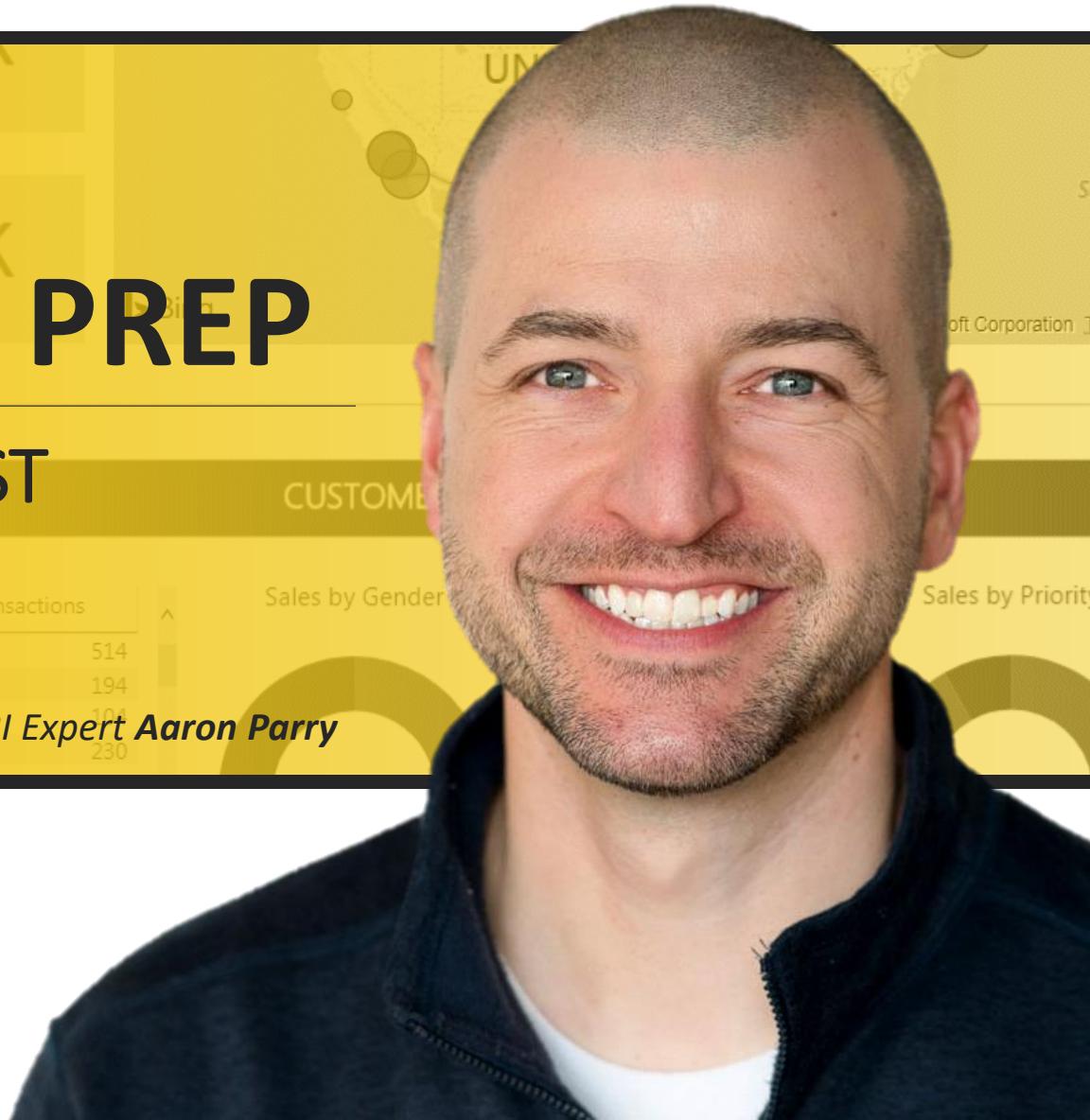


PL-300 EXAM PREP

POWER BI DATA ANALYST

★★★★★ With Microsoft Certified Power BI Expert Aaron Parry



COURSE STRUCTURE



This is a project-based course, designed to help you build the *exact* skills you need to pass the **Microsoft PL-300 exam (formerly DA-100)**

Course resources include:

- ★ **Downloadable PDF eBook** to serve as a helpful reference when you're offline or on the go (*or just need a refresher!*)
- ★ **Quizzes** and **Hands-On Demos** to test and reinforce key concepts throughout the course
- ★ Full-length **Practice Test** designed to replicate the PL-300 exam experience, with detailed solution walkthroughs

COURSE OUTLINE

1

Preparing for the PL-300 Exam

Review the skills measured in the PL-300 exam (formerly DA-100) and get familiar with the test structure and environment

2

Setting Up Desktop & Service

Install Power BI Desktop, set up a Power BI Service account, and activate your Pro/PPU trial

3

Measured Skills Review

- Prepare the Data
- Model the Data
- Visualize & Analyze the Data
- Deploy & Maintain Assets

Practice the core Power BI skills required for certification:

- Extract, profile, clean, transform, and load data from different sources
- Design a data model, create DAX measures, and optimize performance
- Create reports & dashboards to identify patterns and trends
- Create and manage files, datasets & workspaces

4

Practice Exam

Simulate the real testing experience with a full-scale practice exam and comprehensive solution walkthrough

INTRODUCING THE COURSE PROJECT

THE SITUATION

Congratulations! You've just been hired as the lead Business Intelligence Analyst for **Maven Cycles***, a boutique bicycle equipment shop

THE BRIEF

You've been asked to build an end-to-end business intelligence solution from the ground up, using raw data containing information about sales, products, customers, and store locations.

Your goal is to use the **entire Microsoft Power BI ecosystem** to design, build and deploy reports and dashboards to share across the organization.

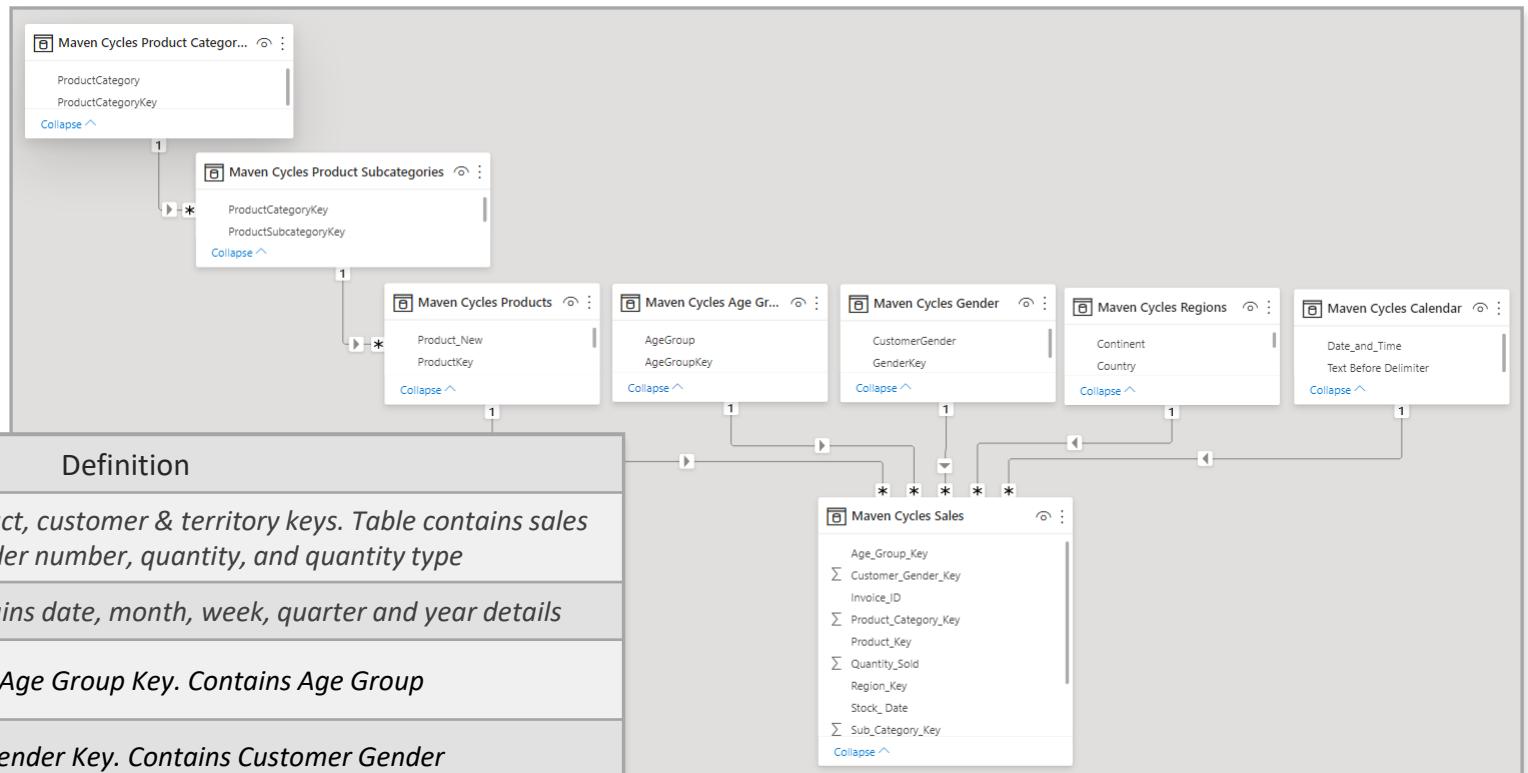
THE OBJECTIVES

- Prepare the Data
- Model the Data
- Visualize & Analyze the Data
- Deploy & Maintain Assets



THE MAVEN CYCLES DATA MODEL

| Table Name | Table Type | Definition |
|---------------------|------------|---|
| Sales | Fact | <i>Foreign keys are date, product, customer & territory keys. Table contains sales data including order number, quantity, and quantity type</i> |
| Calendar | Date | <i>Primary key is Date. Contains date, month, week, quarter and year details</i> |
| Age Group | Lookup | <i>Primary key is Age Group Key. Contains Age Group</i> |
| Gender | Lookup | <i>Primary key is Gender Key. Contains Customer Gender</i> |
| Product Category | Lookup | <i>Primary key is Product Category Key. Contains Product Category</i> |
| Product Subcategory | Lookup | <i>Primary key is Product Subcategory Key. Contains Subcategory and product category key</i> |
| Products | Lookup | <i>Primary key is Product Key. Contains subcategory key, product, cost, and unit price details</i> |
| Regions | Lookup | <i>Primary key is Sales Territory Key. Contains region, country, continent, territory manager, and manager email details</i> |



SETTING EXPECTATIONS



This course is for users who already have a **basic level of Power BI proficiency**

- *We'll review fundamentals, but you should have a basic understanding of how to import data, create a data model, use DAX formulas, build visuals, and distribute reports through Power BI Service*



Our goal is to help you **ace the Microsoft PL-300 exam**

- *This is not a deep dive into ALL of Power BI's capabilities, but an effective and comprehensive guide to the specific topics covered in the PL-300 exam (formerly DA-100)*



What you see on your screen **may not always match mine**

- *Power BI features are updated frequently, so tools and interface options may look different or change over time (I'll be using a Chrome browser on a PC/Windows machine)*



You'll need a **compatible email address** to create a Power BI Service account

- *NOTE: You must use a work or school email address to access Power BI Service, and some features are only accessible with a PRO or Premium Per User license (60-day free trial)*

INTRO TO THE PL-300 EXAM

EXAM STRUCTURE

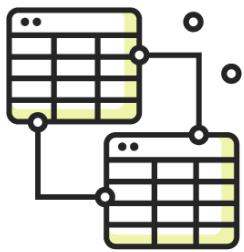
| | | |
|---|----------------------------|---|
|  | Platform | Pearson VUE (remote connection) |
|  | Question Format | Active Screen, Build List, Drag & Drop, Hot Area, Multiple Choice, Case Studies |
|  | Number of Questions | ~40 - 60 |
|  | Time Limit | 100 minutes (120 minutes seat time) |
|  | Passing Score | 70% (700/1000) |
|  | Expiration | 1 Year* <small>*Annual renewal required</small> |
|  | Cost | ~\$165 USD* <small>*Price is based on the country in which the exam is proctored</small> |

SKILLS MEASURED



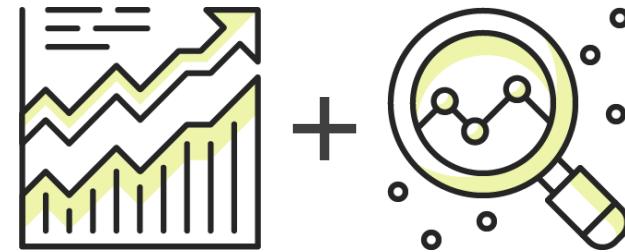
Prepare the Data

- Get data from different sources
- Clean, transform, and load data



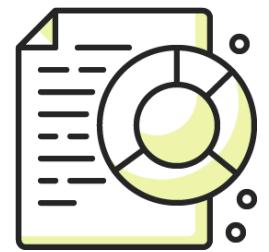
Model the Data

- Design a data model
- Develop a data model
- Create model calculations with DAX
- Optimize model performance



Visualize & Analyze the Data

- Create reports
- Create dashboards
- Enrich reports for usability
- Enhance reports for usability & storytelling
- Identify patterns & trends



Deploy & Maintain Assets

- Manage files & datasets
- Manage workspaces

EXAM QUESTION TYPES

Knowledge-Based Questions

Evaluate Power BI product knowledge related to process, formulas, functions, modeling, analysis, etc.

Question types include:

- Active screen
- Build list
- Drag and drop (from a list of options)
- Hot area (hot spot)
- Multiple choice



HEY THIS IS IMPORTANT!

The exam doesn't include any questions where you use or interact with Power BI

Case Study Questions

Multiple choice questions which require you to derive the correct answer based on a provided case

Each case is divided into the following parts:

- Introduction & how to start
- Overview
- Existing environment
 - Data available
 - Data structure & format
 - Data concerns
- Reporting requirements
- Question

EXAMPLE: KNOWLEDGE-BASED QUESTION

Multiple Choice

From the Power Query editor, what data profiling tool (Data Preview) allows you to only see the **percentage of empty values** in each column?

- a. Monospaced
- b. Column quality
- c. Column distribution
- d. Column profile

Build List

You are building a report from a SQL Server database and need to import database tables into Power BI Desktop. What are the **first three actions** you should take?

Actions

- Set Data Connectivity mode to Import
- Get data -> SQL Server
- Verify credentials & connect
- Select tables and press Load
- Enter Server & Database names



Answer Area

- Get data -> SQL Server
- Enter Server & Database names
- Set Data Connectivity mode to Import

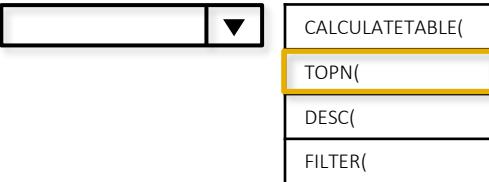


EXAMPLE: KNOWLEDGE-BASED QUESTION

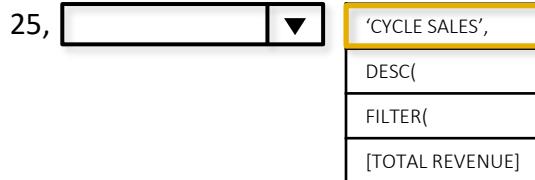
Hot Area (Hot Spot)

How would you complete the following DAX calculated table expression, so it returns a table of the top 25 customers based on Total Revenue?

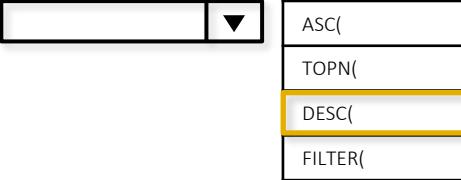
Top 25 Customers =



25,



[Total Revenue],



EXAMPLE: CASE STUDY

Overview

You've just been hired as a Web Analytics Manager for Maven Toy Emporium, an ecommerce toy shop, to help build a faster and more efficient reporting process. Currently, it takes multiple analysts' weeks to create quarterly business reports. You've been asked to help build an end-to-end Power BI solution to help the company streamline reporting and grow the business.

Sales Data

You have access to Maven Toy Emporium's entire online data repository, which includes information about products, stores, sales, customers, inventory, and projections →

| Source | Table Name | Column Name | Data Type | Example |
|--------------------|-------------|------------------------|-----------|-----------------------------|
| Azure SQL Database | Sales | Sale_ID | INT | 15 |
| | | Date | Date | 2021-07-28 |
| | | Product_ID | INT | 31 |
| | | Product_Name | String | Teenie Genies |
| | | Unit_Sales | INT | 1 |
| | | Region_ID | INT | 3 |
| | | Customer_ID | INT | 101 |
| | Inventory | Stock_Date | Date | 2020-09-06 |
| | | Store_ID | INT | 5 |
| | | Product_ID | INT | 18 |
| | | Stock_Date | Date | 2018-02-10 |
| Dataverse | Customers | Stock_On_Hand | INT | 175 |
| | | Customer_ID | INT | 101 |
| | | First_Name | String | Adam |
| | | Last_Name | String | Juan |
| | | Email_Address | String | ajuan@mavencustomer.toy |
| | | Billing_Address | String | 555 Main St, Somewhereville |
| | Products | Purchased_Last_30_Days | Boolean | Yes |
| | | Date_Time_Created | Date/Time | 2015-05-31 11:23:00 |
| | | Product_ID | INT | 38 |
| | | Product_Name | String | Action Figure |
| | | Product_Category | String | Toys |
| SharePoint Online | Projections | Cost | Currency | \$9.99 |
| | | Price | Currency | \$15.99 |
| | | Product_ID | INT | 19 |
| | Regions | Forecast_Sales | INT | 300,000 |
| | | Month_Start_Date | Date | 2022-03-01 |
| | Regions | Region_ID | INT | 4 |
| | Regions | Region_Name | String | Central |

EXAMPLE: CASE STUDY

Concerns

You have no concerns about the structure or quality of the data

Reporting Requirements

Maven Analytics has identified the following technical requirements:

- Leadership team wants to see sales by region
- Regional sales managers need to see sales and returns at different date granularities
- Regional sales managers must be able to see the data for their assigned region only
- Leadership and regional sales managers need to analyze sales performance against projections
- Sales is requesting reports showing the stock on hand

Question #1

What is the best way to distribute the reports to the Leadership team?

- A. Share the reports with each team member
- B. Add the leadership team as members to the Workspace
- C. Create and publish the reports via an App
- D. Publish the reports to Web

EXAM RULES (REMOTE)

Power BI certification exams have **specific rules** which are actively enforced by proctors; any violation can result in disqualification, so be mindful!



Photo ID
(GOVT issued)



Pass Tech Checks



Close all programs



Browser Open



Clear Desk



No phones, headphones, external monitors



No Talking
(except proctor questions)



Alone in room

EXAM RULES (IN-PERSON)

Power BI certification exams have **specific rules** which are actively enforced by proctors; any violation can result in disqualification, so be mindful!



Two Forms of ID Required
(GOVT issued + 1 additional)



Enhanced security protocol
(digital photo & digital signature)



No Personal Items
(phones, bags, notes, watches, wallets, etc.)



No Hats or hooded shirts



No Talking
(except proctor questions)



Arrive 15 Minutes Early
(more than 15 min late not admitted)

SCHEDULING THE EXAM

- 1 Head to the **PL-300 site*** and create an account

Schedule exam

Exam PL-300: Microsoft Power BI Data Analyst

Languages: English, Chinese (Simplified), Korean, Japanese
Retirement date: none

This exam measures your ability to accomplish the following technical tasks: prepare the data; model the data; visualize the data; analyze the data; and deploy and maintain deliverables.

For non-students interested in technology

[Schedule with Pearson VUE >](#)

For job seekers impacted by COVID-19

[Learn about our commitment to support people impacted by COVID-19.](#)

[Schedule for USD15 >](#)

Official practice test for Analyzing Data with Microsoft Power BI
All objectives of the exam are covered in depth so you'll be ready for any question on the exam.

*Make sure account name matches your ID

- 3 Launch the exam on testing day!

View or **launch** an online exam

Exams available for view or launch

- [DA-100: Analyzing Data with Microsoft Power BI](#)

- 2 Select the **exam language & details**

In-person or remote

How do you want to take your exam? [Exam delivery option descriptions](#)

- At a local test center
 Online from my home or office
 I have a Private Access Code

Payment

| Description | Details | Price |
|---|--|--------|
| Exam DA-100: Analyzing Data with Microsoft Power BI Language: English Exam Length: 150 minutes | Appointment Friday, April 30, 2021 Check-in time: 15:30 EDT Start time: 16:00 EDT | 165.00 |

| Exams for | Order Total |
|------------------------|------------------------------|
| Name: Aaron Parry | Subtotal: 165.00 |
| MS ID: MS0991352143 | Tax: 0.00 |
| | TOTAL DUE: USD 165.00 |
| | VISA ****0315 |
| | USD 165.00 |

Date & time

Select Date
[Why can't I find an available appointment?](#)

| April 2021 | | | | | | |
|------------|----|----|----|----|----|----|
| Su | Mo | Tu | We | Th | Fr | Sa |
| | | | | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | |

| Select a date from the calendar. On | Morning | Afternoon |
|-------------------------------------|---------|-----------|
| | 00:00 | 12:15 |
| | 00:15 | 12:45 |
| | 00:30 | 13:15 |
| | 00:45 | 13:45 |

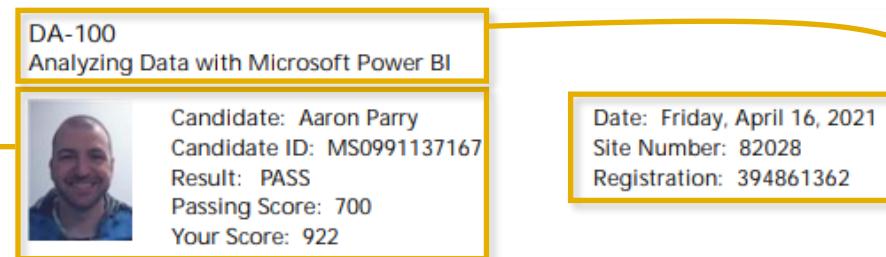


PRO TIP: To avoid surprises, take 5 minutes to **run a system test** before your remote exam day to make sure your computer and internet speed is sufficient

EXAM RESULTS

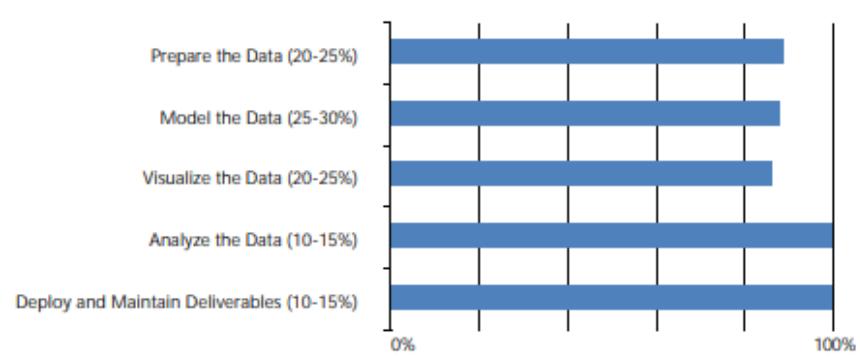
BASIC EXAM INFO

Exam details including name, id, result, and score



EXAM DETAILS

Exam type, location, and registration information



PERFORMANCE BY EXAM SECTION

*Bar chart that represents your section-level performance
(Bar length cannot be used to calculate number of questions answered correctly)*

PERFORMANCE COMPARISON

How your performance compares to others who have taken the PL-300 exam

| Content Area | Opportunity for Improvement | Comparable | Strength |
|---|-----------------------------|------------|----------|
| 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%) | | | ✓ |

RENEWAL PROCESS

The PL-300 certification must be **renewed annually** in order to remain active

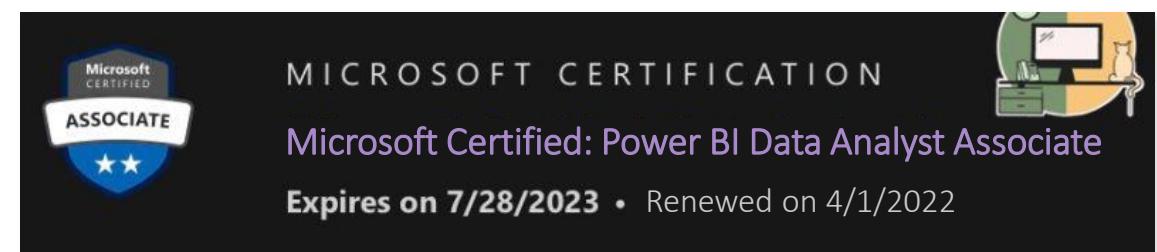
- This is designed to promote continuous learning and help keep you up to date with technology

Renewal Information

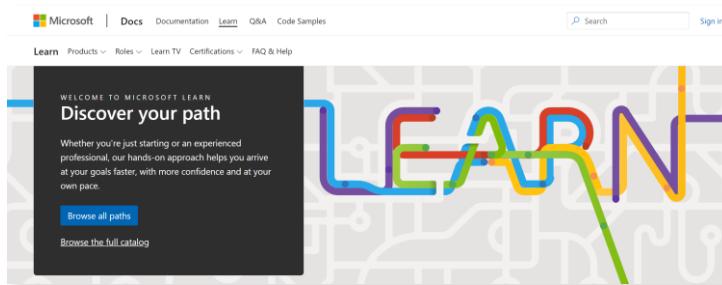
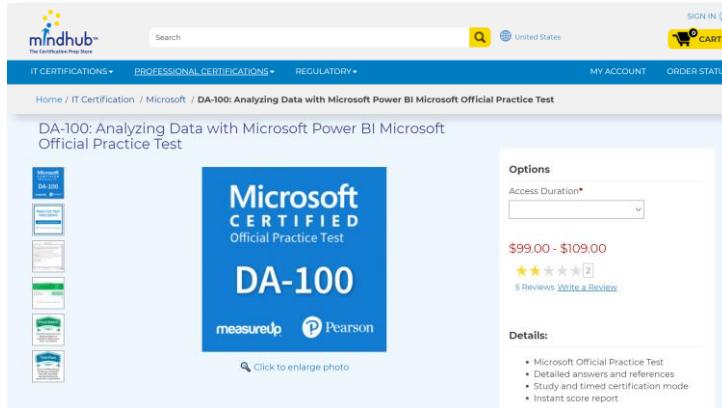
- Role-based certifications **expire every year**
- **Online renewal** process via Microsoft Learn
- Renewal window opens **6 months prior to expiration**
- Renewal covers **technology updates** only
- **No cost** (*free annual renewal!*)
- Renewal exam is **not proctored**
- **Scenario-based** multiple-choice questions

Renewal Process

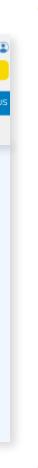
1. **Connect** Microsoft Learn profile with certification profile
2. **Study** with the available learning modules (*Microsoft Learn*)
3. **Take** renewal assessment and pass before certification expires



HELPFUL RESOURCES

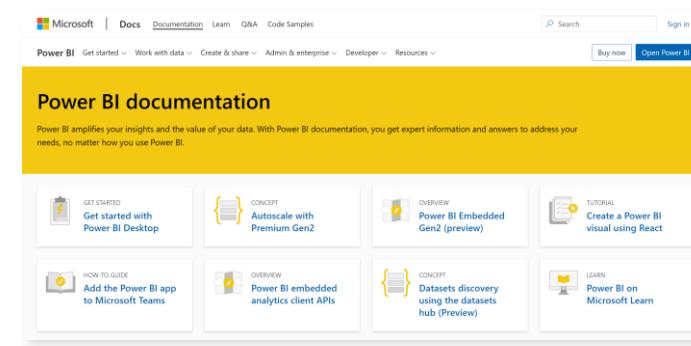


Microsoft Learn offers on-demand or instructor-led learning paths tailored to the PL-300 (docs.microsoft.com/learn)

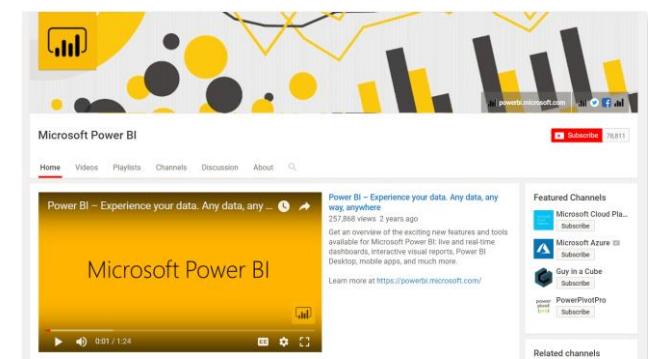
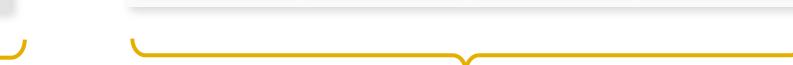


MeasureUp offers the official Microsoft Power BI practice test, which includes practice questions, detailed answers & references, study & certification testing modes, and an instant score report

(mindhub.com/da-100-analyzing-data-with-microsoft-power-bi-microsoft-official-practice-test/p/MU-DA-100)



Power BI Documentation provides detailed information for entire ecosystem (powerbi.microsoft.com/blog)



The **Power BI YouTube Channel** publishes demos, feature summaries, and advanced tutorials (check out “Guy in a Cube” too!)

TIPS FOR SUCCESS



Learn by doing – use Power BI every day

- *Nothing beats on-the-job experience and hands-on practice with Power BI, so use it often!*



Use your resources, and study how you learn best

- *Leverage resources available to you, including the official practice test & Microsoft Learn*



Remember the rules of the exam (*don't fail on a technicality!*)

- *Be sure you follow all rules based on your exam setting (ID, no talking, clean environment, no phones)*



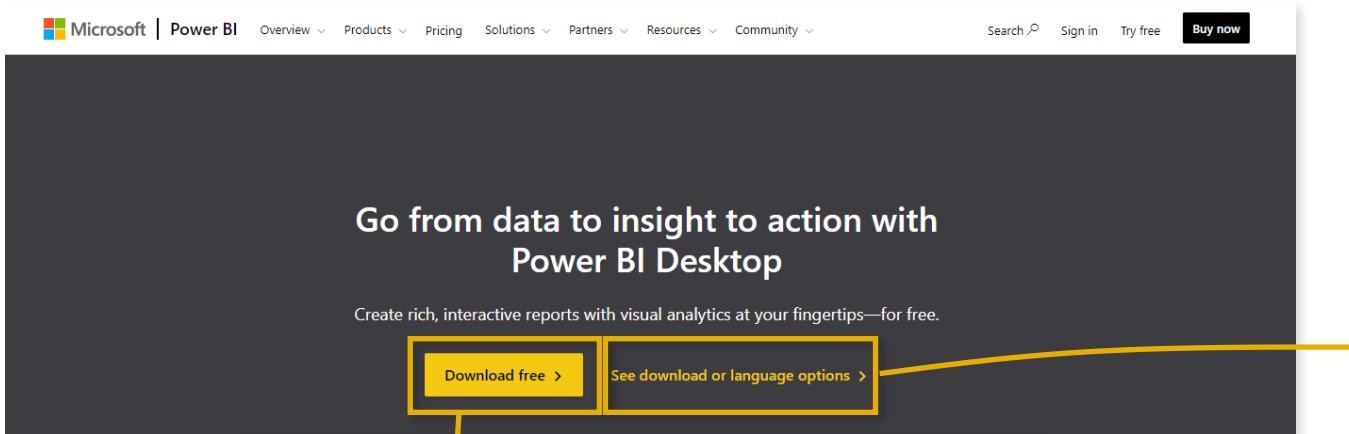
Skip questions if you get stuck, and revisit them later

- *When allowed, move on to familiar questions before returning to work through harder ones*

SETTING UP DESKTOP & SERVICE

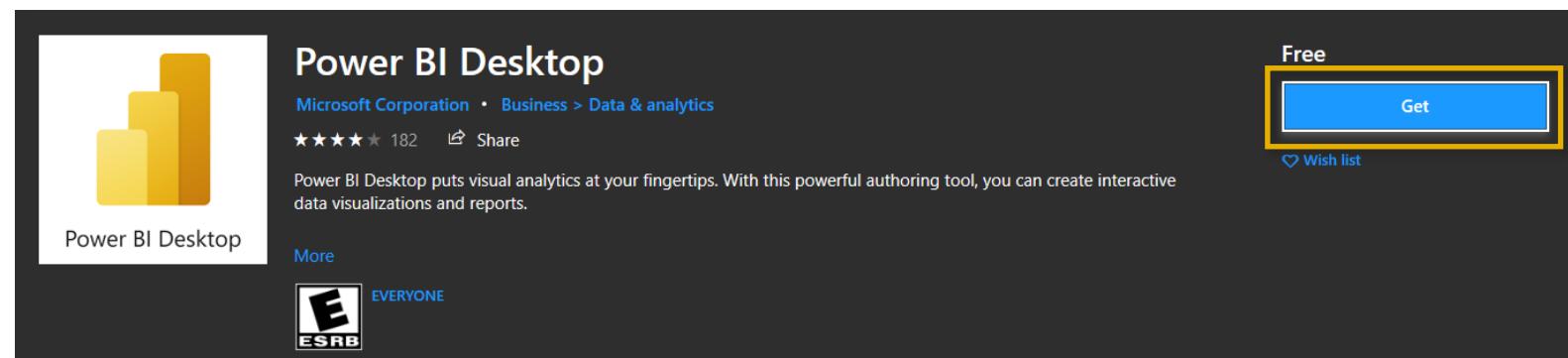
INSTALLING POWER BI DESKTOP

- 1 Head to powerbi.microsoft.com/desktop and click “Download free”



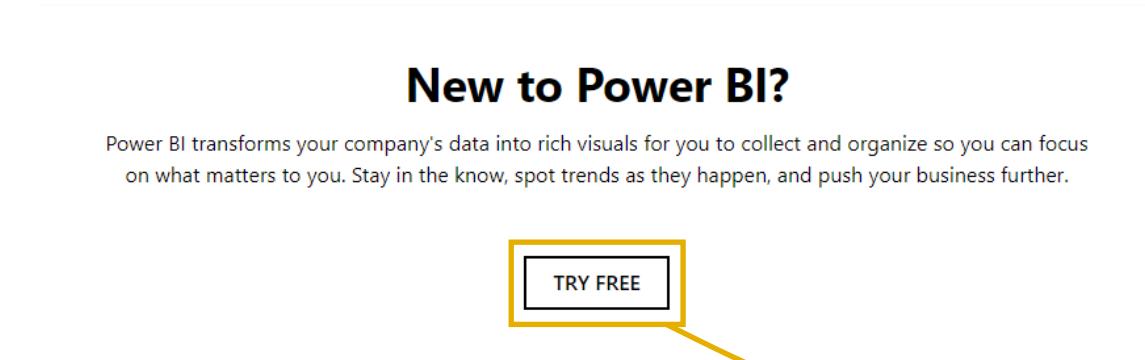
Use **See download or language options** to update Power BI Desktop

- 2 Click on “Get” to download Power BI Desktop from the Microsoft Store

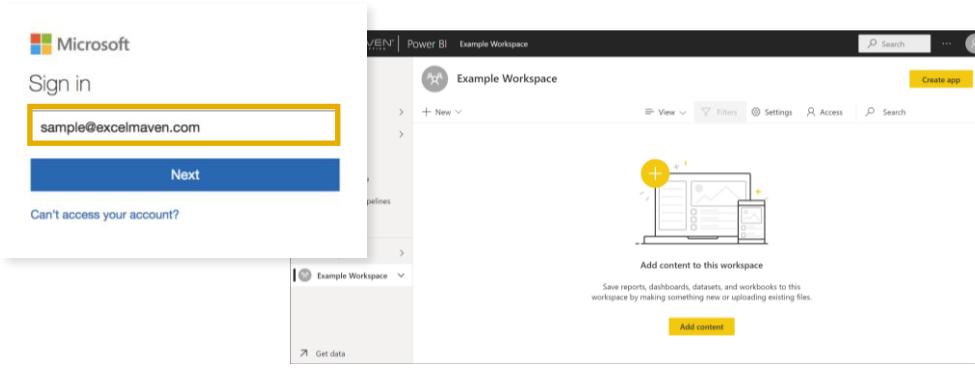


CREATING A POWER BI SERVICE ACCOUNT

- 1 Head to powerbi.microsoft.com/landing/signin and click “TRY FREE”



- 3 Navigate directly to app.powerbi.com to log in



- 2 Create & verify your account

Thank you for choosing **Microsoft Power BI**

- 1 Let's set up your account

Enter your work or school email address, we'll check if you need to create a new account.

