

7/19/2021

7/22/2021















[Exam DA-100: Analyzing Data with Microsoft Power BI - Learn | Microsoft Docs](#)

The content of this exam will be updated on July 29, 2021.

- Prepare the data (20-25%)
- Model the data (25-30%)
- Visualize the data (20-25%)
- Analyze the data (10-15%)
- Deploy and maintain deliverables (10-15%)
- Example Report: <https://zoomcharts.com/en/microsoft-power-bi-custom-visuals/>

Course Materials: Skillpipe book, AdventureWorksDW2020, [XtremeLabs](#).

Module 0 Introduction	Tim's Notes Analyzing Data PBI Labs 7/12/21
Module 1 Getting Started with Microsoft Data Analytics	
Module 2 Get Data in Power BI	-Plan 4 days / 13 mods = 3.25 per day:
Module 3 Clean, Transform, and Load Data in Power BI	Load; Model; Report; Analyze; Share
Module 4 Design a Data Model in Power BI	1-3 - Load
Module 5 Create Model Calculations using DAX in Power BI	4-7 - Model
Module 6 Optimize Model Performance	8-10 - Report
Module 7 Create Reports	11-13 - Share
Module 8 Create Dashboards	
Module 9 Create Paginated Reports in Power BI	
Module 10 Perform Advanced Analytics	
Module 11 Create and Manage Workspaces	
Module 12 Manage Datasets in Power BI	
Module 13 Row-level Security	

PPT	Lab List: Note Module numbers do not match line numbers
 DA-100 Mod0-Introduction.pptx  DA-100 Mod1-Getting Started.pptx  DA-100 Mod2-Get Data.pptx <b>Start Labs</b>  DA-100 Mod3-Clean Transform Load Data.pptx  DA-100 Mod4-Design a Data Model.pptx  DA-100 Mod5-Create Model Calculations.pptx  DA-100 Mod6-Optimize Model Performance.pptx  DA-100 Mod7-Create Reports.pptx  DA-100 Mod8-Create Dashboards.pptx  DA-100 Mod9-Create Paginated Reports.pptx  DA-100 Mod10-Perform Advanced Analytics.pptx  DA-100 Mod11-Create and Manage Workspaces.pptx  DA-100 Mod12-Manage Datasets.pptx  DA-100 Mod13-Row-Level Security.pptx	<ol style="list-style-type: none"> <li>1. Mod 02: <a href="#">Lab - Prepare data in Power BI Desktop - Learn   Microsoft Docs</a></li> <li>2. Mod 03: <a href="#">Lab - Load data in Power BI Desktop - Learn   Microsoft Docs</a></li> <li>3. Mod 04: <a href="#">Model data in Power BI Desktop, part 1</a></li> <li>4. Mod 04: <a href="#">Model data in Power BI Desktop, part 2</a></li> <li>5. Mod 05: <a href="#">Create DAX calculations in Power BI Desktop, part 1</a></li> <li>6. Mod 05: <a href="#">Create DAX calculations in Power BI Desktop, part 2</a></li> <li>7. Mod 07: <a href="#">Design a report in Power BI Desktop, part 1</a></li> <li>8. Mod 07: <a href="#">Design a report in Power BI Desktop, part 2</a></li> <li>9. Mod 08: <a href="#">Create a Power BI dashboard</a></li> <li>10. Mod 09: <a href="#">Perform data analysis in Power BI Desktop</a></li> <li>11. Mod 10: <a href="#">Create a Power BI paginated report</a></li> </ol> <p>GitHub items 10/11 are swapped</p> <ol style="list-style-type: none"> <li>10. Create a Power BI Paginated Report</li> <li>11. Perform Data Analysis in Power BI Desktop</li> </ol>

**Learning Path Links DA-100** | [DAX sample model - Power BI](#) | [Microsoft Docs](#) AdventureWorks2020 MCols?

1. \*Ch01a: DA-100 Discover data analysis (no lab)
  - a. <https://docs.microsoft.com/en-us/learn/modules/data-analytics-microsoft/>
2. \*Ch01b: DA-100 Get started building with Power BI
  - a. <https://docs.microsoft.com/en-us/learn/modules/get-started-with-power-bi/>
3. \*Ch2: DA-100 Prepare data for analysis
  - a. <https://docs.microsoft.com/en-us/learn/modules/get-data/>
4. \*Ch3: DA-100 Clean, transform, and load data in Power BI
  - a. <https://docs.microsoft.com/en-us/learn/modules/clean-data-power-bi/>
  - b. [The Power Query user interface | Microsoft Docs](#)
5. \*Ch04: DA-100 Design a data model in Power BI
  - a. <https://docs.microsoft.com/en-us/learn/modules/design-model-power-bi/>
6. \*Ch05: DA-100 Introduction to creating measures using DAX in Power BI
  - a. <https://docs.microsoft.com/en-us/learn/modules/create-measures-dax-power-bi/>
7. \*Ch06: DA-100 Optimize a model for performance in Power BI
  - a. <https://docs.microsoft.com/en-us/learn/modules/create-measures-dax-power-bi/>
8. \*Ch07a: DA-100 Work with Power BI visuals
  - a. <https://docs.microsoft.com/en-us/learn/modules/visuals-power-bi/>
9. \*Ch07b: DA-100 Create a data-drive story with Power BI – *drill thru - slicers*
  - a. <https://docs.microsoft.com/en-us/learn/modules/data-driven-story-power-bi/>
10. \*Ch08: DA-100 Create dashboards in Power BI
  - a. <https://docs.microsoft.com/en-us/learn/modules/create-dashboards-power-bi/>
11. \*Ch09: DA-100 Create Paginated Reports
  - a. <https://docs.microsoft.com/en-us/learn/modules/create-paginated-reports-power-bi/>
12. Ch10a: DA-100 Perform analytics in Power BI
  - a. <https://docs.microsoft.com/en-us/learn/paths/perform-analytics-power-bi/>
13. Ch10b: Work with AI visuals
  - a. <https://docs.microsoft.com/en-us/learn/modules/ai-visuals-power-bi/>
14. \*Ch11: DA-100 Create and manage Workspaces in Power BI
  - a. <https://docs.microsoft.com/en-us/learn/modules/create-manage-workspaces-power-bi/>
15. \*Ch12: DA-100 Manage datasets in Power BI
  - a. <https://docs.microsoft.com/en-us/learn/modules/manage-datasets-power-bi/>
16. \*Ch13: DA-100 Implement row-level security
  - a. <https://docs.microsoft.com/en-us/learn/modules/row-level-security-power-bi/>
17. End Learning Path Links DA-100

**DA-100 MS Learning Path Labs:** These links have a Free lab environment.

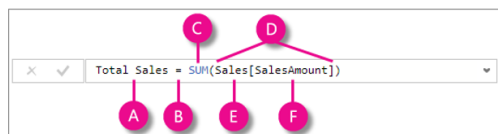
1. \*Mod 02: [Lab - Prepare data in Power BI Desktop - Learn | Microsoft Docs](#)
  - a. Title: **Prepare data in Power BI Desktop**
  - b. **Master list of links to labs:** You get lab environment here.
  - c. Open Power BI Desktop: **Create empty Sales Analysis.pbix**
  - d. Set Power BI Desktop options
  - e. Connect to **source data**: AdventureWorksDW2020, ResellerSalesTargets.csv
  - f. Preview source data
  - g. Use data preview techniques to better understand the data
2. \*Mod 03: [Lab - Load data in Power BI Desktop - Learn | Microsoft Docs](#)
  - a. Title: **Load data in Power BI Desktop**
  - b. Apply various transformations
  - c. Apply queries to load them to the data model
  - d. **Uses fresh file:** D:\DA100\Labs\02-load-data-with-power-query-in-power-bi-desktop\Starter – **UNLESS you started from scratch and it works so far!**
  - e. Configure queries: rem columns, renames, etc
3. \*Mod 04: [Model data in Power BI Desktop, part 1](#)
  - a. Title: **Model data in Power BI Desktop, Part 1**
  - b. Create model relationships
  - c. Configure table and column properties
  - d. Create hierarchies
  - e. Create quick measures
  - f. [Model relationships in Power BI Desktop - Power BI | Microsoft Docs](#)
  - g. [Add a filter to a report in Power BI - Power BI | Microsoft Docs](#)
4. URHere-labs: Mod 04: [Model data in Power BI Desktop, part 2](#)
  - a. Title: **Model data in Power BI Desktop, Part 2**
  - b. Configure many-to-many relationships
  - c. Enforce row-level security
5. Mod 05: [Create DAX calculations in Power BI Desktop, part 1](#)
  - a. Title: **Introduction to DAX in Power BI Desktop**
  - b. Create calculated tables
  - c. Create calculated columns
  - d. Create measures
6. Mod 05: [Create DAX calculations in Power BI Desktop, part 2](#)
  - a. Title: **Time Intelligence and Measures in DAX**
  - b. Use the CALCULATE() function to manipulate filter context
  - c. Use Time Intelligence functions
7. Mod 07: [Design a report in Power BI Desktop, part 1](#)
  - a. Title: **Design a report in Power BI desktop**
  - b. Use Power BI Desktop to create a live connection
  - c. Design a report
  - d. Configure visual fields and format properties
8. Mod 07: [Design a report in Power BI Desktop, part 2](#)
  - a. Title: **Design a report in Power BI desktop, Part 2**
  - b. Sync slicers
  - c. Create a drillthrough page
  - d. Apply conditional formatting
  - e. Create and use bookmarks
9. Mod 08: [Create a Power BI dashboard](#)
  - a. Title: **Create a Power BI dashboard**
  - b. Pin visuals to a dashboard

- c. Use Q&A to create dashboard tiles
- d. Configure a dashboard tile alert
- 10. Mod 09: [Perform data analysis in Power BI Desktop](#)
  - a. Title: *Perform data analysis in Power BI Desktop*
  - b. Create animated scatter charts.
  - c. Use a visual to forecast values.
  - d. Work with the decomposition tree visual.
  - e. Work with the key influencers visual.
- 11. Mod 10: [Create a Power BI paginated report](#)
  - a. Title: *Create a Power BI paginated report*
  - b. Use Power BI Report Builder
  - c. Design a multi-page report layout
  - d. Define a data source
  - e. Define a dataset
  - f. Create a report parameter
  - g. Export a report to PD
- 12. Mod 11 – no labs?
- 13. Mod 12 – no labs?
- 14. Mod 11 – no labs?3
- 15. End MS Learn DA-100 Lab List

### The Dax and Only The DAX; Well maybe a Capital M too...

- 1. [DAX For SQL Folks: Part I- Intro to DAX, Power BI and Data Viz – SQLServerCentral](#)
- 2. [DAX for SQL Folks: Part II - Translating SQL Queries to DAX Queries – SQLServerCentral](#)
- 3. Mods 04, 05, 06 in Skillpipe
- 4. [Use DAX in Power BI Desktop - Learn | Microsoft Docs](#)
  - a. <https://docs.microsoft.com/en-us/learn/paths/dax-power-bi/>
  - b. So you can see the path to 1.
- 5. Power BI Sidetools: Good discussion examples:
  - a. <https://thebipower.fr/index.php/power-bi-sidetools/>
- 6. [DAX basics in Power BI Desktop - Power BI | Microsoft Docs](#) - Breaks out syntax

Syntax: A simple DAX formula for a measure:



This formula includes the following syntax elements:

- A. **Measure name, Total Sales.**
- B. Equals sign operator (=) *indicates the beginning of the formula; it returns a result.*
- C. The **DAX function SUM**, which adds up all of the numbers in the **Sales[SalesAmount]** *column.*
- D. Parenthesis (), wrap an expression that contains one or more *arguments*. Most functions require at least one argument. An argument *passes a value to a function.*
- E. The **referenced table, Sales.**
- F. The **referenced column, [SalesAmount]**, in the Sales table. The column is the argument on which to aggregate a SUM.
- a.
- 7. [DAX overview - DAX | Microsoft Docs](#) – Good entry point for everything DAX
- 8. [Table manipulation functions \(DAX\) - DAX | Microsoft Docs](#)
- 9. [DAX function reference - DAX | Microsoft Docs](#)
- 10. [Writing DAX Queries \(daxstudio.org\)](#)
- 11. [Dynamic M query parameters in Power BI Desktop \(preview\) - Power BI | Microsoft Docs](#)

## DAX Studio: Connecting to Power BI Desktop

- If you have *installed DAX Studio* with the default All Users option, the installer will register DAX Studio with Power BI Desktop as an External Tool and you should *see a DAX Studio icon in the External Tools ribbon in Power BI Desktop*.
  - If you launch DAX Studio from there *it will open with a connection already established to the data model* in Power BI Desktop.
- Or if you launch DAX Studio while Power BI Desktop is running you can see a list of the open pbix files in the PBI / SSDT option and connect to your file that way.

