

LU6: DATA ANALYTICS

Data analytics converts raw data into actionable insights. It includes a range of tools, technologies, and processes used to find trends and solve problems by using data. In today's digital age, we generate an enormous amount of data through various sources such as social media, sensors, online transactions, and more. Data analytics allows us to leverage this vast amount of information to gain a deeper understanding of customer behaviour, market trends, operational efficiency, and numerous other aspects of business and society.

Data analytics can shape business processes, improve decision-making, and foster business growth using suitable visualization.

In this section, we will cover two (2) data visualization tools that is available to support the data analysis process:

- Microsoft Excel – PivotTable
- Microsoft Power BI

NotebookLM

Google AI Studio

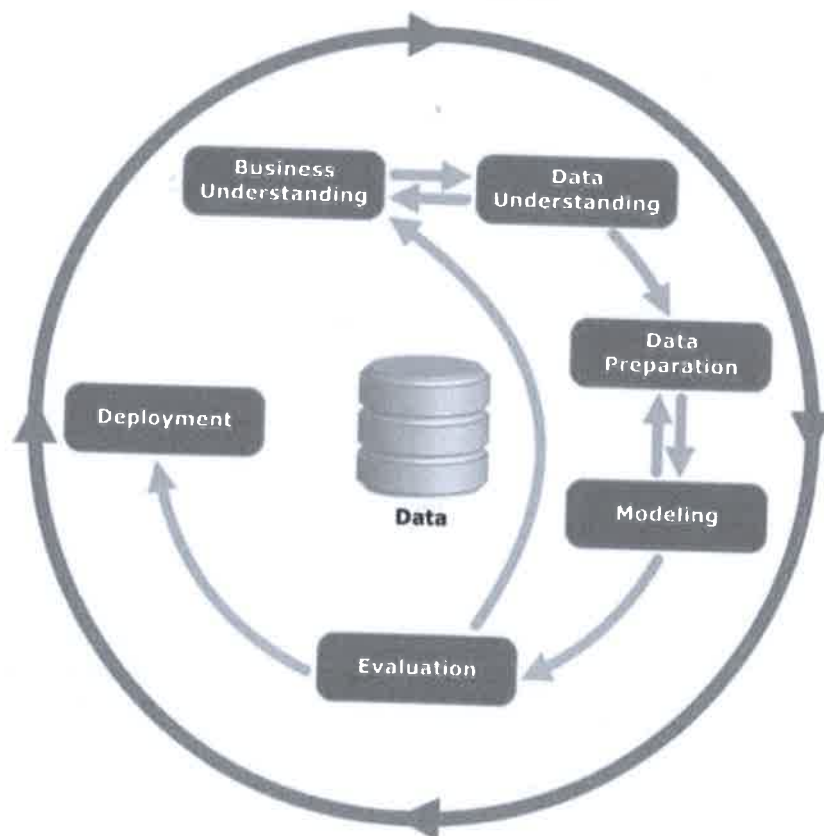
Sharescreen

DATA ANALYTICS BASICS

Data Analysis Process

Meeting Otter

The data analysis process defines the roadmap of how data is generated, collected, processed, used and analysed to achieve business goals.



Expend funds instead of saving funds.

- **Business Understanding** – Understand the project objectives and requirements from a business perspective and then convert this knowledge into a data mining problem definition and a preliminary plan design to achieve the objectives. It is trying to understand what the questions are you are trying to answer through the analysis process.
- **Data Understanding** – Start by collecting the data and getting familiar with it and identify data quality problems and then discover first insights into the data or to detect any interesting subsets to support hypotheses about hidden information.
- **Data Preparation** – This includes all activities required to conduct the final data set (the data that will be used in the modelling) from the initial raw data. This entail identifying the table, case and attribute selection as well as transforming and cleaning of data for the creation of a data model.
- **Modelling** – Select and apply a variety of modelling techniques and calibrate tool parameters to optimal values. Typically, there are several techniques for the same data mining problem type. Some techniques have specific requirements on the form of data. Therefore, sometimes we need to revert to the data preparation phase to review the preparation process.
- **Evaluation** – Thoroughly evaluate the model and review the steps executed to construct the model, to be certain it properly achieves the business objectives. Determine if there is some important business issue that has not been sufficiently considered. At the end of this phase, a decision is required on the use of the data mining results.
- **Deployment** – Organise and present the results of data mining. Deployment can be as simple as generating a report or a dashboard or as complex as implementing a repeatable data mining process.

Benefits of Data Analytics

Data analytics offers numerous benefits across various industries and domains. Here are some of the key advantages of data analytics:

- **Informed Decision-Making:** Data analytics provides valuable insights that support informed decision-making processes. By analysing large volumes of data, organizations can identify trends, patterns, and correlations that help them make data-driven decisions. This leads to more accurate and informed choices, reducing reliance on intuition or guesswork.
- **Improved Operational Efficiency:** Data analytics helps optimize operations by identifying inefficiencies, bottlenecks, and areas for improvement. By analysing data on processes, resources, and performance, organizations can identify areas where they can streamline operations, reduce costs, and enhance productivity. This leads to better resource allocation and improved operational efficiency.
- **Enhanced Customer Understanding:** Data analytics enables organizations to gain a deeper understanding of their customers. By analysing customer data, such as purchase history, behaviour patterns, preferences, and feedback, organizations can segment their customers, personalize experiences, and deliver targeted marketing campaigns. This leads to improved customer satisfaction, loyalty, and retention.
- **Competitive Advantage:** Data analytics provides a competitive edge by uncovering insights that competitors may overlook. By analysing market trends, customer behaviour, and competitor

performance, organizations can identify opportunities for innovation, develop effective strategies, and stay ahead of the competition. Data analytics helps organizations understand their strengths, weaknesses, opportunities, and threats, enabling them to make strategic decisions and differentiate themselves in the market.

- **Risk Management:** Data analytics helps organizations mitigate risks by identifying potential issues and anomalies. By analysing historical data and patterns, organizations can develop predictive models to detect fraud, identify potential security breaches, and assess risks. Data analytics enables organizations to proactively manage risks, implement preventive measures, and minimize potential losses.
- **Improved Product Development:** Data analytics can drive product development by providing insights into customer needs, preferences, and market demands. By analysing customer feedback, usage data, and market trends, organizations can identify gaps in the market, uncover opportunities for new products or features, and make data-driven decisions during the product development lifecycle. This leads to the creation of products that better meet customer requirements and have higher market acceptance.
- **Data-Driven Innovation:** Data analytics fosters innovation by uncovering new insights and ideas. By exploring data and identifying patterns or anomalies, organizations can discover innovative solutions, improve existing products or processes, and identify untapped market opportunities. Data analytics helps organizations think creatively and make data-driven decisions that drive innovation and business growth.
- **Enhanced Forecasting and Planning:** Data analytics enables organizations to improve forecasting and planning activities. By analysing historical data and trends, organizations can develop accurate demand forecasts, optimize inventory management, and plan resources effectively. This leads to improved resource allocation, reduced costs, and better decision-making in areas such as budgeting and capacity planning.

In conclusion, data analytics provides organisations with a wide range of benefits, including informed decision-making, operational efficiency, enhanced customer understanding, competitive advantage, risk management, improved product development, data-driven innovation, and enhanced forecasting and planning. By leveraging data effectively, organisations can unlock valuable insights and drive positive outcomes in various aspects of their operations.

