Microsoft Power BI Introduction

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Course Contents

- Power BI Introduction
- Obtaining Data
- Steps – Basic
- Steps – Complex
- Extract Relationships
- Introducing DAX Formulas and Measures
- Visualisations
- Visualisation Manipulation
- Publishing/Sharing Reports

Power BI – The Product

What is Power BI?

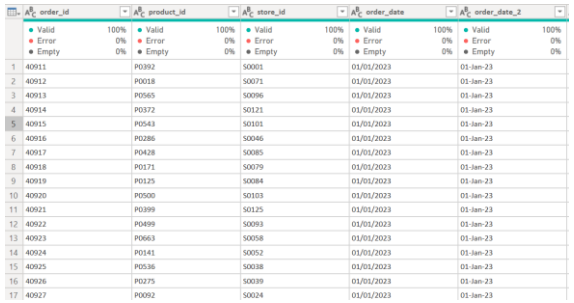
- Power BI is a business analytics service that lets you visualize your data and share insights.
- Power BI was developed from taking Excel's Power Query, Power Pivot and Power View add-ins, and providing it a tool within the Microsoft Power Platform.
- Power BI allows you to develop interactive dashboards and reports.
- Which tool to use will depend on your final output – your objective will be one of the following:
  - Users will need to still manipulate the data using Excel – use the Power Query Editor
  - Need more than the maximum rows Excel can offer – use Power Query loading your data into a Data Model
  - Power Pivot has the additional feature of reporting using KPI's (Key Performance Indicators)
  - Delivery via the Web or mobile app – Power BI is the tool to use here.

Common Uses of Power BI Desktop

- Data from any range of sources across your business can be connected to **Power BI**.
- **Transform** and Refine the data sources into a single Data Model.
- **Visuals** – build charts and maps to represent the data in your model.
- **Reports** – taking your visuals, collating and presenting them on to one or more pages.
- Share reports and dashboards with other users via Power BI Services.
- Power BI has become one of the market leaders in interactive Reporting Tools – some of its competitors are Tableau, Qlik Sense, ThoughtSpot, Looker

The Process

Data Transformation → Data Model → Data Visualisation



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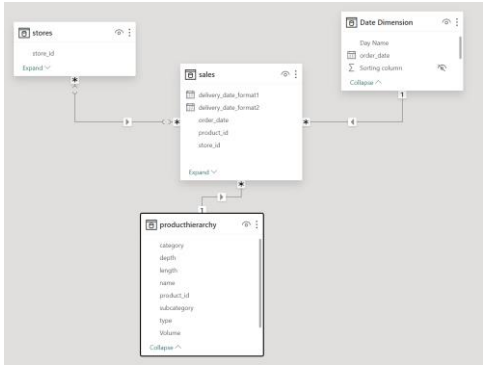

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Power BI Desktop

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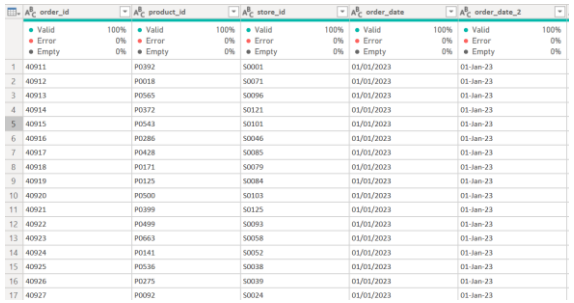

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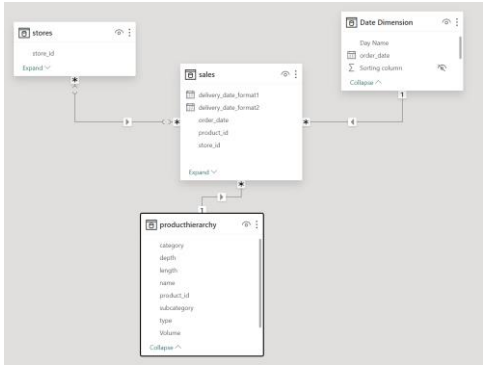


Power BI Mobile

Power BI Cloud

Share & Collaborate

Report Designers v Consumers

- It is important to make the distinction between Report Designers and Report Consumers.
- **Designers** – you will be responsible for building or modifying the report, you will also have edit permission to the underlying dataset.
- **Consumer** – If a report or dashboard has been shared with you, you are the report consumer. You will be able to view and interact with the report, however no editing functionality of the underlying design and data will be available.

Power BI Licenses

- **Power BI Desktop**
  Free version to download. Connect to variety of data sources, build reports including various visualisations and publish to the web. Reports build in this version cannot be distributed to other end users.
- **Power BI Pro**
  With this version, which is chargeable, you can achieve all the functionality of Power BI Desktop, but with the ability to share with other Power BI Pro license users.
- **Power BI Premium**
  Using Power BI Report Server, this offers you on-premise deployment and distribution of reports. This is generally used by larger organisations for deployments and workloads.

- You can download a free Power BI Desktop from https://powerbi.microsoft.com/en-us/desktop/

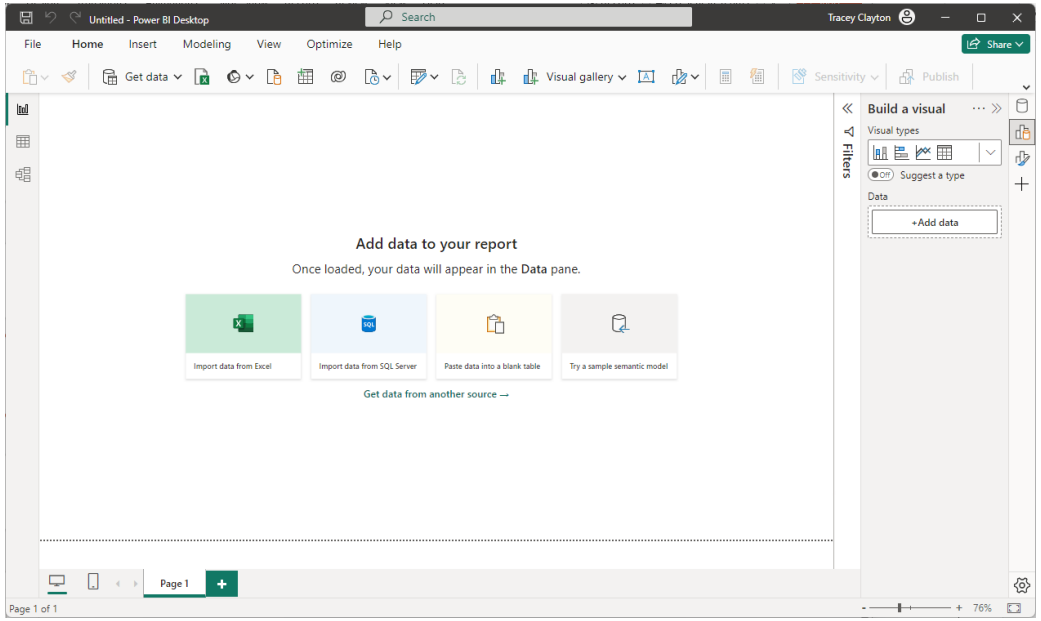
Functionality	Power BI Desktop	Power BI Cloud Service
Organise Data	Yes	Yes
Combine Data	Yes	Yes
Add or Delete Columns	Yes	Yes
Modify Tables	Yes	Yes
Create Visuals	Yes	Yes
Create Reports	Yes	Yes
Create Dashboards	**No**	Yes
Share Dashboards and Reports	**No**	Yes

Tour of the Interface

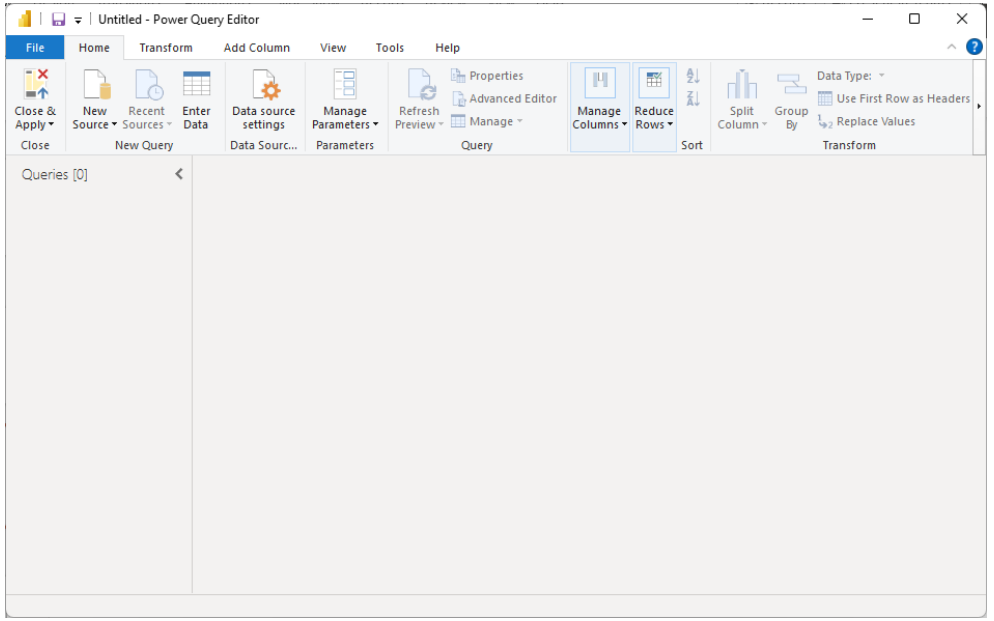
- REPORT BUILDER
- POWER QUERY EDITOR
- VIEWS
- PANES

Interface Explained

- **Power BI Desktop** has two main areas you will work within:
- **Report Builder**: used to manage your data sources, data relationships, build and design your reports.

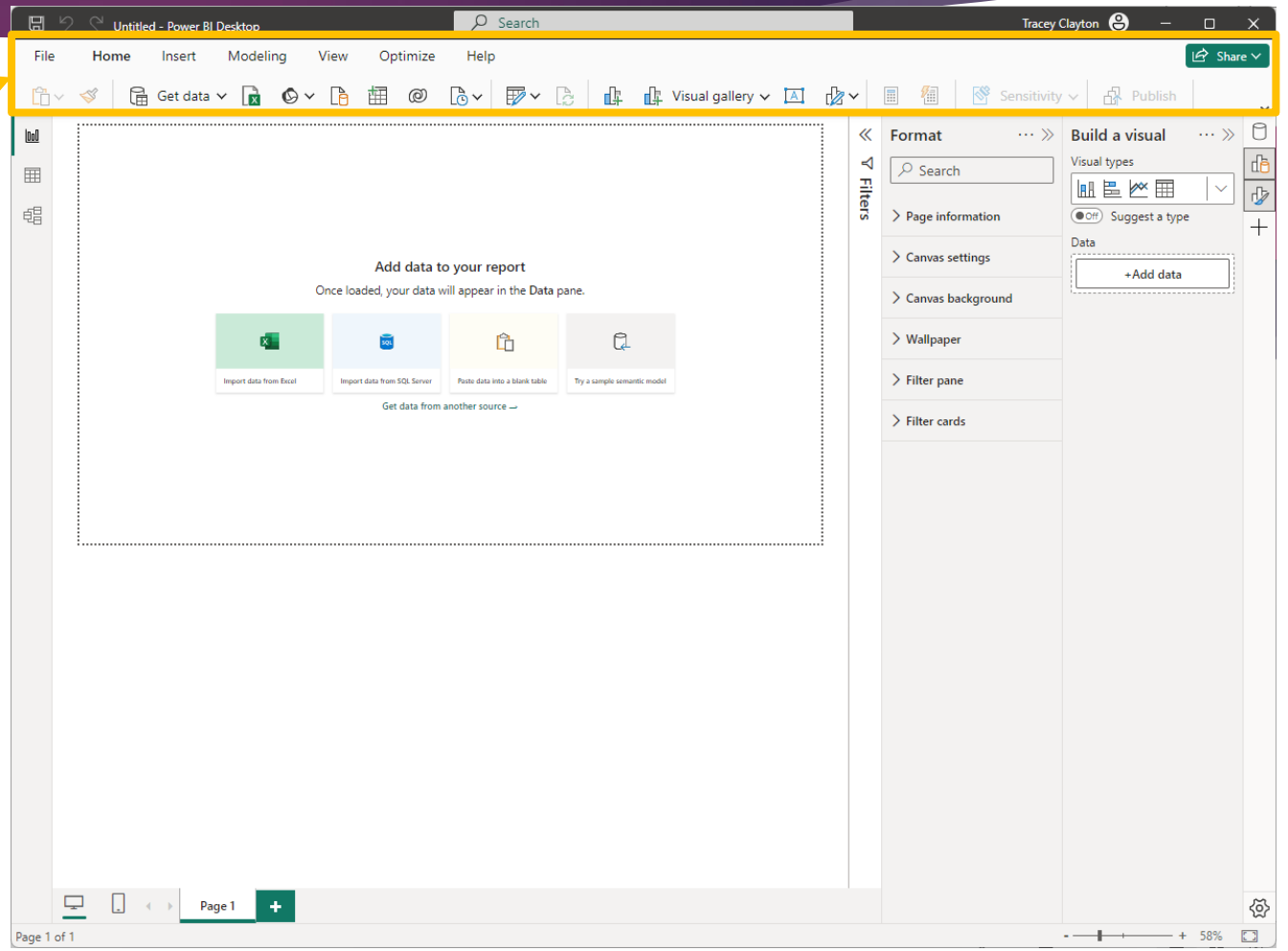


- **Power Query Editor:** used to do all transforming and shaping of your data, connecting to one or more data sources