Enter your email address

By proceeding you acknowledge that if you use your organization's email, your organization may have rights to access and manage your data and account.
[Learn More](#)

Next

- 2 Create your account

- 3 You're all set

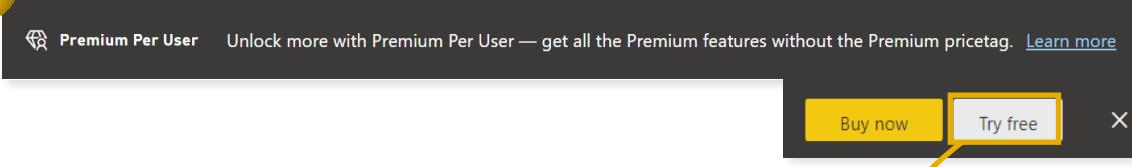


HEY THIS IS IMPORTANT!

Microsoft requires a **work or school** email address, so domains like @gmail, @yahoo or @outlook will not be accepted

ACTIVATING A PREMIUM PER USER TRIAL

1



2

Try Premium per user for free

To use this feature, upgrade to a Premium per user license. When you upgrade, you'll have access to all Premium features including paginated reports, deployment pipelines, and new AI capabilities.

Try Premium per user free for 60 days. [Learn more](#)



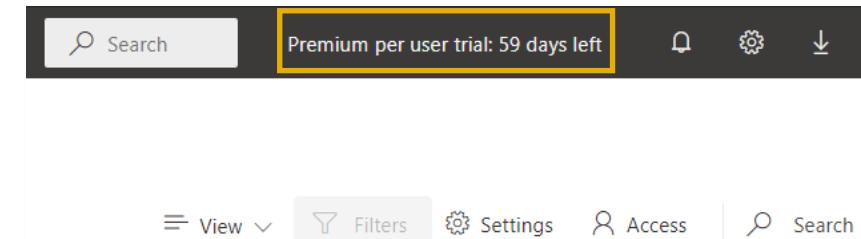
3

A Premium per user license is yours for 60 days

You get to use all Premium per user features for the next 60 days. If you love it, upgrade to a Premium per user license.



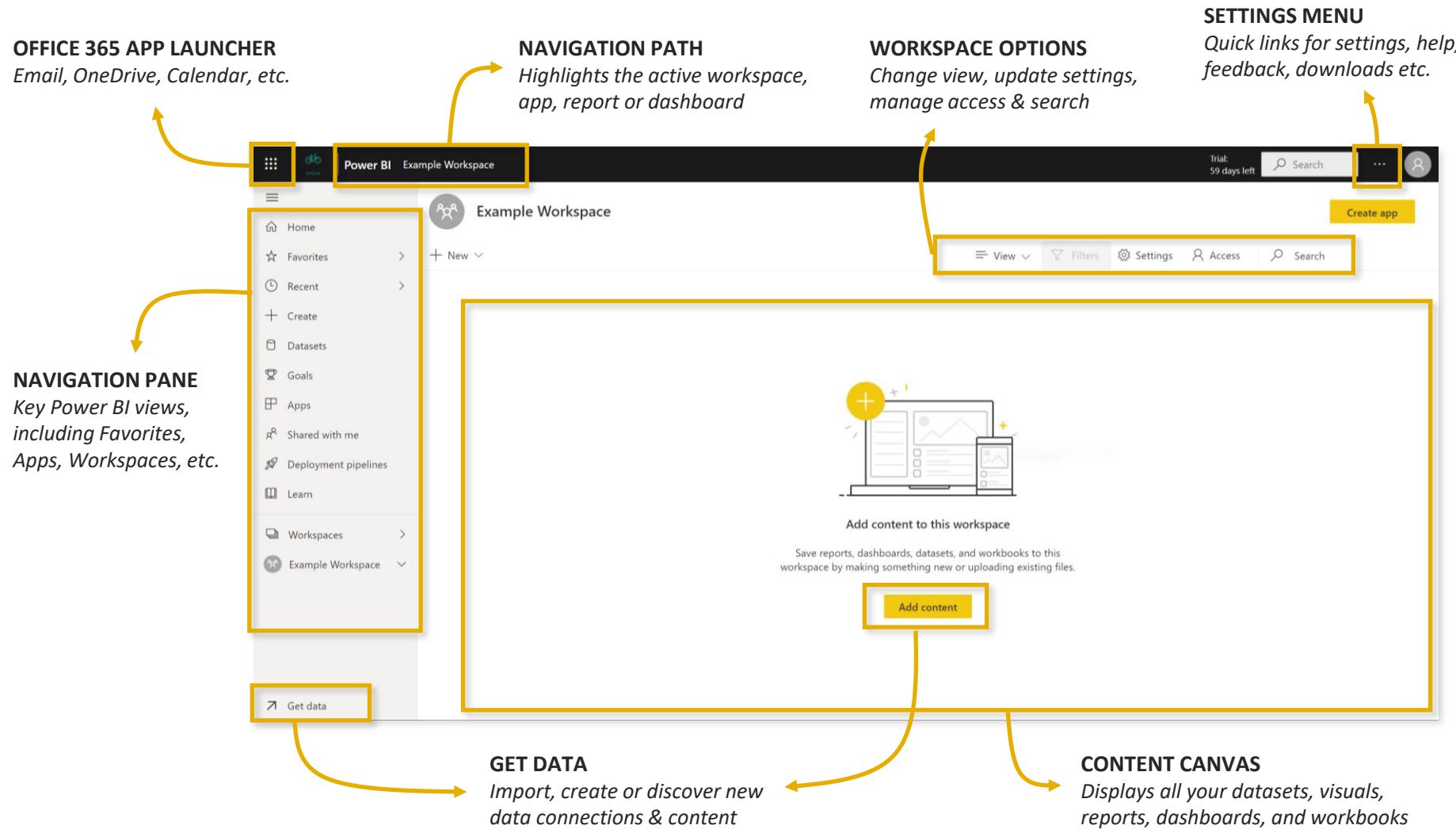
Your **trial period** lasts for **60 days**, and you'll see your remaining time in the header bar each time you log in



HEY THIS IS IMPORTANT!

You are activating a **Premium per User (PPU) trial**. All Pro features are included with a PPU trial, and we'll focus on additional features included with PPU later in the course.

THE POWER BI SERVICE (APP) INTERFACE



WORKSPACES

There are *two types* of workspaces in Power BI Service: **My Workspace & Workspaces**

My Workspace

- **Personal workspace** for a single user
(*Free or paid license*)
- **Only you** can access its content
(*can't collaborate with others*)
- Content can be shared with **individual Pro/PPU users** (*shared with me*)
- Contains core **building blocks** (*datasets, workbooks, reports, and dashboards*)

Workspaces

- **Shared workspace** for many users
(*with paid licenses*)
- **Multiple users** can access & collaborate on content
- Content can be created & shared **across your organization**
- Contains core **building blocks** (*datasets, workbooks, reports, and dashboards*) plus **dataflows**

CREATING A WORKSPACE

Add a *Name* (required) and optional *Description* for your workspace

Create a workspace

YOU'RE CREATING AN UPGRADED WORKSPACE
Enjoy new features, better sharing options, and improved security controls.
[Revert to classic](#) | [Learn more](#)

Workspace image
 [Upload](#) [Delete](#)

Workspace name

Description

[Learn more about workspace settings](#)

Advanced ▾

Save Cancel

HEY THIS IS IMPORTANT!
We'll use this workspace later in the course when we publish a report to Power BI Service

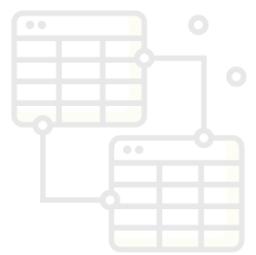
MEASURED SKILLS REVIEW

PREPARING THE DATA



Prepare the Data

- Get data from different sources
- Clean, transform, and load data



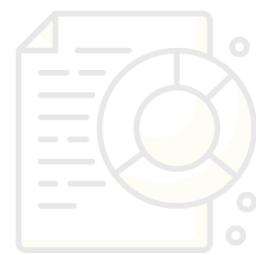
Model the Data

- Design a data model
- Develop a data model
- Create model calculations with DAX
- Optimize model performance



Visualize & Analyze the Data

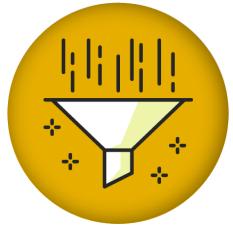
- Create reports
- Create dashboards
- Enrich reports for usability
- Enhance reports for usability & storytelling
- Identify patterns & trends



Deploy & Maintain Assets

- Manage files & datasets
- Manage workspaces

GETTING DATA FROM DIFFERENT SOURCES



In this section we'll cover **getting data from different sources**, including changing data source settings, selecting storage modes, identifying query issues, and using parameters

TOPICS WE'LL COVER:

Connecting to Data

Data Sources

Storage Modes

Parameters

COMMON QUESTIONS:

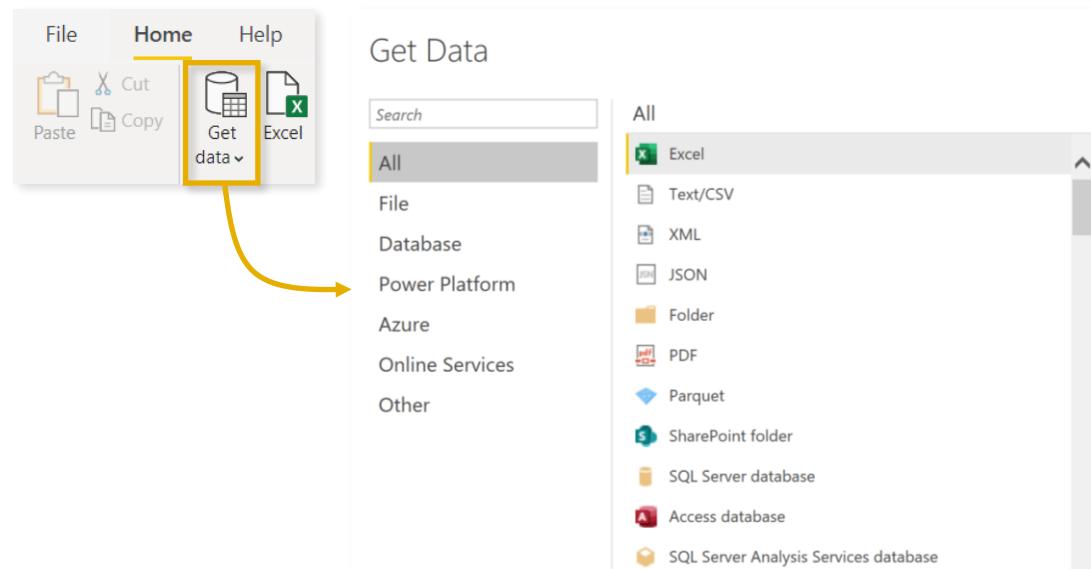
- *You need to provide users with a summary version of a sales dataset, which of the following actions should you take and in what order?*
- *You have a large SQL database table and only want to import a sample. Which of the following techniques will help you import a sample of data?*
- *What query editor tool can be used to dynamically change a data source between different servers?*



CONNECTING TO DATA

Power BI can **connect** to virtually any type of **data source**, including (*but not limited to*):

- Flat files & Folders (csv, text, Excel, JSON etc.)
- Databases (SQL, Access, Oracle, IBM, MySQL, etc.)
- Power Platform (Dataflows, Power BI datasets, Dataverse, etc.)
- Azure (SQL Database, Blob Storage, Cosmos DB, Data Lake Storage, etc.)
- Online Services (SharePoint, GitHub, Dynamics 365, Google Analytics, Salesforce, etc.)
- Others (Web feeds, R scripts, Spark, Hadoop, etc.)



Connecting to
Data

Data Sources

Storage Modes

Parameters



THE QUERY EDITOR (INTRODUCTION)

Once you connect to data, the Query Editor lets you **shape & transform** the data to meet your needs, then **load** that model into Power BI Desktop

Connecting to Data

Data Sources

Storage Modes

Parameters

QUERY EDITING TOOLS
Table transformations, calculated columns, etc.

The screenshot shows the Power Query Editor window with the following components highlighted:

- QUERY EDITING TOOLS:** Located at the top, this toolbar contains various icons for table transformations, calculated columns, and data analysis.
- FORMULA BAR:** This is where M code is written. A yellow arrow points from the text "This is 'M' code" to the formula bar area.
- QUERY PANE:** This pane on the left lists the tables available in the query. A yellow arrow points from the text "COLUMN PROFILE" to the query pane.
- COLUMN PROFILE:** Based on first 1,000 rows, this section provides a preview of the data and statistics for each column. A yellow arrow points from the text "Based on first 1,000 rows" to the column profile area.
- TABLE NAME & PROPERTIES:** A yellow arrow points from the text "TABLE NAME & PROPERTIES" to the "Properties" section of the Query Settings pane.
- APPLIED STEPS:** Like a macro! This pane on the right lists the steps taken to transform the data, such as "Promoted Headers" and "Changed Type". A yellow arrow points from the text "APPLIED STEPS Like a macro!" to the applied steps pane.

Maven Cycles Report - Power Query Editor

File Home Transform Add Column View Tools Help

Column From Examples Custom Column Invoke Custom Function Conditional Column Index Column Duplicate Column Format Extract Parse Statistics Standard Scientific Trigonometry Date Time Duration Text Analytics Azure Machine Learning

Queries [0] Transaction_Date Stock_Date A^{bc} Invoice_ID Age_Group_Key Customer_G

1/1/2015 8/30/2014 INV-1001
1/1/2015 10/17/2014 INV-1002
1/1/2015 11/28/2014 INV-1003
1/1/2015 8/22/2014 INV-1004
1/1/2015 12/9/2014 INV-1005
1/2/2015 10/17/2014 INV-1006
1/2/2015 8/1/2014 INV-1007
1/2/2015 12/12/2014 INV-1008
1/2/2015 9/30/2014 INV-1009
1/3/2015 9/4/2014 INV-1010
1/3/2015 9/21/2014 INV-1011
1/3/2015 12/10/2014 INV-1012
1/3/2015 9/18/2014 INV-1013
1/3/2015 12/1/2014 INV-1014
1/3/2015 11/7/2014 INV-1015
1/3/2015 10/28/2014 INV-1016
1/3/2015 8/22/2014 INV-1017
1/4/2015 11/4/2014 INV-1018

Query Settings

Properties Name Maven Cycles Sales

All Properties

Applied Steps Source Promoted Headers Changed Type

10 COLUMNS, 999+ ROWS Column profiling based on top 1000 rows

PREVIEW DOWNLOADED AT 14:55



DATA SOURCE: JSON FILE

To connect to a **JSON file** or transform a field within a flat file that contains JSON:

- Connecting to Data**
- Data Sources**
- Storage Modes**
- Parameters**

Get Data

Search:

All

- All
- File
- Database
- Azure
- Online Services
- Other

All

- Excel
- Text/CSV
- XML
- JSON**
- Folder
- SharePoint folder
- SQL Server database
- Access database
- SQL Server Analysis Services database
- Oracle database

1 Convert the JSON list to a table

= Table.FromRecords({Source})

| ABC 123 | people |
|---------|--------|
| 1 | List |

2 Expand the attributes in the list to columns

= Table.ExpandRecordColumn#"Expanded people", "people", {"firstName", "lastName", "gender", "age"}

| ABC 123 | people.firstName | ABC 123 | people.lastName | ABC 123 | people.gender | ABC 123 | people.age |
|---------|------------------|---------|-----------------|---------|---------------|---------|------------|
| 1 | Joe | ABC 123 | Jackson | ABC 123 | male | ABC 123 | 28 |
| 2 | James | ABC 123 | Smith | ABC 123 | male | ABC 123 | 32 |

3 Change the data type for each column

= Table.TransformColumnTypes#"Expanded people1",{{"people.firstName", type}}

| ABC 123 | people.firstName | ABC 123 | people.lastName | ABC 123 | people.gender | ABC 123 | people.age |
|---------|------------------|---------|-----------------|---------|---------------|---------|------------|
| 1 | Joe | ABC 123 | Jackson | ABC 123 | male | ABC 123 | 28 |
| 2 | James | ABC 123 | Smith | ABC 123 | male | ABC 123 | 32 |



DATA SOURCE: POWER BI DATA SOURCE FILES (PBIDS)

Connecting to
Data

Data Sources

Storage Modes

Parameters

Power BI Data Source files (PBIDS) contain a single set of pre-wired data source connection settings (no data)

Key Benefits:

- ✓ They make data sources easier to share with other users
- ✓ They are useful for new report designers who are not familiar with available data sources
- ✓ They speed up the “Get Data” process
- ✓ They only support a single data source in one file
- ✓ They can be autogenerated within Power BI Desktop (preferred method) or directly from a text editor



HEY THIS IS IMPORTANT!

Power BI Data Source files do not store user authentication credentials like username and password



DATA SOURCE: POWER BI DATA SOURCE FILES (PBIDS)

Connecting to Data

Data Sources

Storage Modes

Parameters

To create a PBIDS file:

1. Open “Data source settings”
2. Select the data source to convert
3. Export & save as a PBIDS file

Options and settings



Data source settings

Data source settings

Manage settings for data sources that you have connected to using Power BI Desktop.

Data sources in current file Global permissions

Search data source settings

Power BI dataflows

Export PBIDS

Change Source... Edit Permissions... Clear Permissions ▾

To connect to a PBIDS file:

1. Open the PBIDS file, enter credentials, launch “Data Source Navigator” window

| order_item_refund_id | created_at | order_item_id | order_id | refur |
|----------------------|-----------------------|---------------|----------|-------|
| 1 | 4/6/2012 12:32:43 PM | 57 | 57 | |
| 2 | 4/13/2012 2:09:43 AM | 74 | 74 | |
| 3 | 4/15/2012 3:03:48 AM | 71 | 71 | |
| 4 | 4/17/2012 8:00:37 PM | 118 | 118 | |
| 5 | 4/22/2012 9:53:49 PM | 116 | 116 | |
| 6 | 5/4/2012 12:59:07 PM | 147 | 147 | |
| 7 | 5/12/2012 3:41:14 AM | 186 | 186 | |
| 8 | 5/16/2012 2:06:01 PM | 191 | 191 | |
| 9 | 5/24/2012 5:00:09 PM | 179 | 179 | |
| 10 | 5/30/2012 6:20:44 PM | 199 | 199 | |
| 11 | 6/6/2012 3:22:14 PM | 271 | 271 | |
| 12 | 6/10/2012 8:13:12 PM | 290 | 290 | |
| 13 | 6/20/2012 8:13:12 PM | 335 | 335 | |
| 14 | 6/28/2012 7:54:22 PM | 382 | 382 | |
| 15 | 6/29/2012 4:50:01 PM | 357 | 357 | |
| 16 | 7/5/2012 2:34:53 PM | 409 | 409 | |
| 17 | 7/7/2012 8:36:44 AM | 368 | 368 | |
| 18 | 7/7/2012 8:54:28 PM | 391 | 391 | |
| 19 | 7/8/2012 3:59:09 AM | 424 | 424 | |
| 20 | 7/10/2012 3:31:05 PM | 393 | 393 | |
| 21 | 7/11/2012 11:16:10 PM | 442 | 442 | |
| 22 | 7/19/2012 7:57:16 AM | 472 | 472 | |
| 23 | 7/20/2012 7:51:51 PM | 470 | 470 | |

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DATA SOURCE: MICROSOFT DATAVERSE

The **Microsoft Dataverse** (Common Data Service) is a cloud-based storage option for your organization's data that you can connect to business applications

Connecting to
Data

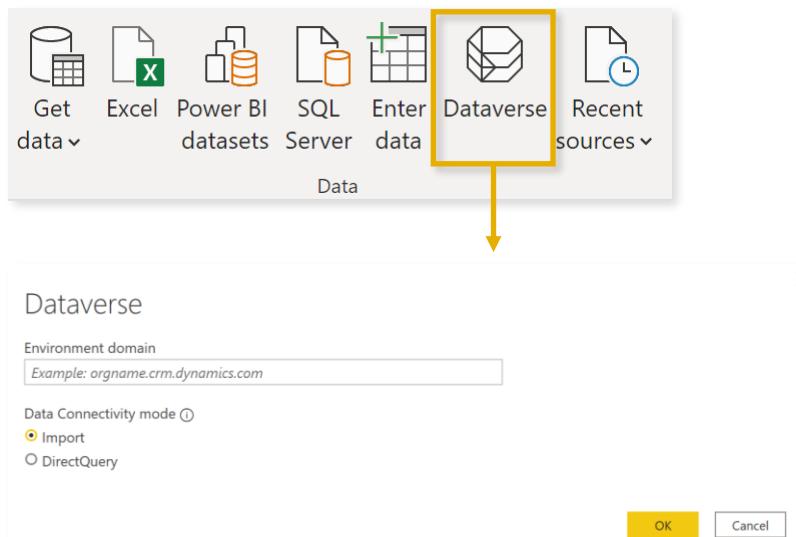
Data Sources

Storage Modes

Parameters

Key Benefits:

- ✓ **Easy to manage** – Both the metadata and data are stored in the cloud
- ✓ **Easy to secure** – Users can only see data if they are granted access
- ✓ **Easy to access** – Connect to Power BI, Power Apps, Power Automate, and Power Virtual Agents



HEY THIS IS IMPORTANT!

To connect to Microsoft Dataverse, you'll need to know the server address, which typically has the following format: *https://company.crm.dynamics.com*. And maker permissions to access the portal and read permissions to access data within tables

DATA SOURCE: SQL SERVER ANALYSIS SERVICES TABULAR (SSAS)



There are two methods to connect SSAS tabular models: **Import & Live Connection**

The diagram illustrates the two methods to connect SSAS tabular models:

- Import:** This method involves selecting a model or perspective, and then specific table or column. It imports data into memory and allows for shaping data with Query Editor and creating/enhancing data models.
- Live Connection:** This method provides a live connection to the tabular model, allowing for selecting a model or perspective and viewing the most recent data.

Get Data screen (left):

- Search bar
- All
- File
- Database** (selected)
- Power Platform
- Azure
- Online Services
- Other

Import screen (top right):

- Navigator
- Show All | Show Selected [0]
- AdvWorks_ASTabular [1]
- AW Internet Sales Tabular Model 2014 [1]
- Model [2]
- Internet Sales [7]
- Customer
- Date
- Geography

Live Connection screen (bottom right):

- Navigator
- AdvWorks_ASTabular [1]
- AW Internet Sales Tabular Model 2014 [2]
- Internet Sales
- Model

HEY THIS IS IMPORTANT!

If you plan to publish your tabular model to Power BI Service and it's built from a **Live connection**, you must have a **data gateway** installed

Connecting to Data

Data Sources

Storage Modes

Parameters



DATA SOURCE: SHAREPOINT ONLINE

Connecting to Data

Data Sources

Storage Modes

Parameters

SharePoint Online lets companies organize, share, and access information via **sites**
Sites contain **document libraries**, a special type of folder, that store folders and files

SharePoint Sites

The screenshot shows the SharePoint Home page. At the top, there's a blue header bar with the SharePoint logo and navigation links. Below it, a large blue banner with white text says "SharePoint". Underneath, there are two buttons: "+ Create site" and "+ Create news post". The "Frequent sites" section lists two items: "Maven Internal Reporting Group" (marked with a star) and "MySQL Dataflow Demo Group" (marked with a star). At the bottom, there are two notifications: "AP You viewed MASTER Maven Partner Raw Data on 4/5/2021" and "AP You viewed tickets 10 hours ago".

Document Libraries

The screenshot shows a SharePoint Document Library titled "DA-100 Example". The library interface includes a toolbar with "+ New", "Upload", "Edit in grid view", "Sync", "Add shortcut to OneDrive", and more. On the left, a navigation pane lists "Shared with us", "Notebook", "Pages", "Incremental Refresh Test", and "DA-100 Example" (which is highlighted with a yellow box). The main area displays a grid of items with columns for Name, Modified, and Modified By. Two items are listed: "Test 1" and "Test 2", both modified yesterday at 7:34 PM by Aaron Parry.

| Name | Modified | Modified By |
|--------|----------------------|-------------|
| Test 1 | Yesterday at 7:33 PM | Aaron Parry |
| Test 2 | Yesterday at 7:34 PM | Aaron Parry |



DATA SOURCE: SHAREPOINT ONLINE

You can get data from a SharePoint Online site by connecting to a **SharePoint folder**

Connecting to Data

Data Sources

Storage Modes

Parameters

Get Data

SharePoint

All

All

File

Online Services

Other

SharePoint folder

SharePoint Online List

SharePoint list

1 Enter the site root URL

SharePoint folder

Site URL

A^BC

https://mavenanalytics.sharepoint.com/sites/PowerBIExample/

2

Combine & Transform the data

https://mavencycles.sharepoint.com/sites/DA-100ExampleSite

| Content | Name | Extension | Date accessed | Date modified | Date created | Attributes | Folder Path |
|---------|-------------------------------|-----------|---------------|-------------------|-------------------|------------|------------------------------|
| Binary | products.csv | .csv | null | 6/8/2021 20:51:15 | 6/8/2021 20:51:15 | Record | https://mavencycles.sharepoi |
| Binary | inventory.csv | .csv | null | 6/8/2021 20:51:15 | 6/8/2021 20:51:15 | Record | https://mavencycles.sharepoi |
| Binary | stores.csv | .csv | null | 6/8/2021 20:51:17 | 6/8/2021 20:51:17 | Record | https://mavencycles.sharepoi |
| Binary | inventory_data_dictionary.csv | .csv | null | 6/8/2021 20:51:18 | 6/8/2021 20:51:18 | Record | https://mavencycles.sharepoi |
| Binary | products_data_dictionary.csv | .csv | null | 6/8/2021 20:51:18 | 6/8/2021 20:51:18 | Record | https://mavencycles.sharepoi |
| Binary | sales_data_dictionary.csv | .csv | null | 6/8/2021 20:51:43 | 6/8/2021 20:51:43 | Record | https://mavencycles.sharepoi |
| Binary | stores_data_dictionary.csv | .csv | null | 6/8/2021 20:51:43 | 6/8/2021 20:51:43 | Record | https://mavencycles.sharepoi |

Combine
Load
Transform Data
Combine & Transform Data
Combine & Load

3

Filter folder path to correct document library

Folder Path

Sort Ascending

Sort Descending

Clear Sort

Clear Filter

Remove Empty

Text Filters

Search

(Select All)

(null)

https://mavenanalytics.sharepoint.com/sites/PowerBIExample/

OK Cancel



STORAGE MODES

Connecting to Data

Data Sources

Storage Modes

Parameters

Power BI lets you choose between these types of **storage modes** for your data sources:

- **Import:** Tables stored in-memory within Power BI and queries are fulfilled by cached data
- **DirectQuery:** Tables connected directly to the source & queries executed on-demand at the source
- **Dual:** Tables come from in-memory data or by an on-demand query to the data source

Use DirectQuery when:

- ✓ Dataset is too large to be stored in-memory
- ✓ Source data changes frequently & reports must show the most recent data
- ✓ Company policy states data can only be accessed from the original source

| | Imported Data | DirectQuery |
|------------------------|--|---|
| Performance | -Best | -Depends on the data source. Generally, slower compared to imported data |
| Number of Data Sources | -Unlimited | -Unlimited |
| Data Transformations | -No M transform restrictions | -Limited M transforms -Transforms based on data source language |
| Data Modeling | -No restrictions on data modeling | -Very restricted -Limited DAX & no calculated tables -Quick Insights not supported |
| Data Model Size | -Loaded in-memory (increases model size) -Pro: 1GB per dataset -Premium: Capacity based | -Large/frequent volume of data -Does not increase model size -Limited by data source hardware |
| Data Refresh | -Data only current to last refresh -Pro: 8x per day 30-min intervals -Full refreshes are "expensive" | -Near real-time -Report always shows latest data available |
| Row-level Security | -User-level role definitions | -User-level role definitions only available for some data sources |



DATA SOURCE SETTINGS

The **Data Source Settings** allow you to manage data connections and permissions

Connecting to Data

Data Sources

Storage Modes

Parameters

The screenshot shows the Power BI Desktop ribbon with the 'File' tab selected. The 'Data source settings' option under the 'Data Sources' section is highlighted with a yellow box and a yellow arrow pointing to it from the left. Below the ribbon is a window titled 'Data source settings'. It contains a list of local files with their paths:

- c:\users\chris\documents\secon...ks\adventureworks_calendar.csv
- c:\users\chris\documents\secon...s\adventureworks_customers.csv
- c:\users\chris\documents\secon...eworks_product_categories.csv
- c:\users\chris\documents\secon...orks_product_subcategories.csv
- c:\users\chris\documents\secon...ks\adventureworks_products.csv
- c:\users\chris\documents\secon...rks\adventureworks_returns.csv
- c:\users\chris\documents\secon...works\adventureworks_sales.csv
- c:\users\chris\documents\secon...adventureworks_territories.csv
- c:\users\chris\documents\secon...i\data\adventureworks\aw_sales

At the bottom of the window, there are three buttons: 'Change Source...', 'Edit Permissions...', and 'Clear Permissions...'. A yellow arrow points from the 'Change Source...' button to the 'Comma-Separated Values' dialog box.

Comma-Separated Values

Basic Advanced

File path: C:\Users\Chris\Desktop\Power BI Course Files\Adventure Works\Adventure

Open file as: Csv Document

File origin: 1252: Western European (Windows)

Line breaks: Apply all line breaks

Delimiter: Comma



HEY THIS IS IMPORTANT!

Connections to local files reference the **exact** path
If the file name or location changes, you will need to
change the source and browse to the current version



PRO TIP: DYNAMIC SOURCES WITH PARAMETERS

Parameters are a useful way to change data source values dynamically in Power Query

Connecting to Data

Data Sources

Storage Modes

Parameters



APPLIED STEPS

- Source
- Changed Type
- Promoted Headers

Comma-Separated Values

Basic Advanced

File path: AdventureWorks Calendar

Type: Text

Parameter: New Parameter...

Line breaks: Apply all line breaks

Delimiter: Comma

Parameter
name

Parameter
data type

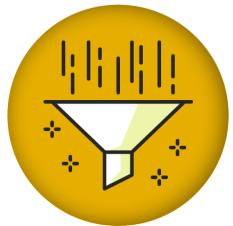
Parameter
value

HEY THIS IS IMPORTANT!