The screenshot shows the DAX Studio 'Connect' dialog box with 'PBI / SSDT Model' selected. Below it, the main DAX Studio window is open, displaying a DAX query and its results. A red box highlights the 'Open PBI File then Open DAX Studio Connect to the file...' text. The query is as follows:

```

1 //Define is like Declare for variables
2 DEFINE SalesA =
3     VAR SalesA =
4         CALCULATETABLE ( Sales )
5     EVALUATE
6     SalesA
7
8
9

```

The results table shows data for SalesOrderNumber, OrderDate, ProductKey, ResellerKey, EmployeeKey, SalesTerritoryKey, Quantity, Unit Price, Sales, and C. The status bar at the bottom indicates 'Ready' and 'Ln 6 Col 30'.

- Using Sales Analysis.pbix
- 
- [Relationships in Power BI and Tabular models - SQLBI](#)
- <https://daxstudio.org/tutorials/getting-connected/#pbidesktop>

## R:

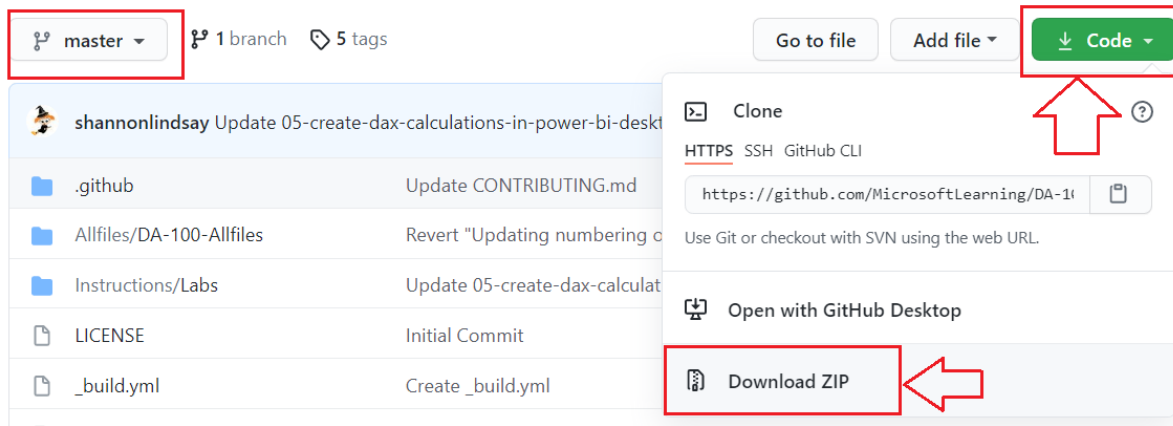
- Using R with PBI
- <https://docs.microsoft.com/en-us/power-bi/connect-data/desktop-r-in-query-editor#use-r-in-power-query-editor-1>
- Install R:
- <https://docs.microsoft.com/en-us/power-bi/connect-data/desktop-r-scripts>

5. Download R:
6. <https://mran.revolutionanalytics.com/download>

space

**GitHub DA-100 Labs:** GitHub & MS Learn have same content:

Download AllFiles & Instructions [MicrosoftLearning/DA-100-Analyzing-Data-with-Power-BI \(github.com\)](https://github.com/MicrosoftLearning/DA-100-Analyzing-Data-with-Power-BI)



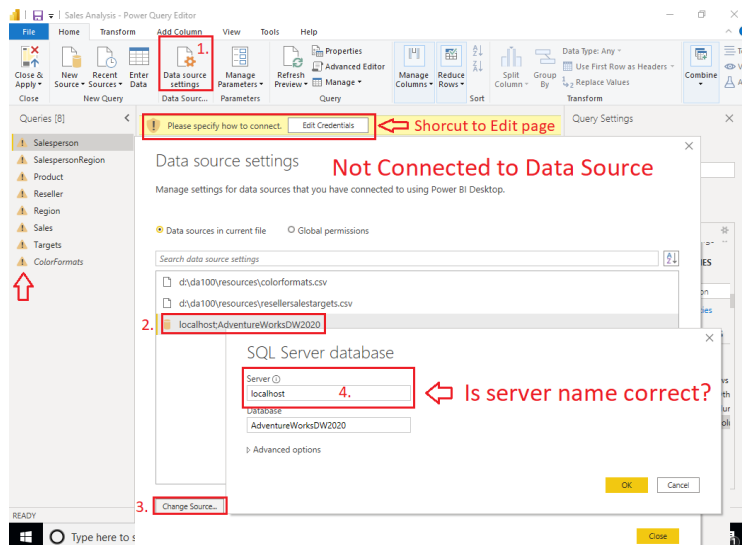
<https://github.com/MicrosoftLearning/DA-100-Analyzing-Data-with-Power-BI>

Note: **Git Labs** Line numbers, Title and Module number are not the same: Some Mods have 2 labs

1. Mod 02: [01-prepare-data-with-power-query-in-power-bi-desktop.md](#)
  - a. Title: **Prepare Data in Power BI Desktop**
  - b. Open Power BI Desktop
  - c. Set Power BI Desktop options
  - d. Connect to source data
  - e. Preview source data
  - f. Use data preview techniques to better understand the data
2. Mod 03: [02-load-data-with-power-query-in-power-bi-desktop.md](#)
  - a. Title: **Load Data in Power BI Desktop**
  - b. Apply various transformations
  - c. Apply queries to load them to the data model
3. Mod 04: [03-configure-data-model-in-power-bi-desktop.md](#)
  - a. Title: **Model Data in Power BI Desktop, Part 1**
  - b. Create model relationships
  - c. Configure table and column properties
  - d. Create hierarchies
  - e. Create quick measures
4. Mod 04: [04-configure-data-model-in-power-bi-desktop-advanced.md](#)
  - a. Title: **Model Data in Power BI Desktop, Part 2**
  - b. Configure many-to-many relationships
5. Mod 05: [05-create-dax-calculations-in-power-bi-desktop.md](#)
  - a. Title: **Create DAX Calculations in Power BI Desktop, Part 1**
  - b. Create calculated tables
  - c. Create calculated columns
  - d. Create measures
6. Mod 05: [06-create-dax-calculations-in-power-bi-desktop-advanced.md](#)
  - a. Title: **Create DAX Calculations in Power BI Desktop, Part 2**
  - b. Use the CALCULATE() function to manipulate filter context

- c. Use Time Intelligence functions
7. Mod 07: [07-design-report-in-power-bi-desktop.md](#)
  - a. Title: **Design a Report in Power BI Desktop, Part 1**
  - b. Design a report
  - c. Configure visual fields and format properties
8. Mod 07: [08-design-report-in-power-bi-desktop-enhanced.md](#)
  - a. Title: **Design a Report in Power BI Desktop, Part 2**
  - b. Sync slicers
  - c. Create a drillthrough page
  - d. Apply conditional formatting
  - e. Create and use bookmarks
9. Mod 08: [09-create-power-bi-dashboard.md](#)
  - a. Title: **Create a Power BI Dashboard**
  - b. Pin visuals to a dashboard
  - c. Use Q&A to create dashboard tiles
  - d. Configure a dashboard tile alert
10. Mod 09: [10-create-power-bi-paginated-report.md](#)
  - a. Title: **Create a Power BI Paginated Report**
  - b. Use Power BI Report Builder
  - c. Design a multi-page report layout
  - d. Define a data source
  - e. Define a dataset
  - f. Create a report parameter
  - g. Export a report to PDF
11. Mod 10: [11-perform-data-analysis-in-power-bi-desktop.md](#)
  - a. Title: **Perform Data Analysis in Power BI Desktop**
  - b. Create animated scatter charts
  - c. Use a visual to forecast values
  - d. Work with the decomposition tree visual
  - e. Work with the key influencers visual
12. End GitHub DA-100 Lab list

## Change Data Source Connection





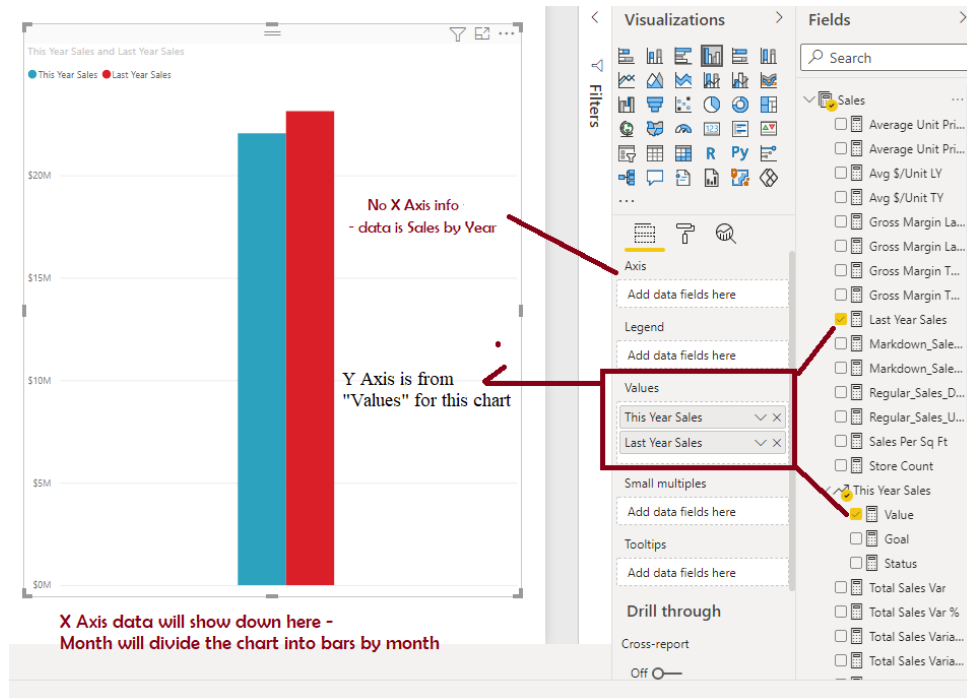
## Trends and Making Them Visual



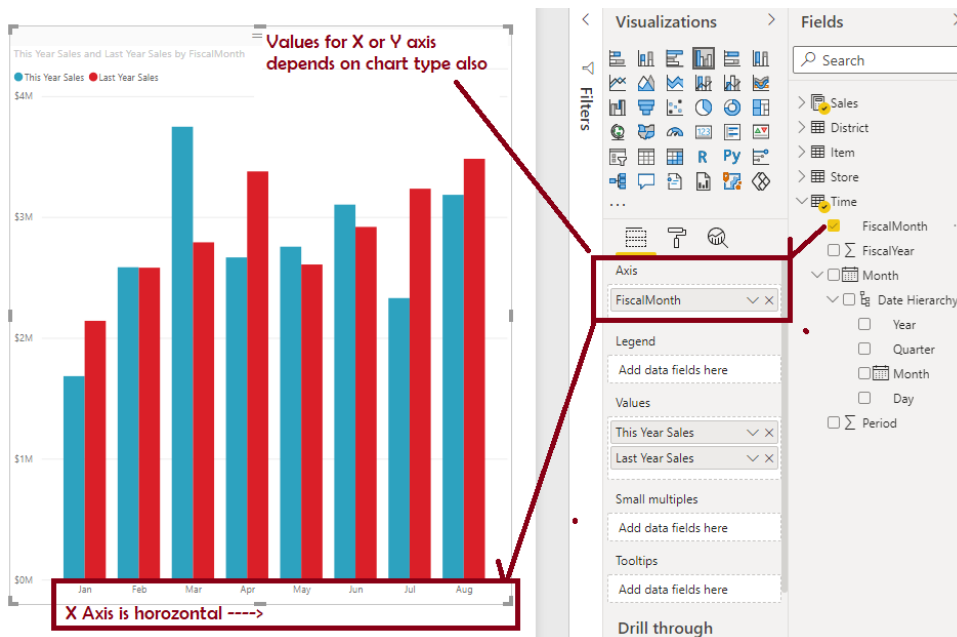
KPI: A visual cue that communicates the amount of progress made toward a measurable goal.