Report Builder

- Essentially separated into 6 Areas:
- **Menu Ribbon** – select all your Power BI features



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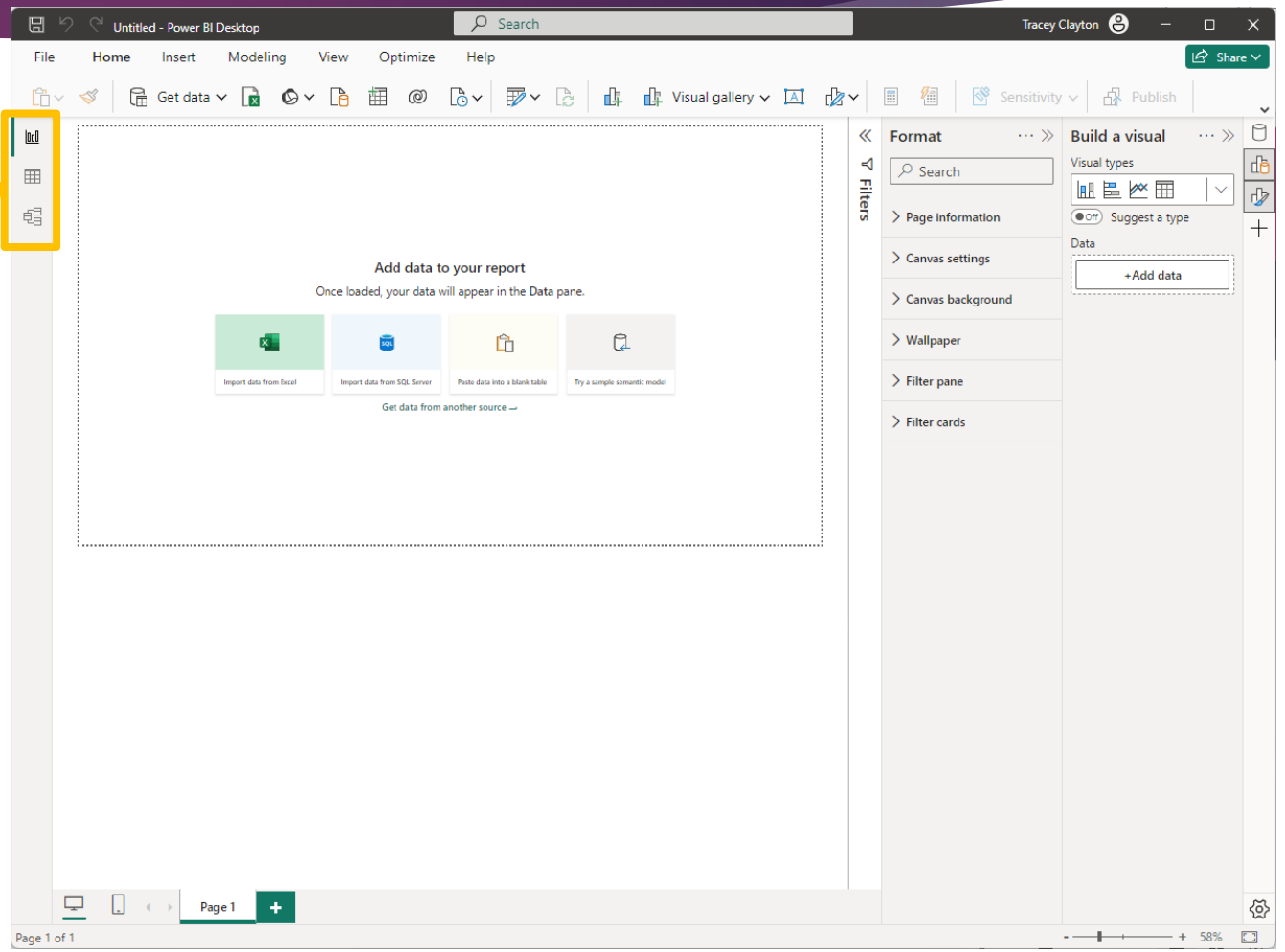

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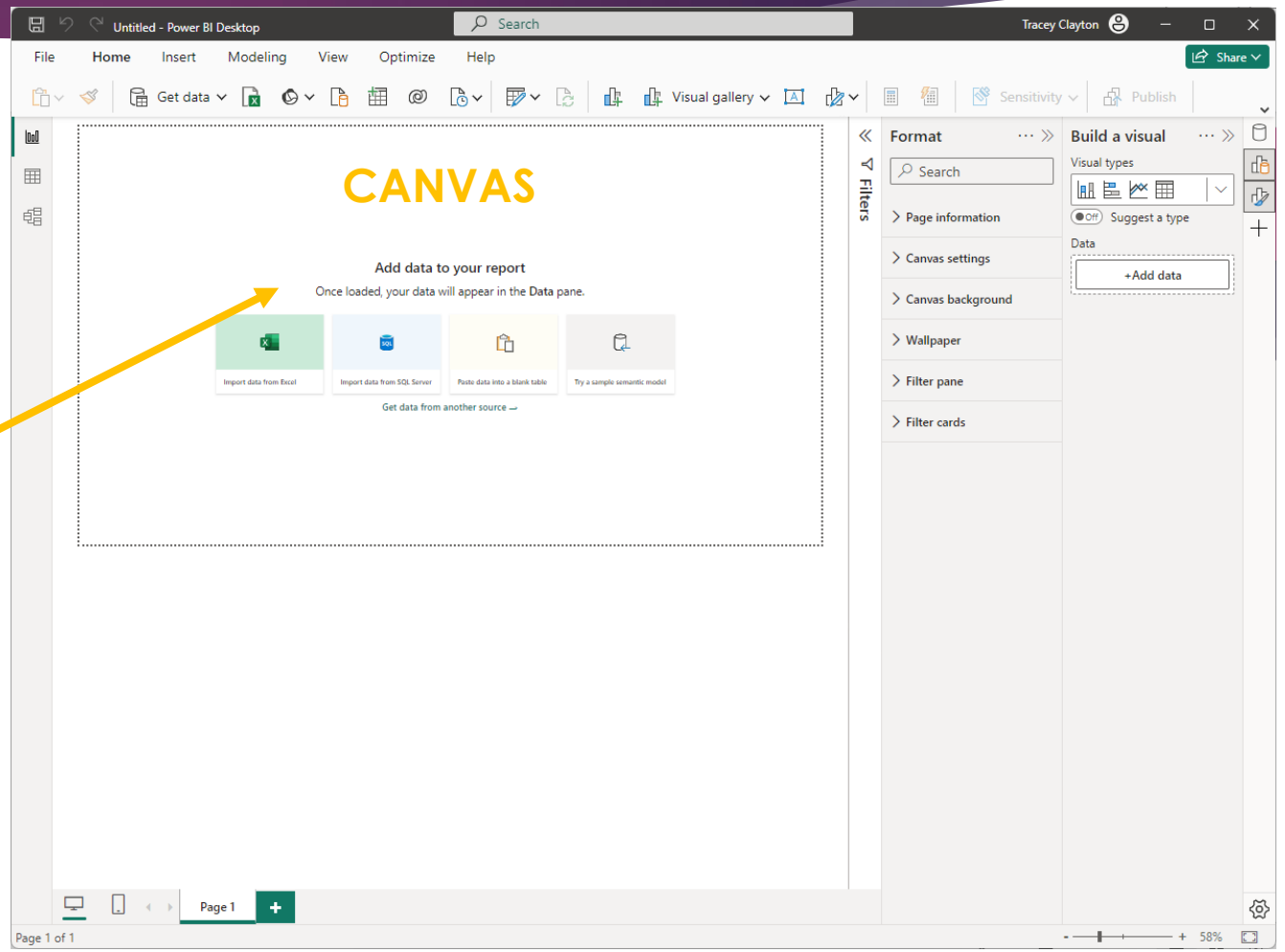

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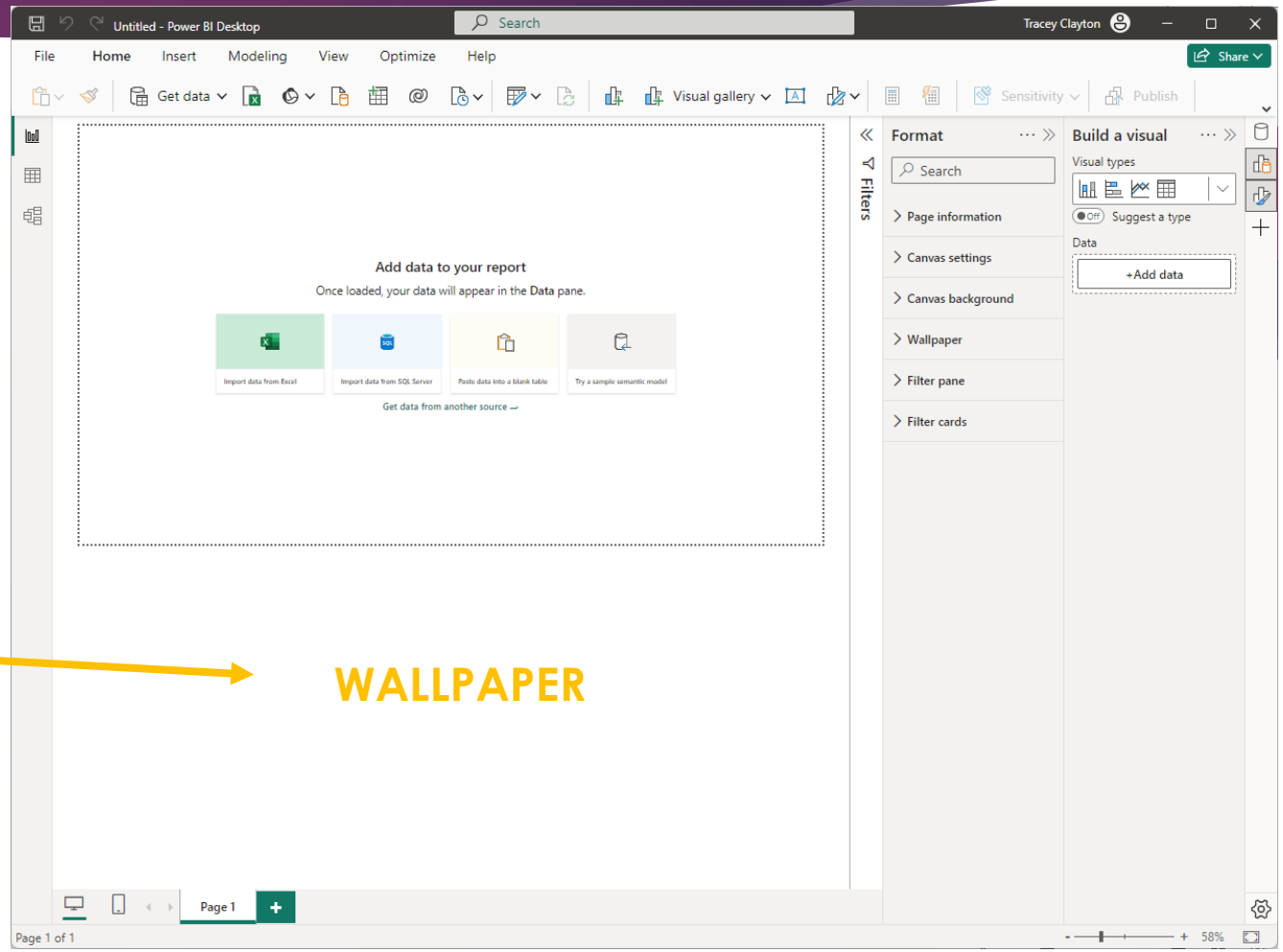

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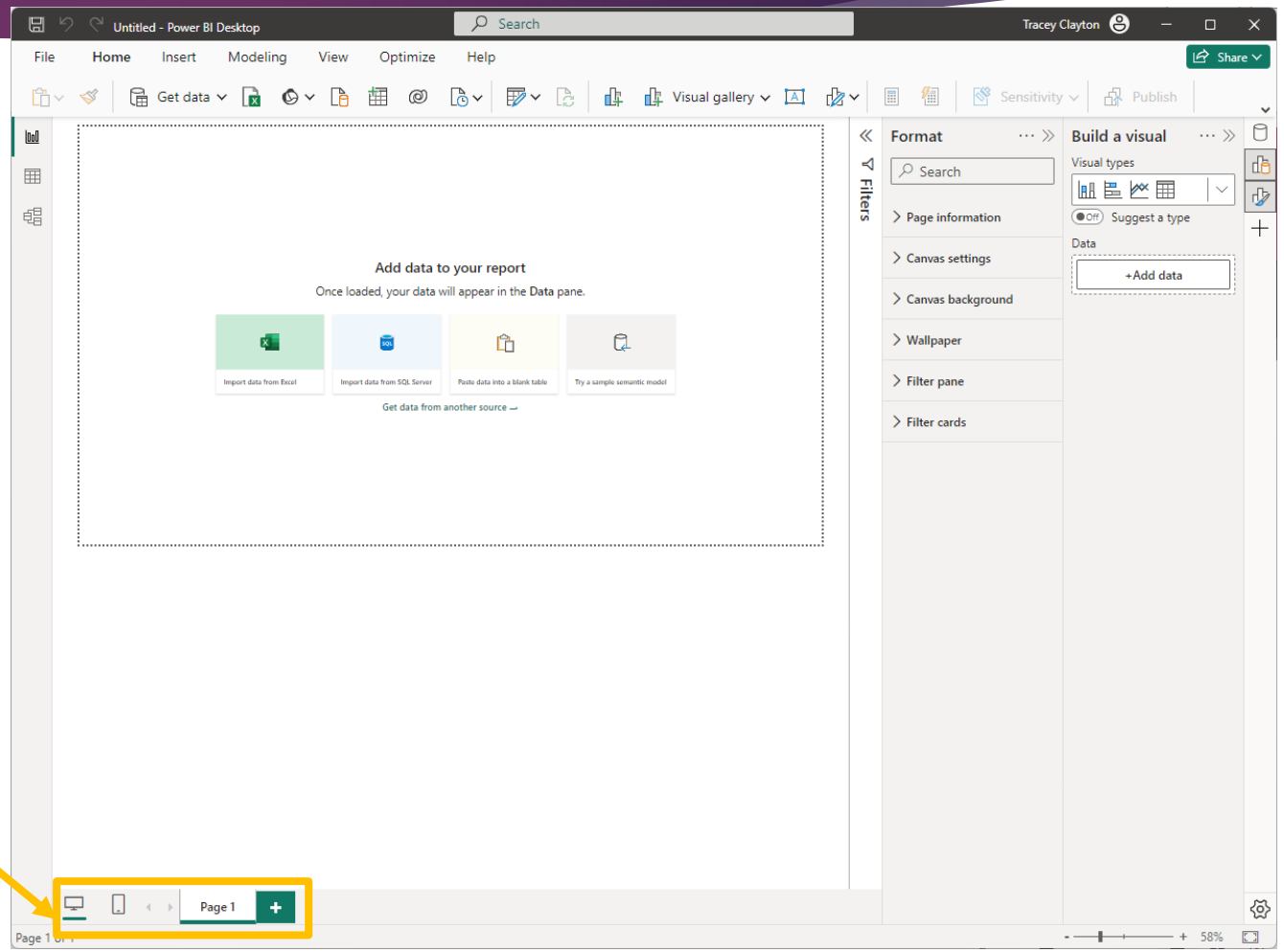

