can use the Power Query user interface to create queries by clicking on buttons and commands, and Power Query will write the M code for you. Sometimes, however, the best option is to write your own M code. In this chapter, you will learn how to create queries both ways.

As you begin to learn how to use Power Query, it is helpful to understand that Power Query queries are different from Excel worksheet formulas in two main ways:

- With worksheet formulas, you must type out and write your formulas manually, but when you create a query, most of the time you click on buttons and invoke commands, and the M code formulas are written for you.
- In a worksheet, formulas mostly deliver individual values in individual cells or arrays of values, but in Power Query, M code can deliver *values* such as tables with fields, records, lists, functions, binary files, and individual values such as text, numbers, dates, times, nulls, and Boolean values.

You can work with more types of objects (or *values*, as they are officially called in M code) in Power Query than in an Excel worksheet. This makes sense because in data analysis, the objects that you often work with are not simply numbers, text, and dates but instead are tables with fields, records, lists, and binary files.

Luckily, Microsoft put the Power Query tool in both the Excel app and in the Power BI Desktop app. Figure 18.64 shows that in the Excel app, Power Query is in the Data tab in the Excel Ribbon. Figure 18.65 shows that in the Power BI Desktop app, Power Query is in the Home tab in the Power Query Ribbon. Although the Power Query user interface is somewhat different in the two tools, almost everything else is the same. Whatever you learn about Power Query in the Excel app can help you in the Power BI Desktop app and vice versa. In this example, you will use Power Query in the Excel app, and then in Example 3, you will use Power Query in the Power BI Desktop app.

Using the Power Query Editor Window and User Interface

Figure 18.71 shows the Power Query Editor window and the Power Query Ribbon with the File menu and four tabs: Home, Transform, Add Column, and View. The Power Query Editor opens as a new window that sits on top of the Excel app window. In the Query Settings task pane on the right, you can see the default query name in the Name textbox and the three query steps that Power Query automatically created in the Applied Steps list. The last step in this list, Changed Type, automatically changed the data type for both fields.

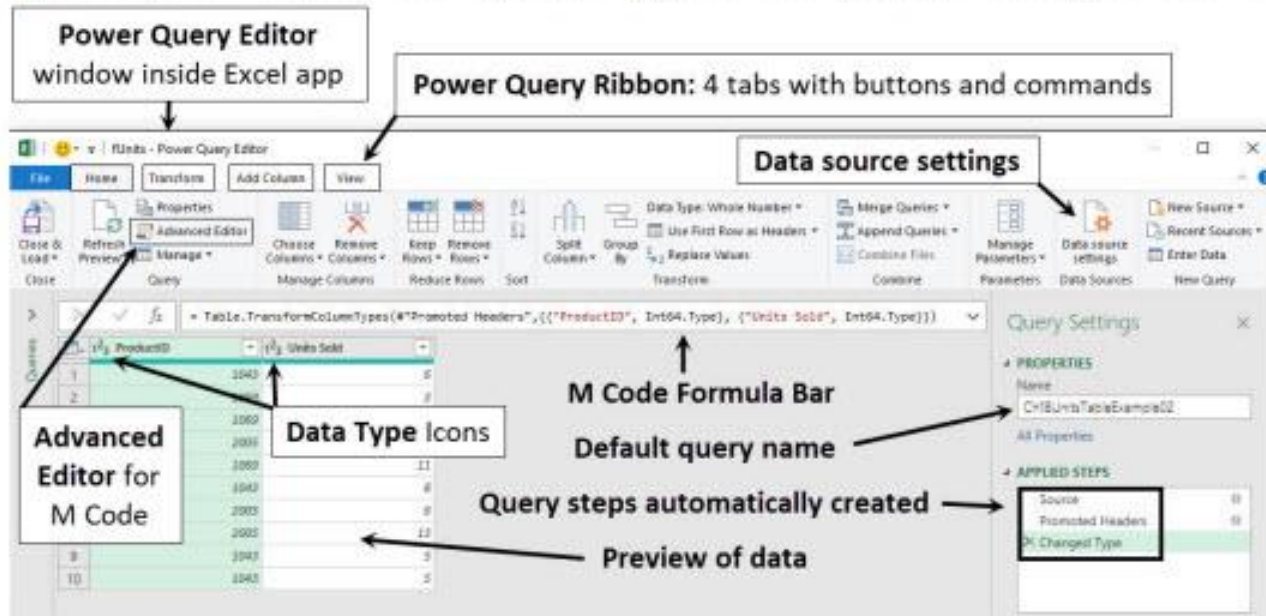


Figure 18.71 The Power Query Editor with the Power Query Ribbon

At the top of each field in the data preview, to the left of the field name, you can see the Data Type icon. For both of the fields in this example, the icon shows the 1-2-3 symbol, which indicates that the fields were given the whole number data type. Figure 18.72 shows a full list of the different Power Query Data Types that are possible.

Data Type	Icon	Short Description	M Code
Decimal number	1.2	Number up to 15 decimals	type number
Currency (Fixed decimal number)	\$	Number up to 4 decimals	Currency.Type
Whole number	1 ² 3	Number with no digit to right of decimal	Int64.Type
Percentage	%	Number up to 15 decimals with % Number Format	Percentage.Type
Date/Time	📅🕒	Serial number date and time together	type datetime
Date	📅	Serial number date	type date
Time	🕒	Serial number time	type time
Date/Time/Timezone	🌐📅🕒	Represents a UTC date/time with a time-zone offset	type datetimetimezone
Duration	🕒	Serial Number Length of Date and Time	type duration
Text	A ^B C	Text	type text
True/False	☑️	Boolean	type logical
Binary	📄	File like Excel file or Text file	type binary
Any	ABC 123	Sets numbers such as dates and decimals according to regional settings	type any

Figure 18.72 Data types in Power Query.

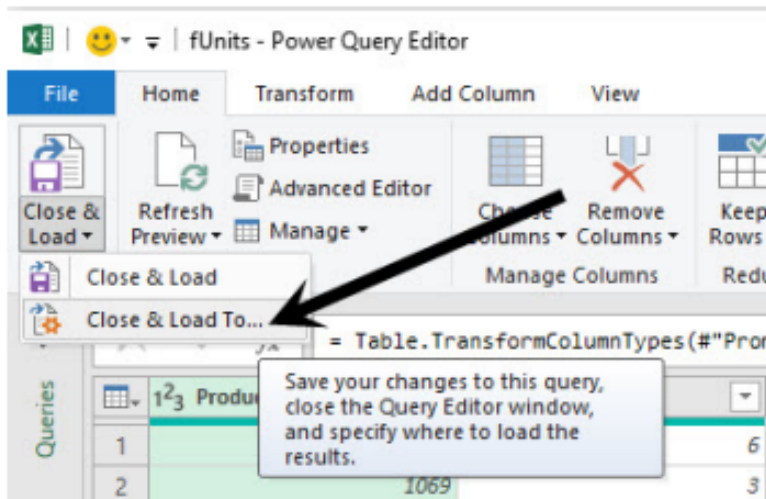


Figure 18.76 Use the *Close & Load To* option to choose where the data is loaded.

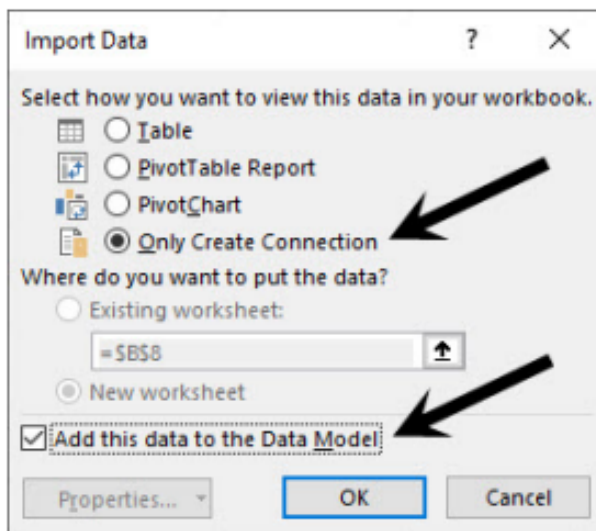


Figure 18.77 When you load to the Data Model, you must select both of these options.

2. In the Import Data dialog box that appears, to load the table to the Power Pivot Data Model, select the Only Create Connection option button and check the Add This Data to the Data Model checkbox, as shown in Figure 18.77.
3. Click OK in the Import Data dialog box. The fact table is loaded into the Data Model's columnar database, and you are taken back to the Excel app window.

Take a closer look at the Import Data dialog box in Figure 18.77. The top four options allow you to select how to view the data in the Excel workbook file:

- **Table:** The query is loaded as an Excel Table in the worksheet
- **PivotTable Report:** The query is loaded into the PivotTable cache.
- **PivotChart:** The query is loaded into the PivotTable cache.
- **Only Create Connection:** The query is not loaded to the worksheet or the PivotTable cache. This option allows Power Query to run the query steps on the source data in the Power Query Editor but then pass the data along to other queries—or, in this case, pass the data into the Data Model's columnar database.

Note: A *columnar database* is a special type of behind-the-scenes data storage location that is loaded into random access memory (RAM) when you open an Excel file. A columnar database compresses the data into a smaller size and stores the data one column at a time (hence the "columnar" name). For each column of data that is stored, the columnar database stores a unique list of items. The more unique items in any given column, the larger the size of the stored column in the database. The database also stores a type of mapping that allows it to reconstruct records of data from the columns of unique lists that are stored in the columnar database. This database was specifically designed by Microsoft to work efficiently with big data for data analysis and is part of the Power Pivot Data Model tool.

Using the M Code Advanced Editor and Let Expressions

Finally, before you load the table to the Data Model, you need to look at all of the M code that was written for you, including the editing that you performed. You can view it in the Advanced Editor.

To open the Advanced Editor, click on the Advanced Editor button in the Query group in the Home tab of the Power Query Ribbon.

As you can see in Figure 18.98, the Advanced Editor shows all the Power Query M code in a let expression. But what is a let expression? A *let expression* allows Power Query to combine all the query steps that you created into a single statement that can deliver the final value.



Figure 18.98 The Advanced Editor shows the full let expression that combines all query steps to deliver a final value.

To help you understand let expressions, the following list defines a number of important M code terms:

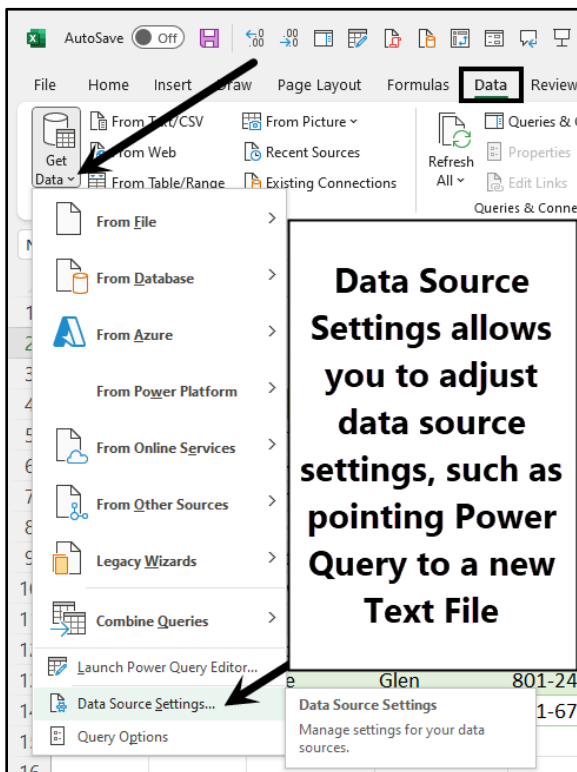
- An *expression* is any M code that results in a value. There are a number of types of expressions, including:
 - The let expression
 - A function like `Table.ColumnNames(Table Name)`
 - A query step
 - A list
 - A number
- The *values* possible in Power Query M code are:
 - **Table:** A proper dataset with fields dataset
 - **Record:** A row from a table
 - **List:** For example, {1,2,3} or {"Quad","Aspen"}
 - **Function:** A user-built custom function
 - **Binary:** A file such as an Excel, text, or CSV file
 - **Data Type:** A data validation control for fields, such as *type number* for the decimal data type
 - **Text:** For example, Quad
 - **Number:** For example, 43
 - **Date:** For example, 10/01/2021 or #date(2021,10,01)
 - **Time:** For example, 11:10:57 or #time(11,10,57)
 - **DateTime:** For example, 10/01/21 11:10:57 AM or #datetime(2021,10,01,11,10,57)
 - **DateTimeZone:** For example, #datetimezone(2021,10,01,11,10,57.09,00)
 - **Duration:** A length of time, like 1 day and 1 hour 10 minutes or #duration(01,01,10,0)
 - **Null value:** null
 - **Boolean Value:** Either true or false

- A new query that is created with the Power Query tool uses a let expression.
- A let expression is designed to combine all query steps (that is, expressions) to deliver a final value. The final value delivered by the let expression is what the query delivers as its result.
- The rules for a let expression are:
 - Start the let expression with **let**.
 - Start each query step with an identifier (the query step name), followed by an equal sign, then an expression, then (if it is not the last step) a comma to indicate that the query step delivers a reusable value (a variable). The identifier can be used in other locations in the let expression and is usually used immediately in the subsequent step. Although the identifier can be used anywhere within the let expression, it cannot be accessed outside the let expression.
 - Ensure that the last query step does not end with a comma.
 - End the let expression with **in** followed by the identifier for the final value to be delivered by the new query. The result of the query is almost always the identifier of the last query step.
- When you create a query, the query can be used in other queries in the workbook.

Power Query Data Source Settings

You can adjust the data source settings by going to the Data tab in the Excel Ribbon, Get & Transform group, Get Data dropdown arrow, then click on Data Source Settings, as shown in picture below. You can change settings such as:

1. Point Power Query to a new “.csv” file, so query can get the latest data. As shown in Example 5.
2. Change the “On-premise” file location, when a file changes location. As shown in Example 6.
3. Adjust settings for an on-line SQL database. As shown in example 10.



Power Pivot

Power Pivot creates **Data Model PivotTables** and does these things:

- 1 Allows you to create **relationships between related tables** to avoid many lookup formulas like XLOOKUP
- 2 Allows you to use **more than one table** in a Data Model PivotTable Report
- 3 Allows you to **import large amounts of data** into a behind the scenes Data Model location called the "Columnar Database", which compresses data and can hold millions of rows of data
- 4 You can **create re-usable, formattable DAX Measures** (Formulas used in Data Model PivotTable)
There are about 250 DAX functions which allow you more varied calculations than a Standard PivotTable



You must add Power Pivot as an add-in so that the Power Pivot tab in the Excel Ribbon will show up:

File, Options, Add-ins, Manage dropdown, Com- add-ins, Check Box for Microsoft Power Pivot for Excel

Notes about Power Pivot from my book *The Only App That Matters*:

Power Pivot

Microsoft introduced the Power Pivot tool in 2009 to help deal with big datasets and complex calculations involving multiple tables. When you are working with a dataset that has 50,000 rows of data or more and you want to create summary PivotTable reports with conditional calculations, or when you have multiple tables that work together to create reports and visualizations, it can be worthwhile to use Power Pivot. However, as you will see in this example, even when you have a small dataset, there are some advantages that make using the Power Pivot tool worthwhile.

Power Pivot consists of three components that together are considered the *Data Model*, which is the source of data for Data Model PivotTable reports and PivotChart visualizations:

- **In-RAM columnar database:** This database efficiently compresses data to a small file size and stores data so that DAX formulas can work quickly with big data. When you load data to the Data Model, the behind-the-scenes columnar database is where the data is stored.
- **Relationships:** Relationships are created between related tables and can replace worksheet lookup formulas. Relationships help reduce the complexity of DAX formulas, allow you to drag and drop fields from multiple tables in a PivotTable report, and work as a filtering mechanism to reduce the size of tables when DAX formulas are evaluated.
- **DAX (Data Analysis Expressions):** DAX is a function-based formula programming language that contains more than 250 functions and works in conjunction with the columnar database and relationships to create efficient formulas. DAX formulas are programmed to work efficiently with big data and can significantly reduce the number of intermediate steps in complex calculations by creating columns and tables within formulas. DAX formulas can deliver *DAX measures* (which are premade, preformatted, drag-and-drop formulas), *DAX calculated columns* (which are fields in tables), or *DAX tables*. DAX includes many functions that are almost identical to Excel worksheet functions, such as SUM, AVERAGE, and EOMONTH, as well as functions that are unique to DAX, such as RELATED, SUMX, and CALCULATE.

Viewing the Power Pivot Data Model

After you use Power Query to load a table to the Data Model, you can open the Power Pivot for Excel window and see a preview of the table by clicking the Manage Data Model button in one of two locations:

- The Data Tools group in the Data tab of the Excel Ribbon, as shown in Figure 18.80
- The Data Model group in the Power Pivot tab in the Excel Ribbon, as shown in Figure 18.81

Note: I tend to use the Manage Data Model button in the Data tab because I often have that tab open. Also, the keyboard shortcut for the Manage Data Model button in the Data tab is Alt, A, D, M, which is easy to remember because it includes **D** (Data) and **M** (Model).