DATA VISUALIZATION TOOLS

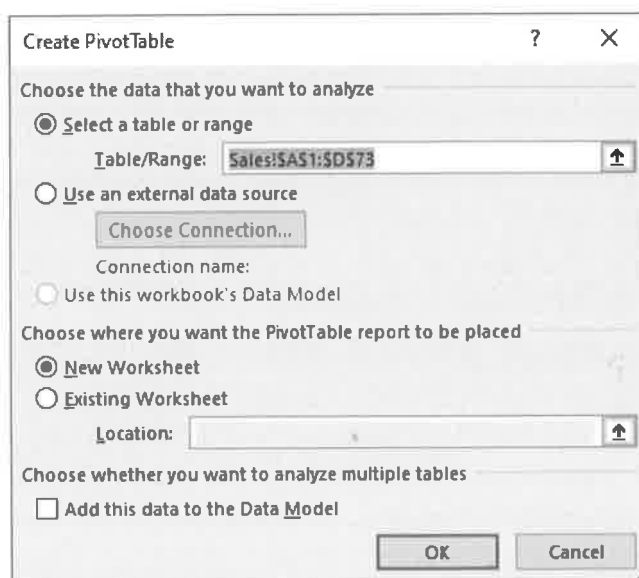
Microsoft Excel

Microsoft Excel is a spreadsheet application developed by Microsoft and a part of Microsoft's Office suite of office productivity applications. It is widely found in many offices and is one of the most popular applications for capturing, managing, and analysing business data.

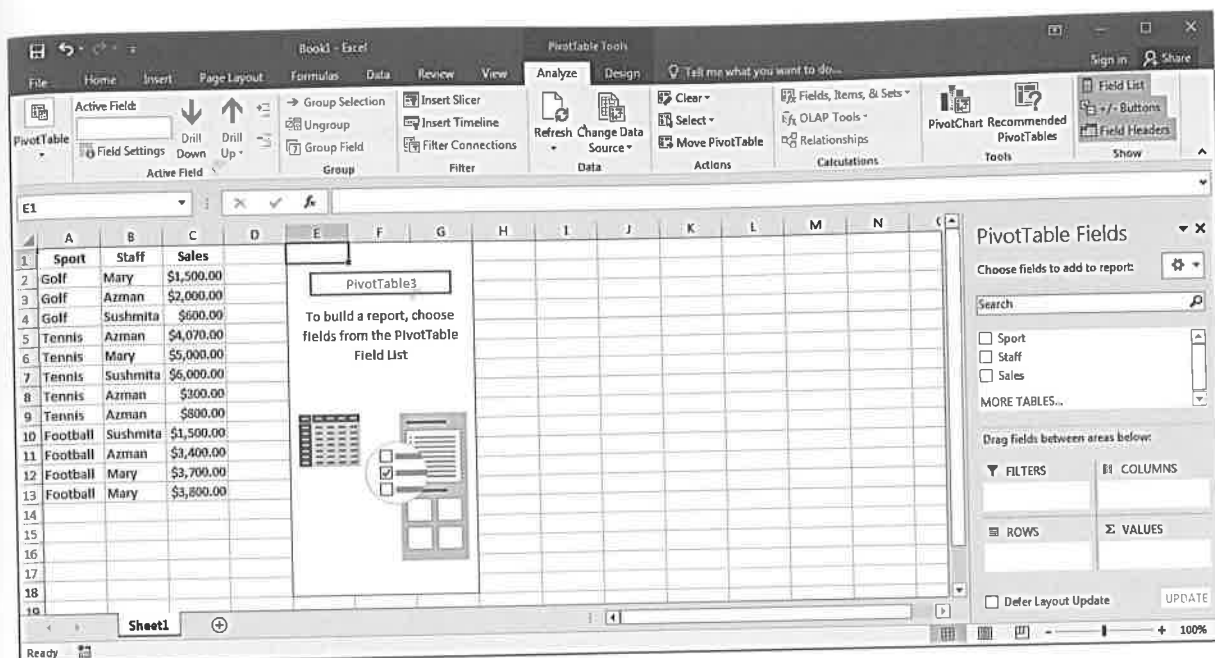
One commonly used feature in Microsoft Excel to analyse data is PivotTable. A PivotTable report is an interactive table that you can use to quickly summarise large amounts of data. You can rotate its rows and columns to see different summaries of the source data, filter the data by displaying different pages, or display the details for areas of interest.

Creating a PivotTable

- 1) Open the workbook where you want to create the PivotTable report. If you are basing the report on a Microsoft Excel list or database, click a cell in the list or database.
- 2) From the **Insert** tab → **Tables** group → click the **[PivotTable]** button.
- 3) The **Create PivotTable** dialogue is displayed.



- b. You can select the range of data to be analysed or select data from an external source like Microsoft Access.
 - c. The default option is to place the PivotTable on a **New Worksheet**.
 - d. Click on the option for **Existing Worksheet** if you want the PivotTable to be in the same worksheet as the data. Then specify the starting cell reference of the location for the PivotTable.
- 4) Click **[OK]** to close the dialogue box and the screen below will be displayed.



Anatomy of a PivotTable

Microsoft Excel uses specific terms to identify the various parts of the PivotTable. You need to be familiar with the various terms so that you can use the PivotTable effectively.

The diagram shows a PivotTable with the following structure:

Period	Sum of Repair Cost	Comms and Signal	ECU	Engine	Grand Total
Circuit Board	7500		5170	7270	19940
Sensors	5800		6000	7500	19300
Switches		600	2800	1500	4900
Grand Total	13300	600	13970	16270	44140

The PivotTable Fields task pane is open on the right, showing the 'PivotTable Fields' tab. The 'Choose fields to add to reports' section shows 'Equipment Part', 'Category', 'Period', and 'Repair Cost'. The 'Drag fields between areas below' section shows 'Filters' (Period), 'Columns' (Category), 'Rows' (Equipment Part), and 'Values' (Sum of Repair Cost). The 'Defer Layout Update' checkbox is checked.

1	Report Filter	This area is used to filter for a subset of the entire table. In this example you can filter to display a particular quarter or a few quarters combined.
2	Data Field	This cell shows the function used and the data being summarised. In this example the table shows the SUM of the Sales field.
3	Column Labels	Fields assigned to this area are display horizontally in a row.

4	Item	These are the detailed items in the Row and Column Label areas.
5	Row Labels	Fields assigned to this area are display vertically in a column
6	Values	This area contains the summarised numeric data

Add Data to a PivotTable

Add data to the PivotTable by moving the fields into the **Row Labels** area, **Column Labels** area, **Values** area and **Report Filter** area.

- If you tick the check box next to a field containing text data from the **PivotTable Field List** task pane displayed on the right, it will be placed in to **Row Labels** area by default. If you tick a field containing numeric data, it will be placed in the **Values** area.
- Alternatively, you can drag the required field from the **Choose fields to add to report** section of the task pane and drop it in the **Row** or **Column Labels** areas.

So if you want to find out the quarterly sale amount for each sport, tick on the Sport, Period and Sales field.

PivotTable Fields

Choose fields to add to report:

Search

☒ Sport
☐ Staff
☒ Period
☒ Sales

Drag fields between areas below:

Filters **Columns**

Rows **Σ Values**

Sport
Period

Sum of Sales

☐ Defer Layout Update Update

Row Labels	Sum of Sales
Football	\$19,300.00
Qtr1	\$5,600.00
Qtr2	\$6,300.00
Qtr3	\$1,500.00
Qtr4	\$5,900.00
Golf	\$4,900.00
Qtr3	\$3,500.00
Qtr4	\$1,400.00
Tennis	\$19,940.00
Qtr1	\$1,270.00
Qtr2	\$2,100.00
Qtr3	\$5,570.00
Qtr4	\$11,000.00
Grand Total	\$44,140.00

- To remove a field either:
 - Un-tick the check box next to the field.