In statistics, an outlier is a data point that differs significantly from other observations.

## Where to Put Columns for Values, Axis, Legends, Slicers on a Report?


































What values get assigned to X or Y axis may depend on the Visual chosen



Recognizing the data structure or component by Icon in the Field List.

[Using the Field list in Power BI Desktop - Power BI | Microsoft Docs](#)

## FIELD LIST ICONS

Original icon	New icon	Description
		Folder in the Fields list
		Numeric field: Numeric fields are aggregates that can be summed or averaged, for example. Aggregates are imported with the data and defined in the data model your report is based on.
		Calculated column with a non-numeric data type: A new non-numeric column you create with a Data Analysis Expressions (DAX) formula that defines the column's values.
		Numeric calculated column: A new column you create with a Data Analysis Expressions (DAX) formula that defines the column's values.
		Measure: A measure has its own hard-coded formula. Report viewers can't change the calculation, for example, if it's a sum, it can only be a sum. The values aren't stored in a column. They're calculated on the fly, depending solely on their location in a visual.
		Measure group.
		KPI: A visual cue that communicates the amount of progress made toward a measurable goal.
		Hierarchy of fields: Select the arrow to see the fields that make up the hierarchy.
		Geo data: These location fields can be used to create map visualizations.
		Identity field: Fields with this icon are unique fields, set to show all values, even if they have duplicates.
		Parameter: Set parameters to make parts of your reports and data models (such as a query filter, a data source reference, a measure definition, etc.) depend on one or more parameter values.
		Calendar date field with a built-in date table.
		Calculated table: A table created with a Data Analysis Expressions (DAX) formula based on data already loaded into the model. These are best used for intermediate calculations and you want to store as part of the model.
		Warning: A calculated field with an error. For example, the syntax of the DAX expression might be incorrect.
		Group: Values in this column are based on grouping values from another column, by using the groups and bins feature.
no original icon		Change detection measure: When you configure a page for automatic page refresh, you can configure a <a href="#">change detection measure</a> that is queried to determine if the rest of a page's visuals should be updated.

## Analyze This!

*Identify outliers to isolate data points that significantly differ from other data points and take action to investigate the reasons for the differences.*

**Scenario:** Analyzing data for a shipping warehouse. You notice that *the number of orders increased above average for a specific product category*. You first want to *identify the product category*.

Ask questions about the outlier:

1. Did above average shipments happen that day?
2. Did this anomaly occur in a specific warehouse?
3. Did a single event cause the increase in orders for that specific category?
4. Did this event occur on other days in the last month, quarter, year, or prior year?

*Determine the logic behind the outlier.*

- Use trigger points, such as calculations, around what is considered the outlier.

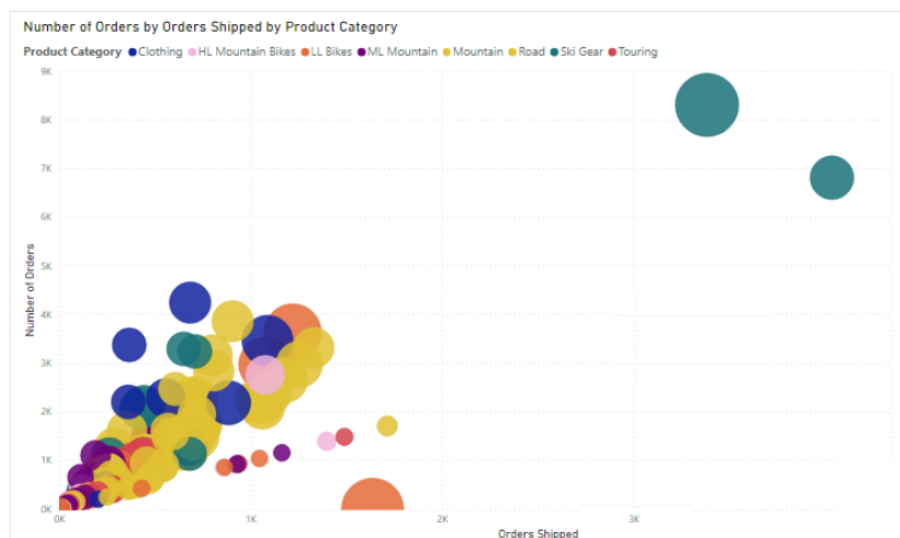
**Identifying outliers** involves *segmenting your data into two groups*:

- One group is the outlier data and the other group is not.
- Use calculated columns to identify outliers for static results until you refresh the data.
- Use a visualization or DAX formula to ensure that your results are dynamic.

When you have identified the outliers in your data:

- *Use slicers or filters to highlight those outliers.*
- *Add a legend to your visuals so that the outliers can be identified among the other data.*
- You can then drill in to the outlier data for more detailed analysis.

The *best visual to use* for identifying outliers is the scatter chart



Outliers are the isolated items that are away from the bulk of the data.

Power BI Desktop aggregates your data into groups, based on the values that it finds in the underlying data. *Any Group or Bin can be used in any visual.*

- **Grouping** is used for categories of data.
- **Binning** is similar to grouping, but it is used for grouping continuous fields, such as numbers and dates.
- To clearly view, analyze, and explore the data and trends in your visuals
- Identify clusters, patterns of behavior, data averages, and more.
- Example: Identify the cities with the highest sales.
- [Group and bin data for analysis - Learn | Microsoft Docs](#)

Clustering allows you to identify a segment (cluster) of data that is similar to each other but dissimilar to the rest of the data.

- **Example:** Look for patterns in sales data, such as the behavior of customers overall. *Segment the customers into clusters according to their similarities*, such as age or location.
- In the upper-right corner of the visual; More options (...) - Automatically find clusters.

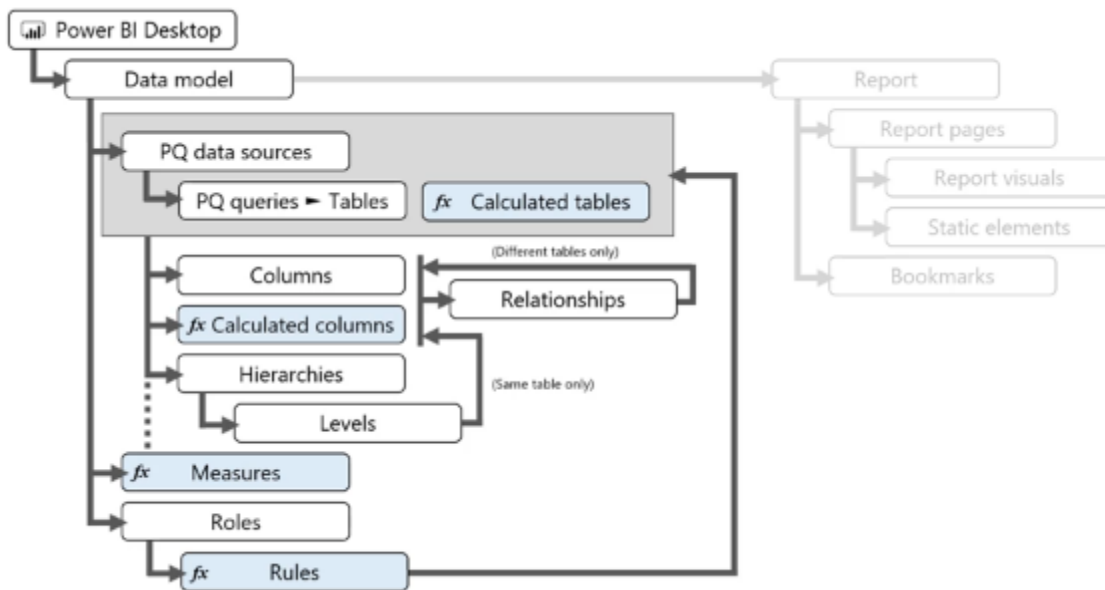
space

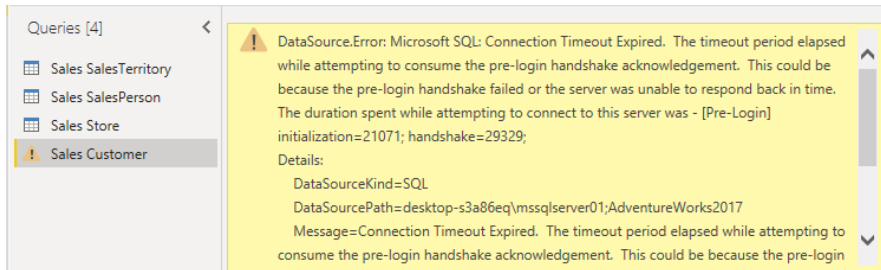
**Where do I do this or that?** *What columns would I use for; Answering the Question; Filling the Visual...*

1. Load Data
2. Configure a query
  - a. To open the Power Query Editor window, in Power BI Desktop, on the Home ribbon tab, click Transform Data.
  - b. Rename the query
    - i. Query Settings pane (located at the right), in the Name box, replace the text with new query name, press Enter.
    - ii. *The query name will determine the model table name.* It's recommended to define concise, yet friendly, names.
  - c. Choose the correct data type if you expect to do math.
  - d. Filter the query rows (True or False flag does?)
    - i. Locate a specific column on the Home ribbon tab inside Manage Columns group
    - ii. Click the Choose Columns down-arrow, and then select Go to Column.
    - iii. Check or Uncheck columns to keep or remove
  - e. Right-click column header, and then select Replace Values.
  - f. Applied Steps list
    - i. Each transformation you create results in additional step logic.
    - ii. It's possible to edit or delete steps.
    - iii. Can select a step to preview the query results at that stage of transformation.
3. Preview Queries
  - a. Column quality allows you to easily determine the percentage of valid, error, or empty values.
  - b. Column Distribution
    - i. *When the distinct and unique counts are the same, it means the column contains unique values.*
    - ii. When modeling, it's important that some tables contain unique columns.
    - iii. You can *use these unique columns to create one-to-many relationships.*
  - c. Define a many-to-many relationship
  - d. Create a hierarchy to support analysis
  - e. Save: When prompted to apply the queries, select Apply Later.
    - i. *Applying the queries will load their data to the data model.*
4. Apply transformations to queries.
5. Apply the queries to load

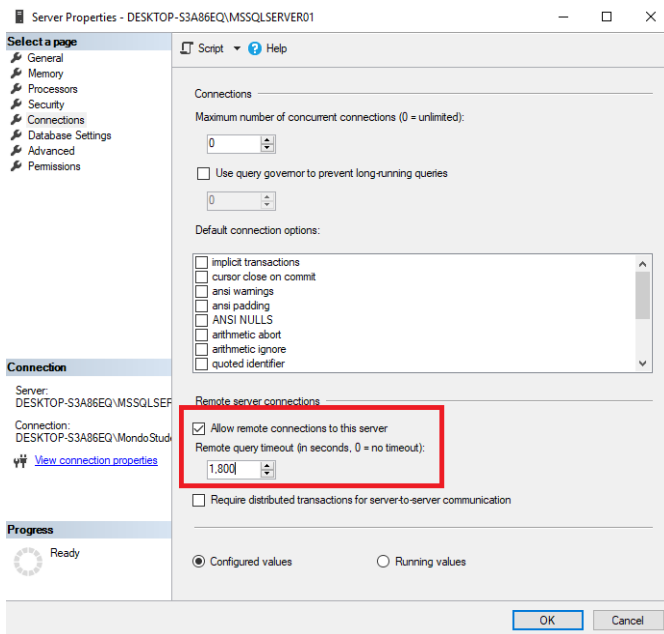
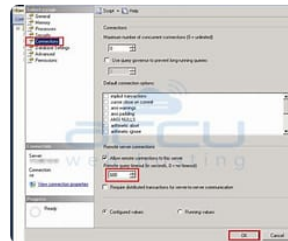
- a. As a table
  - b. To the data model.
6. The DimProduct column has been included to *retrieve the product standard cost, to fix the missing values.*
7. Configure row-level security
  - a. UPN is an acronym for User Principal Name. *The values in this column will be used when you configure row-level security* in Lab 05A.
  - b. [Row-level security \(RLS\) with Power BI - Power BI | Microsoft Docs](#)
  - c. Filters restrict data access at the *row level*
  - d. Define filters within *roles*.
  - e. In the Power BI service, members of a workspace have access to datasets in the workspace.
  - f. RLS *doesn't restrict* this data access.
  - g. Manage roles | Create also *writes DAX formula – Always watch for ways to get working code!*
  - h. You can't assign users to a role within Power BI Desktop. *Assign them in the Power BI service.*
  - i. Enable dynamic security within Power BI Desktop by making use of the username() or userprincipalname() DAX functions and having the proper relationships configured.
8. Privacy levels can be configured for data source to determine whether data can be shared between sources.
  - a. Setting each data source as Organizational allows them to share data, if necessary.
9. *Disabling the load won't load as a table to the data model.*
  - a. This is done *because* the query was merged with the Product query
  - b. Which is enabled to load to the data model.
  - c. Query Properties window, uncheck the Enable Load To Report checkbox.
10. Space

### Power BI “Parts”



**Working with SQL Servers and other Data Sources: Timeout issue**[Configure the remote query timeout Server Configuration Option - SQL Server | Microsoft Docs](#)

- Connect to MS SQL server via SQL Management Studio.
- In Object Explorer, right-click on the server name and then select Properties.
- In the new tab, click on Connections node.
- In Remote Query Timeout change it to your desired value or specify 0 to set no limit.
- Click on OK to save the changes.



