

**Advance Exce 2016**

## About the Tutorial

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Advanced Excel 2016 is a comprehensive course that provides a good insight into the latest and advanced features available in Microsoft Excel. It explains in detail how to perform various data analysis functions using the features available in MS-Excel.

The course has plenty of practices that explain how to use a particular feature, in a step-by-step manner.

## Audience

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This tutorial has been designed for corporate staff who depend heavily on MS-Excel to prepare charts, tables, and professional reports that involve complex data. It will help all those who use MS-Excel regularly to analyze data.

## Prerequisites

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The participants of this course are expected to have a good prior understanding of the basic features available in Microsoft Excel.

## Instructor

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The course is prepared and conducted in collaboration with Villa College by Yusuf Abdulla Shunan and have tried to update the contents of this course as timely and as precisely as possible, however, the contents may contain inaccuracies or errors. If you discover any errors please notify me via email:

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# Advanced Excel 2016

Excel, is a program that was developed by Microsoft Corporation for spreadsheet management. The most advance use of a spreadsheet are for as a data analysis tool, to organize, summarize, analyze, model, and visualize data. Hence this Advanced Excel course will look at using data analysis, without which the Advanced Features of Excel will have no meaning.

# 1. Data Analysis – Overview

Data Analysis is a process of inspecting, cleaning, transforming and modeling data with the goal of discovering useful information, suggesting conclusions and supporting decision-making.

## Types of Data Analysis

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Several data analysis techniques exist encompassing various domains such as business, science, social science, etc. with a variety of names. The major data analysis approaches are-

- Data Mining
- Business Intelligence
- Statistical Analysis
- Predictive Analytics
- Text Analytics

### Data Mining

Data Mining is the analysis of large quantities of data to extract previously unknown, interesting patterns of data, unusual data and the dependencies. Note that the goal is the extraction of patterns and knowledge from large amounts of data and not the extraction of data itself.

Data mining analysis involves computer science methods at the intersection of the artificial intelligence, machine learning, statistics, and database systems.

The patterns obtained from data mining can be considered as a summary of the input data that can be used in further analysis or to obtain more accurate prediction results by a decision support system.

### Business Intelligence

Business Intelligence techniques and tools are for acquisition and transformation of large amounts of unstructured business data to help identify, develop and create new strategic business opportunities.

The goal of business intelligence is to allow easy interpretation of large volumes of data to identify new opportunities. It helps in implementing an effective strategy based on insights that can provide businesses with a competitive market-advantage and long-term stability.

### Statistical Analysis

Statistics is the study of collection, analysis, interpretation, presentation, and organization of data.

In data analysis, two main statistical methodologies are used-

- **Descriptive statistics:** In descriptive statistics, data from the entire population or a sample is summarized with numerical descriptors such as-
  - Mean, Standard Deviation for Continuous Data
  - Frequency, Percentage for Categorical Data
- **Inferential statistics:** It uses patterns in the sample data to draw inferences about the represented population or accounting for randomness. These inferences can be-
  - answering yes/no questions about the data (hypothesis testing)
  - estimating numerical characteristics of the data (estimation)
  - describing associations within the data (correlation)
  - modeling relationships within the data (E.g. regression analysis)

## Predictive Analytics

Predictive Analytics use statistical models to analyze current and historical data for forecasting (predictions) about future or otherwise unknown events. In business, predictive analytics is used to identify risks and opportunities that aid in decision-making.

## Text Analytics

Text Analytics, also referred to as Text Mining or as Text Data Mining is the process of deriving high-quality information from text. Text mining usually involves the process of structuring the input text, deriving patterns within the structured data using means such as statistical pattern learning, and finally evaluation and interpretation of the output.

## Data Analysis Process

Data Analysis is defined by the statistician John Tukey in 1961 as "Procedures for analyzing data, techniques for interpreting the results of such procedures, ways of planning the gathering of data to make its analysis easier, more precise or more accurate, and all the machinery and results of (mathematical) statistics which apply to analyzing data."

Thus, data analysis is a process for obtaining large, unstructured data from various sources and converting it into information that is useful for-

- Answering questions
- Test hypotheses
- Decision-making
- Disproving theories



## Data Analysis with Excel

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Microsoft Excel provides several means and ways to analyze and interpret data. The data can be from various sources. The data can be converted and formatted in several ways. It can be analyzed with the relevant Excel commands, functions and tools - encompassing Conditional Formatting, Ranges, Tables, Text functions, Date functions, Time functions, Financial functions, Subtotals, Quick Analysis, Formula Auditing, Inquire Tool, What-if Analysis, Solvers, Data Model, PowerPivot, PowerView, PowerMap, etc.

You will be learning these data analysis techniques with Excel as part of two parts-

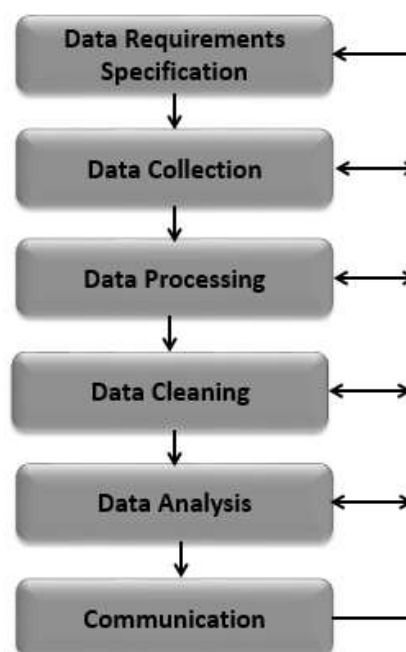
- Data Analysis with Excel and
- Advanced Data Analysis with Excel

## 2. Data Analysis Process

Data Analysis is a process of collecting, transforming, cleaning, and modeling data with the goal of discovering the required information. The results so obtained are communicated, suggesting conclusions, and supporting decision-making. Data visualization is at times used to portray the data for the ease of discovering the useful patterns in the data. The terms Data Modeling and Data Analysis mean the same.

Data Analysis Process consists of the following phases that are iterative in nature-

- Data Requirements Specification
- Data Collection
- Data Processing
- Data Cleaning
- Data Analysis
- Communication



### Data Requirements Specification

The data required for analysis is based on a question or an experiment. Based on the requirements of those directing the analysis, the data necessary as inputs to the analysis is identified (e.g., Population of people). Specific variables regarding a population (e.g., Age and Income) may be specified and obtained. Data may be numerical or categorical.

## **Data Collection**

Data Collection is the process of gathering information on targeted variables identified as data requirements. The emphasis is on ensuring accurate and honest collection of data. Data Collection ensures that data gathered is accurate such that the related decisions are valid. Data Collection provides both a baseline to measure and a target to improve.

Data is collected from various sources ranging from organizational databases to the information in web pages. The data thus obtained, may not be structured and may contain irrelevant information. Hence, the collected data is required to be subjected to Data Processing and Data Cleaning.

## **Data Processing**

The data that is collected must be processed or organized for analysis. This includes structuring the data as required for the relevant Analysis Tools. For example, the data might have to be placed into rows and columns in a table within a Spreadsheet or Statistical Application. A Data Model might have to be created.

## **Data Cleaning**

The processed and organized data may be incomplete, contain duplicates, or contain errors. Data Cleaning is the process of preventing and correcting these errors. There are several types of Data Cleaning that depend on the type of data. For example, while cleaning the financial data, certain totals might be compared against reliable published numbers or defined thresholds. Likewise, quantitative data methods can be used for outlier detection that would be subsequently excluded in analysis.

## **Data Analysis**

Data that is processed, organized and cleaned would be ready for the analysis. Various data analysis techniques are available to understand, interpret, and derive conclusions based on the requirements. Data Visualization may also be used to examine the data in graphical format, to obtain additional insight regarding the messages within the data.

Statistical Data Models such as Correlation, Regression Analysis can be used to identify the relations among the data variables. These models that are descriptive of the data are helpful in simplifying analysis and communicate results.

The process might require additional Data Cleaning or additional Data Collection, and hence these activities are iterative in nature.

## **Communication**

The results of the data analysis are to be reported in a format as required by the users to support their decisions and further action. The feedback from the users might result in additional analysis.

The data analysts can choose data visualization techniques, such as tables and charts, which help in communicating the message clearly and efficiently to the users. The analysis tools provide facility to highlight the required information with color codes and formatting in tables and charts.

# 3. Data Analysis with Excel – Overview

Excel provide commands, functions and tools that make your data analysis tasks easy. You can avoid many time consuming and/or complex calculations using Excel. In this tutorial, you will get a head start on how you can perform data analysis with Excel. You will understand with relevant examples, step by step usage of Excel commands and screen shots at every step.

## Ranges and Tables

The data that you have can be in a range or in a table. Certain operations on data can be performed whether the data is in a range or in a table.

However, there are certain operations that are more effective when data is in tables rather than in ranges. There are also operations that are exclusively for tables.

You will understand the ways of analyzing data in ranges and tables as well. You will understand how to name ranges, use the names and manage the names. The same would apply for names in the tables.

## Data Cleaning – Text Functions, Dates and Times

You need to clean the data obtained from various sources and structure it before proceeding to data analysis. You will learn how you can clean the data

- With Text Functions
- Containing Date Values
- Containing Time Values

## Conditional Formatting

Excel provides you conditional formatting commands that allow you to color the cells or font, have symbols next to values in the cells based on predefined criteria. This helps one in visualizing the prominent values. You will understand the various commands for conditionally formatting the cells.

## Sorting and Filtering

During the preparation of data analysis and/or to display certain important data, you might have to sort and/or filter your data. You can do the same with the easy to use sorting and filtering options that you have in Excel.

## Subtotals with Ranges

As you are aware, PivotTable is normally used to summarize data. However, Subtotals with Ranges is another feature provided by Excel that will allow you to group / ungroup data and summarize the data present in ranges with easy steps.

## **Quick Analysis**

With Quick Analysis tool in Excel, you can quickly perform various data analysis tasks and make quick visualizations of the results.

## **Understanding Lookup Functions**

Excel Lookup Functions enable you to find the data values that match a defined criteria from a huge amount of data.

## **PivotTables**

With PivotTables you can summarize the data, prepare reports dynamically by changing the contents of the PivotTable.

## **Data Visualization**

You will learn several Data Visualization techniques using Excel Charts. You will also learn how to create Band Chart, Thermometer Chart, Gantt chart, Waterfall Chart, Sparklines and PivotCharts.

## **Data Validation**

It might be required that only valid values be entered into certain cells. Otherwise, they may lead to incorrect calculations. With data validation commands, you can easily set up data validation values for a cell, an input message prompting the user on what is expected to be entered in the cell, validate the values entered with the defined criteria and display an error message in case of incorrect entries.

## **Financial Analysis**

Excel provides you several financial functions. However, for commonly occurring problems that require financial analysis, you can learn how to use a combination of these functions.

## **Working with Multiple Worksheets**

You might have to perform several identical calculations in more than one worksheet. Instead of repeating these calculations in each worksheet, you can do it one worksheet and have it appear in the other selected worksheets as well. You can also summarize the data from the various worksheets into a report worksheet.

## **Formula Auditing**

When you use formulas, you might want to check whether the formulas are working as expected. In Excel, Formula Auditing commands help you in tracing the precedent and dependent values and error checking.

## **Inquire**

Excel also provides Inquire add-in that enables you compare two workbooks to identify changes, create interactive reports, and view the relationships among workbooks, worksheets, and cells. You can also clean the excessive formatting in a worksheet that makes Excel slow or makes the file size huge.

## 4. Working with Range Names

While doing Data Analysis, referring to various data will be more meaningful and easy if the reference is by Names rather than cell references – either a single cell or a range of cells. For example, if you are calculating Net Present Value based on a Discount Rate and a series of Cash Flows, the formula

**Net\_Present\_Value = NPV (Discount\_Rate, Cash\_Flows)**

is more meaningful than

C10 =NPV (C2, C6:C8)

With Excel, you can create and use meaningful names to various parts of your data. The advantages of using range names include-

- A meaningful Range name (such as Cash\_Flows) is much easier to remember than a Range address (such as C6:C8).
- Entering a name is less error prone than entering a cell or range address.
- If you type a name incorrectly in a formula, Excel will display a **#NAME?** error.
- You can quickly move to areas of your worksheet by using the defined names.
- With Names, your formulas will be more understandable and easier to use. For example, a formula Net\_Income = Gross\_Income – Deductions is more intuitive than C40 = C20 – B18.
- Creating formulas with range names is easier than with cell or range addresses. You can copy a cell or range name into a formula by using formula Autocomplete.

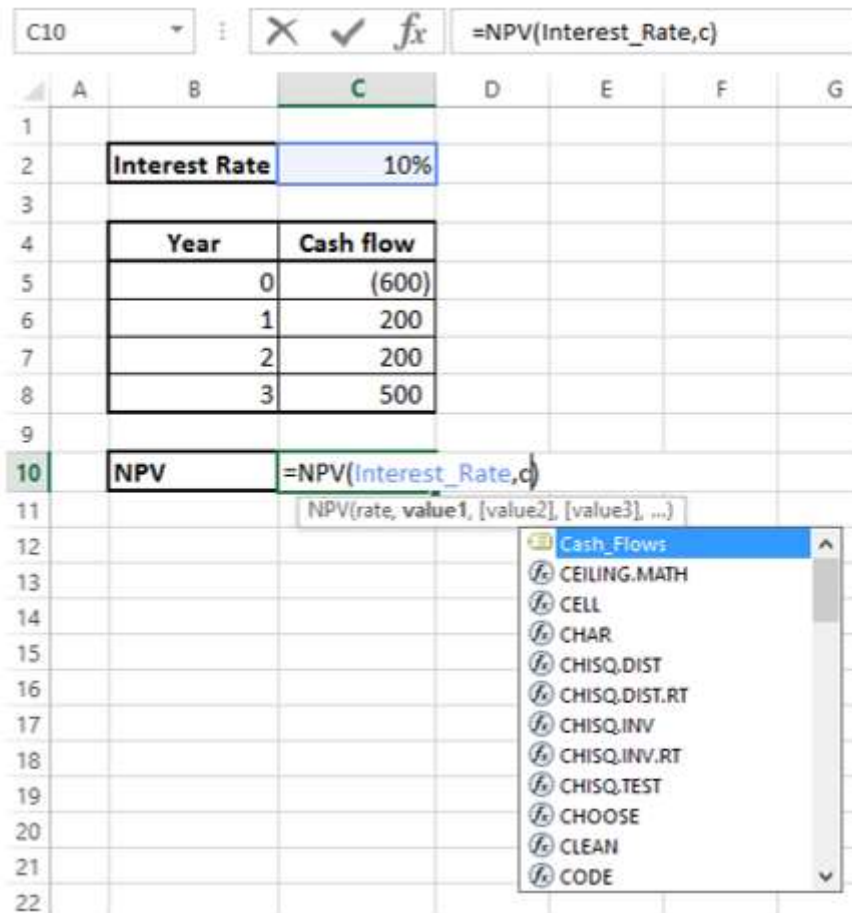
In this chapter, you will learn-

- Syntax rules for names.
- Creating names for cell references.
- Creating names for constants.
- Managing the names.
- Scope of your defined names.
- Editing names.
- Filtering names.
- Deleting names.
- Applying names.
- Using names in a formula.
- Viewing names in a workbook.

- Using paste names and paste list.
- Using names for range intersections.
- Copying formulas with names.

## Copying Name using Formula Autocomplete

Type the first letter of the name in the formula. A drop-down box appears with function names and range names. Select the required name. It is copied into your formula.



## Range Name Syntax Rules

Excel has the following syntax rules for names-

- You can use any combination of letters, numbers and the symbols - underscores, backslashes, and periods. Other symbols are not allowed.
- A name can begin with a character, underscore or backslash.
- A name cannot begin with a number (example- 1stQuarter) or resemble a cell address (example- QTR1).



- If you prefer to use such names, precede the name with an underscore or a backslash (example- \1stQuarter, \_QTR1)
- Names cannot contain spaces. If you want to distinguish two words in a name, you can use underscore (example- Cash\_Flows instead of Cash Flows)
- Your defined names should not clash with Excel's internally defined names, such as **Print\_Area, Print\_Titles, Consolidate\_Area, and Sheet\_Title**. If you define the same names, they will override the Excel's internal names and you will not get any error message. However, it is advised not to do so.
- Keep the names short but understandable, though you can use up to 255 characters

## Creating Range Names

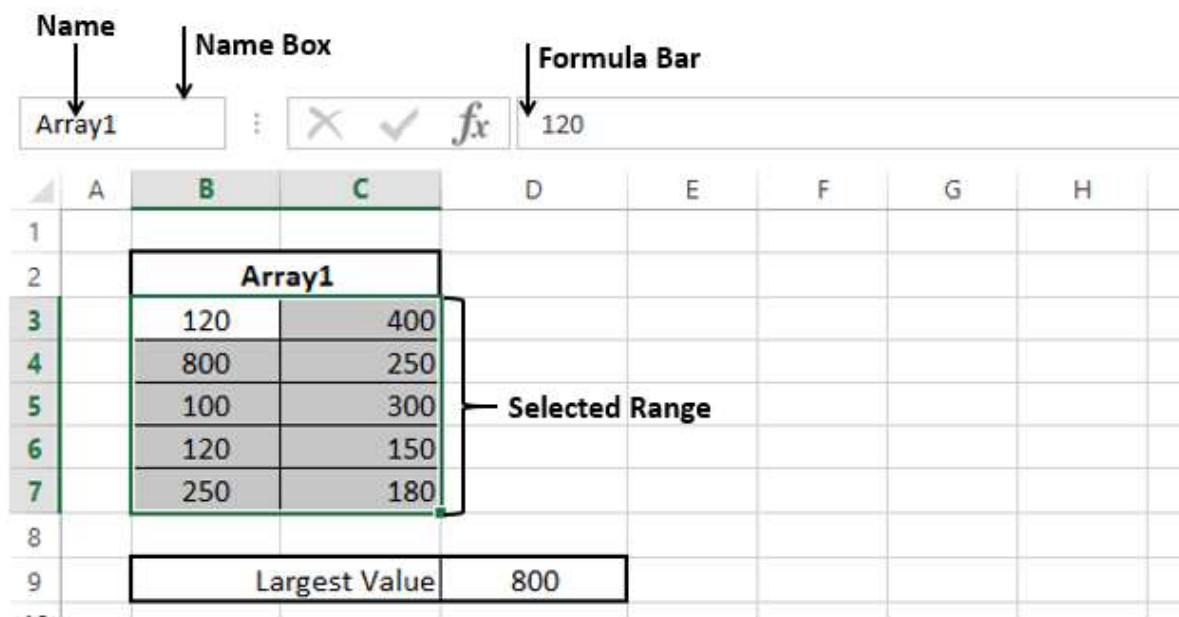
You can create Range Names in two ways-

- Using the **Name box**.
- Using the **New Name** dialog box.
- Using the **Selection** dialog box.