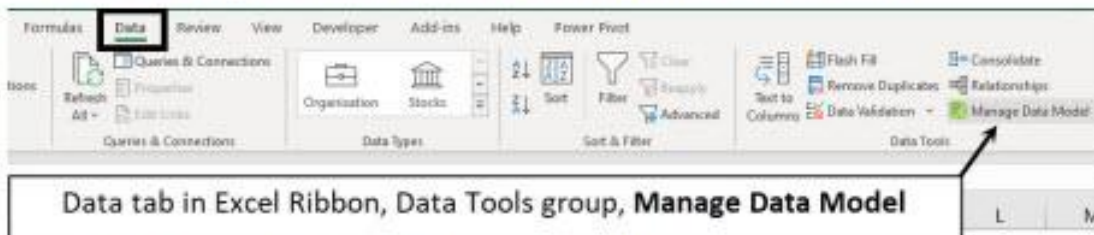


Figure 18.80 To view the Data Model, you can use the Manage Data Model button in the Excel app Data tab.



Figure 18.81 To view the Data Model, you can use the Manage Data Model button in the Excel app Power Pivot tab.

The Power Pivot for Excel Window and User Interface

To take a look at the Power Pivot for Excel window, follow these steps:

1. To view the Data Model and open the Power Pivot for Excel window, click the Manage Data Model button or use the keyboard shortcut Alt, A, D, M. Figure 18.82 shows the Power Pivot for Excel window.

In this figure, you can see the Power Pivot Ribbon with the File menu and three tabs: Home, Design, and Advanced. The Power Pivot for Excel window opens as a new window that sits on top of the Excel app window. This window is where you work directly with the Data Model to preview data that is stored in a columnar database, create relationships, create DAX formulas, and carry out other data modeling tasks. When you open the Power Pivot for Excel window, the Data View button is selected by default so that you have a preview of the table.

The table you loaded in this case contains only 10 rows of data, so you can preview the whole table. When you use the Power Pivot for Excel window to view a table that contains millions of rows of data, you see only a preview of some of the data that is compressed in the columnar database.

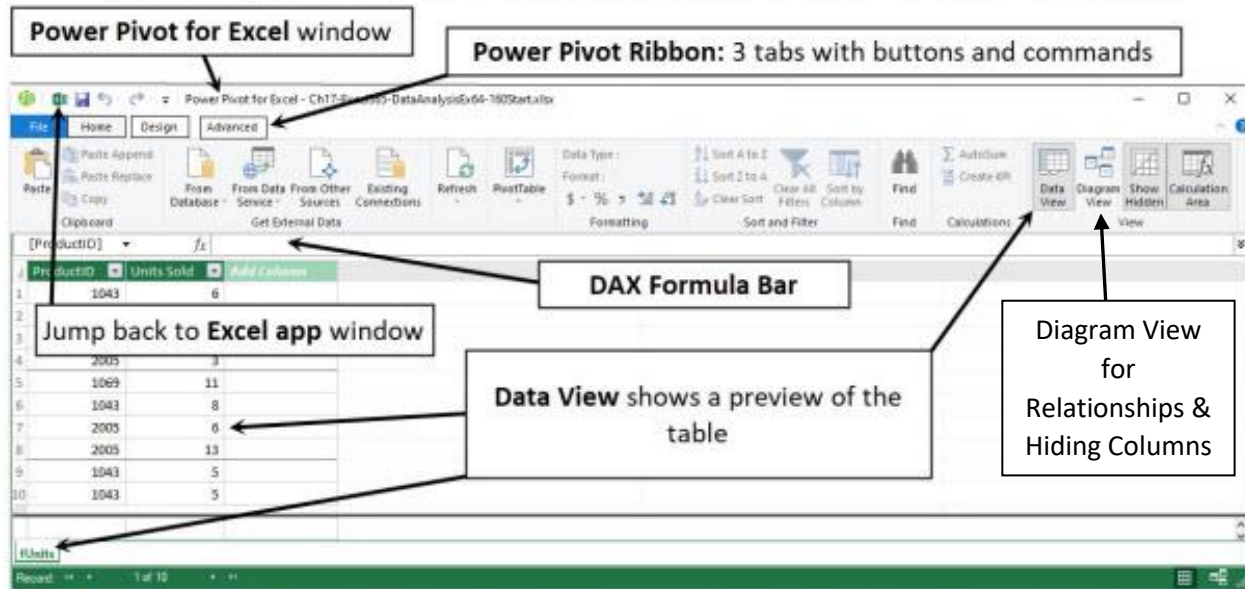


Figure 18.82 The Power Pivot for Excel window shows a preview of the table that was loaded to the Data Model.

Steps to Create DAX Measures

Steps to Create a DAX Measure

To create a DAX measure, you follow these basic steps:

1. In the View group in the Home tab of the Power Pivot Ribbon, make sure that the Calculation Area button is selected. This button hides/unhides the measure grid.
2. Select the table tab where you want to create the measure. The measure you create will appear under this table name in the Data Model PivotTable Fields task pane.
3. Click in a cell in the measure grid below the table.

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4. Type the name of the measure. When you type the name, you are automatically moved to the formula bar. (DAX formulas can only be typed out in the formula bar.) The name you typed will appear in the Data Model PivotTable Fields task pane, so be sure to use a name that the user will understand.
5. Type the assignment operator := (a colon followed by an equal sign).

Note: An *assignment operator* is a symbol used to tell a program that everything after it is the formula. Whereas Excel worksheet formulas, Power Query M code formulas, and Power BI DAX formulas all use an equal sign as the assignment operator, Power Pivot uses a colon followed by an equal sign.

6. Type your DAX formula and then press Enter.
7. Add number formatting to the formula from the Formatting group in the Home tab of the Power Pivot Ribbon. You can also right-click the cell in the measure grid that contains the formula and select Format.

Note: The number formatting you add to the cell in the measure grid that contains the measure is attached to the formula and will show up any time you use the measure in a report or visualization.

8. If you want to add a description, right-click the cell in the measure grid that contains the formula, click on Description, and enter a description.
9. To edit the measure, go back to the measure grid or navigate to the Calculations group in the Power Pivot tab in the Excel Ribbon, click the Measure dropdown arrow and select Manage Measures, and then, in the Manage Measures dialog box, select the measure and click the Edit button.

As you can see in these steps, when you create a DAX measure, you create the name of the measure, type the assignment operator, and type the formula all in one place (that is, *Name of Measure := Formula*). In addition, although you can create measures in the measure grid, there is a dialog box for creating measures that you can access from the Power Pivot tab in the Excel Ribbon. I rarely use this dialog box, though, because it does not let me decide where to place the measure in the measure grid. I like to manually place my measures in the measure grid so that I can neatly organize them in different rows.

Filter Context for DAX Measures

Filter context allows DAX measures that are used in a PivotTable, PivotChart, or Power BI visualization to automatically use the conditions and criteria in the Rows, Columns, or Filters areas to make conditional calculations. This is the context part, where the DAX measure can see the surrounding situation and pick out all the conditions in the context of the report or visualization. In addition, when the behind-the-scenes Data Model engine evaluates the DAX context, it does not use the full fact table but instead uses only rows that match the conditions. This is the filter part, as the underlying tables are filtered down to a smaller size so that the formula has less work to perform and can make the calculation more quickly. To see a great video presentation of how Filter Context works, see MECS video #4 at the 01:57:21 minute mark.

Explicit Measures vs. Implicit Measures

Notes about Power Pivot from my book *The Only App That Matters*:

Implicit Measures: Why They're Problematic and When to Use Them

The mistake I just mentioned has to do with creating something Microsoft calls *implicit measures*. To see what happens, drag the Sales (\$) field from the fUnits table down to the Values area in the task pane, as shown in Figure 18.129. You get the correct product sales amounts in each row of the report when you do this, but there are a number of drawbacks.

Product	Total Sales (\$)	Sum of Sales (\$)
Aspen	658.90	658.9
Quad	1,150.80	1150.8
Sunspot	482.90	482.9
Grand Total	2,292.60	2292.6

Do NOT drag fields to
Values area.
This action creates:
~~Implicit Measures~~

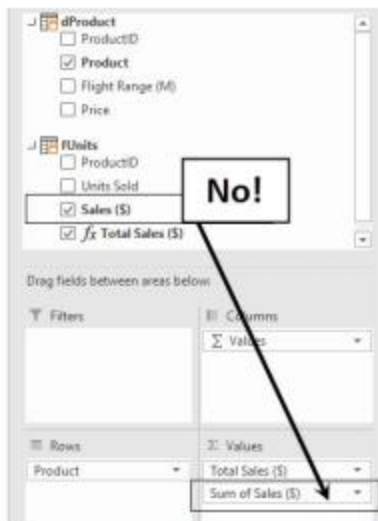


Figure 18.129 When you drag a field to the Values area, an inefficient implicit measure is created.

When you drag a field from a table into the Values area of a Data Model PivotTable, Power Pivot creates a read only measure in a hidden behind the scenes location. Microsoft calls this hidden measure an *implicit measure*. When you author your own measure, as you did with the Total Sales (\$) measure, Microsoft calls that an *explicit measure*. Implicit measures can sometimes get the right calculation results, but they do so in an inefficient way.

Implicit measures have a number of drawbacks, including:

- By default, implicit measures are hidden in the Data Model.
- The measures do not appear in the PivotTable Fields task pane, and therefore you cannot reuse them in other reports or visuals.
- You cannot edit the name or the formula part of an implicit measure.
- You cannot attach number formatting to an implicit measure. (However, you can manually add number formatting in the report or chart.)
- When you create multiple implicit measures in a data model, duplicate or unnecessary implicit measures may be created.

When you create an explicit measure, you have complete control of the formula in the measure: You can edit the name, edit the formula, add number formatting to the formula, use the formula over and over, and share your data model online.

It is important to know how to look for and delete implicit measures because you may at times accidentally drag fields to the Values area of the PivotTable Fields task pane or inherit a Data Model PivotTable that contains implicit measures. Here's the process:

1. As shown in Figure 18.130, to show the implicit measure for the fUnits table, click the Show Implicit Measures button in the Advanced tab of the Power Pivot Ribbon. The implicit measures are now highlighted in the measure grid.
2. Select the cell that contains the implicit measure. Notice in the formula bar that everything is grayed out and cannot be edited, including the number formatting. You can see the grayed-out measure in the formula bar in Figure 18.130.
3. To delete the implicit measure, select the cell that contains the implicit measure and press Delete. In the Confirm dialog box, click the Delete from Model button.

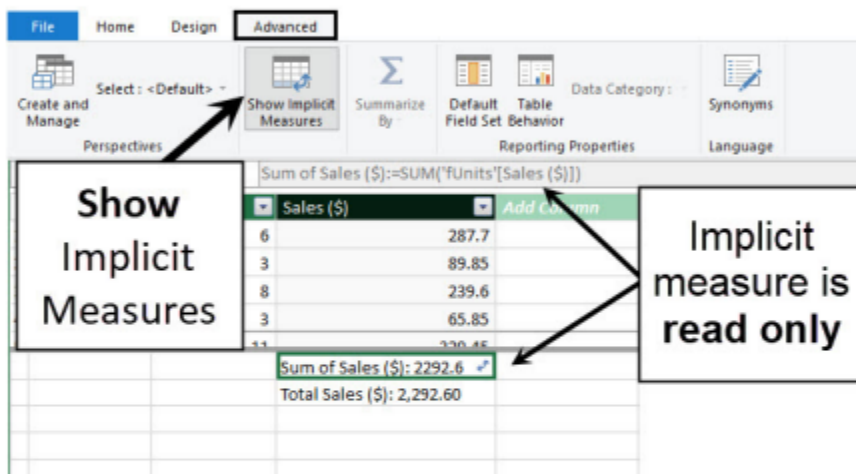


Figure 18.130 The Show Implicit Measure button is in the Advanced tab of the Power Pivot Ribbon.

When you delete an implicit measure, it is removed from the measure grid and from the Data Model PivotTable. In general, as you work in the Data Model, it is a good idea to have the Show Implicit Measure button selected in case you encounter implicit measures.

You have already seen that implicit measures are inefficient, but there are some situations where they're useful. For example, if you have some big data datasets and you just want a quick report, it can be okay to load a big data flat table to the Data Model and use implicit measures. For example, say that you get a large amount of single-column text data, and you want to quickly create a frequency distribution that shows counts and percentages by category. (You saw an example of this sort of frequency distribution in Example 2 in Chapter 17.) In this case, you can import the data by using Power Query, load it to the Data Model, and drag the text field to the Values area, thereby creating an implicit measure for the frequency calculation. Then you can drag the text field to the Values area a second time and use the standard PivotTable Show Values As, % of Column Total feature to create the percentage frequency calculation. In this case, you would be mixing and matching a Data Model PivotTable with a standard PivotTable. Specifically, you would be creating a Data Model implicit measure for counting and a standard PivotTable Show Values As, % of Column Total calculation for the percentage calculation. In this example, the potential benefits of the quick-and-easy Show Values As calculation outweigh any inefficiencies of the implicit measure.

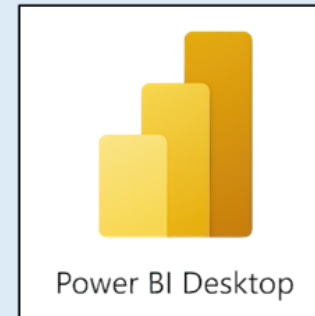
Advantages of Power Pivot & Data Model as listed in MECS Video #4 at 02:06:37 minute mark:

1. Relationships rather than many XLOOKUP formulas
2. Multiple Tables in one PivotTable Report
3. Reusable & Formattable DAX Measures
4. The Columnar Database allows you to use tables with millions of rows of data
5. Hide Unnecessary Field
6. Filter Context helps with Big Data
7. Can Send Data Model to Power BI Desktop

Power BI Desktop

Power BI Desktop does these things:

- Power BI Desktop is a **free Microsoft download**
- Power BI Desktop has the **same tools as Power Pivot & Power Query**
- Power BI has **more varied visuals and reporting tools** than Excel
- The **visuals are interactive**
- There are **more DAX formulas**, including Table Formulas
- You can **import your Power Pivot Data Model** into Power BI Desktop



Power BI Online does these things:

- Power BI Online** requires buying a license. Many entities buy it for employees with M 365 Office
- Upload Power BI Desktop file to Power BI Online to easily share reports, visuals, dashboards and Data Models
- Upload Excel files and Power Pivot Data Models
- When you upload Data Models groups of workers can access the data from within Excel or Power BI Desktop
 - This means there is "One Source of Truth", one location for data. No need to share files by e-mail!
- Create online Workspaces for groups of workers to share reports, visuals, dashboards and Data Models

Live link to download Power BI Desktop: <https://powerbi.microsoft.com/en-us/desktop/>

Note about Data Model / Semantic Model:

Power BI changed the term "Data Model" and "Dataset" to the new term: "**Semantic Model**". "**Semantic Model**" = "**Dataset**" = "**Data Model**".

The definition of a "Semantic Model" / "Dataset" / "Data Model" is:

Semantic models present a mapping of the tables, columns, hierarchies, relationships, measures and other model components that sits between the underlying data sources and the workbooks, reports, dashboards and analysis. Semantic models should match the structure and data security needs of the business. Semantic models serve as the single source of truth that end users can connect to easily and interpret easily so that they can create consistent, data-driven and useful information for decision makers.

Notes about Power BI Desktop and Power BI Online from my book The Only App That Matters on next pages:

The Power BI Desktop and Power BI Online Tools

In 2013, Microsoft combined Excel Power Pivot Data Model tools, such as relationships and DAX formulas, with Excel's Power View and Power Query tools into a free download called Power BI Desktop. Microsoft introduced *Power BI Desktop* (where BI stands for *business intelligence*) as a tool for performing business analytics and creating interactive visualizations to build reports and dashboards.

Power BI Desktop contains these tools, among others:

- **Power Query and M code:** These tools allow you to clean, transform, and import data.
- **The Data Model:** This tool includes the in-RAM columnar database to efficiently store tables of data.

- **Relationships:** Relationships enable data modeling and reporting to occur between related tables.
- **DAX formulas:** You can use DAX to build analytics formulas that work efficiently on big data.

Microsoft introduced the Power BI Online website in 2015. To use Power BI Online, you must buy a Power BI Pro license or higher, and you need to use an e-mail address from an entity that has purchased a bulk license from Microsoft for a product such as Office. You can use Power BI Online to share reports, dashboards, and datasets.

Note: Power Query does not exist in Power BI Online. Power BI Online includes a pared-down version of Power Query called Dataflows, but it does not have the full set of tools. For the full set of Power Query tools, you must use Power BI Desktop when building data models. In this book, you will learn about Power Query in the Power BI Desktop app. You will not learn about Dataflows.

These are the key reasons that you would switch from using Excel to using Excel's Power Query and Power Pivot to using Power BI Desktop and Power BI Online:

- Power BI Desktop is a free tool.
- Power BI offers a larger variety of visualizations than you can get in Excel.
- Visualizations tend to be easier to create and have a cleaner look in Power BI than in Excel. In addition, Power BI visualizations are interactive: Click on one element in a visual, and it filters the other visuals.
- The Data Model in Power BI Desktop and Power BI Online can work with multiple processors to deal with big data more efficiently than can the Power Pivot Data Model.
- You can use DAX table functions to build a table that you can use in the Data Model with the other tables that you import using Power Query. You cannot do this in PowerPivot's Data Model.
- There are more M code and DAX functions in Power BI Desktop and Power BI Online than there are in Excel PowerPivot.
- If you buy a Power BI Pro license or higher, you can publish your Power BI Desktop files and Excel workbook files to Power BI Online and share your results so that they can be viewed on any device. You can easily share data analysis results to help others make smarter, data-driven decisions.
- If you buy a Power BI Pro license or higher, you can publish tables of data and complete data models to Power BI Online to give others access to the data. This makes it possible for multiple people to work with the same data to perform their own specific analyses from a "single source of truth."