**Lab Notes:** Some of the “Why” or “Scenario” book/lab discussions

1. Mod 01 – Getting Started with MS DA - **no lab 01**
2. Mod 02 – Get Data – (*first lab – so don't get lost Mod # vs Lab title*)
  - a. Lab [Prepare data in Power BI Desktop](#)
  - b. *Create Sales Analysis empty file and connect to data – CSV and SQL server*
3. Mod 03: Clean & Transform & Load Data
  - a. [Lab - Load data in Power BI Desktop](#)
  - b. [Enter data directly into Power BI Desktop - Power BI | Microsoft Docs](#)
    - i. Copy portions of a workbook or web page, then paste it to table in PBI.
4. Mod 04: Model Relationships – Filtering direction
  - a. [UseRelationship or Role-Playing Dimension; Dealing with Inactive Relationships in Power BI - RADACAD](#)
    - i. **Example:** A column chart with SalesAmount from the FactInternetSales table and FullDateAlternateKey from DimDate table.
    - ii. Because the *FullDateAlternateKey is a date field*, Power BI creates a default hierarchy
      1. The *visual slicing and dicing data* by the highest level of the hierarchy, which is Year is *visible*.
    - iii. Chart is *showing the same SalesAmount for every single year* from 2005 to 2010.
    - iv. The *value is the grand total of the sales* in my dataset.
    - v. FullDateAlternateKey field **is NOT filtering** the FactSalesAmount table.

**Relationship Means Filtering**

- vi. Applying a filter on the one-side of a relationship affects the many-side.

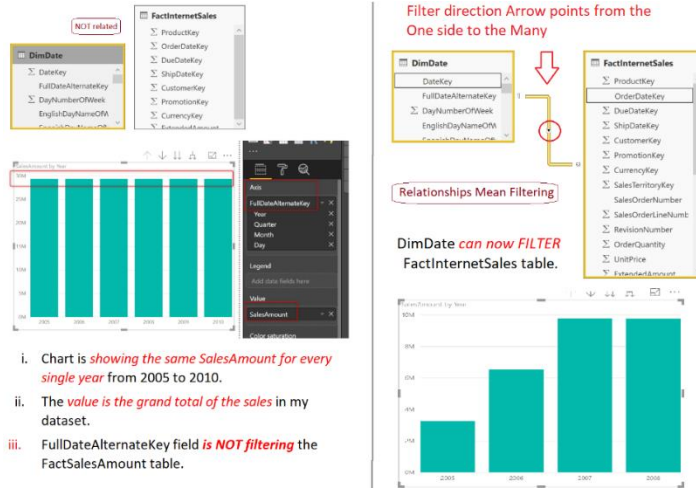
```

1 AppleSales :=
2 CALCULATE (
3     SUM ( Sales[Amount] ),
4     Product[Product] = "Apple"
5 )

```

**Filter Propagation:** The filter applied on Product[Product] follows the relationship between Product and Sales filtering Sales table

- vii.
- viii. **Filter Propagation:** The filter applied on Product[Product] *follows the relationship* between Product and Sales and *filters the Sales table*.
  1. When you filter Product[Product], *all the tables that contain that column* – either native or related – *are filtered*.
  2. So Sales is filtered by Product[Product] because the expanded version of Sales contains Product[Product].
- ix. *Create the ACTIVE relationship between these two tables*, based on the OrderDateKey in the FactInternetSales table and the DateKey in the DimDate table.
- x. DimDate *can now FILTER* the FactInternetSales table.



xi.

**b. Inactive Relationship**

- i. Previous example: *Sliced and diced data by the OrderDateKey field connected through the relationship* to the DimDate table.
- ii. Change to slice and dice data by the ShipDateKey.
- iii. Create another relationship between the DimDate table and FactInternetSales to the ShipDateKey.
- iv. Shows as dashed line compared to the active which was a solid line.
- v. Can only have one active relationship.
- vi. Inactive relationship needs a special treatment to work.

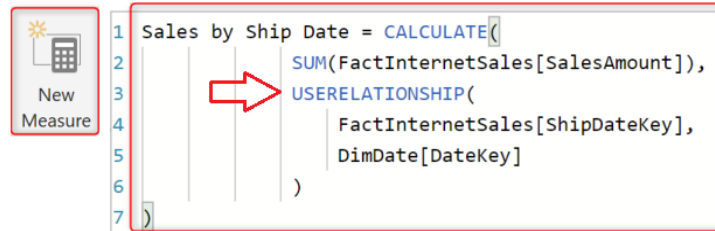
**c. Role-playing dimension and UseRelationship**

- i. Calculated Tables to create role play dimensions.
- ii. Role Play dimensions are *dimensions with the same structure and data rows that plays different roles* in our data model. (a copy of an existing column)
- iii. **Example:** Date Dimension is a generic dimension.
- iv. A sales transaction table might have more than one date columns to relate with the date dimension.
- v. **Example** three date fields in FactInternetSales table: Order Date, Ship Date, and Due Date.
- vi. The three fields should be related to three different date dimensions.

**d. Working with Inactive relationships**

- i. First Choice: Remove the cause to create it!
- ii. Create *a copy of the same table* and then you would need only one relationship per table.
  - 1. Each table | columns set meaningfully renamed for visuals.
  - 2. Uses more memory resources than UseRelationship.
- iii. ALL function **example** to copy the DimDate table and call it ShipDate.
  - 1. Ship Date = ALL(DimDate)
  - 2. Create a normal active relationship between ShipDate and FactInternetSales table
  - 3. Can now slice and dice by the ShipDate table as well as the Order Date (or let's say DimDate table);
- iv. UseRelationship Function
  - 1. Be sure the inactive relationship exists.
  - 2. To filter using inactive relationship provide the columns to UseRelationship function.
  - 3. **Example** Measure:





- 4.
5. Does not consume extra memory but must create a measure for every calculation with UseRelationship.
- v. The DimDate table can *filter the fact table based on both ShipDateKey and OrderDateKey at the same time.*
- vi. space
- e. Scenarios of Using Calculated Tables in Power BI - RADACAD
  - i. Generate Date Dimensions T-SQL script
  - ii. <https://radacad.com/script-to-generate-and-populate-date-dimension-version-2-adding-multiple-financial-years>
- f. **Expanded Tables**
  - i. Expanded tables in DAX - SQLBI
  - ii. Expansion always happens to the 1-side of a relationship.
    1. If you activate the bidirectional cross-filter on a relationship,
    2. You are not relying on table expansion.
  - iii. Contains *all the columns of the base table*
  - iv. And *all the columns of the tables that are linked* to the base table
  - v. *Through* one or more many-to-one or one-to-one *relationships*.
  - vi. The expanded version of both Product and TopSellerProduct *is the same with a one-to-one relationship* is known as an identity.
  - vii. A one to one expanded table is created by joining the columns of two tables into a larger table using a FULL OUTER JOIN.
  - viii. Regular many-to-one relationships use the usual LEFT OUTER JOIN.

**Native columns**  
Related columns

**Expanded (Product)**

Table	Product	TopSellerProduct
Column	Product	Product
	Apple	Pie
	Pie	Pie
	Pizza	Pizza

- Expanded ( Product ) contains Product[Product] and TopSellerProduct[Product]

**Expanded ( TopSellerProduct )**

Table	TopSellerProduct	Product
Column	Product	Product
	Pie	Apple
	Pie	Pie
	Pizza	Pizza

- Expanded ( TopSellerProduct ) contains Product[Product] and TopSellerProduct[Product]
- Expanded ( Sales ) contains all the columns of the three tables

**Expanded ( Sales )**

Table	Sales					Product	TopSellerProduct
Column	Customer	Date	Amount	Product	DueDate	Product	Product
	Marco	1/1/2018	100	Apple	3/1/2018	Apple	
	Marco	2/1/2018	100	Pie	4/1/2018	Pie	Pie
	Marco	3/1/2018	100	Pizza	5/1/2018	Pizza	Pizza
	Alberto	2/1/2018	500	Apple	4/1/2018	Apple	
	Alberto	3/1/2018	500	Pie	5/1/2018	Pie	Pie
	Daniele	3/1/2018	1000	Pizza	6/1/2018	Pizza	Pizza

ix.

## g. RELATED, RELATEDTABLE and table expansion

- i. RELATED lets you *access the related columns of an expanded table*.
- ii. Date[Month] belongs to the expanded version of Sales

```
1 Sales[TopSellerProduct] = RELATED ( TopSellerProduct[Product] )
2 Sales[Month] = RELATED ( 'Date'[Month] )
```

## iii.

- iv. There is a value for RELATED(Date[Month]) because *Sales was expanded to include Date using a relationship*.

table expansion happens when you define a table.

```
1 DEFINE
2   VAR SalesA =
3     CALCULATETABLE ( Sales, USERELATIONSHIP ( Sales[Date], 'Date'[Date] ) )
4   VAR SalesB = contains the expanded Sales table
5     CALCULATETABLE ( Sales, USERELATIONSHIP ( Sales[DueDate], 'Date'[Date] ) )
6   EVALUATE
7     ADDCOLUMNS ( SalesB, "Month", RELATED ( 'Date'[Month] ) )
```

RELATED accesses the related columns of the expanded version of Sales.

The two variables store the Sales table using two different relationships. SalesA uses the default relationship, whereas SalesB uses the relationship with Sales[DueDate] instead of Sales[Date]. The last ADDCOLUMNS iterates SalesB and returns the RELATED Date[Month]. What will the result be? The month of the Sales[Date] column or the month of the Sales[DueDate] column?

when ADDCOLUMNS is executed, the active relationship is the relationship using Sales[Date] and you would think that the month is the month of that date. Right? Wrong!

The correct reasoning is as follows:

SalesB contains the expanded Sales table, and that expansion happened when the active relationship was the relationship with Sales[DueDate]. As a result, Date[Month] contained in SalesB is related to Sales[DueDate], not to Sales[Date].

## v.

vi. [TREATAS – DAX Guide](#)h. [Modify filter context - Learn | Microsoft Docs](#)

- i. Filters can be Boolean expressions or table expressions.
  1. Measures (or measure expressions) are **always evaluated in filter context**.
  2. The CALCULATE function *modifies filter context* by adding or removing filters or by modifying standard filter behavior.
- ii. [REMOVEFILTERS function \(DAX\) - DAX | Microsoft Docs](#)
- iii. Using DAX to manipulate relations between tables and differences in visuals.
- iv. Remove filters from one or more columns or from all columns of a single table.
- v. [FILTER Function in DAX and Power BI: Apply Custom Filter to Calculations - RADACAD](#)

```
DAX
Revenue High Margin Products =
CALCULATE(
  [Revenue],
  FILTER(
    'Product',
    'Product'[List Price] > 'Product'[Standard Cost] * 2
  )
)
```

Table to filter Filter Expression

## vi.

## vii. Values

1. Lets your formulas determine what values are in filter context.
2. HASONEVALUE returns TRUE when a given column has been filtered to a single value.

3. SELECTEDVALUE will return a single value, or when more than one value is in filter context, it'll return BLANK (or an alternate value that you pass to the function).
- i. Lab - [Model data in Power BI Desktop, Part 1](#)
- j. Lab - [Model data in Power BI Desktop, Part 2](#)
- k. Notice that the table visual lists four product categories, and that the sales value is the same for each, and the same for the total.