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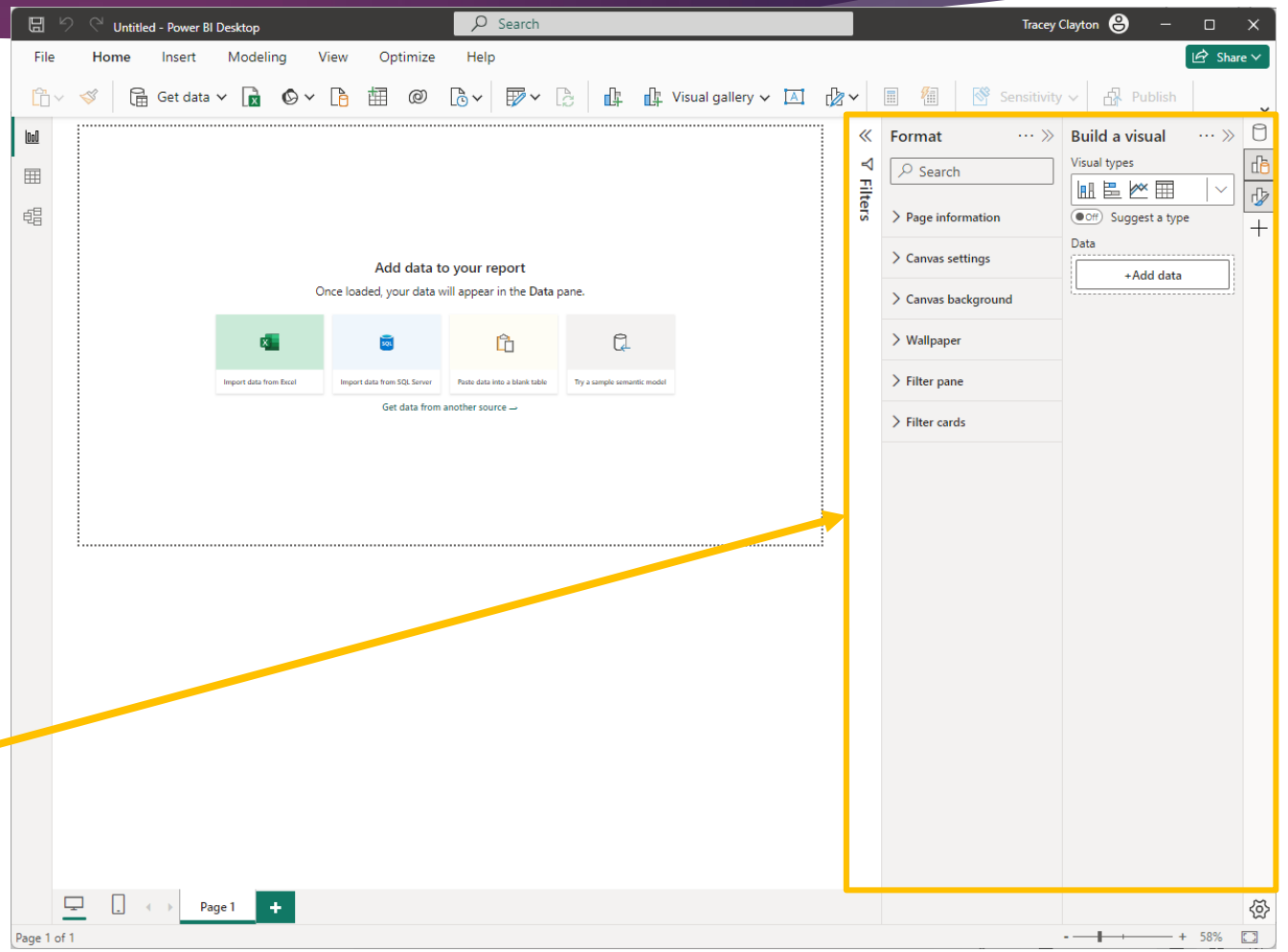
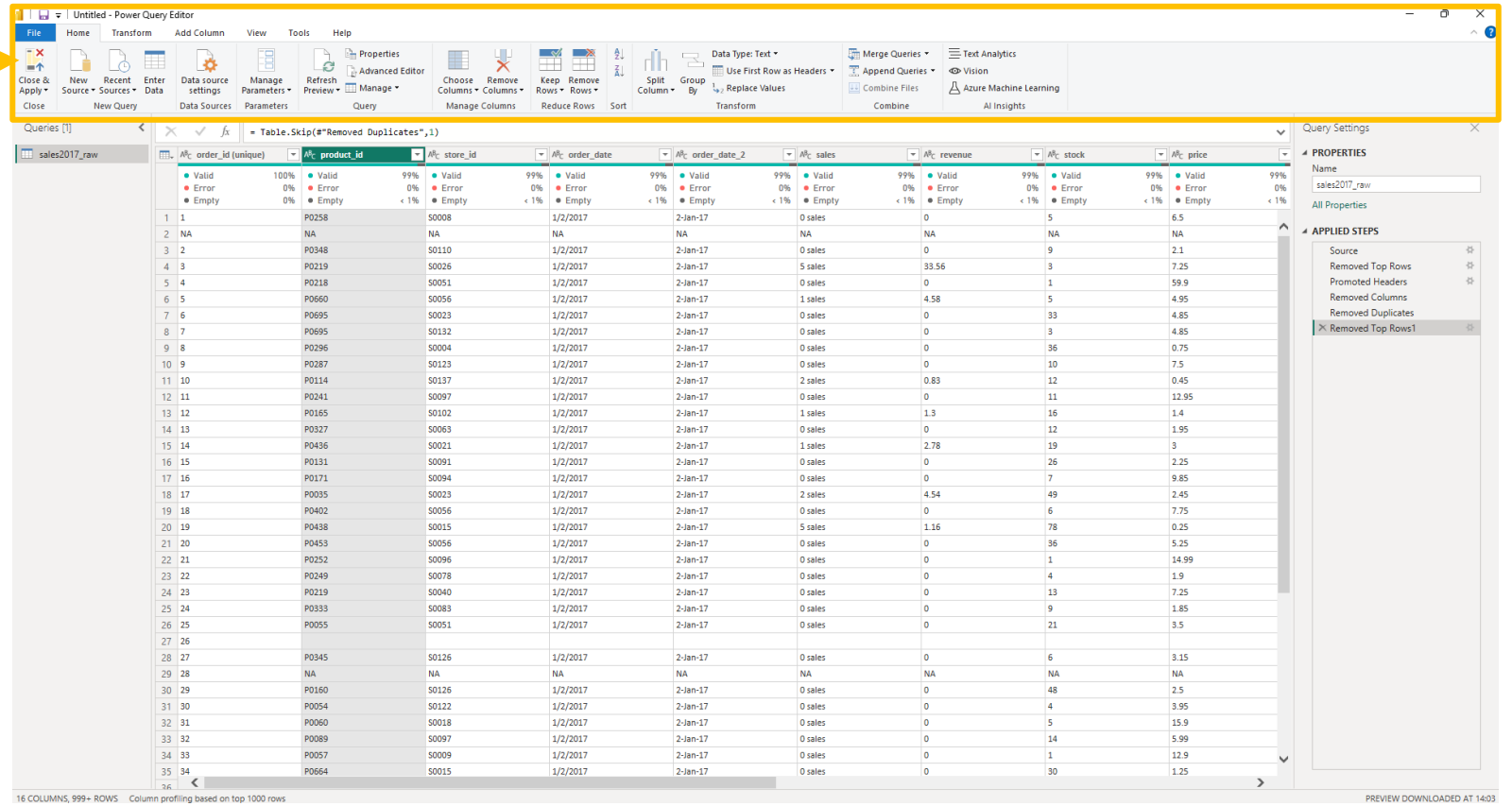
- **Panes** – switch on and off the various panes of tasks/format to apply to your report.



Power Query Editor

- Access the Power Query Editor by selecting **Home, Transform Data** on the Report Builder Ribbon.
- **Top Ribbon Menu** – the main navigation area to perform tasks.



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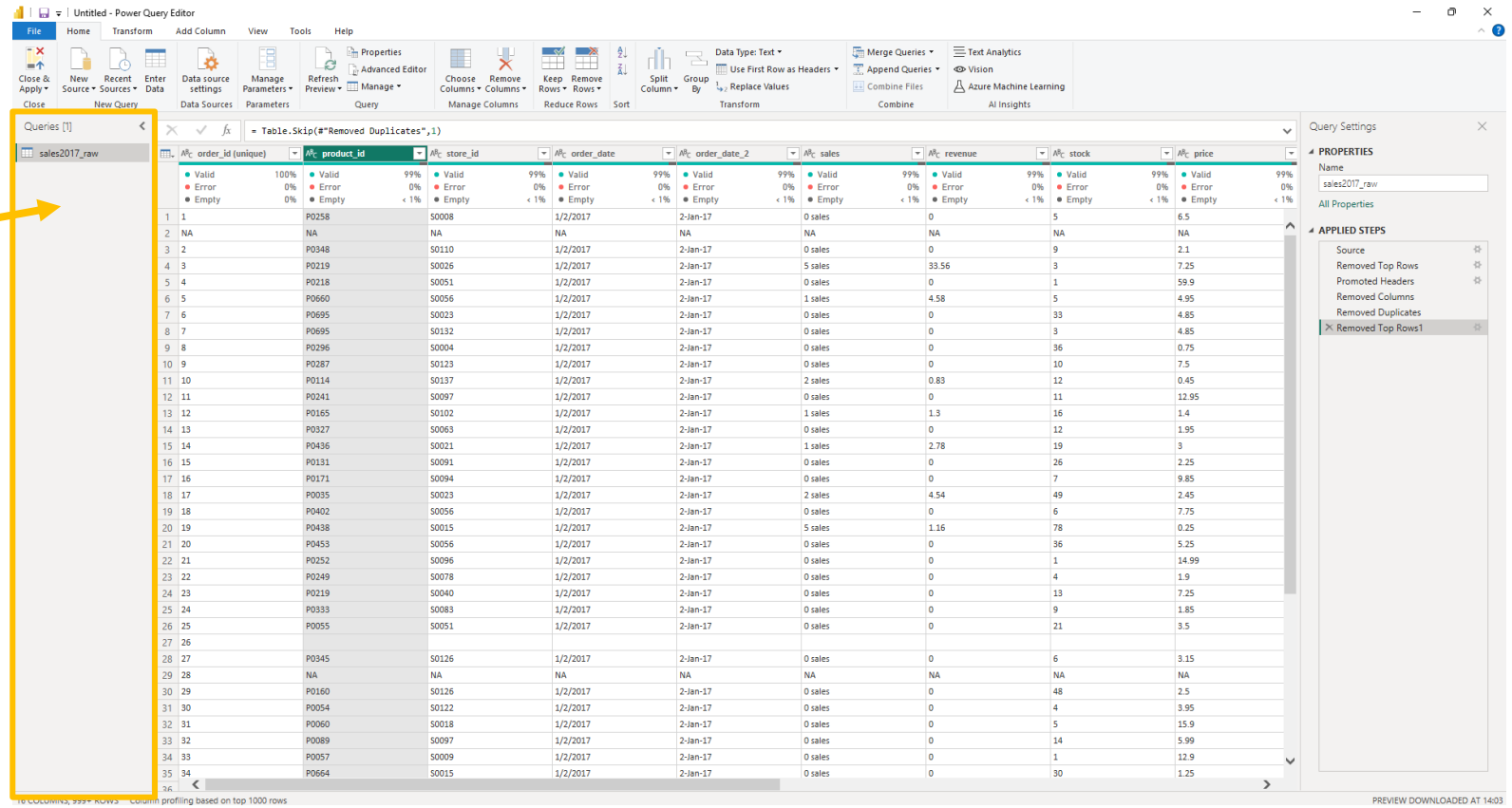