### Create a Range Name using the Name Box

To create a Range name, using the **Name** box that is to the left of formula bar is the fastest way. Follow the steps given below-

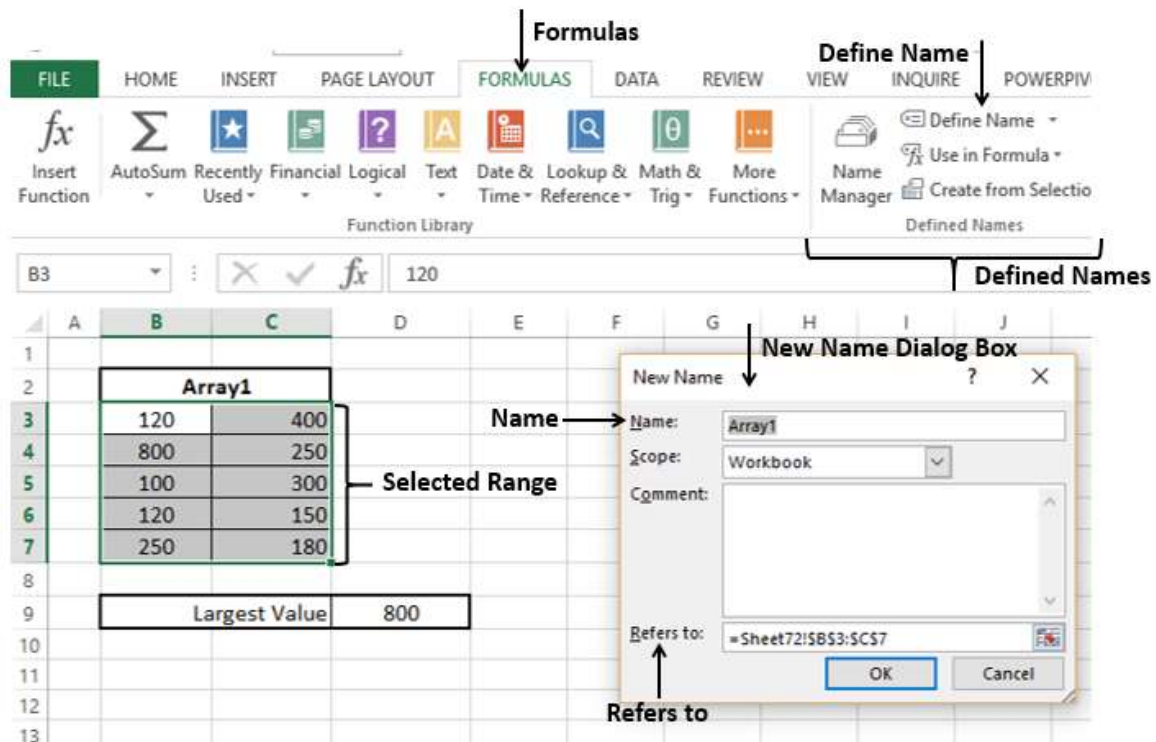
1. Select the range for which you want to define a Name.
2. Click on the Name box.
3. Type the name and press Enter to create the Name.



## Create a Range Name using the New Name dialog box

You can also create Range Names using the New Name dialog box from Formulas tab.

1. Select the range for which you want to define a name.
2. Click the Formulas tab.
3. Click Define Name in the Defined Names group. The **New Name** dialog box appears.
4. Type the name in the box next to Name
5. Check that the range that is selected and displayed in the Refers to box is correct. Click OK.



## Create a Range Name using the Create Names from Selection dialog box

You can also create Range names using the **Create Names** from the Selection dialog box from Formulas tab, when you have Text values that are adjacent to your range.

1. Select the range for which you want to define a name along with the row / column that contains the name.
2. Click the Formulas tab.
3. Click **Create from Selection** in the Defined Names group. The **Create Names from Selection** dialog box appears.
4. Select top row as the Text appears in the top row of the selection
5. Check the range that got selected and displayed in the box next to Refers to be correct. Click OK.

Formulas

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW INQUIRE POWERPivot

fx Insert Function    Σ AutoSum    Recently Used    Financial    Logical    Text    Date & Time    Lookup & Reference    Math & Trig    More Functions

Function Library

Create from Selection

Define Name    Use in Formula    Create from Selection

Name Manager    Defined Names

B2    Array1

Create Names from Selection Dialog Box

Create names from values in the:

☒ Top row

☐ Left column

☐ Bottom row

☐ Right column

OK Cancel

Selected Range

Top row

	B	C
2	Array1	
3	120	400
4	800	250
5	100	300
6	120	150
7	250	180
9	Largest Value	800

Now, you can find the largest value in the range with **=Sum** (Student Name), as shown below-

Range Name in Formula

	B	C
2	Array1	
3	120	400
4	800	250
5	100	300
6	120	150
7	250	180
9	Largest Value	=LARGE(Array1,1)

You can create names with multiple selection also. In the example given below, you can name the row of marks of each student with the student's name.

The screenshot shows the Excel ribbon with the **Formulas** tab selected. The **Create from Selection** button in the **Defined Names** group is highlighted. Below the ribbon, the worksheet displays a table titled "First Quarter Exam Scores". The table has columns for Student, Exam 1, Exam 2, Exam 3, Exam 4, and Total. The data rows are for Kreiger, Doris; Oliviera, Manuel; Kodeda, Adam; Lange, Michael; and Taylor, Maurice. A "Selected Range" label points to the data range B4:F8. The "Create Names from Selection" dialog box is open, showing the "Left column" checkbox checked, which will create names for each row based on the student names in column B.

Now, you can find the total marks for each student with **=Sum** (student name), as shown below.

	A	B	C	D	E	F	G
1		First Quarter Exam Scores					
2							
3		Student	Exam 1	Exam 2	Exam 3	Exam 4	Total
4		Kreiger, Doris	87	90	79	96	=SUM(Kreiger_Doris)
5		Oliviera, Manuel	92	94	85	97	=SUM(Oliviera_Manuel)
6		Kodeda, Adam	88	95	75	80	=SUM(Kodeda_Adam)
7		Lange, Michael	85	87	87	88	=SUM(Lange_Michael)
8		Taylor, Maurice	81	88	82	85	=SUM(Taylor_Maurice)

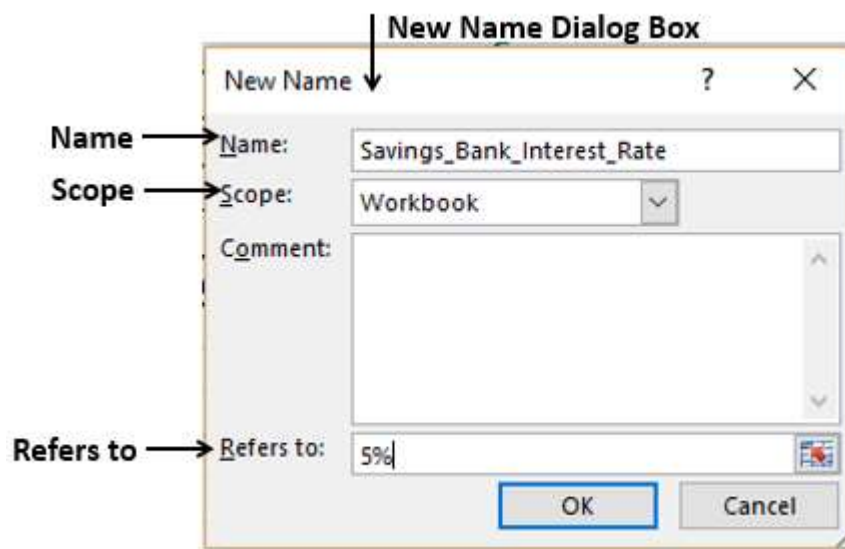
The table shows the same data as the previous screenshot, but with the 'Total' column calculated using the SUM function with the student name as a range name. A "Range Names in Formulas" label points to the formulas in the Total column.

## Creating Names for Constants

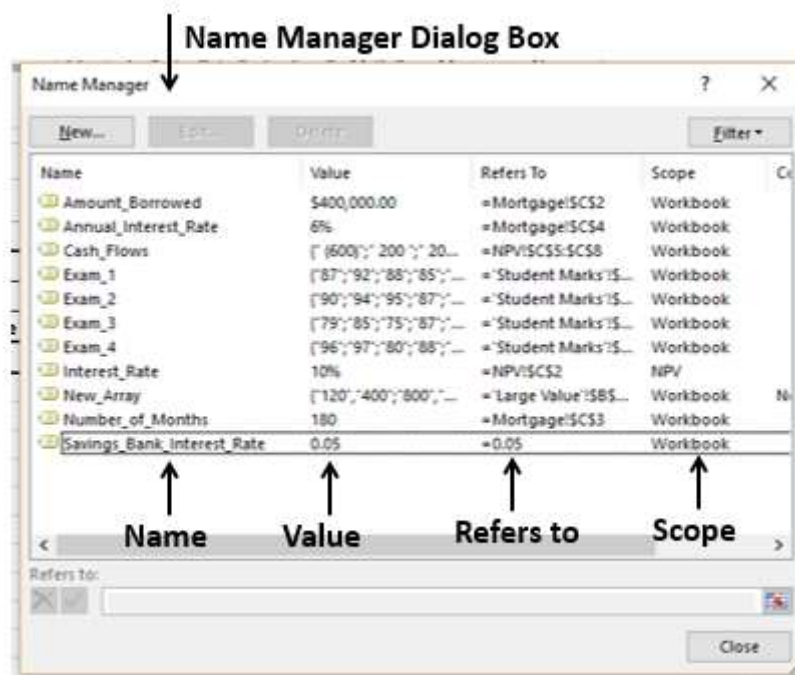
Suppose you have a constant that will be used throughout your workbook. You can assign a name to it directly, without placing it in a cell.

In the example below, Savings Bank Interest Rate is set to 5%.

- Click Define Name.
- In the New Name dialog box, type Savings\_Bank\_Interest\_Rate in the Name box.
- In Scope, select Workbook.
- In Refers to box, clear the contents and type 5%.
- Click OK.



The Name **Savings\_Bank\_Interest\_Rate** is set to a constant 5%. You can verify this in Name Manager. You can see that the value is set to 0.05 and in the **Refers to** =0.05 is placed.

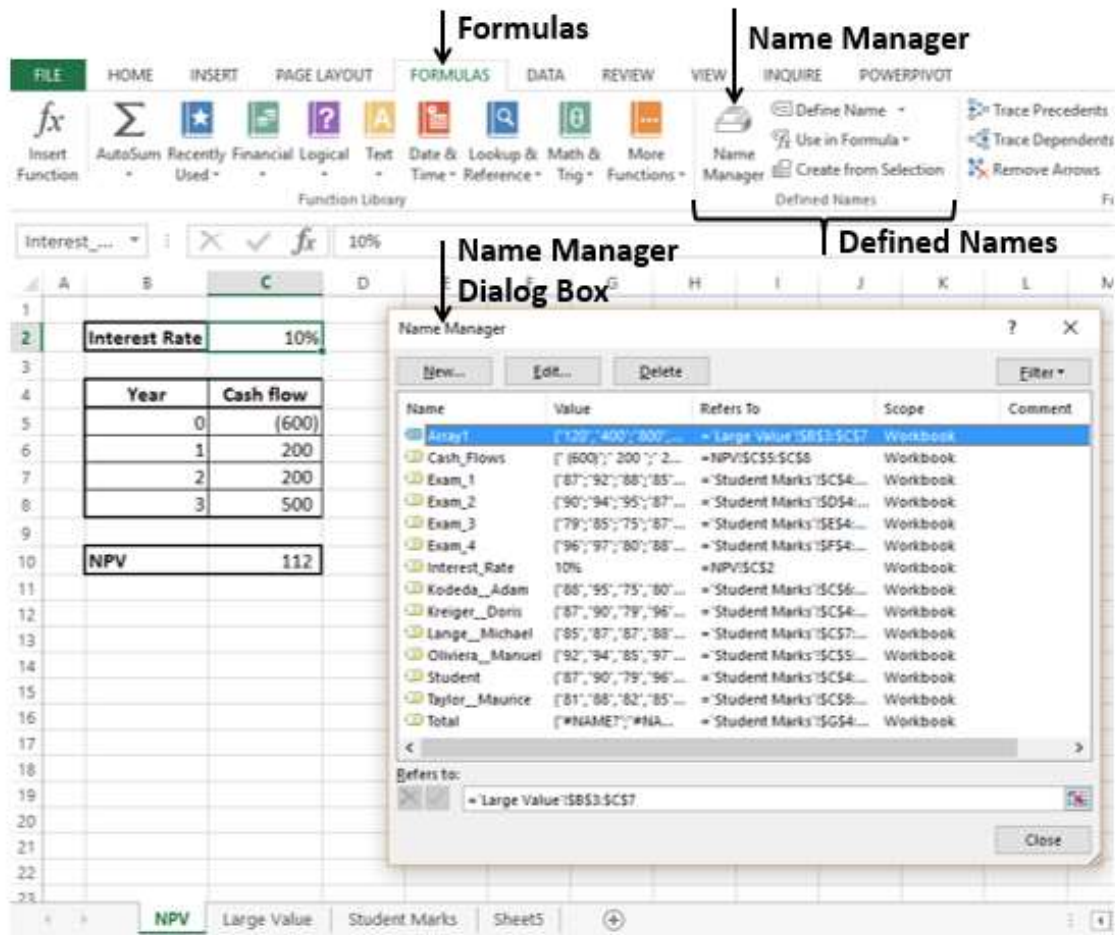


## Managing Names

An Excel Workbook can have any number of named cells and ranges. You can manage these names with the Name Manager.

- Click the Formulas tab.

- Click **Name Manager** in the **Defined Names** group. The **Name Manager** dialog box appears. All the names defined in the current workbook are displayed.

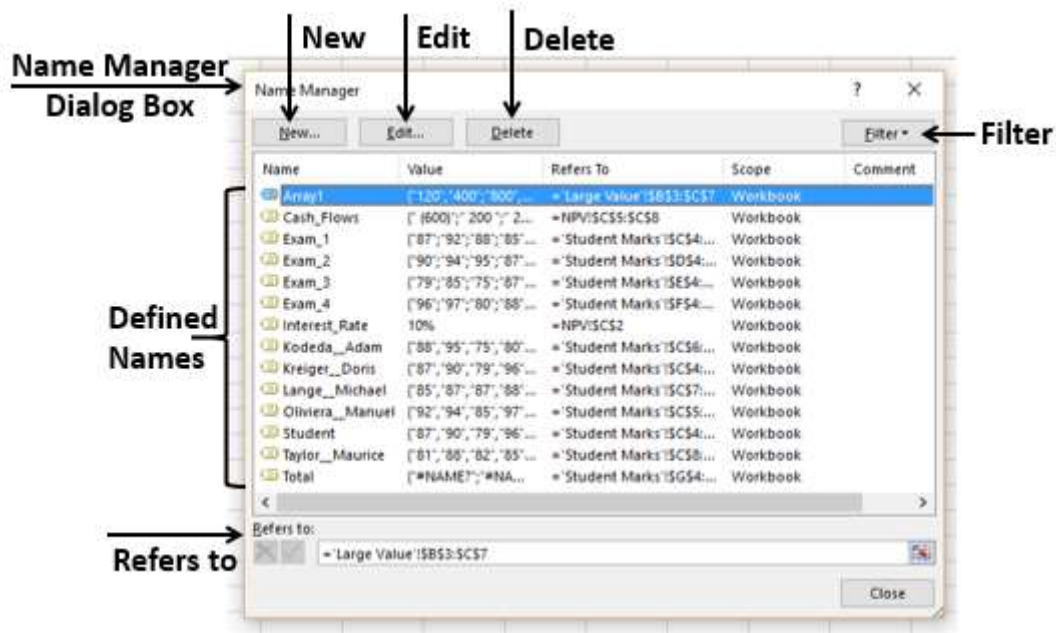


The List of **Names** are displayed with the defined **Values**, **Cell Reference** (including Sheet Name), **Scope** and **Comment**.

The Name Manager has the options to-

- Define a **New** Name with the **New** Button.
- Edit** a Defined Name.
- Delete** a Defined Name.
- Filter** the Defined Names by Category.
- Modify the Range of a Defined Name that it **Refers to**.