Category	Sales
Accessories	\$77,548,570.2
Bikes	\$77,548,570.2
Clothing	\$77,548,570.2
Components	\$77,548,570.2
<b>Total</b>	<b>\$77,548,570.2</b>

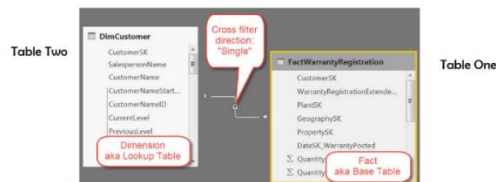
- l.
- m. The issue is that *the table is based on fields from different tables.*
- n. The expectation is that each product category displays the sales for that category.
- o. Because there isn't a model relationship between these tables, the Sales table is not filtered.*
- p. You'll now add a relationship to propagate filters between the tables.

Category	Sales
Accessories	\$539,106.09
Bikes	\$64,069,033.16
Clothing	\$1,714,056.05
Components	\$11,226,374.9
<b>Total</b>	<b>\$77,548,570.2</b>

- q.
- r. I have data (Fact Table) – what do I want to “filter” or “slice” it by?
  - i. [Create and manage relationships in Power BI Desktop - Power BI | Microsoft Docs](#) – additional discussion and mini lab.
  - ii. Dimension table
  - iii. Cross filter direction

Follow the direction of the arrow on the relationship between tables to know which direction the filter will flow.

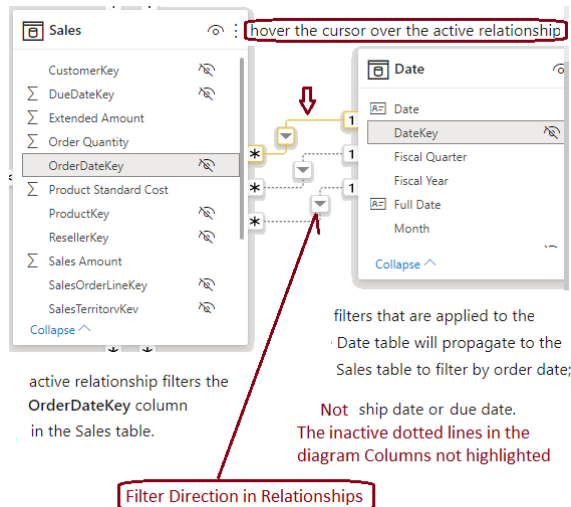
Typically want these arrows to point to a fact table.



My One can be filtered by many? Who is table one vs two?



- s.
- t. Single:
  - i. Default direction
  - ii. Propagate from the "one side" to the "many side". It means *filters applied to the Product table will propagate to the Sales table, but not in the other direction.*
  - iii. Filtering choices in connected tables work on the table where values are being aggregated. (Fact Table?)



- iv.
- u. Both: For filtering purposes, both tables are treated as if they're a single table.
  - i. Works well with a star schema; a central table with several lookup tables that surround it. (Many to one - FactTable is central table, dimensions are lookup tables?)
  - ii. Example is a sales table with a lookup table for its department. (Many to one - one dept many sales?)
  - iii. Do not use with two or more tables that also have common lookup tables
  - iv. A budget sales table records target budget for each department and the department table is connected to both the sales and the budget table.
- v. Create Hierarchies
  - i. Hierarchies in your data *allow drill down into the details* using the structure of the hierarchy.
  - ii. A *date hierarchy* allows analyzing data on yearly, monthly, or weekly basis.
  - iii. Create a common date table that can be used by multiple tables.
  - iv. *What does the order of columns in hierarchy change?*

1. Consider a hierarchy with 3 levels.

BusinessUnitID	BusinessUnit	Division	Group
1	Baby Care BU	Personal care	Baby Care
4	Hair Care BU	Personal care	Hair Care

A hierarchy with 3 levels.

The top-level is Division, followed by Group and then BusinessUnit.

This means that several BusinessUnits belong to one Group and several Groups belong to one Division.

- 2.
3. The top-level is Division, followed by Group and then BusinessUnit.
4. This means that several *BusinessUnits belong to one Group* and several *Groups belong to one Division*.

**Regions Hierarchy**  
**3 Levels**

- Group
  - Country
    - Region

What is the natural hierarchy in the data?

Who belongs to who?

SalesTerritoryKey	Region	Country	Group
1	Northwest	United States	North America
2	Northeast	United States	North America
3	Central	United States	North America
4	Southwest	United States	North America
5	Southeast	United States	North America
6	Canada	Canada	North America
7	France	France	Europe
8	Germany	Germany	Europe
9	Australia	Australia	Pacific
10	United Kingdom	United Kingdom	Europe

5. Test the visual to see if Drill Through works as desired... Change order if needed.
6. Can now expand and collapse the different levels of the hierarchy in a visual.
7. Hide any level of the hierarchy in a visual unselect the level which should not be shown.
8. Use drag and drop to change the grouping order of the levels.
9. Apply Level Changes.
10. **Test the visual** to see if Drill Through works as desired... Change order if needed.

**Properties**

Synonyms  
Enter a comma-separated list of synonyms for Q&A

Display folder  
Enter the display folder

Is hidden  
No ☐

**Hierarchy**

Select a column to add level...

- Category (Category)
- Subcategory (Subcategory)
- Product (Product)

Apply Level Changes

**Fields**

Search Create Hierarchies

- Product
  - Background Color Format
  - Category
  - Color
  - Font Color Format
  - Product
  - ProductKey
  - Products
    - Category
    - Standard Cost
    - Subcategory
- Region
- Reseller
- Sales
- Salesperson
- SalespersonRegion
- Targets...

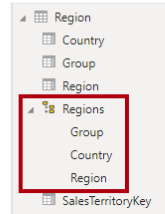
v. **Finished Hierarchy**

- Products
  - Category
  - Subcategory
  - Product

- vi.
- vii. The column that is created first is the one Rt Mouse clicked to open the menu.
- viii. Columns can be drag and dropped into different grouping order.

1. In the **Region** table, create a hierarchy named **Regions**, with the following three levels:

- Group
- Country
- Region

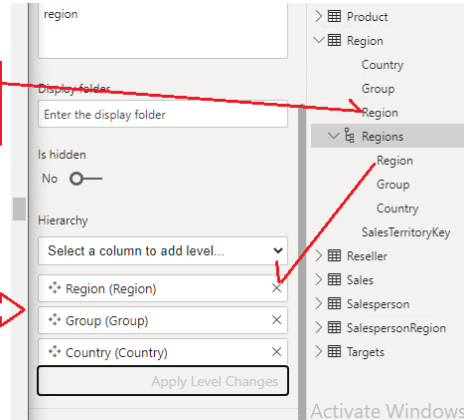


When creating hierarchies - not the column that is created first is the one Rt Mouse clicked to open the menu.

Region Column at top

Moved to bottom

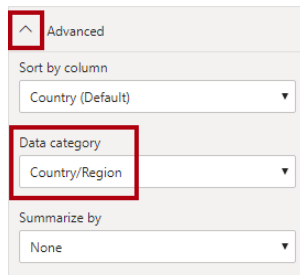
Drag and drop them in different order as needed



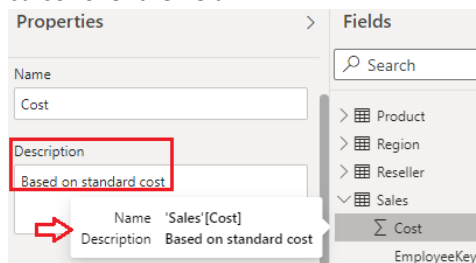
- ix.
- x. Achieve *hierarchy function by adding multiple columns* (Year, Month) to the "Axis" of a bar or column chart.
- xi. [Create Hierarchy in Power BI \(tutorialgateway.org\)](https://tutorialgateway.org)
- xii. [Creating hierarchies in Power BI - PBI Help Center \(zebrabi.com\)](https://zebrabi.com)
- xiii. [Sort a hierarchy by custom sort logic - PBI Help Center \(zebrabi.com\)](https://zebrabi.com)
- xiv. [TIQ Part 3 — Ultimate Guide to Date dimension creation | by Nikola Ilic | Towards Data Science](#)
- xv. [Relationships in Power BI and Tabular models - SQLBI](#) – *Good explanations*

w. *Data categorization* provides hints to the report designer.

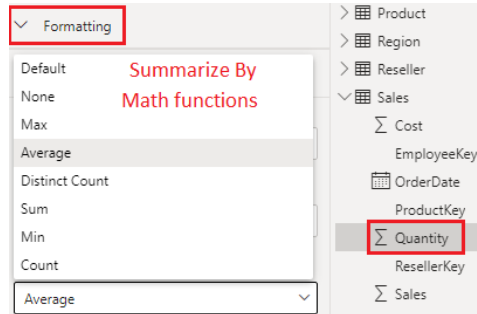
- i. Should Power BI Desktop treat the codes in the GeoCode column as an abbreviation for a Country or a US State?
- ii. That's not clear because a code like this can mean either one. For instance, AL can mean Alabama or Albania, AR can mean Arkansas or Argentina, or CA can mean California or Canada.
- iii. It makes a difference when we go to chart our GeoCode field on a map.



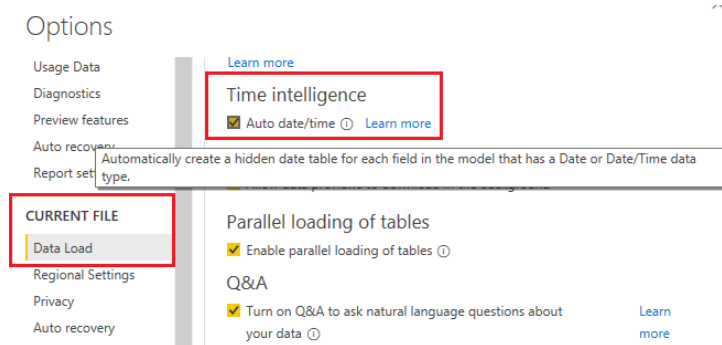
- iv.
- v. [Data categorization in Power BI Desktop - Power BI | Microsoft Docs](#)
- vi. [Data categorization for measure - Microsoft Power BI Community](#)
- x. *Organize columns into a display folder* to declutter tables that contain many fields.
- y. Properties: Descriptions can be applied to table, columns, hierarchies, or measures.
  - i. In the Fields pane, *description text is revealed in a tooltip* when a report author hovers their cursor over the field.



- z. Formatting | Summarize By: Math functions



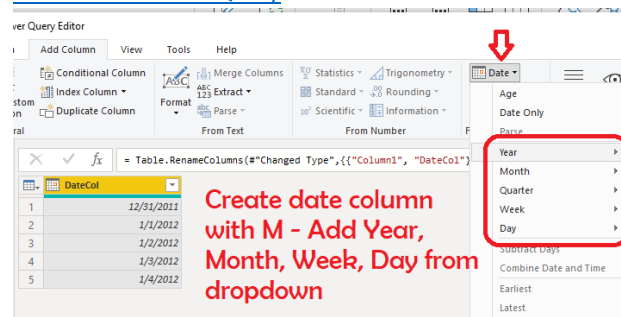
- i.
- ii. By default, numeric columns will summarize by summing values together.
- iii. This default behavior is not suitable for a column like Unit Price, which represents a rate.
- aa. Update multiple columns in a single bulk update.
  - i. You will use this approach to hide columns, and format column values.
  - ii. Because they are either used by relationships or calculation logic



### Mod 04: Modeling Challenges

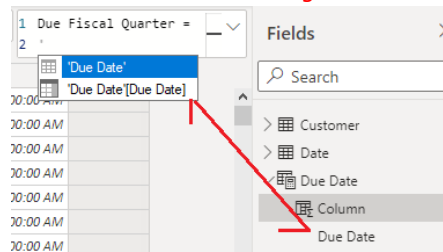
#### bb. Date table:

- i. New Table or PowerQuery
  1. Dates = **CALENDAR**(DATE(2011, 5, 31), DATE(2021, 5, 31))
  2. Year = YEAR(Dates[Date])
  3. MonthNum = MONTH(Dates[Date])
  4. WeekNum = WEEKNUM(Dates[Date])
  5. DayoftheWeek = FORMAT(Dates[Date].[Day], "DDDD")
  6. [Power BI Calendar | How to Use Calendar DAX Function in Power BI? \(educba.com\)](https://educba.com/power-bi-calendar-how-to-use-calendar-dax-function-in-power-bi/)
  7. =List.Dates(#date(2011, 12, 31), 5, #duration(1, 0, 0, 0))
  8. [List.Dates - Power Query](#)



- 9.
- 10. Right-click the name of the table and then select Mark as date table.
- ii. **CALENDARAUTO**
  1. Takes a single optional argument, which is the last month number of the year, and returns a single-column table.
  2. If you don't pass in a month number, it's assumed to be 12 (for December).

