Data Visualization

Unit 2: Introduction to Power BI

Static Graphical Techniques – 1

Aim

To familiarise students about all aspects of bar graph.

Objectives

The objectives of this module are to understand:

- Making of basic bar graph.
- Customization of bar graphs by changing colour, size etc.
- Application of bar graph in business.

Outcome

At the end of this module, you are expected to explain/describe:

- How we can use power BI.
- Useful knowledge for betterment of Power BI.

Content

- Introduction to Data Visualization,
- Story Telling with Data,
- Introduction to the Power BI Interface I,
- Introduction to the Power BI Interface II,
- Data Connections in Power BI,
- Power Query and Data Cleaning in Power BI,
- Data Modelling in Power BI,
- Basic Visualizations and Dashboards in Power BI

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Data Visualization With Power BI

01 BI and Data Visualization

02 What is Power BI?

03 Power BI Components

04 Building Blocks Of Power BI

05 Power BI Installation

06 Power BI DAX

07 Visual Analytics

08 Power BI Visuals/Charts

What Is Business Intelligence?

What Is Data Visualization?

Design

Information Science

Data Visualization

Communication

William Playfair
(Geometric Charts 1781)

Explored exports from
seventeen countries to Scotland

Graphical representation of data for better understanding.

- Simplifies data interpretation.
- Identifies patterns, trends, and outliers.
- Enhances decision-making through visuals.

Data Visualization Tools

tableau

Principles of Effective Visualization

- • Use appropriate chart types.
- • Ensure clarity and simplicity.
- • Emphasize key insights.
- • Use color and design effectively.

What Is PowerBI?

From connection to collaboration, PowerBI is the most powerful, secure and flexible end-to-end analytics platform for your data

- Apt Visualizations
- Depth
- Automatic Function
- Connection To Data

Power BI

- Power BI is the collection of software apps, services, and connectors that turn the raw data into meaningful, immersive, and interactive insights. **Power BI** is a business analytics service offered by Microsoft that allows users to analyze data and share insights. It provides an intuitive interface for creating interactive reports and dashboards.
- It is very versatile to use. It can accept input from Excel sheets, databases, or even cloud storage. You can connect the data sources, derive insights, and share them with others. Power BI is the most popular business intelligence tool out there, but why? let's discuss why is Power BI in demand and what makes it different from other tools.
- ***Download Here:*** *https://www.microsoft.com/en-us/download/details.aspx?id=45331*

Power BI

- Power BI is a **business intelligence tool** that allows you to connect to various data sources, visualize the data in reports and dashboards, and then share them with anyone you want.
- Power BI is made up of 3 main elements:
- **Power BI Desktop** - a free desktop application for building and designing reports.
- **Power BI Service** - the online publishing service for viewing and sharing reports and dashboards.
- **Power BI mobile apps** - for viewing reports and dashboards on the go.

Power BI Desktop

- Power BI is a free application that can be downloaded and installed on the system. It can be connected to multiple data sources. Usually, an analysis work begins in **Power BI Desktop** where report creation takes place. The report is then published to **Power BI service** from where it can be shared to the **Power BI Mobile apps** so that people can view the reports even on mobiles.
-

Power Bi - Features

- Data Visualization
- Data Exploration
- Data Modeling
- Data Transformation
- Collaboration
- Mobile Access
- Natural Language Processing:
- Real-time data

Building Blocks Of PowerBI

- *Visualizations*
- *Datasets*
- *Reports*
- *Dashboards*
- *Tiles*

Power Bi Products

- Power BI Desktop
- Power BI Service
- Power BI Mobile
- Power BI Embedded
- Power BI Report Server
- Power BI Premium

Power BI Compare to Other Tools Like Tableau and Excel?

- Power BI and Tableau are both business intelligence tools and have a lot of overlap in terms of their capabilities. There are 2 key differences between Power BI and Tableau:
- Power BI only works on Windows, whereas Tableau supports Windows and MacOS.
- Pricing options differ between Power BI and Tableau. However, Tableau is generally the more expensive option.

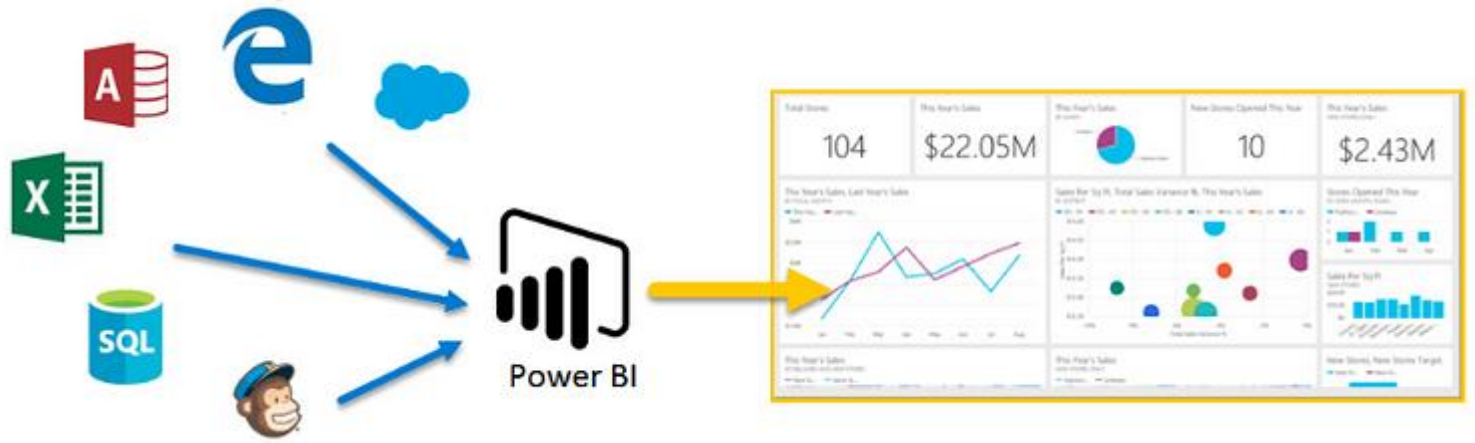
Power Bi

- Set of Business Intelligence and Analytical Services from Microsoft.
- It offers Interactive Visualization and advance analytics capabilities that empower everyone to take faster and smarter Realtime decisions.
- It is on the top of popular BI tools due to ease of use and interactive visualization.
- It offers self service analytics capability to end users to create reports and dashboards.
- BI is a widely popular BI tool having customers ranging from students, startup , SME to large organizations.
- No programming skills are required.
- Any analyst can connect to any data source and quickly summaries findings in simple reports.

Overview Power BI

Power Bi **Overview** Power BI gives the ability to analyze and explore data on-premise as well as in the cloud. Power BI provides the ability to collaborate and share customized dashboards and interactive reports across colleagues and organizations, easily and securely.