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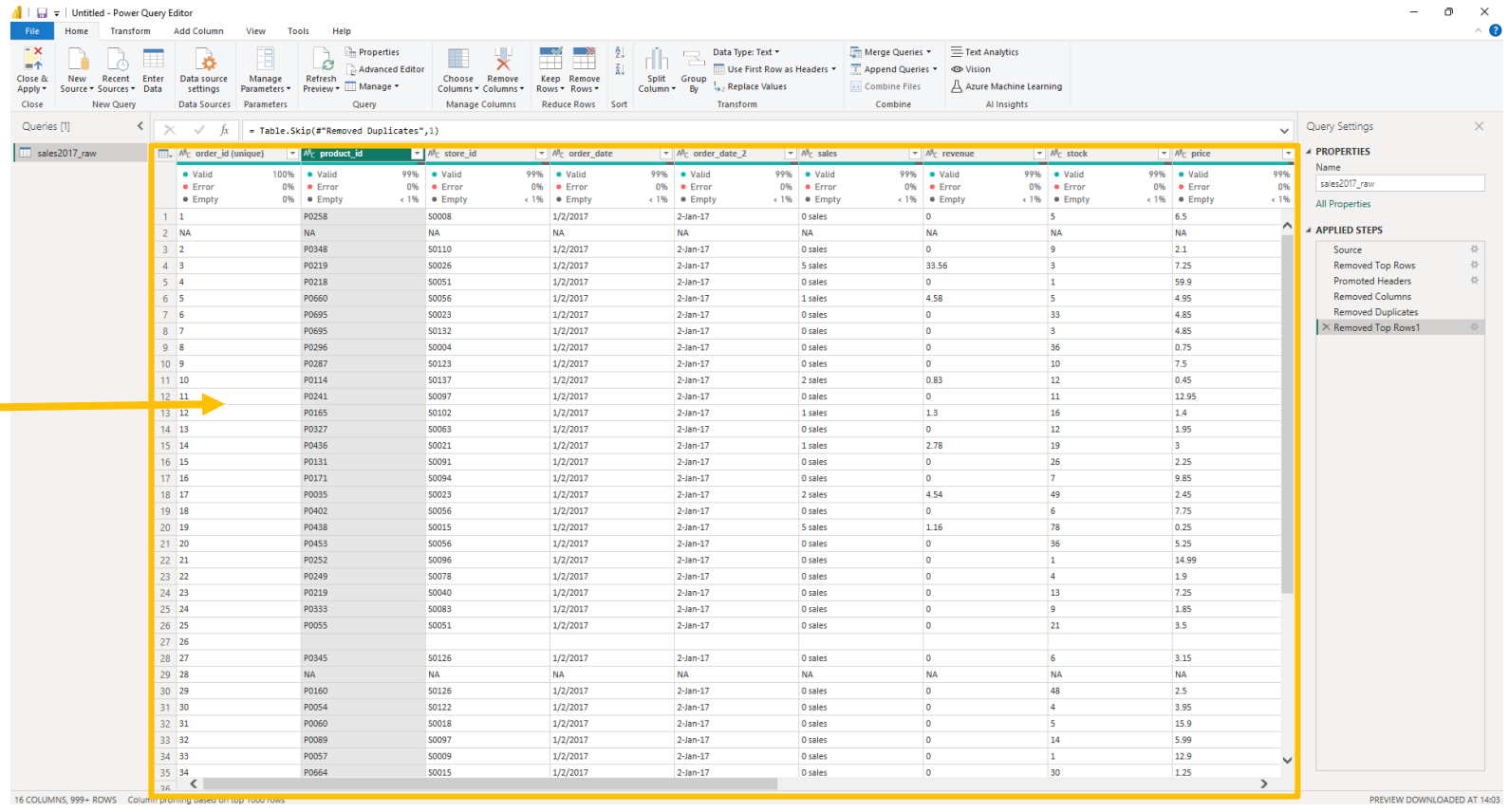

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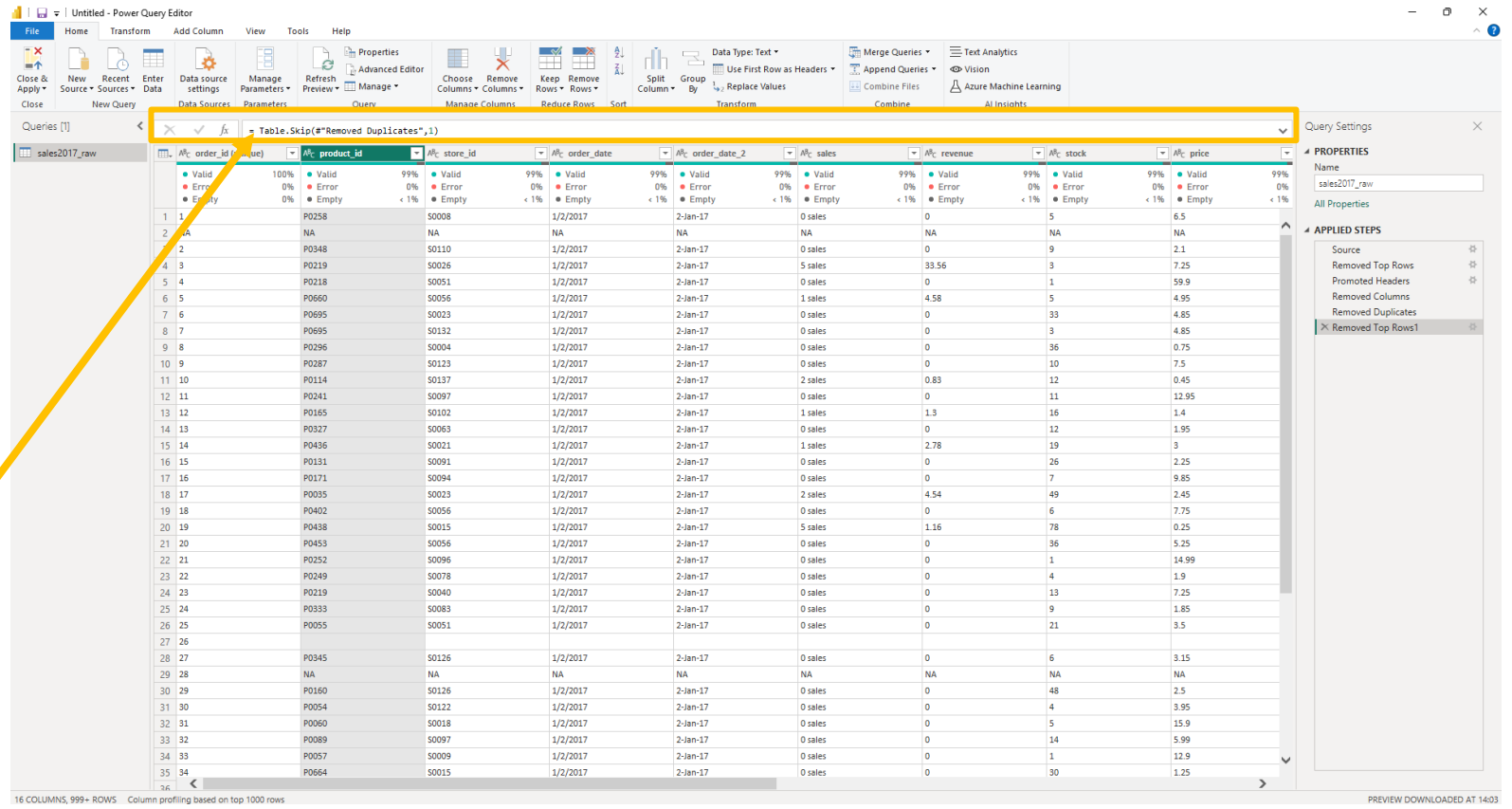

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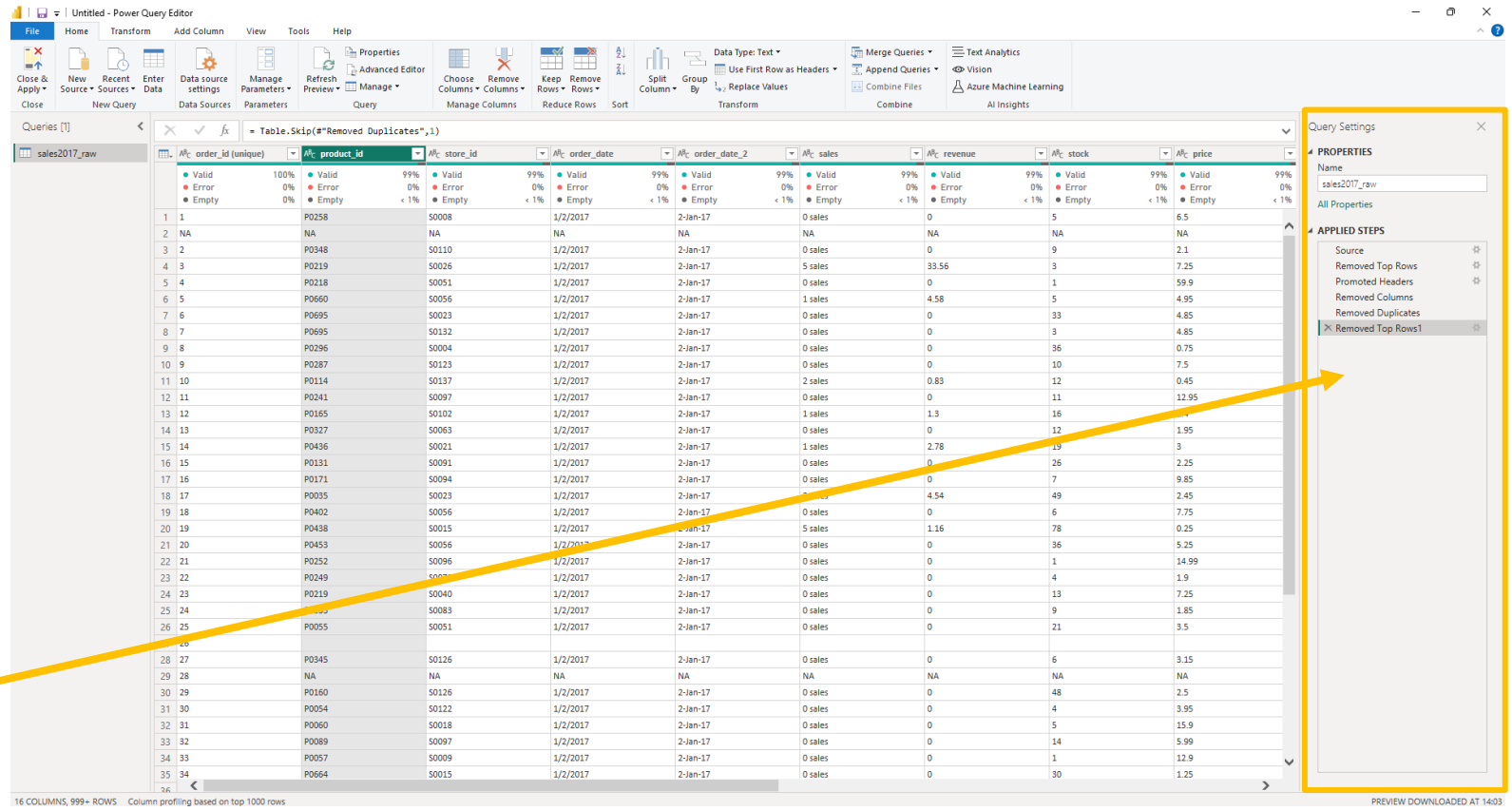
- **Query Properties and Steps** – query naming and current steps are displayed and edited here.



Obtaining Data

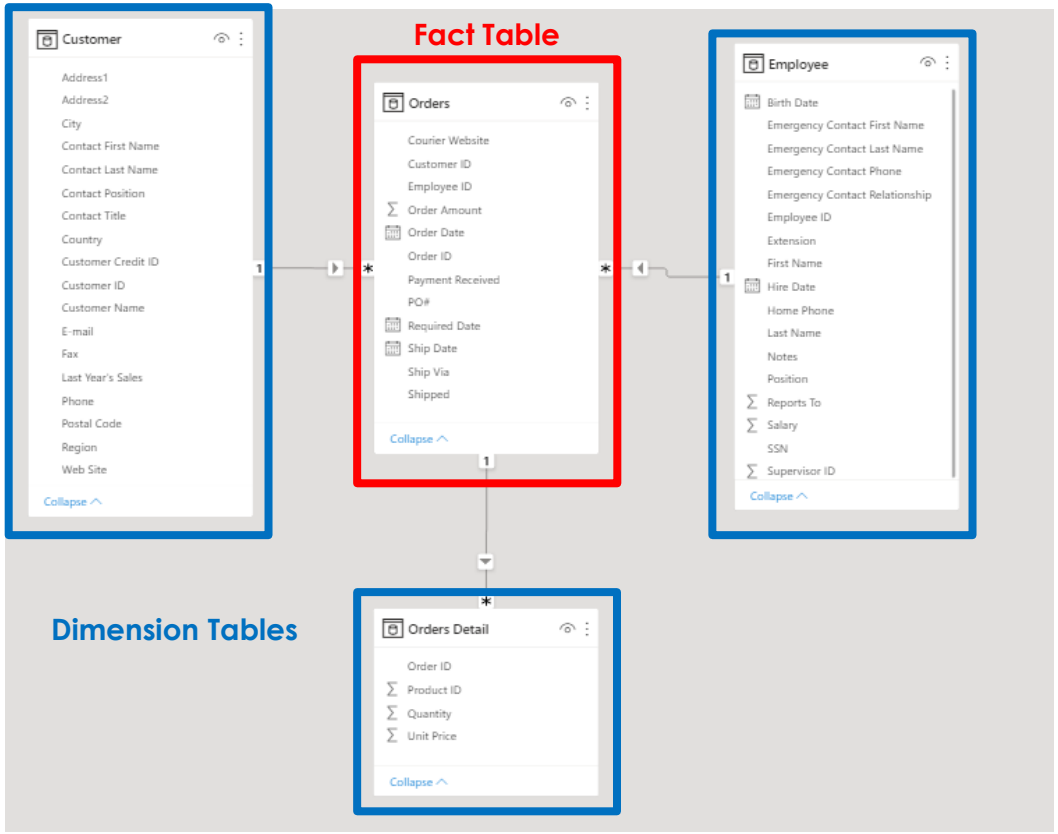
- DATA SOURCES
- REPOINT TO MOVED DATA

Data Sources

- First step to using Power BI is to gather the data you require for reporting.
- Connect to a wealth of sources, ie, Data on the Web, SQL, Microsoft Excel Sheets, CSV files to name a few.
- Placing a series of Similar CSV or Excel files into a folder allows Excel Power Query to combine/append the files into one data source in Power BI
- Data is obtained via Excel Power Query and a Data Model is created.
- In most part this will be a collection of Tables with Relationships applied.