3. **Example**, Adventure Works financial year ends on June 30 of each year, so the value 6 (for June) is passed in.
4. Earliest date that is stored in your model is October 15, 2017
  - a. First date returned is July 1, 2017.
  - b. Latest date is June 15, 2020, t
  - c. Last date is June 30, 2020.
5. When the table rows and distinct values are the same, it means that the column contains unique values.
6. That factor is important for two reasons:
  - a. It satisfies the requirements to mark a date table
  - b. It allows this column to be used in a model relationship as the one-side.
7. Changing the format of values – Custom dates and times
  - a. [FORMAT function \(DAX\) - DAX | Microsoft Docs](#)
8. The MonthKey calculated column
  - a. Multiplies the due date year by the value 100
  - b. Adds the month number of the due date.
  - c. Produces *a numeric value that can be used to sort the Due Month text values in chronological order.*



Typing DAX - PBI shows what is in Fields

9.
  - iii. Space
- cc. [Sort one column by another column in Power BI Desktop - Power BI | Microsoft Docs](#)
  - i. Choose a column to define the sort order of another column by setting the Sort by column.
  - ii. **Example**. A Month Name column, and when you add it to a visual, the months are being sorted *alphabetically*: April, August, December, February, and so on.
  - iii. Need to be sorted *chronologically*.
  - iv. Both columns need to be at the same level of granularity.
  - v. For **example**, to sort a column of month names, *you need a column that contains a number for each month.*
  - vi. The sort order will apply to any visual in the report that contains the sorted column.
- dd. Developing reports for the Sales team and are examining the relationships between tables.
  - i. Poorly designed data model
  - ii. Table 1 has a many-to-one relationship with a column in Table 2
  - iii. Table 2 has a one-to-many relationship with Table 3
  - iv. Table 3 has its own relationship with Table 1.
  - v. Identify circular relationships so that your data is usable.
- ee. Role-playing dimensions (tables) have multiple relationships with fact tables
  - i. Use one same dimension for creating multiple relationships to your fact table
  - ii. The same dimension can be used to filter multiple columns or tables of data
  - iii. Can filter data differently depending on what information you need to retrieve.
- ff. Manage Relations **issues**: This attempt has a *Product | ProductKey Column that has duplicate entries.*



12. In the second dropdown list (beneath the **Product** table grid), select the **Sales** table.

Cardinality & Cross filter did not default as lab suggested

13. Notice the **ProductKey** columns in each table have been selected.

The columns were automatically selected because they share the same name and data type.

14. In the **Cardinality** dropdown list, notice that **One To Many (1:\*)** is selected.

The cardinality was automatically detected, because Power BI understands that the **ProductKey** column from the **Product** table contains unique values. One-to-many relationships are the most common cardinality, and all relationships you create in this lab will be of this type. You'll work with a many-to-many cardinality in the **Model data in Power BI Desktop, Part 2** lab.

15. In the **Cross Filter Direction** dropdown list, notice that **Single** is selected.

gg.

Single (Sales filters Product)  
Single (Product filters Sales)  
Both

What direction to filter?

Not Both but Single:

Sales by Products or Products by Sales

hh.

This relationship has cardinality Many-Many. This should only be used if it is expected that neither column (**ProductKey** and **ProductKey**) contains unique values, and that the significantly different behavior of Many-many relationships is understood. [Learn more](#)

Activate

PBI message: neither column contains unique values

ii.

jj. Using fresh lab file 03 – Starter to compare notes: **Product | ProductKey** must contain same number of Unique and Distinct values (Primary Key?) – meaning **no value is duplicated**.

kk.

Create relationship

Select tables and columns that are related.

Product

ProductKey	Product	Standard Cost	Color	Subcategory	Category	Background Color	Form
210	HL Road Frame - Black, S8	\$868.63	Black	Road Frames	Components	#000000	
215	Sport-100 Helmet, Black	\$12.03	Black	Helmets	Accessories	#000000	
216	Sport-100 Helmet, Black	\$13.88	Black	Helmets	Accessories	#000000	

Sales

SalesOrderNumber	OrderDate	ProductKey	ResellerKey	EmployeeKey	SalesTerritoryKey	Quantity
5043897	Friday, August 25, 2017	235	312	282		4
5043897	Friday, August 25, 2017	351	312	282		4
5043897	Friday, August 25, 2017	348	312	282		4

Cardinality: One to many (1:\*)

Cross filter direction: Single

Make this relationship active

Assume referential integrity

Power Query Editor

File Home Transform Add Column View Tools

Formula Bar Monospaced Column distribution Show whitespace Column quality

Queries [8]

Salesperson SalespersonRegion Product Reseller Region Sales

ProductKey

Valid 100%  
Error 0%  
Empty 0%

397 distinct, 397 unique

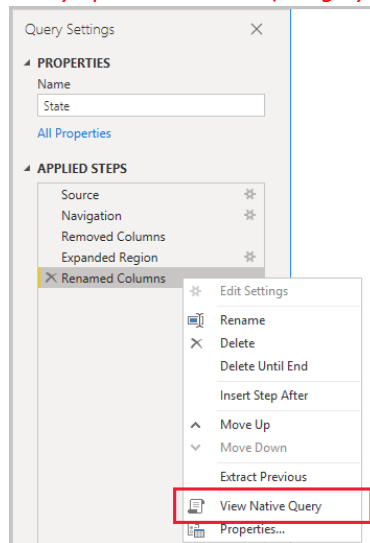
Product | ProductKey has 397 Distinct - 397 Unique  
Meaning only one each in the column

## 5. Mod 05: Create Model Calculations: Measures, Calculated Columns, Time Intelligence

- Lab: [Create DAX calculations in Power BI Desktop, part 1](#)
- Lab: [Create DAX calculations in Power BI Desktop, part 2](#)
- [DAX basics in Power BI Desktop - Power BI | Microsoft Docs](#)
- Measures (I want to measure something – add on the fly calcs that reuse)
  - What to create on the fly to generate data from data among other things...
  - An aggregation
  - Over the entire dataset

- iv. Want the total sales of all rows
- v. Want to slice and dice that data by other criteria (Dimensions) like total sales by year, by employee, or by product.
- vi. Total Sales = sum('Sales OrderDetails'[Total Price])
- vii. [Use quick measures for common and powerful calculations - Power BI | Microsoft Docs](#)
- e. Calculated column
  - i. Total Price = 'Sales OrderDetails'[Quantity] \* 'Sales OrderDetails'[Unit Price]
    - 1. Multiplies the unit price with the quantity.
    - 2. The calculated column will create a value for each row called Total Price.
  - ii. Create a calculated column when you pull the data from the data source.
  - iii. Make the data source do the calculations for you; (Server side)
  - iv. Use Power Query to create a custom column. (M)
    - 1. [Power Query M formula language reference - PowerQuery M | Microsoft Docs](#)
  - v. Calculated columns based on DAX expressions do not need to refresh the dataset to see the new column.
  - vi. A DAX *calculated column* should be *limited to cases where* the result is obtained by accessing data in different rows of the same table or in different tables;
  - vii. *Choose* a Power Query *computed column* when the business logic to implement relies on the values of other columns of the same table.
  - viii. [Comparing DAX calculated columns with Power Query computed columns - SQLBI](#)
- f. Computed columns generated by Power Query.
  - i. An M expression that defines the transformations to apply to a data source *before importing a table* in the data model.
  - ii. Use DAX calculated columns *whenever you cannot implement the same calculation in a Power Query computed column*.
    - 1. The typical case is when aggregating data from other tables in the model.
    - 2. Another case would be the *denormalization of tables coming from different data sources*, because this would not be optimized using the query folding technique in Power Query.
- g. Calculated Table:
  - i. A calculated table *can't connect to external data*; you must use Power Query to accomplish that task.
  - ii. A calculated table *only duplicates data*; it doesn't duplicate any model configurations like column visibility or hierarchies.
  - iii. Cost: They *increase* the model storage size and they can *prolong* the data refresh time.
  - iv. Because calculated tables recalculate when they have formula dependencies to refreshed tables.
  - v. Rename columns so that they better describe their purpose. *Example*, the Fiscal Year column in the Ship Date table can be renamed as Ship Fiscal Year.
  - vi. Fields from the Ship Date table are *used in visuals and their names are automatically included* in captions like the visual title or axis labels.
  - vii. [Add calculated tables and columns to Power BI Desktop models - Learn | Microsoft Docs](#)
  - viii. Uses **Adventure Works DW 2020 M03.pbix**
- h. Query folding
  - i. Query folding is the ability for a Power Query to *generate a single query statement to retrieve and transform source data*.
  - ii. *M expressions are translated* into equivalent SQL expressions,
  - iii. Performance and parallelism entirely depend on the SQL data source.
  - iv. Query folding may occur *for an entire Power Query or for a subset of its steps*.

- v. When query folding cannot be achieved—either partially or fully—the Power Query mashup engine must compensate by processing data transformations itself.
- vi. Relational data source *transformations that can be query folded are those that can be written as a single SELECT statement.*
- vii. A SELECT statement can be constructed with appropriate WHERE, GROUP BY, and JOIN clauses.
  - 1. It can also contain column expressions (calculations) that use common built-in functions supported by SQL databases.
- viii. Determine when a Power Query can be folded In the Power Query Editor window.
- ix. In the Query Settings pane, when you right-click the last applied step, *if the View Native Query option is enabled (not greyed out), then the entire query can be folded.*



- x. [Query folding | Microsoft Docs](#)
- xi. [Query folding | Microsoft Docs](#)
- i. Incremental Refresh
  - i. Incremental refresh *extends scheduled refresh* operations by providing automated partition creation and management *for dataset tables that frequently load new and updated data.*
  - ii. For most datasets, this is one or more tables that contain transaction data that changes often and can grow exponentially, *like a fact table* in a relational or star database schema.
  - iii. By *partitioning the table* and *refreshing only the most recent partition(s)* significantly reduces the amount of data that has to be refreshed.
  - iv. Incremental refresh is supported for Power BI Premium, Premium per user, Power BI Pro, and Power BI Embedded datasets.
    - 1. [Pricing & Product Comparison | Microsoft Power BI](#)
  - v. <https://docs.microsoft.com/en-us/power-bi/connect-data/incremental-refresh-overview>
  - vi. [Troubleshooting refresh scenarios - Power BI | Microsoft Docs](#)
- j. X Functions (instead of calculated columns)
  - i. Create measures that are aware of the data in individual rows and calculate totals based on the totals in the row.
  - ii. X function will perform better and use less disk space than a calculated column
  - iii. [SUMX function \(DAX\) - DAX | Microsoft Docs](#)
- k. Context: The Visual makes a difference in the data presented.
  - i. [CALCULATE function \(DAX\) - DAX | Microsoft Docs](#)
  - ii. When you have multiple filters, they're evaluated by using the AND logical operator, which means that *all conditions must be TRUE at the same time.*

- iii. Use columns to create filters; Ex: the Revenue measure by using a Boolean expression filter for red products.

I. USERELATIONSHIP

- i. Two visuals: Sales by Ship Date (active) and Sales by Order Date (inactive)
- ii. Shared Date table with active vs. inactive relations to other tables and slicer behavior.
- iii. [USERELATIONSHIP function \(DAX\) - DAX | Microsoft Docs](#) – Override active relationship to create different data points –
- iv. Sales by Ship Date = CALCULATE(Sales[TotalPrice], USERELATIONSHIP('Calendar'[Date], Sales[ShipDate]))

m. [Many-to-many relationships in Power BI Desktop - Power BI | Microsoft Docs](#)

- n. Semi Additive measures are values that you can summarize across any related dimension except time.
  - i. For example, Sales and costs are fully **additive**; if you sell 100 yesterday and 50 today then you've sold 150 in total. You **can add them up over time**.
  - ii. Stock levels however are **semi additive**; if 100 in stock yesterday, and 50 in stock today, total stock is 50, not 150. It doesn't make sense to add up the measures over time, you need to **find the most recent value**.
  - iii. Use the CALCULATE with LastDate function to complete this action.

```
Last Inventory Count =
CALCULATE (
    SUM ( 'Warehouse'[Inventory Count] ),
    LASTDATE ( 'Date'[Date] ) )
```

iv.