These parameters are different from the "What-If" parameters created in the Power BI Desktop front-end



DATA PROFILING



In this section we'll cover **data profiling** with the Query Editor, including identifying data anomalies, examining data structures, and interrogating column properties and statistics

TOPICS WE'LL COVER:

[View Menu](#)

[Column Quality](#)

[Column Distribution](#)

[Column Profile](#)

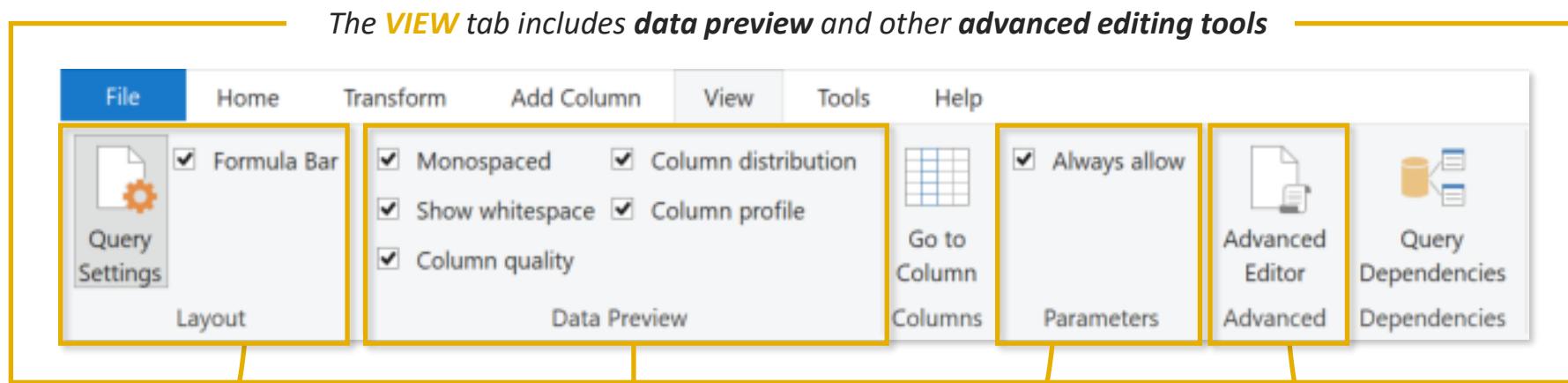
COMMON QUESTIONS:

- *What data profiling tool shows row values as either valid, error, or empty?*
- *As part of data QA, you need to determine if the 'state' column values are defined consistently, what should you do?*
- *From the query editor, you turn on column profile and column distribution, which of the following are true?*



VIEW MENU

- View Menu**
- Column Quality
- Column Distribution
- Column Profile



Turn off or on the **Applied Steps** menu and **M code formula bar**

Enable **parameter creation**

Open the **M code advanced editor**

Data profiling tools like column quality, distribution, and profile



DATA PROFILING TOOLS (COLUMN QUALITY)

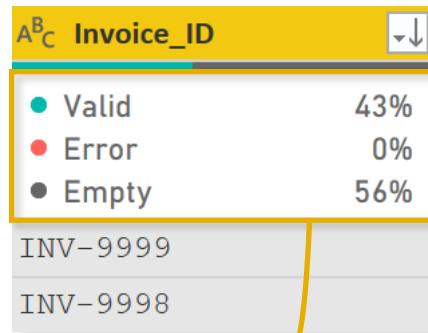
Data profiling tools like *column quality*, *column distribution*, and *column profile* provide a visual way to **explore data** and get a sense of your **dataset composition**

View Menu

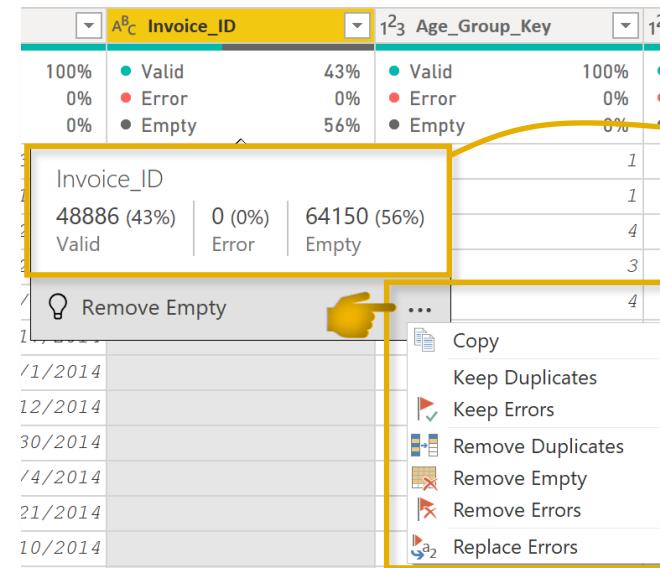
Column Quality

Column Distribution

Column Profile



Column quality shows the percentage of values within a column that are valid, have errors, or are empty



Hover over the column quality box to reveal a **contextual menu**

Use the **options menu** to clean duplicates, errors & empty values



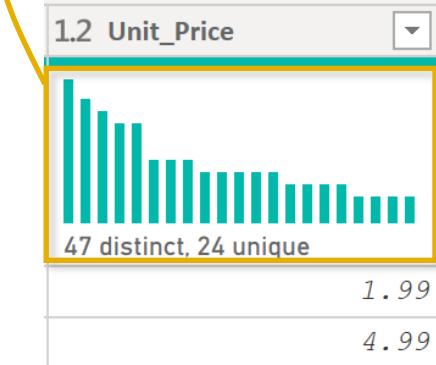
PRO TIP: Use the contextual menu to solve **column quality** issues instead of having to right-click or find the right Power Query option



DATA PROFILING TOOLS (COLUMN DISTRIBUTION)

Column distribution provides a sample distribution of the data within the column

- View Menu
- Column Quality
- Column Distribution
- Column Profile



Suggested action based on column distribution results

| Transaction_Date | Stock_Date | A ^B C |
|------------------------|-------------------------|------------------|
| 155 distinct, 2 unique | 276 distinct, 55 unique | 10 |
| 8/30/2014 INV | | |
| 10/17/2014 INV | | |
| 11/28/2014 INV | | |
| 8/22/2014 INV | | |
| 12/9/2014 INV | | |
| 7 1/2/2015 | | |
| 8 1/2/2015 | | |
| 9 1/2/2015 | | |
| 10 1/3/2015 | | |
| 11 1/3/2015 | | |
| 12 1/3/2015 | | |

Hover over the **column quality** box to reveal a contextual menu

Use the **options menu** to clean duplicates, errors & empty values



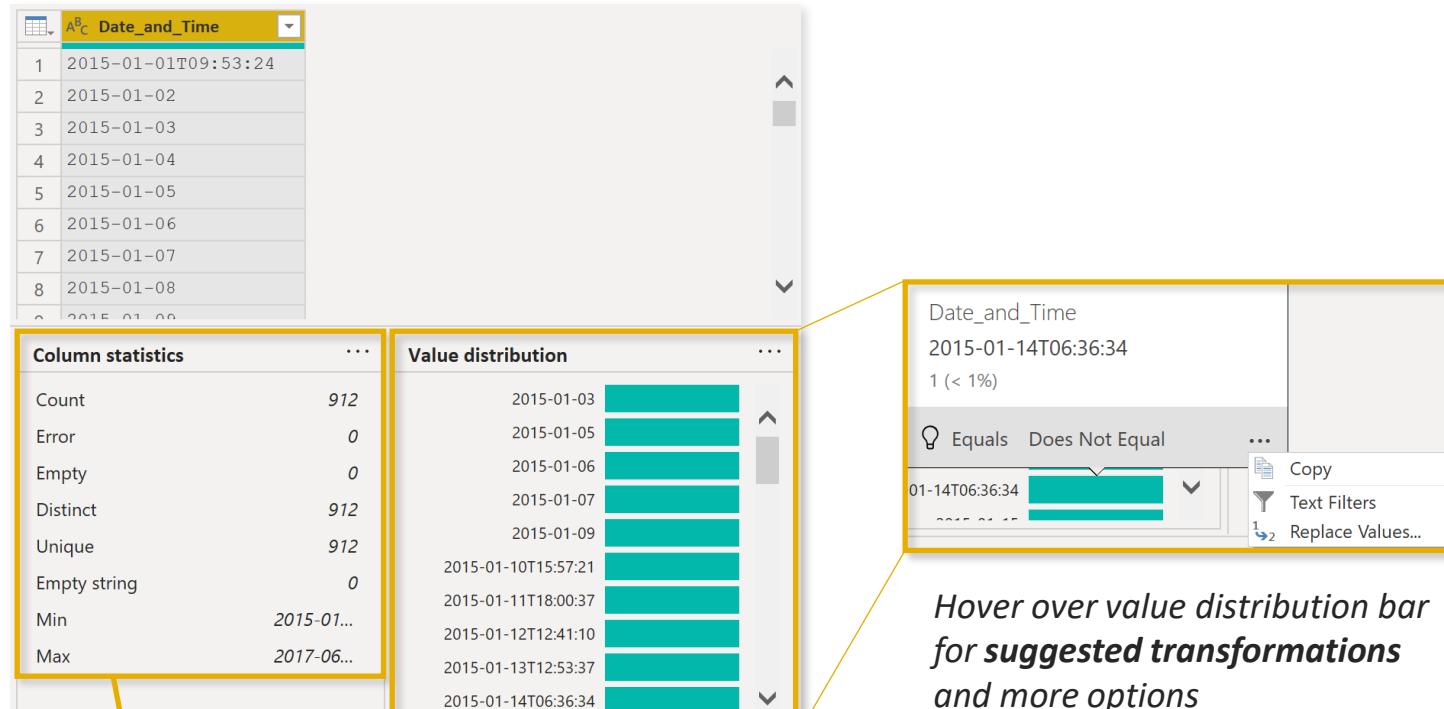
PRO TIP: Use column distribution to identify primary keys within your lookup tables



DATA PROFILING TOOLS (COLUMN PROFILE)

Column profile provides a more holistic view of data within a column providing sample distribution of the data and column statistics

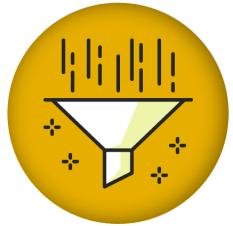
- [View Menu](#)
- [Column Quality](#)
- [Column Distribution](#)
- [Column Profile](#)



Column statistics provide a bit more detail than distribution view

Hover over value distribution bar for **suggested transformations** and more options

CLEAN, TRANSFORM & LOAD DATA



In this section we'll cover how to **clean, transform, and load data into Power BI**, including identifying keys for joins, shaping tables, combining queries, and modifying M code

TOPICS WE'LL COVER:

Cleaning Data

Identifying Keys

Shaping Tables

Combining Queries

Modifying M Code

COMMON QUESTIONS:

- *Based on the following M code, what will be the output of the applied step?*
- *From the Query Editor, you want to remove a leading underscore from records in the 'source' column. How would you write the M code?*
- *You import the dataset pictured below. How should you transform the dataset to support period-over-period calculations?*



BASIC TABLE TRANSFORMATIONS

Cleaning Data

The **HOME** tab includes **general settings and common table transformation tools**

The screenshot shows the Power BI ribbon with the 'Home' tab selected. The ribbon tabs include File, Home, Transform, Add Column, View, Tools, and Help. Under the Home tab, there are icons for Close & Apply, New Source, Recent Sources, Enter Data, Data source settings, Manage Parameters, Refresh, Advanced Editor, Properties, Choose Columns, Remove Columns, Keep Rows, Remove Rows, Sort, Split Column, Group By, Data Type (Date), Merge Queries, Append Queries, Use First Row as Headers, Replace Values, Combine Files, Combine, Text Analytics, Vision, Azure Machine Learning, and AI Insights.

Identifying Keys

Shaping Tables

Combining
Queries

Modifying M Code

The **TRANSFORM** tab includes tools to **modify existing columns** (splitting/grouping, transposing, extracting text, etc.)

The screenshot shows the Power BI ribbon with the 'Transform' tab selected. The ribbon tabs include File, Home, Transform, Add Column, View, Tools, and Help. Under the Transform tab, there are icons for Group, Use First Row By as Headers, Transpose, Reverse Rows, Count Rows, Detect Data Type, Fill, Rename, Pivot Column, Convert to List, Unpivot Columns, Move, Format, Extract, Parse, Statistics, Standard, Scientific, Information, Trigonometry, Rounding, Date, Time, Duration, Run R script, Run Python script, and Scripts.

The **ADD COLUMN** tools **create new columns** (based on conditional rules, text operations, calculations, dates, etc.)

The screenshot shows the Power BI ribbon with the 'Add Column' tab selected. The ribbon tabs include File, Home, Transform, Add Column, View, Tools, and Help. Under the Add Column tab, there are icons for Column From Examples, Custom Column, Invoke Custom Function, Conditional Column, Index Column, Duplicate Column, Merge Columns, Format, Extract, Parse, Statistics, Standard, Scientific, Information, Trigonometry, Rounding, Date, Time, Duration, Text Analytics, Vision, Azure Machine Learning, and AI Insights.



BASIC TABLE TRANSFORMATIONS

Cleaning Data

Identifying Keys

Shaping Tables

Combining Queries

Modifying M Code

The screenshot shows the Microsoft Power Query ribbon with several key sections highlighted:

- Sort values (A-Z, Low-High, etc.)**: Points to the "Sort" button in the Transform ribbon tab.
- Change data type (date, \$, %, text, etc.)**: Points to the "Data Type" dropdown in the Transform ribbon tab.
- Promote header row**: Points to the "Use First Row as Headers" option in the Transform ribbon tab.
- Choose or remove columns**: Points to the "Remove Columns" and "Remove Other Columns" options in the Home ribbon tab.
- Keep or remove rows**: Points to the "Remove Top Rows", "Remove Bottom Rows", "Remove Alternate Rows", "Remove Duplicates", "Remove Blank Rows", and "Remove Errors" options in the Home ribbon tab.
- Duplicate, move & rename columns**: Points to the context menu that appears when right-clicking a column header, specifically the "Transform" section.
- Tip: use the "Remove Other Columns" option if you always want a specific set**: Provides a tip for the "Choose or remove columns" section.
- Tip: use the "Remove Duplicates" option to create a new lookup table from scratch**: Provides a tip for the "Keep or remove rows" section.

Below the ribbon, a sample table is shown with a context menu open over the first column header. The menu includes options like Copy, Remove, Remove Other Columns, Duplicate Column, Add Column From Examples..., Remove Duplicates, Remove Errors, Change Type, Transform, Replace Values..., Replace Errors..., Group By..., Fill, Unpivot Columns, Unpivot Other Columns, Unpivot Only Selected Columns, Rename..., Move, Drill Down, and Add as New Query.

| Stock Date | A_B_Invoice ID |
|------------|--------------------|
| 1 7 | 6/26/2017 INV-9983 |
| 2 7 | 5/28/2017 INV-9982 |
| 3 7 | |
| 4 7 | |
| 5 7 | |
| 6 7 | |
| 7 7 | |
| 8 7 | |
| 9 7 | |
| 10 7 | |
| 11 7 | |
| 12 7 | |
| 13 7 | |
| 14 7 | |
| 15 7 | |
| 16 7 | |
| 17 7 | |
| 18 7 | |



ADDING INDEX COLUMNS

Index columns contain a list of sequential values that can be used to identify each unique row in a table (*typically starting from 0 or 1*)

- They are often used to create **unique IDs** and form relationships between tables (*more on that later!*)



The screenshot shows the Power BI desktop interface with the 'Add Column' ribbon tab selected. The 'Index Column' option is highlighted with a yellow box and a yellow arrow points from it to a table view on the right. The table has columns for Transaction Date, Stock Date, and Invoice ID, with an additional 'Index' column on the left containing sequential numbers from 1 to 16. A legend at the top of the table indicates three categories: Valid (green), Error (red), and Empty (black).

| | Transaction Date | Stock Date | A ^B C | Invoice_ID |
|----|------------------|------------|------------------|------------|
| 1 | 8/5/2017 | 7/7/2017 | Valid | 43% |
| 2 | 8/5/2017 | 7/10/2017 | Error | 0% |
| 3 | 8/5/2017 | 7/31/2017 | Empty | 56% |
| 4 | 8/5/2017 | 7/9/2017 | INV-9999 | |
| 5 | 8/5/2017 | 6/11/2017 | INV-9995 | |
| 6 | 8/5/2017 | 2/13/2017 | INV-9994 | |
| 7 | 8/5/2017 | 6/23/2017 | INV-9993 | |
| 8 | 8/5/2017 | 3/12/2017 | INV-9992 | |
| 9 | 8/5/2017 | 3/19/2017 | INV-9991 | |
| 10 | 8/5/2017 | 6/16/2017 | INV-9990 | |
| 11 | 8/5/2017 | 7/12/2017 | INV-9989 | |
| 12 | 8/5/2017 | 7/25/2017 | INV-9988 | |
| 13 | 8/5/2017 | 7/29/2017 | INV-9987 | |
| 14 | 8/5/2017 | 2/26/2017 | INV-9986 | |
| 15 | 8/5/2017 | 4/8/2017 | INV-9985 | |
| 16 | 8/5/2017 | 6/13/2017 | INV-9984 | |



ADDING CONDITIONAL COLUMNS

Conditional columns allow you to define new fields based on logical rules (*IF statements*)

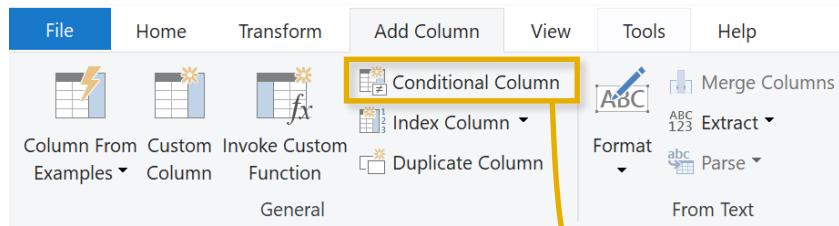
Cleaning Data

Identifying Keys

Shaping Tables

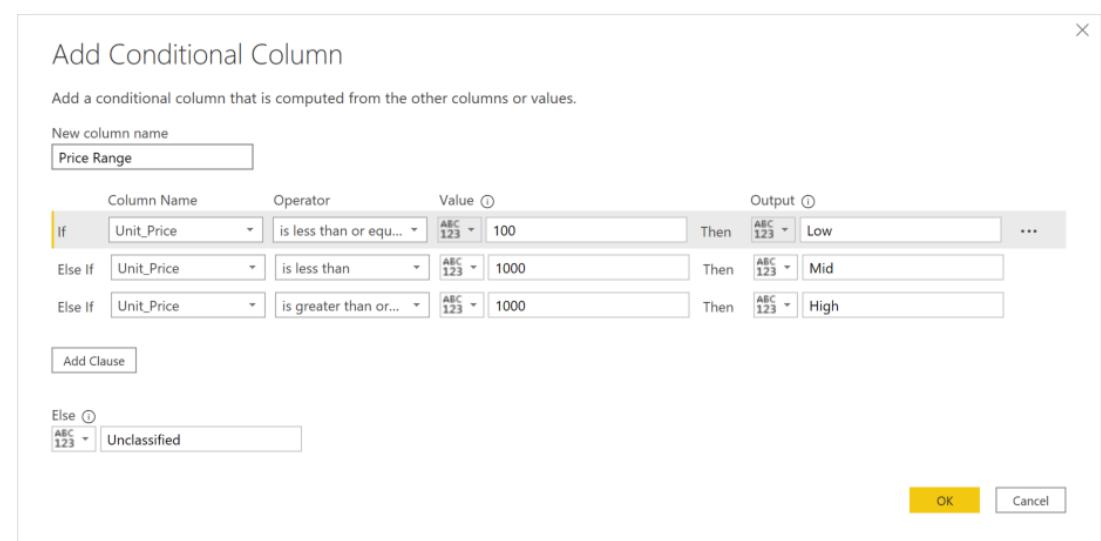
Combining
Queries

Modifying M Code



In this case we're creating a new conditional column called "**QuantityType**", which depends on the values in the "**OrderQuantity**" column, as follows:

- If Unit Price <= 100, then Price Range = "Low"
- If Unit Price < 1,000, then Price Range = "Mid"
- If Unit Price >= 1,000, then Price Range = "High"
- Otherwise, Price Range = "Unclassified"





ADDING COLUMNS FROM EXAMPLE

Columns from examples allow you to add new columns by providing an example value

- Column examples can be created from individual or all existing columns in the table



The screenshot shows the Power BI desktop interface. The ribbon is open to the 'Add Column' tab. A yellow box highlights the 'Column From Examples' button under the 'General' section. An arrow points down to the 'Add Column From Examples' dialog box. The dialog has 'Query Settings' and 'PROPERTIES' sections. In the properties section, 'Name' is set to 'AdventureWorks_Calen'. Below the dialog is a table with four rows labeled 1 through 4, and a column header 'Date_and_Time'. Another arrow points to a 'Column1' properties panel where '2015-01-01' is selected. A third arrow points to a 'Text Before Delimiter' table containing dates from 2015-01-01 to 2015-01-06. A fourth arrow points to an 'APPLIED STEPS' pane which lists 'Source', 'Changed Type', 'Promoted Headers', and 'Inserted Text Before Delimiter'.

New column created based on example

Creates column using text before delimiter transformation

Text Before Delimiter

| |
|------------|
| 2015-01-01 |
| 2015-01-02 |
| 2015-01-03 |
| 2015-01-04 |
| 2015-01-05 |
| 2015-01-06 |

APPLIED STEPS

- Source
- Changed Type
- Promoted Headers
- Inserted Text Before Delimiter



PRO TIP: Use this when you know the outcome you want but don't know which transformation, or group of transformations, to use



GROUPING & AGGREGATING DATA

Group by allows you to aggregate your data at a different level

- **For example:** Transform daily data into monthly, roll up transaction-level data by store, etc.

Cleaning Data

Identifying Keys

Shaping Tables

Combining Queries

Modifying M Code

The screenshot illustrates the Power BI Data Editor interface for transforming data. On the left, a table named 'Transaction' is shown with columns: Transaction_Date, Product_Key, and Stock_Date. A yellow arrow points from the 'Group By' button in the ribbon to the 'Group By' dialog box. The 'Group By' dialog box shows 'ProductKey' selected for grouping, with 'TotalQuantity' as the new column name and 'Sum' as the operation for the 'OrderQuantity' column. On the right, the resulting summary table is shown with columns: Product_Key and TotalQuantity.

| Product_Key | TotalQuantity |
|-------------|---------------|
| 1 | 271 |
| 2 | 273 |
| 3 | 252 |
| 4 | 244 |
| 5 | 227 |
| 6 | 247 |
| 7 | 255 |
| 8 | 269 |
| 9 | 229 |
| 10 | 249 |
| 11 | 268 |
| 12 | 226 |
| 13 | 245 |
| 14 | 314 |
| 15 | 248 |

In this case we're transforming a daily, transaction-level table into a summary of "TotalQuantity" rolled up by "ProductKey"

NOTE: Any fields not specified in the Group By settings are lost



PIVOTING & UNPIVOTING

“Pivoting” is a fancy way to describe the process of turning **distinct row values** into **columns** (“*pivoting*”) or turning **columns** into **rows** (“*unpivoting*”)

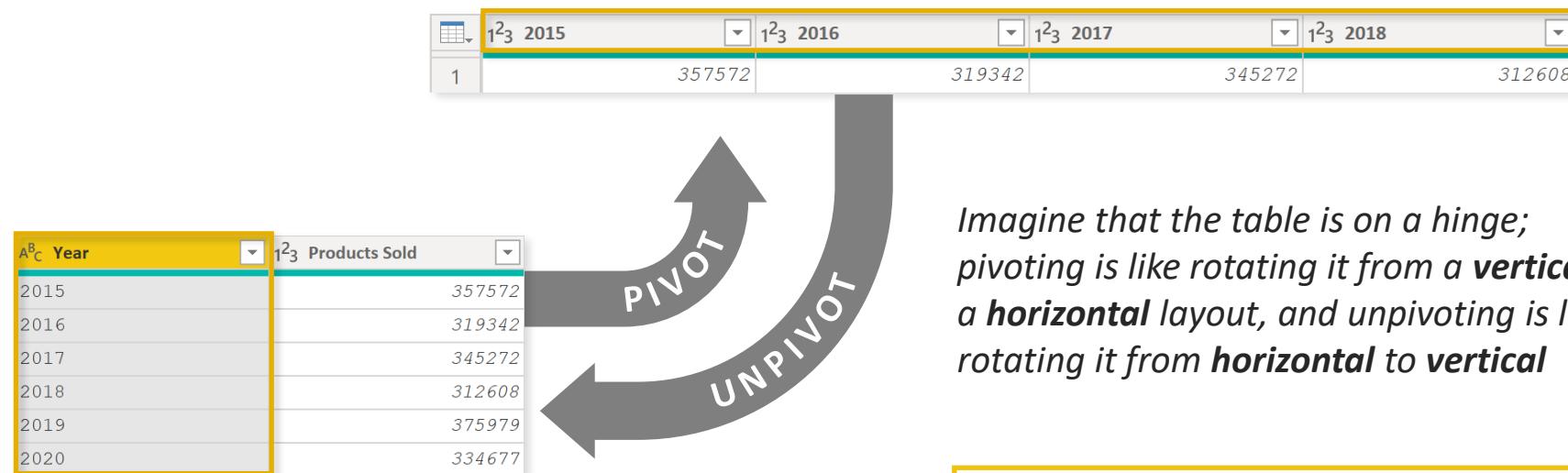
Cleaning Data

Identifying Keys

Shaping Tables

Combining Queries

Modifying M Code



Imagine that the table is on a hinge; pivoting is like rotating it from a **vertical** to a **horizontal** layout, and unpivoting is like rotating it from **horizontal** to **vertical**

HEY THIS IS IMPORTANT!

Transpose works very similarly, but doesn’t recognize unique values; instead, the entire table is transformed so that each row becomes a column and vice versa





MERGING QUERIES

Merging queries allows you to join tables based on a common column

Cleaning Data

Identifying Keys

Shaping Tables

Combining Queries

Modifying M Code

In this case we're merging the **Maven Cycles Sales** table with the **Maven Cycles Products** table, which share a common "Product_Key" column

NOTE: Merging adds columns to an existing table

HEY THIS IS IMPORTANT!

Just because you **can** merge tables, doesn't mean you **should**.

In general, it's better to keep tables separate and define **relationships** between them in your data model



APPENDING QUERIES

Appending queries allows you to combine (or stack) tables that share the exact same column structure and data types

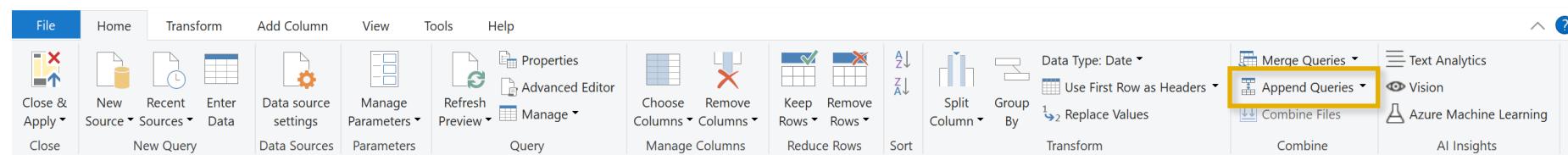
Cleaning Data

Identifying Keys

Shaping Tables

Combining
Queries

Modifying M Code



Append

Concatenate rows from two tables into a single table.

Two tables Three or more tables

First table

Maven Cycles Sales - 2019

Second table

Maven Cycles Sales - 2020

In this case we're appending the **Maven Cycles Sales – 2019** table to the **Maven Cycles Sales – 2020** table, which is valid since they share identical table structures

NOTE: Appending **adds rows** to an existing table



PRO TIP: Use the “Folder” option (Get Data > More > Folder) to append all files within a folder (assuming they share the same structure); as you add new files, simply refresh the query and they will automatically append!



MODIFYING QUERIES

- Cleaning Data
- Identifying Keys
- Shaping Tables
- Combining Queries
- Modifying M Code

Select Transform Data from the Home tab to launch the Query Editor

View or modify existing queries in the “Queries” pane

Within each query, you can click each item within the “Applied Steps” pane to view each stage of the transformation, add new steps, delete existing ones, or modify individual steps by clicking the gear icons

The screenshot shows the Microsoft Power BI desktop application. The ribbon is visible at the top with the Home tab selected. In the center, the Power Query Editor window is open, displaying a table titled "Maven Cycles Sales". The "Queries" pane on the left lists nine queries, with "Maven Cycles Sales" currently selected. The main area shows a table with columns: Transaction_Date, Product_Key, Stock_Date, Invoice_ID, and Age_Group_Key. The "Applied Steps" pane on the right shows a list of transformations applied to the query, including "Promoted Headers", "Changed Type", "Reordered Columns", and "Sorted Rows". Arrows point from the text instructions to the corresponding sections in the interface.



INTRO TO M CODE

Data Mashup, or **M code**, is the formula language that drives Power Query

Cleaning Data

Identifying Keys

Shaping Tables

Combining
Queries

Modifying M Code

The Query Editor writes the corresponding **M code**

The Query Editor writes the corresponding **M code**

```
= Table.Sort(#"Reordered Columns",{{"Product_Key", Order.Ascending}})
```

| Transaction_Date | Product_Key | Stock_Date | Invoice_ID | Age_Group_Key |
|------------------|-------------|------------|------------|---------------|
| 7/30/2020 | 201 | 6/9/2020 | INV-113948 | |
| 7/8/2017 | 201 | 5/14/2017 | INV-8430 | |
| 9/3/2017 | 201 | 7/8/2017 | INV-13571 | |
| 7/30/2020 | 201 | 3/26/2020 | INV-113947 | |
| 7/1/2017 | 201 | 3/16/2017 | INV-8098 | |
| 8/30/2017 | 201 | 6/29/2017 | INV-13085 | |
| 7/28/2017 | 201 | 2/18/2017 | INV-9337 | |
| 9/13/2017 | 201 | 5/24/2017 | INV-14876 | |
| 8/19/2017 | 201 | 5/18/2017 | INV-11782 | |
| 9/15/2017 | 201 | 4/7/2017 | INV-15248 | |
| 7/28/2020 | 201 | 7/16/2020 | INV-113767 | |
| 8/27/2017 | 201 | 3/22/2017 | INV-12775 | |
| 8/20/2017 | 201 | 5/10/2017 | INV-11927 | |
| 8/17/2017 | 201 | 4/13/2017 | INV-11510 | |

Use the UI tools to **sort**
Product_Key ascending

Query Settings

PROPERTIES

Name: Maven Cycles Sales

[All Properties](#)

APPLIED STEPS

- Source
- Promoted Headers
- Changed Type
- Reordered Columns
- Sorted Rows**

A new Applied Step is
added for **Sorted Rows**



EDITING & ADDING APPLIED STEPS

Although you can perform many transformations with the Power Query UI tools, you can do even more by directly **editing or writing new M code**

Cleaning Data

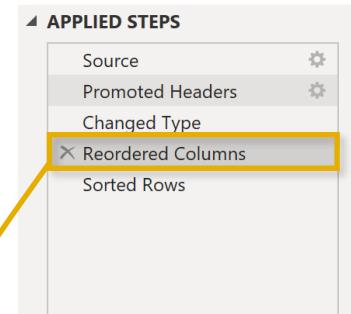
Identifying Keys

Shaping Tables

Combining
Queries

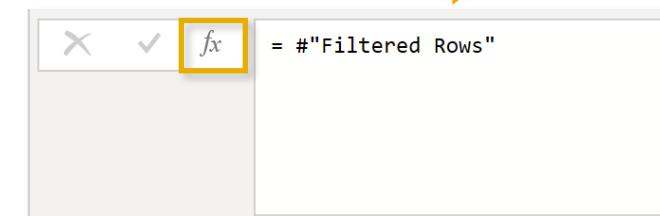
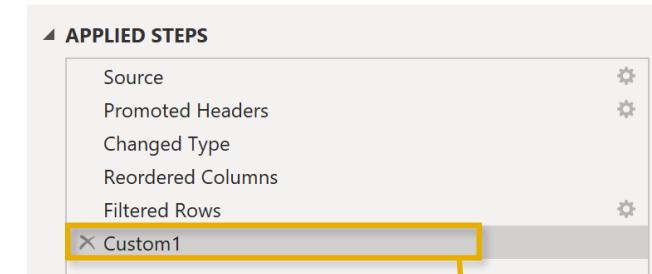
Modifying M Code

Click on an applied step to **edit** the M code from the formula bar



```
= Table.ReorderColumns(#"Changed Type", {"Transaction_Date",  
    "Product_Key", "Stock_Date", "Invoice_ID", "Age_Group_Key",  
    "Customer_Gender_Key", "Region_Key", "Product_Category_Key",  
    "Sub_Category_Key", "Quantity_Sold"})
```

Click the *fx* button to open a Blank Query and **write your own** custom applied step

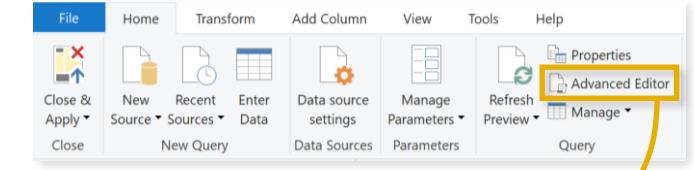
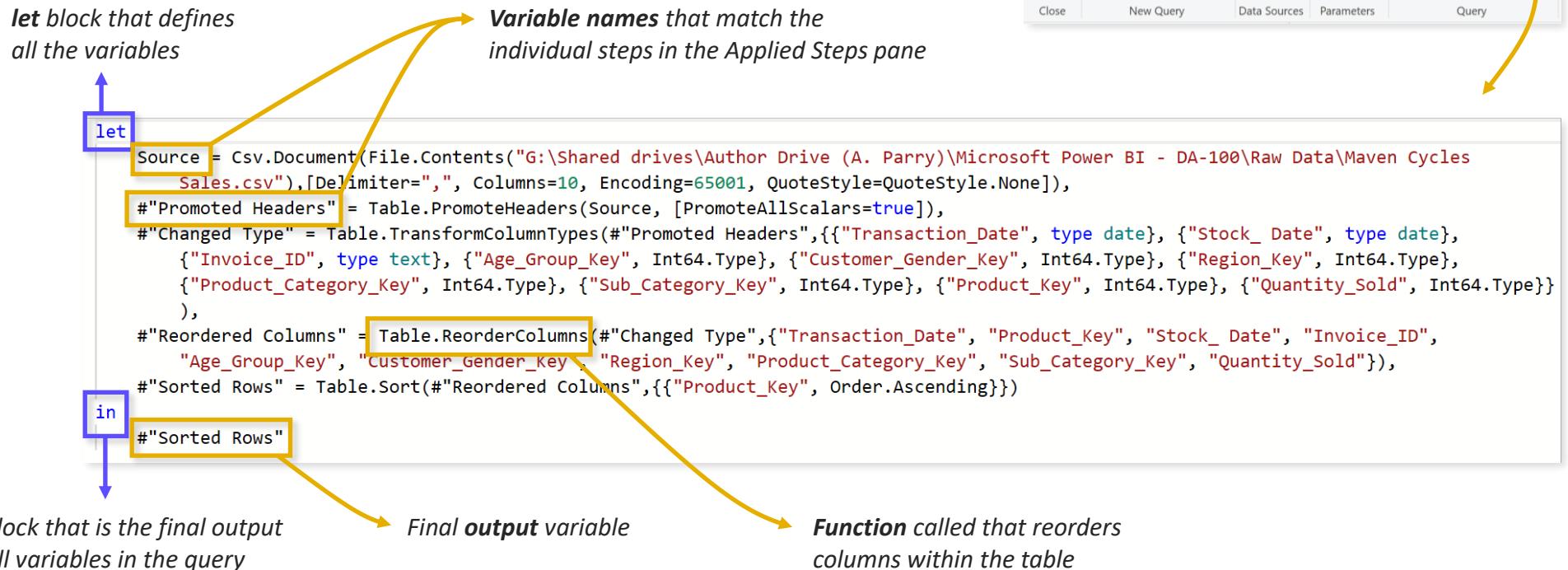




ADVANCED EDITOR (INTRO TO M CODE)

Opening the **advanced editor** allows you to see the M code that makes up your query, which consists of two blocks:

1. **let**: the definition of all variables
2. **in**: the output of your query





COMMON FUNCTION CATEGORIES

Cleaning Data

Identifying Keys

Shaping Tables

Combining Queries

Modifying M Code

TABLE

Functions

Functions to create and manipulate table values

Common Examples:

- Table.FromList
- Table.ToList
- Table.IsEmpty
- Table.FindText
- Table.RemoveColumns
- Table.Contains

Table function categories:

- Table construction
- Conversion
- Information
- Row operations
- Column operations
- Membership

LIST

Functions

Functions to create and manipulate list values

Common Examples:

- List.Select
- List.Contains
- List.Union
- List.Median
- List.Numbers

List function categories:

- Selection
- Membership
- Set operations
- Ordering
- Generators

TEXT

Functions

Functions to create and manipulate text values

Common Examples:

- Text.Length
- Text.From
- Text.Middle
- Text.Contains
- Text.Remove
- Text.BeforeDelimiter

Text function categories:

- Information
- Text comparisons
- Extraction
- Membership
- Modification
- Transformations

DATE

Functions

Functions to create and manipulate date, datetime, and datetimezone values

Common Examples:

- Date.EndOfMonth
- Date.EndOfQuarter
- Date.Day
- Date.StartOfWeek
- Date.StartOfMonth



M CODE SYNTAX

Cleaning Data

Identifying Keys

Shaping Tables

Combining
Queries

Modifying M Code

Let's say we want to filter Maven Cycles Sales where the quantity sold equals 2

In order to accomplish this, we need to write the following code as an applied step:

= **Table.SelectRows**(#"Reordered Columns", each ([Quantity_Sold] = 2))

FUNCTION NAME

This example uses a table function to select certain rows based on filter criteria

PREVIOUS STEP

This function will be applied after the Reordered Columns step

FUNCTION ARGUMENTS

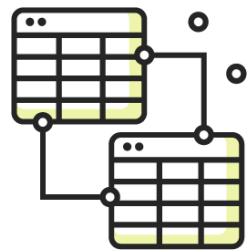
The function in this example requires a filter condition (quantity sold = 2)

MODELING THE DATA



Prepare the Data

- Get data from different sources
- Clean, transform, and load data



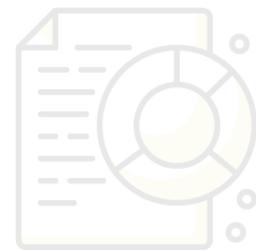
Model the Data

- Design a data model
- Develop a data model
- Create model calculations with DAX
- Optimize model performance



Visualize & Analyze the Data

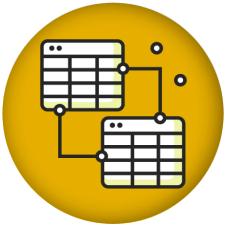
- Create reports
- Create dashboards
- Enrich reports for usability
- Enhance reports for usability & storytelling
- Identify patterns & trends



Deploy & Maintain Assets

- Manage files & datasets
- Manage workspaces

DATA MODELING



In this section we'll cover core **data modeling** topics, including designing a data model, developing a data model, and optimizing model performance

TOPICS WE'LL COVER:

Data Model 101

Table Roles

Table Relationships

Data Model Types

Date Tables

Optimization Tips

COMMON QUESTIONS:

- *You have multiple tables in your data model and need to show MTD revenue compared to last year. Which of the following actions should you take?*
- *In order to reduce the size of your data model, what should you do with a DateTime column that contains unique values for each record in the table?*
- *Which of the following relationship types is the most efficient way to connect a fact and lookup table?*



WHAT'S A "DATA MODEL"?