Understanding the Power BI Desktop Window and User Interface

As shown in Figure 18.157, the Power BI Desktop app has a number of important features:

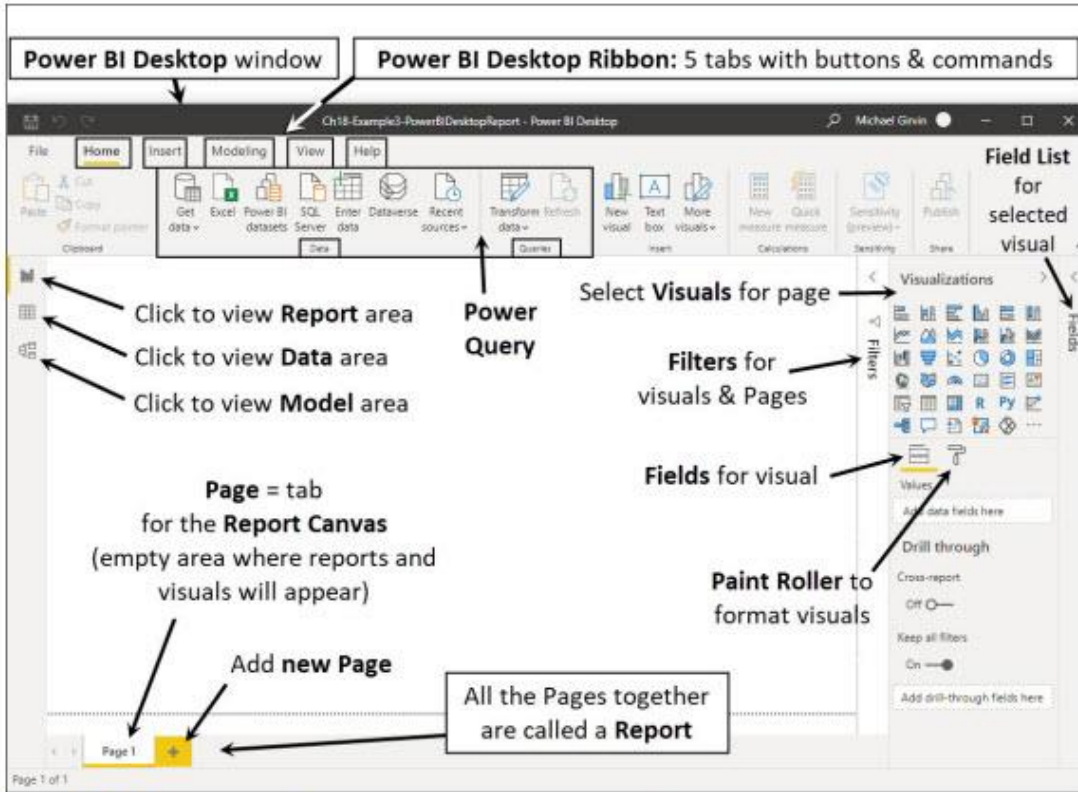


Figure 18.157 The Power BI Desktop window, Ribbon, and user interface.

- **Power BI Desktop Ribbon:** The Ribbon consists of five tabs: Home, Insert, Modeling, View, and Help. Most of your time is spent in the Home and Modeling tabs.
- **Power Query inside the Power BI Desktop:** A number of Power Query buttons and commands are available in the Data and Queries groups in the Home tab of the Ribbon.
- **Pages:** The tabs at the bottom of the Desktop are called *pages*. You use pages to build related reports and visuals. You can have multiple pages that can be interconnected or that can be separate standalone pages. The white area inside a page is called the *report canvas*. All the pages together are called a *report*.
- **Navigation icons:** On the far-left side of the window are three icons you can use to jump to the different areas in Power BI Desktop. Click the *Report View icon* to open the area where you build reports and visuals on pages. Click the *Data View icon* to view and work with tables of data; the Data view in Power BI Desktop is like Data view in Power Pivot. Click the *Model View icon* to view and work with tables, relationships, and other data model elements; the Model view in Power BI Desktop is like Design view in Power Pivot.
- **Task panes:** On the right are three task panes: Visualizations (expanded in Figure 18.157), Fields (collapsed in the figure), and Filters (collapsed in the figure). The Visualizations pane allows you to create and format new visuals and reports. The Fields pane allows you to drag and drop fields and measures into your reports and visuals. The Filters pane allows you to filter reports, visuals, and pages.

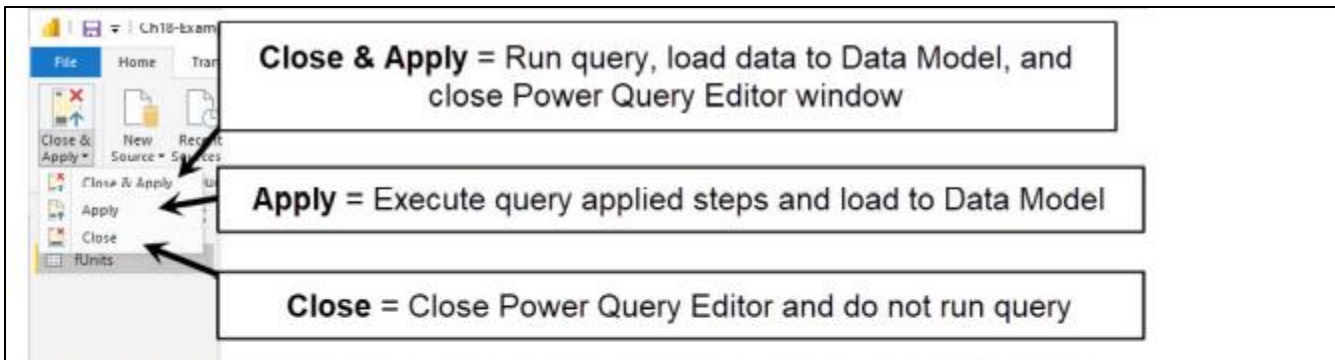


Figure 18.163 There is only one location to load data in Power BI Desktop: the Data Model.

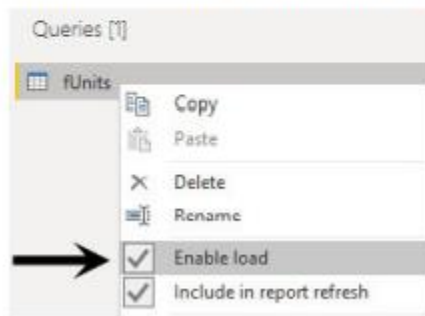


Figure 18.164 Loading a query as a connection only is done differently in Power BI Desktop than in Excel.

Where Is the Queries Pane with All the Queries in Power BI Desktop?

When you create a query in Excel, the Queries & Connections pane opens automatically to show you all the queries in the Excel file. From that pane, you can double-click any query to open the Power Query Editor. But in Power BI Desktop, it is not as obvious how to open the Power Query Editor to view and edit queries. As shown in Figure 18.167, when you need to view or edit an existing query or when you just want to open the Power Query Editor in Power BI Desktop, in the Home tab of the Ribbon, in the Queries group, click the Transform Data dropdown arrow and select Transform Data.

Note: Notice that a Data Source Settings option is available in the Transform Data menu also. This is convenient when you need to edit data source settings because it is listed in the Power BI Desktop Ribbon, and you do not have to open the Power Query Editor to access it.

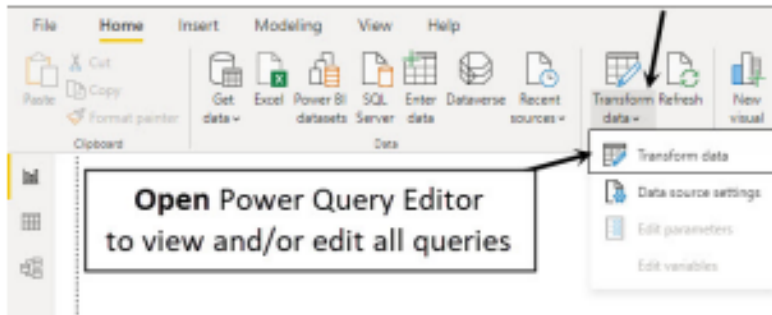


Figure 18.167 How to open the Power Query Editor window to view or edit queries in a Power BI Desktop file.

Using Power Query to Import the Dimension Table from an On-premises Access File

Now that you have imported the fact table from an Excel file, you need to import the dimension table from a Microsoft Access database file. Follow these steps:

1. To import the dimension table from inside the Access file, as shown in Figure 18.168, click the Data View icon to jump to Data view and then, in the Home tab of the Ribbon, in the Data group, click the Get Data dropdown arrow and select More.

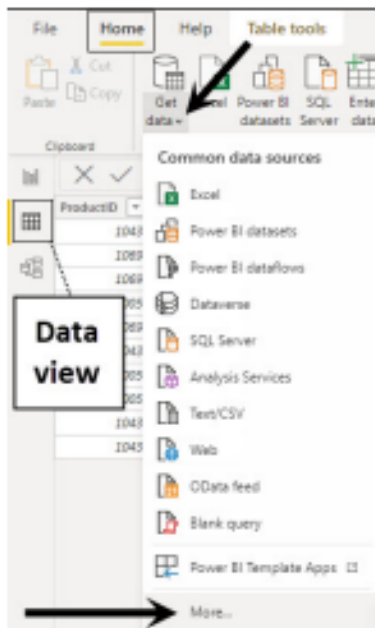


Figure 18.168 Select the Home tab in the Ribbon, Data group, Get Data dropdown arrow, More to open the Get Data dialog box.

- To create a measure for total sales, as shown in Figure 18.177, on the far left on the Power BI window, click the Data View icon and then, on the right side of the Power BI window, in the Fields pane, select the fact table fUnits (which brings up the context-sensitive Table Tools tab). Then, in the Calculations group, click the New Measure button, and the Measure Tools context-sensitive tab appears.

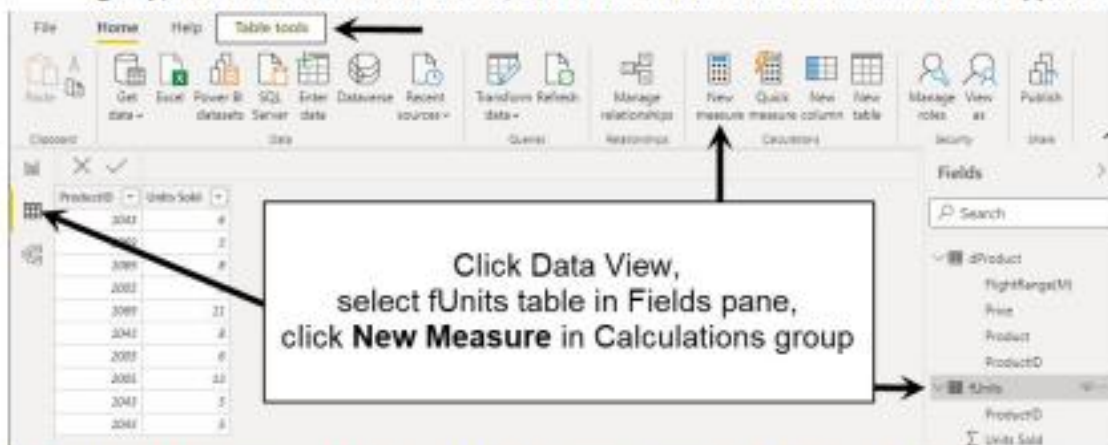


Figure 18.177 Be sure to select the fUnits table before clicking the New Measure button.

- As shown in Figure 18.178, click in the formula bar and create the following measure: **Total Sales (\$)** = SUMX(fUnits,RELATED(dProduct[Price])*fUnits[Units Sold]).

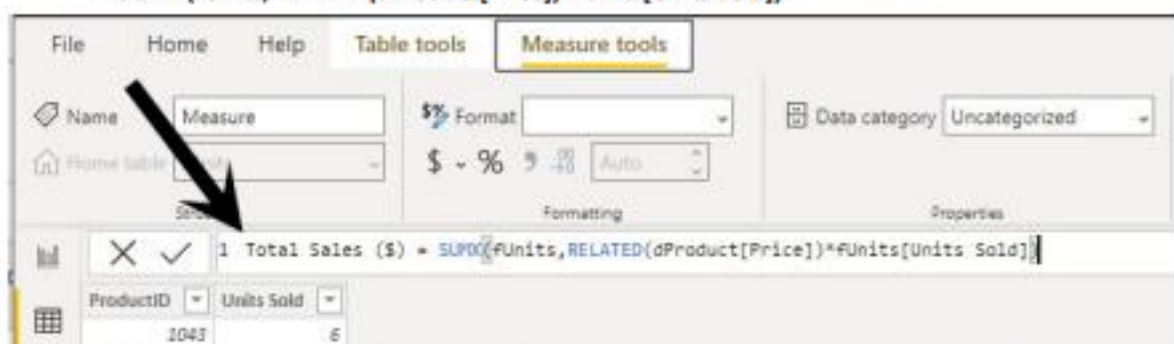


Figure 18.178 Create a one-step measure to calculate the sales amounts for each row in the fact table and then add those amounts.

- Before you press Enter to create the measure, as shown in Figure 18.179, click the Comma button in the Formatting group. By doing this, you apply decimal number formatting with a comma separator to the measure.

Note: Whereas in Power BI the Comma button applies decimal number formatting with a comma separator, in Excel, the Comma button applies comma-separated number formatting.

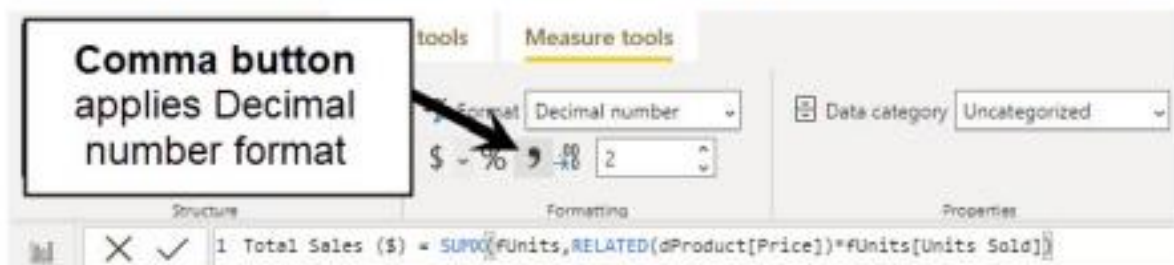


Figure 18.179 With the Measure Tools tab still selected, add decimal number formatting to the measure.

Power BI Online Basics

When you publish a Power BI Desktop file to Power BI Online, you get these benefits:

- You can easily share your data analysis results so they can be viewed on any supported device.
- You can create new reports in the Power BI Online environment.
- You can easily share the in-the-cloud data model from the published Power BI Desktop file so that users can access the published “single source of truth” data model from any Excel or Power BI Desktop file that is open and logged into. This means a data model can be created by someone who has data modeling skills and then shared with others who know how to drag and drop fields and measures to create reports and visuals but who do not have data modeling skills.

To publish to Power BI Online, you must have a Power BI Pro or higher license. Many businesses and entities provide employees with both Microsoft 365 Excel and Power BI Pro license so that they can work seamlessly between Microsoft 365, Power BI Desktop, and Power BI Online. Microsoft 365 Excel and Power BI Pro both must be purchased from Microsoft. The Microsoft 365 E5 version provides both Excel 365 and Power BI Pro. The main benefits of the Power BI Pro or higher license are that you can easily share reports, visuals, and dashboards; you can store data models online for universal access; and you can work collaboratively with teammates in the Power BI Online environment.

Note: Microsoft also offers a Power BI Premium license model that helps you simplify data management and access at enterprise scale. I do not cover the Premium version in this book.

As you learned earlier, Power BI Desktop is a free download. If you do not yet have Power BI Online, you can click the Publish button on the Power BI Desktop Home tab and sign up for a free trial version.

You need to properly log in to all the apps that you want to use so the interaction between the apps is seamless. In both Microsoft 365 Excel and Power BI Desktop, you can log in using the upper-right corner of the title bar. You know you are logged in if your name appears in the title bar. Once you are logged in to both apps, when you publish a Power BI Desktop or Excel file, Power BI Online asks you to log in to the Power BI Online site. You can also log in directly to Power BI Online at the website powerbi.com. Furthermore, if you use the Outlook or Excel Online apps, when you are logged in to them, the app icon in the upper-left corner allows you to jump over to the Power BI Online website, where you will already be logged in. When you log in to any of the Microsoft 365 Online tools, you are automatically logged in to Power BI Online also.

Before you can publish a Power BI Desktop file, you need to log in to Power BI Online and create a workspace. A Power BI *workspace* is a location in the Power BI Online website where you can load Power BI Desktop files and Excel workbook files and create shareable dashboards so that authorized Power BI Pro users can access

the content and collaborate as a team. You can create a workspace with just a few clicks, and then you can add e-mail addresses for the people you want to be able to access the workspace.

Note: There is a location called My Workspace that is for personal use only. When you want to share and collaborate, you use the Workspace option, not the My Workspace option.

Logging In to Power BI Online and Creating a Workspace

To log in to Power BI Online and create a workspace, follow these steps:

1. In a browser, go to the website powerbi.com. Figure 18.204 shows the login screen, where you can sign in to your account or try Power BI for free.

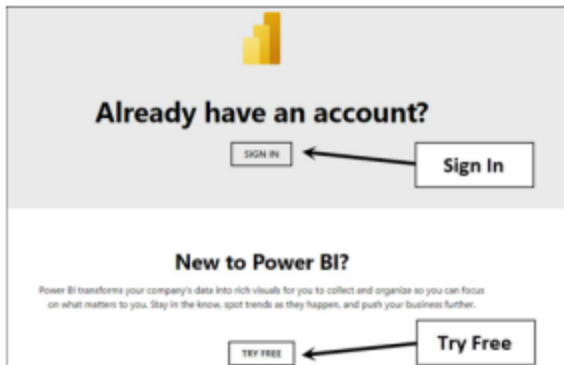


Figure 18.204 *powerbi.com* login window.