- Business analytics tool by Microsoft.
- Interactive visualizations and business intelligence capabilities.
- Data visualization, modeling, and real-time analytics.
- Integration with various data sources.
- Customizable dashboards and natural language query support

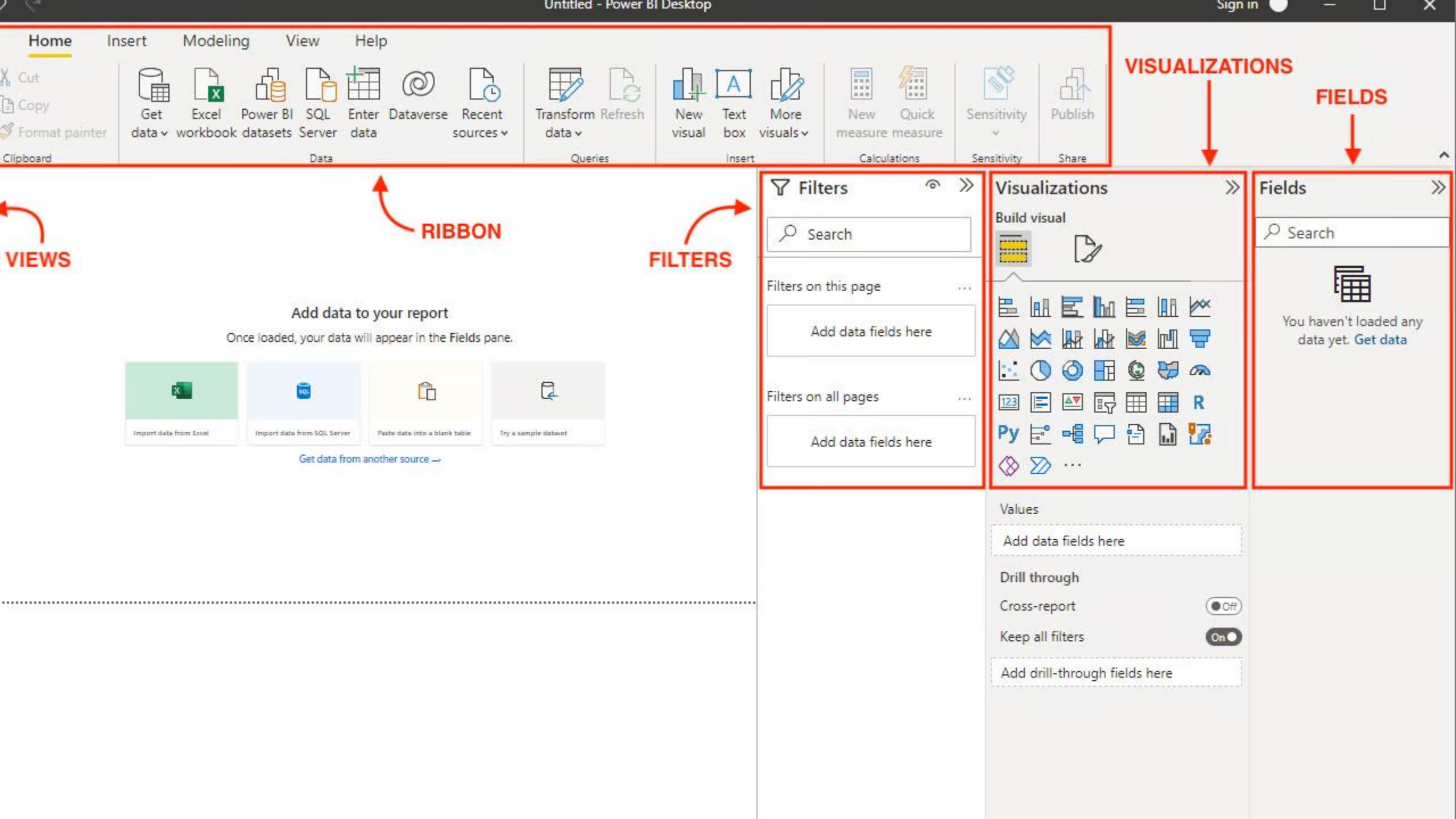


Downloading and Installing Power BI Desktop

- Power BI Desktop is one of the core elements of Power BI and it is the main application for designing and building reports.
- It is recommended to download Power BI Desktop from the Microsoft Store as there are a few advantages:
- Windows will automatically update your Power BI Desktop with the latest version. Since Microsoft releases updates for Power BI every month, this can be a big time-saver.
- Rather than downloading the entire application for each update, Windows will only download the components that changed in the update. This makes updates faster and is useful if you are trying to minimize your data usage.
- You are not required to have admin privileges on your computer to install or update Power BI Desktop (as is often the case with company-provided computers). This also speeds up the monthly update process since you won't need to contact your IT department whenever you need to update the application.
- If you need to download the Power BI Desktop application directly, go to the **product page** and select 'See download or language options'. This will take you to the Microsoft Download Center, where you can download the latest version of the application.
- Keep in mind that you cannot install both the Microsoft Store version and the version from the download center on your computer at the same time. If you do need to switch, be sure to uninstall your current version of the application before installing the next.

Power BI

- Power BI will start with a blank report when you launch the application. Let's go over the components of the Power BI Desktop:
- **Ribbon** - the top ribbon contains most of the controls and options needed for building the report.
- **Views** - this is made up of the report view, the data view, and the model view.
- **Canvas** - this is the main design area where visualizations and other elements are added.
- **Page selector** - for navigation to other pages in the report.
- **Filters** - fields can be added here to filter the data.
- **Visualizations** - this contains the list of available visualizations.
- **Fields** - this section contains the tables and fields that are available in the data model.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Get data
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Queries
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Text box
More visuals
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New measure
Quick measure
Calculations
Sensitivity
Sensitivity
Publish
Share
VISUALIZATIONS
FIELDS
RIBBON
VIEWS
FILTERS
Add data to your report
Once loaded, your data will appear in the Fields pane.
Import data from Excel
Import data from SQL Server
Paste data into a blank table
Try a sample dataset
Get data from another source
Filters
Search
Filters on this page
Add data fields here
Filters on all pages
Add data fields here
Visualizations
Build visual
Values
Add data fields here
Drill through
Cross-report
Off
Keep all filters
On
Add drill-through fields here
Fields
Search
You haven't loaded any data yet. Get data

Importing and Transforming Data in Power BI Desktop

Data sources and connections

Power BI offers a wide variety of supported data sources and connections, making it incredibly easy to connect to the data source of your choosing. For this tutorial, we will import some sample financial data provided by Mic

Importing data

As stated at the beginning of the tutorial, you can download the **sample data** and import it by selecting the Excel data source.

Story Telling with Data

- Data storytelling is the concept of creating a narrative using the data and analytics you've collected that help support the hypothesis of your story. Like with telling a story orally to someone else, you present a cohesive narrative that provides a final message and action to take. Only with data instead of your voice.

- Data storytelling uses several types of data—including scatter plots, geographic maps, timelines, line graphs, pie charts, bar charts, heat maps, and tree charts—to craft a great story.

- But when creating your data story, you'll first need to decide:
- What do you want your users to know?

What do you want users to do?
What's the narrative that'll help drive that action?

Storytelling with Data

- • Combine data visualization with narrative elements.
- • Structure: Context, key findings, and conclusions/recommendations.
- • Engagement: Use visuals and narratives to engage your audience.
- • Call to Action: Highlight actionable insights.

Story Telling with Data

- **Some of the benefits of data storytelling are that it can:**

- Add value so users can connect the dots in your story.

- Increase the credibility of your organization and build trust with the audience.

- Combine an enticing narrative with visually stimulating elements so users can read and retain information.

  Foster engagement with relevant data.