Data Model 101

Table Roles

Table Relationships

Data Model Types

Date Tables

Optimization Tips

The screenshot shows three separate tables in a data model:

- Maven Cycles Products:** Contains columns: Product_New, ProductKey, and a collapse button.
- Maven Cycles Regions:** Contains columns: SalesTerritoryKey, TerritoryManager, and a collapse button.
- Maven Cycles Sales Fact Table:** Contains columns: Age_Group_Key, Customer_Gender_Key, Invoice_ID, Product_Category_Key, Product_Key, Quantity_Sold, Region_Key, Stock_Date, Sub_Category_Key, Transaction_Date, and a collapse button.

This IS NOT a data model

- This is a collection of independent tables, which share no connections or relationships
- If you tried to visualize **Revenue** and **Profit** by **Country**, this is what you'd get



| Country | Total Revenue | Total Profit |
|----------------|------------------|-------------------|
| Australia | 88,747.96 | 150,232.47 |
| Canada | 88,747.96 | 150,232.47 |
| France | 88,747.96 | 150,232.47 |
| Germany | 88,747.96 | 150,232.47 |
| United Kingdom | 88,747.96 | 150,232.47 |
| United States | 88,747.96 | 150,232.47 |
| Total | 88,747.96 | 150,232.47 |



WHAT'S A "DATA MODEL"?

Data Model 101

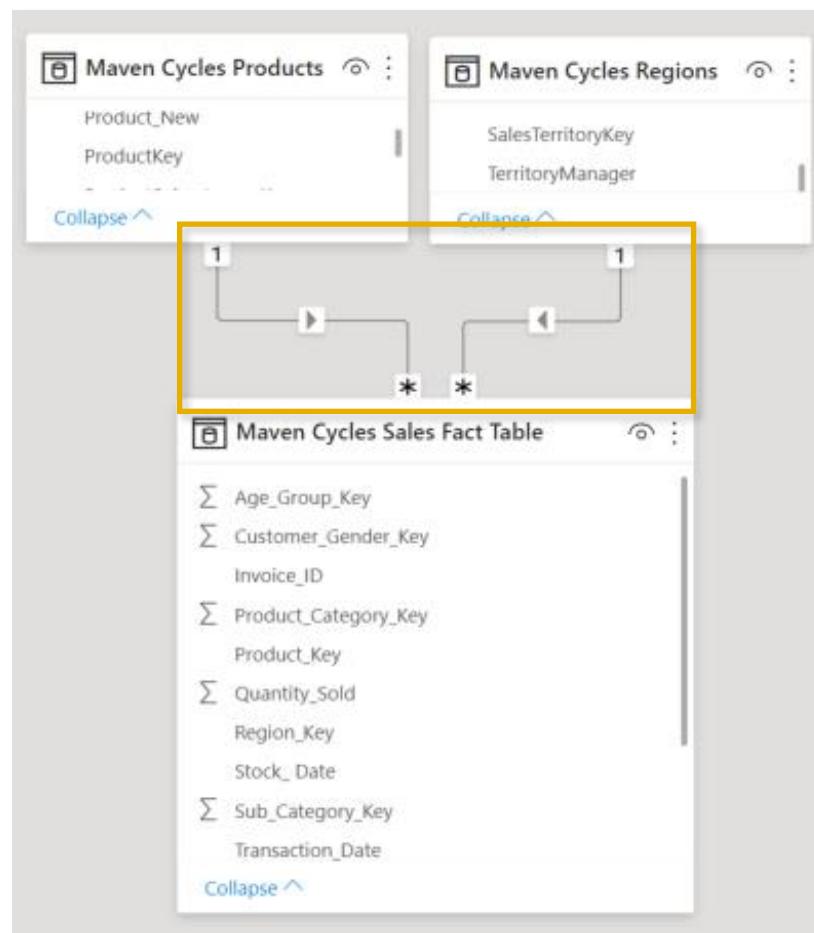
Table Roles

Table Relationships

Data Model Types

Date Tables

Optimization Tips



This **IS** a data model

- The tables are connected via relationships, based on their common fields
- Now the **Sales** table knows how to filter using fields from the **Products & Regions** tables!



| Country | Total Revenue | Total Profit |
|----------------|----------------------|---------------------|
| United States | \$62,726,170 | \$31,156,122 |
| Australia | \$49,811,320 | \$23,283,029 |
| United Kingdom | \$23,632,362 | \$11,623,161 |
| Germany | \$20,499,693 | \$9,896,988 |
| France | \$20,090,553 | \$9,691,311 |
| Canada | \$16,655,827 | \$8,750,364 |
| Total | \$193,415,925 | \$94,400,977 |



DATA MODEL BEST PRACTICES

Data Model 101

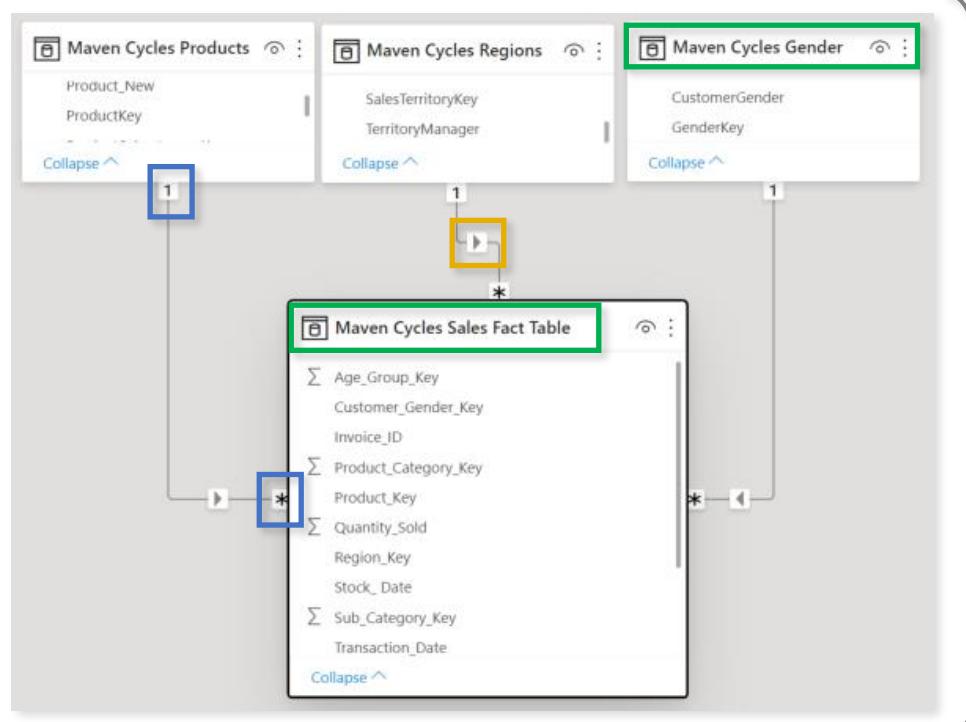
Table Roles

Table Relationships

Data Model Types

Date Tables

Optimization Tips



A well-designed model is **critical** and ideally should:

- ✓ Use a star schema with **one-to-many** (`1:*`) relationships
- ✓ Contain relationships with **one-way** filters (vs. *bidirectional*)
- ✓ Contain tables that each serve a *specific* purpose, including **data** (*fact*) tables and **lookup** (*dim*) tables
- ✓ Only include the data you need for analysis (*no redundant or unnecessary records or fields*)
- ✓ Split out individual **date** and **time** components from **DateTime** fields



DATA TABLES VS LOOKUP TABLES

Data Model 101

Table Roles

Table Relationships

Data Model Types

Date Tables

Optimization Tips

Models generally contain two types of tables: **Data tables & Lookup tables**

- **Data** (or “fact”) tables contain measurable *metrics* about the business (*quantity, revenue, views, etc.*)
- **Lookup** (or “dimension”) tables provide descriptive *attributes* about each dimension in your model (*customers, products, etc.*)

| date | product_id | quantity |
|----------|------------|----------|
| 1/1/1997 | 869 | 5 |
| 1/1/1997 | 1472 | 3 |
| 1/1/1997 | 76 | 4 |
| 1/1/1997 | 320 | 3 |
| 1/1/1997 | 4 | 4 |
| 1/1/1997 | 952 | 4 |
| 1/1/1997 | 1222 | 4 |
| 1/1/1997 | 517 | 4 |
| 1/1/1997 | 1359 | 4 |
| 1/1/1997 | 357 | 4 |
| 1/1/1997 | 1426 | 5 |
| 1/1/1997 | 190 | 4 |
| 1/1/1997 | 367 | 4 |
| 1/1/1997 | 250 | 5 |
| 1/1/1997 | 600 | 4 |
| 1/1/1997 | 702 | 5 |

This **Data Table** contains “**quantity**” values, and connects to lookup tables via the “**date**” and “**product_id**” columns

| date | day_of_month | month | year | weekday | week_of_year | week_ending | month_name | quarter |
|----------|--------------|-------|------|-----------|--------------|-------------|------------|---------|
| 1/1/1997 | 1 | 1 | 1997 | Wednesday | 1 | 1/5/1997 | January | Q1 |
| 1/2/1997 | 2 | 1 | 1997 | Thursday | 1 | 1/5/1997 | January | Q1 |
| 1/3/1997 | 3 | 1 | 1997 | Friday | 1 | 1/5/1997 | January | Q1 |
| 1/4/1997 | 4 | 1 | 1997 | Saturday | 1 | 1/5/1997 | January | Q1 |
| 1/5/1997 | 5 | 1 | 1997 | Sunday | 2 | 1/5/1997 | January | Q1 |
| 1/6/1997 | 6 | 1 | 1997 | Monday | 2 | 1/12/1997 | January | Q1 |

This **Calendar Lookup table** provides additional attributes about each **date** (month, year, quarter, etc.)

| product_id | product_brand | product_name | product_sku | product_retail_price | product_cost | product_weight |
|------------|---------------|-----------------------------|-------------|----------------------|--------------|----------------|
| 1 | Washington | Washington Berry Juice | 90748583674 | 2.85 | 0.94 | 8.39 |
| 2 | Washington | Washington Mango Drink | 96516502499 | 0.74 | 0.26 | 7.42 |
| 3 | Washington | Washington Strawberry Drink | 58427771925 | 0.83 | 0.4 | 13.1 |
| 4 | Washington | Washington Cream Soda | 64412155747 | 3.64 | 1.64 | 10.6 |
| 5 | Washington | Washington Diet Soda | 85561191439 | 2.19 | 0.77 | 6.66 |
| 6 | Washington | Washington Cola | 29804642796 | 1.15 | 0.37 | 15.8 |
| 7 | Washington | Washington Diet Cola | 2019144754 | 2.61 | 0.91 | 18 |
| 8 | Washington | Washington Orange Juice | 89770532250 | 2.59 | 0.8 | 8.97 |

This **Product Lookup table** provides additional attributes about each **product** (brand, name, price, etc.)



PRIMARY VS FOREIGN KEYS

Data Model 101

Table Roles

Table Relationships

Data Model Types

Date Tables

Optimization Tips

| date | product_id | quantity |
|----------|------------|----------|
| 1/1/1997 | 869 | 5 |
| 1/1/1997 | 1472 | 3 |
| 1/1/1997 | 76 | 4 |
| 1/1/1997 | 320 | 3 |
| 1/1/1997 | 4 | 4 |
| 1/1/1997 | 952 | 4 |
| 1/1/1997 | 1222 | 4 |
| 1/1/1997 | 517 | 4 |
| 1/1/1997 | 1359 | 4 |
| 1/1/1997 | 357 | 4 |
| 1/1/1997 | 1426 | 5 |
| 1/1/1997 | 190 | 4 |
| 1/1/1997 | 367 | 4 |
| 1/1/1997 | 250 | 5 |
| 1/1/1997 | 600 | 4 |
| 1/1/1997 | 702 | 5 |

| date | day_of_month | month | year | weekday | week_of_year | week_endings | month_name | quarter |
|----------|--------------|-------|------|-----------|--------------|--------------|------------|---------|
| 1/1/1997 | 1 | 1 | 1997 | Wednesday | 1 | 1/5/1997 | January | Q1 |
| 1/2/1997 | 2 | 1 | 1997 | Thursday | 1 | 1/5/1997 | January | Q1 |
| 1/3/1997 | 3 | 1 | 1997 | Friday | 1 | 1/5/1997 | January | Q1 |
| 1/4/1997 | 4 | 1 | 1997 | Saturday | 1 | 1/5/1997 | January | Q1 |
| 1/5/1997 | 5 | 1 | 1997 | Sunday | 2 | 1/5/1997 | January | Q1 |
| 1/6/1997 | 6 | 1 | 1997 | Monday | 2 | 1/12/1997 | January | Q1 |

| product_id | product_brand | product_name | product_sku | product_retail_price | product_cost | product_weight |
|------------|---------------|-----------------------------|-------------|----------------------|--------------|----------------|
| 1 | Washington | Washington Berry Juice | 90748583674 | 2.85 | 0.94 | 8.39 |
| 2 | Washington | Washington Mango Drink | 96516502499 | 0.74 | 0.26 | 7.42 |
| 3 | Washington | Washington Strawberry Drink | 58427771925 | 0.83 | 0.4 | 13.1 |
| 4 | Washington | Washington Cream Soda | 64412155747 | 3.64 | 1.64 | 10.6 |
| 5 | Washington | Washington Diet Soda | 85561191439 | 2.19 | 0.77 | 6.66 |
| 6 | Washington | Washington Cola | 29804642796 | 1.15 | 0.37 | 15.8 |
| 7 | Washington | Washington Diet Cola | 20191444754 | 2.61 | 0.91 | 18 |
| 8 | Washington | Washington Orange Juice | 89770532250 | 2.59 | 0.8 | 8.97 |

These columns are **foreign keys**; they contain *multiple* instances of each value, and are used to match the **primary keys** in related lookup tables

These columns are **primary keys**; they *uniquely* identify each row of a table, and match the **foreign keys** in related data tables



RELATIONSHIPS VS MERGED TABLES

Data Model 101

Table Roles

Table Relationships

Data Model Types

Date Tables

Optimization Tips



*Can't I just **merge queries** or use **LOOKUP** or **RELATED** functions to pull those attributes into the fact table itself, so that I have everything in one place??*

-Anonymous confused man

| Original Fact Table fields | | | Attributes from Calendar Lookup table | | | | | | | | Attributes from Product Lookup table | | |
|----------------------------|------------|----------|---------------------------------------|-------|------|-----------|------------|---------|---------------|-----------------------------|--------------------------------------|----------------|--|
| date | product_id | quantity | day_of_month | month | year | weekday | month_name | quarter | product_brand | product_name | product_sku | product_weight | |
| 1/1/1997 | 869 | 5 | 1 | 1 | 1997 | Wednesday | January | Q1 | Nationeel | Nationeel Grape Fruit Roll | 52382137179 | 17 | |
| 1/7/1997 | 869 | 2 | 7 | 1 | 1997 | Tuesday | January | Q1 | Nationeel | Nationeel Grape Fruit Roll | 52382137179 | 17 | |
| 1/3/1997 | 1 | 4 | 3 | 1 | 1997 | Friday | January | Q1 | Washington | Washington Berry Juice | 90748583674 | 8.39 | |
| 1/1/1997 | 1472 | 3 | 1 | 1 | 1997 | Wednesday | January | Q1 | Fort West | Fort West Fudge Cookies | 37276054024 | 8.28 | |
| 1/6/1997 | 1472 | 2 | 6 | 1 | 1997 | Monday | January | Q1 | Fort West | Fort West Fudge Cookies | 37276054024 | 8.28 | |
| 1/5/1997 | 2 | 4 | 5 | 1 | 1997 | Sunday | January | Q1 | Washington | Washington Mango Drink | 96516502499 | 7.42 | |
| 1/1/1997 | 76 | 4 | 1 | 1 | 1997 | Wednesday | January | Q1 | Red Spade | Red Spade Sliced Chicken | 62054644227 | 18.1 | |
| 1/1/1997 | 76 | 2 | 1 | 1 | 1997 | Wednesday | January | Q1 | Red Spade | Red Spade Sliced Chicken | 62054644227 | 18.1 | |
| 1/5/1997 | 3 | 2 | 5 | 1 | 1997 | Sunday | January | Q1 | Washington | Washington Strawberry Drink | 58427771925 | 13.1 | |
| 1/7/1997 | 3 | 2 | 7 | 1 | 1997 | Tuesday | January | Q1 | Washington | Washington Strawberry Drink | 58427771925 | 13.1 | |
| 1/1/1997 | 320 | 3 | 1 | 1 | 1997 | Wednesday | January | Q1 | Excellent | Excellent Cranberry Juice | 36570182442 | 16.4 | |

Sure, you can **but it's inefficient!**

- Merging data in this way creates **redundant data** and utilizes **significantly more memory and processing power** than creating relationships between multiple small tables



CREATING TABLE RELATIONSHIPS

Data Model 101

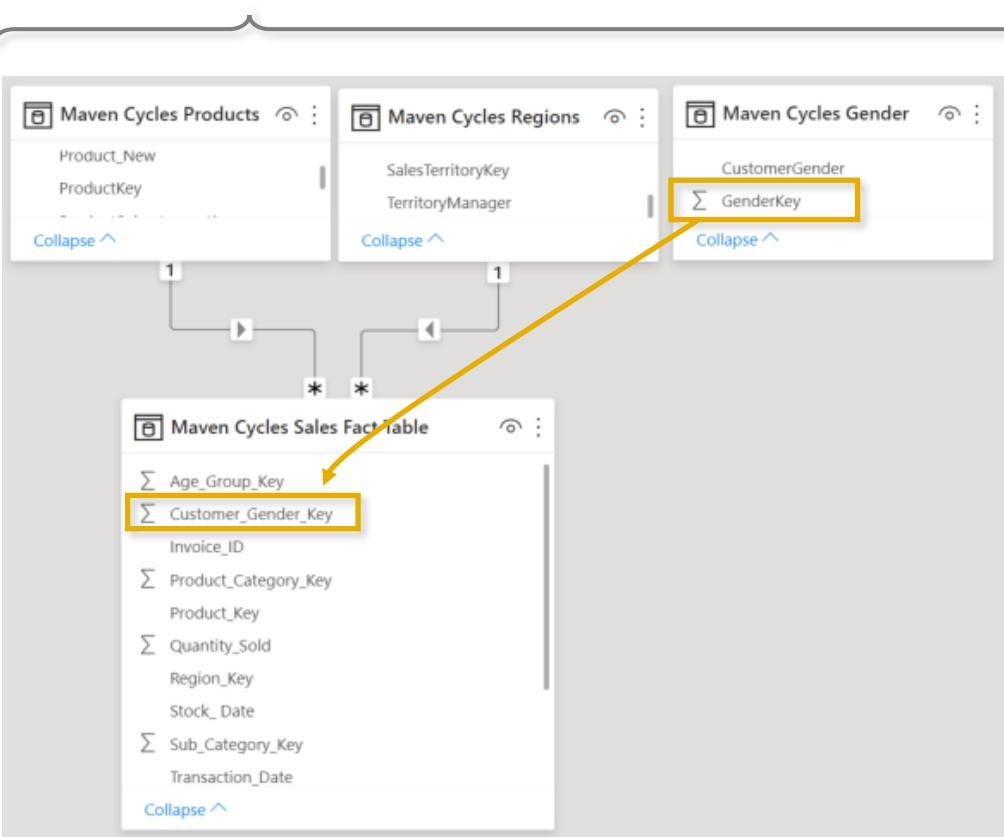
Table Roles

Table Relationships

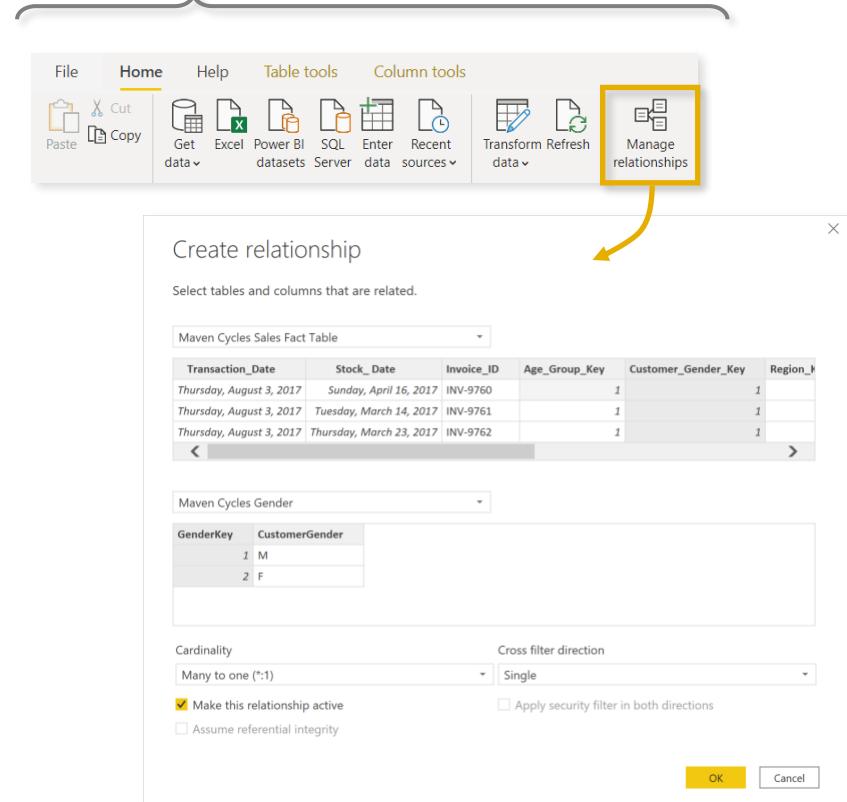
Data Model Types

Date Tables

Optimization Tips



Option 2: Add or detect relationships using the “Manage Relationships” dialog box





RELATIONSHIP CARDINALITY

Data Model 101

Table Roles

Table Relationships

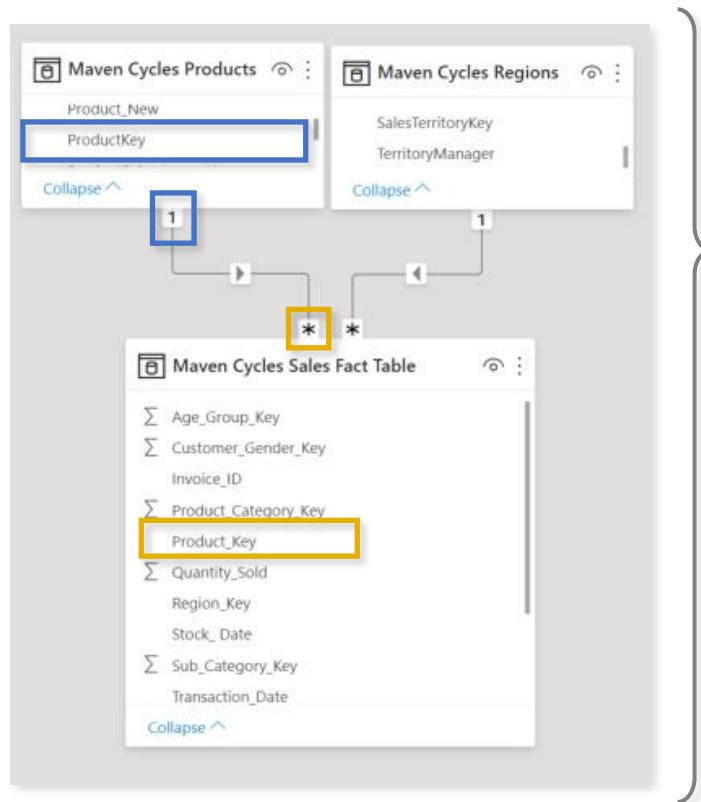
Data Model Types

Date Tables

Optimization Tips

Cardinality refers to the *uniqueness of values* in a column

- As a best practice, all relationships in the data model should follow a “**one-to-many**” cardinality: **one** instance of each *primary key*, but potentially **many** instances of each *foreign key*



In this case, there is only **ONE instance of each Product Key** in the Products table (noted by the “1”), since each row contains **attributes of a single product** (Name, Unit Cost, Unit Price, Price Range, etc.)

There are **MANY instances of each Product Key** in the Sales table (noted by the asterisk *), since there are **multiple sales associated with each product**



FILTER FLOW

Data Model 101

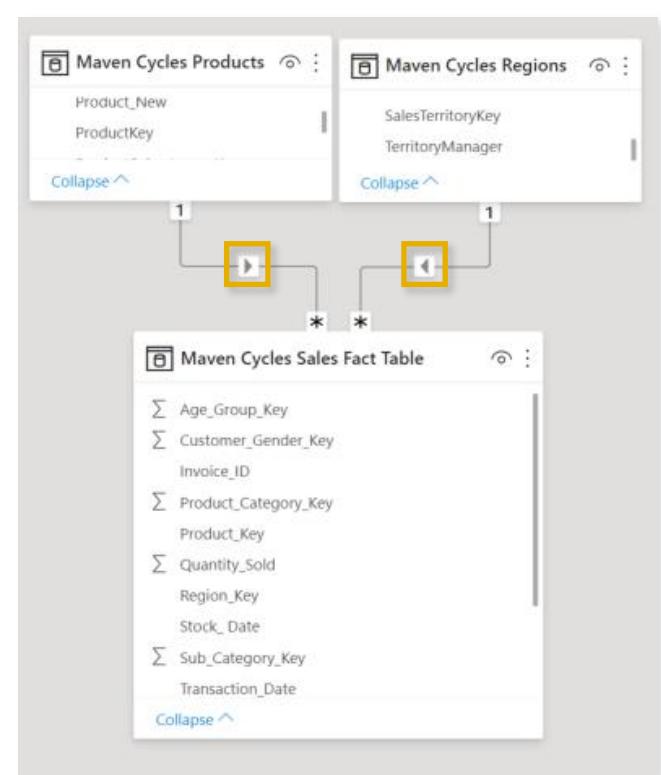
Table Roles

Table Relationships

Data Model Types

Date Tables

Optimization Tips



Here we have a single data table, **Sales**, connected to **Products & Regions** lookups

Note the filter directions (arrows) in each relationship; by default, **these will point from the “one” side of the relationship (lookups) to the “many” side (data)**

- When you filter a table, that filter context is passed along to all related “downstream” tables (following the direction of the arrow)
- Filters **cannot** flow “upstream” (against the direction of the arrow)



PRO TIP: Arrange your lookup tables **above** your data tables in your model as a visual reminder that filters flow “downstream”



ACTIVE & INACTIVE RELATIONSHIPS

Data Model 101

Table Roles

Table Relationships

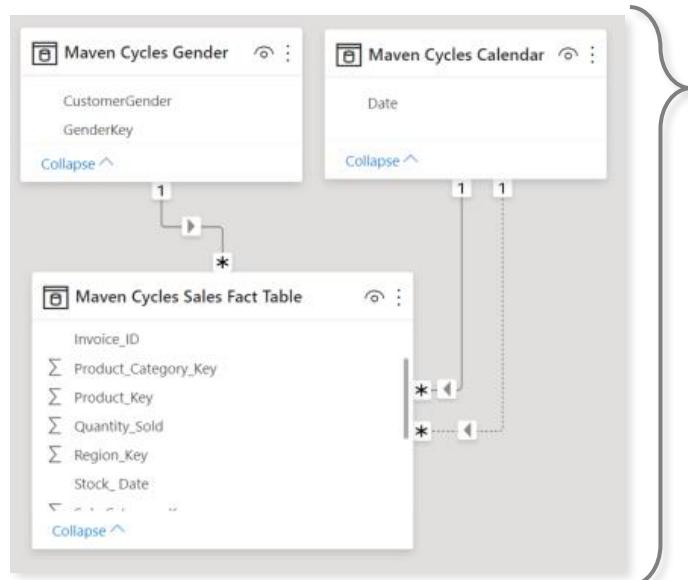
Data Model Types

Date Tables

Optimization Tips

There are two key types of physical table relationships: **Active** & **Inactive**

- **Active** relationships are the primary means of filter propagation in your data model
- **Inactive** relationships filter propagation during a calculation defined using DAX expressions



These are **physical** relationships:

- Visible links between tables (typically 1:/* cardinality)
- Can be **active** or **inactive**
 - **Active** shown with solid line
 - **Inactive** shown by dotted line
- Can be accessed using DAX functions like **RELATED**, **RELATEDTABLE** or **USERELATIONSHIP** (inactive only)
- Best way to connect tables (but not always possible)



CREATING “SNOWFLAKE” SCHEMAS

Data Model 101

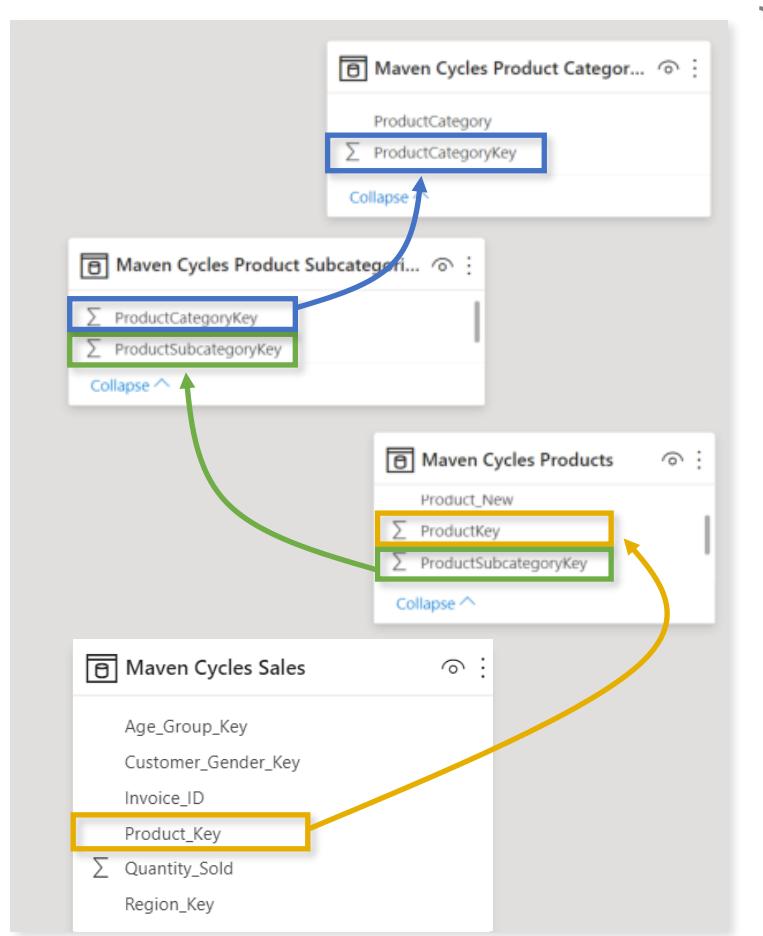
Table Roles

Table Relationships

Data Model Types

Date Tables

Optimization Tips



The **Sales** table can connect to **Products** using the **Product Key** field, but cannot connect directly to the **Subcategories** or **Categories** tables

By creating relationships from **Products** to **Subcategories** (using **ProductSubcategoryKey**) and **Subcategories** to **Categories** (using **ProductCategoryKey**), we have essentially connected **Sales_Data** to each lookup table; filter context will now flow all the way down the chain



PRO TIP: Models with chains of dimension tables are often called “snowflake” schemas (whereas “star” schemas usually have individual lookup tables surrounding a central data table)



AUTOMATIC DATE TABLES

Data Model 101

Table Roles

Table Relationships

Data Model Types

Date Tables

Optimization Tips

By default, Power BI automatically creates a **hidden date table** for any table that contains a **Date** or **DateTime** column on the one-side of a relationship

- Auto-generated calendars include *all* dates through the end of the year, regardless of the actual date range in the table

The screenshot shows the Power BI Data Model interface. On the left, the 'Maven Cycles Sales' table is listed with various columns: Age_Group_Key, Customer_Gender_Key, Invoice_ID, Product_Key, Quantity_Sold, Region_Key, Stock_Date, and Transaction_Date. The 'Transaction_Date' column is highlighted with a yellow box. A large curly brace on the right side of the table indicates that the table is generating a hidden date table. To the right of the main table, a detailed view of the generated date table is shown, containing 12 rows of data from January 1, 2017, to January 12, 2017, along with corresponding Day, MonthNo, Month, QuarterNo, Quarter, and Year values.

| Date | Day | MonthNo | Month | QuarterNo | Quarter | Year |
|--------------------|-----|---------|---------|-----------|---------|------|
| 1/01/2017 00:00:00 | 1 | 1 | January | 1 | Q1 | 2017 |
| 1/02/2017 00:00:00 | 2 | 1 | January | 1 | Q1 | 2017 |
| 1/03/2017 00:00:00 | 3 | 1 | January | 1 | Q1 | 2017 |
| 1/04/2017 00:00:00 | 4 | 1 | January | 1 | Q1 | 2017 |
| 1/05/2017 00:00:00 | 5 | 1 | January | 1 | Q1 | 2017 |
| 1/06/2017 00:00:00 | 6 | 1 | January | 1 | Q1 | 2017 |
| 1/07/2017 00:00:00 | 7 | 1 | January | 1 | Q1 | 2017 |
| 1/08/2017 00:00:00 | 8 | 1 | January | 1 | Q1 | 2017 |
| 1/09/2017 00:00:00 | 9 | 1 | January | 1 | Q1 | 2017 |
| 1/10/2017 00:00:00 | 10 | 1 | January | 1 | Q1 | 2017 |
| 1/11/2017 00:00:00 | 11 | 1 | January | 1 | Q1 | 2017 |
| 1/12/2017 00:00:00 | 12 | 1 | January | 1 | Q1 | 2017 |

Automatically creates a **hidden date table** containing all these columns



PROS & CONS: AUTOMATIC DATE TABLES



PROS:

- Automatically generated
- Enables (some) time intelligence functionality by default
- Simplifies data model creation and management
- Does not require an advanced understanding of DAX



CONS:

- Hidden from view, cannot be modified/customized
- Generated for every date field across every lookup/dimension table (**bloats model size**)
- Can't be enabled or disabled at the table-level
- Hierarchies aren't automatically generated (*if grouped by month, would summarize that month across ALL years*)
- Each automatic date table can *only* filter the table it corresponds to (*cannot traverse table relationships*)



PRO TIP: Turn OFF the **auto date/time** feature in Power BI Desktop and either import a date dimension table or create your own using **CALENDAR** functions

Data Model 101

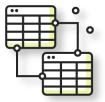
Table Roles

Table Relationships

Data Model Types

Date Tables

Optimization Tips



DATE TABLE REQUIREMENTS

Data Model 101

Table Roles

Table Relationships

Data Model Types

Date Tables

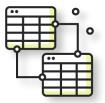
Optimization Tips

If you import or create your own date table, **it must meet these requirements:**

- ✓ Must contain *all* the days for all years represented in your fact tables
- ✓ Must have at least one field set as a **Date** or **DateTime** datatype
- ✓ Cannot contain duplicate dates or datetime values
- ✓ If using a time component within a date column, all times must be identical (*i.e.* 12:00)
- ✓ Should be marked as a **date table** (*not required but a best practice*)

HEY THIS IS IMPORTANT!