OR

 - Drag the field away from the various areas.

Arranging Fields in The PivotTable

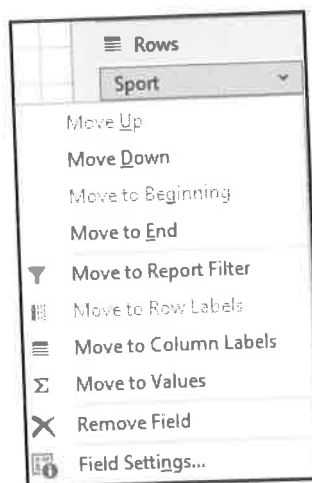
You can easily rearrange the layout of the PivotTable by moving the fields between the various areas. To move a field, either:

- **Right-click** on the field and select the area you want to move to from the resulting menu.



OR

- Click on the field from the **PivotTable Field List** task pane and select the area to move to from the resulting menu.



OR

- Click and drag the fields into the area you want

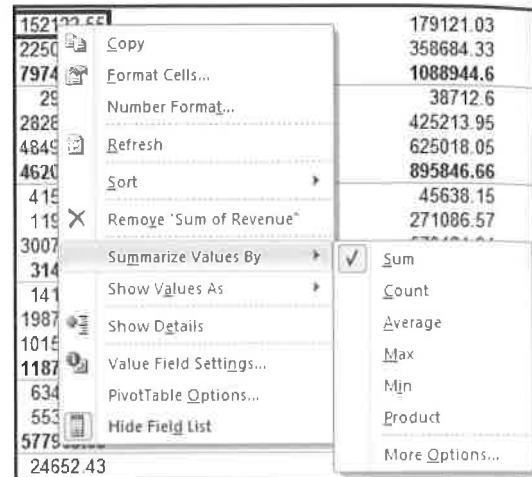
Change Summary Functions in The PivotTable

By default, Excel will summarise numeric data in the PivotTable with a SUM and text data with a COUNT function.

You can change the field settings to select different functions. For example, instead of totalling the sales, you can display the average sales.

1. To change the function, either:

- **Right-click** on any of the cell in the PivotTable.
- Point on **Summarize Values By**.
- Select the summary function you want to use from the resulting list.
- To select other functions, click on **More Options** to display the **Field Settings** dialogue box.

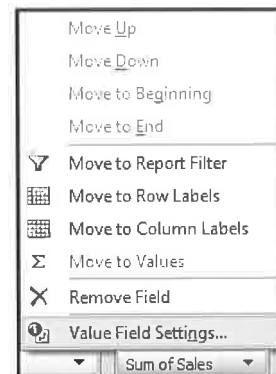


OR

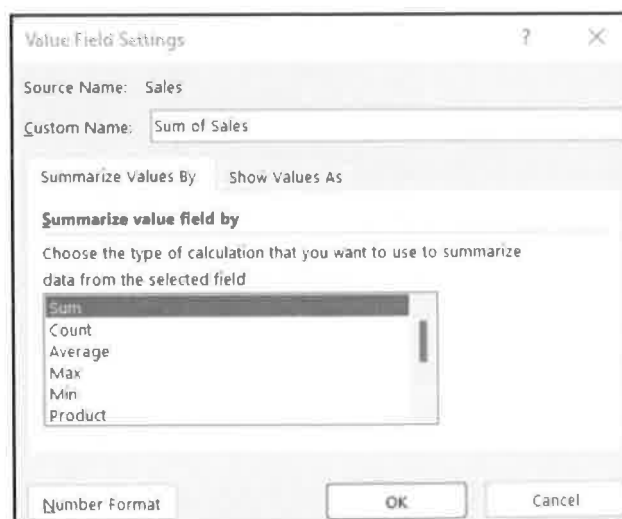
- Click on the arrow beside the field in the **Values** area of the task pane.
- Select **Value Field Settings** to display the **Field Settings** dialogue box.

OR

- **Right-click** on any cell and select **Value Field Settings** to display the **Field Settings** dialogue box.



2. In the **Value Field Settings** dialogue box displayed, choose the type of summary function you want from the list.



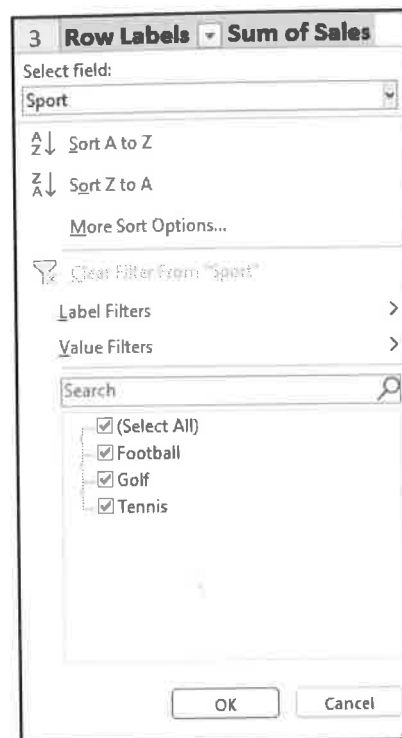
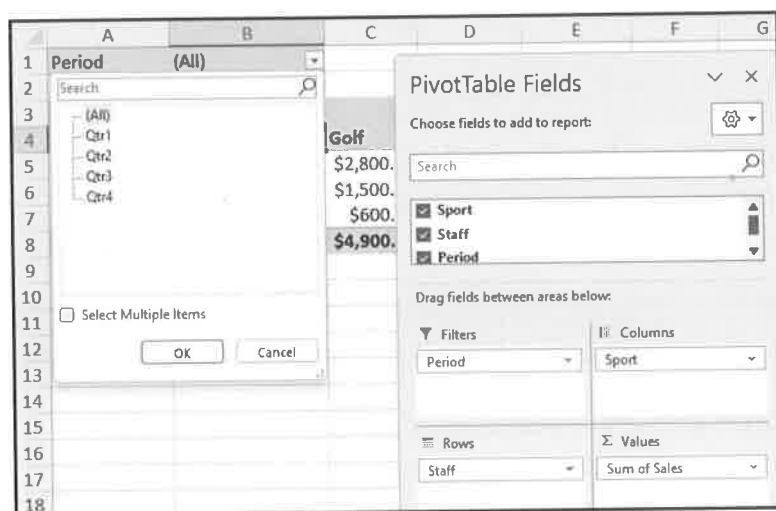
3. Click [OK] when done.

Filtering Data in The PivotTable

You will notice the down arrows on the **Row** and **Column Labels** button the PivotTable. Use these to choose to display or hide selected items from a given field.

- When you click on the down arrow, you will see a list of the items in the row or column.
- Check or uncheck the boxes to display or hide the items to be displayed.

You can also use the **Report Filter** area to extract a subset of a field.