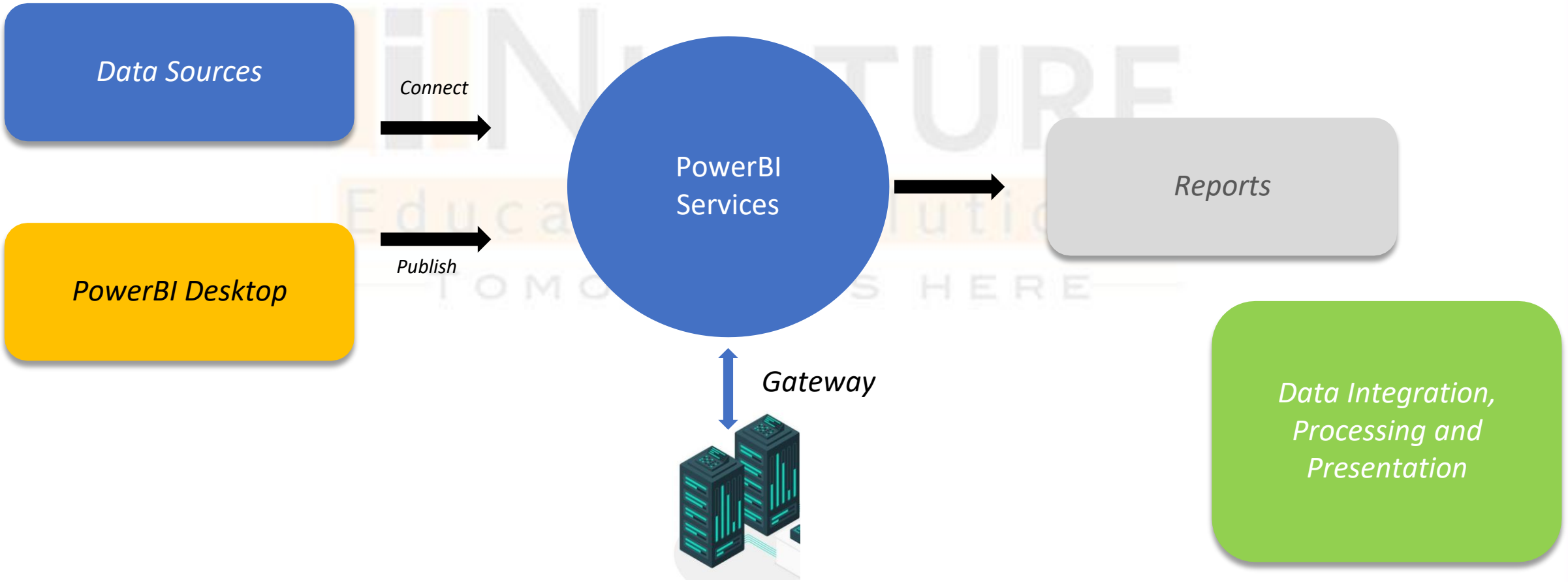
- Provide proprietary data to create new and original stories.

  Versatile so it can be incorporated into other forms of digital media.
  Generate brand awareness to position your organization as an industry leader.

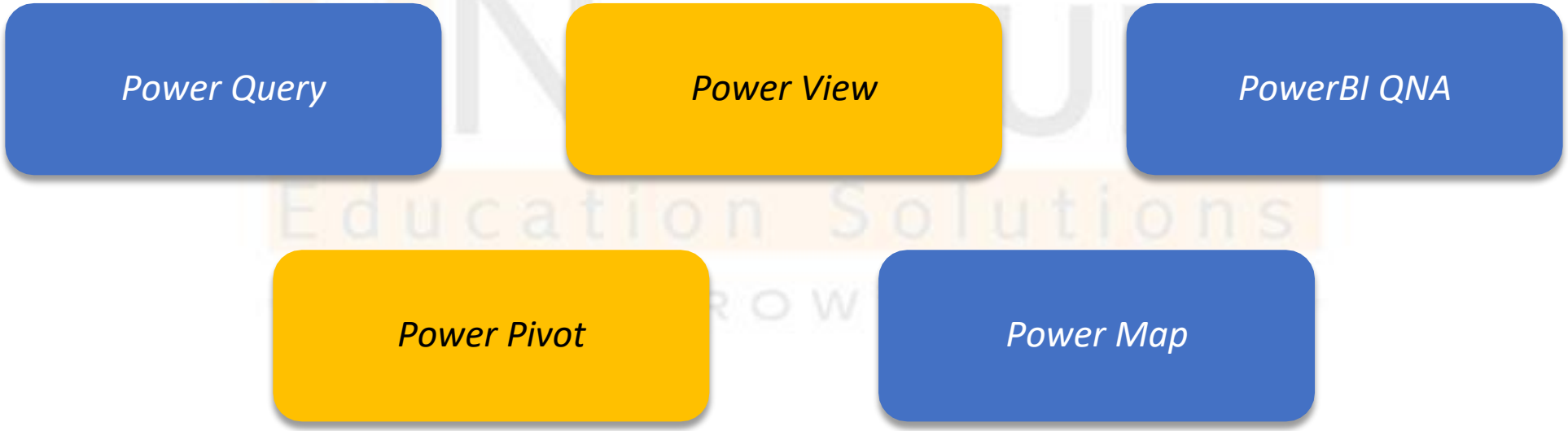
Story Telling with Data

- Ease of Use: Intuitive drag-and-drop interface.
- • Integration: Works seamlessly with Excel, SQL Server, Azure, and other Microsoft products.
- • Scalability: Suitable for individuals, teams, and enterprises.
- • Cloud Support: Access dashboards from anywhere.

PowerBI Architecture



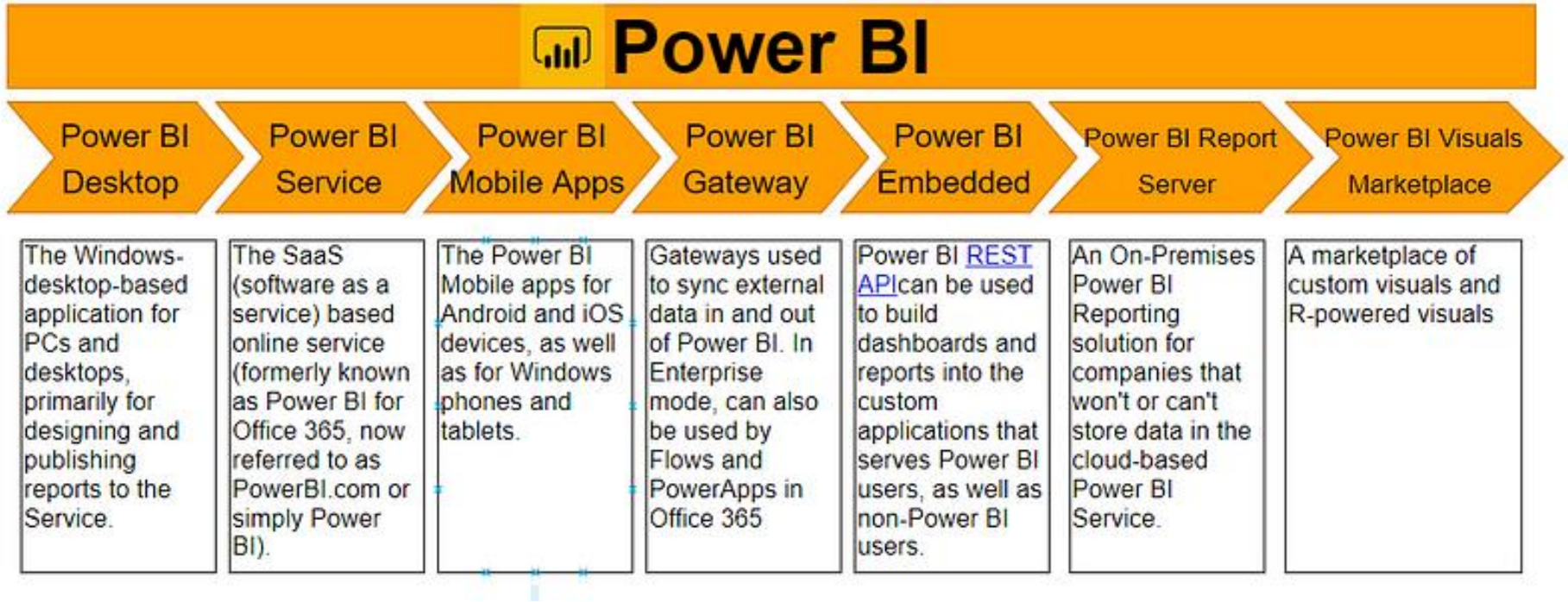
Components of PowerBI



Power BI's components

Power BI consists of various components which are available in the market separately and can be used exclusively.