If **Time** is present in your date field, split the time component into a new column
(this adheres to relationship requirements and decreases column cardinality)



MODEL OPTIMIZATION TIPS

Data Model 101

Table Roles

Table Relationships

Data Model Types

Date Tables

Optimization Tips

Normalization is the process of organizing the tables and columns in a relational database to reduce redundancy and preserve data integrity

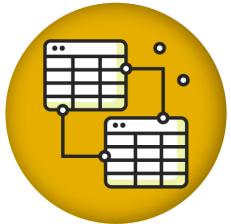
It's commonly used to:

- Eliminate redundant data to decrease table sizes and improve processing speed & efficiency
- Minimize errors and anomalies from data modifications (inserting, updating or deleting records)
- Simplify queries and structure the database for meaningful analysis
- Identify poorly performing measures and relationships
- Create 1:* relationships
- Separate Time component form a DateTime filed
- Aggregate data



PRO TIP: In a normalized database, each table should serve a **distinct** and **specific** purpose (*i.e. product information, dates, transaction records, customer attributes, etc.*)

DAX CALCULATIONS



In this section we'll cover **Data Analysis Expressions**, or **DAX**, which is the formula language that drives front-end calculated tables, columns, and measures in Power BI

TOPICS WE'LL COVER:

Calculated Columns
& Measures

Aggregation
Functions

CALCULATE

CALCULATE
Modifiers

Table Functions

Time Intelligence

COMMON QUESTIONS:

- *You need to create a calculated table that returns the top 50 revenue generating products. How should you complete the following DAX calculation?*
- *How would you complete the following DAX calculated table expression, so it returns a table of the top 25 customers based on Total Revenue?*
- *How would you set up a quick measure to create a monthly rolling average for Transactions?*



MEET DAX

Data Analysis Expressions, known as **DAX**, is the formula language that drives Power BI

Calculated Columns & Measures

Aggregation Functions

CALCULATE

CALCULATE Modifiers

Table Functions

Time Intelligence

With DAX, you can:

- Add **calculated columns** and **measures** to your model, using intuitive syntax
- Go beyond the capabilities of traditional “grid-style” formulas, with powerful and flexible functions built specifically to work with tabular data models

Two ways to use DAX

1) Calculated Columns

The screenshot shows the Power BI Data View interface. A new column is being created with the following DAX formula:

```
1 Week Number =  
2 WEEKNUM(  
3     'Maven Cycles Calendar'[Date],  
4     2  
5 )
```

The resulting table includes the original 'Date' column and the newly added 'Week Number' column, which contains values 1 through 5 corresponding to the dates from January 1 to January 5.

2) Measures

The screenshot shows the Power BI Power Query ribbon with the 'New measure' option selected. A new measure is being defined with the following DAX formula:

```
1 Total Orders =  
2 DISTINCTCOUNT(  
3     'Maven Cycles Sales Fact Table'[Invoice_ID]  
4 )
```

Below it, another measure is being defined with the following DAX formula:

```
1 Quantity Sold =  
2 SUM(  
3     'Maven Cycles Sales Fact Table'[Quantity_Sold]  
4 )
```



CALCULATED COLUMNS

Calculated columns allow you to add new, formula-based columns to tables

Calculated Columns & Measures

Aggregation Functions

CALCULATE

CALCULATE Modifiers

Table Functions

Time Intelligence

- They refer to **entire tables** or **columns** (*no “A1-style” references*)
- They generate values for each row, which are **visible within tables in the Data view**
- They understand **row context**; they’re great for defining properties based on information in each row, but generally useless for aggregation (*SUM, COUNT, etc.*)
- They **increase the size** of your data model!



HEY THIS IS IMPORTANT!

As a rule of thumb, use calculated columns when you want to “stamp” static, fixed values to each row in a table (*or use the Query Editor!*)

DO NOT use calculated columns for aggregation formulas, or to calculate fields for the “Values” area of a visualization (*use measures instead*)



PRO TIP: Creating calculated columns as close to the source as possible helps reduce data model size and improve performance



MEASURES

Measures are DAX formulas used to generate new calculated values

Calculated Columns & Measures

Aggregation Functions

CALCULATE

CALCULATE Modifiers

Table Functions

Time Intelligence

- Like calculated columns, measures reference **entire tables** or **columns** (*no A1-style or “grid” references*)
- *Unlike* calculated columns, **measure** values aren’t visible within tables; they can only be “seen” within a visualization like a chart or matrix (*similar to a calculated field in an Excel pivot*)
- Measures are evaluated based on **filter context**, which means they recalculate when the fields or filters around them change (*like when new row or column labels are pulled into a matrix or when new filters are applied to a report*)

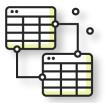


PRO TIP: Use measures to create numerical, calculated values that can be analyzed in the “values” field of a report visual



HEY THIS IS IMPORTANT!

As a rule of thumb, use measures (*vs. calculated columns*) when a single row can’t give you the answer (*in other words, when you need to aggregate*)



RECAP: CALCULATED COLUMNS VS. MEASURES

Calculated Columns & Measures

Aggregation Functions

CALCULATE

CALCULATE Modifiers

Table Functions

Time Intelligence

CALCULATED COLUMNS

- Values are calculated based on information from each row of a table (**has row context**)
- Appends static values to each row in a table and stores them in the model (*which increases file size*)
- Recalculate on data source refresh or when changes are made to component columns
- Primarily used as **rows, columns, slicers or filters**

```

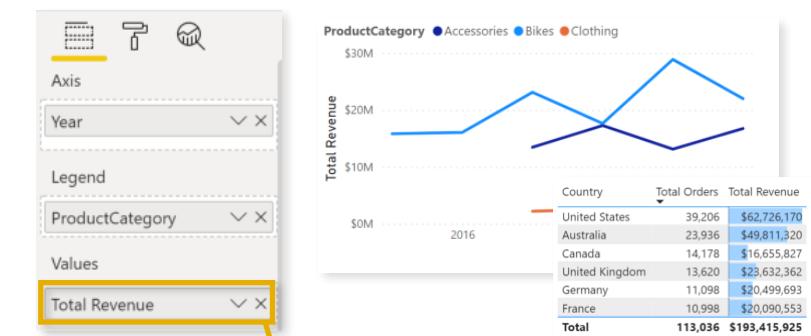
1 Week Number =
2 WEEKNUM(
3     'Maven Cycles Calendar'[Date],
4     2
5 )
  
```

| Date | Year | Quarter | Month | Week Number | Day of Week | Month Name |
|----------------------------|------|---------|-------|-------------|-------------|------------|
| Thursday, January 1, 2015 | 2015 | 1 | 1 | 1 | 4 | Jan |
| Friday, January 2, 2015 | 2015 | 1 | 1 | 1 | 5 | Jan |
| Saturday, January 3, 2015 | 2015 | 1 | 1 | 1 | 6 | Jan |
| Sunday, January 4, 2015 | 2015 | 1 | 1 | 1 | 7 | Jan |
| Monday, January 5, 2015 | 2015 | 1 | 1 | 2 | 1 | Jan |
| Tuesday, January 6, 2015 | 2015 | 1 | 1 | 2 | 2 | Jan |
| Wednesday, January 7, 2015 | 2015 | 1 | 1 | 2 | 3 | Jan |
| Thursday, January 8, 2015 | 2015 | 1 | 1 | 2 | 4 | Jan |
| Friday, January 9, 2015 | 2015 | 1 | 1 | 2 | 5 | Jan |
| Saturday, January 10, 2015 | 2015 | 1 | 1 | 2 | 6 | Jan |

Calculated columns “live” in **tables**

MEASURES

- Values are calculated based on information from any filters in the report (**has filter context**)
- Does not create new data in the tables themselves (*doesn't increase file size*)
- Recalculate in response to any change to filters within the report
- Almost *always* used within the **values** field of a visual



Measures “live” in **visuals**



QUICK MEASURES

Quick measures are pre-built formula templates that allow you to drag and drop fields rather than write DAX from scratch

- They are helpful for defining complex measures (*like weighted averages or time intelligence formulas*)

Calculated Columns & Measures

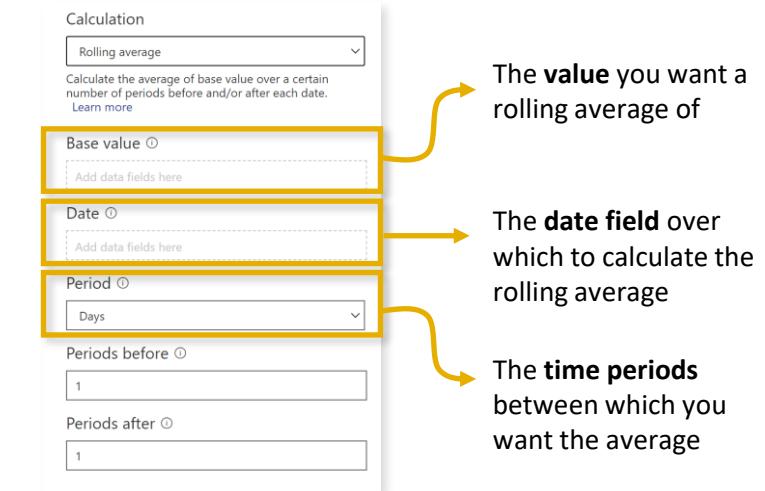
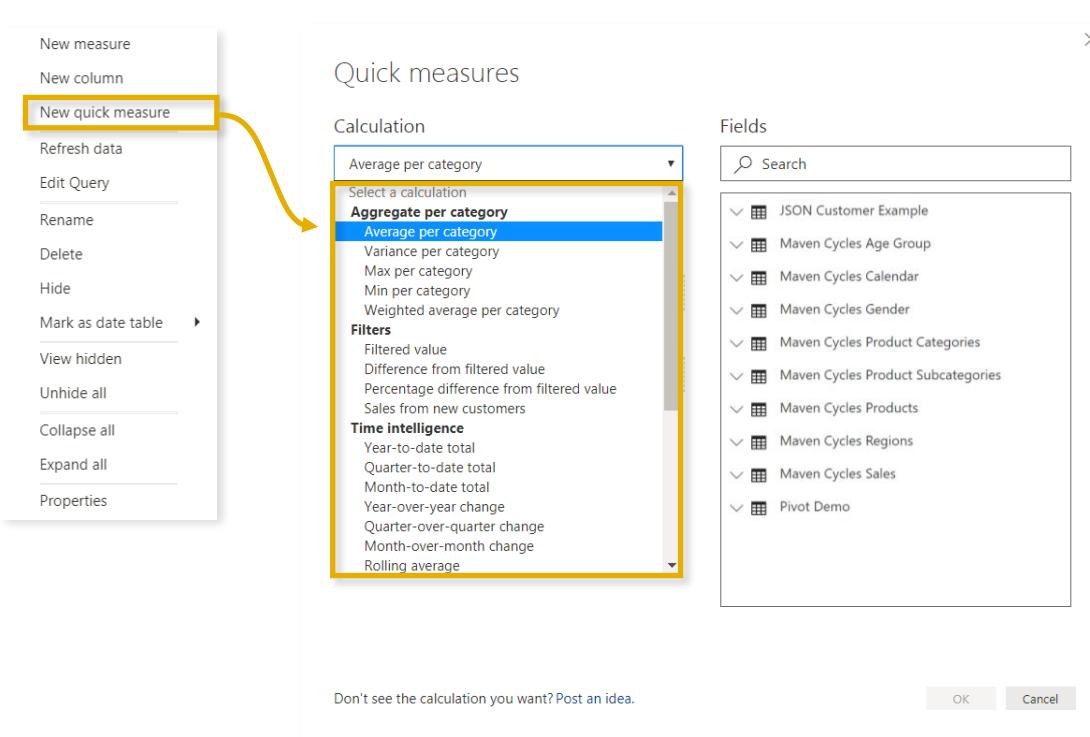
Aggregation Functions

CALCULATE

CALCULATE Modifiers

Table Functions

Time Intelligence





COMMON DAX FUNCTION CATEGORIES

Calculated Columns & Measures

Aggregation Functions

CALCULATE

CALCULATE Modifiers

Table Functions

Time Intelligence

MATH & STATS Functions

*Basic aggregation functions as well as “**iterators**” evaluated at the row-level*

Common Examples:

- SUM
- AVERAGE
- MAX/MIN
- DIVIDE
- COUNT/COUNTA
- COUNTROWS
- DISTINCTCOUNT

Iterator Functions:

- SUMX
- AVERAGEX
- MAXX/MINX
- RANKX
- COUNTX

LOGICAL Functions

Functions that return information about values based on a given conditional expression

Common Examples:

- IF
- IFERROR
- AND
- OR
- NOT
- SWITCH
- TRUE
- FALSE

TEXT Functions

*Functions to manipulate **text strings** or **control formats** for dates, times or numbers*

Common Examples:

- CONCATENATE
- FORMAT
- LEFT/MID/RIGHT
- UPPER/LOWER
- PROPER
- LEN
- SEARCH/FIND
- REPLACE
- REPT
- SUBSTITUTE
- TRIM
- UNICHAR

FILTER Functions

Lookup functions based on related tables and filtering functions for dynamic calculations

Common Examples:

- CALCULATE
- FILTER
- ALL
- ALLEXCEPT
- RELATED
- RELATEDTABLE
- DISTINCT
- VALUES
- EARLIER/EARLIEST
- HASONEVALUE
- HASONEFILTER
- ISFILTERED
- USERELATIONSHIP
- TOPN

DATE & TIME Functions

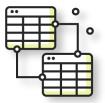
*Basic **date & time** functions as well as advanced **time intelligence** operations*

Common Examples:

- DATEDIFF
- YEARFRAC
- YEAR/MONTH/DAY
- HOUR/MINUTE/SECOND
- TODAY/NOW
- WEEKDAY/WEEKNUM

Time Intelligence Functions:

- DATESYTD
- DATESQTD
- DATESMTD
- DATEADD
- DATESINPERIOD



BASIC AGGREGATION FUNCTIONS

Calculated Columns & Measures

Aggregation Functions

CALCULATE

CALCULATE
Modifiers

Table Functions

Time Intelligence

SUM()

Evaluates the sum of a column

=SUM(Column**Name**)

AVERAGE()

Returns the average (arithmetic mean) of all the numbers in a column

=AVERAGE(Column**Name**)

MAX()

Returns the largest value in a column or between two scalar expressions

=MAX(Column**Name**) or =MAX(Scalar1, [Scalar2])

MIN()

Returns the smallest value in a column or between two scalar expressions

=MIN(Column**Name**) or =MIN(Scalar1, [Scalar2])

DIVIDE()

Performs division and returns the alternate result (or blank) if div/0

=DIVIDE(Numerator, Denominator, [AlternateResult])



DAX SYNTAX

Calculated Columns & Measures

Aggregation Functions

CALCULATE

CALCULATE Modifiers

Table Functions

Time Intelligence

MEASURE NAME

Measures are always surrounded in brackets (i.e. [Total Quantity]) when referenced in formulas, so spaces are OK

Total Quantity: =SUM(Transactions[quantity])

FUNCTION NAME

Calculated columns don't always use functions, but measures do:

- In a Calculated Column, =Transactions[quantity] returns the value from the quantity column in each row (since it evaluates one row at a time)
- In a Measure, =Transactions[quantity] will return an error since Power BI doesn't know how to translate that as a single value (you need some sort of aggregation)

Referenced
TABLE NAME

Referenced
COLUMN NAME

Note: This is a "fully qualified" column, since it's preceded by the table name -- table names with spaces must be surrounded by single quotes:

- Without a space: Transactions[quantity]
- With a space: 'Transactions Table'[quantity]



PRO TIP: For column references, use the fully qualified name (i.e. Table[Column]); for measure references, just use the measure name (i.e. [Measure])



ITERATOR (“X”) FUNCTIONS

Iterator (or “X”) functions allow you to loop through the same calculation on *each row of a table*, and then apply some sort of aggregation to the results (*SUM, MAX, etc.*)

Calculated Columns & Measures

Aggregation Functions

CALCULATE

CALCULATE
Modifiers

Table Functions

Time Intelligence

=SUMX(Table, Expression)

Aggregation to apply to calculated rows*

Table in which the expression will be evaluated

Expression to be evaluated for each row of the given table

Examples:

- SUMX
- COUNTX
- AVERAGEX
- RANKX
- MAXX/MINX

Examples:

- ‘Sales’
- FILTER(‘Sales’, RELATED(‘Products’[Category])=“Clothing”)

Examples:

- [Total Orders]
- Sales[RetailPrice] * Sales[Quantity]



PRO TIP: Imagine the function adding a temporary new column to the table, calculating the value in each row (based on the expression) and then applying the aggregation to that new column



DIVIDE

DIVIDE()

Safe Divide function with ability to handle divide by zero cases

Calculated Columns & Measures

Aggregation Functions

CALCULATE

CALCULATE
Modifiers

Table Functions

Time Intelligence

=DIVIDE(Numerator, Denominator, [AlternateResult])

Numerator of the equation

Examples:

- 4, 7, 10, etc.
- [Total Returns]
- [Sales Amount]

Denominator of the equation

Examples:

- 2, 3, 8, etc.
- [All Returns]
- CALCULATE([Sales Amount],
ALLSELECTED(
'Products'[Category]))

Optional parameter to specify a result in case of divide by zero

Examples:

- “-”
- “N/A”
- 0



CALCULATE

CALCULATE()

Evaluates a given expression or formula under a set of defined filters

Calculated Columns & Measures

Aggregation Functions

CALCULATE

CALCULATE
Modifiers

Table Functions

Time Intelligence

=CALCULATE(Expression, [Filter1], [Filter2],...)

Name of an existing measure, or a DAX formula for a valid measure

Examples:

- [Total Orders]
- SUM(Returns[ReturnQuantity])

List of simple Boolean (True/False) filter expressions
(Note: these require simple, fixed values; you cannot create filters based on other measures)

Examples:

- Territory_Lookup[Country] = "USA"
- Calendar[Year] > 1998



PRO TIP: CALCULATE works just like SUMIF or COUNTIF in Excel, except it can evaluate measures based on ANY sort of calculation (not just sum, count, etc.); it may help to think of it like “CALCULATEIF”



CALCULATE (EXAMPLE)

We've defined a new measure named “**Australian Orders**”, which evaluates the “**Total Orders**” measure when the *Country* in the **Regions** table equals “**Australia**”

```
1 Australian Orders = CALCULATE([Total Orders], 'Maven Cycles Regions'[Country] = "Australia")
```

| Country | Total Orders | Australian Orders |
|----------------|----------------|-------------------|
| United States | 39,206 | 23,936 |
| Australia | 23,936 | 23,936 |
| Canada | 14,178 | 23,936 |
| United Kingdom | 13,620 | 23,936 |
| Germany | 11,098 | 23,936 |
| France | 10,998 | 23,936 |
| Total | 113,036 | 23,936 |

Wait, why do we see **repeating values** when we view a matrix with different countries on rows?

Shouldn't these cells have different filter contexts for **Canada**, **Germany**, **France**, etc.?



HEY THIS IS IMPORTANT!

CALCULATE **modifies** and **overrules** any competing filter context!

In this example, the “France” row has filter context of Country = “**France**” (*defined by the row label*) **and** Country= “**Australia**” (*defined by the CALCULATE function*)

Both can't be true at the same time, “**France**” filter is overwritten, and the “**Australia**” filter (from CALCULATE) takes priority



CALCULATE CREATES NEW FILTER CONTEXT

Calculated Columns & Measures

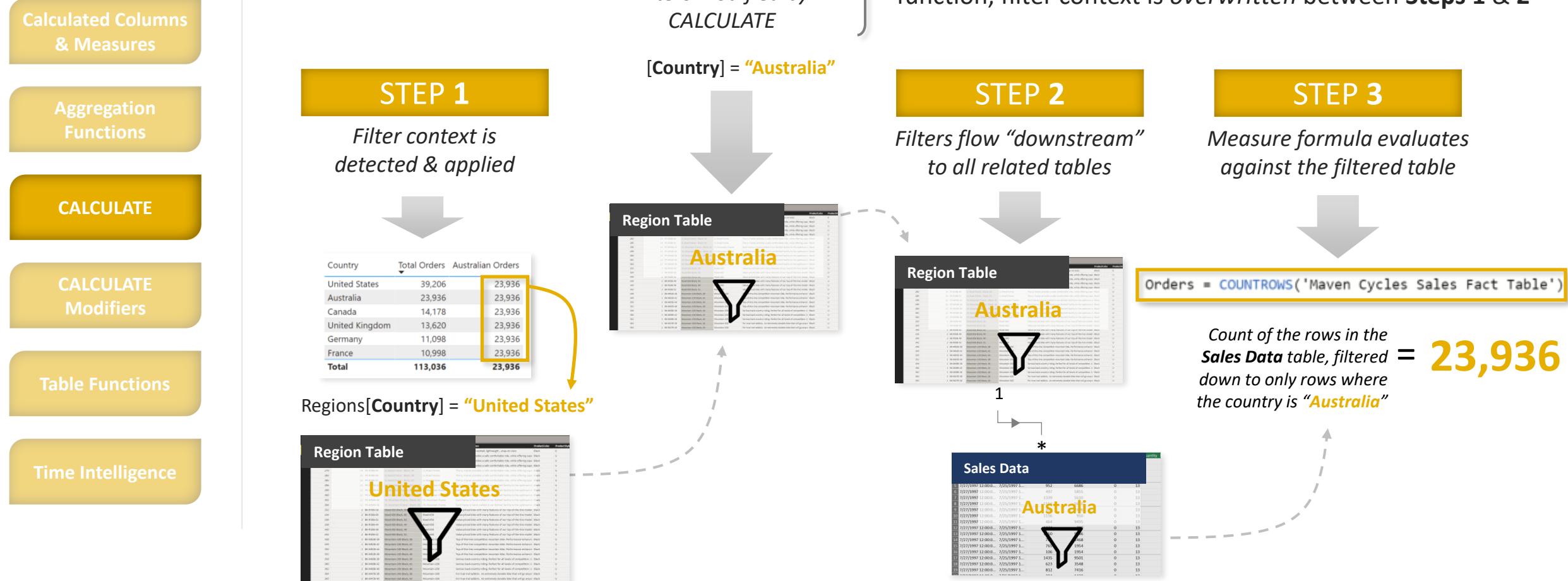
Aggregation Functions

CALCULATE

CALCULATE Modifiers

Table Functions

Time Intelligence





COMMON CALCULATE MODIFIERS

Modifiers are used to alter the way CALCULATE creates filter context, and are added as *filter* arguments within a CALCULATE function

- Modifiers are typically used to change filter context, access inactive table relationships, or change the way filters propagate (*i.e. one-way to bidirectional*)

Modify Filters

Common Examples:

- ALL
- ALLSELECTED
- ALLNOBLANKROW
- ALLEXCEPT
- KEEPFILTERS
- REMOVEFILTERS

Use Relationships

Common Examples:

- USERELATIONSHIP

Change Filter Propagation

Common Examples:

- CROSSFILTER

Calculated Columns & Measures

Aggregation Functions

CALCULATE

CALCULATE
Modifiers

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Time Intelligence



CALCULATE MODIFIERS

=CALCULATE(Expression, [Filter1], [Filter2],...)

Calculated Columns & Measures

Aggregation Functions

CALCULATE

CALCULATE
Modifiers

Table Functions

Time Intelligence

CALCULATE filter expressions accept both Boolean & table functions (individually or at the same time!), but all filter arguments are automatically converted into a table

```
1 Store 3 Sales =  
2 CALCULATE(  
3   [Customer Sales],  
4   'Store Lookup'[store_id] = 3  
5 )
```

DAX interprets this as a table!

- Any time you use write a function that contains a logical statement (IN, >, <, =, etc.) you're **creating a table** (*internally processed with FILTER & ALL*)

```
1 All Store Sales =  
2 CALCULATE(  
3   [Customer Sales],  
4   ALL(  
5     'Store Lookup'  
6   )  
7 )
```

Filter arguments can be table functions too

- In this case we're using the ALL table function to remove all filters from the 'Store Lookup' table



USERELATIONSHIP

USERELATIONSHIP()

Specifies an existing relationship to be used in the evaluation of a DAX expression, defined by naming, as arguments, the two columns that serve as endpoints

Calculated Columns & Measures

Aggregation Functions

CALCULATE

CALCULATE Modifiers

Table Functions

Time Intelligence

=USERELATIONSHIP(Column**Name1**, Column**Name2**)

Foreign (or primary) key of the relationship

Examples:

- Food Inventory[Baked_Date]
- Calendar[Transaction Date]

Primary (or foreign) key of the relationship

Examples:

- Calendar[Transaction Date]
- Food Inventory[Baked_Date]



HEY THIS IS IMPORTANT!

USERELATIONSHIPS can only be used in functions which accept a filter parameter (**CALCULATE**, **TOTALYTD**, etc.)



PRO TIP: If you have *multiple date columns* connected to a single calendar table, **USERELATIONSHIP** is a great way to force measures to use *inactive relationships* without having to manually activate them in your model



ALL

ALL()

Returns all rows in a table, or all values in a column, ignoring any filters that have been applied

Calculated Columns & Measures

Aggregation Functions

CALCULATE

CALCULATE Modifiers

Table Functions

Time Intelligence

=ALL(Table or ColumnName, [ColumnName1], [ColumnName2],...)

The table or column that you want to clear filters on

Examples:

- 'Sales'
- 'Products'[ProductName]

List of columns that you want to clear filters on (optional)

Notes:

- If your first parameter is a table, you can't specify additional columns
- All columns must include the table name, and come from the same table

Examples:

- 'Products'[Product Type]
- 'Products'[Product Size]



PRO TIP: Instead of adding filter context, ALL removes it; use it when you need unfiltered values that won't react to changes in filter context (i.e. % of Total, where the denominator needs to remain fixed)



FILTER

FILTER()

Returns a table that represents a subset of another table or expression

Calculated Columns & Measures

Aggregation Functions

CALCULATE

CALCULATE Modifiers

Table Functions

Time Intelligence

=FILTER(Table, FilterExpression)

Table to be filtered

Examples:

- Gender Lookup
- Customer Lookup

A Boolean (True/False) filter expression to be evaluated for each row of the table

Examples:

- Calendar[Year] = 2020
- Products[Price] > [Avg Price]



HEY THIS IS IMPORTANT!

FILTER is used to add new filter context, and can handle **more complex filter expressions** than CALCULATE (by referencing measures, for example)

Since FILTER returns an entire table, it's almost always used as an *input* to other functions, like CALCULATE or SUMX



PRO TIP: Since FILTER iterates through each row in a table, it can be slow and processor-intensive; don't use FILTER if a CALCULATE function will accomplish the same thing



TOPN

TOPN()

Returns a given number of top rows according to a specified expression

Calculated Columns & Measures

Aggregation Functions

CALCULATE

CALCULATE Modifiers

Table Functions

Time Intelligence

=TOPN(N_Value, TableName, [OrderBy Expression], [Order])

The number of rows to return

Name of a table or table expression that you want to return rows from

Optional expression that's used to sort the table

Optional expression that defines the sort order

Examples:

- 100
- 50
- 10
- 5

Examples:

- 'Maven Cycles Sales'
- ALL('Maven Cycles Sales')
- SUMMARIZE('Sales', 'Sales'[Customer_ID], "Sales", SUM('Sales by Store'[Sales]))

Examples:

- 'Sales'

Examples:

- DESC
- ASC



PRO TIP: TOPN is a great technique to use when you want to show the top “X” number in visuals and not add a visual-level Top N filter



TIME INTELLIGENCE FORMULAS

Time Intelligence functions allow you to easily calculate common time comparisons:

Calculated Columns & Measures

Aggregation Functions

CALCULATE

CALCULATE Modifiers

Table Functions

Time Intelligence

Performance To-Date

=CALCULATE([Measure], DATESYTD(Calendar[Date]))

Use DATESQTD for Quarters or DATESMTD for Months

Previous Period

=CALCULATE([Measure], DATEADD(Calendar[Date], -1, MONTH))

{ }

Select an interval (DAY, MONTH, QUARTER, or YEAR) and the # of intervals to compare (i.e. previous month, rolling 10-day)

Running Total

=CALCULATE([Measure],
DATESINPERIOD(Calendar[Date], MAX(Calendar[Date]), -10, DAY))



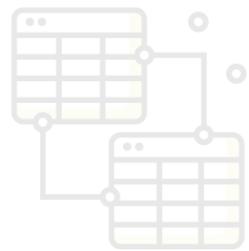
PRO TIP: Use DATESBETWEEN to return dates between two given dates

VISUALIZING THE DATA



Prepare the Data

- Get data from different sources
- Clean, transform, and load data



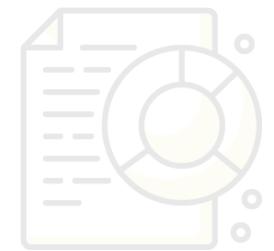
Model the Data

- Design a data model
- Develop a data model
- Create model calculations with DAX
- Optimize model performance



Visualize & Analyze the Data

- Create reports
- Create dashboards
- Enrich reports for usability
- Enhance reports for usability & storytelling
- Identify patterns & trends



Deploy & Maintain Assets

- Manage files & datasets
- Manage workspaces

CREATING REPORTS & DASHBOARDS



In this section we'll cover **creating reports & dashboards**, including adding & formatting visuals, interacting with reports, and publishing to Power BI Service

TOPICS WE'LL COVER:

Inserting Visuals

Formatting Visuals

Report Navigation

Tooltips

Custom Visuals

R & Python Visuals

Accessibility

Dashboards

COMMON QUESTIONS:

- *How would you adjust visual interactions so a segment selection on one chart shows the portion of sales on the other chart?*
- *What feature allows you to see additional detail about a data point when you hover?*
- *You need to build a report that is optimized for viewing on the Power BI mobile app. What steps are needed to build a mobile report?*



THE POWER BI REPORT VIEW

Inserting Visuals

Formatting Visuals

Report Navigation

Tooltips

Custom Visuals

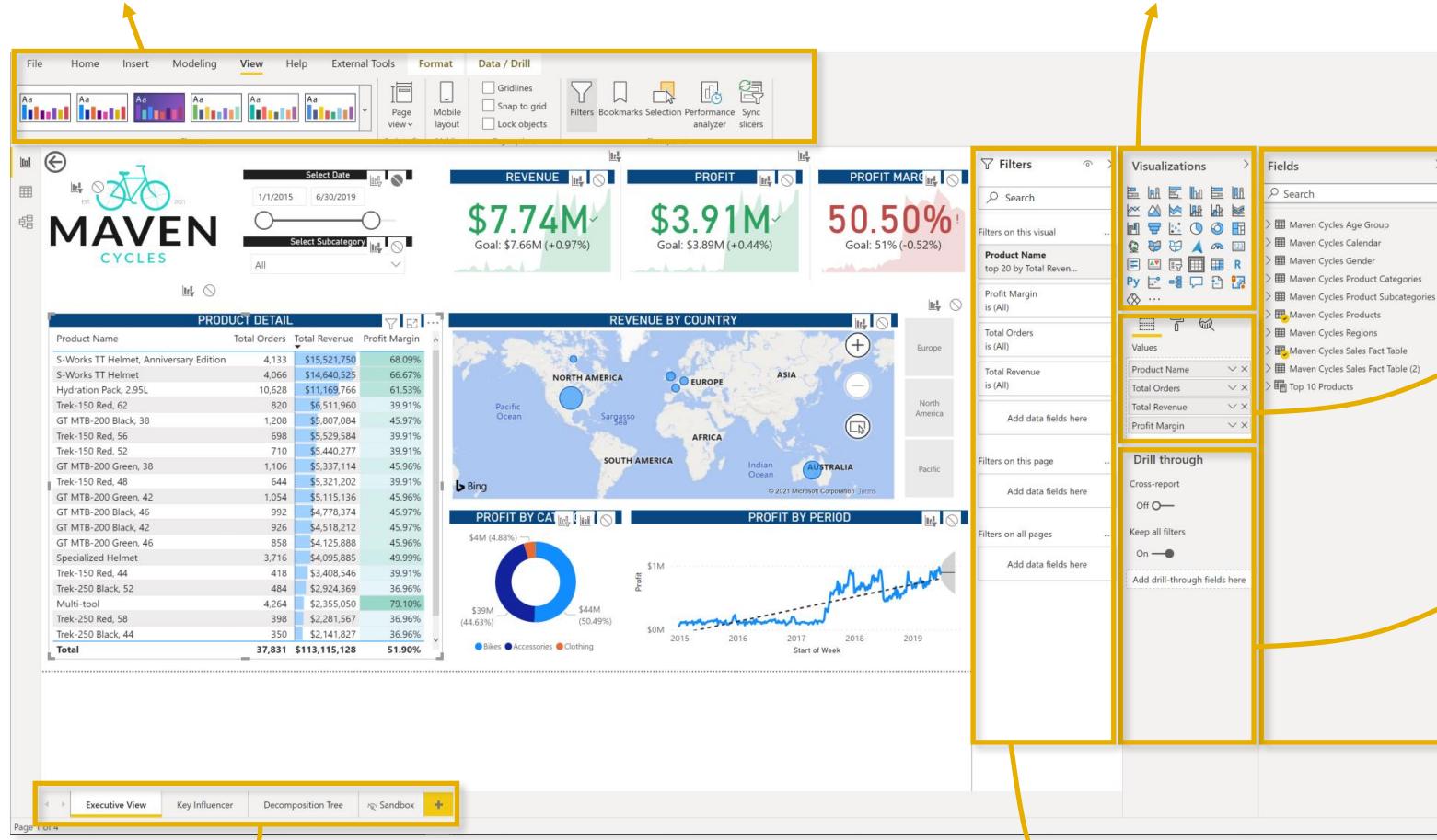
R & Python Visuals

Accessibility

Dashboards

VIEW OPTIONS

Themes, Layouts, Gridlines, Filter/Bookmarks/Selection Panes, etc.