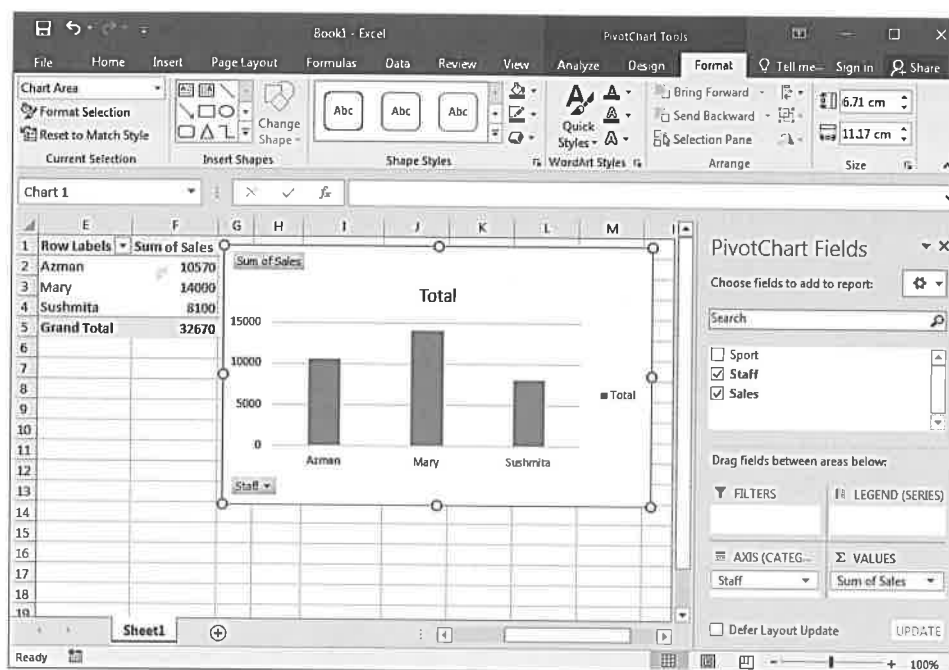


The **Report Filter** area allows you to display more than one (1) item in the report filter. Tick in the box next to **Select Multiple Items** and then check the items that you want to display.

Creating PivotChart

After you have created the PivotTable, you can represent the data as a PivotChart. This allows you to present the data in a more impactful manner.

1. Click on the PivotTable.
2. From the **PivotTable Tools, Analyze** tab → **Tools** group → click on the **[PivotChart]** button.
3. Select the **Chart Type** and click [OK].



The **PivotChart Tools** contextual tab appears. Use the **Analyze**, **Design** and **Format** tabs to add Slicer, Timelines, PivotTable elements, Chart elements and formatting to the PivotChart.



LEARNING ACTIVITIES

Step 1 Open the **Pivot Table** workbook and select **Data** worksheet.

Step 2 Click anywhere in the data and create a PivotTable in a new worksheet.

Step 3 Arrange the PivotTable as follows:

- Drag the **Staff** field to "**Rows**"
- Drag the **Sports** field to "**Columns**"
- Drag the **Sales** field to "**Values**"

Step 4 Move the **Staff** field to the **Column** area and the **Sports** field to the **Row** area.

Step 5 Move the fields back.

Step 6 Change the aggregation method for the Sales from SUM to COUNT.

Step 7 Change the aggregation method to AVERAGE.

Step 8 Change the aggregation method to SUM.

Step 9 Click the drop-down arrow next to the **Sports** field heading and select any three (3) product items.

Step 10 Select all Sports.

Step 11 To view the details for any one (1) club, perform the following:

- Move the **Period** field to the "**Filters**".
- Select any period by clicking the drop-down arrow in the **Period** field the Filter area.

- c. To select more than one (1) period, click the drop-down arrow in the Filter area and check the box next to **Select Multiple Items**.
- d. Select all periods.

Step 12 Select the Sales Data worksheet.

Step 13 Create a PivotTable and place it anywhere on the right of the current worksheet.

Step 14 Arrange the PivotTable as follows:

- a. Drag the **Sports** field to "Rows"
- b. Drag the **Sales** field to "Values"

Step 15 Create a 2D Clustered Column PivotChart using the existing PivotTable.
Save and close the workbook.

Microsoft Power BI

Power BI Desktop is a free data visualization from Microsoft. In the annual Gartner Magic Quadrant ranking for Analytics and Business Intelligence Platforms, Power BI Desktop has consistently been ranked no. 1.

There are 2 versions of Power BI available.

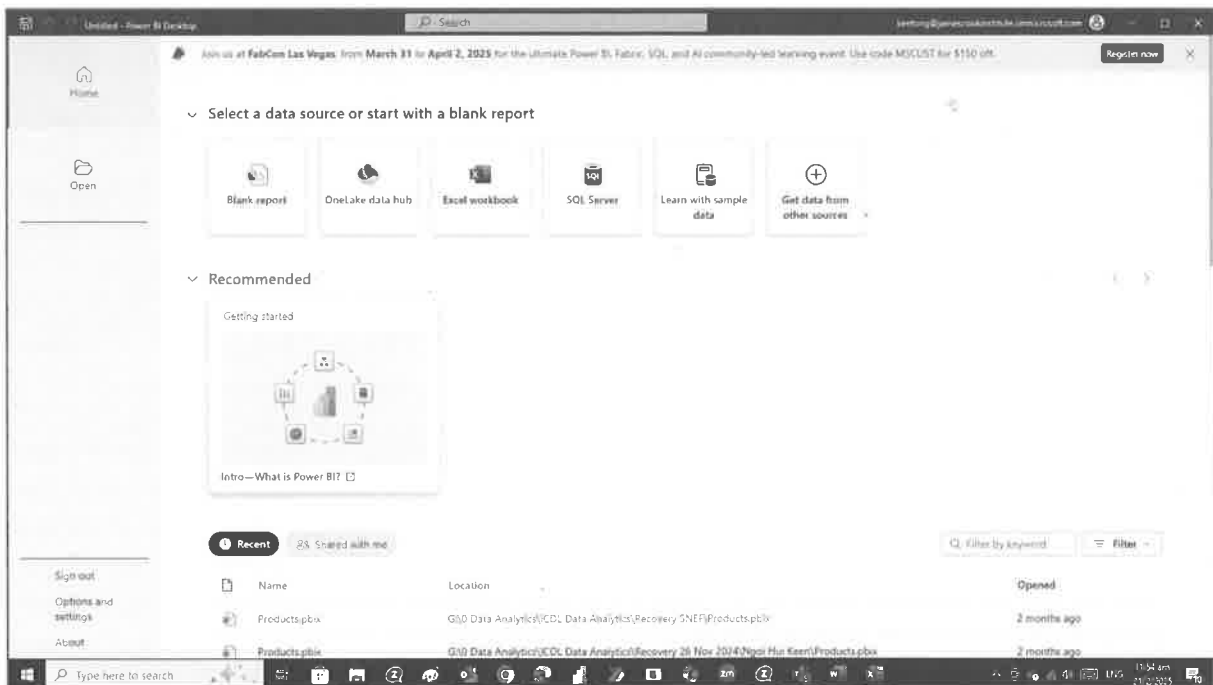
Power BI Desktop is a free application that can be downloaded and installed on your local computer. You can share your files in the same way as you share any other type of files such as Excel or Word.

Power BI Service is a Software as a Service (SaaS) platform that you can login into and use the application online. As a Cloud based platform it allows you to collaborate with others by sharing your files with them in real time. However, to allow for real-time collaborate you will need to have a subscription with Microsoft.

Navigating Through Power BI Desktop

Start Power BI Desktop

During the initial start-up of Power BI Desktop, it will display the startup screen as shown below. If you uncheck the tick at the bottom of the screen displaying Show this screen on startup, the next time you start Power BI Desktop (PBI), this screen will not be shown.