- v. <https://www.purplefrogsystems.com/blog/2008/04/semi-additive-measures-using-sql-server-standard/>

o. Time Intelligence

- i. Create or import a dates table.
- ii. **Example:** Display a running total
- iii. TOTALYTD

- 1. Use the SUM function to get the Total Price – Use Date table to get running values

- iv. **Example:** See the total sales of the month next to the total sales of the prior month

```
YTD Total Sales = TOTALYTD (
    SUM('Sales OrderDetails'[Total Price])
    , Dates[Date]
)
```

```
Total Sales Previous Month = CALCULATE ( overriding the context to evaluate this expression
    sum('Sales OrderDetails'[Total Price])
    , PREVIOUSMONTH(Dates[Date]) using PREVIOUSMONTH for the override.
)
```

v.

- vi. **Examples:** At the Adventure Works company, their **financial year begins** on July 1 and ends on June 30 of the following year. They produce a table visual that displays monthly revenue and year-to-date (YTD) revenue.

- 1. What's the accumulation of revenue for the year, quarter, or month?
- 2. What revenue was produced for the same period last year?
- 3. What growth in revenue has been achieved over the same period last year?
- 4. How many new customers made their first order in each month?
- 5. What's the inventory stock on-hand value for the company's products?
- 6. Calculate the number of new customers for a time period.

vii. [Create date tables in Power BI Desktop - Power BI | Microsoft Docs](#)

- viii. Summarizations over time:

1. DATESYTD - Returns a single-column table that contains dates for the year-to-date (YTD) in the current filter context.
  - a. This group also includes the DATESMTD and DATESQTD DAX functions for month-to-date (MTD) and quarter-to-date (QTD). You can pass these functions as filters into the CALCULATE DAX function.
2. TOTALYTD - Evaluates an expression for YTD in the current filter context. T
  - a. The equivalent QTD and MTD DAX functions of TOTALQTD and TOTALMTD are also included.
3. DATESBETWEEN - Returns a table that contains a column of dates that begins with a given start date and continues until a given end date.
4. DATESINPERIOD - Returns a table that contains a column of dates that begins with a given start date and continues for the specified number of intervals.

ix. BLANK

1. [BLANK function \(DAX\) - DAX | Microsoft Docs](#)
2. **Example** illustrates how you can work with blanks in formulas.
  - a. The formula calculates the ratio of sales between the Resellers and the Internet channels.
  - b. However, before attempting to calculate the ratio the denominator should be checked for zero values.
  - c. If the denominator is zero then a blank value should be returned; otherwise, the ratio is calculated.
3. [Additional time intelligence calculations - Learn | Microsoft Docs](#)

- x. DATESBETWEEN function includes dates until the first date in filter context minus one. Because Microsoft Power BI internally stores dates as numbers, you *can add or subtract numbers to shift a date*.

xi. Snapshot calculations

1. Examples include inventory stock levels or account balances.
2. A snapshot of values is loaded into the table on a periodic basis.
3. Add a measure definition that sums the UnitsBalance value for a single date.
  - a. The date will be the last date of each time period.
  - b. It's achieved by using the LASTDATE function.
4. Filtering by the last date in filter context has inherent problems:
  - a. A recorded *date might not exist* because it hasn't yet happened, or perhaps because stock balances aren't recorded on weekends.
5. Your next step is to adjust the measure formula to *determine the last date that has a non-BLANK result* and then *filter by that date*. You can achieve this task by using the LASTNONBLANK
  - a. It returns the last date that produces a non-BLANK result.
  - b. By iterating through all dates in filter context in descending chronological order.

xii. space

- p. [DAX basics in Power BI Desktop - Power BI | Microsoft Docs](#)
  - q. [\[Ultimate\] Guide of Power BI Dax Function for Beginners | Basics of Power BI Dax \(yodalearning.com\)](#)
  - r. [DAX function reference - DAX | Microsoft Docs](#)
  - s. [Tutorial: Create your own measures in Power BI Desktop - Power BI | Microsoft Docs](#)
  - t. [Use what-if parameters to visualize variables - Power BI | Microsoft Docs](#)
  - u. [You searched for percent change - \(powerbi.tips\)](#)
6. Mod 06: Optimize Model Performance – **No lab (is 4.2, 5.1, 5.2 done?)**
- a. Performance:

- i. Smaller sized data model uses less resources (memory), faster data refresh, calculations, and rendering of visuals in reports.
  - ii. Performance optimization process involves minimizing the size of the data model and making the most efficient use of the data in the model.
    - 1. Ensuring that the correct *data types* are used.
    - 2. Deleting unnecessary columns and rows.
    - 3. Avoiding repeated values.
    - 4. *Replacing numeric columns with measures.*
    - 5. Reducing cardinalities.
    - 6. Analyzing model metadata.
    - 7. *Summarizing* data where possible.
  - iii. Review the performance of measures, relationships, and visuals.
- b. Use *variables* to improve performance and troubleshooting.
  - i. [DAX: Use variables to improve your formulas - Power BI | Microsoft Docs](#)
  - ii. [VAR keyword \(DAX\) - DAX | Microsoft Docs](#) – condense code example
- c. [PARALLELPERIOD function \(DAX\) - DAX | Microsoft Docs](#)
  - i. Returns a table
  - ii. In the current context
  - iii. With the dates shifted a number of intervals either forward in time or back in time.
  - iv. If there is a selection of dates that starts at June 10 and finishes at June 21 of the same year, and *you want to shift that selection forward by one month*
    - 1. PARALLELPERIOD function will return all dates from the next month (July 1 to July 31);
  - v. DATEADD is used instead, then the result will include only dates from July 10 to July 21.
  - vi. Creates a measure that calculates the previous year sales for Internet sales.
  - vii. = CALCULATE(SUM(InternetSales\_USD[SalesAmount\_USD]), PARALLELPERIOD(DateTime[DateKey],-1,year))
- d. Performance Analyzer
  - i. Clear visual and data engine caches – restart Power BI Desktop
    - 1. Add a blank page to your Power BI Desktop (.pbix) file
    - 2. With the blank page selected, save and close the file.
    - 3. Reopen the Power BI Desktop (.pbix) file that you want to analyze.
    - 4. It will open on the blank page.
  - ii. TEST IT: Analyze – close – re open – analyze again and note differences if any.
  - iii. [Use Performance Analyzer to examine report element performance in Power BI Desktop - Power BI | Microsoft Docs](#)
  - iv. [Monitor report performance in Power BI - Power BI | Microsoft Docs](#)
  - v. [Data reduction techniques for Import modeling - Power BI | Microsoft Docs](#)
- e. Auto date
  - i. By default, this feature is enabled globally
  - ii. PBI automatically creates a hidden calculated table for each date column
  - iii. Hidden tables are in addition to the tables that you already have in your dataset.
  - iv. Enable/disable Auto date/time option, **File>Options and settings>Options**, select either the Global or Current File page.
  - v. [Auto date/time in Power BI Desktop - Power BI | Microsoft Docs](#)
- f. Improve performance by *reducing cardinality* levels.
  - i. The cardinality of the relationship means having unique or multiple instances per value for the joining field between two tables.

- ii. Types of Cardinality are- Many to one (\*:1), One to one (1:1), One to many (1:\*) & Many to many (\*:\*)
- iii. A lot of repeated values in its range (distinct count is high) will have a low level of cardinality.
- iv. Conversely, a column that has a lot of unique values in its range (unique count is high) will have a high level of cardinality.
- v. always ensure that both of the columns that you are using to participate in a relationship are sharing the same data type
- vi. [Cardinality of Relationship in Power BI - Power BI Docs](#)
- vii. [SQL Cardinality Estimation](#)
- g. Mixed Mode Storage:
  - i. Mixed mode design produces a Composite model.
  - ii. Allows *table level storage mode for each table*.
  - iii. Each table can have its Storage Mode property set:
    1. Import
    2. DirectQuery
    3. Dual
  - iv. An effective technique to *reduce the model size* is to:
    1. *Set the Storage Mode property for larger fact-type tables to DirectQuery.*
    2. In conjunction with Group by and summarize.
    3. **Example:**
      - a. Summarized sales data could be used to *achieve high performance* "summary" reporting.
      - b. *Drill through* page could display *granular* sales for specific (and narrow) filter context, displaying all in-context sales orders.
      - c. Drill through page would include visuals based on a DirectQuery table to retrieve the sales order data.
    4. Many security and performance implications related to Composite models.
    5. [Data reduction techniques for Import modeling - Power BI | Microsoft Docs](#)
    6. Eight different data reduction techniques covered in this article. These techniques include:
      7. [Remove unnecessary columns](#)
      8. [Remove unnecessary rows](#)
      9. [Group by and summarize](#)
      10. [Optimize column data types](#)
      11. [Preference for custom columns](#)
      12. [Disable Power Query query load](#)
      13. [Disable auto date/time](#)
      14. [Switch to Mixed mode](#)
  - v. [Use storage mode in Power BI Desktop - Power BI | Microsoft Docs](#)
    1. **Import:** Imported tables with this setting are cached. Queries submitted to the Power BI dataset that return data from Import tables can be fulfilled only from cached data
    2. **DirectQuery:** Tables with this setting aren't cached. Queries that you submit to the Power BI dataset—for example, DAX queries—and that return data from DirectQuery tables can be fulfilled only by executing on-demand queries to the data source. Queries that you submit to the data source use the query language for that data source, for example, SQL.
    3. [DirectQuery model guidance in Power BI Desktop - Power BI | Microsoft Docs](#)
    4. **Dual:** Tables with this setting can act as either cached or not cached, depending on the context of the query that's submitted to the Power BI dataset.



- 5. *Changing the Storage mode of a table to Import is an irreversible operation.* Once set, this property can't later be changed to either DirectQuery or Dual.
- vi. space
- h. Table Granularity (Mod 06)
  - i. The following equation, which will concatenate the Year and Month columns, and then add a dash in between the column names.
  - ii. `Column = Table.AddColumn("#Renamed Columns", "Custom", each [Year] & "-" & [Month])`
  - iii. [Table.AddColumn - PowerQuery M | Microsoft Docs](#)
  - iv. [#table - PowerQuery M | Microsoft Docs](#)
  - v. [Creating a Table in Power BI Using DAX Table Constructor - RADACAD](#) – code samples
  - vi. [Using DataTable DAX Function for Creating Structured Table in Power BI - RADACAD](#)
  - vii. `Sample Table = DATATABLE( "First Name",STRING, { {"Reza"}, {"Leila"} } )`

Add a column named "TotalPrice" to the table with each value being the sum of column [Price] and column [Shipping].

```
powerquery-m
Copy

Table.AddColumn(
    Table.FromRecords({
        [OrderID = 1, CustomerID = 1, Item = "Fishing rod", Price = 100.0, Shipping = 10.00],
        [OrderID = 2, CustomerID = 1, Item = "1 lb. worms", Price = 5.0, Shipping = 15.00],
        [OrderID = 3, CustomerID = 2, Item = "Fishing net", Price = 25.0, Shipping = 10.00]
    }),
    "TotalPrice",
    each [Price] + [Shipping]
)
```

- viii.
  - ix. [Add a custom column in Power BI Desktop - Power BI | Microsoft Docs](#)
- i. Create and manage *aggregations*.
  - i. [Use and manage aggregations in Power BI Desktop - Power BI | Microsoft Docs](#)
- j. Drill Through – Slice – Dice – Sort
  - i. [Set up drillthrough in Power BI reports - Power BI | Microsoft Docs](#)
    - 1. With drillthrough in Power BI reports, you can *create a page in your report that focuses on a specific entity such as a supplier, customer, or manufacturer.*
    - 2. When your report readers use drillthrough, they right-click a data *point in other report pages*, and *drill through to the focused page to get details that are filtered* to that context.
    - 3. Suppose you want to provide drillthrough for manufacturers.
      - a. Create a drillthrough page with visuals that show total sales, total units shipped, sales by category, sales by region, and so on.
      - b. When you drill through to that page, *the visuals are specific* to the manufacturer you selected.
  - ii. [Create a drillthrough button in Power BI - Power BI | Microsoft Docs](#)
    - 1. One way to drill through in a report is to right-click in a visual. If you want the drillthrough action to be more obvious, you can create a drillthrough button instead.
  - iii. [Use cross-report drillthrough in Power BI Desktop - Power BI | Microsoft Docs](#)
    - 1. With the Power BI cross-report drillthrough feature, you can contextually jump from one report to another report in the same Power BI service workspace or app.
    - 2. You can use cross-report drillthrough to connect two or more reports that have related content, and to pass filter context along with the cross-report connection.
  - iv. Add a measure or a summarized numeric column to the drillthrough area.
  - v. Drag the drillthrough field to the Drillthrough card to apply it.
- k. Slicers
  - i. Slicers are another way of filtering. They narrow the portion of the dataset that is shown in the other report visualizations.
  - ii. Numeric range slicers.
  - iii. Relative date slicers.