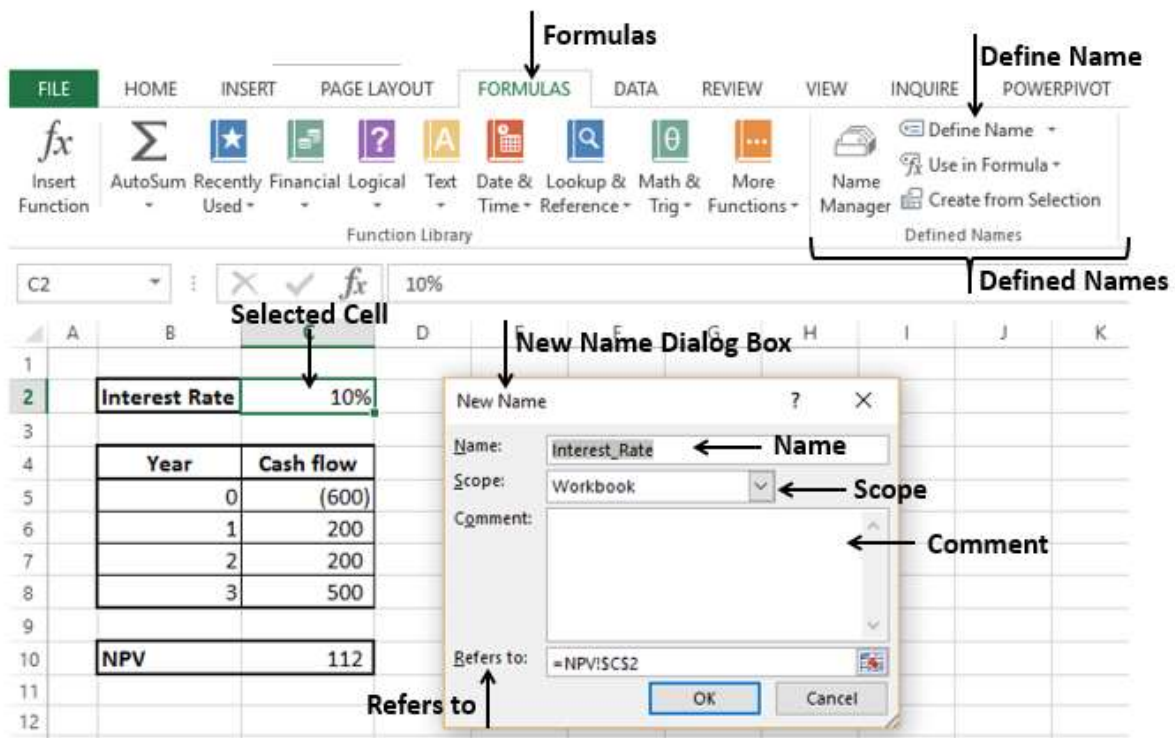




## Scope of a Name

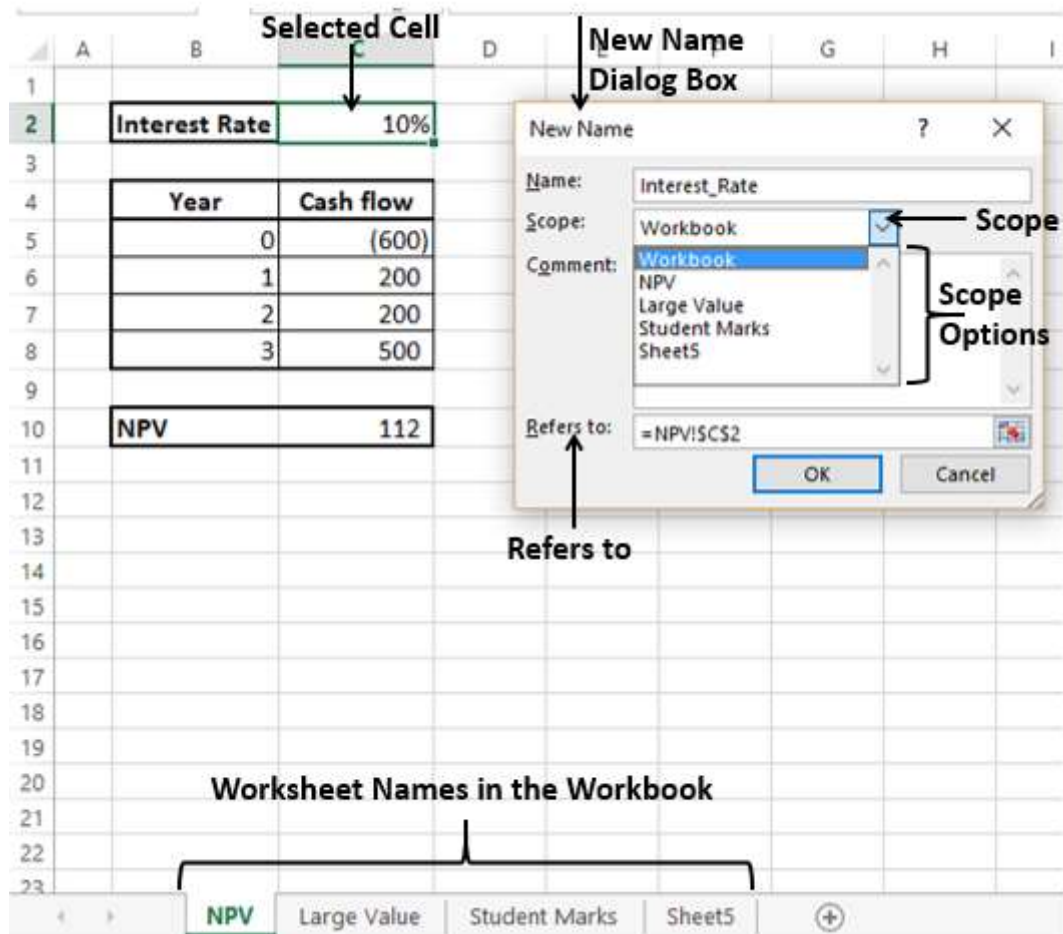
The **Scope** of a name by default is the workbook. You can find the **Scope** of a defined names from the list of names under the **Scope** column in the **Name Manager**.

You can define the **Scope** of a **New Name** when you define the name using **New Name** dialog box. For example, you are defining the name **Interest\_Rate**. Then you can see that the **Scope** of the **New Name** **Interest\_Rate** is the **Workbook**.



Suppose you want the **Scope** of this interest rate restricted to this **Worksheet** only.

1. Click the down-arrow in the Scope Box. The available Scope options appear in the drop-down list.

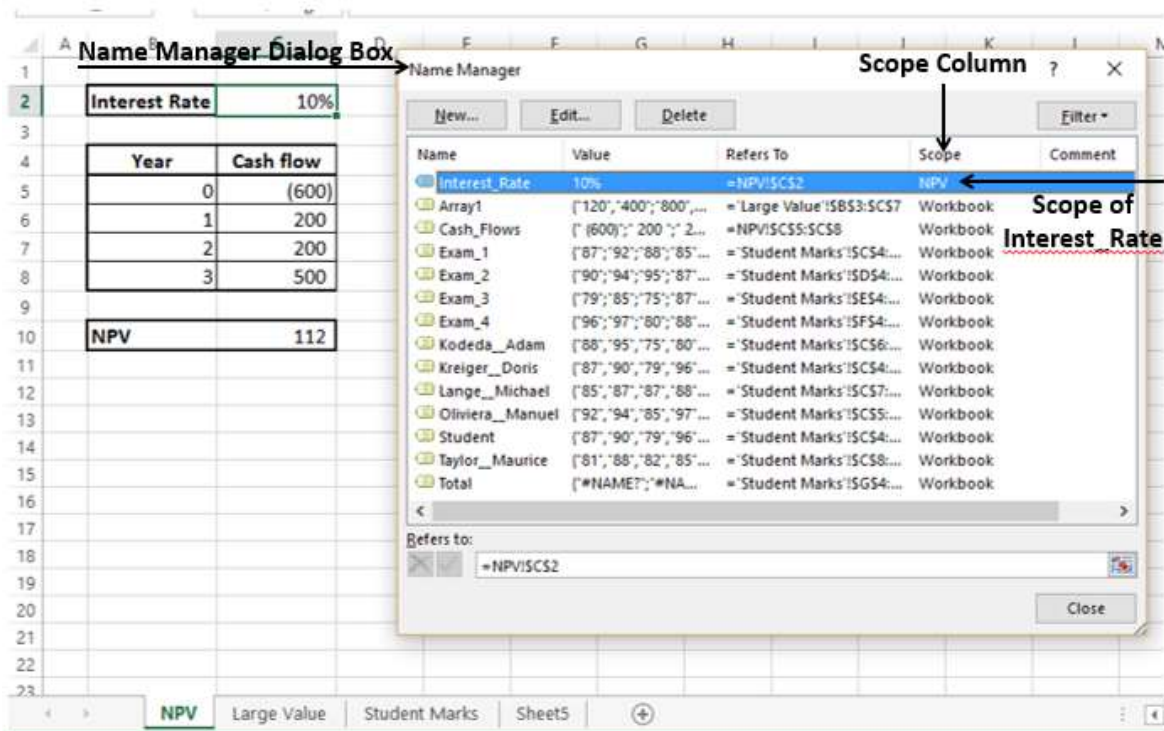


The Scope options include **Workbook**, and the sheet names in the workbook.

2. Click the current worksheet name, in this case NPV and click OK. You can define / find the sheet name in the worksheet tab.

3. To verify that Scope is worksheet, click **Name Manager**. In the Scope column, you will find NPV for Interest\_Rate. This means you can use the Name Interest\_Rate only in the Worksheet NPV, but not in the other Worksheets.





**Note:** Once you define the Scope of a Name, it cannot be modified later.

## Deleting Names with Error Values

Sometimes, it may so happen that Name definition may have errors for various reasons. You can delete such names as follows-

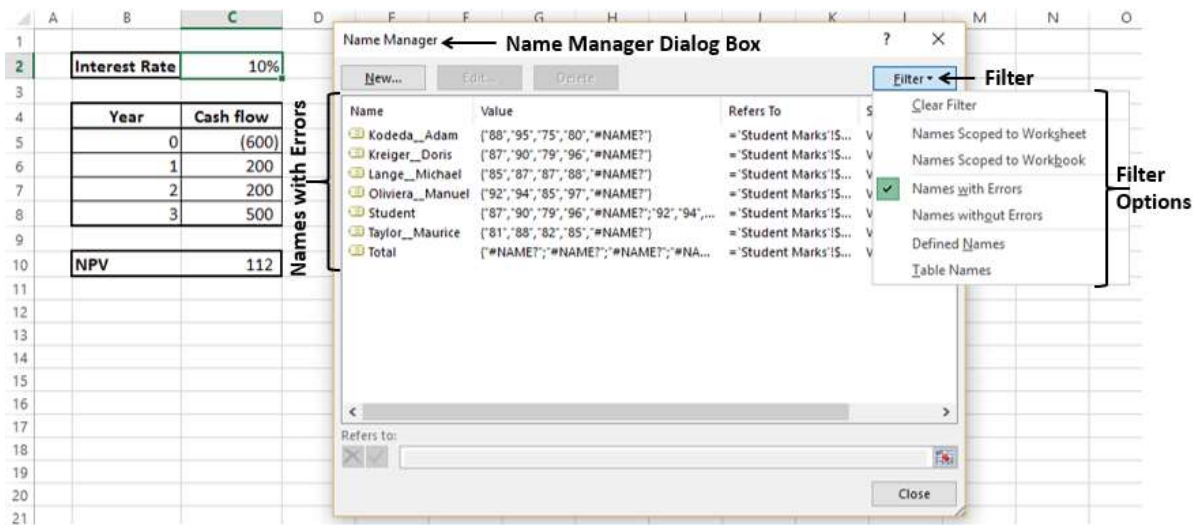
**1.** Click **Filter** in the **Name Manager** dialog box.

The following filtering options appear-

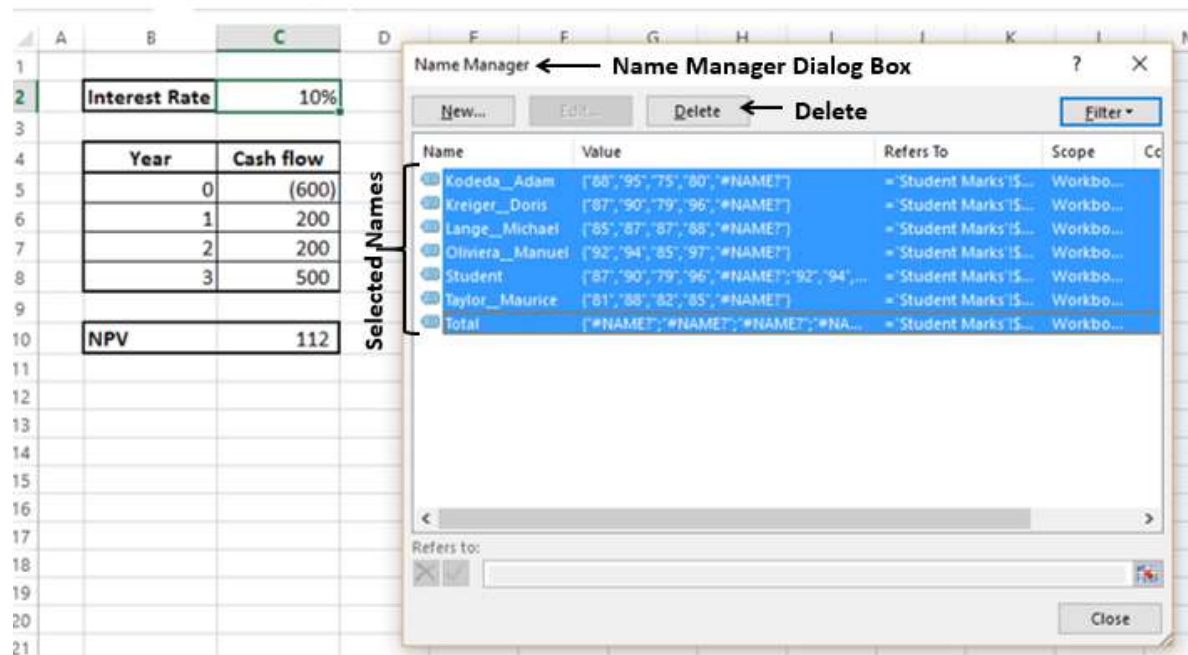
- Clear Filter
- Names Scoped to Worksheet
- Names Scoped to Workbook
- Names with Errors
- Names without Errors
- Defined Names
- Table Names

You can apply **Filter** to the **defined Names** by selecting one or more of these options.

**2.** Select **Names with Errors**. Names that contain error values will be displayed.



3. From the obtained list of **Names**, select the ones you want to delete and click **Delete**.



You will get a message, confirming delete. Click OK.

## Editing Names

You can use the **Edit** option in the **Name Manager** dialog box to-

- Change the **Name** .
- Modify the **Refers to** range
- Edit the **Comment** in a **Name**.

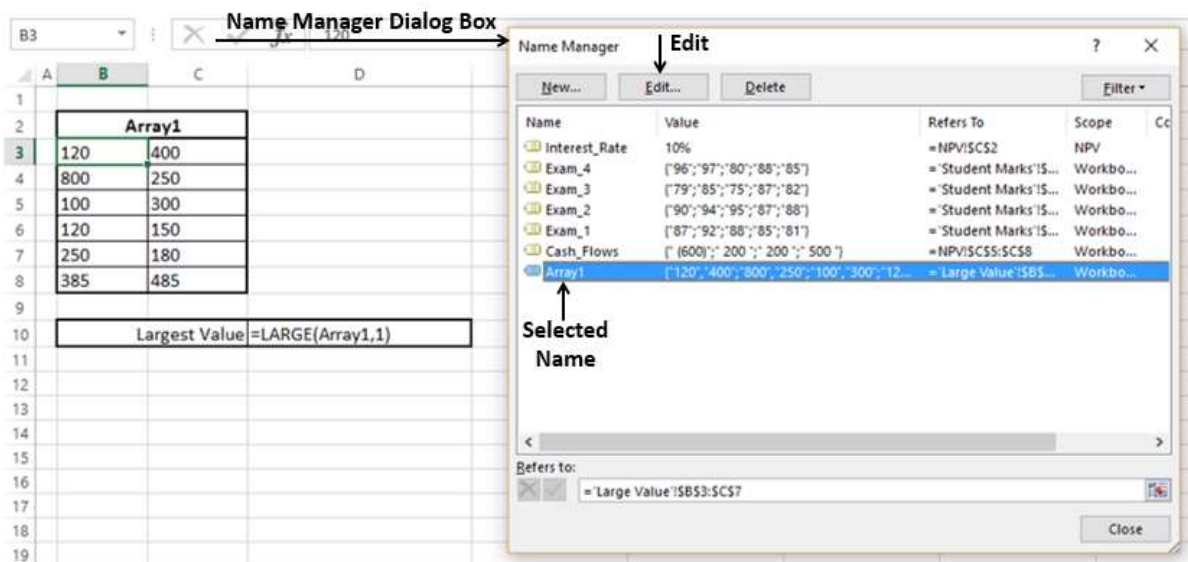
## Change the Name

1. Click the cell containing the function **Large**.

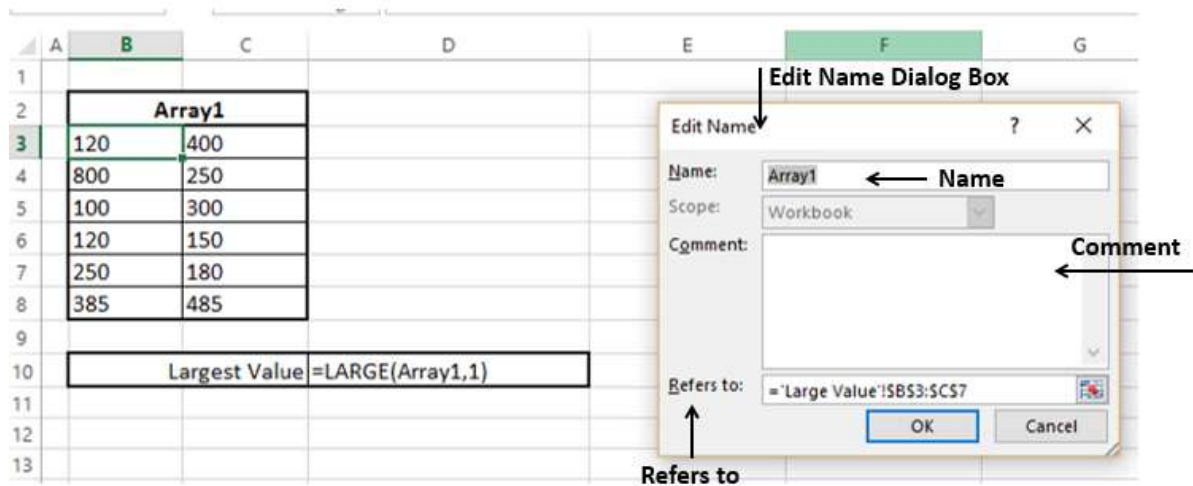
You can see, two more values are added in the array, but are not included in the function as they are not part of Array1.