Power BI Desktop
Power BI Service

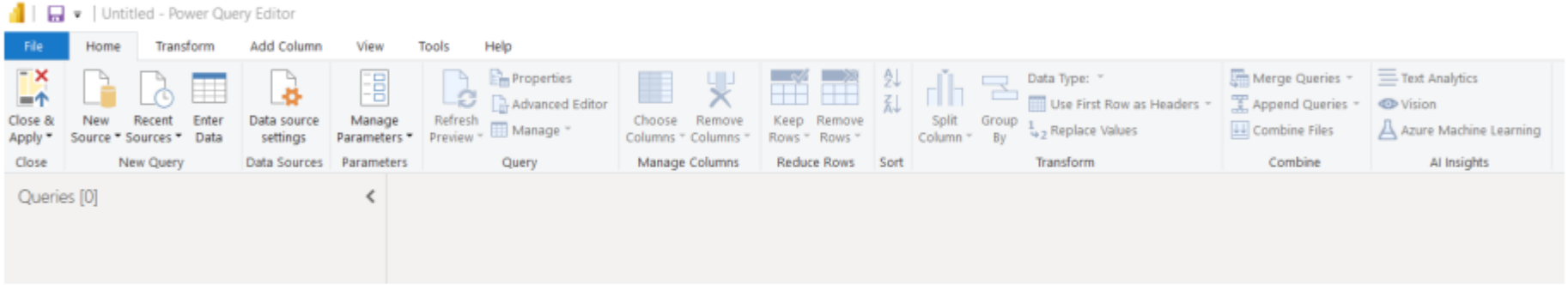


Power BI Interface - Key Components

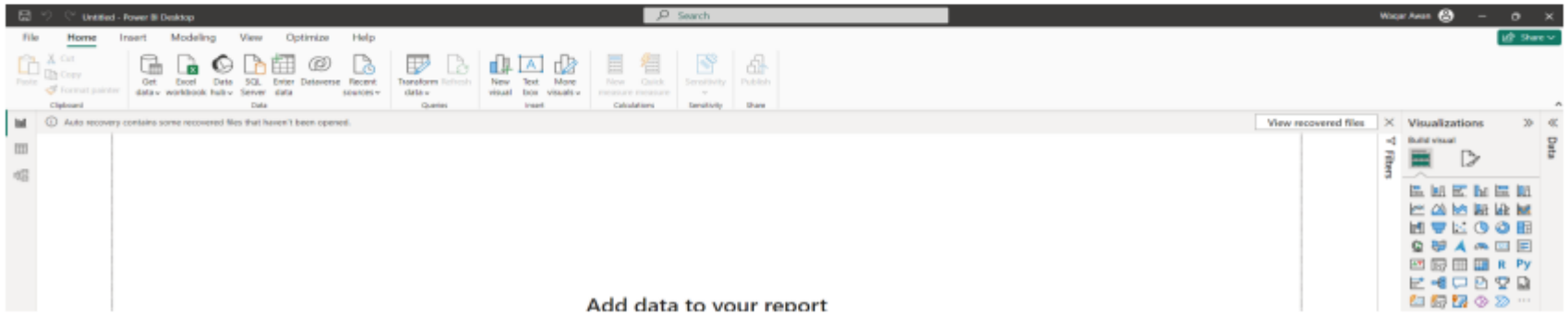
- • Home Ribbon: Import data, transform data, and add visuals.
- • Report View: Main workspace for designing reports.
- • Data View: Inspect and refine imported data.
- • Model View: Manage relationships between tables and fields.
- • Fields and Visualizations Pane: Displays data fields and chart types.

Power Bi Interface Demo

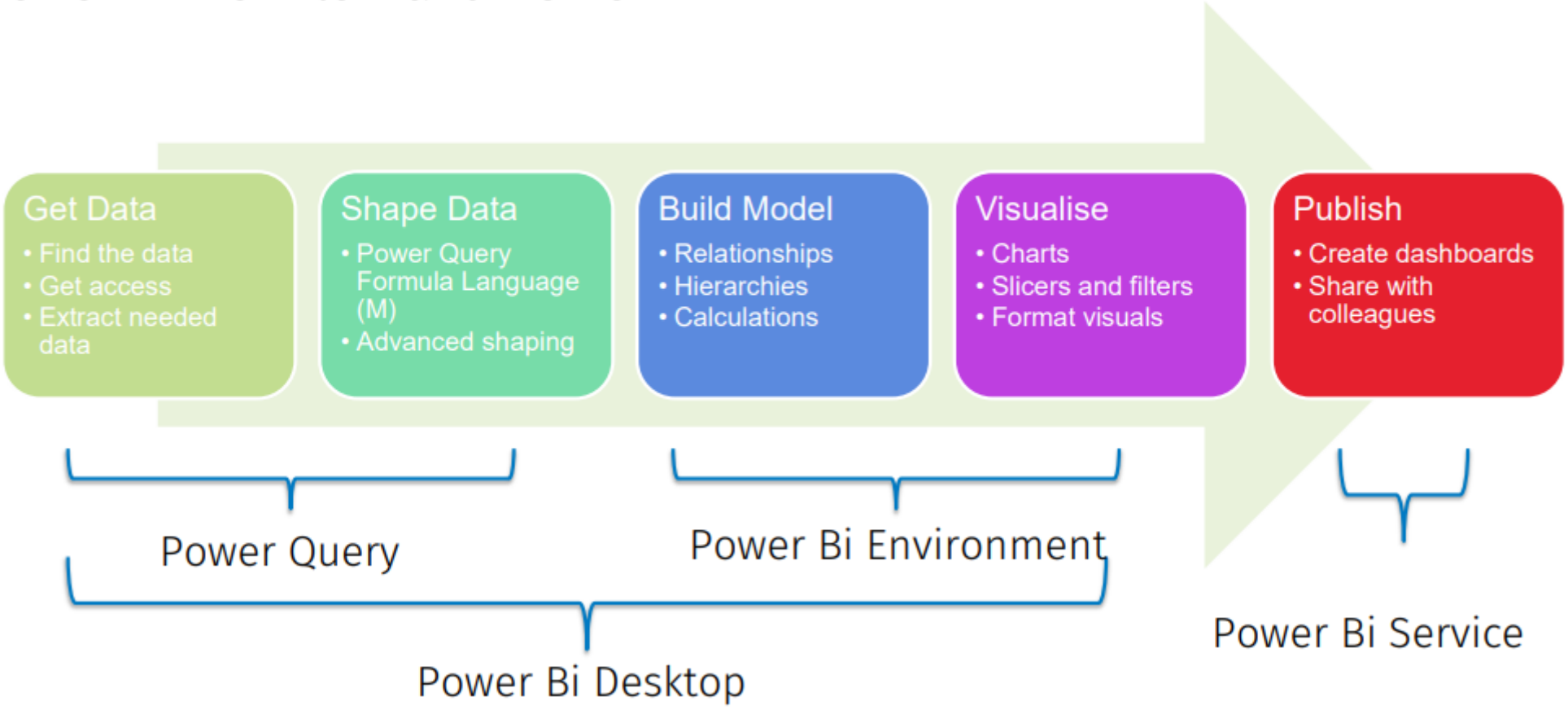
- Power Query Environment



- Power BI Environment



Power Bi Workflow and Demo



Additional Features of Power BI Interface

- • Filter Pane: Apply filters to visuals or reports.
- • Bookmarks: Save specific report views for presentations.
- • Q&A Box: Explore data using natural language queries.
- • Formatting Options: Customize fonts, colors, and layouts.