VISUALIZATION OPTIONS

Charts, Slicers, Maps, Matrices, etc.

FIELD LIST

Tables, Columns, Measures

FIELDS/FORMAT/ANALYICTS PANE

Visual-specific configuration & formatting tools

DRILL THROUGH FILTERS

Options for page-level drill through filters

REPORT PAGES

Similar to Excel tabs; each is a blank reporting canvas

FILTERS PANE

Visual-Level, Page-Level, and Report-Level Filters

INSERTING OBJECTS & BASIC CHARTS



Inserting Visuals

Formatting Visuals

Report Navigation

Tooltips

Custom Visuals

R & Python
Visuals

Accessibility

Dashboards

The screenshot shows the Power BI interface. On the left, the 'Visualizations' ribbon is selected, displaying various chart icons. Below it, the 'Fields' pane lists data fields categorized under 'Maven Cycles Sales'. A yellow arrow points from the 'Quantity Sold' field in the list to a bar chart on the right. Another yellow arrow points from the 'Fields' pane to a second bar chart below it.

Visualizations >

Fields

Search

Maven Cycles Regions

Maven Cycles Sales

- % of Profit
- Age_Group_Key
- ALL Profit
- Australian Orders
- Customer_Gender_Key
- Invoice_ID
- Last Month Profit
- Last Month Profit Margin
- Last Month Revenue
- Mid Price Range Revenue
- Product_Key
- Profit
- Profit Margin
- Quantity Sold
- Quantity Sold (Stock Date)
- \sum Quantity_Sold
- Quantity Sold YTD

Add data fields here

Drill through

Cross-report

Off

Keep all filters

On

Add drill-through fields here

Total Violations
1.0M
0.5M
0.0M

Select a **visualization type** to create a blank chart template on the canvas

(or)

Drag **fields** into the report canvas to automatically generate a new visual (*typically a column chart, by default*)



FORMATTING OPTIONS

Inserting Visuals

Formatting Visuals

Report Navigation

Tooltips

Custom Visuals

R & Python Visuals

Accessibility

Dashboards

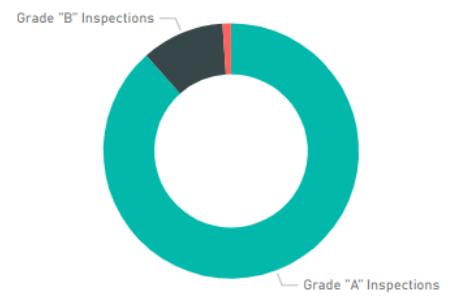
Example: **Line & Column Chart**



Example: **Matrix**

| facility_region | Number of Inspections | Number of Violations |
|---------------------|-----------------------|----------------------|
| Los Angeles | 13,758 | 271,118 |
| San Gabriel Valley | 7,436 | 141,426 |
| San Fernando Valley | 7,010 | 137,167 |
| Southeast | 5,200 | 92,571 |
| South Bay | 4,137 | 81,763 |
| Westside | 2,319 | 38,339 |
| Harbor | 1,629 | 32,688 |
| Verdugos | 1,533 | 34,471 |
| Antelope Valley | 1,270 | 20,017 |
| Northwest County | 1,015 | 11,401 |
| Pomona Valley | 1,000 | 17,090 |

Example: **Donut Chart**



Search

X axis On

Y axis On

Zoom slider Off

Data colors

Data labels Off

Shapes

Plot area

Title On

X axis

Type Continuous

Scale type Linear

Start Auto

End Auto

Color

Text size 8 pt

Font family

Search

General

Style

Column headers

Row headers

Values

Subtotals

Grand total

Field formatting

Conditional formatting

Number of Inspections

Background color Off

Font color Off

Data bars On

Icons Off

Advanced controls

Search

General

Legend Off

Data colors

Grade "A" Inspections

Grade "B" Inspections

Grade "C" Inspections

Detail labels On

Shapes

Title On

Background Off

Lock aspect Off

Border Off

Shadow Off

Detail labels

Label style Category

Color

Display units Auto

Text size 9 pt

Font family DIN



PRO TIP: CONFIGURE SMALL MULTIPLES

Inserting Visuals

Formatting Visuals

Report Navigation

Tooltips

Custom Visuals

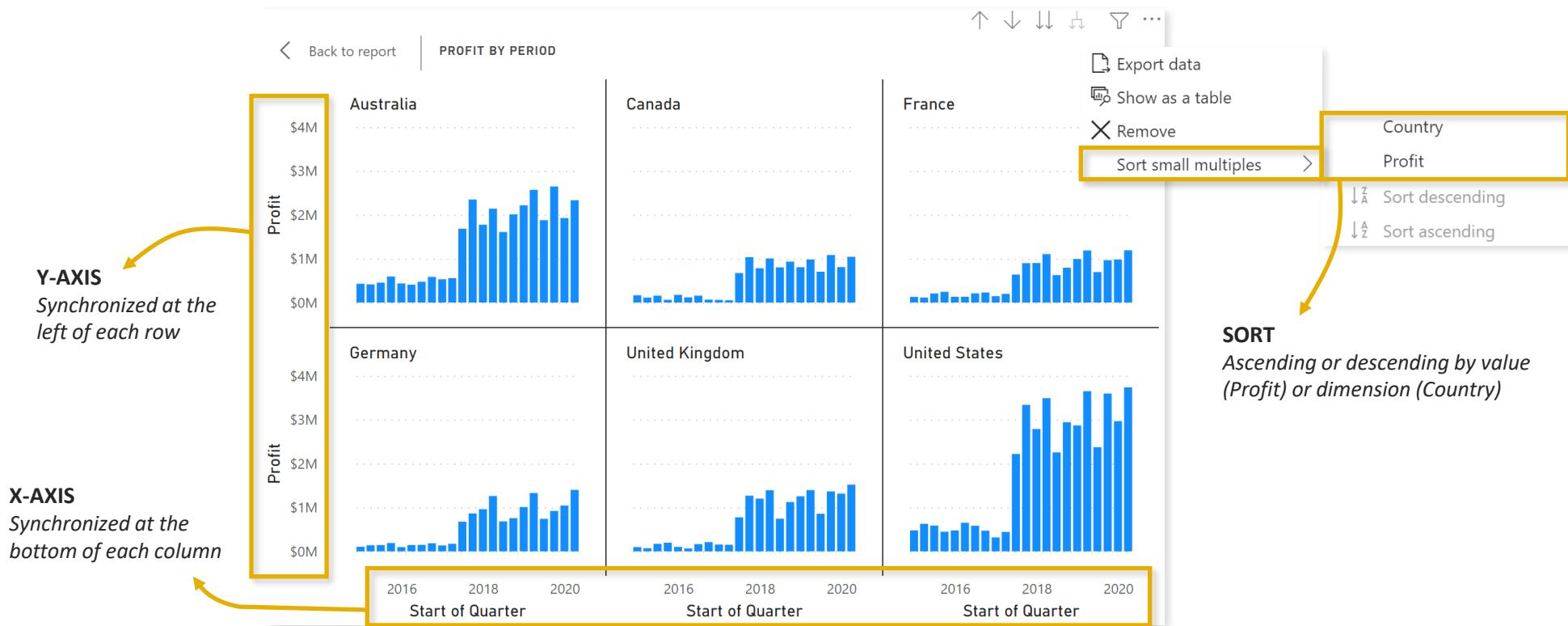
R & Python Visuals

Accessibility

Dashboards

Small multiples, or trellising, splits a visual into multiple versions of itself that are presented side by side, with the data divided across a dimension

- **NOTE:** Currently, you can only create small multiples on bar, column, line, and area charts





EDITING REPORT INTERACTIONS

Inserting Visuals

Formatting Visuals

Report Navigation

Tooltips

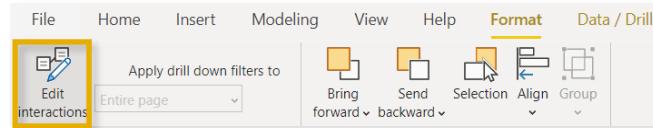
Custom Visuals

R & Python Visuals

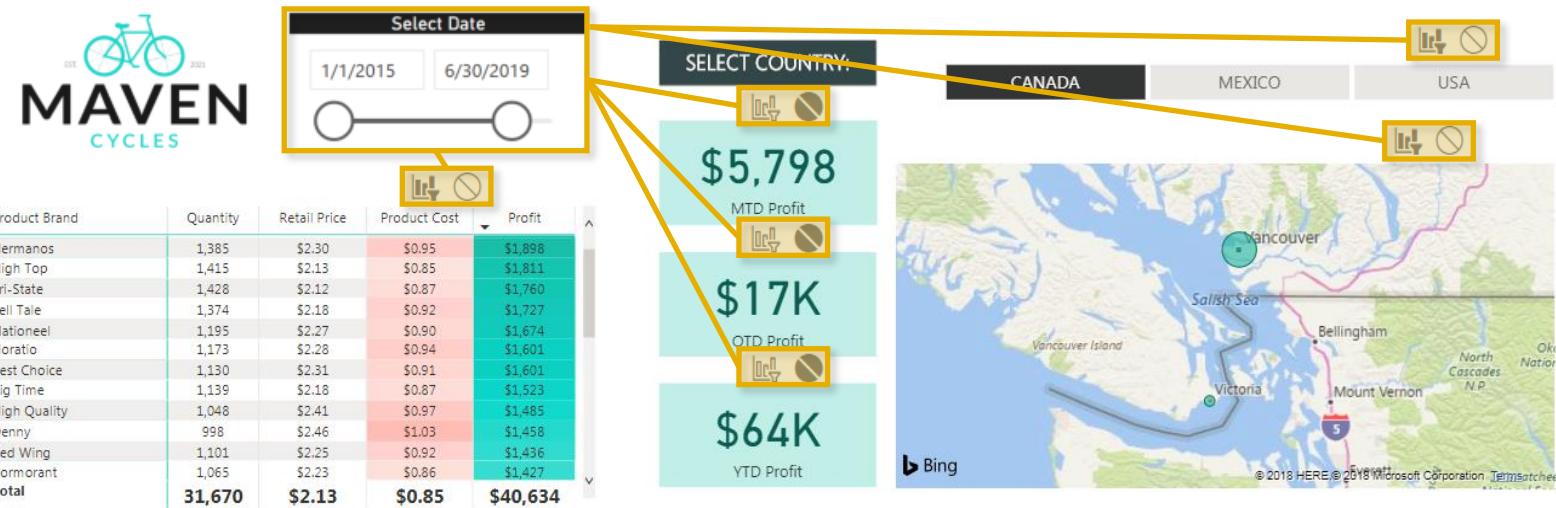
Accessibility

Dashboards

Report interactions allow you to define how filters applied to *one* visual impact the *others*



By selecting the date slicer and enabling “Edit interactions” from the **Format** tab, we can manually determine which visuals should “react” when the date range changes



In this case the **Product matrix**, **Country slicer** and **Map** will filter in response to date slicer changes (), but the **MTD**, **QTD**, and **YTD Profit** cards will not ()



EDITING REPORT INTERACTIONS (CONT.)

Inserting Visuals

Formatting Visuals

Report Navigation

Tooltips

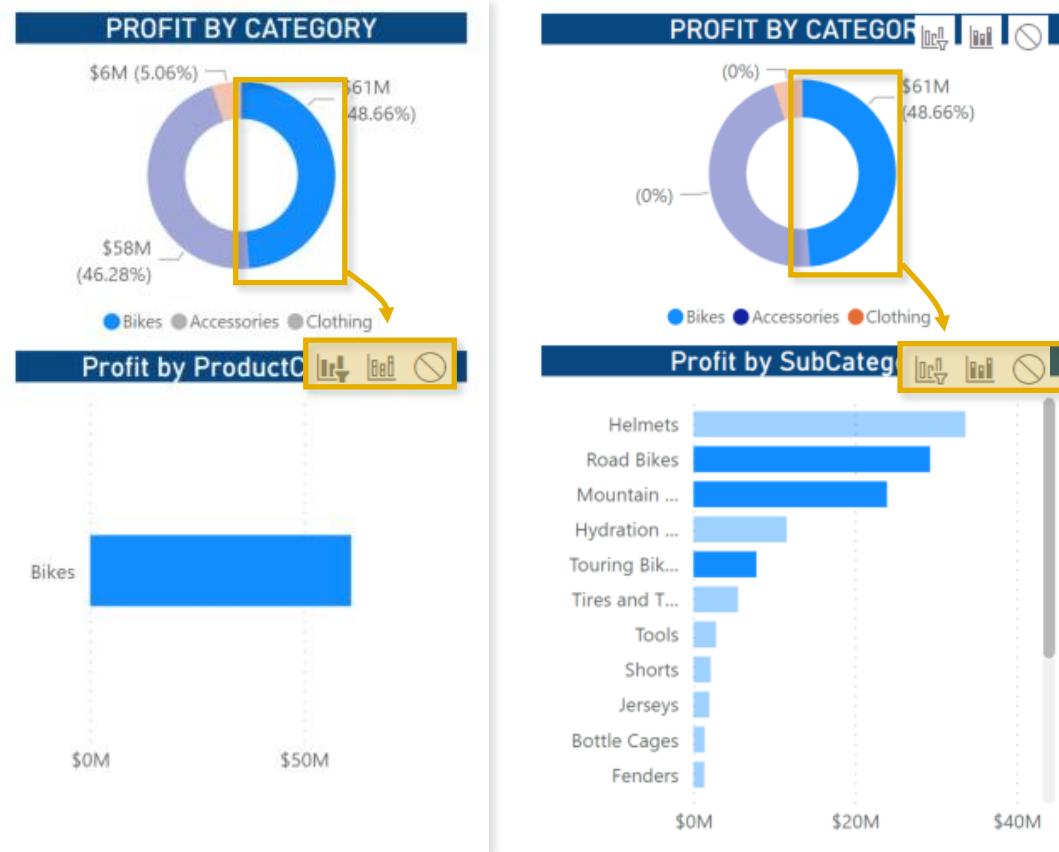
Custom Visuals

R & Python Visuals

Accessibility

Dashboards

For certain types of visuals, a third option allows you to “highlight” subsegments of the data, rather than simply filtering vs. not filtering



*When the interaction mode is set to “filter”, selecting the “**Bikes**” category in the donut chart produces a filtered list of subcategories in the chart*

*When the interaction mode is set to “highlight”, selecting the “**Bikes**” category in the donut chart highlights the relevant subsegments in the chart*



DRILL-THROUGH FILTERS

Inserting Visuals

Formatting Visuals

Report Navigation

Tooltips

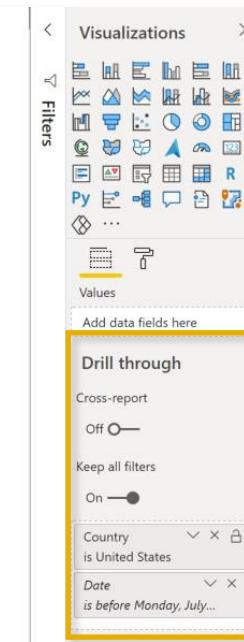
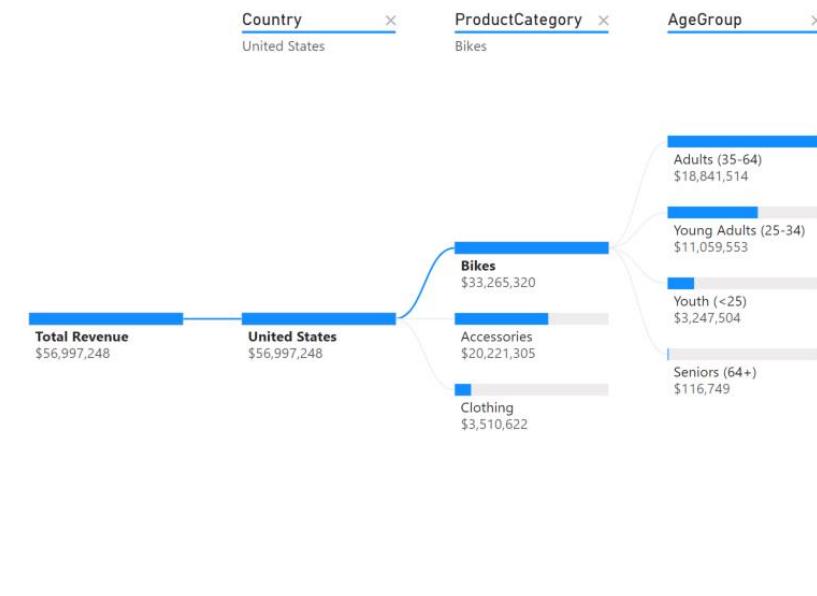
Custom Visuals

R & Python Visuals

Accessibility

Dashboards

Drill-through filters allow users to jump to different report pages (*like bookmarks*), while simultaneously filtering based on the *specific item selected*



Here we've built a report page ("Decomposition Tree") featuring country, product, and age detail, and added a Drillthrough filter for **Country**. Users can now right-click any report visual containing country name, and jump straight to a pre-filtered version of this page ("United States" shown in the example above)



ADDING & LINKING BOOKMARKS

Inserting Visuals

Formatting Visuals

Report Navigation

Tooltips

Custom Visuals

R & Python Visuals

Accessibility

Dashboards

On the report page, we add our ⓘ button, and link it to bookmarks using the object “*Action*” properties

Now we’re able to create a *narrative* from the data, and really bring our insights to life!

In this example, we created a prefiltered view of 1H 2020 for the executive team’s upcoming planning session.

To do this, we add a new **bookmark** (*View > Bookmarks Pane > Add*) and name it “1H 2020”



TOOLTIPS

Inserting Visuals

Formatting Visuals

Report Navigation

Tooltips

Custom Visuals

R & Python Visuals

Accessibility

Dashboards

Toolips in Power BI are a way to add additional data when you hover over a visual

*Map that shows the **Total Revenue** by country, filtered to Europe*



Tooltip shows the Total Revenue along with Total Orders, Profit, & % of Profit for France



IMPORTING CUSTOM VISUALS

Inserting Visuals

Formatting Visuals

Report Navigation

Tooltips

Custom Visuals

R & Python Visuals

Accessibility

Dashboards

Import custom visuals from files, your organization, or the AppSource marketplace (*requires sign-in*) directly into Power BI

The screenshot shows the Power BI desktop interface. On the left, the 'Visualizations' pane is open, displaying various built-in chart types and a '...' button. A yellow callout points to this button with the text 'Power BI Visuals'. Below the pane, the 'AppSource' tab is selected, showing search results for 'histogram'. The first result, 'Histogram Chart' by MAQ Software, is highlighted with a yellow box around its 'Add' button. A yellow arrow points from this button to an 'OK' button in a modal dialog titled 'Import custom visual', which contains the message 'The visual was successfully imported into this report.' To the right of the main interface, a separate 'Visualizations' pane is shown, with a yellow box highlighting the 'Histogram Chart' icon in the list.

We've added a **histogram chart** from the marketplace

PRO TIP: Report visuals loading slowly?
Splitting out visuals to different pages can relieve slow-loading pages



R & PYTHON VISUALS

Inserting Visuals

Formatting Visuals

Report Navigation

Tooltips

Custom Visuals

R & Python Visuals

Accessibility

Dashboards

You can create visuals from queries and datasets generated in **R** or **Python**



Getting Started:

1. Install R on local machine
2. Confirm R home directory

Limitations:

- Plots limited to 150,000 rows
- Visual output limit of 2MB
- Resolution is 72 DPI
- Calculations > 5 minutes will time out



Getting Started:

1. Install Python on local machine
2. Install necessary packages/libraries (*Matplotlib, NumPy*)
3. Confirm Python home directory

Limitations:

- You won't be able to use Python scripts in reports created with Enhanced Metadata (Preview) feature enabled



ACCESSIBILITY FEATURES

Inserting Visuals

Formatting Visuals

Report Navigation

Tooltips

Custom Visuals

R & Python Visuals

Accessibility

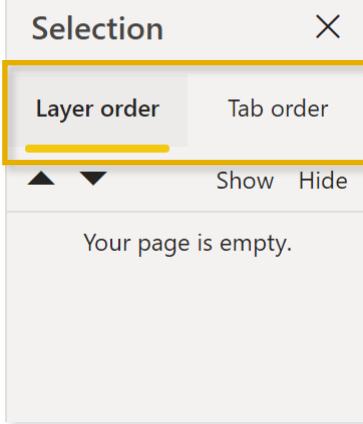
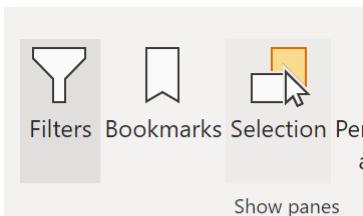
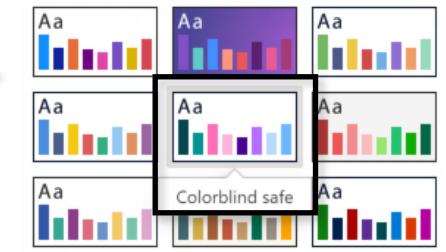
Dashboards

Power BI's different **accessibility features** allow consumers to easily navigate reports



Themes allow you to set a default theme for your entire report

PRO TIP: Use the **colorblind safe** theme to make sure all users can distinguish your report colors



The **selection** pane allows you to adjust the tab and layer order for reports

PRO TIP: Use this on complex reports with overlapping objects

- **Tab order** allows you to override the default creation order and specify how "tab" cycles between visuals
- **Layer order** allows you to change the default layer order and send objects back or bring the forward



PINNING TILES TO A DASHBOARD

Inserting Visuals

Formatting Visuals

Report Navigation

Tooltips

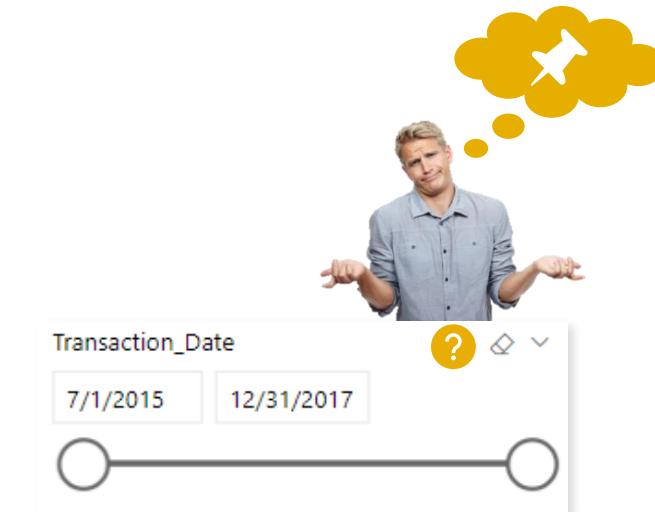
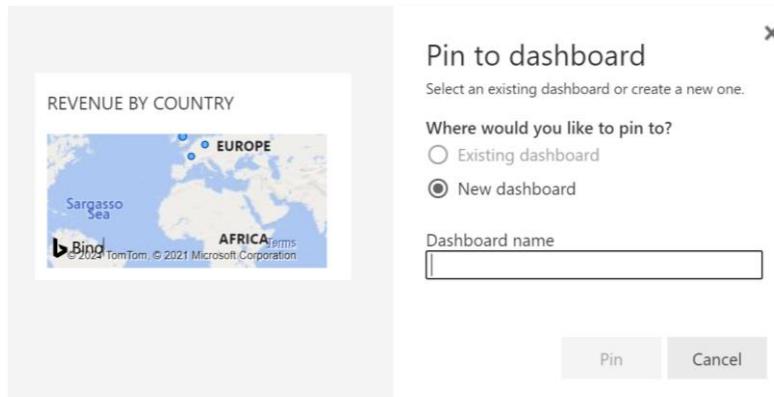
Custom Visuals

R & Python Visuals

Accessibility

Dashboards

Use the pushpin icon to pin an individual visual to a dashboard



HEADS UP!

Slicers have some limitations in Power BI, and cannot:

- Drill down non-hierarchical fields
- Support visual level filters
- Be pinned to a dashboard individually
(they can be pinned as part of a **live page**)



PINNING ENTIRE REPORTS TO A DASHBOARD

Inserting Visuals

Formatting Visuals

Report Navigation

Tooltips

Custom Visuals

R & Python Visuals

Accessibility

Dashboards

Use the **Pin Live Page** option to pin an entire report to a dashboard

The screenshot shows the Power BI desktop interface. On the left, there's a navigation pane with icons for Explore, Text box, Shapes, Buttons, Visual interactions, Refresh, and Duplicate this page. Above the main area, there are three summary cards: REVENUE (\$8.14M), PROFIT (\$4.07M), and PROFIT MARGIN (50.03%). Below these is a map visualization titled 'REVENUE BY COUNTRY'. On the right side, there's a ribbon with Save, Pin to a dashboard, and other options. A yellow arrow points from the 'Pin to a dashboard' button on the ribbon to a callout box. This callout box contains the text 'Pin to dashboard' and 'Select an existing dashboard or create a new one.' It also includes a radio button for 'Existing dashboard' and another for 'New dashboard'. The 'New dashboard' option is selected. A text input field for 'Dashboard name' contains 'Maven Cycles Dashboard'. Below this, a note says 'Pin live page enables changes to reports to appear in the dashboard tile when the page is refreshed.' At the bottom right of the callout are 'Pin live' and 'Cancel' buttons. A yellow arrow also points from the 'Pin live' button to another callout box at the bottom. This second callout box shows a preview of the pinned report titled 'Maven Cycles Report EXECUTIVE VIEW'. The preview includes a thumbnail of the report and a link to 'Last saved state'. The main report view at the bottom shows the 'EXECUTIVE VIEW' with various visualizations like charts and tables.

PRO TIP: Pinning a live page will import slicers, preserve functionality, and reflect any updates to the report



THE DASHBOARD INTERFACE

Inserting Visuals

Formatting Visuals

Report Navigation

Tooltips

Custom Visuals

R & Python Visuals

Accessibility

Dashboards

The screenshot shows a dashboard interface with a toolbar at the top containing File, Share, Chat in Teams, Comment, Subscribe, Edit, and more. A callout points to the 'Edit' dropdown. Below the toolbar is a search bar labeled 'Ask a question about your data'. The main area contains several data tiles: 'REVENUE' (\$8.14M, Goal: \$7.56M (+7.68%)), 'PROFIT' (\$4.07M, Goal: \$3.83M (+6.23%)), and 'PROFIT MARGIN' (50.03%, Goal: 51% (-1.34%)). To the right is a 'PRODUCT DETAIL' table listing products like S-Works TT Helmet, Anniversary Edition with their respective total orders, total revenue, and profit margin. At the bottom is a 'PROFIT BY PERIOD' line chart showing profit from 2015 to 2020.

TOOLBAR

Tools to add new tiles, add/view comments, subscribe, share, set as featured dashboard, etc.