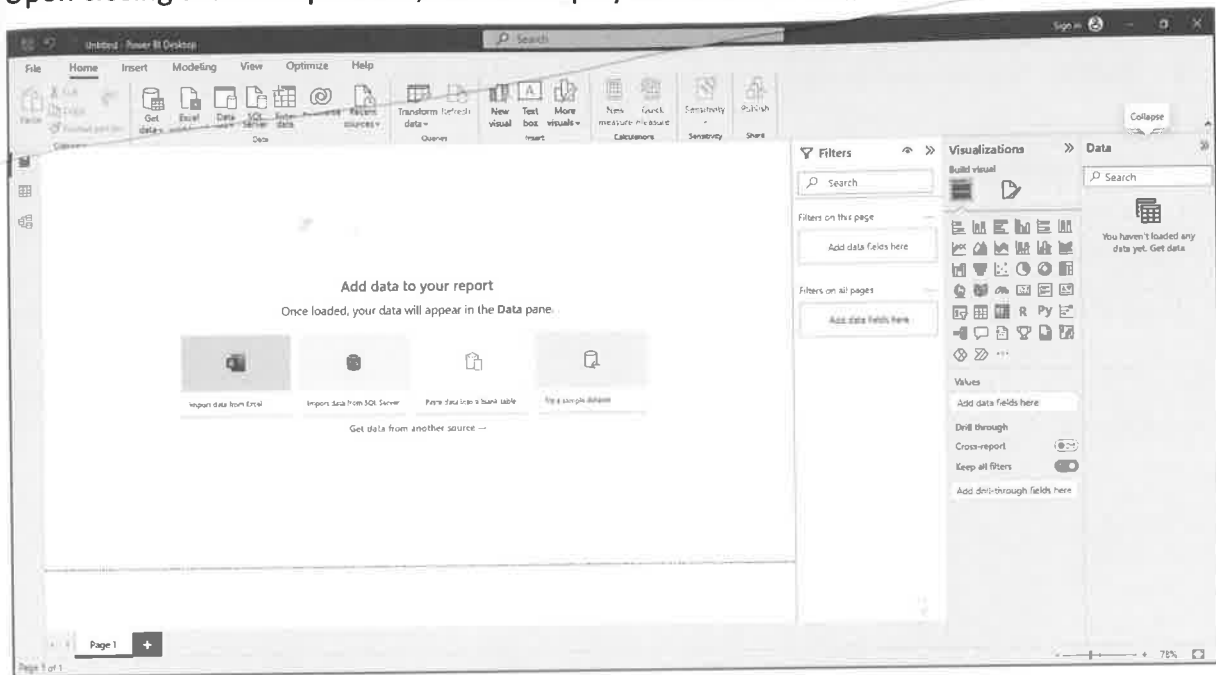


The first portion on the left allows you to open existing Power BI files.

The second portion on the right allows you to import data from various sources into Power BI.

You can use the section on the bottom of the right portion to open previously used Power BI files.

Upon closing the startup screen, PBI will display the initial screen.



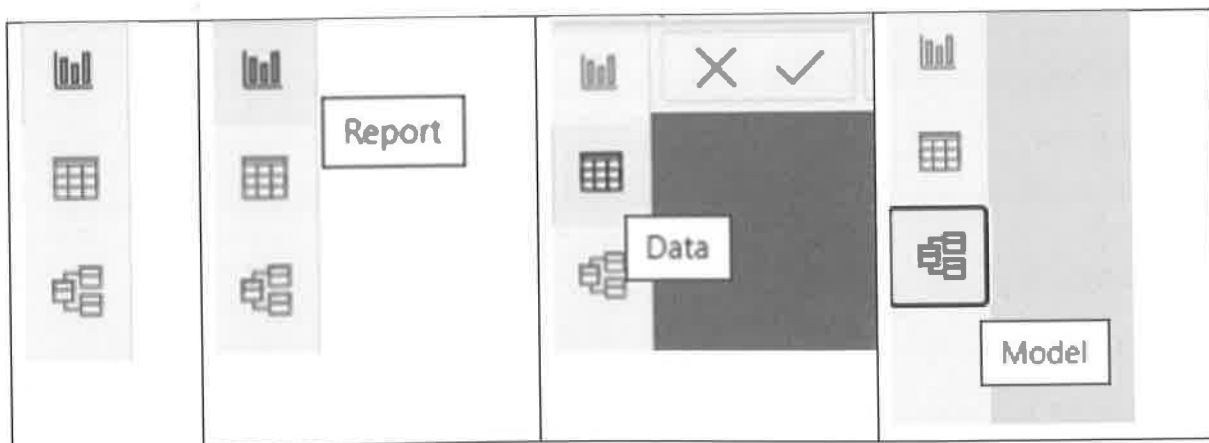
LEARNING ACTIVITIES

- 1) Start your Power BI application.
- 2) Close the startup screen.

Components in Power BI Desktop Screen

Power BI View

In PBI, there are 3 views which users will navigate around. It is located at the left of the screen. See below image.

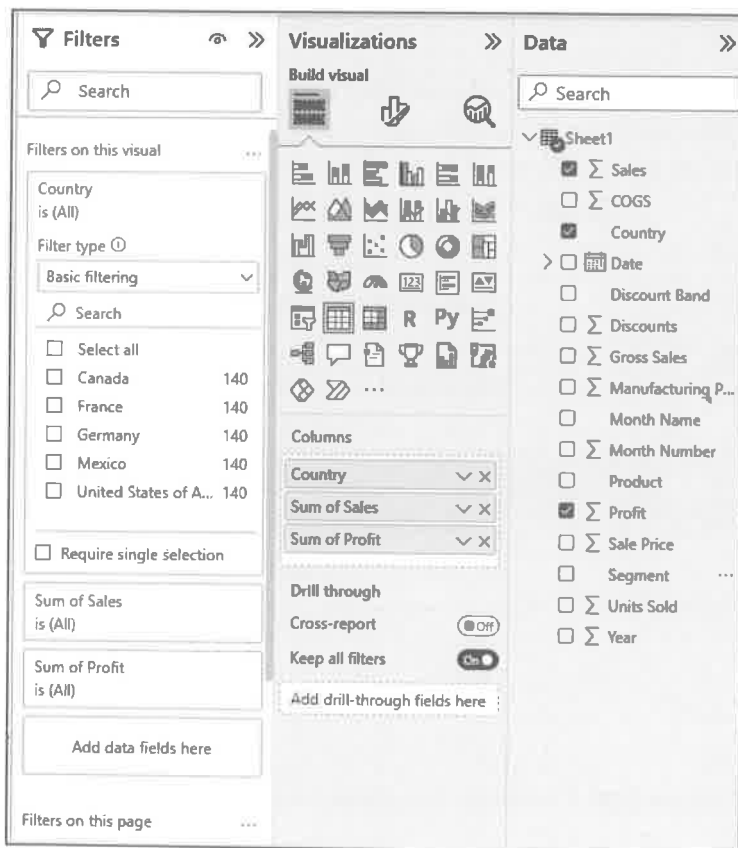


- **Report:** You create reports and visuals, where most of your creation time is spent. This is the default view.

- **Data:** You see the tables, measures, and other data used in the data model associated with your report, and transform the data for best use in the report's model.
- **Model:** You see and manage the relationships among tables in your data model.

Power BI Task Panes

On the right of the screen are 3 tasks panes that you will use to manage data and create and format visuals.



Filters

This pane allows you to select or filter the data from the fields in a visual.

Visualizations

This pane is where you select the type of visual you want to create. The common types of visual are:

- Charts, e.g. column, bar, line, pie, donut, etc.
- Tables
- Key performance Indicators or KPIs
- Maps

Data

This pane allows you to see the fields, or column, within the data imported. You can use this to select which fields or columns you want in the visuals.