Data Schema

- Logical Arrangement of tables in multidimensional databases.
- The arrangement will have a Fact Table and many Dimension Tables linked to the facts.



Activity: Connecting Data

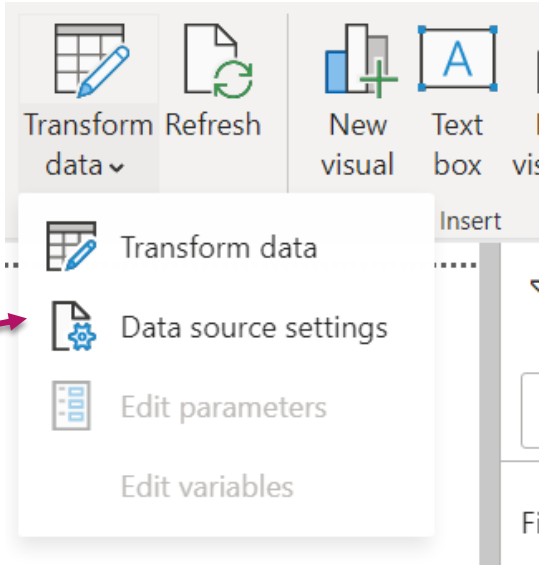
Repointing to Moved Data Source

- From Time to Time, the underlying Data Source files may be moved or even renamed, this will loose the connection to the data, disabling refreshing.
- Use one of the two methods to repoint the data:

  Select **Transform Data** to open Power Query Editor and select **Data Source Settings**

  or

  Selecting the **Transform Data** drop-down will enable you to switch locations/filename as required.

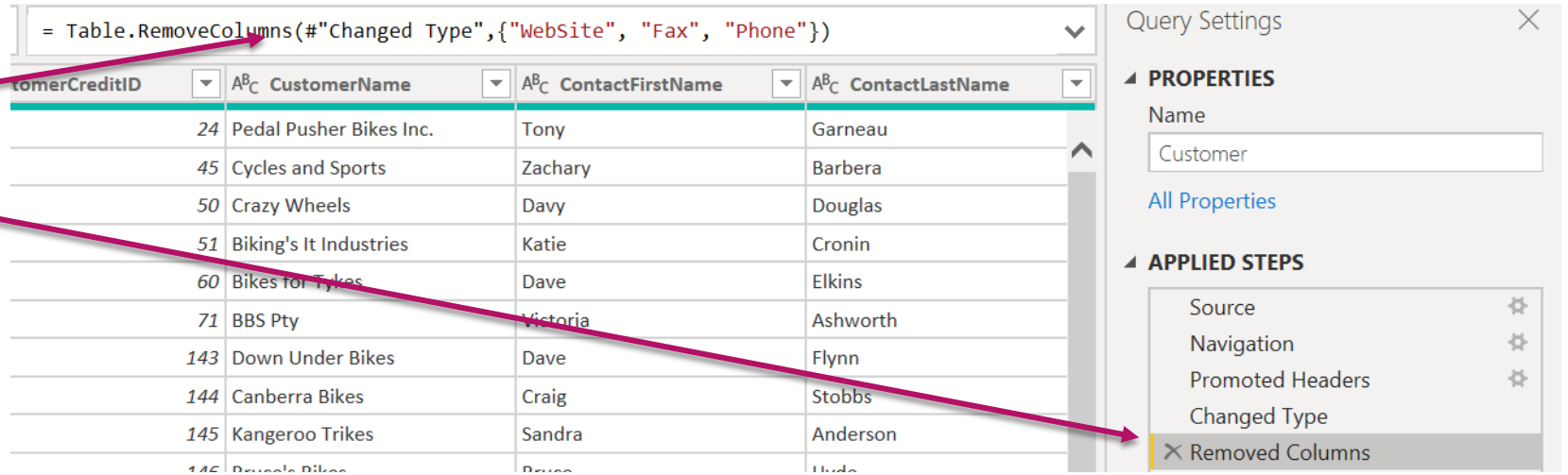


Steps - Basic

- REMOVE COLUMNS/ROWS
- DATA TYPE CHANGE
- FILTERS

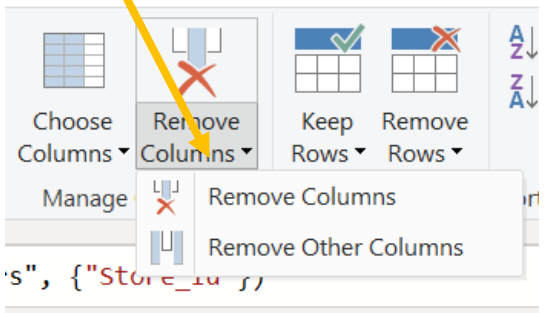
Shaping Data

- Normally a data source will need some **'Refinement'** known as **'Transformation'**.
- As you apply customisation, the data is **'Shaped'** into the format required – each change is recorded as a Step.
- System Steps are standard PowerBI feature, ie. Source – these are displayed with a cog symbol to the right, selecting will display the details about the step.
- Each custom Step you apply will display the detail, which can be updated.
- A custom Step can be deleted if necessary.

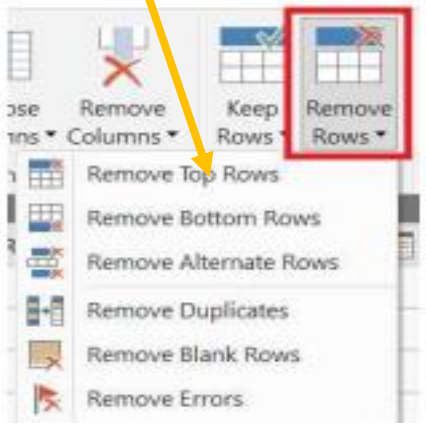


Removing Columns/Rows

- Power Query can be used to exclude unwanted columns and rows from the source table.
- The option is labelled as Remove, but really means Exclude – the underlining connected data table is not modified in any way.
- **Columns** – Use the Manage Columns section on the Ribbon to remove a selected column or remove all others than the selected.

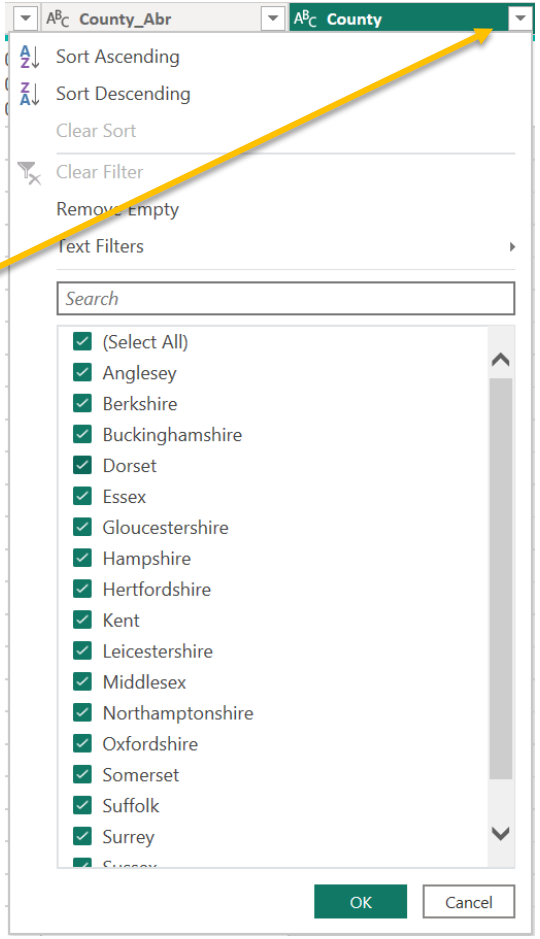


- **Rows** – Use the Reduce Rows section on the ribbon to remove rows at top/bottom, duplicates, blanks and error rows.



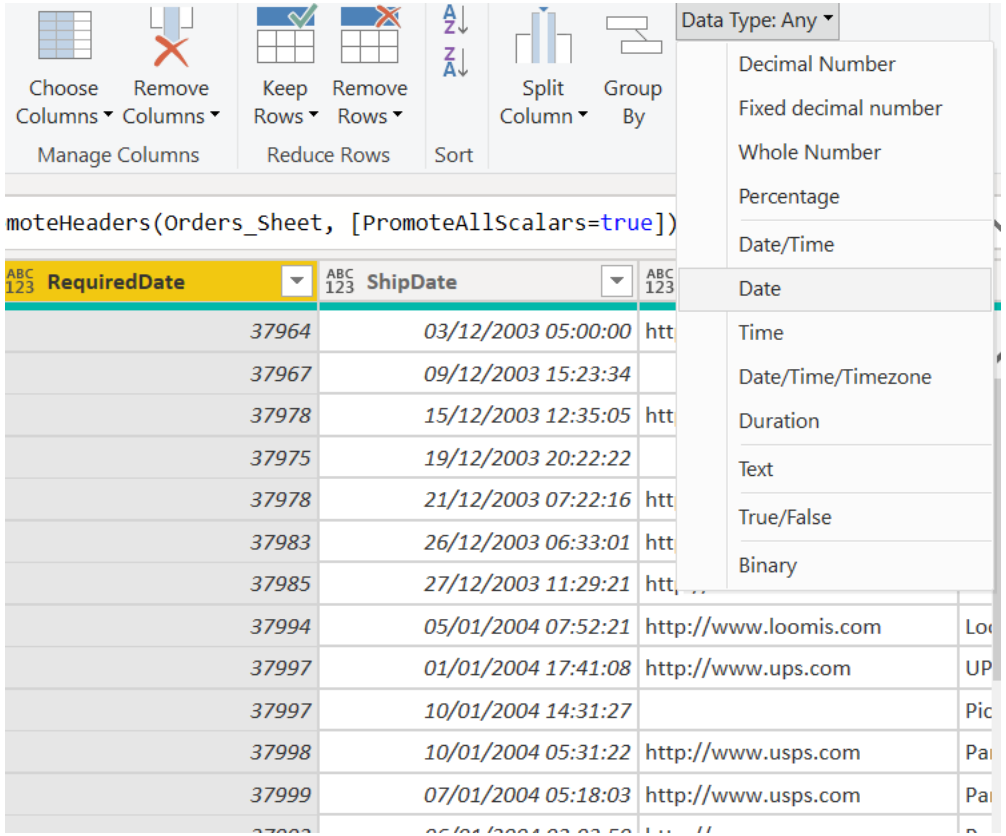
Filters

- Use the Filters function in Power Query to remove any irrelevant data from being displayed in the resulting Table.
- For example, a query is returning Invoices and Credit Notes – you may only want to report on Invoices, this column can be filtered to the data of Invoices only, just same as filtering an Excel Table.
- The Filter is stored as a step, so you can remove or amend the step to display the relevant data.



Data Type Changes

- Power Query will try to identify the type of data stored within a column using the Data Type Detection process.
- Occasionally the type selected may not be determined correctly, use a Step to update the data type as required.
- This will again only change the Data Type for the time the data is being view through the query and not the underlying data file.



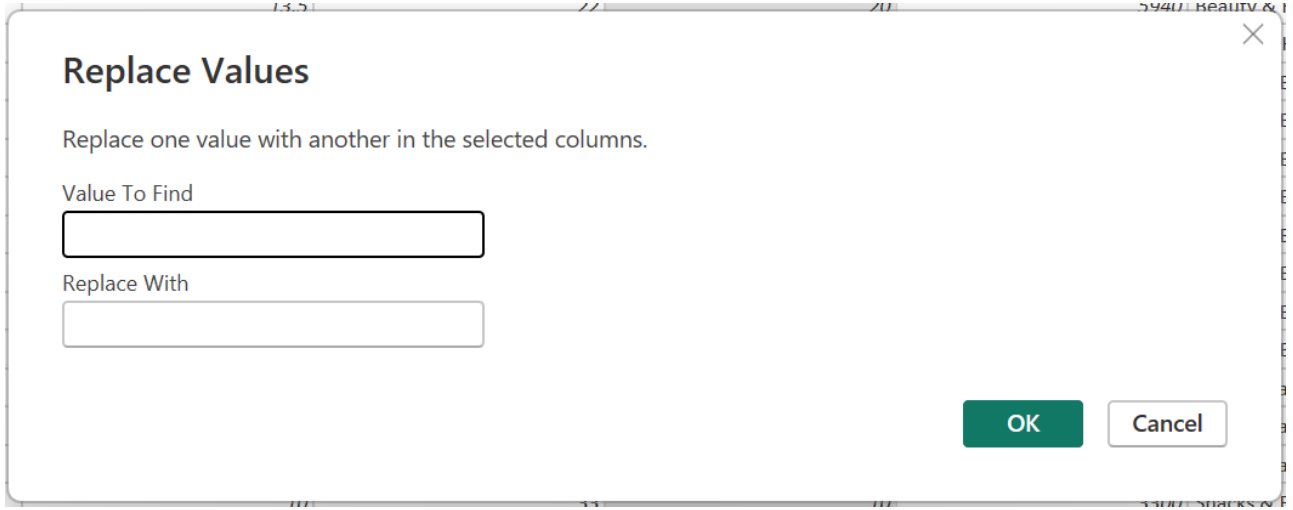
Activity: Simple Steps

Steps - Complex

- REPLACE VALUES
- SPLIT/MERGE
- COMBINE: APPEND & MERGE
- PIVOT/UNPIVOT
- ADD COLUMNS
- CONDITIONAL COLUMNS

Replacing Values

- Replacing values works in two modes:
  - **Replace Entire Cell Contents** – this is the default option when working on a non-text column. It can be selected on for a text column if necessary.