Note: In order to try Power BI Pro for free, you need to use an e-mail address from an entity that has purchased a bulk license from Microsoft for a product such as Office. For hacks to get around this requirement, watch this Guy in a Cube YouTube video: https://www.youtube.com/watch?v=uZyy_qqRPiU.

2. When you log in, you see the Power BI Online home page, as shown in Figure 18.205. At the bottom of the navigation pane on the left side of the Power BI home page, expand the Workspaces option and then click the Create a Workspace Button, as shown in Figure 18.206.



Figure 18.205 The home page of Power BI Online offers established workspaces.

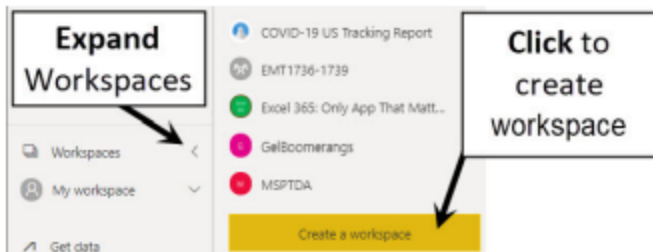


Figure 18.206 Click the Create a Workspace button.

3. In the Create a Workspace dialog box that appears, enter the name **The Only App The Matters** into the Workspace Name textbox (see Figure 18.207). Then, in the Description box, type **This is a workspace for examples from the book The Only App The Matters**. To create this workspace, click the Save button.

Figure 18.207 Enter a workspace name and description and then click the Save button.

4. As shown in Figure 18.208, in the workspace area, click the Access button to add e-mail addresses of people who should have access to the workspace.

Note: You do not have to add any e-mail addresses for this example, but if you want to see the e-mail notification that shows up when you publish content, you can add an e-mail address of your own (a different one from the one you used to sign up) or a friend's e-mail address.

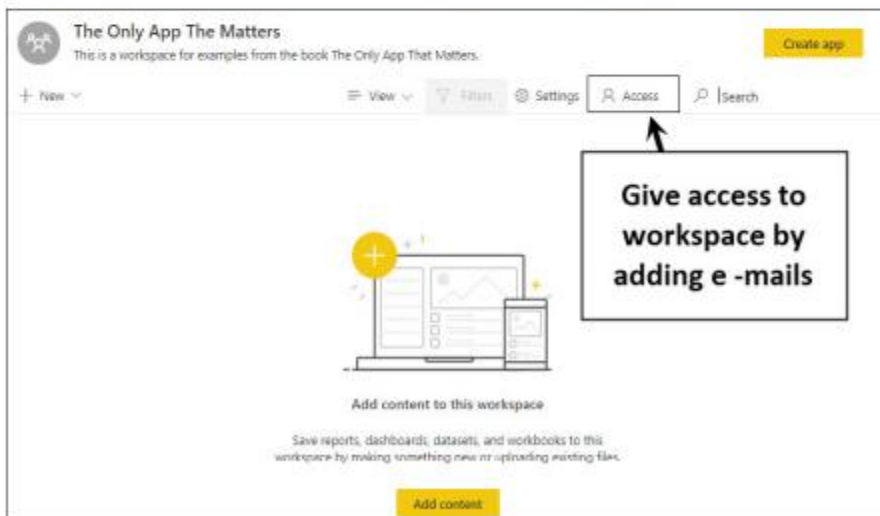


Figure 18.208 The Access button in the new workspace allows you to add users.

5. As shown in Figure 18.209, in the Access dialog box that appears, type an e-mail address, select the workspace role for that person, and then click the Add button. This dialog box makes entering e-mail addresses easy because as soon as you start typing, the e-mail addresses for all the individuals in your entity that

are similar to what you have typed appear in a dropdown list that you can select from. In addition, if you have a list of e-mails separated by semicolons, you can copy and paste them into the e-mail address textbox in the Access dialog box to give all those e-mail addresses access to the workspace.

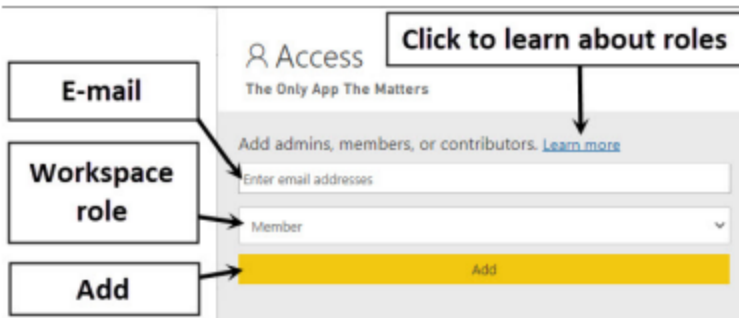


Figure 18.209 Type an e-mail address, select the role, and then click the Add button for each person who should have access to this workspace.

Note: Four different workspace roles are available, each with different capabilities. Table 18.4 lists the roles and the capabilities each one grants. Often, I use the Contributor role because it allows teammates to load and edit content and collaborate to a great degree.

Table 18.4 Admin, Member, Contributor, and Viewer Workspace Roles

Capability	Admin	Member	Contributor	Viewer
Update and delete the workspace	X			
Add/remove people, including other admins	X			
Allow contributors to update the app for the workspace	X			
Add members or others with lower permissions	X	X		
Publish, unpublish, and change permissions for an app	X	X		
Update an app	X	X		
Share an item or an app	X	X		
Allow others to reshare items	X	X		
Feature apps on colleagues' home pages	X	X		
Manage dataset permissions	X	X		
Feature dashboards and reports on colleagues' home pages	X	X	X	
Create, edit, and delete content in the workspace	X	X	X	
Publish reports to the workspace and delete content	X	X	X	
Create a report in another workspace, based on a dataset in this workspace	X	X	X	
Copy a report	X	X	X	
Create goals based on a dataset in this workspace	X	X	X	
Schedule data refreshes via on the on-premises gateway	X	X	X	
Modify gateway connection settings	X	X	X	
View and interact with an item	X	X	X	X
Read data stored in workspace data flows	X	X	X	X

Publishing Power BI Desktop and Excel Files to Power BI Online

Once you have created a workspace, you can publish the Power BI Desktop file and the Excel workbook file that you created earlier in this chapter. These are the two files you will publish in this example:

- Ch18-Fxcel365-AdvancedDataAnalysisStartFx64-155.xlsx
- Ch18-Example3-PowerBIDesktopReport.pbix

When you publish a Power BI Desktop file, the data model and the pages with data analysis results are published. When you publish an Excel file, the data model, any Excel table objects, and the worksheets are published.

To publish the Power BI Desktop and Excel file for this example, follow these steps:

1. To publish the Power BI Desktop file, log in to Power BI Desktop on the right side of the title bar, as shown in Figure 18.210.
2. Make sure your Power BI Desktop file is saved.
3. In the Home tab of the Ribbon, in the Share group, click the Publish button (see Figure 18.210).

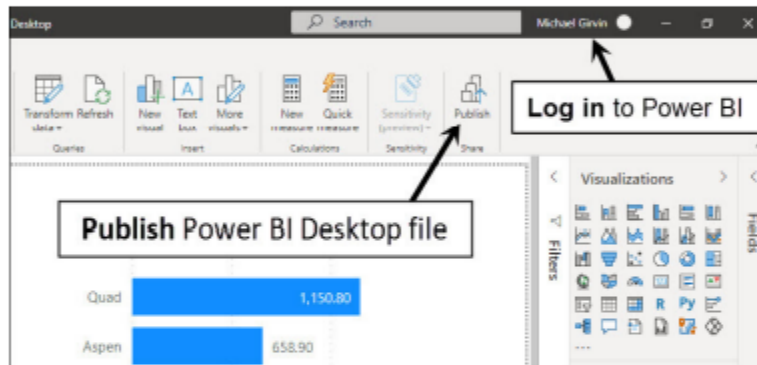


Figure 18.210 Before you publish a file, you must log in.

4. As shown in Figure 18.211, when the Publish to Power BI dialog box pops up, select the workspace where you want to publish—in this case, The Only App The Matters—and then click the Select button.

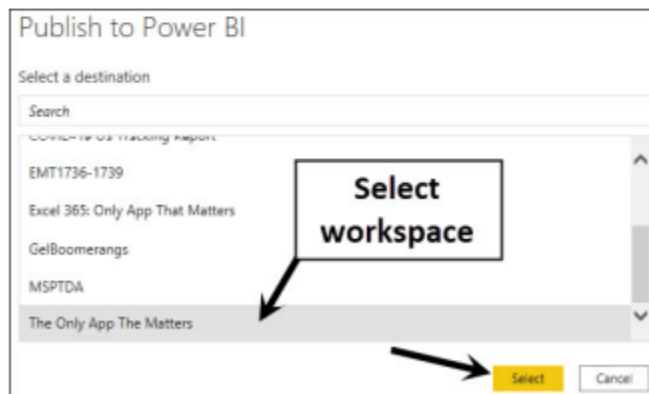


Figure 18.211 You need to select a workspace to publish the file to and then click the Select button.

5. When the Publishing to Power BI dialog box reads Success!, click the Got It button (see Figure 18.212).

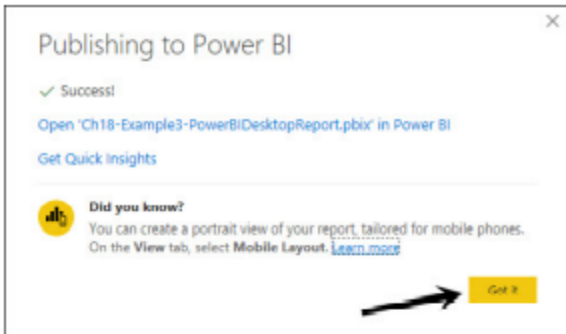


Figure 18.212 Click the Got It button to close the Success! information box.

6. To publish the Excel file, open the Excel workbook file named Ch18-Excel365-AdvancedDataAnalysisStartEx63-153.xlsx.
7. In the Excel file, click File and then click Publish, as shown in Figure 18.213.

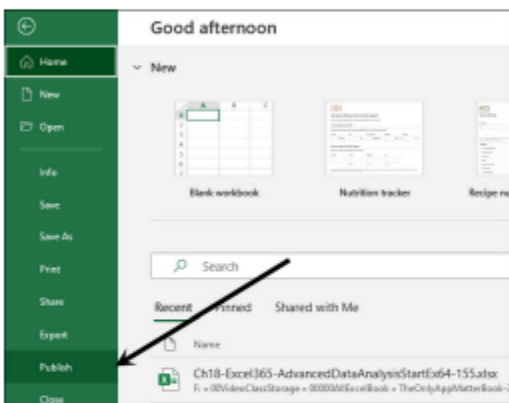


Figure 18.213 To publish an Excel file to Power BI Online, go to the Excel File menu and click Publish.

8. In the Publish dialog box that appears, as shown in Figure 18.214, select the workspace The Only App The Matters from the Select Where You'd Like to Publish in Power BI dropdown. Then click the Upload button to publish the workbook file and the Power Pivot data model.

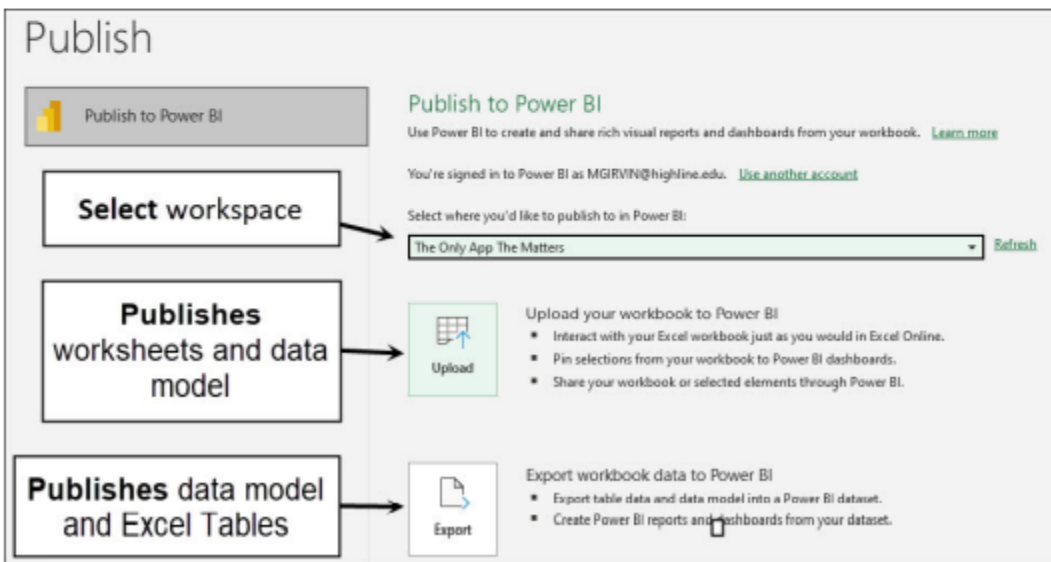


Figure 18.214 Select a workspace to publish to and then select what you want to publish.

You should now see the publishing progress bar pop up in the status bar (see Figure 18.215). Eventually, the workbook should be published, and you should see a yellow banner that indicates the workbook has been uploaded successfully (see Figure 18.216).



Figure 18.215 The status bar at the bottom of the Excel window shows the publishing status.



Figure 18.216 When the workbook is successfully published, a yellow banner appears below the Excel Ribbon.

- Do not click the Go to Power BI button in the yellow banner shown in Figure 18.216. Instead, navigate to the Power BI Online site and then, from the navigation task pane on the left, expand the Workspaces option and click on the workspace The Only App The Matters, as shown in Figure 18.217.

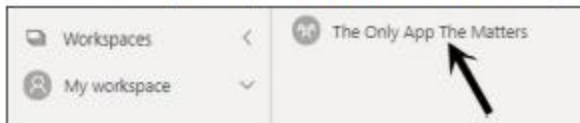


Figure 18.217 In Power BI Online, select the workspace The Only App The Matters.

Exploring What Is Possible Within a Workspace

As shown in Figure 18.218, the workspace home page lists three items in the workspace:

- Report:** The *report* consists of all the pages that were in the Power BI Desktop file when you published it. In your file, you had only one page. If you click Report, the report opens in Power BI Online so that you can interact with it and share it.
- Dataset:** The *dataset* is the published data model. The term Dataset on this screen is somewhat misleading because it is not just a single table or group of tables; rather, it is the full data model, with tables, relationships, DAX measures, and hidden fields. If you click the Dataset link, you get options to create a new report online or to connect to the data model with a new blank Excel workbook file.
- Workbook:** The *workbook* contains the worksheets from the published Excel file and the Power Pivot data model. If you click the Workbook link, all the worksheets open in the Excel Online app.

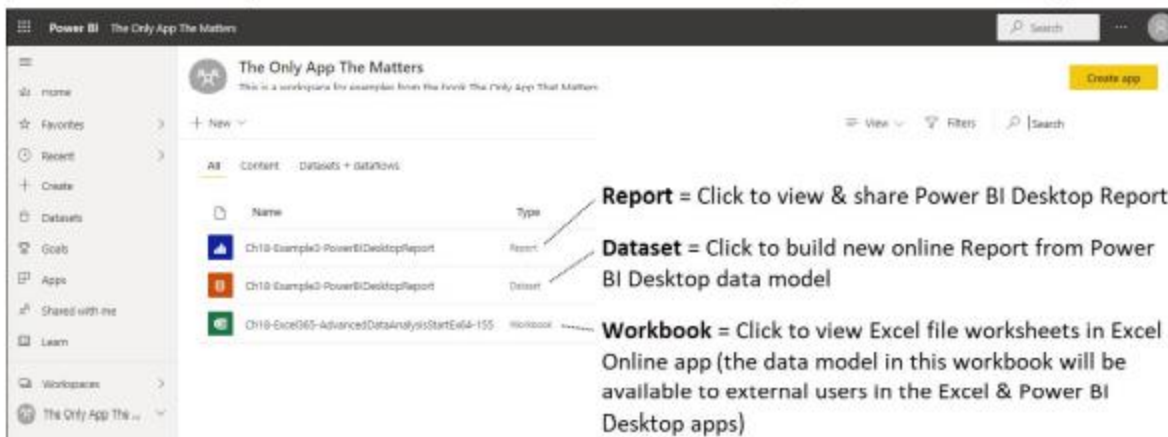


Figure 18.218 Three content items have been published from your two files.

The Excel Online app does not have the full capabilities of Excel 365, but it does allow you to view and interact with the worksheet content.

Note: The Power Pivot data model is not listed as a separate dataset, but if you open any Excel file or Power BI Desktop file, you can access the published Excel file's data model.

To open a published report and explore what is possible within the workspace, follow these steps:

1. To open the report in Power BI Online, in the workspace's Name column, click on the report link. Figure 18.219 shows your report in Power BI Online. You can click the Quad row in the table visual to see that the Quad bar is highlighted here in the online version of Power BI.