2	<b>Array1</b>	
3	120	400
4	800	250
5	100	300
6	120	150
7	250	180
8	385	485
9		
10	Largest Value	=LARGE(Array1,1)

2. Click the **Name** you want to edit in the **Name Manager** dialog box. In this case, **Array1**.



3. Click **Edit**. The **Edit Name** dialog box appears.

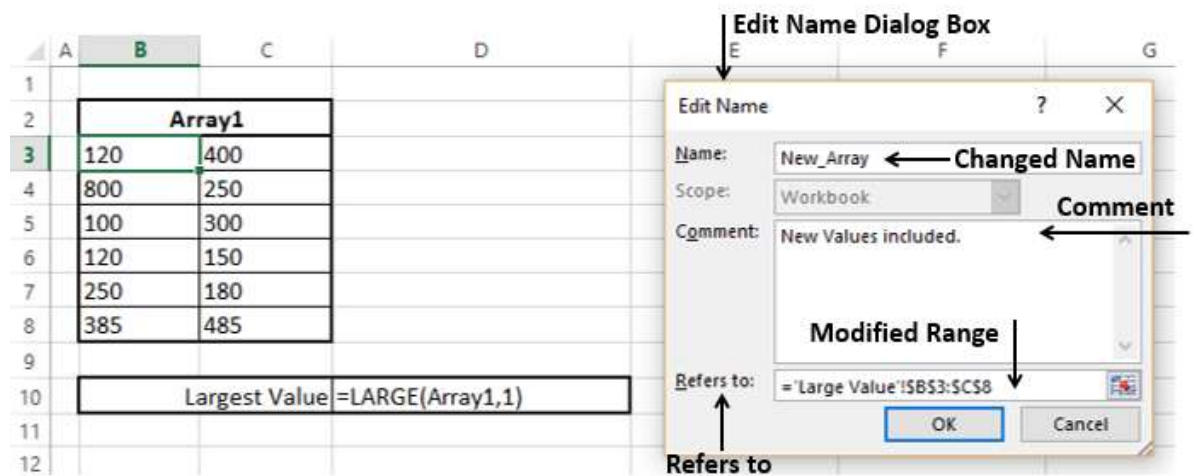


4. Change the **Name** by typing the new name that you want in the **Name Box**.

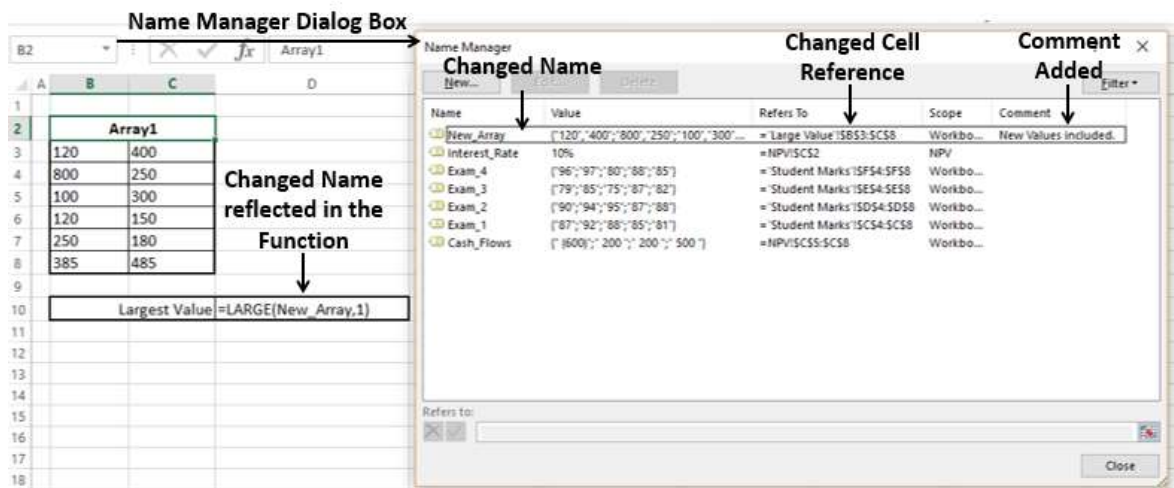
5. Click the **Range** button to the right of **Refers to** Box and include the new cell references.

6. Add a **Comment** (Optional)

Notice that **Scope** is deactive and hence cannot be changed.



Click OK. You will observe the changes made.



## Applying Names


Consider the following example-

	A	B	C
13			
14		<b>Amount Borrowed</b>	<b>400000</b>
15		<b>Number of Months</b>	<b>180</b>
16		<b>Annual Interest Rate</b>	<b>0.06</b>
17		<b>Monthly Payment</b>	<b>=PMT(C16/12,C15,C14)</b>

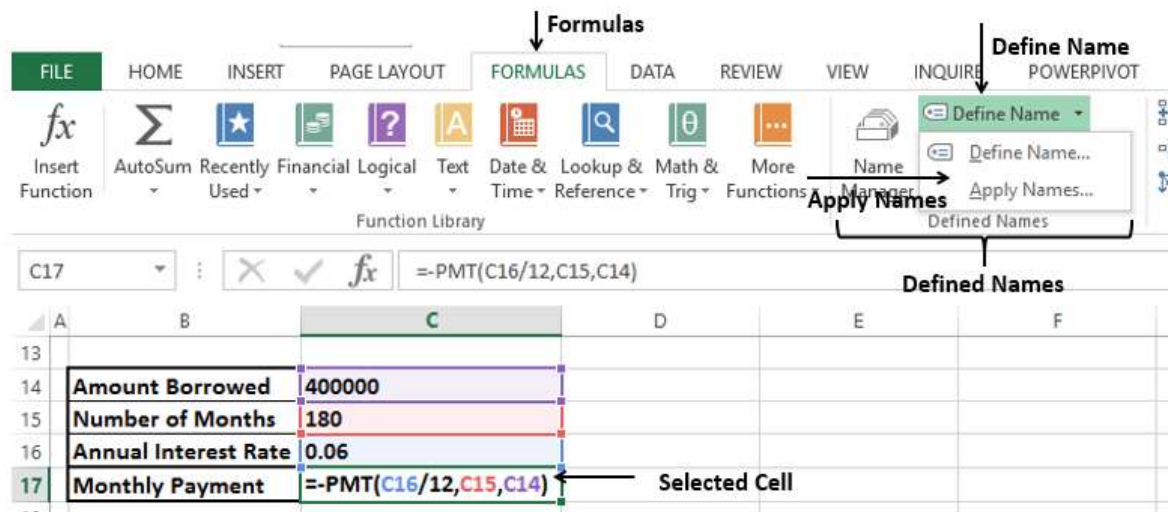
As you observe, names are not defined and used in PMT function. If you place this function somewhere else in the worksheet, you also need to remember where exactly the parameter values are. You know that using names is a better option.

In this case, the function is already defined with cell references that do not have names. You can still define names and apply them.

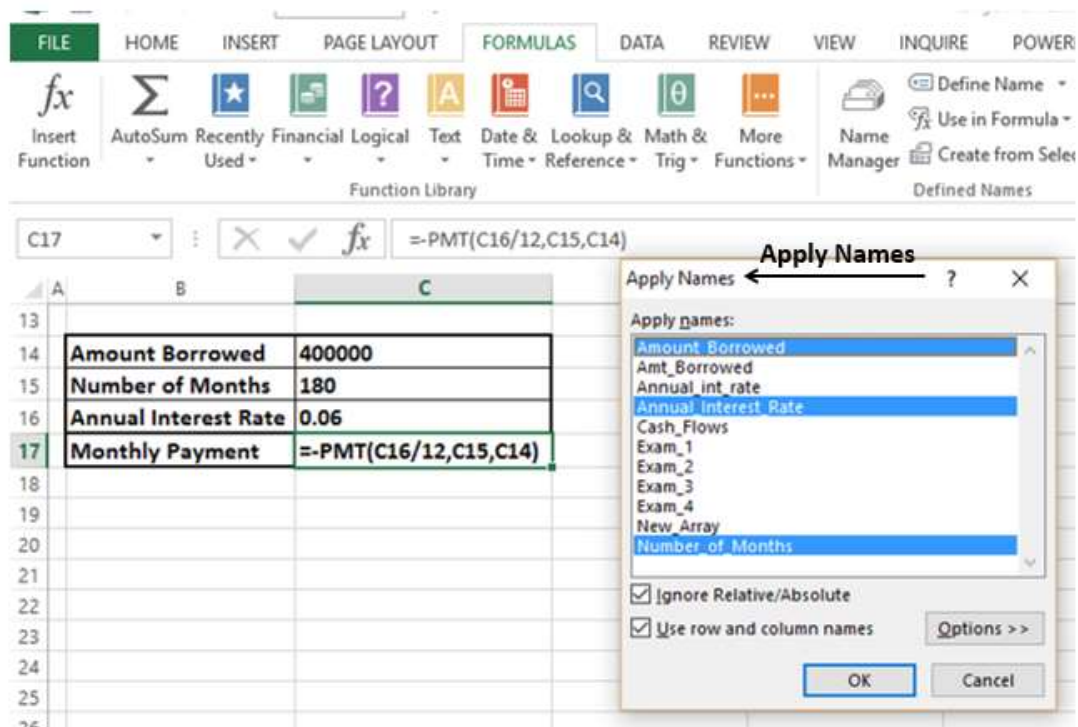
**1. Using Create from Selection**, define the names.

**2. Select the cell containing the formula.** Click  next to **Define Name** in the **Defined Names** group on the **Formulas** tab. From the drop-down list, click **Apply Names**.





3. The **Apply Names** dialog box appears. Select the **Names** that you want to **Apply** and click OK.



The selected names will be applied to the selected cells.

	A	B	C
13			
14		Amount Borrowed	400000
15		Number of Months	180
16		Annual Interest Rate	0.06
17		Monthly Payment	=PMT(Annual_Interest_Rate/12,Number_of_Months,Amount_Borrowed)

Names Applied to the Selection

You can also **Apply Names** to an entire worksheet, by selecting the worksheet and repeating the above steps.

## Using Names in a Formula

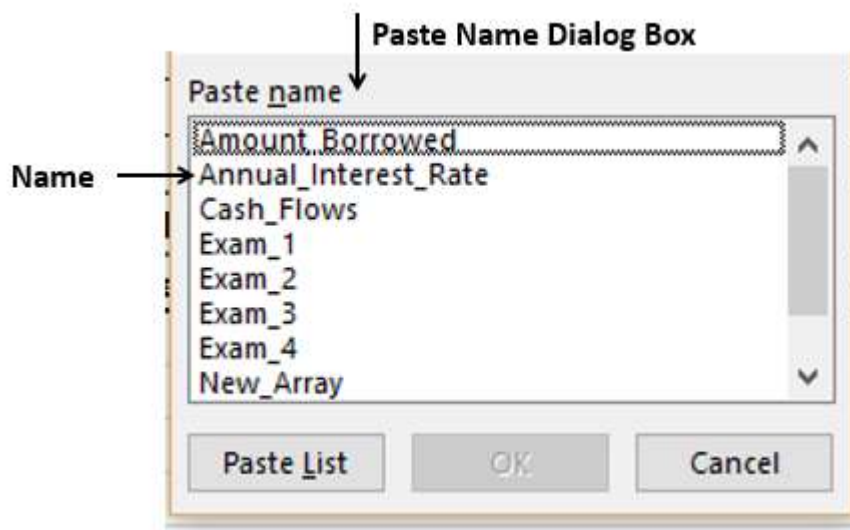
You can use a **Name** in a **Formula** in the following ways-

- Typing the **Name** if you remember it, or
- Typing first one or two letters and using the **Excel Formula Autocomplete** feature.
- Clicking Use in Formula in the Defined Names group on the Formulas tab.
  - Select the required Name from the drop-down list of defined names.
  - Double-click on that name.

The screenshot shows the Excel ribbon with the **Formulas** tab selected. The **Use in Formula** dropdown menu is open, displaying a list of defined names. The names listed include 'Amount\_Borrowed', 'Annual\_Interest\_Rate', 'Cash\_Flows', 'Exam\_1', 'Exam\_2', 'Exam\_3', 'Exam\_4', 'New\_Array', 'Number\_of\_Months', 'Savings\_Bank\_Interest\_Rate', and 'Paste Names...'. The 'Paste Names...' option is highlighted at the bottom of the list. In the background, a worksheet is visible with the following data:

	A	B	C
1			
2		Amount Borrowed	400000
3		Number of Months	180
4		Annual Interest Rate	0.06
5		Monthly Interest Rate	=
6		Monthly Payment	=PMT(Annual_Interest_Rate/12,Number_of_Months,Amount_Borrowed)
7			
8			

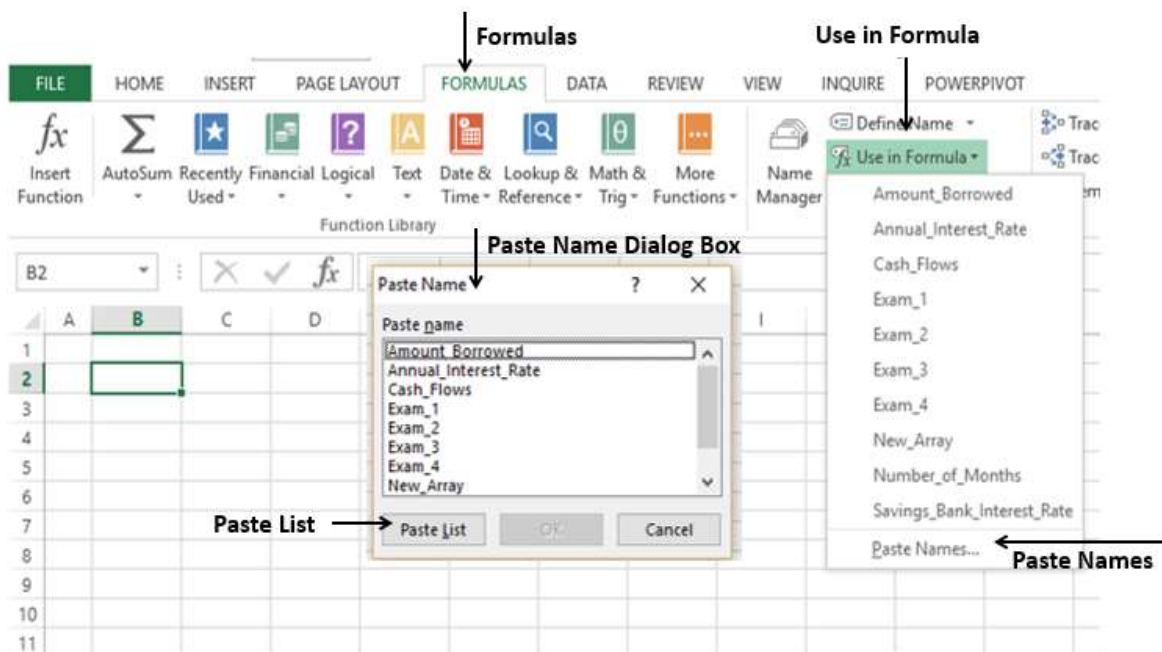
- Using the **Paste Name** dialog box.
  - Select the Paste Names option from the drop-down list of defined names. The Paste Name dialog box appears.
  - Select the **Name** in the **Paste Names** dialog box and double-click it.



## Viewing Names in a Workbook

You can get all the **Names** in your workbook along with their **References** and **Save** them or **Print** them.

- Click an empty Cell where you want to copy the **Names** in your workbook.
- Click **Use in Formula** in the **Defined Names** group.
- Click **Paste Names** from the drop-down list.
- Click **Paste List** in the **Paste Name** dialog box that appears.





The list of names and their corresponding references are copied at the specified location on your worksheet as shown in the screen shot given below-

	A	B	C	D
1				
2		Amount_Borrowed	=Mortgage!\$C\$2	
3		Annual_Interest_Rate	=Mortgage!\$C\$4	
4		Cash_Flows	=NPV!\$C\$5:\$C\$8	
5		Exam_1	=Student Marks!\$C\$4:\$C\$8	
6		Exam_2	=Student Marks!\$D\$4:\$D\$8	
7		Exam_3	=Student Marks!\$E\$4:\$E\$8	
8		Exam_4	=Student Marks!\$F\$4:\$F\$8	
9		New_Array	=Large Value!\$B\$3:\$C\$8	
10		Number_of_Months	=Mortgage!\$C\$3	
11		Savings_Bank_Interest_Rate	=0.05	
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				

Names

References

## Using Names for Range Intersections

**Range Intersections** are those individual cells that have two Ranges in common.

For example, in the data given below, the Range B6:F6 and the Range C3:C8 have Cell C6 in common, which actually represents the marks scored by the student Kodeda, Adam in Exam 1.

	A	B	C	D	E	F
1		First Quarter Exam Scores				
2						
3		Student	Exam 1	Exam 2	Exam 3	Exam 4
4		Kreiger, Doris	87	90	79	96
5		Oliviera, Manuel	92	94	85	97
6		Kodeda, Adam	88	95	75	80
7		Lange, Michael	85	87	87	88
8		Taylor, Maurice	81	88	82	85

Intersection of Ranges B6:F6 and C3:C8  
= C6

You can make this more meaningful with the **Range Names**.

- Create **Names** with **Create from Selection** for both Students and Exams.
- Your **Names** will look as follows-

First Quarter Exam Scores						Created Names and their Cell References	
Student	Exam 1	Exam 2	Exam 3	Exam 4			
Kreiger, Doris	87	90	79	96	Exam_1	=Marks!\$C\$4:\$C\$8	
Oliviera, Manuel	92	94	85	97	Exam_2	=Marks!\$D\$4:\$D\$8	
Kodeda, Adam	88	95	75	80	Exam_3	=Marks!\$E\$4:\$E\$8	
Lange, Michael	85	87	87	88	Exam_4	=Marks!\$F\$4:\$F\$8	
Taylor, Maurice	81	88	82	85	Kodeda__Adam	=Marks!\$C\$6:\$F\$6	
					Kreiger__Doris	=Marks!\$C\$4:\$F\$4	
					Lange__Michael	=Marks!\$C\$7:\$F\$7	
					Oliviera__Manuel	=Marks!\$C\$5:\$F\$5	
					Taylor__Maurice	=Marks!\$C\$8:\$F\$8	

- Type = **Kodeda\_Adam Exam\_1** in B11.

Here, you are using the Range Intersection operation, space between the two ranges.

	A	B	C	D	E	F	G
1		First Quarter Exam Scores					
2							
3		Student	Exam 1	Exam 2	Exam 3	Exam 4	
4		Kreiger, Doris	87	90	79	96	
5		Oliviera, Manuel	92	94	85	97	
6		Kodeda, Adam	88	95	75	80	
7		Lange, Michael	85	87	87	88	
8		Taylor, Maurice	81	88	82	85	
9							
10							
11		=Kodeda__Adam Exam_1					
12							

This will display marks of Kodeda, Adam in Exam 1, that are given in Cell C6.

	A	B	C	D	E	F	G
1		First Quarter Exam Scores					
2							
3		Student	Exam 1	Exam 2	Exam 3	Exam 4	
4		Kreiger, Doris	87	90	79	96	
5		Oliviera, Manuel	92	94	85	97	
6		Kodeda, Adam	88	95	75	80	
7		Lange, Michael	85	87	87	88	
8		Taylor, Maurice	81	88	82	85	
9							
10							
11			88				
12							

## Copying Formulas with Names

You can copy a formula with names by **Copy** and **Paste** within the same worksheet.