Replacing Values

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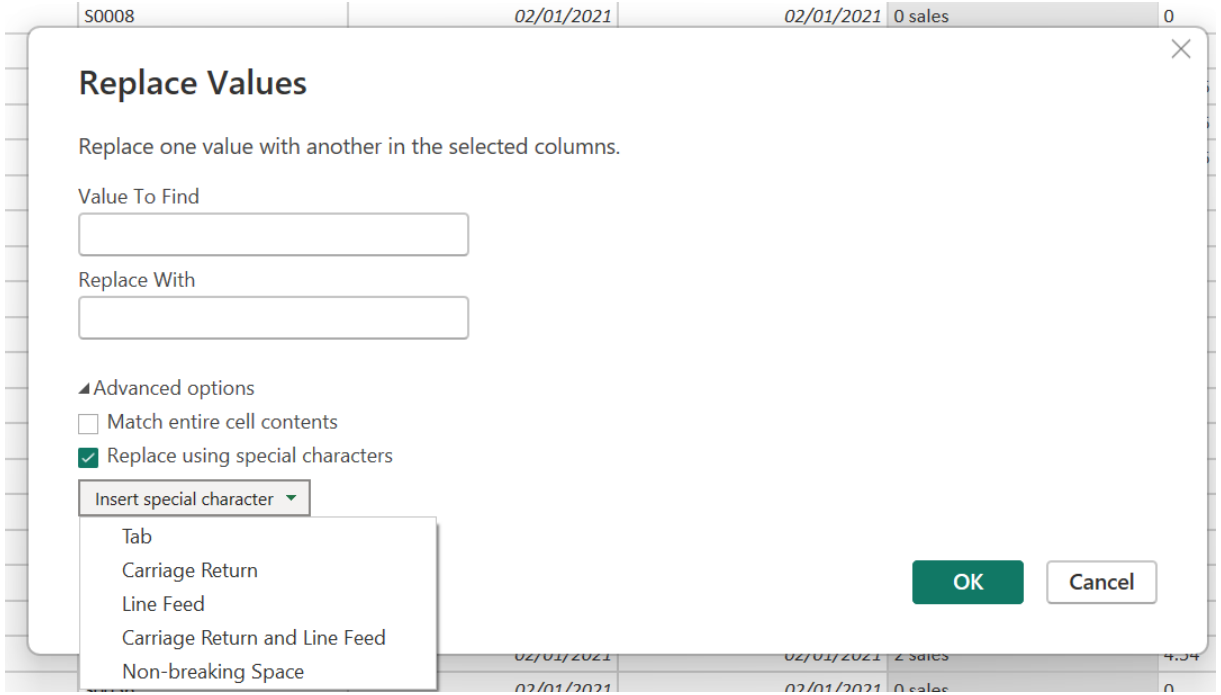
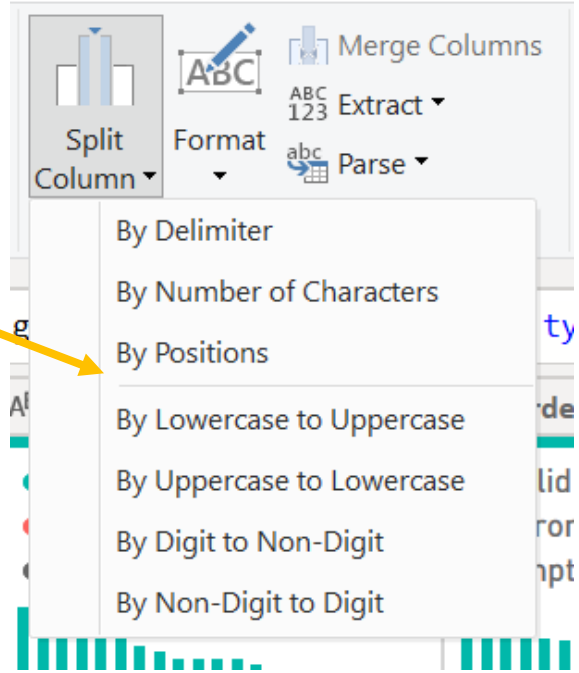
  - **Replace Instances of a Text String** – this is the default option for text columns. Additional features will be available
- When working with text, this feature is case sensitive.



Splitting & Merging Columns

- To separate values out in a Column to create new columns, use the Split Column feature.
- Split Column has different methods of where the split will occur In this case, the column(s) selected can be split by positions.



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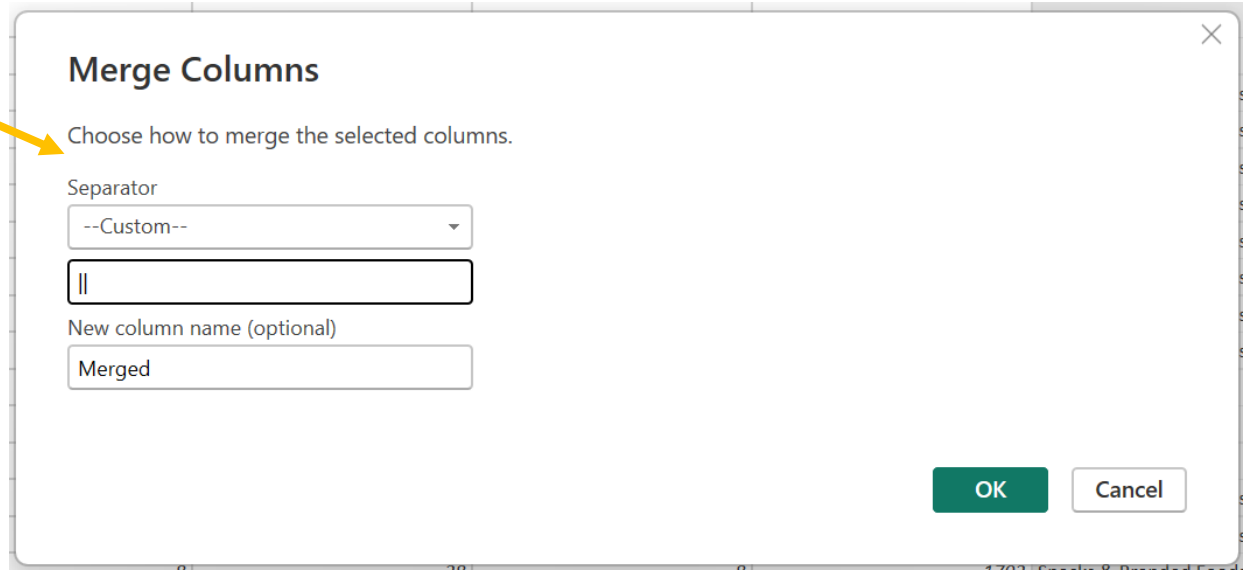


Activity: Complex Steps

Pivot / Unpivot Columns

- Occasionally we are presented with data in a Table where the Column and Row data needs to be pivoted to give us the correct format to be used in our reports.
- The following example shows the Date / Value data is shown as individual column values.
- Once pivoted, the data will be in a format we can deal with the Dates / Values in a better format in our reports.

	Country	6/1/2020	7/1/2020	8/1/2020
1	USA	785	450	567
2	Canada	357	421	254
3	Panama	20	40	80

	Country	Attribute	Value
1	USA	6/1/2020	785
2	USA	7/1/2020	450
3	USA	8/1/2020	567
4	Canada	6/1/2020	357
5	Canada	7/1/2020	421
6	Canada	8/1/2020	254
7	Panama	6/1/2020	20
8	Panama	7/1/2020	40
9	Panama	8/1/2020	80

Activity: Complex Steps – Pivot Column

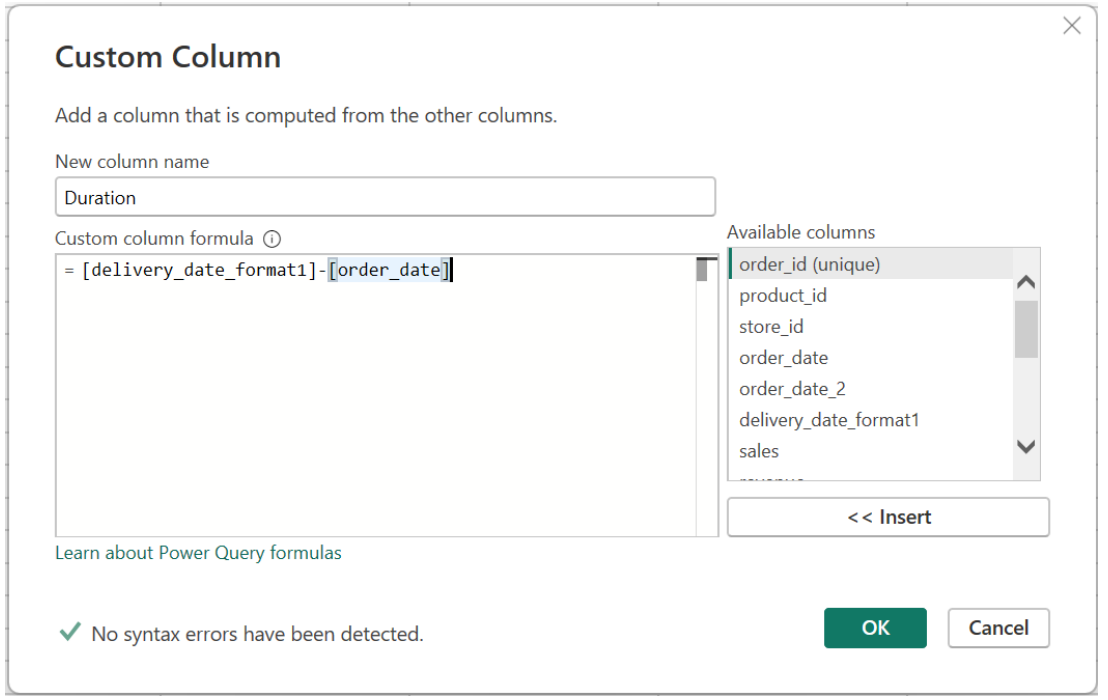
Append / Merge Data Queries

- Combining two queries is one of the most basic and also essential tasks that you would need to do in most of data preparation scenarios.
- There are two types of combining queries - **Merge** and **Append**
- **Append:** The results in two (or more) queries (which are tables themselves) combined into one query in which Rows will be appended after each other
- **Merge:** The combining queries are based on matching rows, rather than columns. There should be joining or matching criteria between two queries. (for example StoreID column of both queries to be matched with each other)

Activity: Complex Steps – Combine/Append

Adding Columns

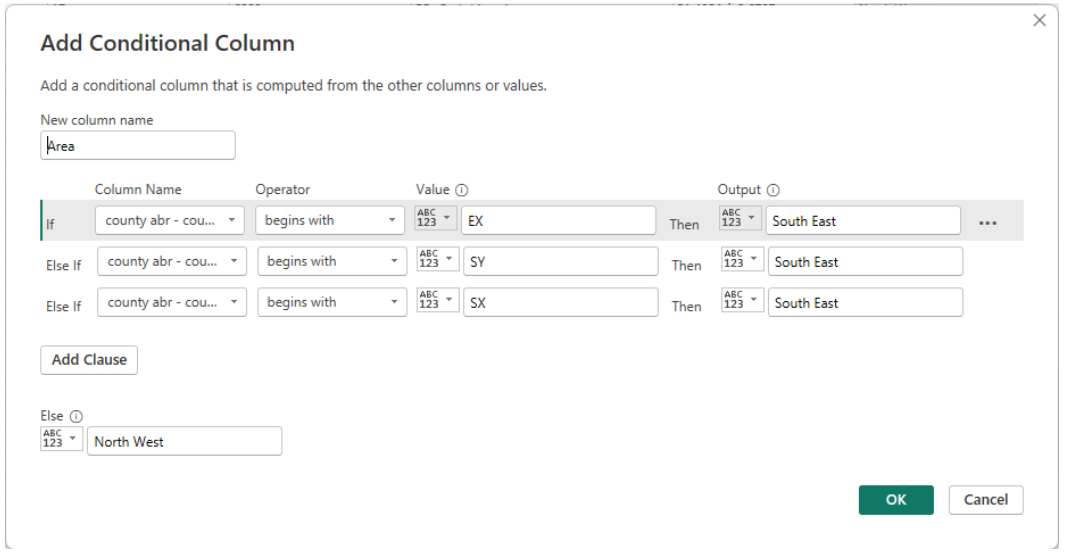
- Columns can be added to your data query to add more flexibility for your report design.
- Columns are added using the Power Query M formula language.
- For example, we have an Order Date and a Delivery Date – maybe having a value already calculated to show the Duration between Order Date and Delivery will be valuable and useful for the report.