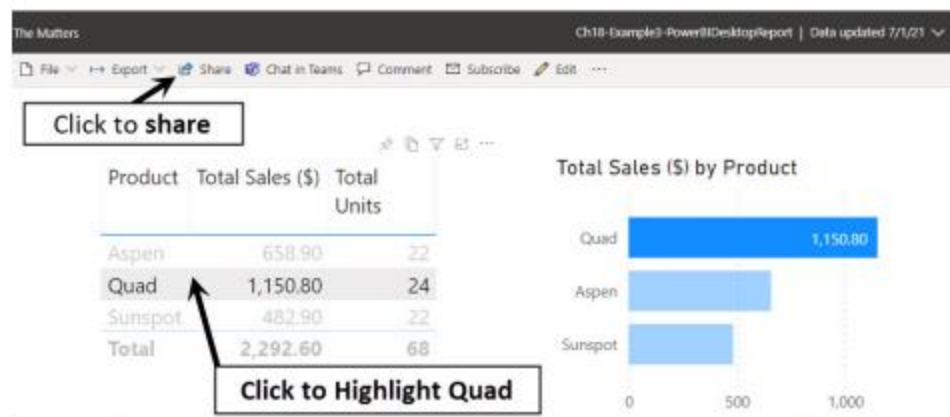


Figure 18.219 When you open the report in Power BI Online, you see that it is interactive and can be shared.

2. Click the Share button above the report canvas, as shown in Figure 18.219, and the dialog box shown in Figure 18.220 pops up. In this dialog box, the Copy Link button copies the report link to the Clipboard. The Outlook button opens the Outlook Online app and prepares an e-mail with a link to the report. The Teams button opens the report in the Teams app. You will not share the report in this case, so click the X button in the upper right to close the dialog box.

Note: Remember that the recipient of a report cannot view the report without a Power BI Pro or higher license.

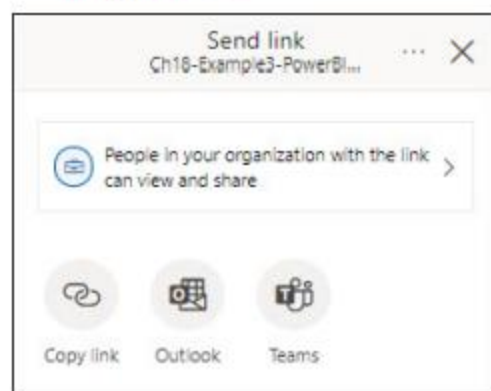


Figure 18.220 In this dialog box, you can copy a link to the report, open Outlook online to share, or share in Teams.

3. To navigate from the online report view back to the workspace home page, click the back arrow in your browser.

- To use your data model to create a new online report, click the three vertical dots to open a menu of options and, as shown in Figure 18.221, click Create Report. (Note that this menu also offers other useful options, like Delete and Rename.)

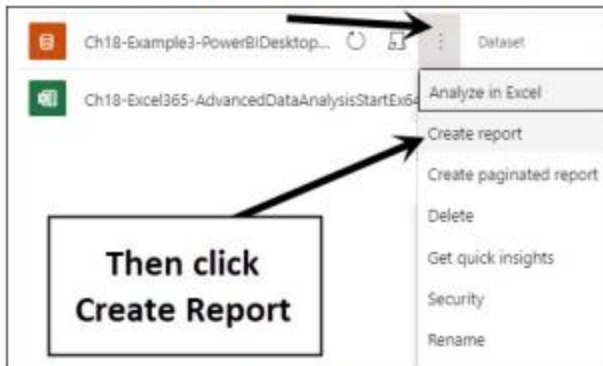


Figure 18.221 To create a report in the online environment, click the three dots icon and select click Create Report.

- When the Report view opens in Power BI Online, note that it looks almost identical to the Report view in Power BI Desktop. As shown in Figure 18.222, create a column chart for Total Sales by FlightRange(M).

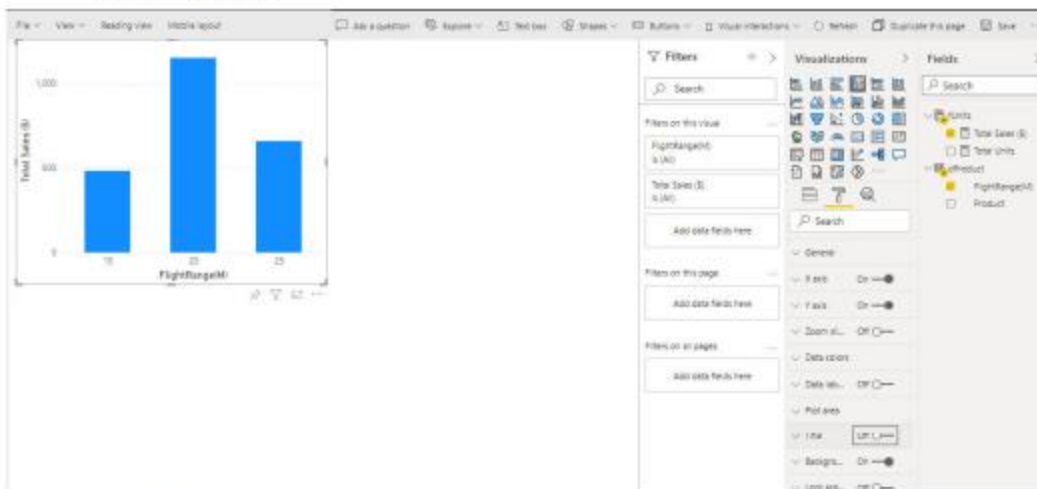


Figure 18.222 The Report view in Power BI Online is almost exactly the same as in Power BI Desktop.

- Save the new report by pressing Ctrl+S and name the report **MyFirstOnlinePowerBIReport**, as shown in Figure 18.223. Then click the Save button.

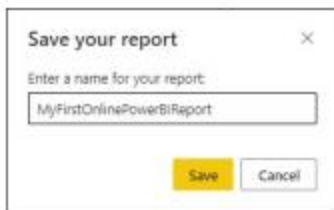


Figure 18.223 Press Ctrl+S to save the report you created in Power BI Online to the workspace.

- To see where the new report is saved, in the navigation pane on the left, expand the Workspaces option and click on the workspace The Only App The Matters. Figure 18.224 shows that there are now four items listed in the workspace, and the new report is the bottom item. You can view and share this new report just as you would any other report.

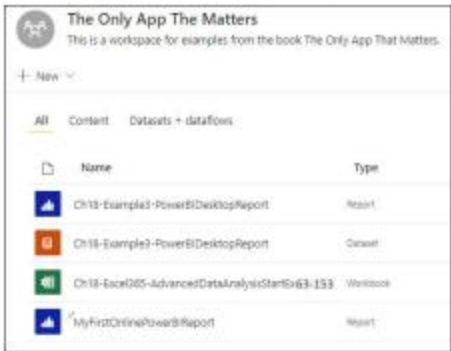


Figure 18.224 The new report is shown in the list of items in the workspace.

- To view the published Excel file, navigate back to the list of items in the workspace home page and click the Excel workbook link. As shown in Figure 18.225, when you click on a Workbook link, Power BI opens the Excel Online app inside the Power BI Desktop app and allows you to click on worksheet tabs to view content. This content is interactive, but it does not give you all the capabilities you would have in the Excel 365 app.

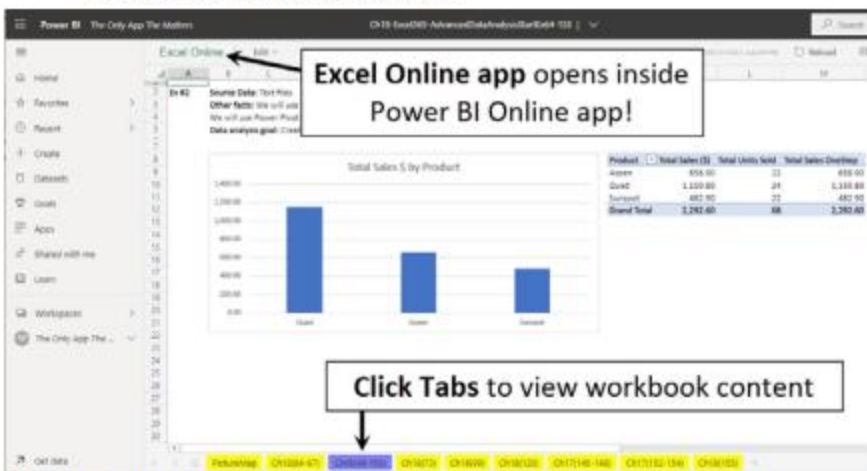


Figure 18.225 When you click to view the Excel file, the Excel Online app opens inside Power BI Online.

- To connect to a Power BI Online dataset in an Excel 365 workbook and make a PivotTable report, open a blank Excel workbook file and log in to Microsoft 365 using the login option on the right side of the title bar. Then click on the Insert tab in the Excel Ribbon and, in the Tables group, click the PivotTable dropdown arrow and select From Power BI, as shown in Figure 18.226.

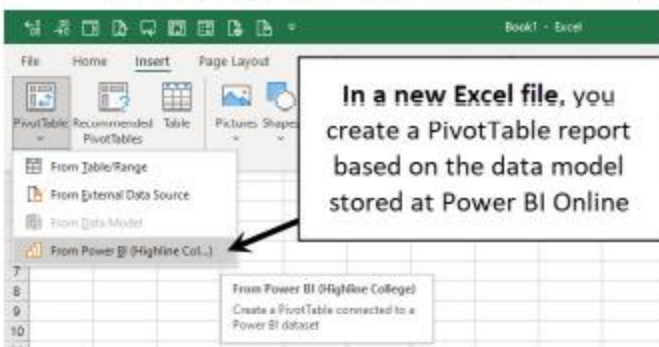


Figure 18.226 If you are logged in to Excel 365 and have access to a workspace, you can build a PivotTable based on online data from that workspace.

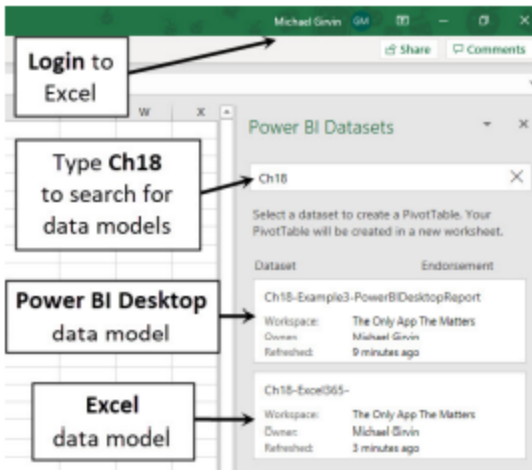


Figure 18.227 In the Power BI Datasets task pane, you can search for Power BI Online data models.

10. As shown in Figure 18.227, when the Power BI Datasets task pane appears on the right, type **Ch18** into the search textbox. The Power BI Desktop data model and the Excel data model appear in the task pane.
11. In the Power BI Datasets task pane, click the Excel data model to connect to the online data source. When you click this online data source, you are not downloading the data model but instead connecting to the data model that lives at the Power BI Online server.
12. As shown in Figure 18.228, from the PivotTable Fields task pane, drag and drop the fields and measures necessary to make a product report that shows total sales and total units. When you are done, you can save the Excel file to your computer. (You will not use this newly created Excel file again, however. I just wanted to show you how to create a PivotTable report based on Power BI Online data.)

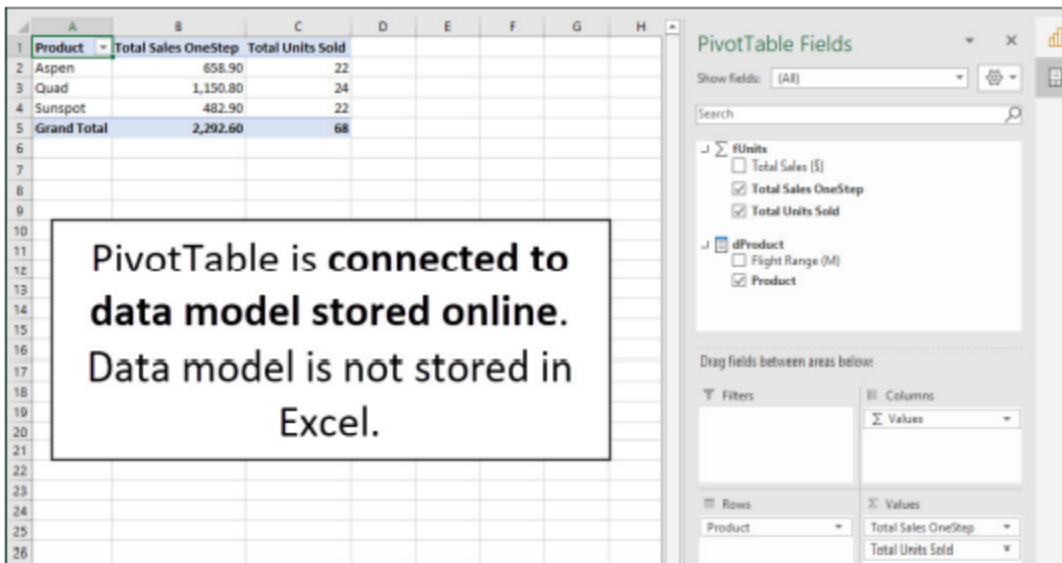


Figure 18.228 When you connect to a data model from Power BI Online, you use the PivotTable user interface to build reports.

13. To connect to a Power BI Online dataset in a Power BI Desktop file, open a blank Power BI Desktop file and save the file to your computer. Then, as shown in Figure 18.229, in the Home tab of Power BI Desktop, go to the Data group and click the Power BI Datasets button. After connecting to the Power BI Desktop data model, create a column chart that shows total sales by product. Save the report. (You will not use this newly created Power BI Desktop file again, however. I just wanted to show you how to create a new report based on Power BI Online data.)

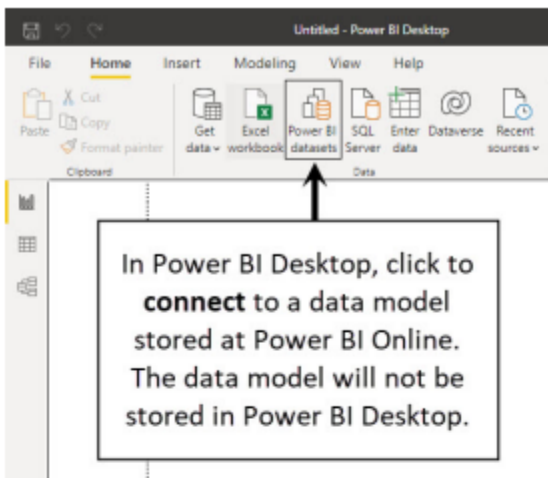


Figure 18.229 If you are logged in to Power BI Desktop, you can connect directly to online data models.

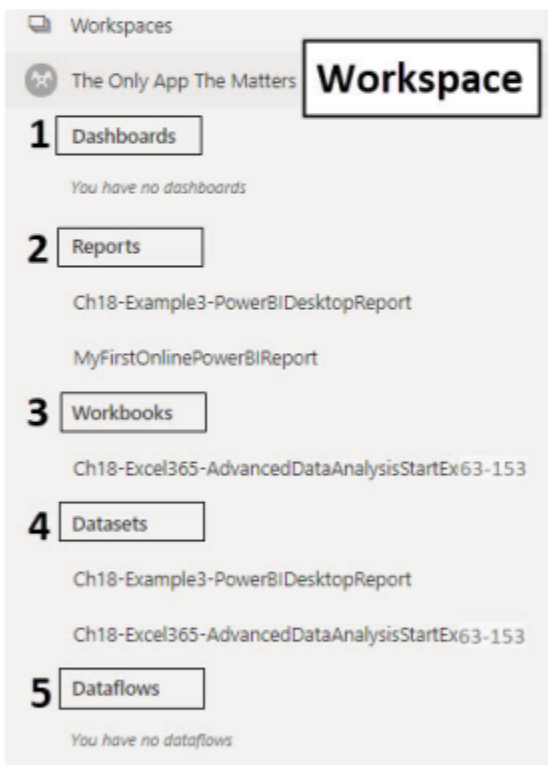


Figure 18.230 Five sections in this workspace.

view and interact with the information to gauge performance, see patterns and trends, and gain insights. The general term *dashboard* can refer to a dashboard created on an Excel worksheet or on a page in Power BI Desktop. However, in the Power BI Online environment, the term *dashboard* refers to a dashboard created and saved in the Power BI workspace.

A Power BI Online dashboard has an important advantage over a dashboard on an Excel worksheet or a Power BI page: It allows you to pick and choose dashboard elements from any published Power BI report or Excel file in a workspace and pin them all in the dashboard location so that the dashboard can be easily shared. Within a given workspace, you have the freedom to pin an entire page from a Power BI report, just an element of a Power BI page, or a section from a published Excel worksheet to your dashboard.

14. Navigate back to Power BI Online and, to see the full list of items that are stored in the workspace The Only App The Matters, in the navigation pane, expand the Workspaces option and click on the workspace The Only App The Matters. Figure 18.230 shows the different sections of the workspace and the items stored in each section:

- **Dashboards:** This section lists the dashboards in the workspace, where each dashboard is a collection of pinned Power BI visuals, Power BI pages, or ranges selected from an Excel Online worksheet from within the workspace. Figure 18.230 shows that you do not have any dashboards yet, but you will create one next.
- **Reports:** This section lists the reports in the workspace that have been published from Power BI Desktop or that have been created with the Power BI Online website. Figure 18.230 shows that there are two reports: the one you published from Power BI Desktop and the one you created in Power BI Online.
- **Workbooks:** This section lists all published Excel workbooks for the workspace. Figure 18.230 shows that there is one published Excel workbook.
- **Datasets:** This section lists all published datasets (that is, data models or Excel Tables) for the workspace. Figure 18.230 shows that there are two datasets: the data model you published from Power BI Desktop and the data model you published from inside the Excel Power Pivot tool in the Excel file.
- **Dataflows:** This section lists the dataflows for the workspace. *Dataflows* are data sources created using the Dataflows online tool. Figure 18.230 shows that you have no dataflows. You will not learn how to use Dataflows in this book.