Power BI - Benefits

- No Memory and Speed Constraints
- Supports Advanced Data Services
- Balanced Simplicity and Performance
- Extract Intelligence Rapidly and accurately..
- No Specialized Technical support required
- Integration with Existing Applications
- Rich Personalized Dashboards
- Secure Report Publishing

Power Pivot, Power View and Power Query

- ☞**Power Pivot :** It is an in-memory component that enables storing compressed data. It is
- used to build data models, relationships, create formulas, calculate columns from different
- resources.
- ☞**Power View:** Power View is a data visualization technology, which lets you create
- interactive graphs, charts, maps, and other visuals to bring life to your data. It is available in
- Excel, SQL Server, SharePoint, and Power BI.
- ☞**Power Query :** Power Query is an ETL tool to clean, shape, and transform data without
- any code using intuitive interfaces. With this: -You can import data from various sources like
- databases from files -Append and join data from a wide range of sources -You can shape data
- as needed by adding and removing it.

Difference between a Filter and a Slicer?

- Using Normal filters users are not allowed to interact with dashboards or reports, but
- using slicers we can interact with dashboards and reports.

- Power BI Service?
- Power BI Service is a cloud-based analytics solution that helps you to create
- dashboards and publish, design reports, collaborate and share the reports with internal and
- external stakeholder

It is a multi-perspective view into a particular data set with visualizations that represent different findings and insights from that a set. A report may be a single visualization or pages full of visualizations.

PowerBI Reports

It is a single page, also known as a canvas, that uses visualizations to tell a particular story. It is limited to one page, and a point note is that a good dashboard contains only the important elements of that story.

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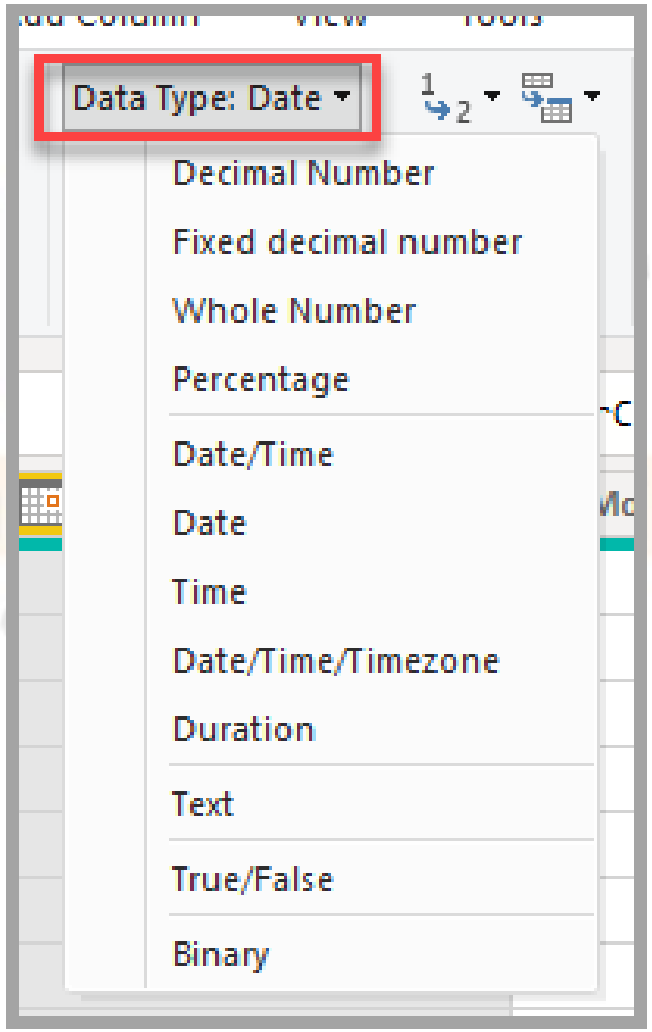
PowerBI Data Types



data sources can you connect to Power BI?

The Power BI data sources are divided as follows: -

📌Files : Data can be imported from Power BI Desktop files (.pbix), Excel (.xlsx, xlxm), and
Comma Separated Value (.csv). –

📌Content Packs: It refers to the collection of related files or documents that are stored as a
group. There are two types of content packs in Power BI: those from service providers
including Google Analytics, Salesforce, and those created and shared by other users in the
organization. –

📌Connectors: To connect databases and other datasets, including Database, Azure SQL,
and SQL Server Analysis Services tabular data, etc

Data Connections in Power BI

There are a plethora of data sources from which you can extract data into Power BI. You can connect to data files on your local system, Excel files, Azure SQL Database, Facebook, Google Analytics, Power BI datasets, etc.
You can connect to cloud-based sources, on-premises data sources using gateways, online services, direct connections, etc. We have listed some commonly used data sources below.

- **File:** Excel, Text/CSV, XML, PDF, JSON, Folder, SharePoint.
- **Database:** SQL Server database, Access database, Oracle database, ***SAP HANA database***, IBM, MySQL, Teradata, Impala, Amazon Redshift, Google BigQuery, etc.
- **Power BI:** Power BI datasets and Power BI dataflows.
- **Azure:** Azure SQL, Azure SQL Data Warehouse, Azure Analysis Services, Azure Data Lake, Azure Cosmos DB, etc.
- **Online Services:** Salesforce, Azure DevOps, Google Analytics, Adobe Analytics, Dynamics 365, Facebook, GitHub, etc.
- **Others:** Python script, R script, Web, Spark, Hadoop File (HDFS), ODBC, OLE DB, Active Directory, etc.

Data Connections in Power BI

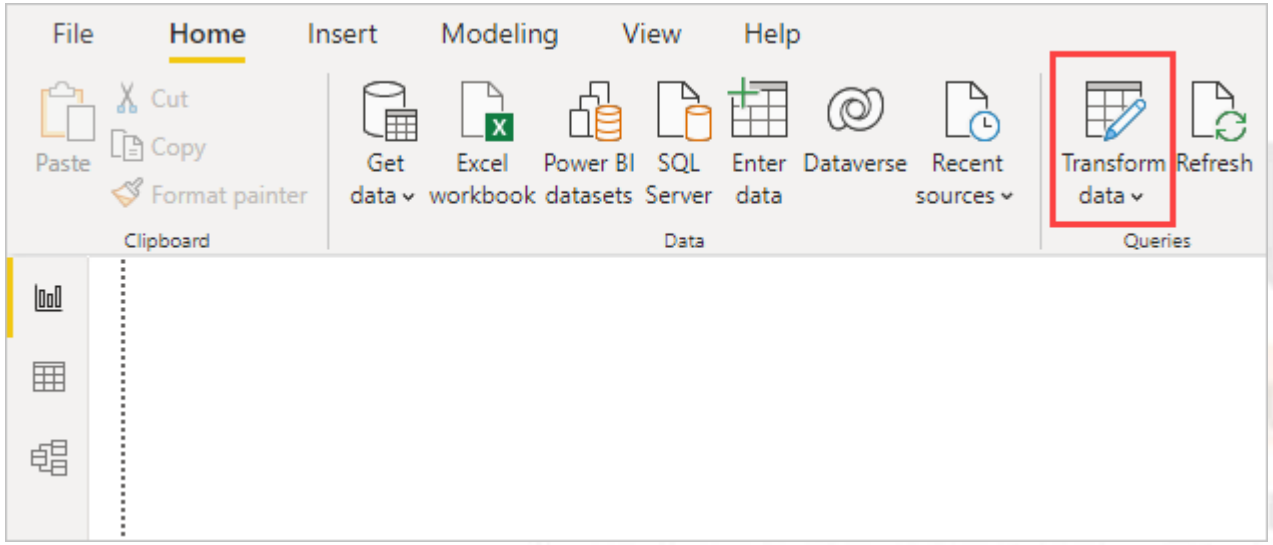
- • Supports databases (SQL Server, Oracle, MySQL), cloud services (Azure, Google Analytics).
- • Excel files, CSV files, and text files.
- • Steps to connect data: Get Data, select source, authenticate, load/transform.