Activity: Adding Columns

Adding Conditional Columns

- One of the most powerful features in Power BI is the ability to create conditional columns.
- These columns allow you to add new columns to your datasets based on specific conditions, giving you more control over your data analysis.
- Conditional Columns follow the logical if/then/else statements.




```
= Table.AddColumn(#"Filtered Rows", "Area", each if Text.StartsWith([#"county abr - county - town"], "EX") then "South East" else if Text.StartsWith(
    [#"county abr - county - town"], "SY") then "South East" else if Text.StartsWith([#"county abr - county - town"], "SX") then "South East" else
    "North West")
```

Activity: Conditional Columns

Extract Relationships

- RELATIONSHIP MANAGEMENT
- JOIN KINDS
- HIERARCHIES
- WORKING WITH RELATED TABLES

Relationships

- Usually most reports created will be using 1 or more Tables of data.
- Data is normalised down into multiple Tables to ensure you are working efficiently and data is not being duplicated – this also improves performance when running reports.
- Fact-Dimension Model (Star Schema) is where we will have a Fact Table (where most transactions occur) and probably multiple Dimension Tables (which is more likely static information).
- In more complex scenarios, a Dimension Table can act as Dimension but also Transactional.

Our Model

Sales Table

OrderID	ProductID	OrderAmount	CustomerID	Region	City
101	2	456	1	Surrey	Woking
102	5	12.4	3	Berkshire	Bracknell
103	3	100	1	Surrey	Woking

Our Model

Sales Table

OrderID	ProductID	OrderAmount	CustomerID	Region	City
101	2	456	1	Surrey	Woking
102	5	12.4	3	Berkshire	Bracknell
103	3	100	1	Surrey	Woking

Customer Table

CustomerID	Region	City	Country	LastYearsSales
1	Surrey	Woking	England	275000
2	Surrey	Guildford	England	23898
3	Berkshire	Bracknell	England	14522

Our Model

Sales Table

OrderID	ProductID	OrderAmount	CustomerID
101	2	456	1
102	5	12.4	3
103	3	100	1

Fact Table

Customer Table

CustomerID	Region	City	Country	LastYearsSales
1	Surrey	Woking	England	275000
2	Surrey	Guildford	England	23898
3	Berkshire	Bracknell	England	14522

Dimension Table

Our Model

Foreign Key

Sales Table

OrderID	ProductID	OrderAmount	CustomerID
101	2	456	1
102	5	12.4	3
103	3	100	1

Fact Table

Primary Key

Customer Table

CustomerID	Region	City	Country	LastYearsSales
1	Surrey	Woking	England	275000
2	Surrey	Guildford	England	23898
3	Berkshire	Bracknell	England	14522

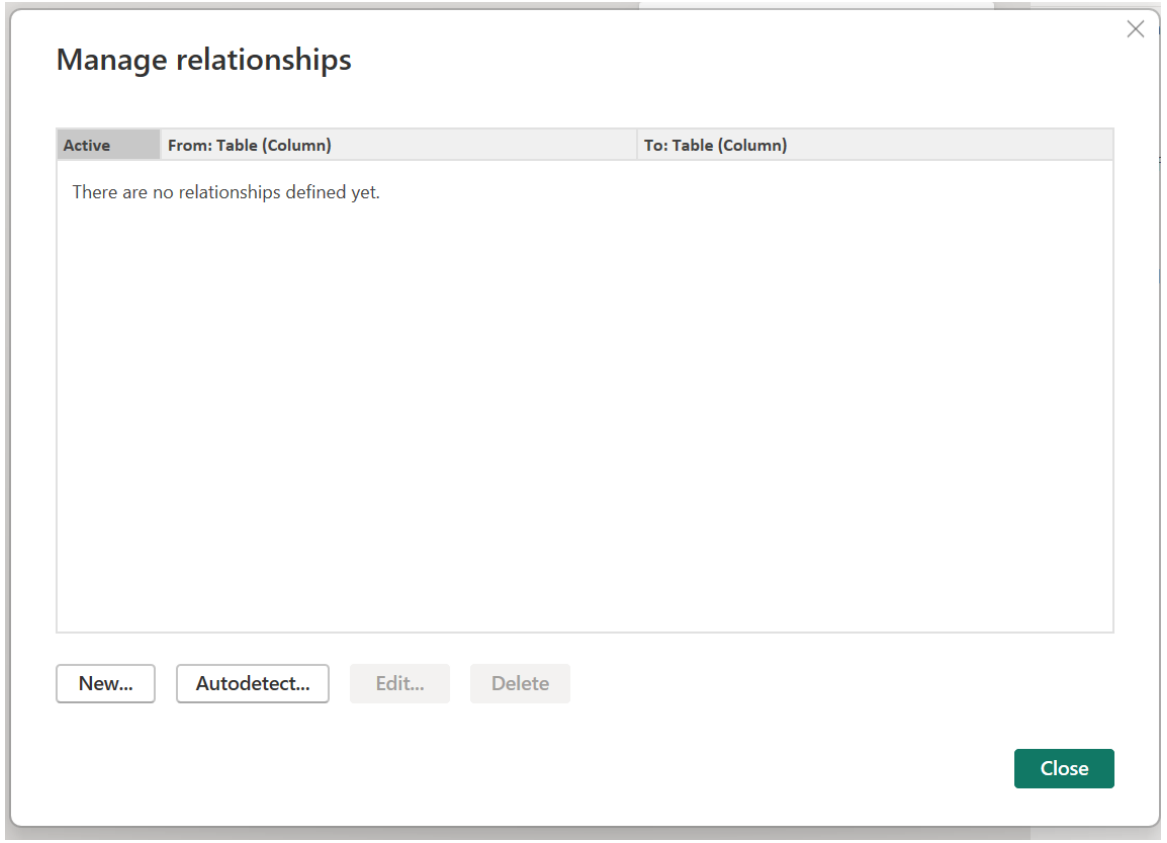
Dimension Table

Relationship Cardinality

- The Relationship Cardinality means having unique or multiple instances per value for the joining fields between two tables.
- Cardinality is defined by the Relationship and it refers to the Relationship between two tables.
- Types of Cardinality:
  a) **Many to one (*:1)** the column in a given table can have more than one instance of a value, and the other related table has only one instance of a value.
  b) **One to one (1:1)** the column in one table has only one instance of a particular value, and the other related table can have more than one instance of a value.
  c) **One to many (1:*)** the column in one table has only one instance of a particular value, and the other related table has only one instance of a particular value.
  d) **Many to Many (*:*)** you can establish a many-to-many relationship between tables, which removes requirements for unique values in tables.

Editing Relationships

- Switch to the Model View to see your Data Model tables and any relationships currently add.
- Use the Manage Relationship button when in the Model View to Add, Edit, Autodetect and Delete Relationships.



Activity: Relating Query Tables

Visualisations & Manipulation

- MATRIX
- CONDITIONAL FORMATTING
- CHART
- KPI'S
- FILTER: BASIC & ADVANCED
- TOP 10
- SLICER
- DRILL THROUGH

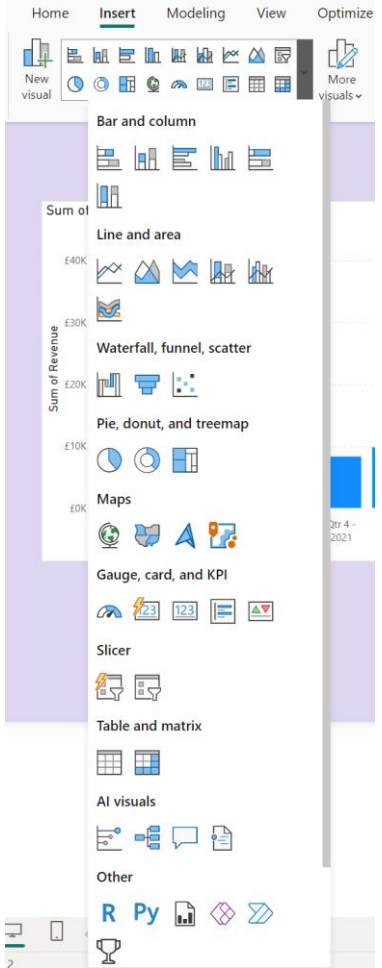
Report Design

- Each report you create will contain a variety of different data and visuals to meet your end requirement.
- There are some general steps you will take to build the final report for Publishing:
  1. **Theme** – select the desired Theme for Colours/Fonts or customise a existing Theme to suit the current report being generated.
  2. **Canvas** – apply the background Colour/Wallpaper to be used, Filter Pane and Filter Card settings.
  3. **Setup a Page Template** – containing Shapes/Text Boxes/Images to be used on all pages. You may have several Page Templates. Once created you can copy these to start as the building blocks for a report page.
  4. Add the Visuals and functionality.

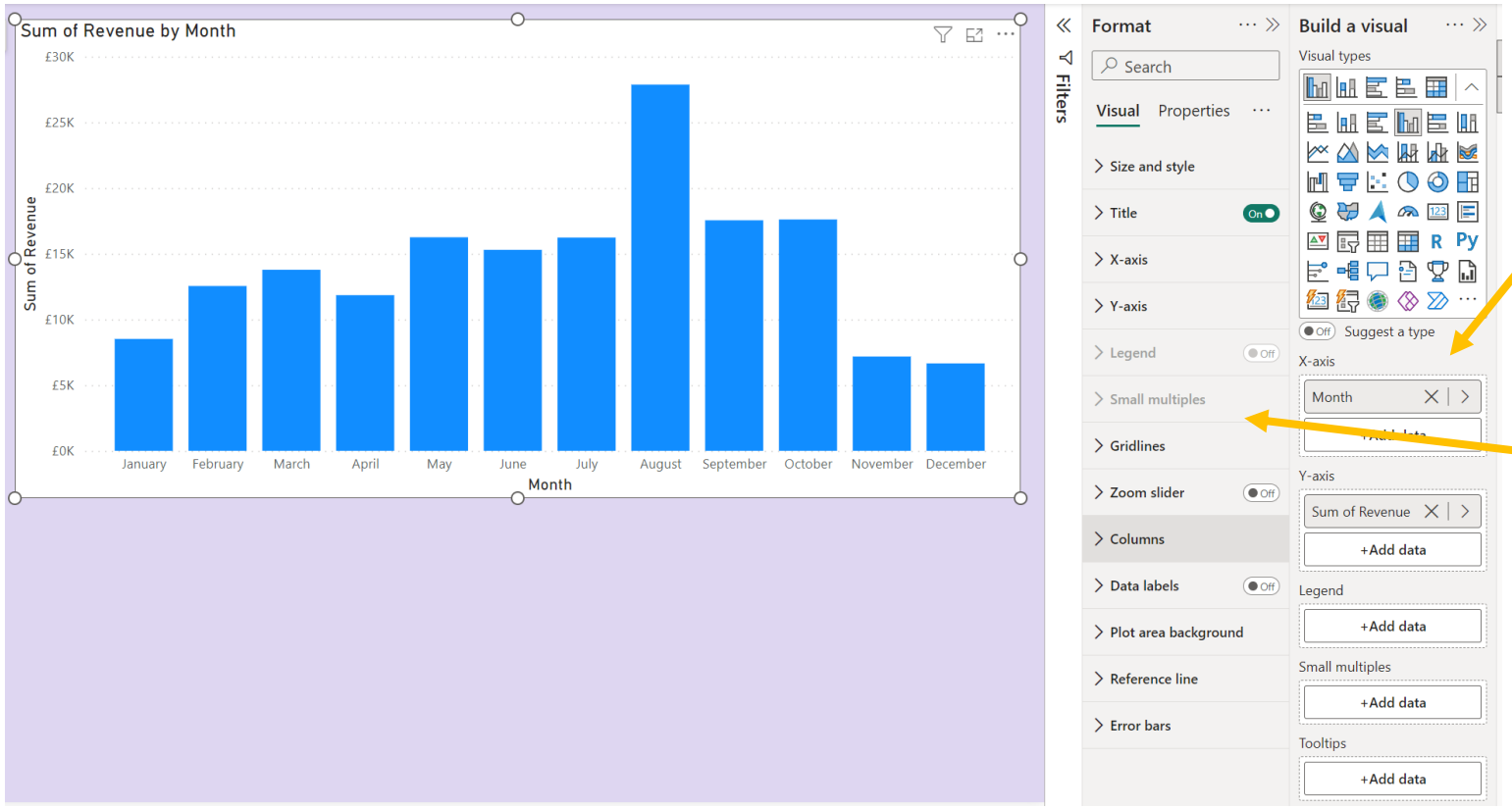
Activity: Building a Page Layout Template

Visualisations

- We now have our data transformed and ready to apply to the visual side of the Power BI file.
- Adding visuals is a simple click away.
- There are many visual types, depending on what you are trying to present to the audience will be governed by the visual used.
- Visuals are added from the Home or Insert Ribbon Tab.



Visual Settings



- Each Visual you will use the Build a Visual Pane to add the necessary data fields.
- The Format Pane will give you a wealth of options to apply for the selected Visual.