- iv. Relative time slicers.
  - v. Responsive, resizable slicers.
  - vi. Hierarchy slicers with multiple fields.
  - vii. [Slicers in Power BI - Power BI | Microsoft Docs](#)
  - l. [Many-to-many relationships in Power BI Desktop - Power BI | Microsoft Docs](#)
  - m. [Query folding guidance in Power BI Desktop - Power BI | Microsoft Docs](#)
  - n. [Use storage mode in Power BI Desktop - Power BI | Microsoft Docs](#)
  - o. [Use composite models in Power BI Desktop - Power BI | Microsoft Docs](#)
  - p. [Text Filter \(microsoft.com\)](#)
  - q. [CALCULATE – DAX Guide](#)
  - r. Calculated tables & Columns
  - s. End of list
7. Mod 07: Create Reports
- a. Lab: [Design a report in Power BI Desktop, part 1](#)
  - b. Lab: [Design a report in Power BI Desktop, part 2](#)
  - c. [Conditional table formatting in Power BI Desktop - Power BI | Microsoft Docs](#)
  - d.
8. Mod 08: Create Dashboards
- a. Lab: [Create a Power BI dashboard](#)
9. Mod 09: Create Paginated Reports in PBI
- a. Lab: [Perform data analysis in Power BI Desktop](#)
10. Mod 10: Perform Advanced Analytics
- a. Lab: [Create a Power BI paginated report](#)
11. Mod 11: - Create and Manage Workspaces - no labs?
12. Mod 12: Mange Datasets in PBI - no labs?
13. Mod 13: Row-Level Security - no labs?

I Can't See It!

Zoom in and out while in Focus mode. This works pretty well on many (but not all) visuals.

[Zooming In on a Power BI Report – Data Savvy](#)

## Pivot | Unpivot

1. Unpivot: It would be difficult to create a total of all sales combined from 2018 and 2019.
2. Your goal would then be to use this data in Power BI with three columns: Month, Year, and SalesAmount.  
Example is Excel Spreadsheet into PBI.

Unpivot from this to that

It would be difficult to create a total of all sales combined from 2018 and 2019.

Year	2018	2019
January	\$ 15,370	\$ 16,063
February	\$ 15,950	\$ 12,161
March	\$ 13,862	\$ 14,180
April	\$ 18,530	\$ 6,516
May	\$ 5,203	\$ 19,395
June	\$ 5,928	\$ 19,324
July	\$ 14,736	\$ 15,939
August	\$ 6,243	\$ 15,390
September	\$ 15,178	\$ 17,832
October	\$ 18,148	\$ 5,185
November	\$ 8,014	\$ 9,299
December	\$ 19,470	\$ 14,082

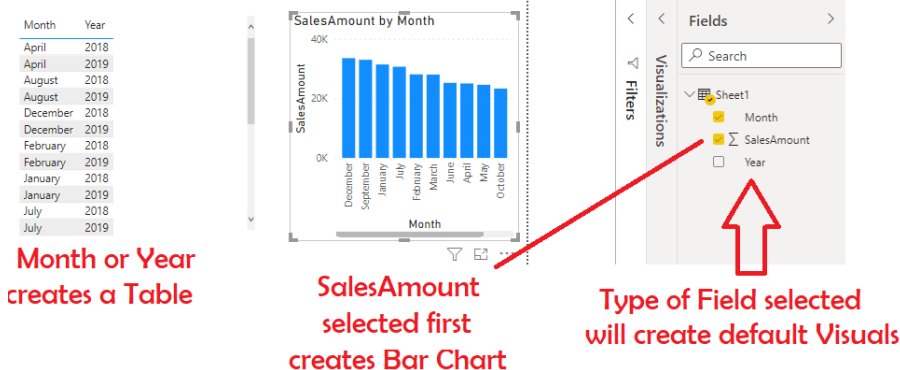
Your goal  
with three columns:  
Month, Year, and SalesAmount.

Year	Attribute	Value
January	2018	15370
January	2019	16063
February	2018	15950
February	2019	12161
March	2018	13862
March	2019	14180
April	2018	18530
April	2019	6516
May	2018	5203
May	2019	19395
June	2018	5928
June	2019	19324
July	2018	14736
July	2019	15939
August	2018	6243
August	2019	15390
September	2018	15178
September	2019	17832
October	2018	18148
October	2019	5185
November	2018	8014
November	2019	9299
December	2018	19470
December	2019	14082

Note "Year" is actually month but Unpivot on this table produced

1. "Year" has one row each for 2018 and 2019 - rename column from "Year" to "Month".
2. Attribute Column shows 2018, 2019 row for each month.
3. Money value is now in Value Column for each Month by Year. - More data for Slicing

- 3.
4. Created a simpler way of slicing the data with the **Year** and **Month** columns
5. [Create a PivotTable to analyze worksheet data - Office Support \(microsoft.com\)](#)
6. In this mini sample: Start with different fields to see default visual.
7. Sideways "M" **SalesAmount** is Numeric field.



- 8.
9. Pivot: Convert your flat data into a table that contains an aggregate value for each unique value in a column
10. Combine multiple tables into a single table: Append & Merge
  - a. Create one source-of-truth table from several data sources.
  - b. Append Queries as New, which means that the **output of appending will result in a new query or table**
  - c. Append Queries, which will **add the rows from an existing table into another**.
  - d. Merge queries, combining the data from multiple tables into one based on a column that is common between the tables. Create JOINS with same set matching ability.
  - e. Add synonyms that can be used to identify the column when you are using the Q&A feature.
  - f. Add a column into a folder to further organize the table structure.

11. Lists out of order – showing a Slicer getting data from a single Month column with duplicate entries.



12.  
13. Merge & Append “Queries” or “Tables”  
14. End of list

### DAX Studio Notes

Needs SQL Browser running

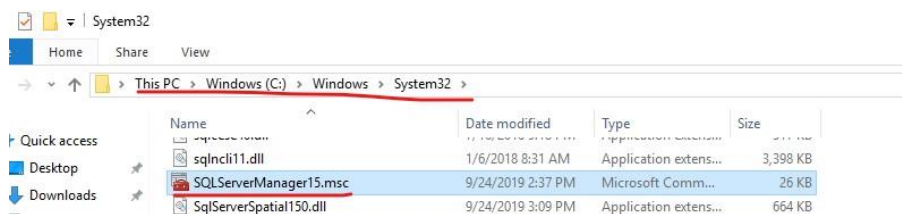


<https://community.powerbi.com/t5/Desktop/Power-BI-Desktop-and-SSAS-Connection-Error/td-p/124112>

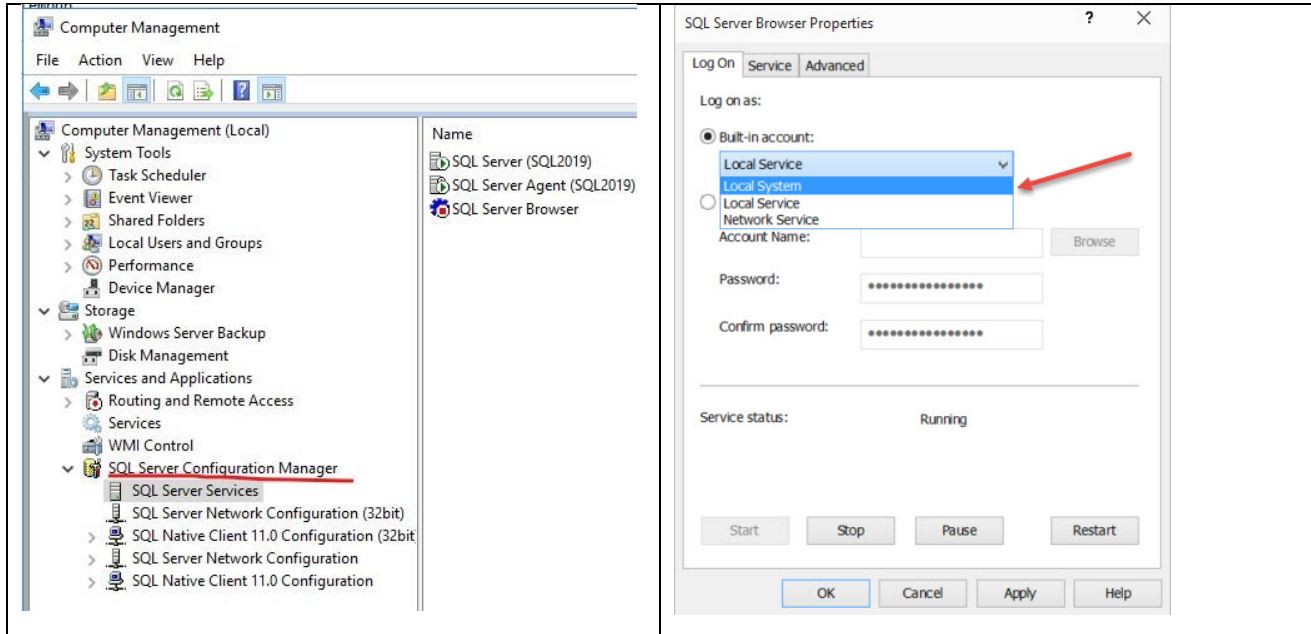
### SQL Server Browser | Configuration Management

Using below methods to access SQL server configure manager.

**A:** Navigate to c:\windows\system32 and look for a file with the name SQLServerManagernn.msc, where nn is the version of SQL Server you have installed. For SQL Server 2019, the name is SQLServerManager15.msc. You can double-click on it and you'll see a result. You can also make a shortcut on the desktop if you like.



**B:** A much simpler way is to run the Computer Management applet from Control Panel→Administrative Tools→Computer Management, where you should find the configuration manager installed



## Exam Notes

Case study tech points to consider in PBI Sales Analysis: build the questions?

1. Executives require a visual that shows sales by region.
2. Regional managers require a visual to analyze weekly sales and returns.
3. Sales managers must be able to see the sales data of their respective region only.
4. The sales managers require a visual to analyze sales performance versus sales targets.
5. The sale department requires reports that contain the number of sales transactions.
6. Users must be able to see the month in reports as shown in the following example: Feb 2020.
7. The customer service department requires a visual that can be filtered by both sales month and ship month
8. independently.

## Reference

1. [Copy Paste List](#)
2. [Exam DA-100: Analyzing Data with Microsoft Power BI - Learn | Microsoft Docs](#)
  - a. Links to labs and discussion
  - b. \*\*Good place to start
  - c. Will be updated on July 29, 2021
3. [Create and use analytics reports with Power BI - Learn | Microsoft Docs](#)
  - a. After DA-100 walk
4. [Generate data insights on your dataset automatically - Power BI | Microsoft Docs](#)
  - a. Run quick insights to generate interesting visualizations based on your data.
5. [MicrosoftLearning/DA-100-Analyzing-Data-with-Power-BI \(github.com\)](#)
  - a. Links to labs and discussion
  - b. Use with Skillpipe book
6. [DA-100-Analyzing-Data-with-Power-BI \(microsoftlearning.github.io\)](#)
  - a. Another set of links to labs and discussion – not sure of date
7. [The Power Query user interface | Microsoft Docs](#)
8. [Change how a chart is sorted in a report - Power BI | Microsoft Docs](#)

9. [Best practices for deployment pipelines, the Power BI Application lifecycle management \(ALM\) tool - Power BI | Microsoft Docs](#)
10. [microsoft/TailwindTraders \(github.com\)](#)
11. [Tailwind Traders](#)
12. Space