Power Query and Data Cleaning

- • Data transformation and preparation tool.
- • Merge, append, and pivot tables.
- • Remove duplicates, filter rows, and replace values.
- • Create new fields using custom formulas.

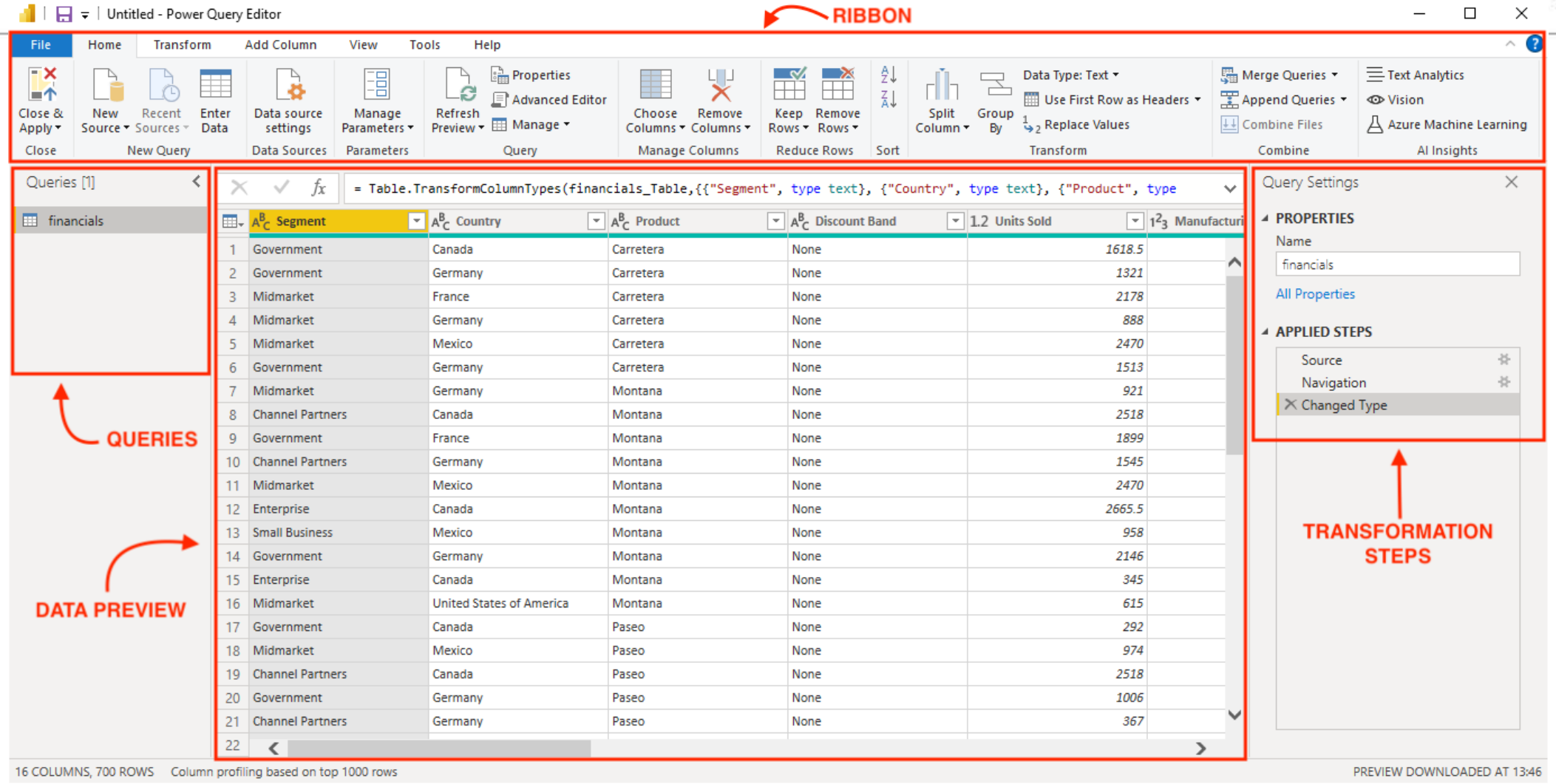
Power Query Editor

To get to Power Query Editor, select **Transform data** from the **Home** tab of Power BI Desktop.



Power Query

- The Power Query Editor can be broken up into 4 main parts:
- **Ribbon** - the top ribbon contains almost all of the data transformation options you need to shape your data. We will explore a few common transformations below.
- **Queries** - this lists all the queries you have set up for this report. For complex reports, you can organize queries into groups for better navigation and management.
- **Data view** - this is the main table containing the data for the selected query as well as a formula bar. A preview of the data is shown with only the first 1000 rows.
- **Transformation steps** - the right-hand pane contains each of the transformation steps that have been applied to the selected query. This allows you to keep track of each individual change that has been made to the data. You can insert, delete, and move steps around as needed.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4 Midmarket Germany Carretera None 888
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6 Government Germany Carretera None 1513
7 Midmarket Germany Montana None 921
8 Channel Partners Canada Montana None 2518
9 Government France Montana None 1899
10 Channel Partners Germany Montana None 1545
11 Midmarket Mexico Montana None 2470
12 Enterprise Canada Montana None 2665.5
13 Small Business Mexico Montana None 958
14 Government Germany Montana None 2146
15 Enterprise Canada Montana None 345
16 Midmarket United States of America Montana None 615
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PROPERTIES
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financials
All Properties
APPLIED STEPS
Source
Navigation
Changed Type
TRANSFORMATION STEPS
16 COLUMNS, 700 ROWS
Column profiling based on top 1000 rows
PREVIEW DOWNLOADED AT 13:46

Power Query

These are some of the most common transformation steps:

- **Removing rows and/or columns** - some Excel data can have a lot of blank rows and/or columns inserted for readability and aesthetic purposes, but these are not useful in Power BI and should be removed.
- **Changing data types** - data types such as number, date, or text should be specified for each column. Power BI will try to automatically detect the data type, yet it can sometimes be wrong or there can be errors so it is a good idea to always double-check the data types.
- **Combining data with merge and append** - similar to join and concatenate in SQL, these transformations allow you to combine queries from multiple sources.
- **Pivot and unpivot** - these options allow you to transform your data from a wide to a long format and vice versa. The unpivot option is particularly useful when dealing with Excel files that have information (such as dates) running across the columns of a table rather than as rows.
- **Adding a conditional column** - this is a useful transformation that allows you to add a column based on if/then/else logic.

Data Cleaning in Power BI

- Data cleaning involves identifying and correcting (or removing) errors and inconsistencies in data to improve its quality. In Power BI, data cleaning is primarily done in the **Power Query Editor**. Here are some key steps involved:
- **1. Removing Duplicates**
- Duplicate records can skew your analysis, leading to inaccurate results. To remove duplicates in Power BI:
- Go to **Home** > **Remove Rows** > **Remove Duplicates** in the Power Query Editor.
- You can remove duplicates from a specific column or an entire table.
- **2. Handling Missing Values**
- Missing values can disrupt calculations and aggregations. There are several ways to handle missing data in Power BI:
- **Remove Missing Data:** If the missing values are not significant, you can remove the rows containing them by going to **Home** > **Remove Rows** > **Remove Blank Rows**.
- **Fill Missing Values:** You can fill missing values using the previous or next available value by selecting the column, then choosing **Transform** > **Fill Down** or **Fill Up**.
- **Replace Missing Data:** You can replace missing values with a specific value, such as a mean, median, or default value, by using the **Replace Values** option under the **Transform** tab.