Matrices v Tables

- **Tables** are used to display detailed, granular data.
- **Tables** are simpler and easier to read.
- **Tables** will have less flexibility with design and data aggregation

County	Town	Year	Sum of Revenue
Anglesey	Holyhead	2021	£123.88
Anglesey	Holyhead	2022	£904.38
Anglesey	Holyhead	2023	£234.59
Berkshire	Ascot	2021	£51.79
Berkshire	Ascot	2022	£147.13
Berkshire	Ascot	2023	£236.9
Berkshire	Bracknell	2021	£319.96
Total			**£171,291**

- **Matrices** are used to display summarizing and aggregation of data.
- **Matrices** are more complex in appearance and require more effort to interpret.
- **Matrices** have a variety of options for data organisation, grouping and drill down

County	2021	2022	2023	**Total**
⊞ **Anglesey**	**£123.88**	**£904.38**	**£234.59**	**£1,262.85**
⊟ **Berkshire**	**£738.3**	**£1,265.98**	**£4,427.68**	**£6,431.96**
Ascot	£51.79	£147.13	£236.9	**£435.82**
Bracknell	£319.96	£645.99	£2,359.17	**£3,325.12**
Maidenhead	£22.77	£72.93	£998.64	**£1,094.34**
Reading	£70.52	£118.08	£215.91	**£404.51**
Slough	£273.26	£281.85	£617.06	**£1,172.17**
⊞ **Buckinghamshire**	**£2,108.03**	**£3,636.25**	**£7,413.51**	**£13,157.79**
⊞ **Dorset**	**£2,246.41**	**£3,745.9**	**£7,015.04**	**£13,007.35**
⊞ **Essex**	**£834.85**	**£1,257.85**	**£3,467.01**	**£5,559.71**
⊞ **Gloucestershire**	**£2,256.22**	**£2,766.41**	**£4,289.82**	**£9,312.45**

Activity: Tables & Matrix

Charts

- Power BI has 30 different types of charts to visualise your data
- The top Chart types are:
  1. Clustered Bar Chart
  2. Clustered Column Chart
  3. Waterfall Chart
  4. Combo Chart
  5. Area Chart
  6. Line Chart
  7. Pie Chart
  8. Doughnut Chart

Activity: Charts & Cards

Conditional Formatting

- Conditional Foramatting in Power BI allows you to apply different formats based on a rule or criteria
- The formatting applied can be:
  - Colours
  - Icons
  - Data Bars
  - Text Styles
- Use the Conditional Formatting option within the Formatting Pane
- The example to the right has icons applied to the Sum of Revenue column – where the value fits within a range the icon will show

County	2021	2022	2023	Total
Anglesey	✗ £123.88	✗ £904.38	✗ £234.59	**£1,262.85**
Berkshire	✗ £738.3	✗ £1,265.98	£4,427.68	**£6,431.96**
Buckinghamshire	£2,108.03	£3,636.25	✓ £7,413.51	**£13,157.79**
Dorset	£2,246.41	£3,745.9	✓ £7,015.04	**£13,007.35**
Essex	✗ £834.85	✗ £1,257.85	£3,467.01	**£5,559.71**
Gloucestershire	£2,256.22	£2,766.41	£4,289.82	**£9,312.45**
Hampshire	✗ £879.07	✗ £1,035.98	£1,792.28	**£3,707.33**
Hertfordshire	✗ £730.11	✗ £1,132.79	£2,168.07	**£4,030.97**
Kent	✗ £1,380.64	£1,940.62	£6,241.04	**£9,562.3**
Leicestershire	✗ £1,287.71	£1,811.26	£5,598.56	**£8,697.53**
Middlesex	£2,294.27	£3,523.09	£5,937.08	**£11,754.44**
Northamptonshire	£5,742.49	✓ £6,701.78	✓ £13,058.64	**£25,502.91**
Oxfordshire	✗ £1,257.73	£3,053.85	✓ £9,890.66	**£14,202.24**
Somerset	✗ £1,138.22	✗ £1,085.52	£2,830.49	**£5,054.23**
Suffolk	£2,482.89	£2,607.14	£4,959.5	**£10,049.53**
Surrey	£2,224.97	£3,261.56	✓ £6,618.94	**£12,105.47**
Sussex	£2,859.02	£4,525.84	✓ £7,662.15	**£15,047.01**
Wiltshire	✗ £589.4	✗ £892.39	✗ £1,363.14	**£2,844.93**
Total	**£31,174.21**	**£45,148.59**	**£94,968.2**	**£171,291**

Activity: Basic Conditional Formatting

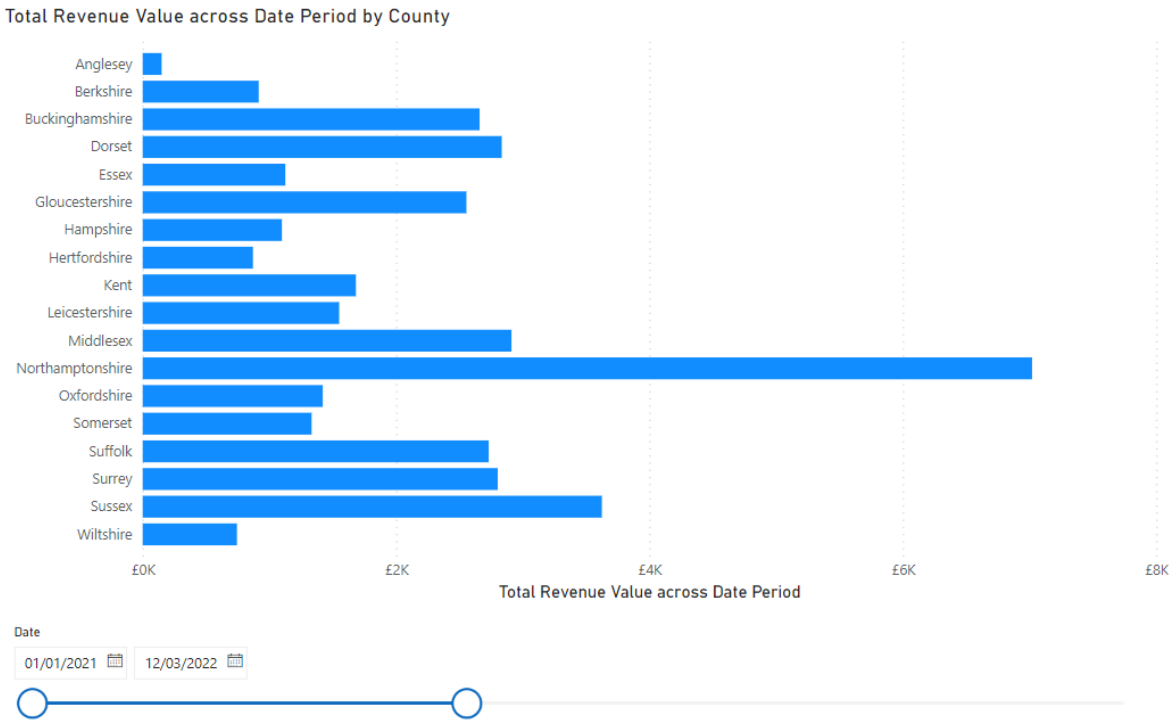
Top N Filtering

- Filtering on the Visual and Page can be set to Basic (standard value selections), Advanced (set against a condition, ie. Value >= X) and also Top N.
- Top N enables a user to see the top results of numerical data.
- The following example, shows us the Top 5 Counties based on their Sum of Revenue for all years.

County	2021	2022	2023	**Total**
Northamptonshire	£5,742.49	£6,701.78	£13,058.64	**£25,502.91**
Sussex	£2,859.02	£4,525.84	£7,662.15	**£15,047.01**
Oxfordshire	£1,257.73	£3,053.85	£9,890.66	**£14,202.24**
Buckinghamshire	£2,108.03	£3,636.25	£7,413.51	**£13,157.79**
Dorset	£2,246.41	£3,745.9	£7,015.04	**£13,007.35**
Total	**£14,213.68**	**£21,663.62**	**£45,040**	**£80,917.3**

Slicers

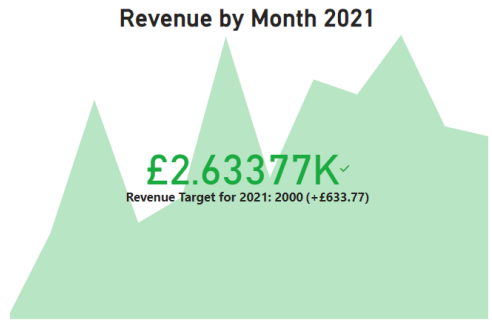
- Slicers are a type of on Canvas Visual Filters.
- These enable a user to sort and filter a packed report and view only the information they require.
- Slicers can operate on a Canvas as either:
  - Checkboxes
  - Radio Buttons
  - Dropdown Lists
  - Tiles (Buttons)
  - Sliders

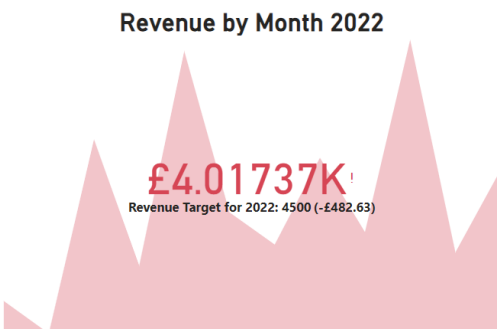


Activity: Simple Slicers

KPI's

- Key Performance Indicator (KPI) is a visual cue, metric or measure used to evaluate the performance of an organisaton or business process.
- KPI's are created by using a combination of data visual techniques, ie. Charts, tables and maps and data calculations.
- Very useful to monitor progress – identify where improvements are needed or define success.





DAX Formulas & Measures

- INTRODUCING DAX FORMULAS
- MEASURES
- QUICK MEASURES

Introducing DAX

- Power BI supports two different languages, **M** language and **DAX** (Data Analysis Expression) that can be used to filter, manage, and visualize data.
- **M** is the query formula language used in the Power Query Editor in order to prepare data before it can be loaded into the Power BI model.
- **DAX** is an analytical data calculation language which can be used for in-depth data analysis during the Data View phase.
- **M** and **DAX** are not dependent upon each other and follow totally different structures and logics, and have different underlying codes.
- **M** and **DAX** cannot be used simultaneously since the M language is used in Query Editor while **DAX** is used in the Data View model.
- You will generally use DAX calculations in either **Calculated Columns** or **Measures**.

Calculated Columns

- Calculated Columns are evaluated at the Row Level within the Power BI Model.
- They will be a member of the Table as a new Column
- To add a new Calculated Column, within the Report view, select one of the following:
  a) Right-click on table name, select New Column

  or

  b) Select the table and choose New Column from the Table Tools ribbon tab

- Within the formula window, enter the required code:


```
1 Discounted Price = if(Sales[promo_discount] == "NA", sales[price],sales[price]-(sales[price]*Sales[promo_discount]/100))
```

Activity: Introducing DAX Columns

Measures

- As discussed, **Calculated Columns** are part of a Table, a physical value.
- They will be calculated for every single row in the table, which in turn will take time to perform and increases the data size of the table.
- A **Measure** is not part of a table, just part of the overall **Data Model**.
- **Measure** are calculated to find aggregated values and calculated on the fly.
- They do not take up physical space in memory or the Data Model.

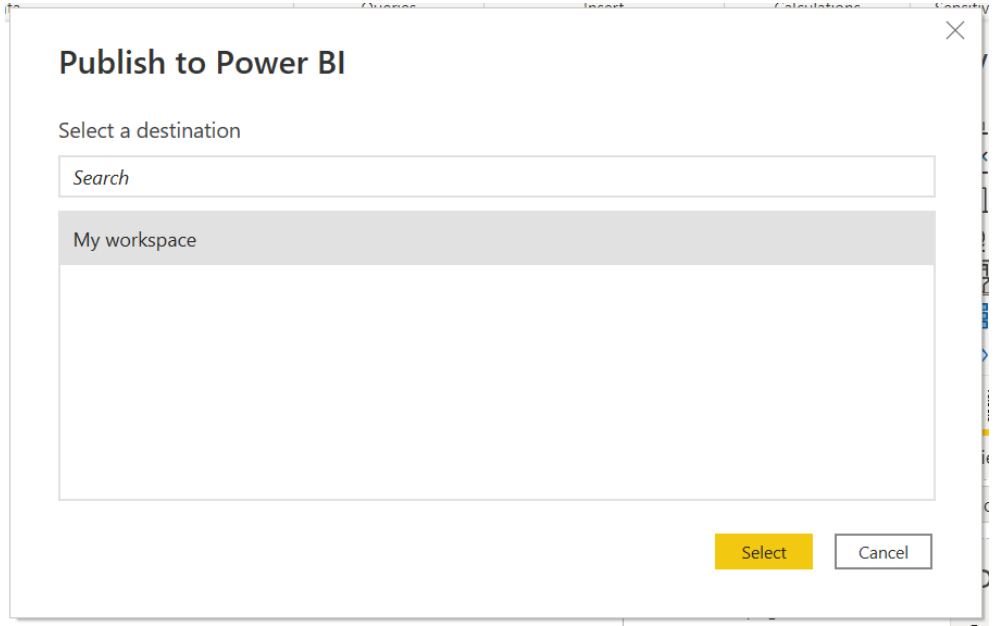
Activity: Introducing Simple DAX Measures

Publishing/Sharing Reports

- PUBLISH TO THE WEB
- PDF

Publishing to the Web

- Publishing to the Web will make your interactive Power BI content available to additional users
- A unique URL is generated for the report, this can then be shared in various ways with colleagues or made publicly available on the web
- You must have a Power BI Pro license to be able to share reports with other users
- Use **File, Publish, Publish to Web** to start the process off



Export to PDF

- Reports generated in Power BI can be exported as **PDF** format.
- Useful when online distribution is not available to individuals.
- Using this method, any Slicers and/or Filters will become static at this point in the exported Report.
- Within **Power BI**, select **File, Export, PDF**