You can also copy a formula with names to a different worksheet by **copy** and **paste**, provided all the **names** in the **formula** have **workbook** as **Scope**. Otherwise, you will get a **#VALUE** error.

# 5. Tables

A **Table** is a rectangular range of structured data. The key features are-

- Each row in the table corresponds to a single record of the data. Example- Employee information.
- Each column contains a specific piece of information. Example- The columns can contain data such as name, employee number, hire date, salary, department, etc.
- The top row describes the information contained in each column and is referred to as header row.
- Each entry in the top row is referred to as column header.

**Table**

	A	B	C	D	E	F	G	H	
1									
2		EmployeeID	ManagerID	Title	BirthDate	MaritalStatus	Gender	HireDate	Header Row
5		3	2	Engineering Manager	11/12/1974	M	M	11/11/2007	
8		7	3	Research and Development Manager	2/24/1987	M	M	2/8/2009	
22		10	4	Research and Development Manager	11/30/1984	M	M	5/3/2009	
32		16	1	Marketing Manager	3/19/1975	S	M	12/20/2007	
44		26	2	Production Control Manager	11/3/1982	M	M	12/1/2008	
71		211	2	Quality Assurance Manager	10/26/1977	S	M	2/28/2009	
91		217	3	Document Control Manager	1/30/1976	M	M	1/4/2009	
141		227	2	Facilities Manager	2/18/1971	M	M	12/2/2009	
152		235	2	Human Resources Manager	2/11/1976	M	F	12/6/2008	
157		241	2	Accounts Manager	7/8/1983	M	M	1/30/2009	
200		249	2	Finance Manager	10/11/1984	S	F	12/25/2008	
219		263	1	Information Services Manager	12/13/1975	S	F	12/11/2008	
220		264	2	Network Manager	3/25/1984	S	F	2/4/2009	

Columns

You can create and use an Excel table to manage and analyze data easily. Further, with Excel Tables you get built-in Filtering, Sorting, and Row Shading that ease your reporting activities.

Further, Excel responds to the actions performed on a table intelligently. For example, you have a formula in a column or you have created a chart based on the data in the table. When you add more data to the table (i.e., more rows), Excel extends the formula to the new data and the chart expands automatically.

## Difference between Tables and Ranges

Following are the differences between a table and range-

- A table is a more structured way of working with data than a range.
- You can convert a range into a table and Excel automatically provides-
  - a Table Name

- Column Header Names
- Formatting to the Data (Cell Color and Font Color) for better Visualization

Tables provide additional features that are not available for ranges. These are-

- Excel provides table tools in the ribbon ranging from properties to styles.
- Excel automatically provides a Filter button in each column header to sort the data or filter the table such that only rows that meet your defined criteria are displayed
- If you have multiple rows in a table, and you scroll down the sheet so that the header row disappears, the column letters in the worksheet are replaced by the table headers.
- When you place a formula in any cell in a column of the table, it gets propagated to all the cells in that column.
- You can use table name and column header names in the formulas, without having to use cell references or creating range names.
- You can extend the table size by adding more rows or more columns by clicking and dragging the small triangular control at the lower-right corner of the lower-right cell.
- You can create and use slicers for a table for filtering data.

You will learn about all these Features in this Chapter.

## Create Table

---

To create a table from the data you have on the worksheet, follow the given steps-

**1.** Select the Range of Cells that you want to include in the Table. Cells can contain data or can be empty. The following Range has 290 rows of employee data. The top row of the data has headers.

	A	B	C	D	E	F	G	H
1								
2		EmployeeID	ManagerID	Title	BirthDate	MaritalStatus	Gender	HireDate
3		1	0	Chief Executive Officer	1/29/1969 S		M	1/14/2009
4		2	1	Vice President of Engineering	8/1/1971 S		F	1/31/2008
5		3	2	Engineering Manager	11/12/1974 M		M	11/11/2007
6		4	3	Senior Tool Designer	12/23/1974 S		M	12/5/2007
7		5	3	Design Engineer	9/27/1952 M		F	1/6/2008
8		6	3	Design Engineer	3/11/1959 M		M	1/24/2008
9		7	3	Research and Development Manager	2/24/1987 M		M	2/8/2009
10		8	4	Research and Development Engineer	6/5/1986 S		F	12/29/2008
11		9	4	Research and Development Engineer	1/21/1979 M		F	1/16/2009
12		10	4	Research and Development Manager	11/30/1984 M		M	5/3/2009
13		11	3	Senior Tool Designer	1/17/1978 S		M	12/5/2010
14		12	4	Tool Designer	7/29/1959 M		M	12/11/2007
15		13	4	Tool Designer	5/28/1989 M		F	12/23/2010
16		14	3	Senior Design Engineer	6/16/1979 S		M	12/30/2010
17		15	3	Design Engineer	5/2/1961 M		F	1/18/2011
18		16	1	Marketing Manager	3/19/1975 S		M	12/20/2007
19		17	2	Marketing Assistant	5/3/1987 S		M	1/26/2007
20		18	2	Marketing Specialist	3/6/1978 S		M	2/7/2011
21		19	2	Marketing Assistant	1/29/1978 S		F	2/14/2011
22		20	2	Marketing Assistant	3/17/1975 M		F	1/7/2011
23		21	2	Marketing Specialist	2/4/1986 M		M	3/2/2009

2. Under the **Insert** tab, in the Tables group, click Tables. The **Create Table** dialog box appears. Check that the data range selected in the **Where is the data for your table?** Box is correct.

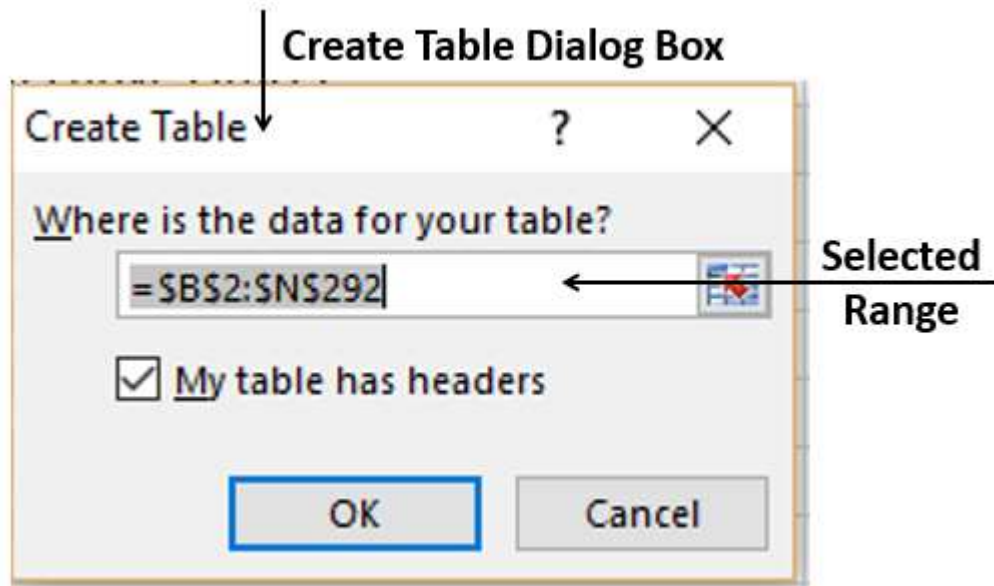
The screenshot shows the Excel ribbon with the **Insert** tab selected. In the **Tables** group, the **Tables** button is highlighted. Below the ribbon, the **Create Table Dialog Box** is open. The dialog box has a title bar with a question mark and a close button. It contains a text box labeled "Where is the data for your table?" with the range "=B2:H25" entered. Below this text box is a checkbox labeled "My table has headers" which is checked. There are "OK" and "Cancel" buttons at the bottom of the dialog box. A bracket on the right side of the table, spanning from row 2 to row 25 and column B to column H, is labeled "Range".

3. Check the **My table has headers** box if the top row of the selected Range contains data that you want to use as the Table Headers.

**Note:** If you do not check this box, your table will have Headers – Column1, Column2, ...



4. Click OK.



Range is converted to Table with the default Style.

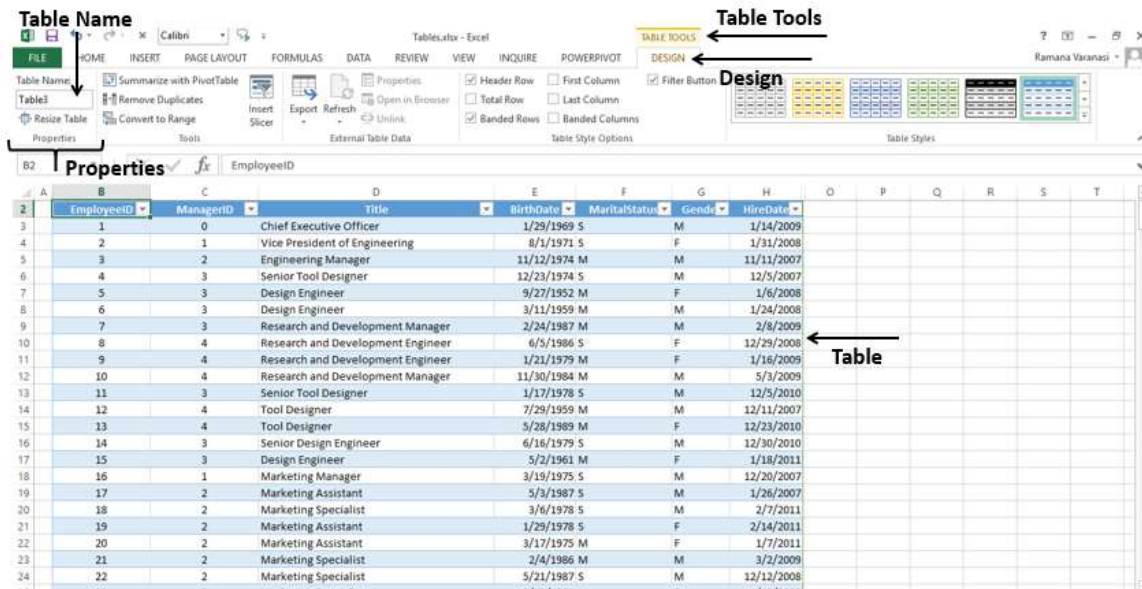
	A	B	C	D	E	F	G	H
2		EmployeeID	ManagerID	Title	BirthDate	MaritalStatus	Gender	HireDate
3		1	0	Chief Executive Officer	1/29/1969 S		M	1/14/2009
4		2	1	Vice President of Engineering	8/1/1971 S		F	1/31/2008
5		3	2	Engineering Manager	11/12/1974 M		M	11/11/2007
6		4	3	Senior Tool Designer	12/23/1974 S		M	12/5/2007
7		5	3	Design Engineer	9/27/1952 M		F	1/6/2008
8		6	3	Design Engineer	3/11/1959 M		M	1/24/2008
9		7	3	Research and Development Manager	2/24/1987 M		M	2/8/2009
10		8	4	Research and Development Engineer	6/5/1986 S		F	12/29/2008
11		9	4	Research and Development Engineer	1/21/1979 M		F	1/16/2009
12		10	4	Research and Development Manager	11/30/1984 M		M	5/3/2009
13		11	3	Senior Tool Designer	1/17/1978 S		M	12/5/2010
14		12	4	Tool Designer	7/29/1959 M		M	12/11/2007
15		13	4	Tool Designer	5/28/1989 M		F	12/23/2010
16		14	3	Senior Design Engineer	6/16/1979 S		M	12/30/2010
17		15	3	Design Engineer	5/2/1961 M		F	1/18/2011
18		16	1	Marketing Manager	3/19/1975 S		M	12/20/2007
19		17	2	Marketing Assistant	5/3/1987 S		M	1/26/2007
20		18	2	Marketing Specialist	3/6/1978 S		M	2/7/2011
21		19	2	Marketing Assistant	1/29/1978 S		F	2/14/2011
22		20	2	Marketing Assistant	3/17/1975 M		F	1/7/2011
23		21	2	Marketing Specialist	2/4/1986 M		M	3/2/2009
24		22	2	Marketing Specialist	5/21/1987 S		M	12/12/2008

5. You can also convert a range to a table by clicking anywhere on the range and pressing Ctrl+T. A **Create Table** dialog box appears and then you can repeat the steps as given above.

## Table Name

Excel assigns a name to every table that is created.

1. To look at the name of the table you just created, click table, click on **table tools – design** tab on the Ribbon.
2. In the **Properties** group, in the **Table Name** box, your Table Name will be displayed.



3. You can edit this Table Name to make it more meaningful to your data.

4. Click the Table Name box. Clear the Name and type Emp\_Data.

**Note:** The syntax rules of range names are applicable to table names.

### Table Name



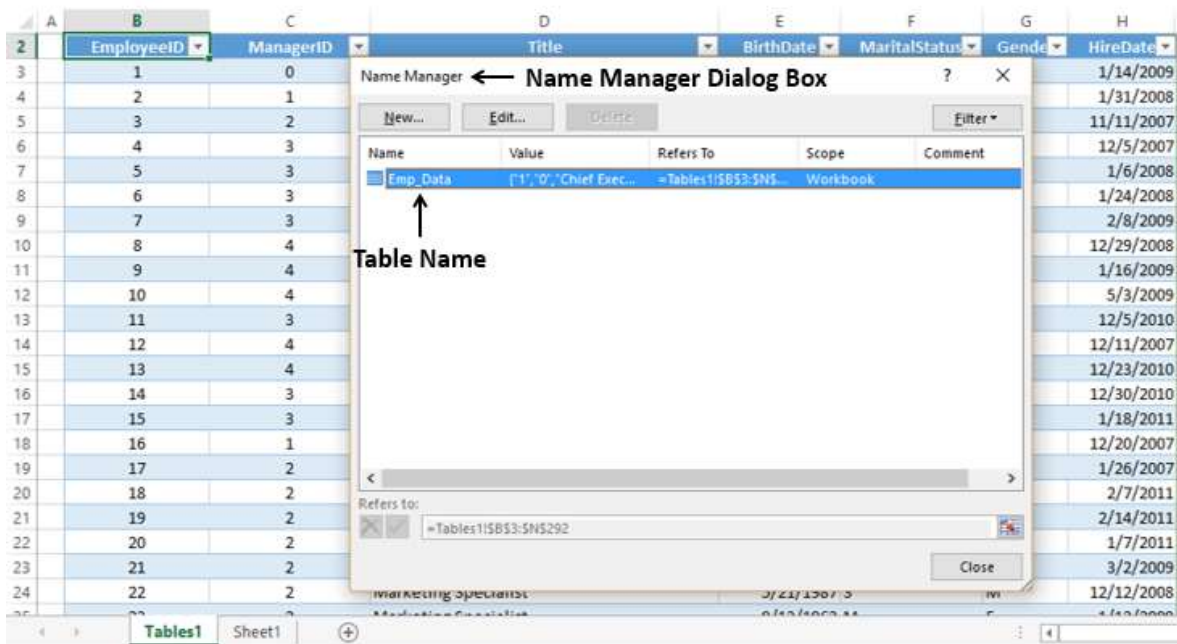


## Managing Names in a Table

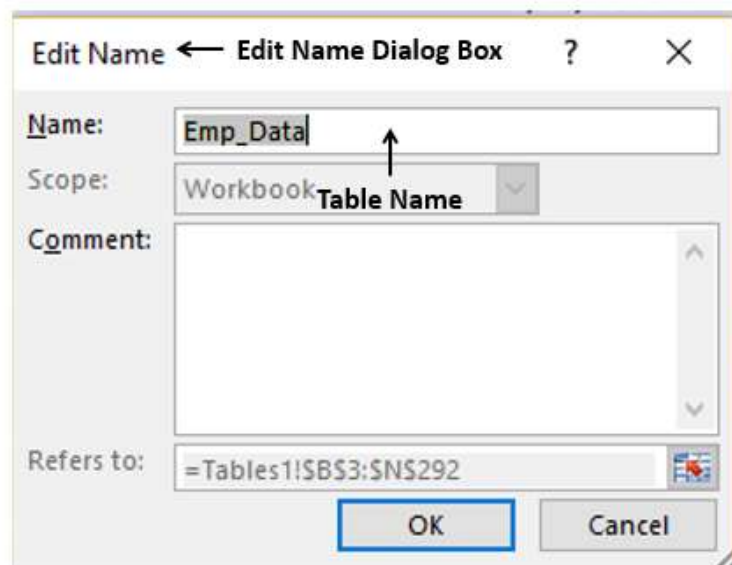
You can manage table names just similar to how you manage range names with Name Manager.

- Click the Table.
- Click **Name Manager** in the **Defined Names** group on **Formulas** tab.

The **Name Manager** dialog box appears and you can find the **Table Names** in your workbook.



You can **Edit** a **Table Name** or add a comment with **New** option in the **Name Manager** dialog box. However, you cannot change the range in **Refers to**.

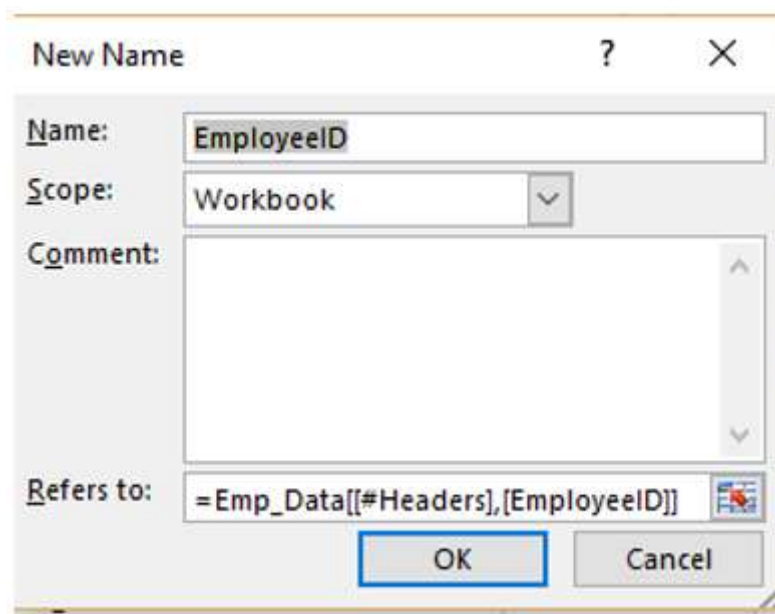


You can **Create Names** with column headers to use them in formulas, charts, etc.