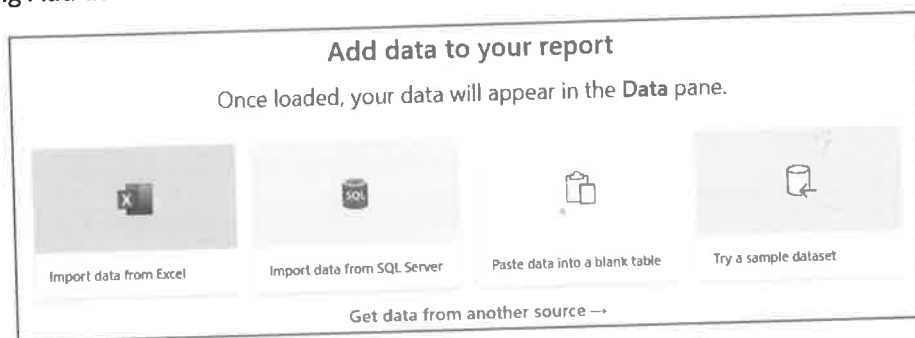
Using Power BI Desktop

Import Data

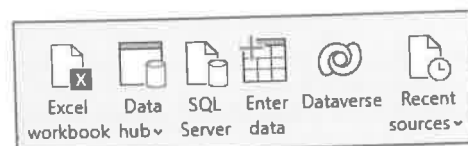
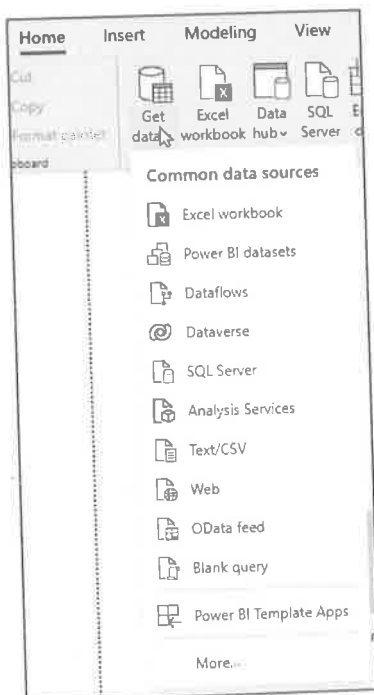
The first step with using Power BI is to import the required into Power BI. The data can be in different formats such as an Excel spreadsheet, another Power BI file, from SQL Servers or Text/CSV files.

There are a number of ways that can be imported into Power BI

- Using Add data buttons on the Power BI report



- Using the Get data button from the Home Ribbon



- Using the relevant buttons from the Home Ribbon

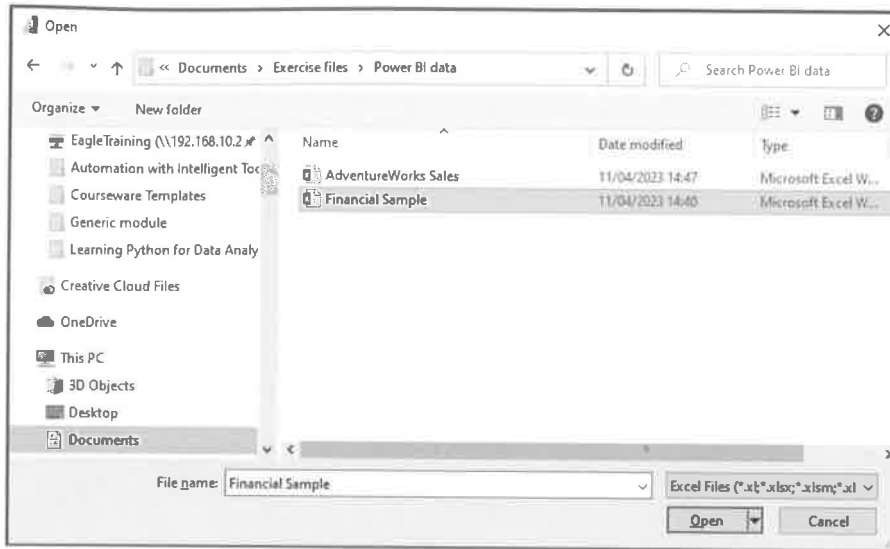




LEARNING ACTIVITIES

To import an Excel spreadsheet:

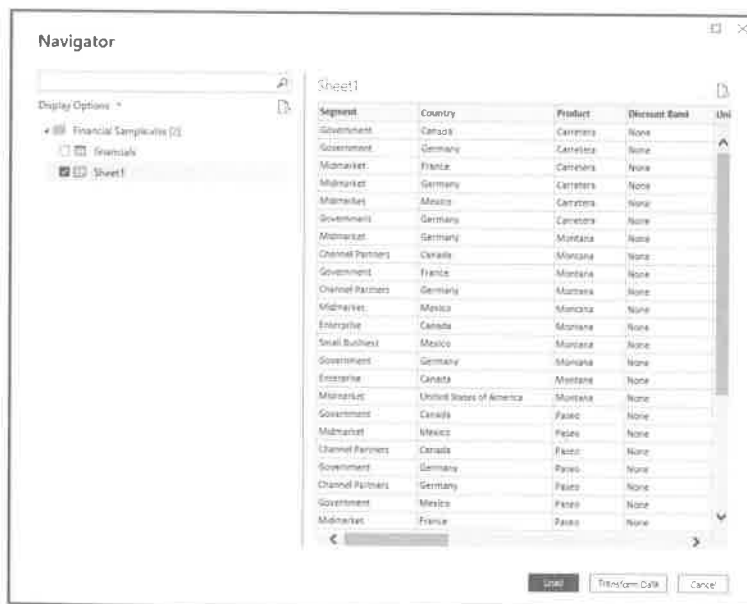
Step 1 Click the Import data from Excel button on the body of the report.

Step 2 In the Open dialogue box  select the Excel file  click the [Open] button.







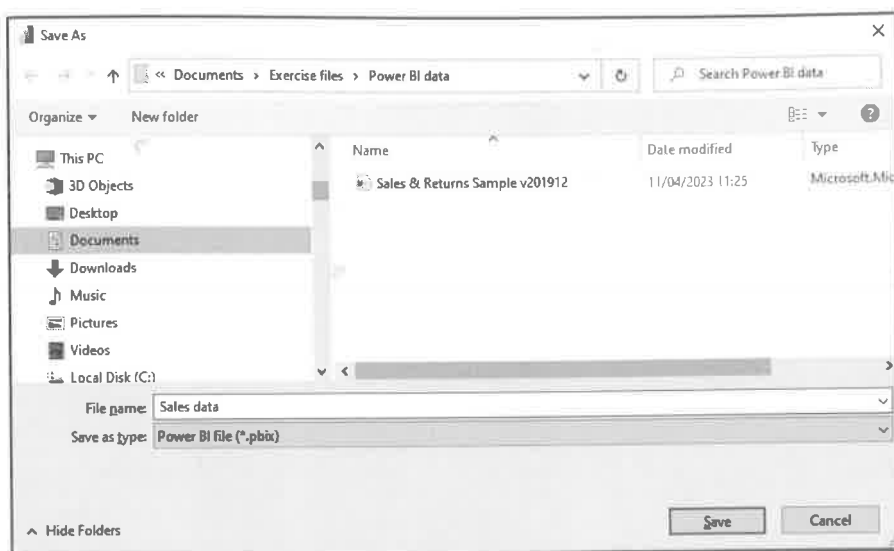
Step 3 In the Navigator dialogue box  tick on the sheet that contains your data  on the right of the dialogue box you will see a preview of the data to be imported.

Step 4 Click the [Load] button.



Step 5 After the data has been loaded it is recommended that you save the Power BI file.

Step 6 Click File tab  Save As  select the folder you want to save to  give file a useful file name  click the [Save] button.



Create Basic Visualisation

There are many types of visuals you can create with Power BI. Some common visuals are:

Table visual – useful if you need to compare number values.