Data Cleaning in Power BI

3. Standardizing Data Formats

Inconsistent data formats can cause issues when merging or analyzing data. Power BI allows you to standardize formats easily:

Dates: Convert date columns to a consistent format using the **Data Type** drop-down in the Power Query Editor.

Text: Standardize text data by converting it to uppercase, lowercase, or proper case using the **Transform** tab's **Format** options.

Numbers: Ensure all numerical data is correctly formatted as either decimal, whole number, or percentage using the **Data Type** option.

Data Cleaning in Power BI

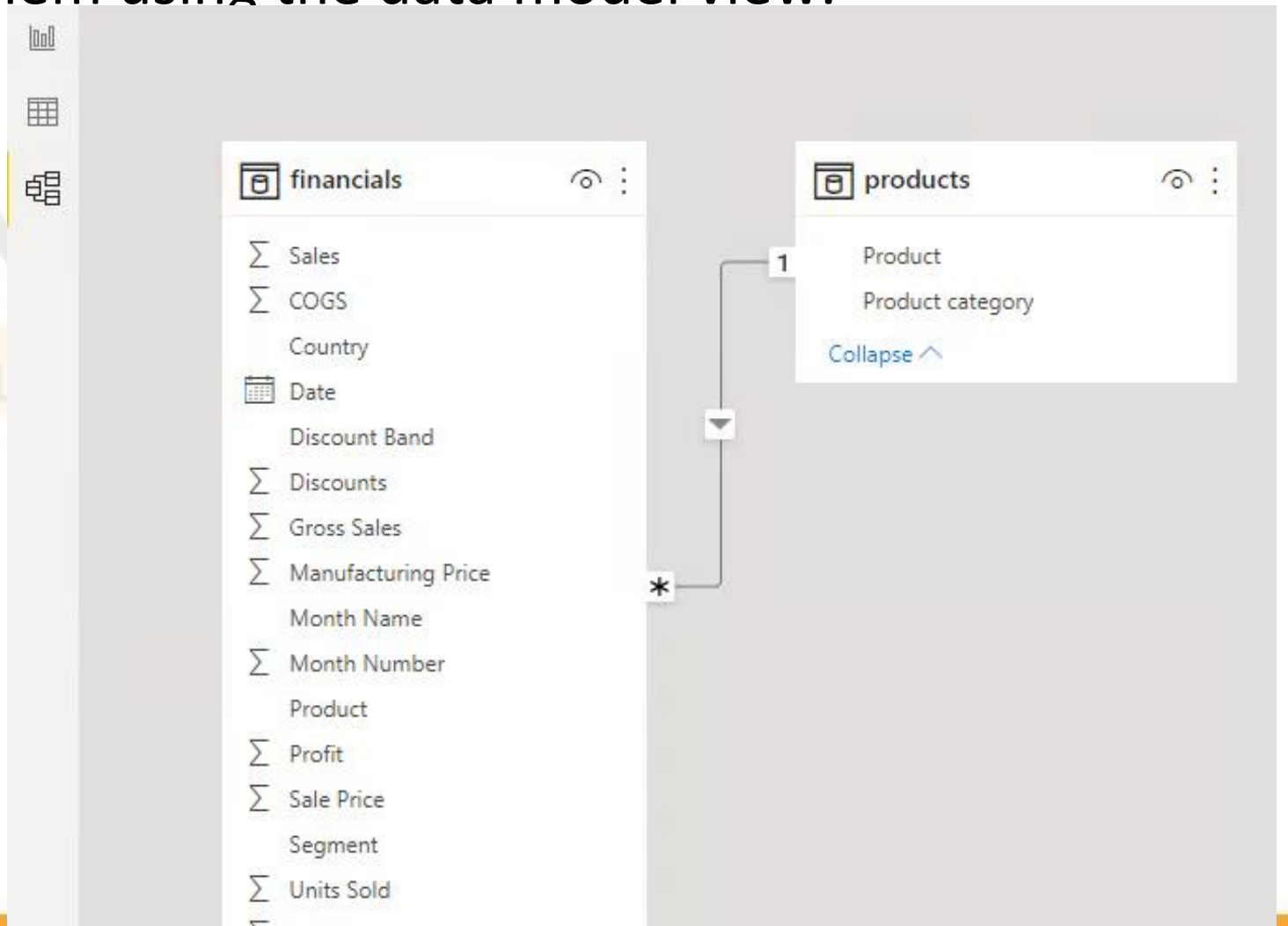
- **4. Splitting and Merging Columns**
- Sometimes, data is stored in a way that's not optimal for analysis. For instance, you may have a column that contains full names when you need separate first and last names. Power BI allows you to split and merge columns:
- **Split Columns:** Select the column you want to split, then go to **Transform** > **Split Column**. You can split by delimiter (like a space or comma), by number of characters, or other criteria.
- **Merge Columns:** To combine columns, select the columns you want to merge, then go to **Transform** > **Merge Columns**.
- **5. Filtering Data**
- Not all data may be relevant for your analysis. You can filter out unnecessary data to keep your model clean and efficient:
- Use the **Filter Rows** option under the **Home** tab to exclude rows based on specific criteria.
- **6. Data Transformation**
- Sometimes, data needs to be reshaped or transformed for better analysis. Power BI offers a variety of transformation options:
- **Pivot/Unpivot:** If you have columns that represent data that should be rows (or vice versa), you can use the **Pivot Column** or **Unpivot Columns** options under the **Transform** tab.
- **Grouping Data:** You can group data based on certain criteria to aggregate values or simplify your dataset.

Data Modelling in Power BI

- • Process of creating relationships between tables.
- • Components: Tables, Relationships, Measures.
- • Best Practices: Meaningful table/field names, normalized data, optimized performance.