- Click the Column Header **EmployeeID** in the Table.
- Click Name Manager.
- Click **New** in the Name Manager dialog box

The **New Name** dialog box appears.

In the Name box, you can find the Column Header, and in the **Refers to** box, you will find **Emp\_Data[[#Headers],[EmployeeID]]**.



As you observe, this is a quick way of defining Names in a Table.

## Table Headers replacing Column Letters

When you are working with more number of rows of data in a table, you may have to scroll down to look at the data in those rows.

However, while doing so, you also require the table headers to identify which value belongs to which column. Excel automatically provides a smooth way of doing this. As you scroll down your data, the column letters of the worksheet themselves get converted to table headers.

In the worksheet given below, the column letters are appearing as they are and the table headers are in row 2. 21 rows of 290 rows of data are visible.

EmployeeID	ManagerID	Title	BirthDate	MaritalStatus	Gender	HireDate
1	0	Chief Executive Officer	1/29/1969	S	M	1/14/2009
2	1	Vice President of Engineering	8/1/1971	S	F	1/31/2008
3	2	Engineering Manager	11/12/1974	M	M	11/11/2007
4	3	Senior Tool Designer	12/23/1974	S	M	12/5/2007
5	3	Design Engineer	9/27/1952	M	F	1/6/2008
6	3	Design Engineer	3/11/1959	M	M	1/24/2008
7	3	Research and Development Manager	2/24/1987	M	M	2/8/2009
8	4	Research and Development Engineer	6/5/1986	S	F	12/29/2008
9	4	Research and Development Engineer	1/21/1979	M	F	1/16/2009
10	4	Research and Development Manager	11/30/1984	M	M	5/3/2009
11	3	Senior Tool Designer	1/17/1978	S	M	12/5/2010
12	4	Tool Designer	7/29/1959	M	M	12/11/2007
13	4	Tool Designer	5/28/1989	M	F	12/23/2010
14	3	Senior Design Engineer	6/16/1979	S	M	12/30/2010
15	3	Design Engineer	5/2/1961	M	F	1/18/2011
16	1	Marketing Manager	3/19/1975	S	M	12/20/2007
17	2	Marketing Assistant	5/3/1987	S	M	1/26/2007
18	2	Marketing Specialist	3/6/1978	S	M	2/7/2011
19	2	Marketing Assistant	1/29/1978	S	F	2/14/2011
20	2	Marketing Assistant	3/17/1975	M	F	1/7/2011
21	2	Marketing Specialist	2/4/1986	M	M	3/2/2009

Scroll down to see the table rows 25 – 35. The table headers will replace the column letters for the table columns. Other column letters remain as they are.

**Column Letters replaced by Table Headers in the Table area**

**Column Letters**

	EmployeeID	ManagerID	Title	BirthDate	MaritalStatus	Gender	HireDate	O	P	Q
25	23	2	Marketing Specialist	9/13/1962 M	F		1/12/2009			
26	24	2	Marketing Specialist	6/18/1979 M	F		1/18/2009			
27	25	1	Vice President of Production	1/7/1983 S	M		2/3/2009			
28	26	2	Production Control Manager	11/3/1982 M	M		12/1/2008			
29	27	3	Production Supervisor - WC60	10/8/1956 S	F		2/27/2008			
30	28	4	Production Technician - WC60	3/13/1988 M	M		6/30/2006			
31	29	4	Production Technician - WC60	9/25/1979 S	M		1/23/2009			
32	30	4	Production Technician - WC60	9/28/1989 M	F		1/29/2009			
33	31	4	Production Technician - WC60	5/20/1986 M	F		1/4/2009			
34	32	4	Production Technician - WC60	7/10/1977 M	F		12/29/2008			
35	33	4	Production Technician - WC60	12/26/1976 M	M		12/17/2008			
36	34	4	Production Technician - WC60	6/10/1987 M	F		2/16/2009			
37	35	4	Production Technician - WC60	1/10/1977 M	M		2/8/2009			
38	36	4	Production Technician - WC60	7/31/1984 M	M		2/10/2009			
39	37	4	Production Technician - WC60	8/7/1986 S	M		3/7/2009			
40	38	4	Production Technician - WC60	12/14/1966 M	F		1/16/2010			
41	39	4	Production Technician - WC60	9/11/1971 S	M		2/5/2010			
42	40	3	Production Supervisor - WC60	1/16/1956 S	F		12/26/2007			
43	41	4	Production Technician - WC60	8/27/1973 S	M		1/21/2009			
44	42	4	Production Technician - WC60	7/25/1984 M	M		12/27/2008			
45	43	4	Production Technician - WC60	11/19/1988 M	F		1/2/2009			
46	44	4	Production Technician - WC60	5/17/1990 S	M		12/8/2008			
47	45	4	Production Technician - WC60	1/10/1986 M	M		2/26/2009			

## Propagation of a Formula in a Table

In the table given below, suppose you want to include the age of each employee.

1. Insert a column to the right of the column Birthdate. Type Age in the Column Header.
2. In any of the Cells in that empty column, type the Formula, **=DAYS ([@BirthDate], TODAY ())** and Press Enter.

Formula

BirthDate

Age

Formula in a Random Cell

REPLACE

$=\text{DAYS}(\text{TODAY}(),[@\text{BirthDate}])/365$

	A	B	C	D	E	F	G	H
1								
2		EmployeeID	ManagerID	Title	BirthDate	Age	MaritalStatus	Gender
3		1	0	Chief Executive Officer	1/29/1969		S	M
4		2	1	Vice President of Engineering	8/1/1971		S	F
5		3	2	Engineering Manager	11/12/1974		M	M
6		4	3	Senior Tool Designer	12/23/1974		S	M
7		5	3	Design Engineer	9/27/1952	$[\text{@BirthDate}]/365$	M	F
8		6	3	Design Engineer	3/11/1959		M	M
9		7	3	Research and Development Manager	2/24/1987		M	M
10		8	4	Research and Development Engineer	6/5/1986		S	F
11		9	4	Research and Development Engineer	1/21/1979		M	F
12		10	4	Research and Development Manager	11/30/1984		M	M
13		11	3	Senior Tool Designer	1/17/1978		S	M
14		12	4	Tool Designer	7/29/1959		M	M
15		13	4	Tool Designer	5/28/1989		M	F
16		14	3	Senior Design Engineer	6/16/1979		S	M
17		15	3	Design Engineer	5/2/1961		M	F
18		16	1	Marketing Manager	3/19/1975		S	M
19		17	2	Marketing Assistant	5/3/1987		S	M
20		18	2	Marketing Specialist	3/6/1978		S	M
21		19	2	Marketing Assistant	1/29/1978		S	F
22		20	2	Marketing Assistant	3/17/1975		M	F
23		21	2	Marketing Specialist	2/4/1986		M	M

The formula propagates automatically to the other cells in that column of the table.

Formula propagated and computed in the entire Table Column

	A	B	C	D	E	F	G	H
2		EmployeeID	ManagerID	Title	BirthDate	Age	MaritalStatus	Gender
3		1	0	Chief Executive Officer	1/29/1969	47.3	S	M
4		2	1	Vice President of Engineering	8/1/1971	44.8	S	F
5		3	2	Engineering Manager	11/12/1974	41.5	M	M
6		4	3	Senior Tool Designer	12/23/1974	41.4	S	M
7		5	3	Design Engineer	9/27/1952	63.7	M	F
8		6	3	Design Engineer	3/11/1959	57.2	M	M
9		7	3	Research and Development Manager	2/24/1987	29.2	M	M
10		8	4	Research and Development Engineer	6/5/1986	30.0	S	F
11		9	4	Research and Development Engineer	1/21/1979	37.3	M	F
12		10	4	Research and Development Manager	11/30/1984	31.5	M	M
13		11	3	Senior Tool Designer	1/17/1978	38.3	S	M
14		12	4	Tool Designer	7/29/1959	56.8	M	M
15		13	4	Tool Designer	5/28/1989	27.0	M	F
16		14	3	Senior Design Engineer	6/16/1979	36.9	S	M
17		15	3	Design Engineer	5/2/1961	55.1	M	F
18		16	1	Marketing Manager	3/19/1975	41.2	S	M
19		17	2	Marketing Assistant	5/3/1987	29.0	S	M
20		18	2	Marketing Specialist	3/6/1978	38.2	S	M
21		19	2	Marketing Assistant	1/29/1978	38.3	S	F
22		20	2	Marketing Assistant	3/17/1975	41.2	M	F
23		21	2	Marketing Specialist	2/4/1986	30.3	M	M



## Resize Table

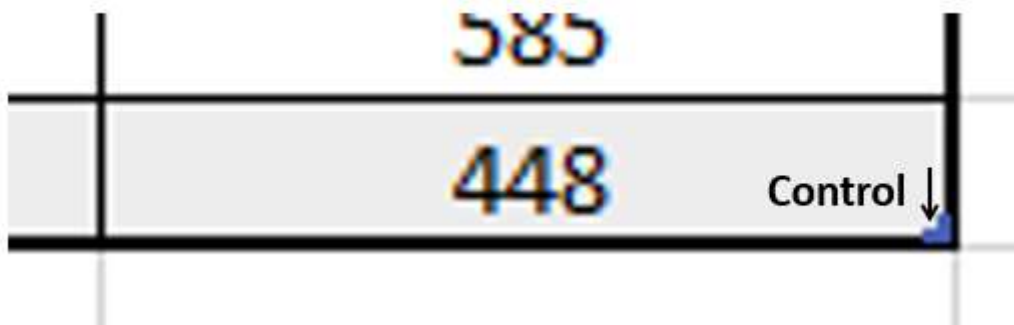
You can resize a table to add or remove rows/columns.

Consider the following table Student\_Marks that contains Total Marks for Batches 1-15.

2	Student Code	Total Marks
3	2015-16-Batch1-1	814
4	2015-16-Batch1-2	657
5	2015-16-Batch1-3	540
6	2015-16-Batch1-4	806
7	2015-16-Batch1-5	433
8	2015-16-Batch1-6	637
9	2015-16-Batch1-7	964
10	2015-16-Batch1-8	605
11	2015-16-Batch1-9	493
12	2015-16-Batch1-10	414
13	2015-16-Batch1-11	889
14	2015-16-Batch1-12	794
15	2015-16-Batch1-13	867
16	2015-16-Batch1-14	585
17	2015-16-Batch1-15	448

Suppose you want to add three more batches 16 – 18 and a column containing pass percentage.

- Click the table.
- Drag the blue-color control at the lower-right, downwards to include three more rows in the table.



- Again drag the blue-color control at the lower-right, sideways to include one more column in the table.

Your table looks as follows. You can also check the range included in the table in the Name Manager dialog box-

The screenshot shows an Excel spreadsheet with a table of student marks. The table has three columns: 'Student Code', 'Total Marks', and 'Column'. The data rows are numbered 3 to 17. The table is highlighted in blue and labeled 'Resized Table' with an arrow. To the right, the 'Name Manager' dialog box is open, showing a list of names: 'Emp\_Data', 'EmployeeID', and 'Student\_Marks'. Arrows point from the labels 'Table Name' and 'Refers to' to the 'Name' and 'Refers To' columns respectively.

Student Code	Total Marks	Column
2015-16-Batch1-1	814	
2015-16-Batch1-2	657	
2015-16-Batch1-3	540	
2015-16-Batch1-4	806	
2015-16-Batch1-5	433	
2015-16-Batch1-6	637	
2015-16-Batch1-7	964	
2015-16-Batch1-8	605	
2015-16-Batch1-9	493	
2015-16-Batch1-10	414	
2015-16-Batch1-11	889	
2015-16-Batch1-12	794	
2015-16-Batch1-13	867	
2015-16-Batch1-14	585	
2015-16-Batch1-15	448	

Name	Value	Refers To	Scope	Comments
Emp_Data	["1","0","Chief Executive ...	=Tables1!\$B\$3:\$N\$292	Workbook	
EmployeeID	EmployeeID	=Emp_Data[[@Headers...	Workbook	
Student_Marks	["2015-16-Batch1-1","81...	=Tables2!\$B\$3:\$D\$20	Workbook	

## Remove Duplicates

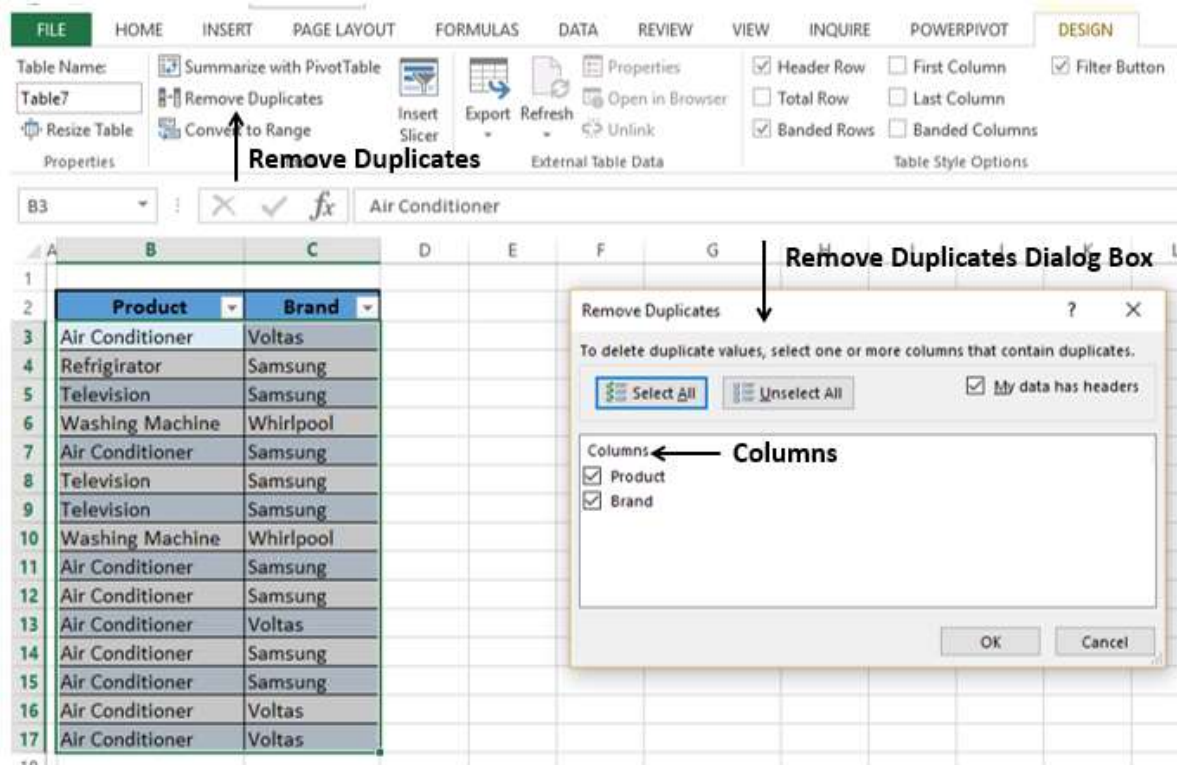
When you gather data from different sources, you probably can have duplicate values. You need to remove the duplicate values before going further with analysis.

Look at the following data where you have information about various products of various brands. Suppose, you want to remove duplicates from this data.

	A	B	C
1			
2		<b>Product</b>	<b>Brand</b>
3		Air Conditioner	Voltas
4		Refrigerator	Samsung
5		Television	Samsung
6		Washing Machine	Whirlpool
7		Air Conditioner	Samsung
8		Television	Samsung
9		Television	Samsung
10		Washing Machine	Whirlpool
11		Air Conditioner	Samsung
12		Air Conditioner	Samsung
13		Air Conditioner	Voltas
14		Air Conditioner	Samsung
15		Air Conditioner	Samsung
16		Air Conditioner	Voltas
17		Air Conditioner	Voltas

- Click the table.
- On the **DESIGN** tab, click **Remove Duplicates** in the Tools group on the Ribbon. The **Remove Duplicates** dialog box appears.





The column headers appear under columns in the Remove Duplicates dialog box.

- Check the column headers depending on which column you want to remove the duplicates and click OK.

You will get a message on how many rows with duplicate values are removed and how many unique values remain. The cleaned data will be displayed in the table.

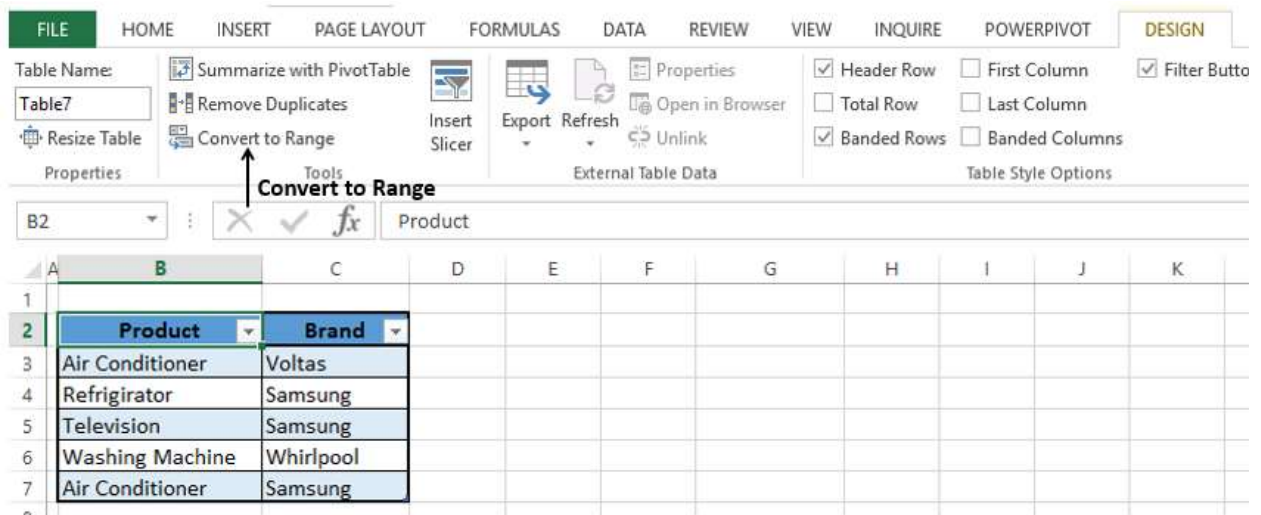
	A	B	C
1			
2		Product	Brand
3		Air Conditioner	Voltas
4		Refrigerator	Samsung
5		Television	Samsung
6		Washing Machine	Whirlpool
7		Air Conditioner	Samsung

You can also remove duplicates with **Remove Duplicates** in the **Data Tools** group under **DATA** tab on the Ribbon.