Chart visuals – useful to compare between series of values or to analyse trends. The types of charts available include Stacked Bar, Stacked Column, Clustered Bar, Clustered Column, 100% Stacked Bar, 100% Stacked Column, Line, etc.

You will use the Visualizations and Data panes.

Remember to ALWAYS click on the blank area of the report before creating a new visual.



LEARNING ACTIVITIES

Table Visualization

Step 1 Click the [Table] button in the Visualization pane.

Step 2 Tick the Country, Sales and Profit fields from the Data pane.

Step 3 Notice that the fields appear in the Columns area.

Step 4 Alternatively, you can click and drag the fields into Columns area.

Step 5 To change the sequence of the fields in the Columns area simply drag the field to the level you want.

Step 6 In the example below, we created a table visual to display Country, Sales and Profit.

The screenshot shows a data visualization tool interface. On the left, a table displays sales and profit data by country. On the right, a sidebar contains two main panels: 'Visualizations' and 'Data'.

Country	Sum of Sales	Sum of Profit
Canada	24,887,654.88	3,529,228.89
France	24,354,172.28	3,781,020.78
Germany	23,505,340.82	3,680,388.82
Mexico	20,949,352.11	2,907,523.11
United States of America	25,029,830.17	2,995,540.66
Total	118,726,350.26	16,893,702.26

Visualizations Panel:

- Build visual:** Includes icons for various chart types (bar, line, pie, etc.).
- Columns:** A list of fields currently in the visualization: Country, Sum of Sales, and Sum of Profit.
- Drill through:** A section with 'Cross-report' (OFF) and 'Keep all filters' (ON) options.
- Add drill-through fields here:** A text input field for additional drill-through fields.

Data Panel:

- Search:** A search bar at the top.
- Sheet1:** A list of data fields with checkboxes:
 - ☒ Sales
 - ☐ COGS
 - ☒ Country
 - ☐ Date
 - ☐ Discount Band
 - ☐ Discounts
 - ☐ Gross Sales
 - ☐ Manufacturing P...
 - ☐ Month Name
 - ☐ Month Number
 - ☐ Product
 - ☒ Profit
 - ☐ Sale Price
 - ☐ Segment
 - ☐ Units Sold
 - ☐ Year

Step 7 Create another table visual to display Segment, Sales and Profit.

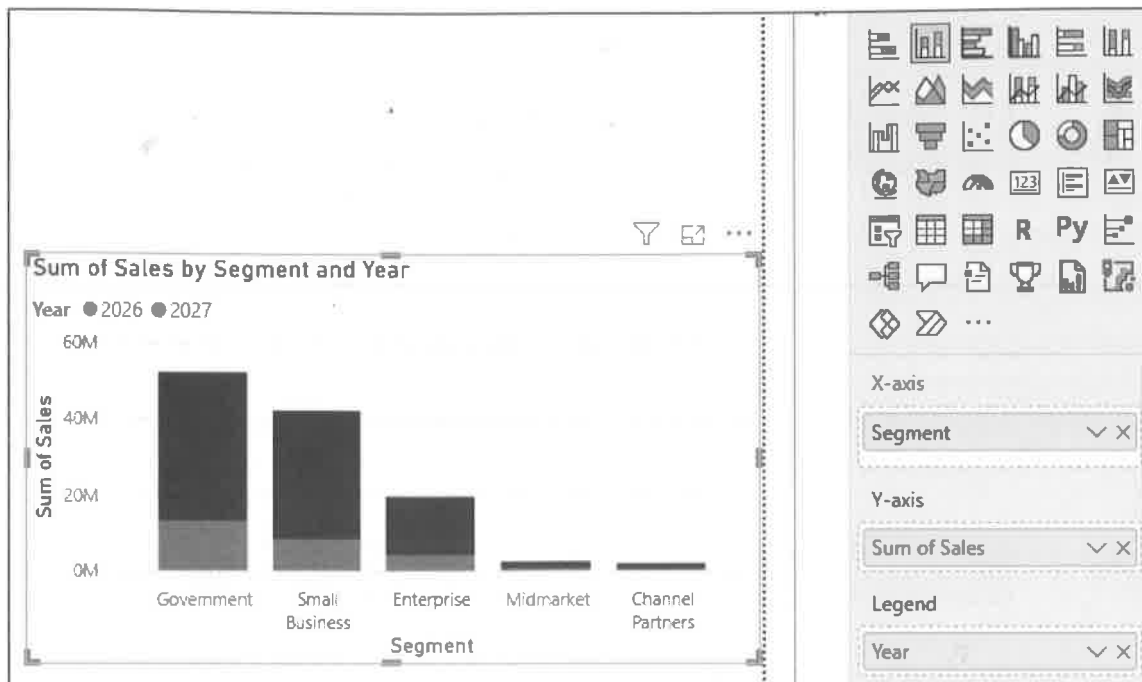
Chart Visualization

Step 1 Click in the blank area of the report.

Step 2 Click the [Stacked column chart] button in the Visualizations pane.

Step 3 Click and drag the fields into the following areas:

- Segment in the X-axis
- Sales in the Y-axis
- Year in the Legend.



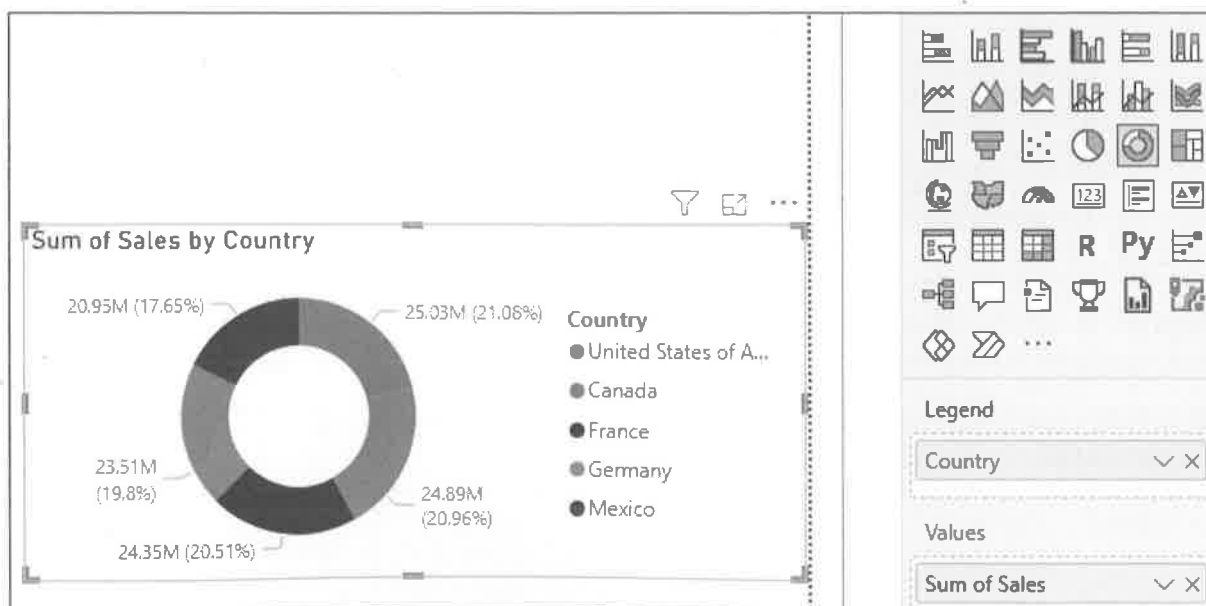
Donut Visualization

Step 1 Click in the blank area of the report.