Creating a Dashboard in Power BI Online

As described earlier in this chapter, a dashboard can contain reports, charts, visualizations, and other useful information in one location so that decision makers can

To create a Power BI Online dashboard, follow these steps:

- Go to your The Only App The Matters workspace and, in the Reports section of the navigation pane, click on the MyFirstOnlinePowerBIReport report. Then, as shown in Figure 18.231, hover your cursor over the lower-right corner of the column chart visual to expose the Pin Visual icon. Click this icon to pin the visual to a new dashboard.

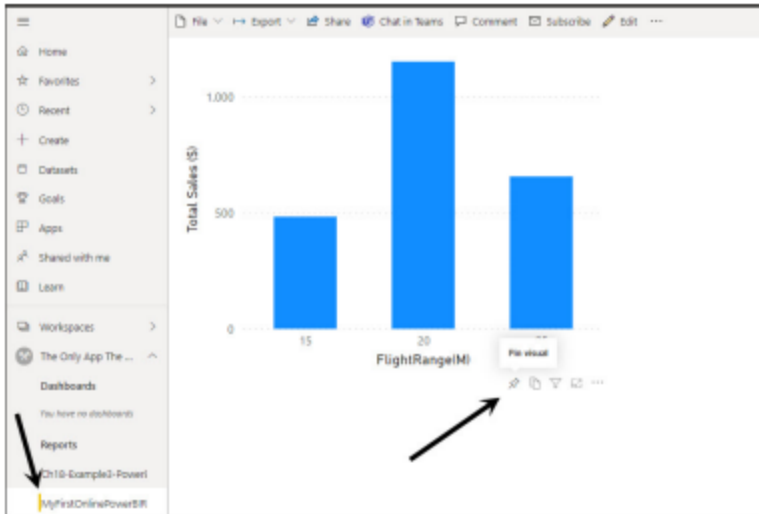


Figure 18.231 The Pin Visual icon on column chart allows you to pin the chart to a dashboard.

- In the Pin to Dashboard dialog box that appears, click the New Dashboard option button and then, in the Dashboard Name textbox, type the dashboard name **MyFirstPowerBIOnlineDashboard** (see Figure 18.232).

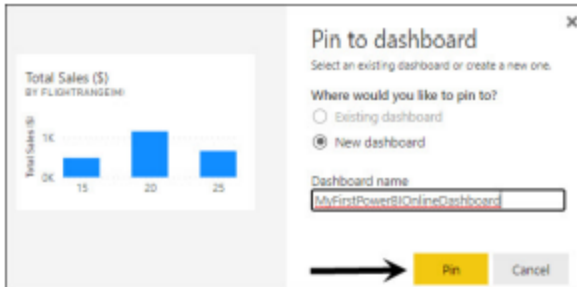


Figure 18.232 Since there are no dashboards in this workspace, you need to create a new dashboard.

- To create the new dashboard, click the Pin button in the Pin to Dashboard dialog box. Then, as shown in Figure 18.233, you can see the newly created dashboard listed in the Dashboards section of the workspace.

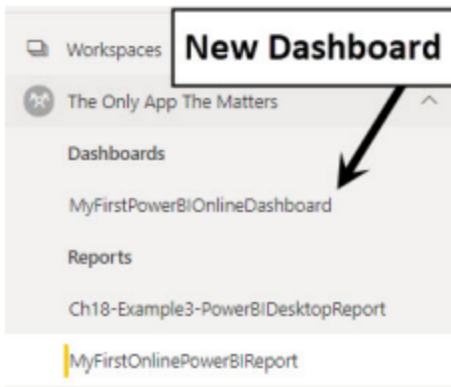


Figure 18.233 The new dashboard appears in the Dashboards section of the workspace.

18. In the Reports area of the navigation pane, click on the Ch18-Example3-PowerBI Desktop Report report. Then, as shown in Figure 18.234, in the upper-right corner, click the three dots icon and select the Pin to a Dashboard option.

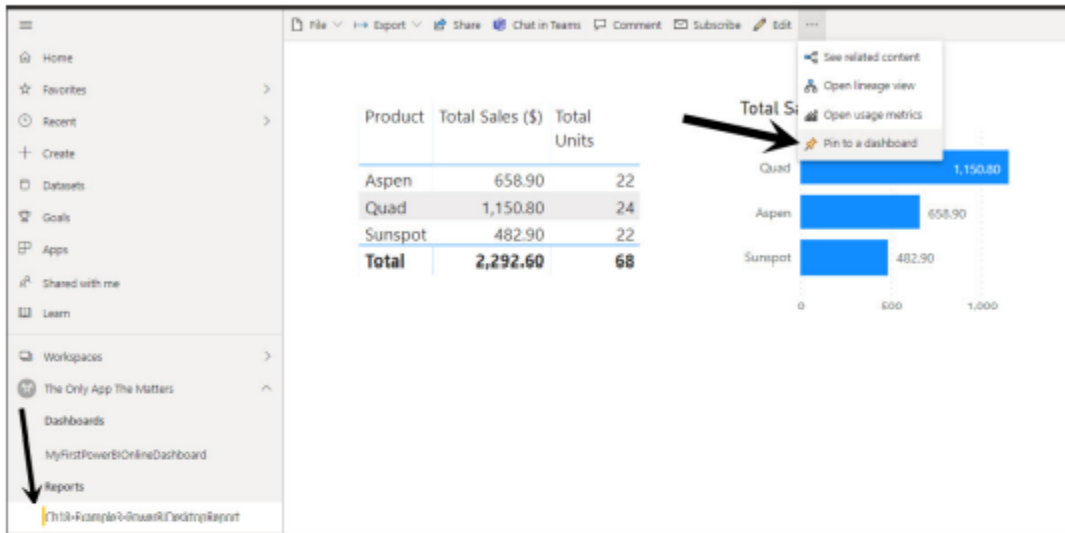


Figure 18.234 Pin the page from the Ch18-Example3-PowerBI Desktop Report report.

19. In the Pin to Dashboard dialog box that appears again, click the existing dashboard option button and then, from the Select Existing Dashboard dropdown, select the dashboard named MyFirstPowerBIOnlineDashboard (see Figure 18.235). To pin to an existing dashboard, click the Pin Live button.

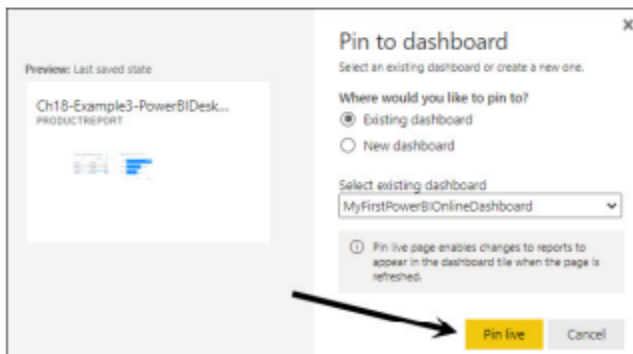


Figure 18.235 Link the page to the existing dashboard.

20. In the Workbooks area of the navigation pane, click on the Ch18-Excel365-AdvancedDataAnalysisStartEx63-153 workbook. Then, as shown in Figure 18.236, select the range J8:M12 on the worksheet named Ch18(67-153) and click the Pin button in the upper-right corner of the Excel Online window.

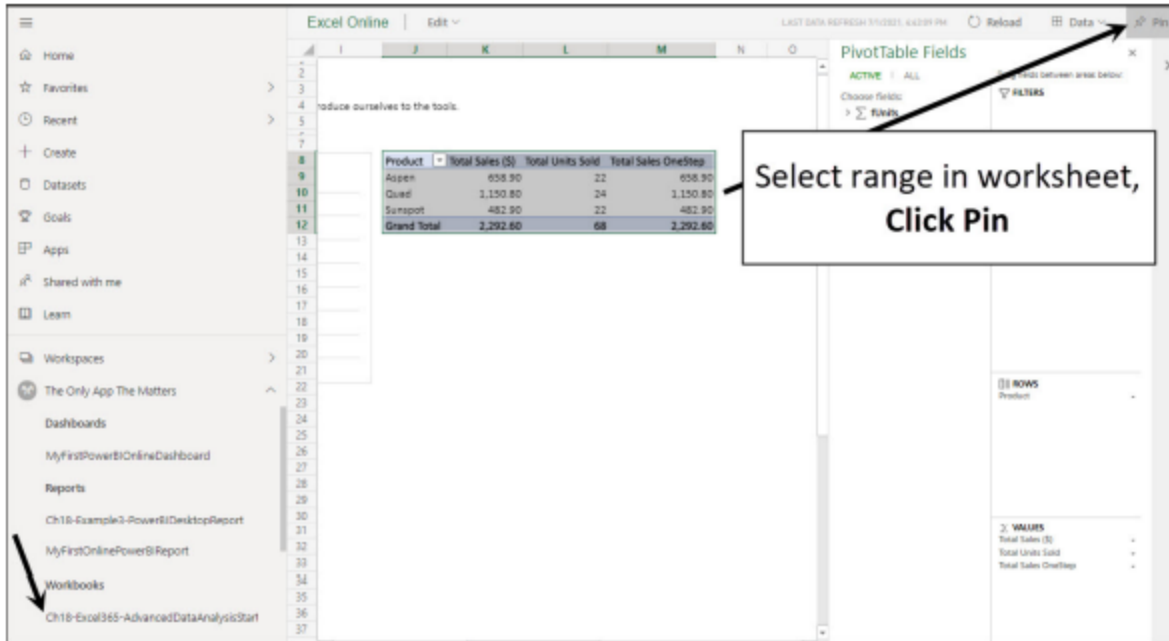


Figure 18.236 Select the range J8:M12 on the worksheet named Ch18(67-153) and click the Pin button.

21. In the Pin to Dashboard dialog box that appears again, click the Existing Dashboard option button and then, from the Select Existing Dashboard dropdown, select the dashboard named MyFirstPowerBIOnlineDashboard (see Figure 18.237). To add the Excel worksheet element to your dashboard, click the Pin button.

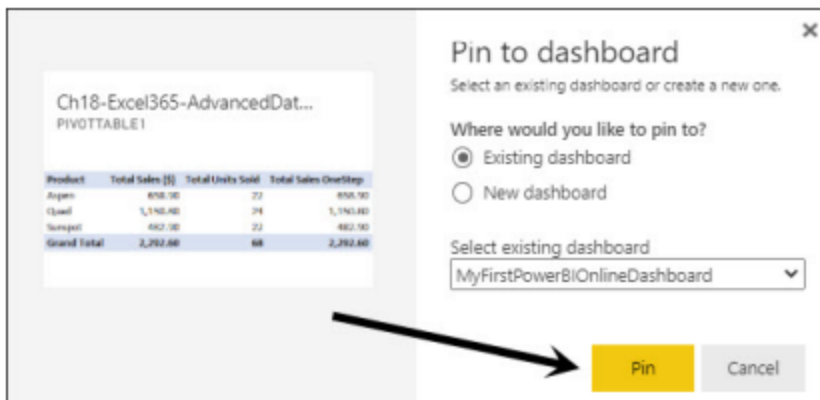


Figure 18.237 Click Pin to pin the selected worksheet range to the dashboard.

22. In the Dashboards area of the navigation pane, click on the MyFirstPowerBIOnlineDashboard dashboard link to view the finished dashboard. Figure 18.238 shows the finished dashboard with the three pinned elements. The Share button at the top of the online dashboard makes it easy to share the dashboard. In addition, the dashboard will update when the data changes. To see that the dashboard will update when the source visuals are changed, you can change the pinned Excel worksheet element in the original Excel 365 file.

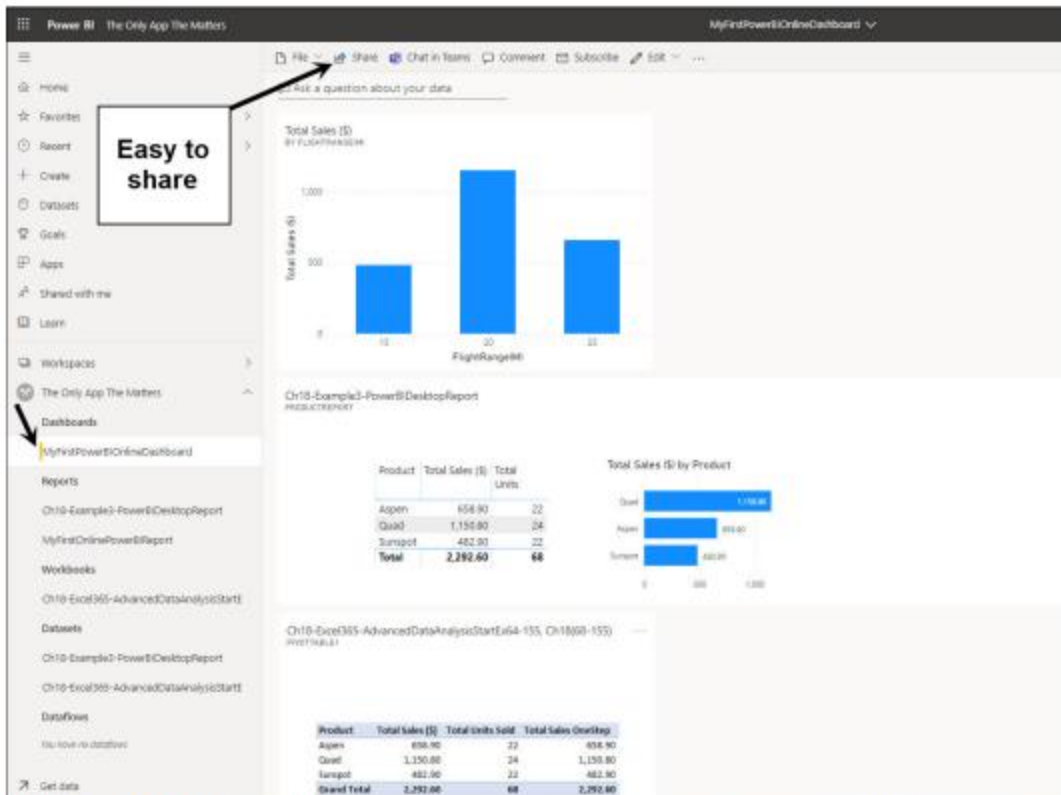


Figure 18.238 All three pinned elements are now in the easy-to-share MyFirstPowerBIOnlineDashboard dashboard.

- To change the pinned Excel worksheet element in the original Excel 365 file, open the workbook named Ch18-Excel365-AdvancedDataAnalysisStartEx63-153. Then, as shown in Figure 18.239, remove the Total Sales OneStep measure from the PivotTable on the worksheet named Ch18(67-153). Save the file and then click the File menu and select Publish to publish the workbook to the workspace The Only App The Matters.

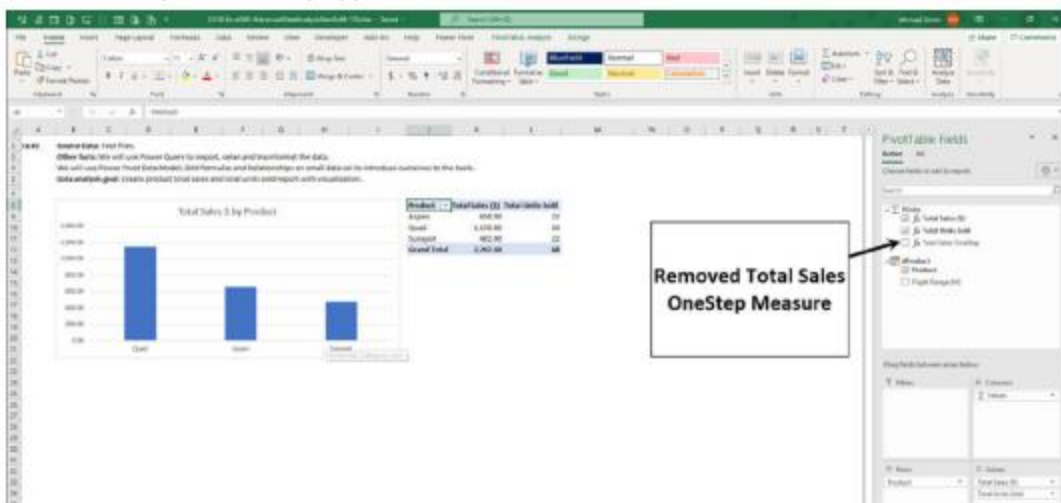


Figure 18.239 Using Excel 365, edit the original Excel file, save it, and then publish it.

24. Go back to the Power BI Online website and, in the workspace The Only App The Matters navigation pane, in the Dashboards section, select the MyFirstPowerBIOnlineDashboard dashboard. As shown in Figure 18.240, the dashboard is updated.

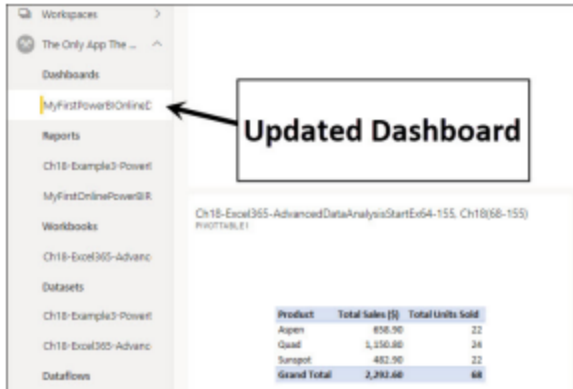


Figure 18.240 After you publish an updated Excel workbook, the dashboard is updated also.