## Convert to Range

You can convert a table to a **Range**.

- Click the table.
- Click **Convert to Range** in the **Tools** group, under the Design tab on the Ribbon.

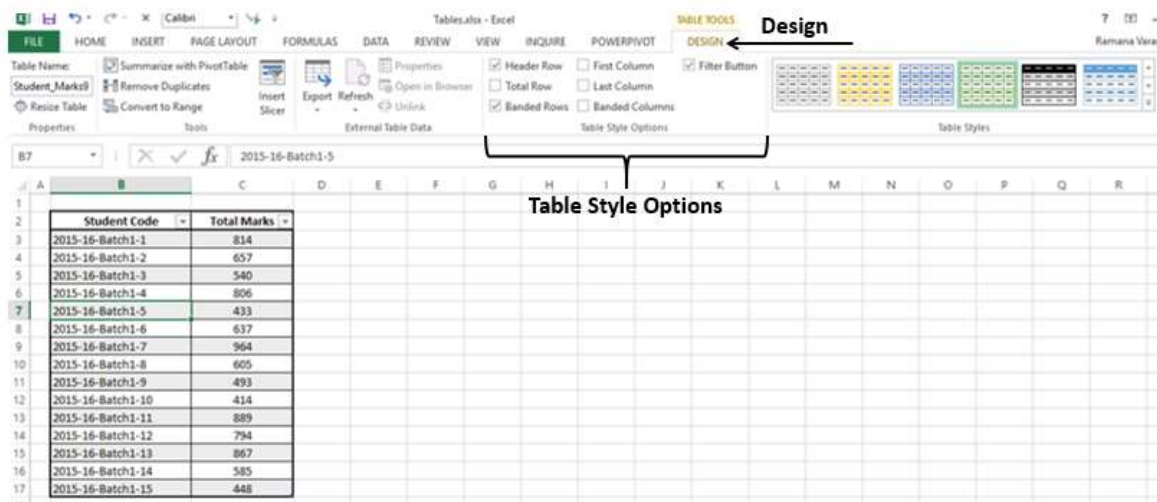


You will get a message asking you if you want to convert the table to a Range. After you confirm with **Yes**, the table will be converted to Range.

	A	B	C
1			
2		Product	Brand
3		Air Conditioner	Voltas
4		Refrigerator	Samsung
5		Television	Samsung
6		Washing Machine	Whirlpool
7		Air Conditioner	Samsung

## Table Style Options

You have several options of **Table Styles** to choose. These options can be used if you need to highlight a Row / Column.

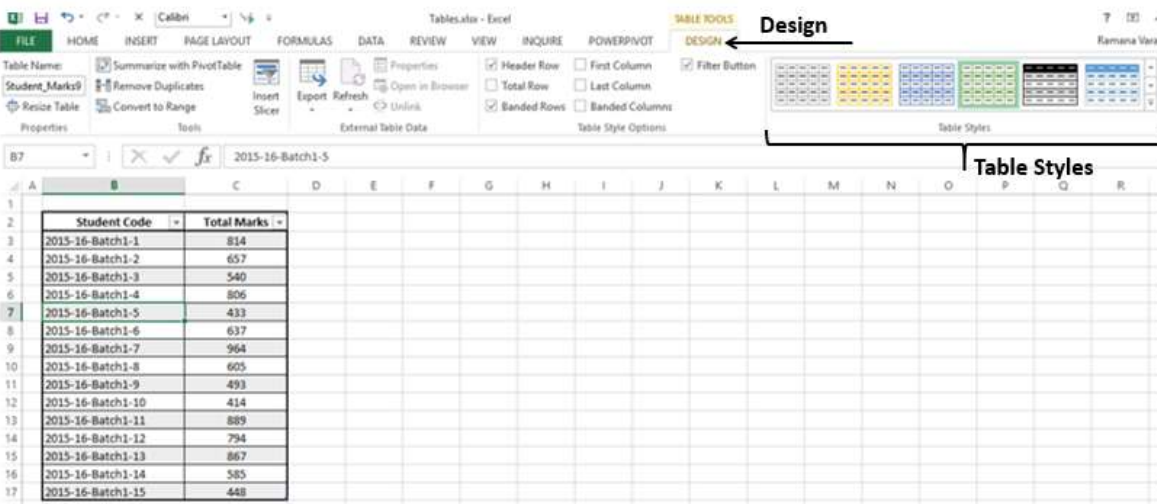


You can check / uncheck these boxes to see how your table looks. Finally, you can decide on what options suit your data.

It is advised that the **Table Style Options** be used only to project important information in your data rather than making it colorful, which is not needed in data analysis.

## Table Styles

You have several table styles to choose from. These styles can be used depending on what color and pattern you want to display your data in the table.



Move your mouse on these styles to have a preview of your table with the styles. Finally, you can decide on what style suit your data.

It is advised that the **Table Styles** be used only to project important information in your data in a presentable way rather than making it colorful, which is not needed in data analysis.

## **Slicers for Tables**

If you are using Excel 2013 or Excel 2016, you can use **Slicers** for filtering data in your table.

For details on how to use Slicers for Tables, refer the chapter on **Filtering** in this tutorial.

## 6. Cleaning Data with Text Functions

The data that you obtain from different sources may not be in a form ready for analysis. In this chapter, you will understand how to prepare your data that is in the form of text for analysis.

Initially, you need to clean the data. Data cleaning includes removing unwanted characters from text. Next, you need to structure the data in the form you require for further analysis. You can do the same by-

- Finding required text patterns with the text functions.
- Extracting data values from text.
- Formatting data with text functions.
- Executing data operations with the text functions.

### Removing Unwanted Characters from Text

---

When you import data from another application, it can have nonprintable characters and/or excess spaces. The excess spaces can be-

- leading spaces, and/or
- extra spaces between words.

If you sort or analyze such data, you will get erroneous results.

Consider the following example-

#### Product Data

```
54482100AFES | CONTROLLER SERVER 1TB H | 304.00
54482100JCP9 | DESKTOP UNIT | 225.00
54482700?BAAS | DESKTOP WINDOWS 8.1 SERVER | 2302.00
54482600?BAAS | DESKTOP WINDOWS 8.1 WKST | 355.00
54482100?BAAS | DESKTOP WINDOWS 10 | 182.00
54482200?BAAS | DESKTOP WINDOWS DESKTOP OS | 255.00
54482500?BAAS | DESKTOP WINDOWS OS | 354.00
54483000?BAAS | MINITOWER NO OS | 1840.00
54483000KEBB | MINI TOWER | 2550.00
```

This is the raw data that you have obtained on product information containing the Product ID, Product description and the price. The character "|" separates the field in each row.

When you import this data into Excel worksheet, it looks as follows-

	A	B
1		
2		<b>Product Data</b>
3		54482100AFES   CONTROLLER SERVER 1TB H   304.00
4		54482100JCP9   DESKTOP UNIT   225.00
5		54482700BAAS   DESKTOP WINDOWS 8.1 SERVER   2302.00
6		54482600BAAS   DESKTOP WINDOWS 8.1 WKST   355.00
7		54482100BAAS   DESKTOP WINDOWS 10   182.00
8		54482200BAAS   DESKTOP WINDOWS DESKTOP OS   255.00
9		54482500BAAS   DESKTOP WINDOWS OS   354.00
10		54483000BAAS   MINITOWER NO OS   1840.00
11		54483000KEBB   MINI TOWER   2550.00

As you observe, the entire data is in a single column. You need to structure this data to perform data analysis. However, initially you need to clean the data.

You need to remove any nonprintable characters and excess spaces that might be present in the data. You can use the CLEAN function and TRIM function for this purpose.

Function	Description
CLEAN	Removes all nonprintable characters from text
TRIM	Removes spaces from text

- Select the Cells C3 – C11.
- Type =TRIM (CLEAN (B3)) and then press CTRL+Enter.

The formula is filled in the cells C3 – C11.



	A	B	C
1			
2		<b>Product Data</b>	<b>Data Cleaning</b>
3		54482100AFES   CONTROLLER SERVER 1TB H   304.00	=TRIM(CLEAN(B3))
4		54482100JCP9   DESKTOP UNIT   225.00	=TRIM(CLEAN(B4))
5		54482700BAAS   DESKTOP WINDOWS 8.1 SERVER   2302.00	=TRIM(CLEAN(B5))
6		54482600BAAS   DESKTOP WINDOWS 8.1 WKST   355.00	=TRIM(CLEAN(B6))
7		54482100BAAS   DESKTOP WINDOWS 10   182.00	=TRIM(CLEAN(B7))
8		54482200BAAS   DESKTOP WINDOWS DESKTOP OS   255.00	=TRIM(CLEAN(B8))
9		54482500BAAS   DESKTOP WINDOWS OS   354.00	=TRIM(CLEAN(B9))
10		54483000BAAS   MINITOWER NO OS   1840.00	=TRIM(CLEAN(B10))
11		54483000KEBB   MINI TOWER   2550.00	=TRIM(CLEAN(B11))

The result will be as shown below-

	A	B	C
1		<b>Raw Data</b>	<b>Nonprintable Characters and Excess Spaces removed</b>
2		<b>Product Data</b>	<b>Data Cleaning</b>
3		54482100AFES   CONTROLLER SERVER 1TB H   304.00	54482100AFES   CONTROLLER SERVER 1TB H   304.00
4		54482100JCP9   DESKTOP UNIT   225.00	54482100JCP9   DESKTOP UNIT   225.00
5		54482700BAAS   DESKTOP WINDOWS 8.1 SERVER   2302.00	54482700BAAS   DESKTOP WINDOWS 8.1 SERVER   2302.00
6		54482600BAAS   DESKTOP WINDOWS 8.1 WKST   355.00	54482600BAAS   DESKTOP WINDOWS 8.1 WKST   355.00
7		54482100BAAS   DESKTOP WINDOWS 10   182.00	54482100BAAS   DESKTOP WINDOWS 10   182.00
8		54482200BAAS   DESKTOP WINDOWS DESKTOP OS   255.00	54482200BAAS   DESKTOP WINDOWS DESKTOP OS   255.00
9		54482500BAAS   DESKTOP WINDOWS OS   354.00	54482500BAAS   DESKTOP WINDOWS OS   354.00
10		54483000BAAS   MINITOWER NO OS   1840.00	54483000BAAS   MINITOWER NO OS   1840.00
11		54483000KEBB   MINI TOWER   2550.00	54483000KEBB   MINI TOWER   2550.00

## Finding required Text Patterns with the Text Functions

To structure your data, you might have to do certain Text Pattern matching based on which you can extract the Data Values. Some of the Text Functions that are useful for this purpose are:

Function	Description
EXACT	Checks to see if two text values are identical
FIND	Finds one text value within another (case-sensitive)
SEARCH	Finds one text value within another (not case-sensitive)

## Extracting Data Values from Text

You need to extract the required data from text in order to structure the same. In the above example, say, you need to place the data in three columns – ProductID, Product\_Description and Price.

You can extract data in one of the following ways-

- Extracting Data Values with Convert Text to Columns Wizard
- Extracting Data Values with Text Functions
- Extracting Data Values with Flash Fill

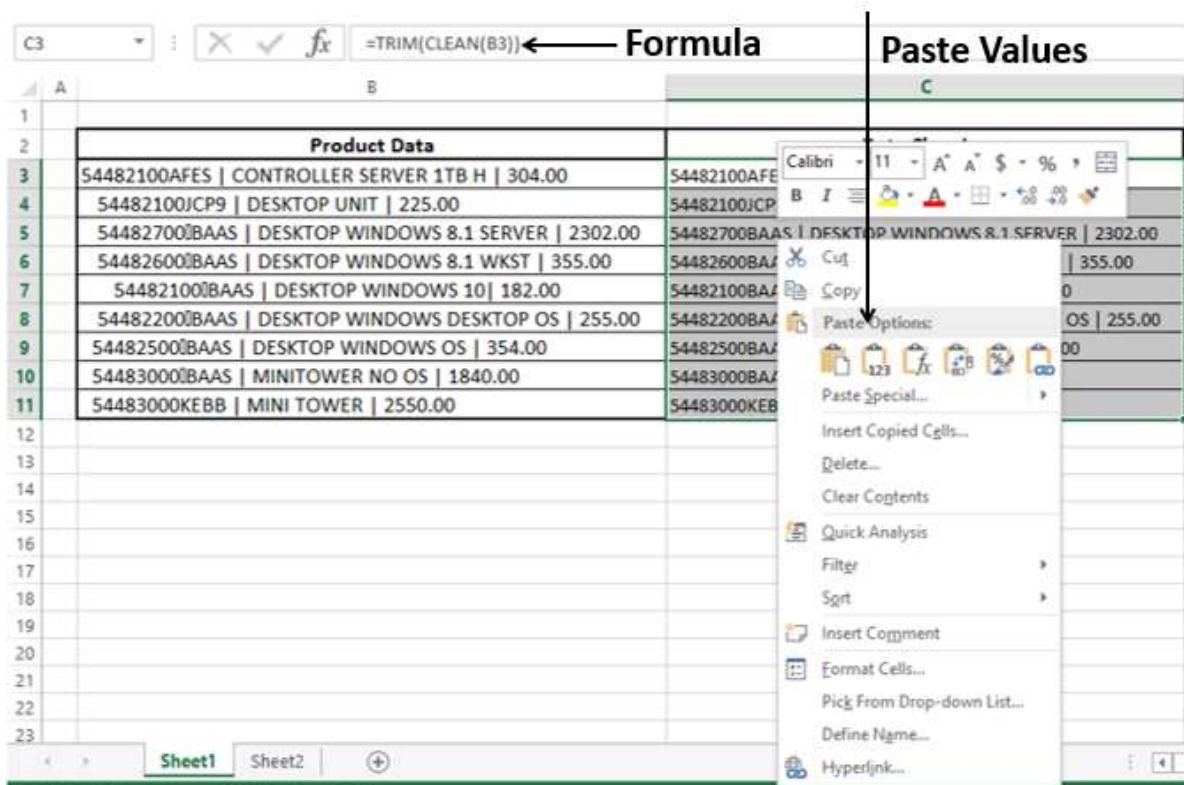
## Extracting Data Values with Convert Text to Columns Wizard

You can use the **Convert Text to Columns Wizard** to extract Data Values into Excel columns if your fields are-

- Delimited by a character, or
- Aligned in columns with spaces between each field.

In the above example, the fields are delimited by the character "|". Hence, you can use the **Convert Text to Columns** wizard.

- Select the data.
- Copy and paste values in the same place. Otherwise, **Convert Text to Columns** takes the functions rather than the data itself as the input

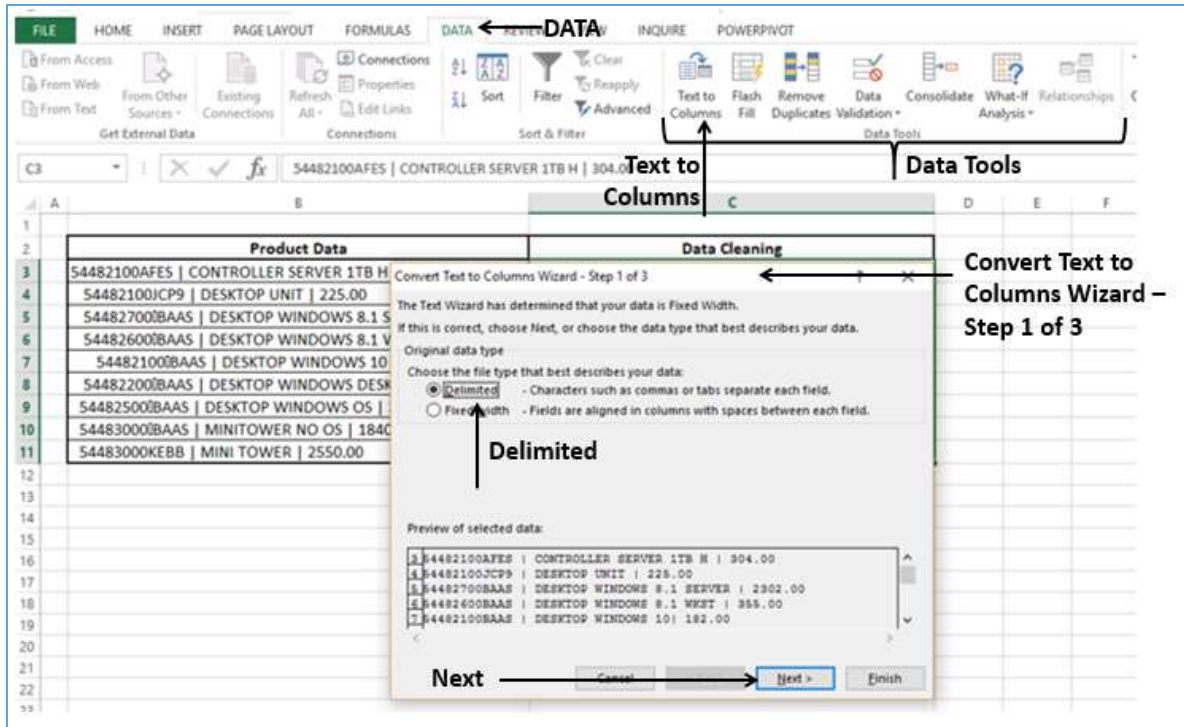


- Select the data.
- Click on **Text to Columns** in the **Data Tools** group under **Data** Tab on the Ribbon.