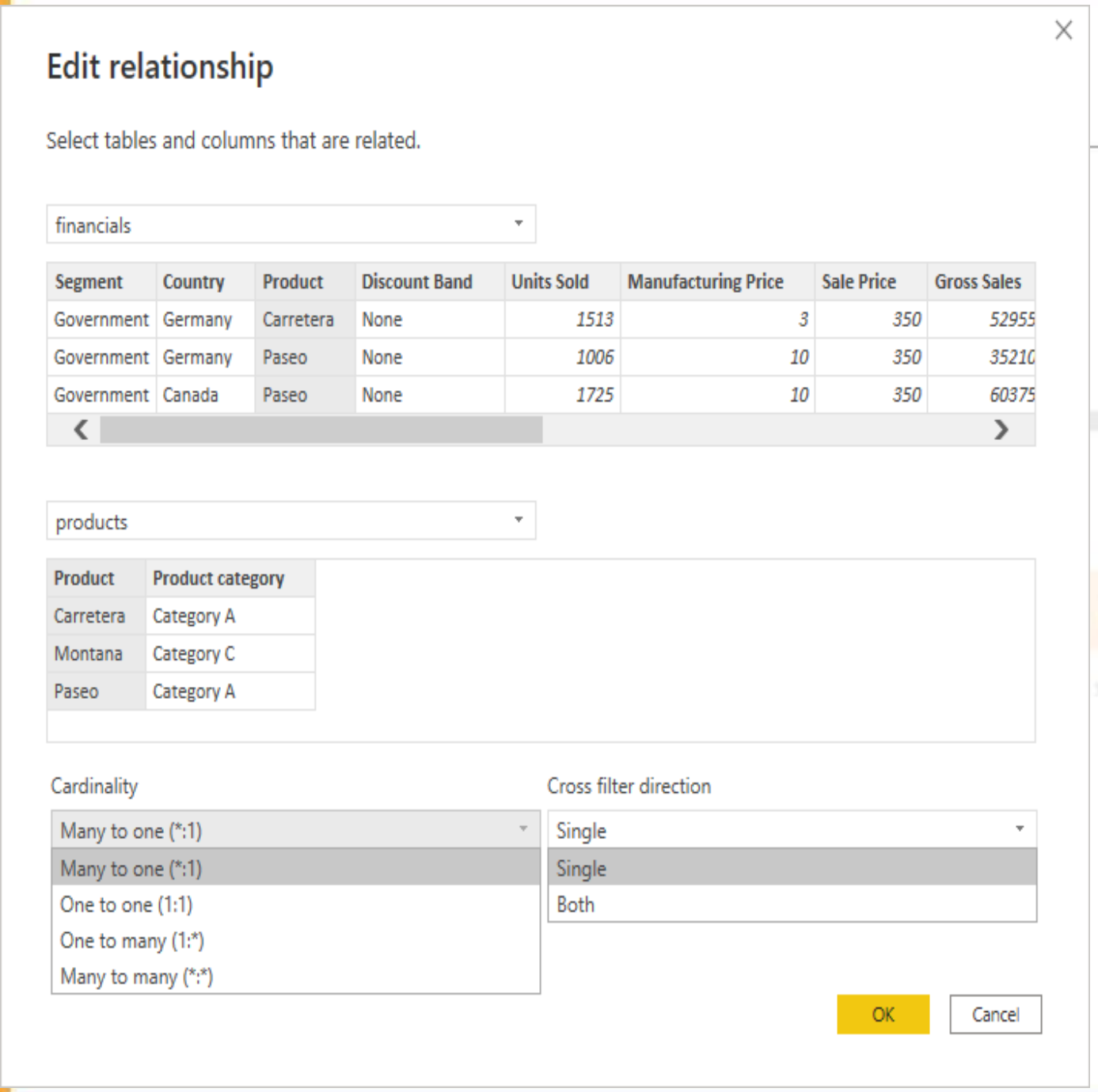
Data model view

- Now that we have imported two data tables, we can create relationships between them using the data model view.



There are two ways you can create a relationship in Power BI:

- Select a field from a table and drag it onto the field in the second table with which you want the relationship to form.
- Select *Manage Relationships* from the ribbon and then select *New* to add a relationship using the same window we will discuss next (except that it will start as "blank").
- By default, Power BI will try to infer a relationship between tables. It doesn't always get this right, so you may wish to turn this feature off in the settings. To edit the relationship, right-click the connecting line between them and select *Properties*.



Cardinality has four choices: many to one, one to one, one to many, or many to many. When creating relationships, it is recommended that the joining fi contains unique values in at least one of the table Our data shows a relationship between the Financials table and the Products table using the Product field. The Products table has unique valu for the Product field (each product only appears once in the table). However, the Financials table c have each product showing up several times by date, country, segment, etc.

Cross-filter direction gives a choice between singl and both directions. Relationships flow from the table with unique values to the table with many values. In our case, the relationship flows from the Products table to the Financials table. This means that if the cross-filter direction is set to single, then the Financials table can be filtered by the Product and product Category fields in the Products table, but the Products table cannot be filtered by using

Basic Visualizations and Dashboards

- • Common visualizations: Bar, Line, Pie Charts; Maps; Tables and Matrices.
- • Steps to create dashboards: Pin visuals, arrange layout, add tiles.
- • Tips for effective dashboards: Focus on key metrics, use slicers and filters, clean design.

Data Modeling in Power BI**

- Data modeling in Power BI is the process of creating relationships between different tables to form a cohesive data model. This enables you to perform advanced analytics and create insightful visualizations.

  ### Steps to Create a Data Model:

  1. **Load Your Data**: Import the necessary tables into Power BI.
  2. **Navigate to Model View**: Click on the "Model" icon in the left-hand pane to switch to the Model view.
  3. **Create Relationships**:
  - Drag and drop fields between tables to create relationships.
  - Configure the relationship by specifying cardinality (e.g., one-to-many) and cross-filter direction.
  4. **Validate the Model**: Ensure all relationships are correctly defined and there are no circular dependencies.

Data Modeling in Power BI

Example:
Let’s consider a scenario where you have three tables: "Sales", "Products", and "Customers".

1. **Import Tables**: Load "Sales", "Products", and "Customers" tables into Power BI.
2. **Model Relationships**:
- Create a relationship between "Sales[ProductID]" and "Products[ProductID]".
- Create a relationship between "Sales[CustomerID]" and "Customers[CustomerID]".
3. **Configure Relationships**:
- Ensure the relationships are set as one-to-many from "Products" to "Sales" and from "Customers" to "Sales".
- Set the cross-filter direction to "Single" for each relationship.
4. **Create Visuals**: Use the modeled data to create visuals like a Sales report by Product and Customer demographics.

Data Sets Websites

- Kaggle
- Google Public Datasets
- UCI Machine Learning Reposority
- Data.gov
- Heathdata.gov
- WHO – Covid data

Big Brands using Power BI

- Netflix
- Amazon
- Starbucks
- IBM
- Deloitte
- TCS

Opportunities for Power BI

- Data Analyst
- Data Analytics Specialist
- Data Visulization Specialist
- Product Data Analyst
- Marketing Analyst
- Health Care Data Analyst
- Financial Analyst

Opportunities for Power BI..

- Digital Marketing Analyst
- HR Analyst
- Customer Insight Analyst
- Web Analyst
- CRM Data Analyst
- Analytics Manager
- BI Analyst

Power Bi Vs Excel

	Power Bi	Excel
Data Size	we can handle millions of rows together with fast speed	It is frustrating to handle large amounts of data
Cloud-Based Features	we can publish the report to the end-users with Microsoft's cloud-based services	we need to share the large data with the dashboard via email or any online sharing tool.
Visualizations	we have plenty of visualizations to design the dashboard,	we have only limited visualizations.
Custom Visualizations	Power BI allows us to import visualizations that are not there in the file by going to the marketplace	Excel does not have that luxury.

Power Bi Vs Tableau

	Power Bi	Tableau
Cost	Power BI is less expensive and cheap.	To acquire Tableau, you need to break the bank and expensive product
Free Versions	Power BI Desktop is a free version with enough resources and tools to visualize the data,	Tableau's free version has very few limited access to all the advanced tools
Data Capacity	Power BI can handle only 10 GB of data, and anything more than that requires cloud services like Azure.	Tableau can handle billions of data without any problem and requirement of cloud services.

Power Bi Products

- Power BI Desktop
- Power BI Service
- Power BI Mobile
- Power BI Embedded
- Power BI Report Server
- Power BI Premium

Data Sources

- Files
- Data Base
- Power Platform
- Online Services
- Others
- Data Sources – Paid, Free, Freemium

PowerBI
DAX

PowerBI DAX

It is a formula expression language called (DAX) that can be used with various visualization tools like Power BI. It is also known as a functional language, where the full code is kept inside a function.

Data types of Dax are:

1) Numeric,
2) Boolean,
3) Date Time,
4) String, and
5) Decimal

PowerBI DAX

DAX is a collection of functions, operators and constant used in formulas, to return one or more values. It is a native formula and Query language by Microsoft

Functional Query Language

Deals with relational data

Performs Aggregations

PowerBI DAX

Syntax

Context

Function

```
Measure =
Function(TableName(ColumnName))
```