DASHBOARD TOOLS

Inserting Visuals

Formatting Visuals

Report Navigation

Tooltips

Custom Visuals

R & Python
Visuals

Accessibility

Dashboards

Share via email or to
Microsoft Teams

Subscribe to receive
periodic email updates



- Save a copy
- Print this page
- Performance inspector
- Settings

Add **comments** & start a
data-driven conversation

- Add a tile
- Dashboard theme
- Mobile view



WEB VS. MOBILE LAYOUT

Inserting Visuals

Formatting Visuals

Report Navigation

Tooltips

Custom Visuals

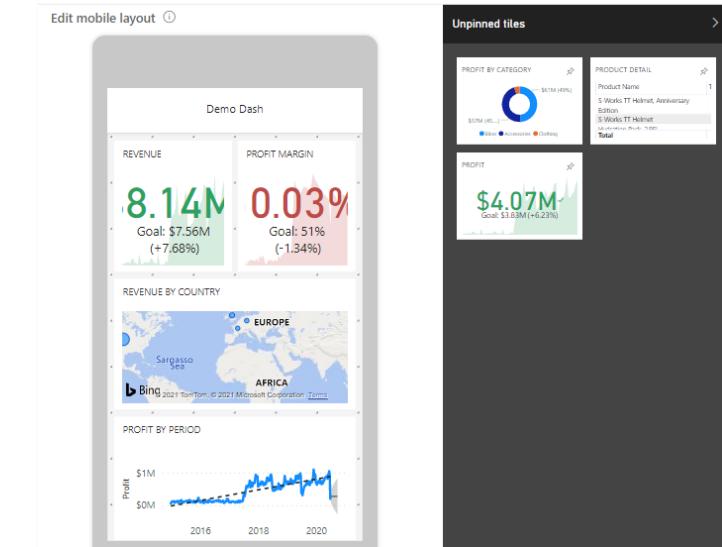
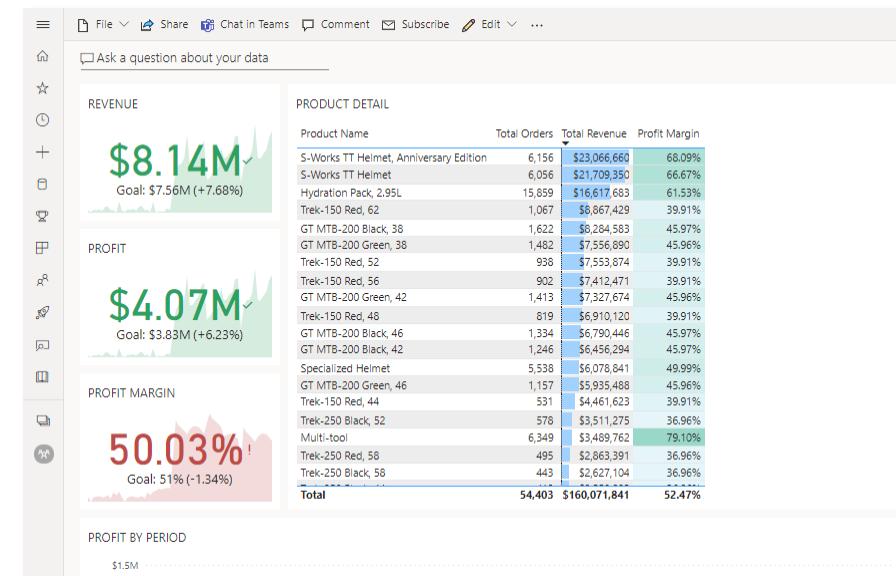
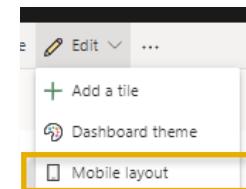
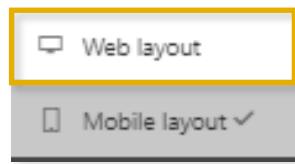
R & Python Visuals

Accessibility

Dashboards

Mobile Layout allows you to design reports optimized for mobile viewing (vs. web)

- NOTE: You can't build content within the Mobile Layout view; you need to build in Web Layout and assemble select visuals to share via the Power BI mobile app





WEB VS. MOBILE LAYOUT

Inserting Visuals

Formatting Visuals

Report Navigation

Tooltips

Custom Visuals

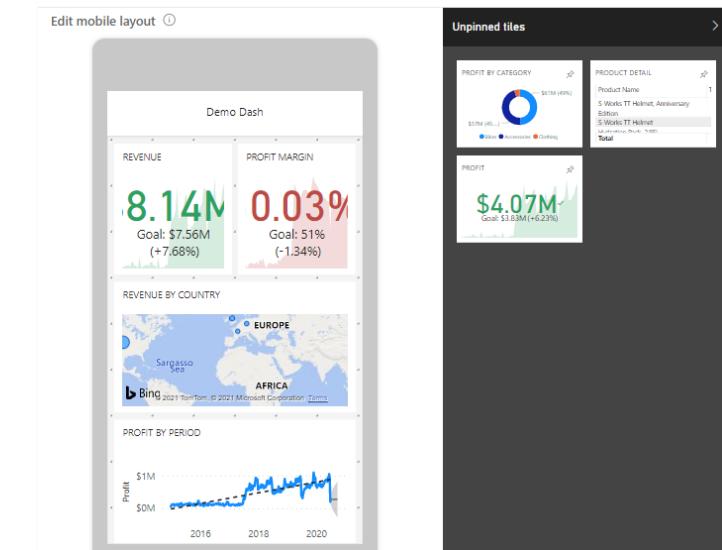
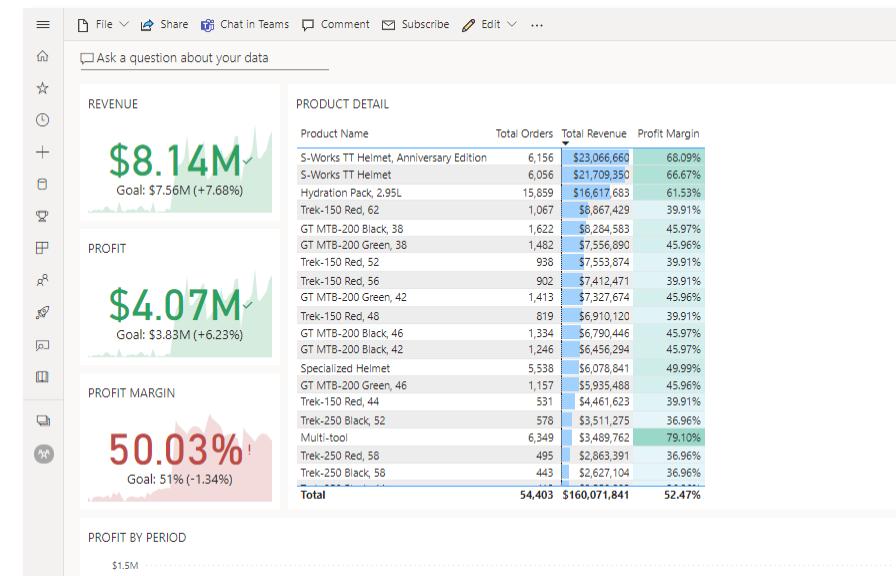
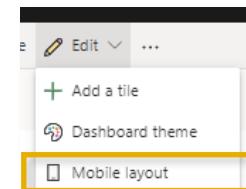
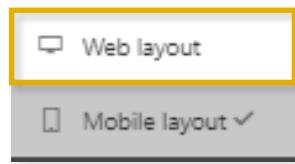
R & Python Visuals

Accessibility

Dashboards

Mobile Layout allows you to design reports optimized for mobile viewing (vs. web)

- NOTE: You can't build content within the Mobile Layout view; you need to build in Web Layout and assemble select visuals to share via the Power BI mobile app





PRO TIP: PAGINATED REPORTS

Inserting Visuals

Formatting Visuals

Report Navigation

Tooltips

Custom Visuals

R & Python Visuals

Accessibility

Dashboards

Paginated Reports are called *paginated* because they're formatted to fit well on a page and are designed to be printed or shared

Benefits & requirements:

- Control the layout for **pixel perfect** reports
- **Print** all the data, no matter how long
- **Premium capacity** needed to publish & share
- **Pro** or **PPU** license to publish
- Apply **sensitivity labels** in Power BI Service
- **Report Builder** required to build (*separate tool*)
- Same foundation as **SSRS** (*backwards compatible*)

Orders & Revenue by Customer

| Customer Name | Product Name | Orders | Total Revenue |
|--------------------|-----------------------|--------|---------------|
| Abby Rana | Total | 3 | 73.92 |
| | Fender Set - Mountain | 1 | 43.96 |
| | Mountain Bottle Cage | 1 | 19.98 |
| | Water Bottle - 30 oz. | 1 | 9.98 |
| Adriana Gonzalez | Total | 9 | 9195.69 |
| Alejandro Beck | Total | 5 | 2975.22 |
| Alexa Cox | Total | 3 | 88.02 |
| Alexa Watson | Total | 1 | 17.28 |
| Alexander Jackson | Total | 1 | 49.98 |
| Alexandra Evans | Total | 2 | 68.49 |
| Alexandria Stewart | Total | 1 | 1700.99 |
| Alisha Liu | Total | 3 | 2214.51 |

PRO TIP: CREATING A PIVOT TABLE FROM A POWER BI DATASET



You can create **PivotTables** from **Power BI datasets** to leverage the best of both PivotTables & Power BI
(available for Microsoft 365 only)

The screenshot shows the Microsoft Excel ribbon with the 'Insert' tab selected. Under the 'Tables' section, the 'PivotTable' icon is highlighted with a yellow box. A yellow arrow points from this icon to the 'From Power BI (Maven Analytics)' option in the dropdown menu, which is also highlighted with a yellow box. Below the ribbon, a yellow circle with a white exclamation mark is enclosed in a yellow box, with a yellow line connecting it to the 'From Power BI' option. The main area of the screen displays the 'Power BI Datasets' dialog box. It contains a search bar, a list of datasets, and detailed information about each dataset, such as workspace, owner, and refresh time. One dataset, 'Los Angeles Restaurant Inspections - RLS', is selected and highlighted with a yellow box. To the right of the dialog, a PivotTable is being created in a worksheet. The PivotTable Fields pane on the right lists various measures and facts from the dataset, including 'Total Orders', 'Total Revenue', and 'Profit Margin'. The PivotTable itself shows data for these metrics across different categories.

HEY THIS IS IMPORTANT!

Create measures first! PivotTables from Power BI datasets do not support drag-and-drop aggregation

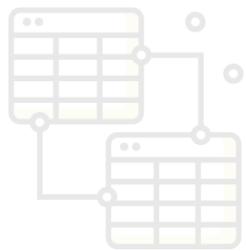
| | A1 | B | C | D |
|----|------------------------|--------------|---------------|---------------|
| 1 | Row Labels | Total Orders | Total Revenue | Profit Margin |
| 2 | Bike Rack | 881 | \$1,394,589 | 74.86% |
| 3 | Bike Shorts, Padded, L | 760 | \$866,232 | 69.44% |
| 4 | Bike Shorts, Padded, M | 969 | \$1,119,930 | 71.43% |
| 5 | Bike Shorts, Padded, S | 916 | \$991,304 | 73.53% |
| 6 | Chain Lube | 2,656 | \$430,719 | 69.97% |
| 7 | Fender Extenders | 5,948 | \$2,137,164 | 63.62% |
| 8 | GT MTB-100 Black, 38 | 105 | \$744,120 | 44.30% |
| 9 | GT MTB-100 Black, 42 | 84 | \$593,190 | 44.30% |
| 10 | GT MTB-100 Black, 44 | 99 | \$730,080 | 44.30% |
| 11 | GT MTB-100 Black, 48 | 107 | \$803,790 | 44.30% |
| 12 | GT MTB-100 Green, 38 | 118 | \$887,536 | 44.31% |
| 13 | GT MTB-100 Green, 42 | 76 | \$594,048 | 44.31% |
| 14 | GT MTB-100 Green, 44 | 81 | \$625,872 | 44.31% |
| 15 | GT MTB-100 Green, 48 | 84 | \$615,264 | 44.31% |
| 16 | GT MTB-200 Black, 38 | 1,622 | \$8,284,583 | 45.97% |
| 17 | GT MTB-200 Black, 42 | 1,246 | \$6,456,294 | 45.97% |
| 18 | GT MTB-200 Black, 46 | 1,334 | \$6,790,446 | 45.97% |
| 19 | GT MTB-200 Green, 38 | 1,482 | \$7,556,890 | 45.96% |
| 20 | GT MTB-200 Green, 42 | 1,413 | \$7,327,674 | 45.96% |
| 21 | GT MTB-200 Green, 46 | 1,157 | \$5,935,488 | 45.96% |
| 22 | GT MTB-400-W Green, 38 | 464 | \$802,959 | 45.91% |
| 23 | GT MTB-400-W Green, 40 | 293 | \$487,054 | 45.91% |
| 24 | GT MTB-400-W Green, 42 | 403 | \$667,000 | 45.91% |

ANALYZING THE DATA



Prepare the Data

- Get data from different sources
- Clean, transform, and load data



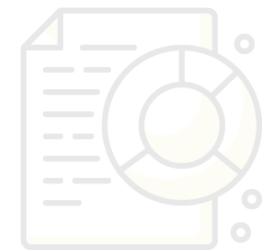
Model the Data

- Design a data model
- Develop a data model
- Create model calculations with DAX
- Optimize model performance



Visualize & Analyze the Data

- Create reports
- Create dashboards
- Enrich reports for usability
- Enhance reports for usability & storytelling
- Identify patterns & trends



Deploy & Maintain Assets

- Manage files & datasets
- Manage workspaces

ENHANCE REPORTS



In this section we'll cover tools and techniques that can be used to **enhance reports** to expose insights and perform advanced analysis

TOPICS WE'LL COVER:

Basic Chart Types

Analytics Options

Q&A

Filtering Options

AI Visuals

COMMON QUESTIONS:

- *You need to add a visualization to a report that helps the team understand factors that drive a specific metric. What visualization should you add?*
- *Which of the following visualizations should be used to show the relationship between cost and revenue and help identify possible outliers?*
- *Which of the following options is the best way to create a visual to show the top 10 States based on population?*



CHART TYPES BASED ON ANALYSIS

Basic Chart Types

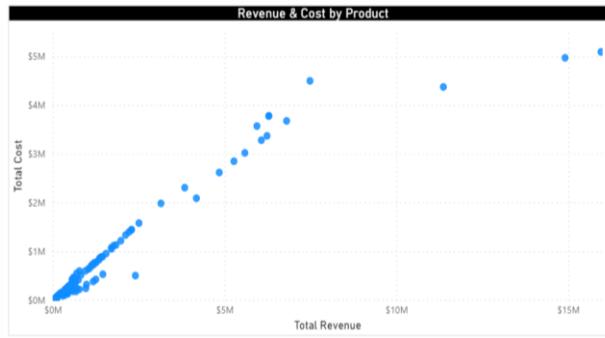
Analytics Options

Q&A

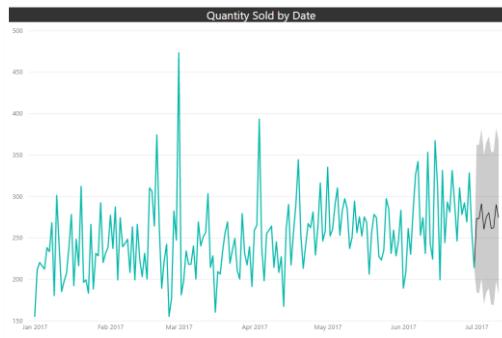
Filtering Options

AI Visuals

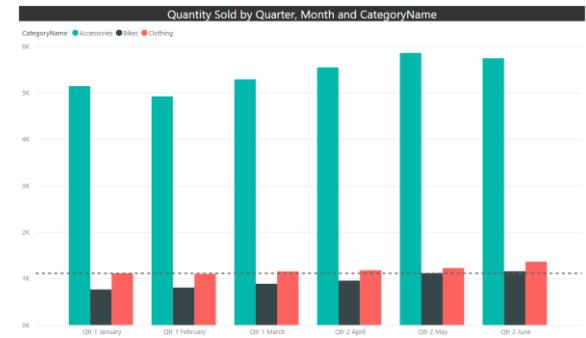
Scatter charts show the relationship between two numerical values



Line charts are used to track changes over periods of time



Clustered Column charts compare values across different categories



Common Uses:

- Show patterns in large sets of data
- Show linear & non-linear trends
- Cluster analysis
- Outlier identification

Common Uses:

- Show changes in values over time
- Add multiple lines to compare trends between series (categories)

Common Uses:

- Show distribution of data points
- Comparisons across categories



CHART ANALYTICS OPTIONS

Basic Chart Types

Analytics Options

Q&A

Filtering Options

AI Visuals

Scatter charts

- ✓ X-Axis Constant Line
- ✓ Y-Axis Constant Line
- ✓ Min line
- ✓ Max line
- ✓ Average line
 - ✓ Median line
 - ✓ Percentile line
- ✓ Symmetry shading

X & Y-Axis Constant line adds a constant line to your visual

Median line adds a line that separates the higher half of data from lower half

Symmetry shading makes it easier to see if the Y or X axis value is bigger. Border is where the values are the same

Line charts

- ✓ Trend line
- ✓ Constant line
- ✓ X-Axis Constant Line
- ✓ Min line
- ✓ Max line
- ✓ Average line
- ✓ Median line
- ✓ Percentile line
- ✓ Forecast
- ✓ Find anomalies

Trend line adds a trend line to your visual

Forecast adds a forecast to your visual based on a specific number of periods

Find anomalies mark datapoint outside the expected range of values

Clustered Column charts

- ✓ Constant line
- ✓ Min line
- ✓ Max line
- ✓ Average line
- ✓ Median line
- ✓ Percentile line 1

Min & Max line adds min/max context to your visual

Average line adds the arithmetic mean of the values in the visual

Percentile add a dynamic reference line based on a percentage



PRO TIP: CLUSTERING

Basic Chart Types

Analytics Options

Q&A

Filtering Options

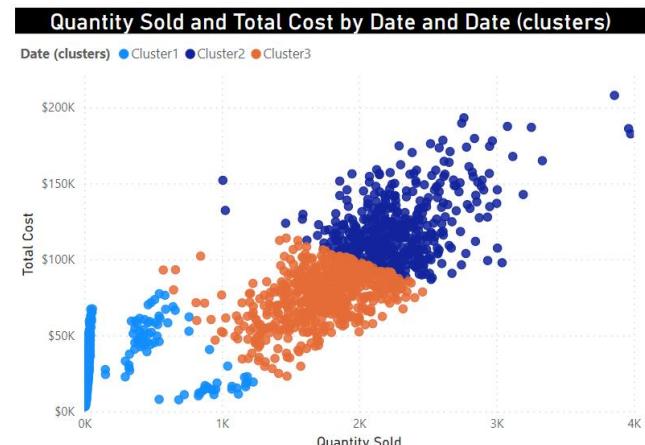
AI Visuals

Clustering allows you to group observations in a dataset with similar characteristics

- Clustering is a form of unsupervised machine learning
- Power BI's default clustering algorithm is the *Expectation Maximization (EM)** method

Typical Use Cases:

- ✓ Identify relationships that may not be derived through casual observation
- ✓ Detection of anomalies in the dataset
- ✓ Identify performance by segments (*i.e. customer segmentation*)
- ✓ Clustering dimensions based on factors (*i.e. store locations by sales, orders, ratings, etc.*)



PRO TIP: Remember, there's no “right” answer or single optimization metric when it comes to clustering; the best outputs help you **answer the question at hand** and **make practical, data-driven business decisions**





PRO TIP: GROUPING & BINNING

Basic Chart Types

Analytics Options

Q&A

Filtering Options

AI Visuals

Grouping is the process of creating logical categories with *text* data, while **binning** is the process of creating logical ranges for *numerical* data

GROUPING



BINNING



Common Uses:

- Group 2 or more categories together
- Refine how groups are presented
- Add/remove categories from existing groups

Common Uses:

- Creating logical ranges of numerical data
- Use bins to “right-size” data
- Create equal size ranges
- **NOTE:** Bins can be created for calculated columns but not for measures



Q&A

Q&A in lets you explore your data “in your own words” using **natural language queries**

- Basic Chart Types
- Analytics Options
- Q&A**
- Filtering Options
- AI Visuals

Q&A Tooling Interface

The interface shows a sidebar with 'Q&A setup' and 'Getting started' options like 'Field synonyms', 'Review questions', 'Teach Q&A', 'Manage terms', and 'Suggest questions'. The main area has four cards:

- Field synonyms**: Add terms people might use as synonyms for the fields and tables in your data. **Field synonyms** button.
- Review questions**: Review questions people have asked and fix misunderstandings. **Review questions** button.
- Teach Q&A**: Teach Q&A to understand questions and terms people might use. **Teach Q&A** button.
- Suggest questions**: Help people explore your data by adding suggested questions. **Suggest questions** button.

Table & Column Synonyms

The properties panel shows a 'Synonyms' section with 'maven cycles product, maven cycle product, product, cycles product, cycle product'. A yellow arrow points from the 'Field synonyms' card in the Q&A interface to this list. Below it is a table with columns 'Name', 'Type', and 'Actions'.

| Name | Type | Actions |
|-----------------------|------|---|
| Maven Cycles Products | * | Price Range Product Key Product New Collapse ^ |

Best Practices:

- ✓ Use new Q&A tooling to interact with queries and make improvements
- ✓ Add missing relationships between tables
- ✓ Rename tables and columns
- ✓ Fix incorrect data types
- ✓ Normalize your model (single table or column per question)
- ✓ Add synonyms to tables and columns



FILTERING OPTIONS

There are four primary **filter options** in Power BI reports:

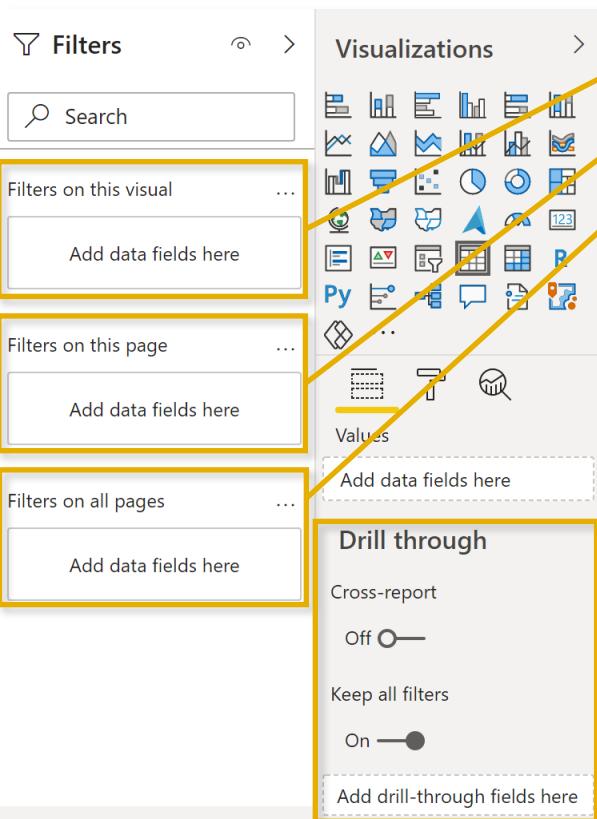
Basic Chart Types

Analytics Options

Q&A

Filtering Options

AI Visuals



1. **Visual Level:** Applies only to the *specific visual* in which it is defined
2. **Page Level:** Applies to *all visuals on the specific page* in which it is defined
3. **Report Level:** Applies to *all visuals* across *all pages* of the report
4. **Drill through:** Applies to *specific pages*, and *updates* based on the item clicked

Filter settings include Basic, Advanced, and Top N options

Filter type ⓘ
Basic filtering

Search

Select all
 Accessories 1
 Bikes 1

Basic Options

Filter type ⓘ
Top N

Show items:
Top 2

By value
Total Returns

Apply filter

Show items when the value:

| |
|---------------------|
| contains |
| contains |
| does not contain |
| starts with |
| does not start with |
| is |
| is not |
| is blank |
| is not blank |

Top N Options

Advanced (Values)

Show items when the value:

| |
|---------------------|
| contains |
| contains |
| does not contain |
| starts with |
| does not start with |
| is |
| is not |
| is blank |
| is not blank |

Advanced (Text)



SLICERS

Slicers provide an interactive way for users to sort and filter a report

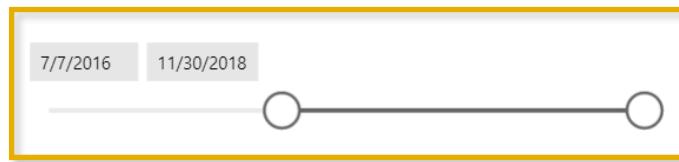
Basic Chart Types

Analytics Options

Q&A

Filtering Options

AI Visuals

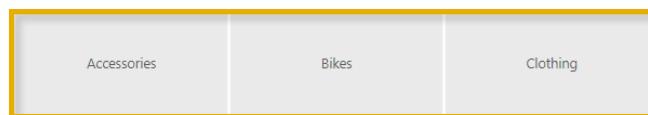


Date slicer formatted as a slider

Can also be a list, range, or “in the past X time period” option



Categorical slicers can also be created from dimensions or attributes within your model (*Category, Store Location, Gender, etc.*)





AI VISUALS (KEY INFLUENCERS)

The **key influencers** visual helps you understand the factors that drive a specific metric

Basic Chart Types

Analytics Options

Q&A

Filtering Options

AI Visuals

DROP DOWN BOX

The value or metric under investigation

LEFT PANE

Visual that shows a list of the top key influencers



RIGHT PANE

Column chart display all values for the key influencer theme selected in the left pane

AVERAGE LINE

Shows the percentage of the other themes that increase quantity sold



AI VISUALS (DECOMPOSITION TREE)

Basic Chart Types

Analytics Options

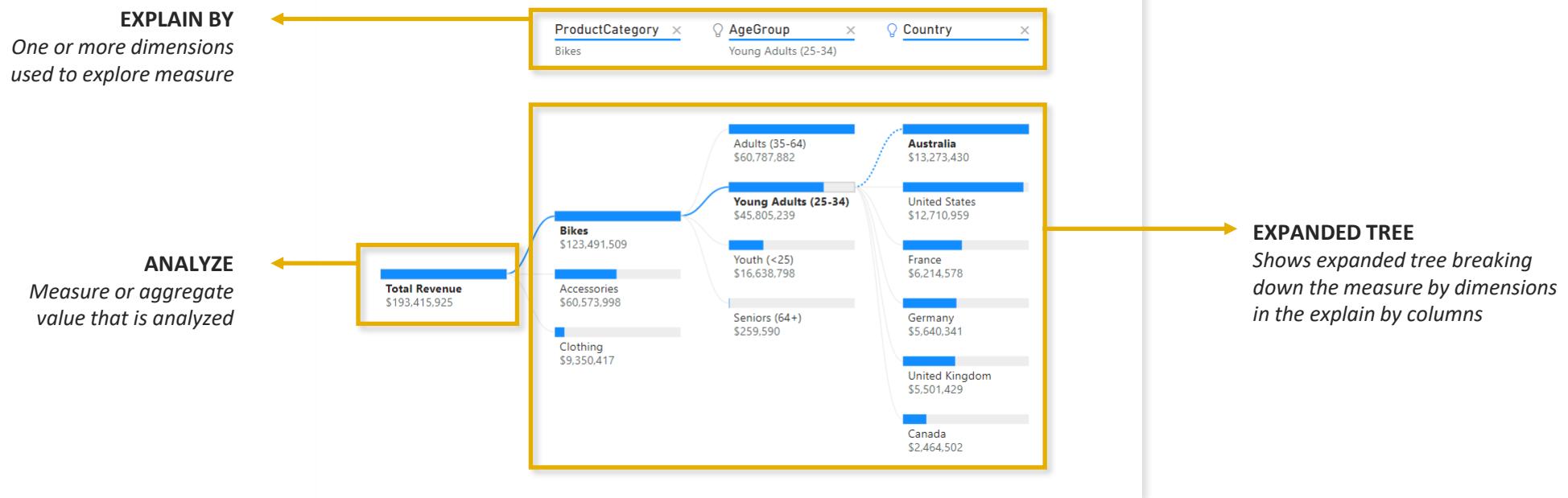
Q&A

Filtering Options

AI Visuals

The **decomposition tree** visual allows you to perform exploratory analysis by successively breaking down a measure across multiple dimensions

- This is a great choice when you want to perform a **root cause analysis** or **ad hoc exploration**

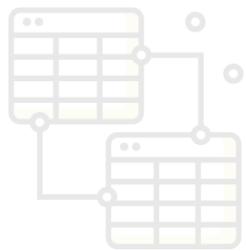


DEPLOYING & MAINTAINING ASSETS



Prepare the Data

- Get data from different sources
- Clean, transform, and load data



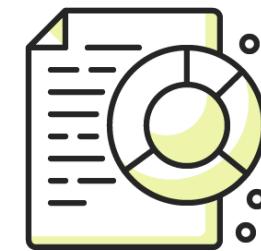
Model the Data

- Design a data model
- Develop a data model
- Create model calculations with DAX
- Optimize model performance



Visualize & Analyze the Data

- Create reports
- Create dashboards
- Enrich reports for usability
- Enhance reports for usability & storytelling
- Identify patterns & trends



Deploy & Maintain Assets

- Manage files & datasets
- Manage workspaces

DEPLOY & MAINTAIN ASSETS



In this section we'll cover tools and techniques to **deploy & maintain assets**, including managing datasets, refreshing data, securing datasets, and creating and managing workspaces

TOPICS WE'LL COVER:

Scheduled Refresh

Row Level Security

Sharing Options

Data Lineage

Incremental Refresh

Endorse Content

Storage Formats

Sensitivity Labels

COMMON QUESTIONS:

- *Which of the following steps should you take to ensure a Dataflow is updated every morning?*
- *What DAX expression would you use to create an RLS role based on a manager's Region?*
- *Which of the following roles can add other members to a workspace?*



SCHEDULED REFRESH (DATASET)

Scheduled Refresh

Row Level Security

Sharing Options

Data Lineage

Incremental Refresh

Storage Formats

Endorse Content

Sensitivity Labels

Scheduled refresh allows you to keep your Power BI reports up to date by automatically refreshing datasets based on a given frequency & time of day

Datasets Workbooks Dataflows App

Settings for Maven Cycles Reporting

This dataset has been configured by Aaron@mavenanalytics.onmicrosoft.com.

[Refresh history](#)

► Gateway connection

► Data source credentials

► Parameters

► Scheduled refresh

Keep your data up to date

On

Refresh frequency: Daily

Time zone: (UTC-05:00) Eastern Time (US and Canada)

Time: 7 30 AM X
7 30 PM X

Add another time

Send refresh failure notifications to the dataset owner

Email these users when the refresh fails

Aaron Parry Enter email addresses

Apply Discard

Select the dataset to refresh and click **Scheduled Refresh** or **Settings** from the ellipsis menu options

Confirm dataset refresh is working properly (schedules align, errors, etc.)

+ New ▾

| All | Content | Datasets + dataflows | Type | Owner | Refreshed | Next refresh |
|-----|------------------------|----------------------|-------------------------|---------------------|---------------------|--------------|
| | Maven Cycles Reporting | Dataset | Maven Cycles Reporti... | 6/18/21, 9:31:34 AM | 6/19/21, 9:30:00 AM | |

Set a **Frequency** (daily or weekly), **Time Zone**, and **Time** (half-hour increments AM/PM)



HEY THIS IS IMPORTANT!
A data gateway is required to refresh on-premises & online data sources



STATIC ROW-LEVEL SECURITY

Scheduled Refresh

Row Level Security

Sharing Options

Data Lineage

Incremental Refresh

Storage Formats

Endorse Content

Sensitivity Labels

Static roles allow you to define filtered views for specific audiences (*territory managers, department leads, execs, etc.*) using simple DAX statements

- This is not the same as bookmarks or pre-filtered views; roles **filter data out of your model** and limit what audiences can access
- Static roles must first be configured in Power BI Desktop and then applied in Power BI Service

HEY THIS IS IMPORTANT!
If a user is part of two roles, the RLS roles are combined for the individual

The screenshot shows the Power BI Desktop ribbon with the 'Modeling' tab selected. The 'External Tools' section of the ribbon has a 'Manage roles' button highlighted with a yellow box and an arrow pointing to it from the callout box. To the right, a 'Manage roles' dialog box is open. It shows a list of roles under 'Region Managers' and a list of tables under 'Tables'. On the right, a 'Table filter DAX expression' field contains the DAX expression `[Country] = "France"`. At the bottom of the dialog, there are 'Save' and 'Cancel' buttons.



TESTING ROW-LEVEL SECURITY

Scheduled Refresh

Row Level Security

Sharing Options

Data Lineage

Incremental Refresh

Storage Formats

Endorse Content

Sensitivity Labels

As a best practice, use the **View as** option to confirm that the security role properly limits the data prior to publishing to Power BI Service

The screenshot illustrates the process of testing row-level security in Power BI. It shows the Power BI desktop ribbon with the 'Modeling' tab selected. A yellow box highlights the 'View as' button under the 'External Tools' section. An arrow points from this button to a 'View as roles' dialog box. The dialog box shows three options: 'None', 'Other user', and 'Los Angeles'. The 'Los Angeles' option is checked, and a yellow box highlights the status message 'Now viewing as: Region Managers'. Below the dialog, a Power BI report for 'MAVEN CYCLES' is visible, showing financial KPIs like \$0.8M and 49.48%.



DYNAMIC ROW-LEVEL SECURITY

Scheduled Refresh

Row Level Security

Sharing Options

Data Lineage

Incremental Refresh

Storage Formats

Endorse Content

Sensitivity Labels

Dynamic roles allow you to define filtered views for a specific list of users with the DAX functions **USERNAME** or **USERPRINCIPALNAME**

- These DAX functions require adding an additional table into your data model
- Dynamic roles must first be configured in Power BI Desktop and then applied in Power BI Service

USERNAME

Manage roles

Roles

Tables

[Territory Manager]

Table filter DAX expression

[Territory Manager] = USERNAME()

Territory Manager Email Address

Jenna Stubbs jstubbs@mavencycles.onmicrosoft.com

Lauren Burns lburns@mavencycles.onmicrosoft.com

Aden Holt aholt@mavencycles.onmicrosoft.com

Susie Salt ssalt@mavencycles.onmicrosoft.com

Jake Kay jkay@mavencycles.onmicrosoft.com

Kathy Meza kmeza@mavencycles.onmicrosoft.com

Adam Juan ajuan@mavencycles.onmicrosoft.com

David Hahn dhahn@mavencycles.onmicrosoft.com

Benny Blanco bblanco@mavencycles.onmicrosoft.com

Dirk Gently dgently@mavencycles.onmicrosoft.com

Save Cancel

Dynamic role will filter by the Username in this table

USERPRINCIPALNAME

Manage roles

Roles

Tables

[Inspector Lookup]

Table filter DAX expression

[email_address] = USERPRINCIPALNAME()

Territory Manager Email Address

Jenna Stubbs jstubbs@mavencycles.onmicrosoft.com

Lauren Burns lburns@mavencycles.onmicrosoft.com

Aden Holt aholt@mavencycles.onmicrosoft.com

Susie Salt ssalt@mavencycles.onmicrosoft.com

Jake Kay jkay@mavencycles.onmicrosoft.com

Kathy Meza kmeza@mavencycles.onmicrosoft.com

Adam Juan ajuan@mavencycles.onmicrosoft.com

David Hahn dhahn@mavencycles.onmicrosoft.com

Benny Blanco bblanco@mavencycles.onmicrosoft.com

Dirk Gently dgently@mavencycles.onmicrosoft.com

Save Cancel

Filter the data that this role can see by entering a DAX filter expression that returns a True/False value. For example: [Entity ID] = "Value"

Dynamic role will filter by the Email Address in this table

*Copyright 2022, Maven Analytics, LLC



USERNAME

Scheduled Refresh

Row Level Security

Sharing Options

Data Lineage

Incremental Refresh

Storage Formats

Endorse Content

Sensitivity Labels

USERNAME()

Returns the domain name and username of the current logged in user

=USERNAME()



USERNAME doesn't have any parameters

Examples:

- [Name] = USERNAME()

HEY THIS IS IMPORTANT!

USERNAME returns the domain and user's username in the format of *domain-name\user-name*

- Person's **username** (i.e., *aaronp*)
- Company **domain** (i.e., *mavencycles*)
- USERNAME** returns (i.e., *mavencycles\aaronp*)



Table filter DAX expression

[Territory Manager] = USERNAME()

Filter the data that this role can see by entering a DAX filter expression that returns a True/False value. For example: [Entity ID] = "Value"

Save

Cancel



USERPRINCIPALNAME

Scheduled Refresh

Row Level Security

Sharing Options

Data Lineage

Incremental Refresh

Storage Formats

Endorse Content

Sensitivity Labels

USERPRINCIPALNAME()

Returns the user's name as their email address (i.e., aaron@mavendemo.com)

=USERPRINCIPALNAME()



USERPRINCIPALNAME doesn't have any parameters

Examples:

- [Email] = USERPRINCIPALNAME()

HEY THIS IS IMPORTANT!