Figure 18.241 shows the completed workspace with six items. A workspace such as this provides an easy and efficient way for a team to work together on data analysis projects and share and collaborate with Excel workbook files, Power BI Desktop files, and content created in Power BI Online.

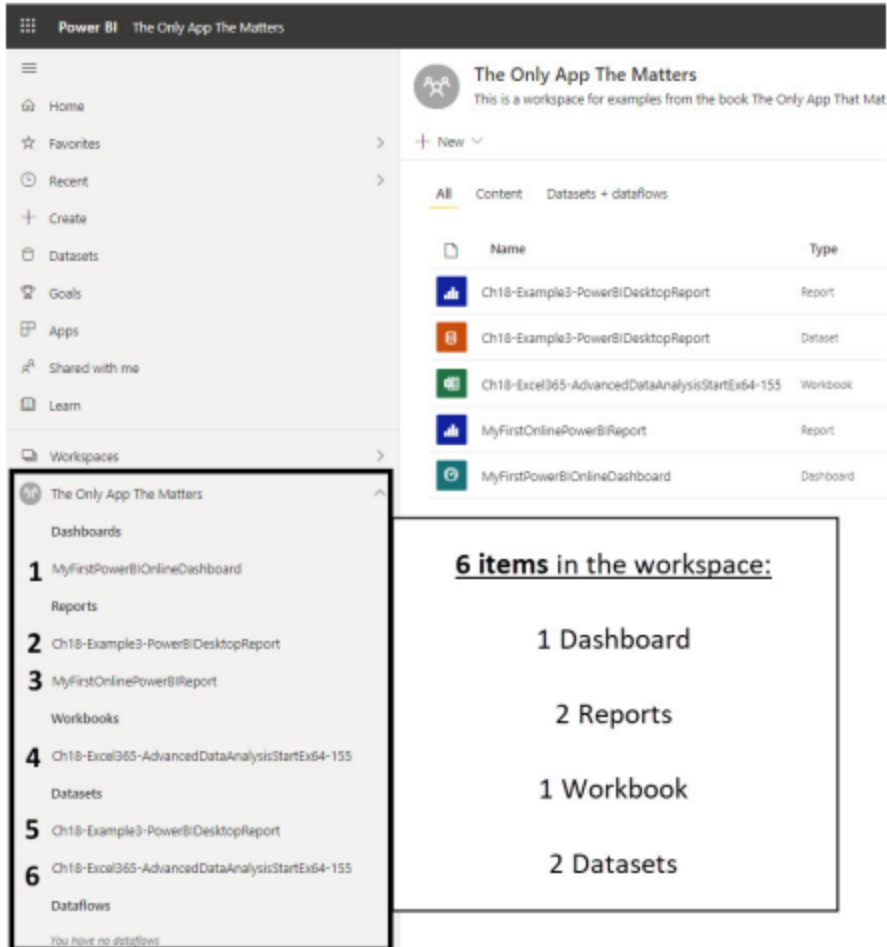
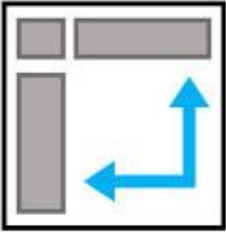




Figure 18.241 Completed workspace with six items.

Compare Reporting & Visualization tools:

Some Advantages of each tool:		
Standard PivotTable (SPT) Advantages:	Power Pivot Data Model PivotTable (PPDMPT) Advantages:	Power BI (Desktop or Online)
Fast & Easy when you have < about 50,000 rows of data	Number formatting attached to formulas	Power BI Desktop is a free download!
Grouping feature is fast and easy for dates, times and numbers	Consistent name attached to formula	Interactive Visualizations
Show Values As has many calculations that are easier than the parallel DAX Solution	Avoid 2 step calculation process (Helper Column then Aggregation) with one step Measures like with SUMX	With Power BI Online (Pro license or higher: \$ cost): Share Easily
Don't have to spend time building Data Model with DAX and Date Table	Some complex calculations can be easier	Can store single source of truth: Data Model, Reports, Dashboards
Some Reports such as Frequency Distributions for Text Data are super fast & easy with SPT	Iterating over a table to pre-aggregate numbers before an aggregate calculation	Works faster on BIG DATA than Power Pivot. Behind the scenes, Power Pivot uses MDX language, Power BI uses DAX language.
	Relationships can replace VLOOKUP & XLOOKUP	DAX Table function can deliver table to Data Model
	You can have multiple tables in PivotTable Field task pane	You can NOT share & send Data Model to Excel
	You can have BIG DATA data sets	Same as Power Pivot:
	You can share & send Data Model to Power BI	Number formatting attached to formulas
	DAX Measures can be re-used.	Consistent name attached to formula
		Avoid 2 step calculation process (Helper Column then Aggregation) with one step Measures like with SUMX
		Some complex calculations can be easier
		Iterating over a table to pre-aggregate numbers before an aggregate calculation
		Relationships can replace VLOOKUP & XLOOKUP
		You can have multiple tables in PivotTable Field task pane
		You can have BIG DATA data sets
		DAX Measures can be re-used
 PivotTable		 Power BI Desktop

Example 1 -3

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	
1																			
2		Example 1:	Sort: To sort means to organize the records in a table from smallest to biggest (A-Z, or ascending) or biggest to smallest (Z-A, or descending), based on a specified column																
3		Example 2:	Filter: To filter means to show only certain records, based on one or more conditions from one or more columns																
4		Example 3:	FlashFill: One-time simple data cleaning tool. If there is a consistent pattern, you can clean data by typing example to right of column of data, then click FlashFill button or Ctrl + E																
5																			
6			SalesRe				Produc												
7		Date	pID	Region	Sales	tID	SalesRep	Product											
8		6/27/20	3	West	352.003	3	Shayla	Carlota											
9		8/17/20	3	MidWest	302.593	5	Shayla	Yanaki											
10		2/4/21	3	East	161.851	7	Shayla	FlyFast											
11		10/18/21	5	MidWest	228.229	1	Ahmed	Quad											
12		4/12/21	5	SouthWest	390.618	5	Ahmed	Yanaki											
13		7/10/21	4	MidWest	154.549	1	Chantel	Quad											
14		5/18/20	4	SouthWest	464.432	7	Chantel	FlyFast											
15		9/24/20	4	SouthWest	407.913	1	Chantel	Quad											
16		11/25/21	3	MidWest	321.895	6	Shayla	SpitFire											
17		9/15/21	4	MidWest	159.275	7	Chantel	FlyFast											
18		11/7/21	4	West	1413.34	2	Chantel	Sunshine											
19		9/12/21	5	MidWest	379.218	5	Ahmed	Yanaki											
20		1/15/21	3	South	473.771	5	Shayla	Yanaki											
21		2/1/21	3	South	345.916	3	Shayla	Carlota											
22		8/3/21	4	East	497.488	1	Chantel	Quad											
23		11/20/20	5	NorthWest	467.306	5	Ahmed	Yanaki											
24		12/10/20	3	West	761.005	6	Shayla	SpitFire											
25		8/22/20	3	East	393.039	3	Shayla	Carlota											
26		11/25/21	3	West	127.241	1	Shayla	Quad											
27		7/14/21	2	West	465.011	7	Gigi	FlyFast											
28		4/22/21	1	East	145.929	1	Sioux	Quad											
29		3/22/21	5	NorthWest	367.31	1	Ahmed	Quad											
30		1/15/21	1	East	316.73	2	Sioux	Sunshine											
31		2/8/21	1	South	491.44	1	Sioux	Quad											
32		10/20/20	4	West	424.324	1	Chantel	Quad											
33		4/29/21	3	West	470.674	1	Shayla	Quad											
34		6/30/20	5	East	453.922	7	Ahmed	FlyFast											
35		2/22/21	1	East	412.46	3	Sioux	Carlota											
36		10/16/21	1	East	446.135	1	Sioux	Quad											
37																			
38																			
39																			
40																			
41																			
42																			
43																			


Example 4

	A	B	C	D	E	F	G	H	I
1									
2		Example 4:	Standard PivotTable with Summarize Values By and Show Values As calculations						
3									
4		Survey Data		Survey Data	Count	% of Total			
5		Yes		No	77	48.43%			
6		Yes		Somewhat	35	22.01%			
7		No		Yes	47	29.56%			
8		Yes		Grand Total	159	100.00%			
9		No							
10		No							
11		No							

Example 5

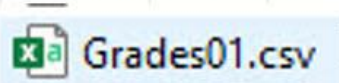
Example 5: Power Query to import, clean and transform table and load to Excel Worksheet

1 Web site gets updates regularly:



Name	ID	Quarter	Course Name	Test 1 - Summer2022	Test 2 - Summer2022	Test 3 - Summer2022	Test 4 - Summer2022	Quiz 1 - Summer 2022	Quiz 2 - Summer 2022
Tara Tyler	801-530-102	Summer2022	Busn 101	38	98				30
Oscar Santos	801-263-488	Summer2022	Busn 101	88	92				24
Nadine Erickson	801-948-260	Summer2022	Busn 101	78	75				30
Lamar Rivera	801-555-146	Summer2022	Busn 101	34	89				22

2 Download data as Text File:



```
Name, ID, Quarter, Course Name, Test 1 -- Summer2022, Test 2 -- Summer2022, Test 3 -- Summer2022, Test 4 -- Summer2022, Quiz 1 -- Summer 2022, Quiz 2 -- Summer 2022, Quiz 3 -- Summer 2022, Quiz 4 -- Summer 2022, Current, % Current, Total Points, % Total Points¶
Tara Tyler, 801-530-102, Summer2022, Busn 101, 38, 98, , , 30, 24, , , 190, 0.730769231, 190, 0.365384615¶
```

3 Power Query: to import the text file, clean and transform the data and load to worksheet:

	Max Points	100	100	100		30	30	30				390
Last	First	ID	Test1	Test2	Test3	Test4	Quiz1	Quiz2	Quiz3	Quiz4	Total Points	% Grade
Berry	Colleen	801-827-244	28	79	60		16	10	25		218	0.55897436
Erickson	Nadine	801-948-260	78	75	91		30	28	25		327	0.83846154
Mims	Tyrone	801-681-137	98	99	98		30	30	27		382	0.97948718
Rivera	Lamar	801-555-146	34	89	92		22	20	25		282	0.72307692
Santos	Oscar	801-263-488	88	92	63		24	30	29		326	0.83589744
Stewart	Charlie	801-624-430	89	80	83		26	25	30		333	0.85384615
Tyler	Tara	801-530-102	38	98	71		30	24	30		291	0.74615385
Wade	Chantel	801-765-966	97	100	96		30	30	30		383	0.98205128
Wise	Glen	801-241-076	94	23	85		24	1	27		254	0.65128205
Wolfe	Geraldine	801-674-115	81	49	83		28	7	26		274	0.7025641

4 Add worksheet formulas and formatting:

5 When web site is updated, we download new data and refresh our Excel file:

Example 6

Example 6: Power Query to Import and combine 12 tables into one table for a PivotTable Report & Excel Chart Visualization

- Source Data: 12 text files with ".txt" file extension in folder: MECS04TextFiles
- Power Query to import 12 text files from a folder, and transform into one table
- Calculate Sales Field in Power Query
- Load to PivotTable Cache and create PivotTable Month Sales Report and Chart:

12 Text Files:

- 01-JanPP01-Data.TXT
- 02-FebPP01-Data.txt
- 03-MarPP01-Data.txt
- 04-AprPP01-Data.txt
- 05-MayPP01-Data.txt
- 06JunPP01-Data.txt
- 07JulPP01-Data.txt
- 08AugPP01-Data.txt
- 09SepPP01-Data.txt
- 10OctPP01-Data.txt
- 11NovPP01-Data.txt
- 12DecPP01-Data.txt

1 Tab Delimited File:

```

Date→Units→Price
1/23/23 → 3 → 21.95
1/17/23 → 4 → 21.95
1/21/23 → 24 → 26.36
1/28/23 → 6 → 16.95
1/3/23 → 5 → 21.95
1/26/23 → 96 → 11.37
1/30/23 → 72 → 14.27
1/22/23 → 4 → 19.95
1/8/23 → 2 → 43.95
1/23/23 → 48 → 12.97
1/11/23 → 36 → 17.56
1/5/23 → 40 → 17.56
1/17/23 → 50 → 14.27
1/13/23 → 108 → 25.05
1/23/23 → 120 → 25.05
1/19/23 → 84 → 28.57
1/13/23 → 3 → 21.95
                    
```

Date	Units	Price	Sales
1/23/23	3	21.95	65.85
1/17/23	4	21.95	87.8
1/21/23	24	26.36	632.64
1/28/23	6	16.95	101.7
1/3/23	5	21.95	109.75
1/26/23	96	11.37	1091.52
1/30/23	72	14.27	1027.44
1/8/23	2	43.95	79.8
1/23/23	48	12.97	622.56

Months	Sum of Sales (\$)	Change (\$)	% Change	% of Total
Jan	789,074			5.14%
Feb	671,049	-118,025	-14.96%	4.37%
Mar	520,312	-150,737	-22.46%	3.39%
Apr	1,078,522	558,210	107.28%	7.03%
May	1,108,698	30,176	2.80%	7.22%
Jun	1,139,435	30,737	2.77%	7.42%
Jul	1,268,183	128,748	11.30%	8.26%
Aug	909,895	-358,288	-28.25%	5.93%
Sep	537,299	-372,596	-40.95%	3.50%
Oct	1,341,043	803,744	149.59%	8.74%
Nov	2,124,445	783,403	58.42%	13.84%
Dec	3,861,663	1,737,217	81.77%	25.16%
Grand Total	15,349,617			100.00%

Month	Change (%)
Jan	-
Feb	-15%
Mar	-22%
Apr	107%
May	3%
Jun	3%
Jul	11%
Aug	-28%
Sep	-41%
Oct	150%
Nov	58%
Dec	82%

Example 7

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1																	
2			Example 7:	XLOOKUP function to look values and create helper columns for table that is used in PivotTable Report & Excel Chart Visualization													
3																	
4			1	3 Tables you need for PivotTable Report													
5			2	Use Worksheet function XLOOKUP to lookup product and salerep names and bring them into the fact table (sales table). This creates one flat table you can use in a Standard PivotTable													
6				This method creates over 80,000 separate formulas.													
7			3	Create three PivotTable Reports with three separate Total SUM calculations and three separate applications of Number Formatting													
8																	
9			Date	SalesRepID	Region	Sales	ProductID	SalesRep	Product	SalesRepID	SalesRep		ProductID	Product			
10			6/27/20	3	West	352.003	3	=XLOOKUP(D10,\$K\$10:\$K\$14,\$L\$10:\$L\$14)					1	Quad			
11			8/17/20	3	MidWest	302.593	5	Shayla	Yanaki	2	Gigi		2	Sunshine			
12			2/4/21	3	East	161.851	7	Shayla	FlyFast	3	Shayla		3	Carlota			
13			10/18/21	5	MidWest	228.229	1	Ahmed	Quad	4	Chantel		4	Aspen			
14			4/12/21	5	SouthWest	390.618	5	Ahmed	Yanaki	5	Ahmed		5	Yanaki			
15			7/10/21	4	MidWest	154.549	1	Chantel	Quad				6	SpitFire			
16			5/18/20	4	SouthWest	464.432	7	Chantel	FlyFast				7	FlyFast			
17			9/24/20	4	SouthWest	407.913	1	Chantel	Quad								
18			11/25/21	3	MidWest	321.895	6	Shayla	SpitFire	SalesRep	Sum of Sales (\$)		Region	Sum of Sales (\$)			
19			9/15/21	4	MidWest	159.275	7	Chantel	FlyFast	Ahmed	2,453,274		East	1,704,604			
20			11/7/21	4	West	1413.34	2	Chantel	Sunshine	Chantel	3,884,167		MidWest	1,705,110			
21			9/12/21	5	MidWest	379.218	5	Ahmed	Yanaki	Gigi	1,076,089		NorthWest	3,454,527			
22			1/15/21	3	South	473.771	5	Shayla	Yanaki	Shayla	3,792,433		South	1,715,836			
23			2/1/21	3	South	345.916	3	Shayla	Carlota	Sioux	2,520,758		SouthWest	1,743,583			
24			8/3/21	4	East	497.488	1	Chantel	Quad	Grand Total	13,726,722		West	3,403,063			
25			11/20/20	5	NorthWest	467.306	5	Ahmed	Yanaki	Grand Total	13,726,722		Grand Total	13,726,722			
26			12/10/20	3	West	761.005	6	Shayla	SpitFire								
27			8/22/20	3	East	393.039	3	Shayla	Carlota								
28			11/25/21	3	West	127.241	1	Shayla	Quad								
29			7/14/21	2	West	465.011	7	Gigi	FlyFast								
30			4/22/21	1	East	145.929	1	Sioux	Quad								
31			3/22/21	5	NorthWest	367.31	1	Ahmed	Quad								
32			1/15/21	1	East	316.73	2	Sioux	Sunshine								
33			2/8/21	1	South	491.44	1	Sioux	Quad								
34			10/20/20	4	West	424.324	1	Chantel	Quad								
35			4/29/21	3	West	470.674	1	Shayla	Quad								
36			6/30/20	5	East	453.922	7	Ahmed	FlyFast								
37			2/22/21	1	East	412.46	3	Sioux	Carlota								