Step 2 Click the [Donut chart] button in the Visualization pane.

Step 3 Click and drag the fields into the following areas:

- Country in the Legend
- Sales in the Values.



Change Visualization

To change the visual, click on the visual and select a new visual from the Visualizations pane.



LEARNING ACTIVITIES

Step 1 Select the Stacked column chart.

Step 2 Click the [Clustered column chart] button to change the chart type.

Format Visualization

In addition to creating visuals, Power BI allows you to apply various types of formatting to enhance the visual appeal of the report as well as to highlight clearly items of interest for the attention of the users of the reports.



LEARNING ACTIVITIES

Format Font and Background

Step 1 Select the Country Table visual.

Step 2 To format font, click the [Format Visual] button.

Step 3 Click the Visual tab and then click the Values section. You can use the menu to change font type, size, colour and apply a background colour for the cells.

Step 4 Use Alternate text color and Alternative background color to apply banding to the table.

Country	Sum of Sales	Sum of Profit
Canada	24,887,654.88	3,529,228.89
France	24,354,172.28	3,781,020.78
Germany	23,505,340.82	3,680,388.82
Mexico	20,949,352.11	2,907,523.11
United States of America	25,029,830.17	2,995,540.66
Total	118,726,350.26	16,893,702.26

Step 5 Use Column headers and Totals section to apply formatting to the top row and the Total row.

Step 6 Use Specific column section to apply formatting to only a single column.

Visualizations

Format visual

Visual General

Values

Values

Font

Segoe UI 10

B I U

Text color

Background color

Alternate text color

Alternate background col...

Text wrap On

Reset to default

Format Chart Elements

Step 1 Select the Sum of Sales by Segment and Year chart.

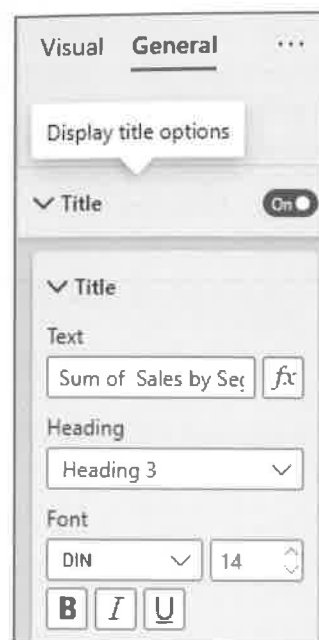
Step 2 To change column colour, click the Visual tab and then click the Columns section.

Step 3 To format and edit titles for charts, click the General tab and use the Title section. Change the chart title to Segment Sales.

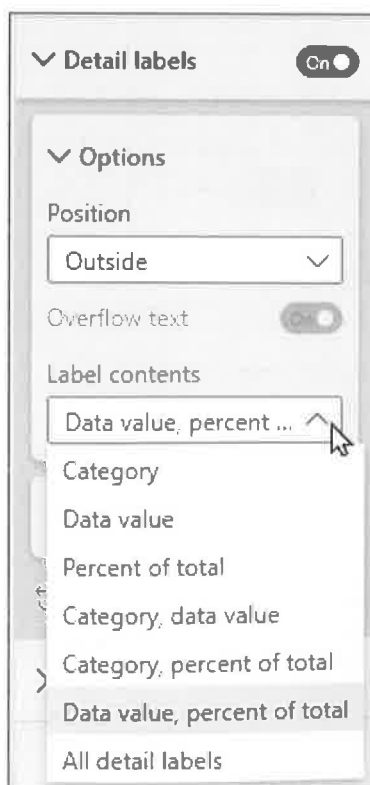
Step 4 Select the Sum of Sales by Country chart.

Step 5 Click the Visual tab and expand the Legend section to change the position of the legend.

Step 6 Use the On/Off slider to turn off display of legend.



Step 7 To add the names of the countries to labels, use the Detail labels section and select Category, data value from the Label contents section. Change the Label contents to Category, percent of total.



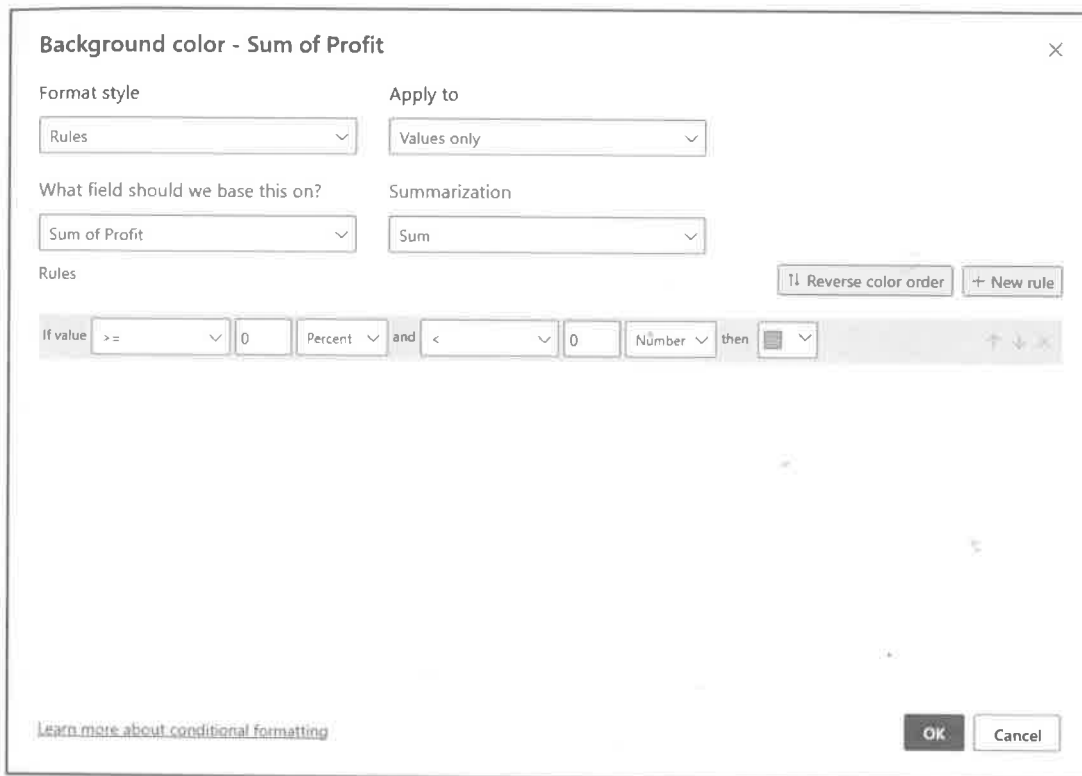
Conditional Formatting

This feature allows you to apply formatting but only for values that mean specific conditions or criteria. This highlights clearly important items in the reports. You can apply font colours, background colours or data bars to the visuals.

Step 1 Select the Segment table and apply conditional formatting, using background colour to the Profit field using Rules as shown below.

- If value ≥ 0 Percent and < 0 Number then a colour of your choice

This applies colour to all cells with negative values.



Step 2 Using the Segment table again, apply conditional formatting, using background colour to the Sales field using Rules as shown below.

- If value ≥ 0 Percent and < 3000000 Number then a colour of your choice
- If value ≥ 10000000 Percent and < 20000000 Number then a different colour of your choice

Background color - Sum of Sales

Format style

Rules

Apply to

Values only

What field should we base this on?

Sum of Sales

Summarization

Sum

Rules

Reverse color order

New rule

If value

>=

0

Percent

and

<

30000

Number

then

If value

>=

10000

Number

and

<

20000

Number

then

Learn more about conditional formatting

OK

Cancel