User Principal Name (UPN) looks like an email address, but technically it's a combination of three items:

1. Person's **username** (i.e., aaronp)
2. "@" symbol
3. Company **domain** (i.e., maven inspectional services)



Table filter DAX expression

```
[email_address] = USERPRINCIPALNAME()
```

Filter the data that this role can see by entering a DAX filter expression that returns a True/False value. For example: [Entity ID] = "Value"

Save Cancel



APPLYING RLS IN SERVICE

Scheduled Refresh

Row Level Security

Sharing Options

Data Lineage

Incremental Refresh

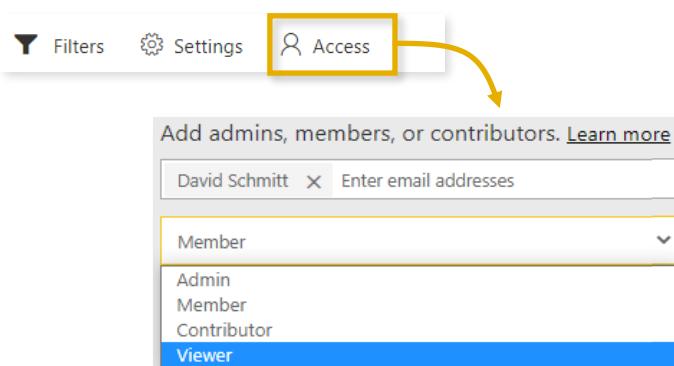
Storage Formats

Endorse Content

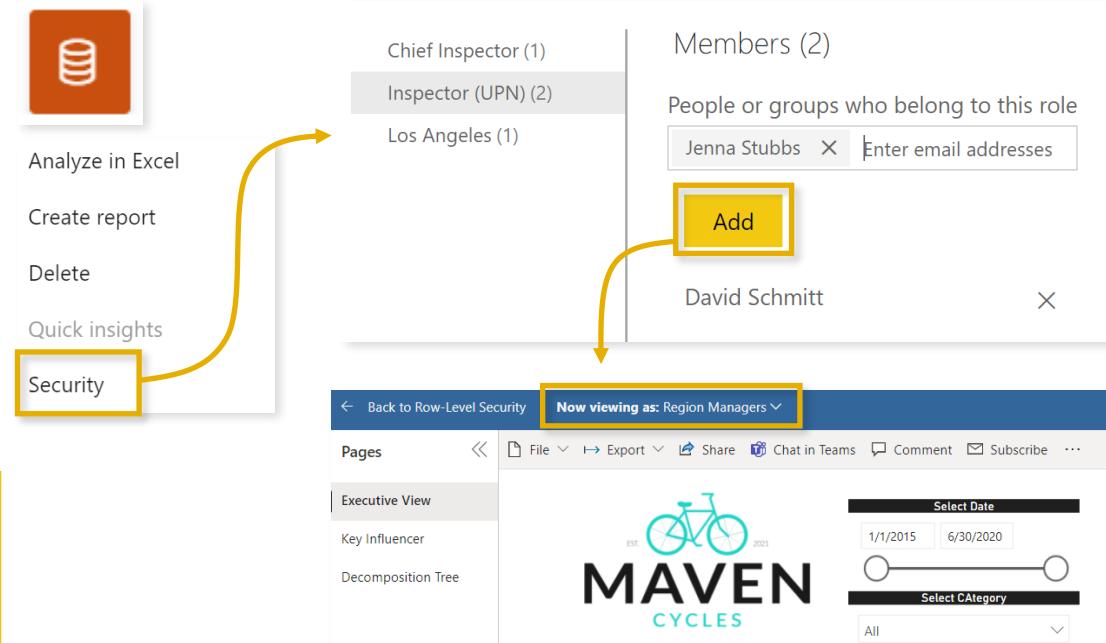
Sensitivity Labels

Once RLS rules have been defined in Power BI Desktop, they can be applied to users who you've shared reports with or have **Viewer** permissions in Power BI Service

- 1 Confirm that users impacted by RLS are assigned to the **Viewer** role



- 2 Add people or groups to the RLS rule



HEY THIS IS IMPORTANT!

If a user is assigned as an Admin, Member, or Contributor, RLS will be overridden



PRO TIP: RLS AZURE GROUPS

Scheduled Refresh

Row Level Security

Sharing Options

Data Lineage

Incremental Refresh

Storage Formats

Endorse Content

Sensitivity Labels

Azure Active Directory **security groups** allow you to manage an entire group of users instead of a list of individual users

The screenshot shows the 'New Group' creation interface in the Microsoft Azure portal. The 'Group type' dropdown is set to 'Security'. The 'Group name' field contains 'Client Reporting Security Group'. The 'Group description' field has the placeholder 'Enter a description for the group'. The 'Membership type' dropdown is set to 'Assigned'. Under 'Owners', it says 'No owners selected'. Under 'Members', it says 'No members selected'. At the bottom is a blue 'Create' button.

Security Group Benefits:

- ✓ Used to manage member and computer access to shared resources for a group of users
- ✓ Create specific security policies (permission levels) for different groups of users
- ✓ Allows you to set permissions for all members of a group at once
- ✓ Great for managing user access when people join and leave teams



SUBSCRIPTIONS

Scheduled Refresh

Row Level Security

Sharing Options

Data Lineage

Incremental Refresh

Endorse Content

Storage Formats

Sensitivity Labels

Subscribe to receive periodic email updates with a report, dashboard, or app snapshot

- Creating subscriptions requires a Pro or PPU license (self & others)
- Add email, subject and an optional message
- Set frequency & time (monthly, weekly, daily, hourly)
- Schedule the start and end dates

Report View



Dashboard View



App View



Subscribe to emails

+ Add new subscription

Inspections & Violations Run Now On

Subscribe Aaron Parry Enter email addresses

Subject Subject

Include an optional message...

Report page Inspections & Violations Manage all subscriptions

Save and close Cancel



SHARING OPTIONS

Scheduled Refresh

Row Level Security

Sharing Options

Data Lineage

Incremental Refresh

Storage Formats

Endorse Content

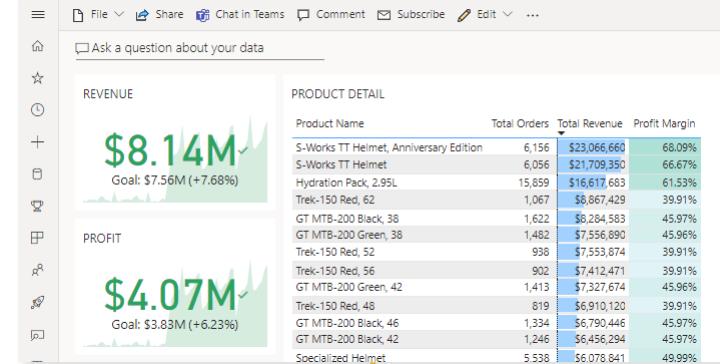
Sensitivity Labels



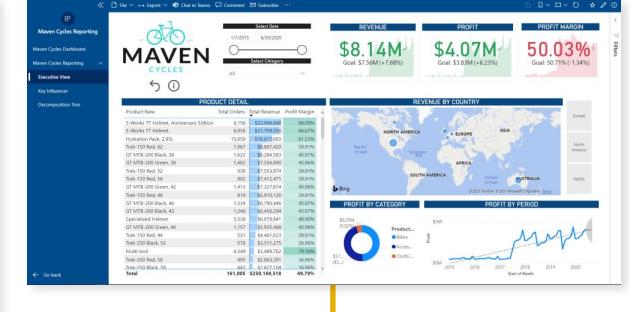
Reports



Dashboards



Apps



INDIVIDUALS



TEAMS



ORGANIZATIONS



PRO TIP: When sharing reports & dashboards, the maximum number of recipients is **100** at a time (500 total); if you need to share with more than 100 recipients, split into multiple sends or use groups



VIEWING RIGHTS

Scheduled Refresh

Row Level Security

Sharing Options

Data Lineage

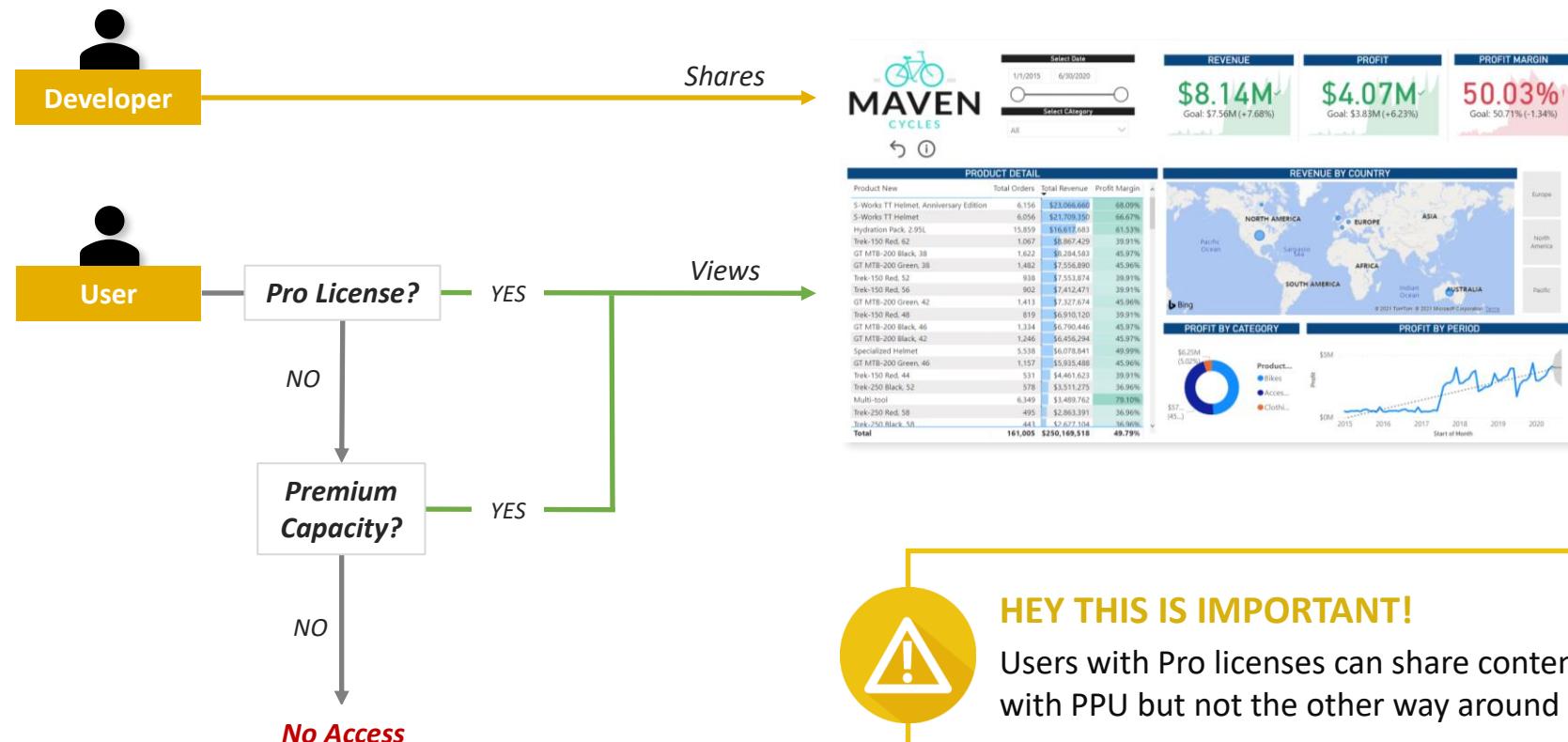
Incremental Refresh

Storage Formats

Endorse Content

Sensitivity Labels

When a developer shares a report or dashboard or publishes an app, users must have either a **pro license** or **access to premium capacity** in order to view





USER PERMISSIONS

Scheduled Refresh

Row Level Security

Sharing Options

Data Lineage

Incremental Refresh

Storage Formats

Endorse Content

Sensitivity Labels

When sharing workspaces, you can assign roles based on these **levels of permissions**:

VIEWER

- View workbooks, reports, and dashboards
- Can't access datasets, dataflows, or edit content

CONTRIBUTOR

- Lifts Viewer restrictions, plus:*
- Publish, create, edit, and delete content
 - Can't add people to new roles or modify members
 - Can share if the content has been previously shared but can't share new content

MEMBER

- All Contributor rights, plus:*
- Add members or users with lower permission levels
 - Publish and update apps
 - Share an item or app
 - Allow others to reshare

ADMIN

- All Member rights, plus:*
- Update/delete workspaces
 - Add or remove other users (including admins)



PRO TIP: When assigning privileges, use the **principle of least privilege** so users only have access to what they need



Add admins, members, or contributors. [Learn more](#)

Chris Dutton Enter email addresses

Member

Admin
Member
Contributor
Viewer



PUBLISHING APPS

Scheduled Refresh

Row Level Security

Sharing Options

Data Lineage

Incremental Refresh

Storage Formats

Endorse Content

Sensitivity Labels

You can select reports and dashboards to **publish as an app** so large groups of people, both internal and external to your organization, can view them

2 Select **Create app** to publish the app

Create app

1 From within a workspace, select any **reports** and **dashboards** you want to include

| All | Content | Datasets + dataflows | | | | | | |
|-----|----------------------------|----------------------|-------------------------|----------------------|--------------|-------------|-------------|---|
| | Name | Type | Owner | Refreshed | Next refresh | Endorsement | Sensitivity | Include in app |
| | Maven Cycles Dashboard | Dashboard | Maven Cycles Reporti... | — | — | — | — | <input checked="" type="checkbox"/> Yes |
| | Maven Cycles Pin Live Page | Dashboard | Maven Cycles Reporti... | — | — | — | — | <input type="checkbox"/> No |
| | Maven Cycles Reporting | Report | Maven Cycles Reporti... | 6/18/21, 10:13:25 AM | — | — | — | <input checked="" type="checkbox"/> Yes |



PUBLISHING APPS

Scheduled Refresh

Row Level Security

Sharing Options

Data Lineage

Incremental Refresh

Storage Formats

Endorse Content

Sensitivity Labels

After selecting Create app, configure the **setup**, **navigation**, and **permissions**

3

In the **Setup** tab, name the app, add a description, logo, and color theme

4

In the **Navigation** tab, use the navigation builder to customize the order, name, and navigation width

5

In the **Permissions** tab, add individuals, groups, or entire organizations to the App

6

Publish the app!



PUBLISHING APPS

Scheduled Refresh

Row Level Security

Sharing Options

Data Lineage

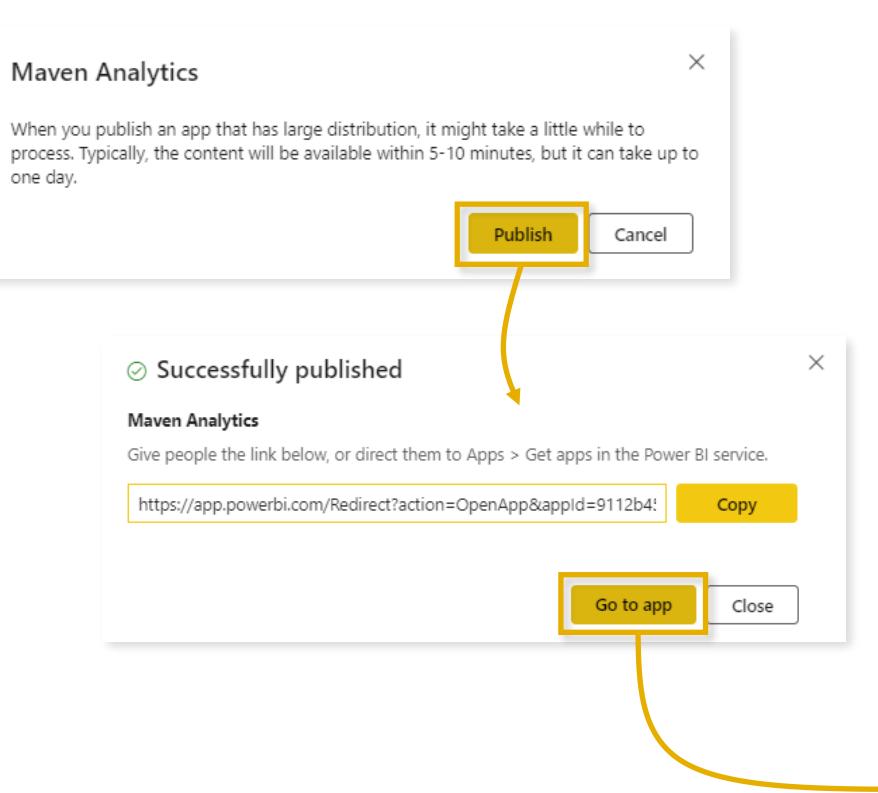
Incremental Refresh

Storage Formats

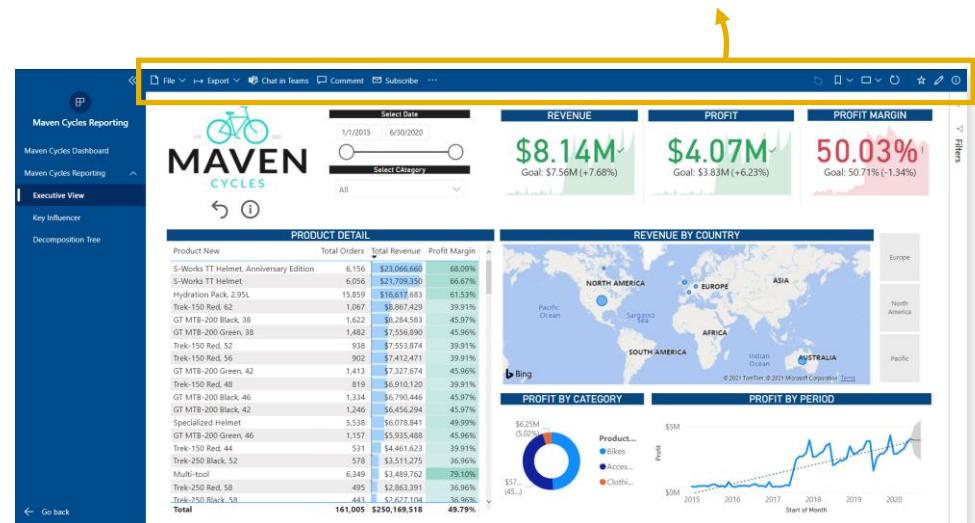
Endorse Content

Sensitivity Labels

After publishing the app, you'll be provided a **link for direct access**



Menu options allow users to do things like **print**, chat in **Teams**, add **comments**, **subscribe**, **favorite**, **edit** (*permissions depending*), etc.





DEPLOYMENT PIPELINES

Scheduled Refresh

Row Level Security

Sharing Options

Data Lineage

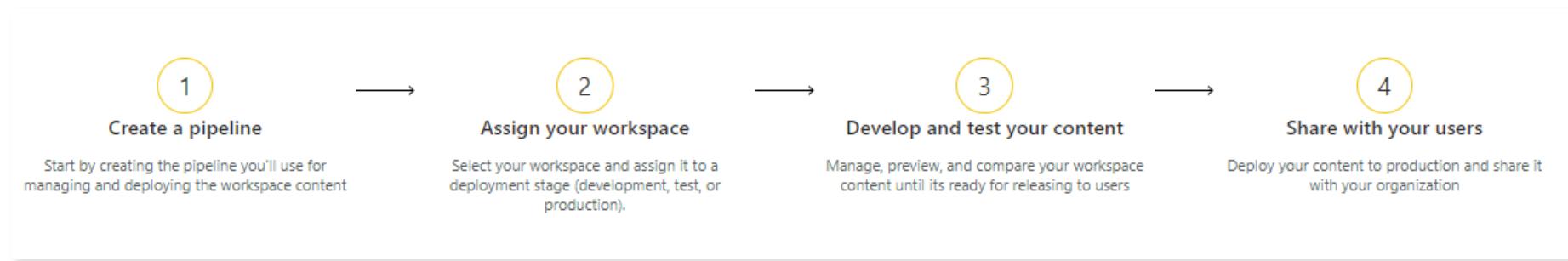
Incremental Refresh

Storage Formats

Endorse Content

Sensitivity Labels

Deployment pipelines allow you to manage the lifecycle of your organization's content (ALM) by developing and testing in Power BI before it's consumed by the end-user



Development

- First stage in Deployment Pipeline
- Used to design, build & upload new content with fellow creators

Test

- Share with testers & reviewers
- Test with larger volumes of data
- See how app looks for end-users

Production

- Share final version of content with users across organization

HEY THIS IS IMPORTANT!

This concept is possible by manually creating separate workspaces, but deployment pipelines automate the process!



DATA LINEAGE

Scheduled Refresh

Row Level Security

Sharing Options

Data Lineage

Incremental Refresh

Storage Formats

Endorse Content

Sensitivity Labels

Data lineage refers to the flow of data from a data source to a report and dashboard



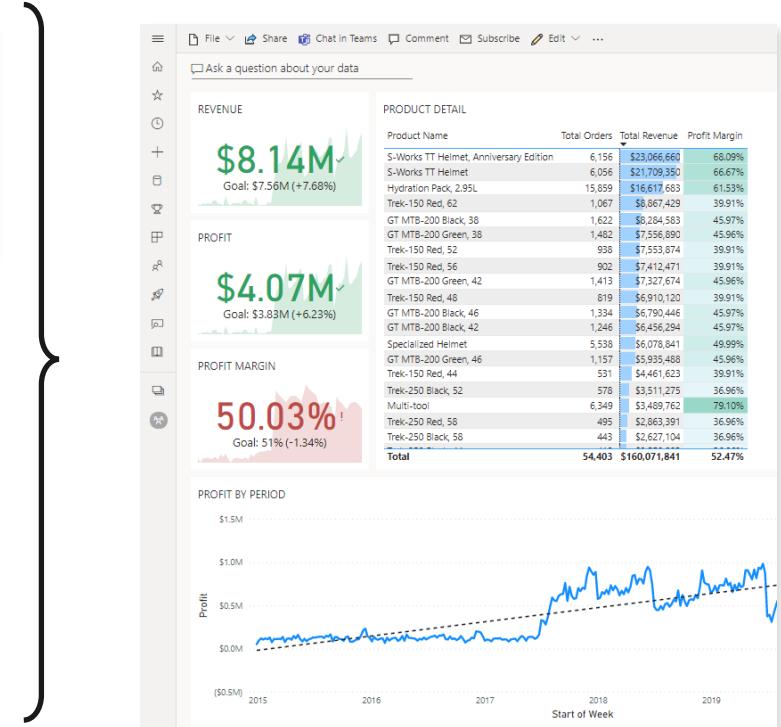
Datasets

Data sources you've connected to



Reports

Visuals built from a single dataset



Google Analytics





DATA LINEAGE VIEW

Scheduled Refresh

Row Level Security

Sharing Options

Data Lineage

Incremental Refresh

Storage Formats

Endorse Content

Sensitivity Labels

Lineage view shows how data is linked across multiple data sources & dependencies

List View

Maven Cycles Reporting

+ New ▾

All Content Datasets + dataflows

Name Type Owner Refreshed Next refresh Endorsement Sensitivity Include in app

| Name | Type | Owner | Refreshed | Next refresh | Endorsement | Sensitivity | Include in app |
|------------------------|---------|------------------------|----------------------|--------------|-------------|-------------|----------------|
| Maven Cycles Reporting | Dataset | Maven Cycles Report... | 6/18/21, 10:13:25 AM | N/A | — | — | — |

Lineage View

```
graph TD; A[mvcycprod.csv] --> B[Text/CSV  
Maven Cycles Product Subcategories.csv]; A --> C[Text/CSV  
Maven Cycles Regions.csv]; A --> D[Text/CSV  
Maven Cycles Sales.csv]; A --> E[sample4.json]; B --> F[Maven Cycles Reporting]; C --> F; D --> F; E --> F; F --> G[Maven Cycles Dashboard]; G --> H[Maven Cycles Pin Live Page]
```

DATA LINEAGE TOOLS

Scheduled Refresh

Row Level Security

Sharing Options

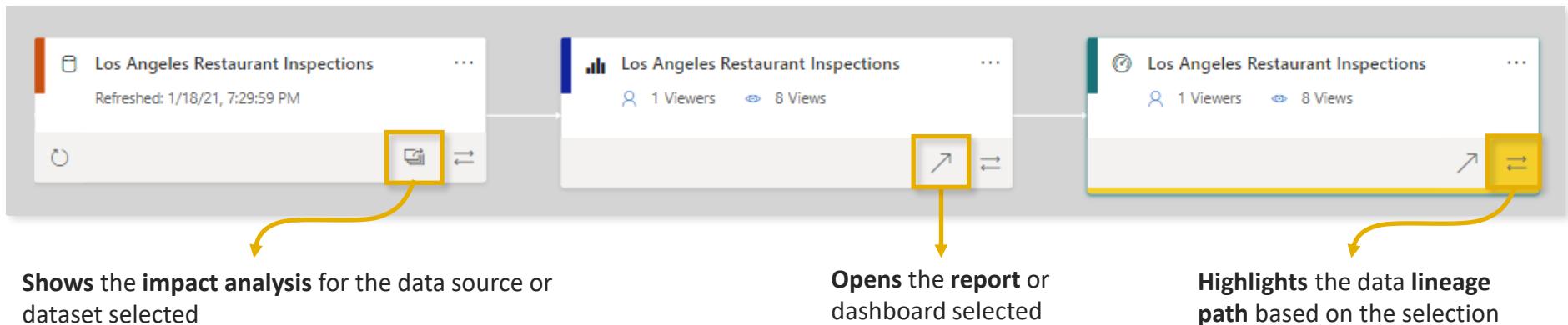
Data Lineage

Incremental Refresh

Storage Formats

Endorse Content

Sensitivity Labels



The screenshot shows the "Impact analysis" interface for "Los Angeles Restaurant Inspections".

Impact analysis

Los Angeles Restaurant Inspections

1 Workspaces | 1 Reports | 1 Dashboards | 16 Views

Notify contacts

| Name | Viewers | Views |
|-------------------------------------|---------|-------|
| Maven Analytics This workspace | 1 | 16 |
| Los Angeles Restaurant Inspectio... | 1 | 8 |
| Los Angeles Restaurant Inspectio... | 1 | 8 |



PRO TIP: Use the **lineage path** tool to help diagnose errors in reports and dashboards that get data from multiple data sources; this is especially useful when sharing dataflows and datasets across workspaces



INCREMENTAL REFRESH

Scheduled Refresh

Row Level Security

Sharing Options

Data Lineage

Incremental Refresh

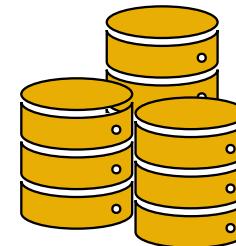
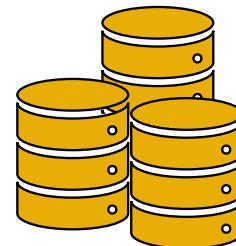
Storage Formats

Endorse Content

Sensitivity Labels

Incremental Refresh is the process of reloading only the part of a dataset that may change over time and adding it to the rest of the data set that no longer changes

- **Faster Refresh Times** - Typically used with large datasets to decrease processing time
- **More Reliable** - Decreases the time connections are made to external sources
- **Reduced Resource Usage** - Easier on the internal resources of your computer (i.e., memory)



Example 1: Macro Data (*i.e. population*)

- 20+ years of data
- Daily-level data
- 1 Billion records

Example 2: Micro Data (*i.e. sensor data*)

- 3 years of data
- Daily-level (hours, minutes, seconds)
- 100 Million records



QUERY FOLDING

Scheduled Refresh

Row Level Security

Sharing Options

Data Lineage

Incremental Refresh

Storage Formats

Endorse Content

Sensitivity Labels

Query folding is the ability for Power Query to generate a single query statement to retrieve and transform source data to improve the efficiency of the Power Query engines

- **IMPORTANT:** The whole purpose of incremental refresh is lost if a query cannot be folded

Incremental refresh



Unable to confirm if the M query can be folded. It is not recommended to use incremental refresh with non-foldable queries. [Learn more](#)

You can improve the speed of refresh for large tables by using incremental refresh. This setting will apply once you've published a report to the Power BI service.



Once you've deployed this table to the Power BI service, you won't be able to download it back to Power BI Desktop. [Learn more](#)

Table

Incremental refresh

Restaurant Inspection Data

Off

Store rows in the last:

Enter value... Select value... ▾

Refresh rows in the last:

Enter value... Select value... ▾

Detect data changes [Learn more](#)

Only refresh complete periods [Learn more](#)

Sources that **support** Query Folding:

- Relational Databases
- Odata (SharePoint lists)
- Microsoft Exchange
- Azure Active Directory

Sources that **don't support** Query Folding:

- Flat files (csv, xlsx, etc.)
- Azure Blob storage
- Web page data



CONFIGURING INCREMENTAL REFRESH

Scheduled Refresh

Row Level Security

Sharing Options

Data Lineage

Incremental Refresh

Storage Formats

Endorse Content

Sensitivity Labels

1

Set RangeStart & RangeEnd parameters from the Query Editor in Power BI Desktop

Manage Parameters

The screenshot shows the 'Manage Parameters' dialog in Power BI Desktop. A 'New' button is at the top right. Below it is a list of parameters: 'RangeStart' (selected) and 'RangeEnd'. The 'RangeStart' row contains fields for 'Name' (RangeStart), 'Description' (empty), 'Required' (checked), 'Type' (Date/Time), 'Suggested Values' (Any value), and 'Current Value' (1/1/2016 12:00:00 AM). A yellow box highlights the 'RangeStart' parameter.

IMPORTANT: The Name & Type **must** reflect what's shown here; these parameters are case sensitive and are reserved by Power BI specifically for incremental refresh

Current Value should be a date/time value within your date/time range; this will be overwritten when you later define Incremental refresh

RangeStart & RangeEnd parameters are added to the list of Query Editor queries

| Queries [3] | |
|-------------|-----------------------------------|
| | Restaurant Inspection Data |
| | RangeStart (1/1/2016 12:00:00 AM) |
| | RangeEnd (12/31/2016 12:00:00 AM) |

HEY THIS IS IMPORTANT!

Current Value data type must be set to Date/Time
Additionally, your fact table **date column** data type must also be set to Date/Time



CONFIGURING INCREMENTAL REFRESH

Scheduled Refresh

Row Level Security

Sharing Options

Data Lineage

Incremental Refresh

Storage Formats

Endorse Content

Sensitivity Labels

2 Apply RangeStart & RangeEnd parameters to a date column using a *Custom Filter* from the filter options

Parameters are used to filter data imported into Power BI Desktop & dynamically partition the data into ranges

The screenshot shows the 'activity_date' column's filter options. On the left, there are sorting and filtering controls like 'Sort Ascending', 'Sort Descending', and 'Clear Filter'. Below these are 'Date/Time Filters' and a 'Search' bar. The main area lists specific dates from January 4 to 15, 2016. At the bottom, a note says 'List may be incomplete.' and there are 'Load more' and 'OK/Cancel' buttons. A yellow box highlights the 'Custom Filter...' button at the bottom right.

To avoid duplicated rows, only add an “=” sign on one side of the parameter; try using “>=” on StartRange and “<” on EndRange

Filter Rows

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

Basic Advanced

Keep rows where 'activity_date'

is after or equal to RangeStart
 And Or
 is before RangeEnd
RangeStart
RangeEnd

OK Cancel

HEY THIS IS IMPORTANT!

Since the date field is what determines the partial refresh of the underlying data source, incremental refresh only works with a **Date/Time** column





CONFIGURING INCREMENTAL REFRESH

Scheduled Refresh

Row Level Security

Sharing Options

Data Lineage

Incremental Refresh

Storage Formats

Endorse Content

Sensitivity Labels

3 Define the incremental refresh policy on the dataset (right-click dataset)

You can improve the speed of refresh for large tables by using incremental refresh. This setting will apply once you've published a report to the Power BI service.

- (i)* Once you've deployed this table to the Power BI service, you won't be able to download it back to Power BI Desktop. [Learn more](#)

| Table | Incremental refresh |
|---|-------------------------------------|
| Restaurant Inspection Data | <input checked="" type="radio"/> On |
| Store rows where column "activity_date" is in the last: | 2 Years |
| Refresh rows where column "activity_date" is in the last: | 1 Months |
| <input type="checkbox"/> Detect data changes Learn more | |
| <input type="checkbox"/> Only refresh complete month Learn more | |

Detect data changes is an advanced setting that requires a separate "LastUpdateAt" column (this isn't the same column used to partition the RangeStart & RangeEnd parameters)

Table incremental refresh is applied to

*The number of rows you want to store
(think of this like "load only once and never load again")*

*The number of rows you want to refresh
(think of this like "the rows I want to re-load each time")*



HEY THIS IS IMPORTANT!

Once you publish and configure incremental refresh in Power BI Service, you will not be able to download the dataset to Power BI Desktop



4 Publish to Service for the policy to take effect



LARGE DATASET STORAGE FORMAT

Scheduled Refresh

Row Level Security

Sharing Options

Data Lineage

Incremental Refresh

Storage Formats

Endorse Content

Sensitivity Labels

Large dataset storage format is used for datasets over the 10GB refresh limit in Service

- This is available for Premium & Embedded capacities and Premium Per User



Steps to enable:

- After creating a model in Power BI Desktop, configure **incremental refresh** if you expect your dataset will become larger and progressively consume more memory
- Publish the model as a **dataset** to Power BI Service
- In Power BI Service, go to Dataset > Settings > **Large dataset storage format**, click the slider to turn “On”, and then “Apply”
- Refresh the dataset to load **historical data** based on the incremental refresh policy (*the first refresh could take a while to load, but subsequent refreshes should be faster depending on your incremental refresh policy*)



ENDORSE CONTENT

Scheduled Refresh

Row Level Security

Sharing Options

Data Lineage

Incremental Refresh

Storage Formats

Endorse Content

Sensitivity Labels

Endorsement is a way to flag content that's ready for others to use

- Any content owner or member with write permissions can endorse content
- It's possible to endorse **datasets, dataflows, reports, and apps**

Endorsement (preview)

Help coworkers find your quality content by endorsing this dataflow. [Learn more](#)

None

This dataflow will appear in search results but isn't endorsed.

Promoted

When you're ready to distribute the dataflow to your coworkers, promote it to let them know.

Certified

Certify your dataflow to show coworkers that it's been reviewed and meets your org's certification criteria. [How do I get my dataflow certified?](#)

Apply

Discard

Certification means that the content meets the organization's quality standards and can be regarded as reliable, authoritative, and ready to use across the organization



SENSITIVITY LABELS

Scheduled Refresh

Row Level Security

Sharing Options

Data Lineage

Incremental Refresh

Storage Formats

Endorse Content

Sensitivity Labels

Sensitivity labels in Power BI provide a simple way to classify and safeguard sensitive content by labeling reports, dashboards, datasets, dataflows, and .pbix files

| Name | Type | Owner | Refreshed | Next refresh | Endorsement | Sensitivity | Include in app |
|--------------------------------|-----------|---------------------|---------------------|--------------|-------------|-----------------------------|----------------|
| Contoso Q2 Division Sales | Report | Sales and Marketing | 3/10/20, 5:40:44 AM | — | — | Confidential - Finance ⓘ | Yes |
| Contoso Q2 Division Sales | Dataset | Sales and Marketing | 3/10/20, 5:40:44 AM | N/A | — | Highly Confidential Pr... ⓘ | Yes |
| Contoso Q2 Division Sales.pbix | Dashboard | Sales and Marketing | — | — | — | Highly Confidential Pr... ⓘ | Yes |
| Sales | Report | Sales and Marketing | 3/10/20, 5:40:17 AM | — | — | Highly Confidential Pr... ⓘ | Yes |
| Sales | Dataset | Sales and Marketing | 3/10/20, 5:40:17 AM | N/A | — | Confidential - Finance ⓘ | Yes |
| Sales.pbix | Dashboard | Sales and Marketing | — | — | — | General ⓘ | Yes |

SENSITIVITY LABEL
Hover over label to see a description

To apply sensitivity labels:

1. You must have a Pro or Premium per User license and edit permission on the content
2. Belong to a security group that has permission to apply sensitivity labels
3. Sensitivity labels must be enabled for your organization
4. Subscribe to Azure Information Protection



HEY THIS IS IMPORTANT!

Sensitivity labels do not affect access to content in Power BI Service; access is solely managed by Power BI permissions



LEARN ON!