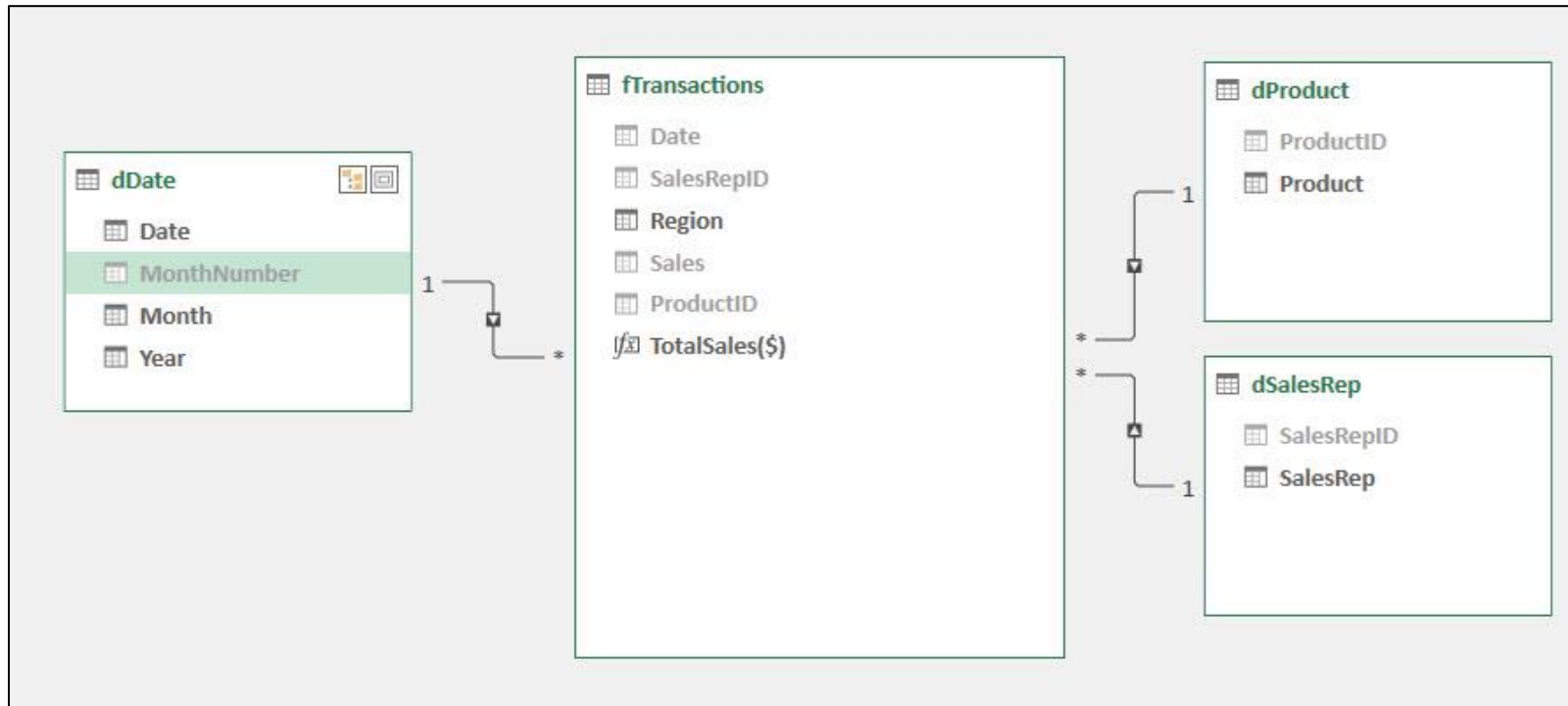
Product	Sales (\$000)
Quad	3,936
Yanaki	3,880
Aspen	1,227
Sunshine	1,202
Carlota	1,164
FlyFast	1,163
SpitFire	1,155

Example 8

	A	B	C	D	E	F	G	H	I	J	K	L	M
1													
2			Example 8:	Power Pivot to build Data Model PivotTable Reports									
3													
4			1	Add Power Pivot Com Add-in: File, Options, Add-ins, Manage dropdown, Com- add-ins, Check Box for Microsoft Power Pivot for Excel									
5			2	Use Power Query to import 4 tables from an external Excel file and load tables to Data Model									
6				In the Data Model, the tables are stored in a specific part of the Data Model called the Columnar Database.									
7			3	Create Relationships between One-To-Many Related Fields to replace many XLOOKUP formulas									
8			4	Create a DAX Measure to add Total Sales and add format to the DAX Measure									
9			5	Hide columns that are not needed in reporting area									
10			6	Sort Month field by MonthNumber field									
11			7	Create four PivotTable reports:									
12													
13													
14													
15													
16													
17													
18													
19													
20													
21													
22													
23													
24													
25													
26													
27													
28													
29													

	R	S	T	U	V	W	X	Y	Z
3									
4		Region	TotalSales(\$)		Year	Month	TotalSales(\$)		
5		East	1,704,604		2020	Jan	545,159		
6		MidWest	1,705,110			Feb	518,016		
7		NorthWest	3,454,527			Mar	529,203		
8		South	1,715,836			Apr	552,185		
9		SouthWest	1,743,583			May	535,533		
10		West	3,403,063			Jun	529,017		
11		Grand Total	13,726,722			Jul	553,573		
12						Aug	553,501		
13						Sep	538,706		
14		Product	TotalSales(\$)			Oct	547,404		
15		Aspen	1,226,594			Nov	547,927		
16		Carlota	1,164,155			Dec	915,584		
17		FlyFast	1,162,711		2020 Total		6,865,808		
18		Quad	3,935,965		2021	Jan	572,944		
19		SpitFire	1,155,276			Feb	516,512		
20		Sunshine	1,202,266			Mar	547,625		
21		Yanaki	3,879,756			Apr	527,721		
22		Grand Total	13,726,722			May	528,664		
23						Jun	530,740		
24						Jul	552,693		
25		Product	TotalSales(\$)			Aug	548,787		
26		Aspen	1,226,594			Sep	540,950		
27		Carlota	1,164,155			Oct	548,313		
28		FlyFast	1,162,711			Nov	511,627		
29		Quad	3,935,965			Dec	934,338		
30		SpitFire	1,155,276		2021 Total		6,860,915		
31		Sunshine	1,202,266		Grand Total		13,726,722		
32		Yanaki	3,879,756						
33		Grand Total	13,726,722						
34									

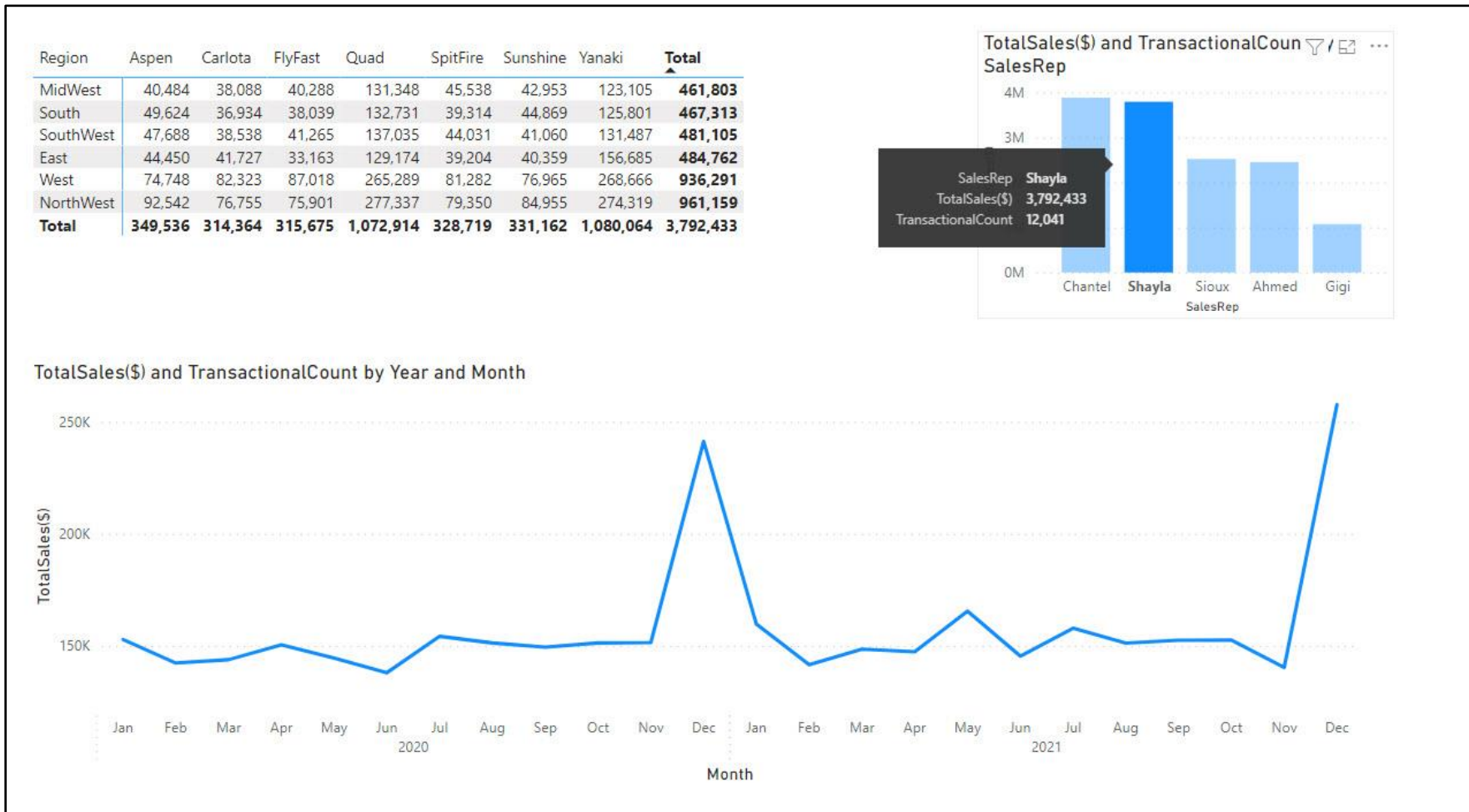
Example 8 Data Model



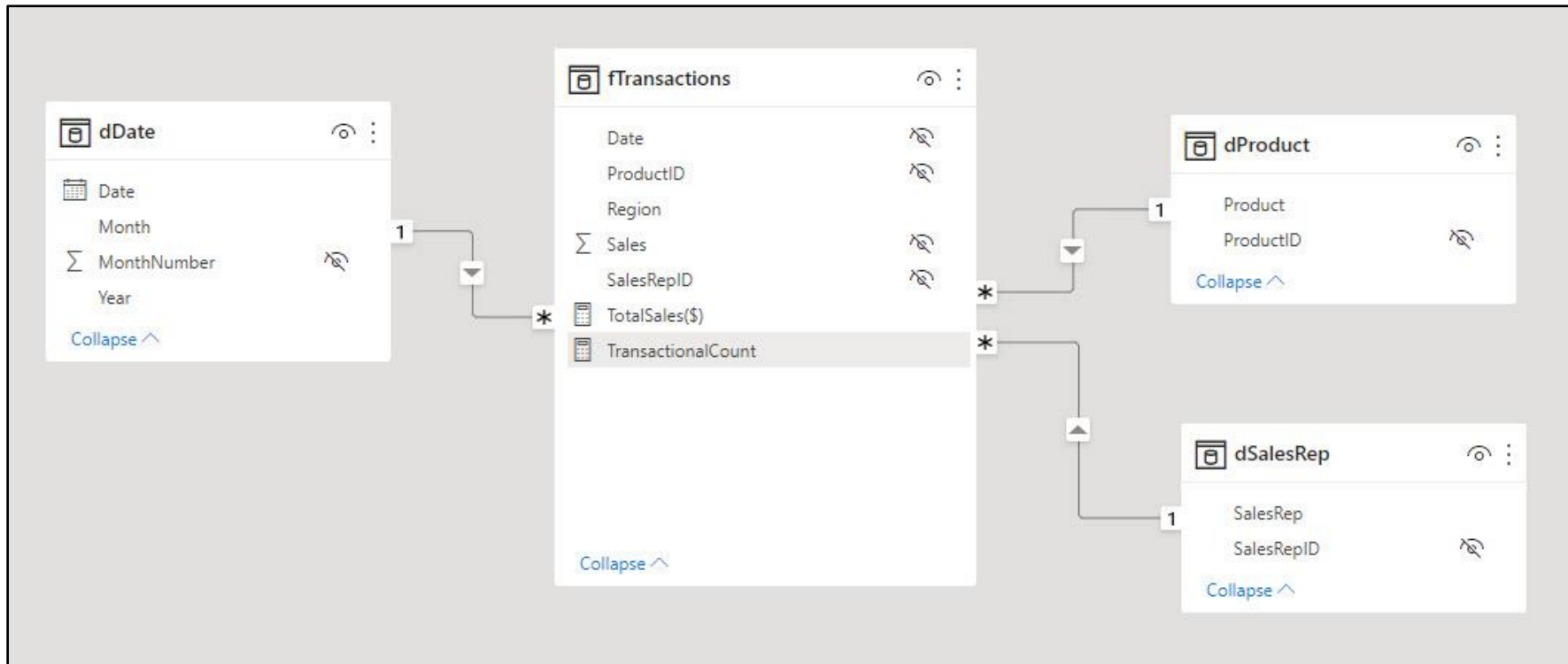
Example 9

N	O	P	Q	R	S
Example 9:					
Send Data Model to Power BI Desktop to make Interactive Dashboard					

Power BI Finished Interactive Dashboard:



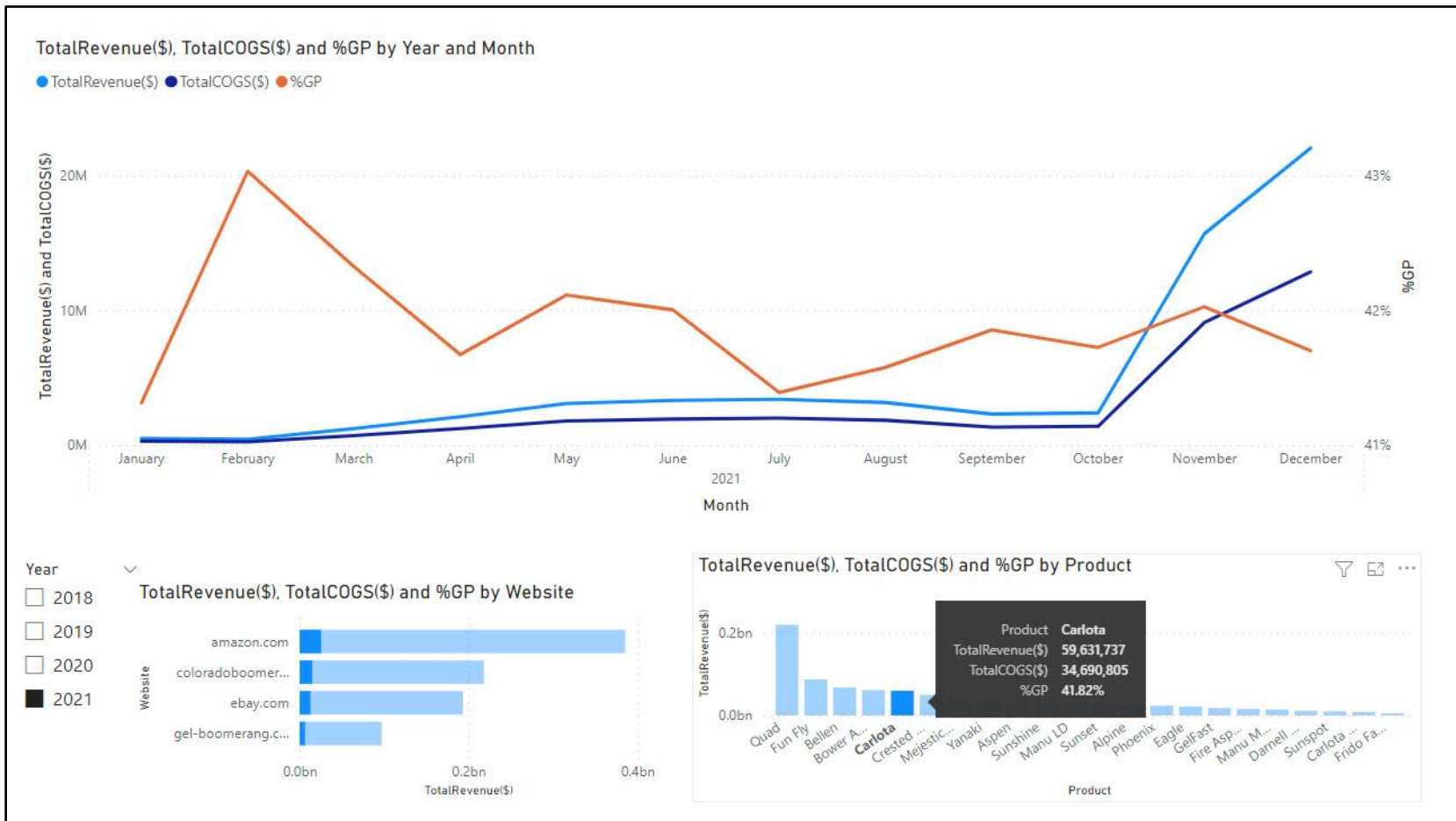
Example 9 data Model



Example 10

	A	B	C	D	E	F	G	H	I
1									
2									
3		Example 10: Power BI Desktop and Power Query to import 7 million rows of sales data							
4		and build Interactive Gross Profit Dashboard							

Power BI Finished Interactive SQL Gross Profit Dashboard and World Sales Map:





Example 10 Data Model