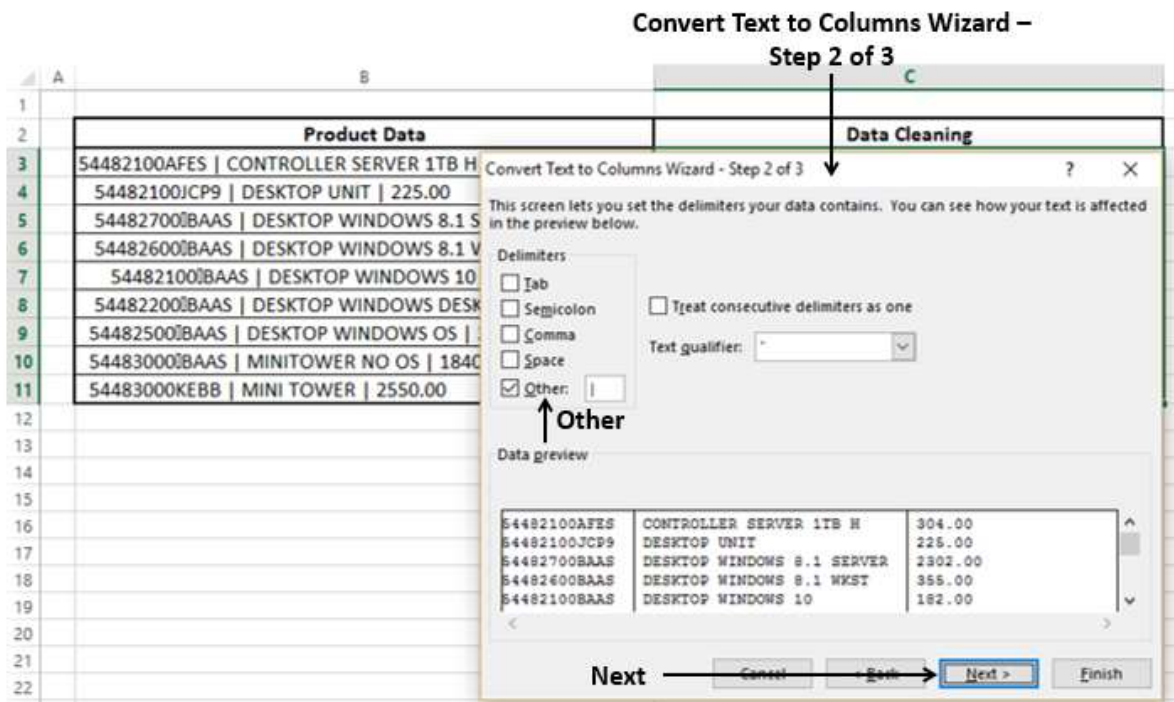
**Step 1:** Convert Text to Columns Wizard - Step 1 of 3 appears.

- Select Delimited.
- Click Next.



**Step 2:** Convert Text to Columns Wizard - Step 2 of 3 appears.

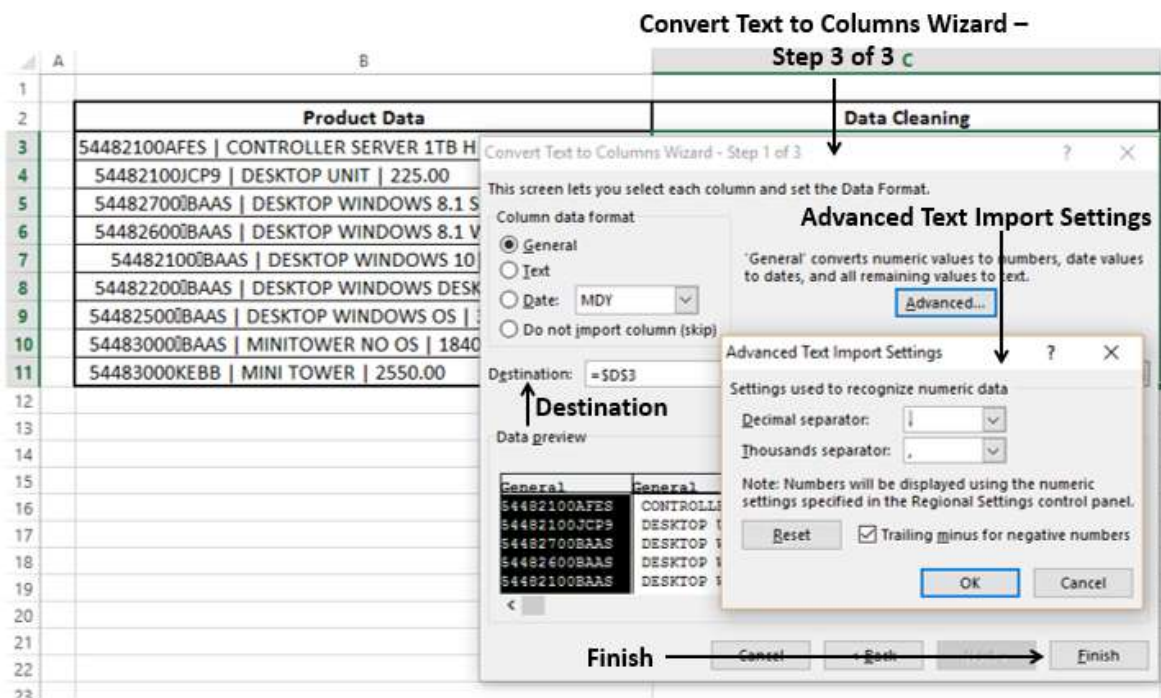
- Under **Delimiters**, select **Other**.
- In the box next to **Other**, type the character |
- Click **Next**.



**Step 3:** Convert Text to Columns Wizard - Step 3 of 3 appears.

In this screen, you can select each column of your data in the wizard and set the format for that column.

- For **Destination**, select the cell D3.
- You can click **Advanced**, and set **Decimal Separator** and **Thousands Separator** in the **Advanced Text Import Settings** dialog box that appears.
- Click **Finish**.



Your data, which is converted to columns appears in the three Columns – D, E and F.

- Name the Column headers as ProductID, Product\_Description and Price.

	C	D	E	F
	Data Cleaning	ProductID	Product_Description	Price
	54482100AFES   CONTROLLER SERVER 1TB H   304.00	54482100AFES	CONTROLLER SERVER 1TB H	304
	54482100JCP9   DESKTOP UNIT   225.00	54482100JCP9	DESKTOP UNIT	225
	54482700BAAS   DESKTOP WINDOWS 8.1 SERVER   2302	54482700BAAS	DESKTOP WINDOWS 8.1 SERVER	2302
	54482600BAAS   DESKTOP WINDOWS 8.1 WKST   355.00	54482600BAAS	DESKTOP WINDOWS 8.1 WKST	355
	54482100BAAS   DESKTOP WINDOWS 10   182.00	54482100BAAS	DESKTOP WINDOWS 10	182
	54482200BAAS   DESKTOP WINDOWS DESKTOP OS   255	54482200BAAS	DESKTOP WINDOWS DESKTOP OS	255
	54482500BAAS   DESKTOP WINDOWS OS   354.00	54482500BAAS	DESKTOP WINDOWS OS	354
	54483000BAAS   MINITOWER NO OS   1840.00	54483000BAAS	MINITOWER NO OS	1840
	54483000KEBB   MINI TOWER   2550.00	54483000KEBB	MINI TOWER	2550

## Extracting Data Values with Text Functions

Suppose the fields in your data neither are delimited by a character nor are aligned in columns with spaces between each field, you can use text functions to extract data values. Even in the case the fields are delimited, you can still use text functions to extract data.

Some of the text functions that are useful for this purpose are-

Function	Description
LEFT	Returns the leftmost characters from a text value
RIGHT	Returns the rightmost characters from a text value

MID	Returns a specific number of characters from a text string starting at the position you specify
LEN	Returns the number of characters in a text string

You can also combine two or more of these text functions as per the data you have at hand, to extract the required data values. For example, using a combination of LEFT, RIGHT and VALUE functions or using a combination of FIND, LEFT, LEN and MID functions.

In the above example,

- All the characters left to the first | give the name ProductID.
- All the characters right to the second | give the name Price.
- All the characters that lie between the first | and second | give the name Product\_Description.
- Each | has a space before and after.

Observing this information, you can extract the data values with the following steps-

- Find the Position of First | - **First | Position**
  - You can use FIND function
- Find the Position of Second | - **Second | Position**
  - You can use FIND function again
- Beginning to (**First | Position** – 2) Characters of the Text give ProductID
  - You can use LEFT Function
- (**First | Position** + 2) to (**Second | Position** - 2) Characters of the Text give Product\_Description
  - You can use MID Function
- (**Second | Position** + 2) to End Characters of the Text give Price
  - You can use RIGHT Function

	A	B	C	D	E	F	G
1							
2		<b>Product Data</b>	<b>First   Position</b>	<b>Second   Position</b>	<b>ProductID</b>	<b>Product_Description</b>	<b>Price</b>
3		54482100AFES   CONTROLLER SERVER 1TB H   304.00	=FIND(" ",B3,1)	=FIND(" ",B3,C3+1)	=LEFT(B3,C3-2)	=MID(B3,C3+2,D3-C3-2)	=RIGHT(B3,LEN(B3)-D3-1)
4		54482100JCP9   DESKTOP UNIT   225.00	=FIND(" ",B4,1)	=FIND(" ",B4,C4+1)	=LEFT(B4,C4-2)	=MID(B4,C4+2,D4-C4-2)	=RIGHT(B4,LEN(B4)-D4-2)
5		54482700BAAS   DESKTOP WINDOWS 8.1 SERVER   2302.00	=FIND(" ",B5,1)	=FIND(" ",B5,C5+1)	=LEFT(B5,C5-2)	=MID(B5,C5+2,D5-C5-2)	=RIGHT(B5,LEN(B5)-D5-2)
6		54482600BAAS   DESKTOP WINDOWS 8.1 WKST   355.00	=FIND(" ",B6,1)	=FIND(" ",B6,C6+1)	=LEFT(B6,C6-2)	=MID(B6,C6+2,D6-C6-2)	=RIGHT(B6,LEN(B6)-D6-2)
7		54482100BAAS   DESKTOP WINDOWS 10   182.00	=FIND(" ",B7,1)	=FIND(" ",B7,C7+1)	=LEFT(B7,C7-2)	=MID(B7,C7+2,D7-C7-2)	=RIGHT(B7,LEN(B7)-D7-2)
8		54482200BAAS   DESKTOP WINDOWS DESKTOP OS   255.00	=FIND(" ",B8,1)	=FIND(" ",B8,C8+1)	=LEFT(B8,C8-2)	=MID(B8,C8+2,D8-C8-2)	=RIGHT(B8,LEN(B8)-D8-2)
9		54482500BAAS   DESKTOP WINDOWS OS   354.00	=FIND(" ",B9,1)	=FIND(" ",B9,C9+1)	=LEFT(B9,C9-2)	=MID(B9,C9+2,D9-C9-2)	=RIGHT(B9,LEN(B9)-D9-2)
10		54483000BAAS   MINITOWER NO OS   1840.00	=FIND(" ",B10,1)	=FIND(" ",B10,C10+1)	=LEFT(B10,C10-2)	=MID(B10,C10+2,D10-C10-2)	=RIGHT(B10,LEN(B10)-D10-2)
11		54483000KEBB   MINI TOWER   2550.00	=FIND(" ",B11,1)	=FIND(" ",B11,C11+1)	=LEFT(B11,C11-2)	=MID(B11,C11+2,D11-C11-2)	=RIGHT(B11,LEN(B11)-D11-2)

The result will be as shown below-

	A	B	C	D	E	F	G
1							
2		<b>Product Data</b>	<b>First   Position</b>	<b>Second   Position</b>	<b>ProductID</b>	<b>Product_Description</b>	<b>Price</b>
3		54482100AFES   CONTROLLER SERVER 1TB H   304.00	14	40	54482100AFES	CONTROLLER SERVER 1TB H	304.00
4		54482100JCP9   DESKTOP UNIT   225.00	14	29	54482100JCP9	DESKTOP UNIT	25.00
5		54482700BAAS   DESKTOP WINDOWS 8.1 SERVER   2302.00	14	43	54482700BAAS	DESKTOP WINDOWS 8.1 SERVER	302.00
6		54482600BAAS   DESKTOP WINDOWS 8.1 WKST   355.00	14	41	54482600BAAS	DESKTOP WINDOWS 8.1 WKST	55.00
7		54482100BAAS   DESKTOP WINDOWS 10   182.00	14	34	54482100BAAS	DESKTOP WINDOWS 10	82.00
8		54482200BAAS   DESKTOP WINDOWS DESKTOP OS   255.00	14	43	54482200BAAS	DESKTOP WINDOWS DESKTOP OS	55.00
9		54482500BAAS   DESKTOP WINDOWS OS   354.00	14	35	54482500BAAS	DESKTOP WINDOWS OS	54.00
10		54483000BAAS   MINITOWER NO OS   1840.00	14	32	54483000BAAS	MINITOWER NO OS	840.00
11		54483000KEBB   MINI TOWER   2550.00	14	27	54483000KEBB	MINI TOWER	550.00

You can observe that the values in the price column are text values. To perform calculations on these values, you have to format the corresponding cells. You can look at the section given below to understand formatting text.

## Extracting Data Values with Flash Fill

Using Excel **Flash Fill** is another way to extract data values from text. However, this works only when Excel is able to find a pattern in the data.

1. Create three columns for ProductID, Product\_Description and Price next to the data.

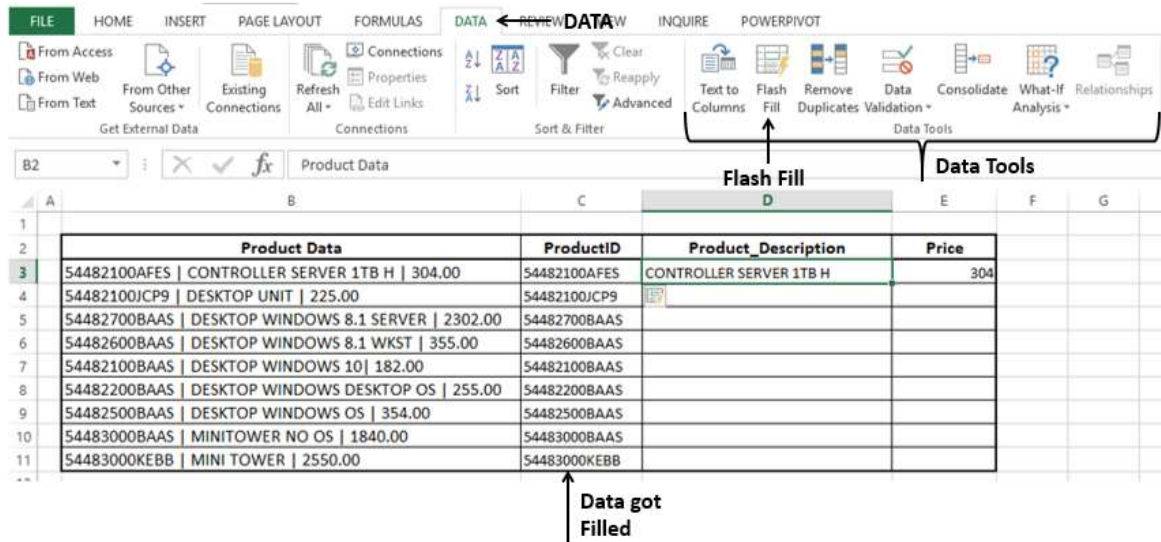
	A	B	C	D	E
1					
2		<b>Product Data</b>	<b>ProductID</b>	<b>Product_Description</b>	<b>Price</b>
3		54482100AFES   CONTROLLER SERVER 1TB H   304.00			
4		54482100JCP9   DESKTOP UNIT   225.00			
5		54482700BAAS   DESKTOP WINDOWS 8.1 SERVER   2302.00			
6		54482600BAAS   DESKTOP WINDOWS 8.1 WKST   355.00			
7		54482100BAAS   DESKTOP WINDOWS 10   182.00			
8		54482200BAAS   DESKTOP WINDOWS DESKTOP OS   255.00			
9		54482500BAAS   DESKTOP WINDOWS OS   354.00			
10		54483000BAAS   MINITOWER NO OS   1840.00			
11		54483000KEBB   MINI TOWER   2550.00			

2. Copy and paste the values for C3, D3 and E3 from B3.

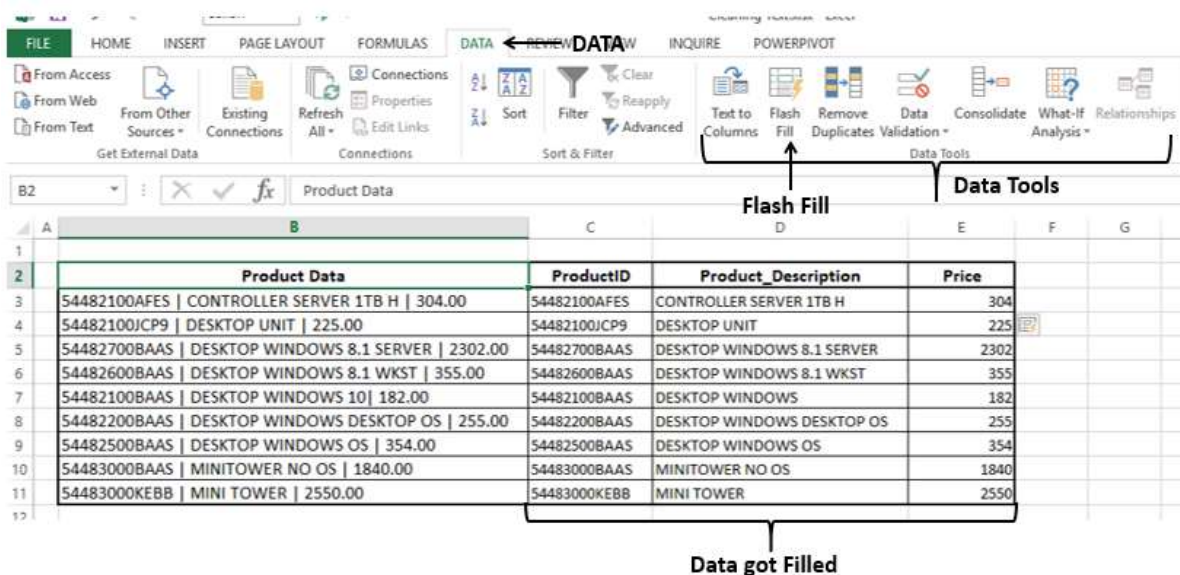
	A	B	C	D	E
1					
2		<b>Product Data</b>	<b>ProductID</b>	<b>Product_Description</b>	<b>Price</b>
3		54482100AFES   CONTROLLER SERVER 1TB H   304.00	54482100AFES	CONTROLLER SERVER 1TB H	304
4		54482100JCP9   DESKTOP UNIT   225.00			
5		54482700BAAS   DESKTOP WINDOWS 8.1 SERVER   2302.00			
6		54482600BAAS   DESKTOP WINDOWS 8.1 WKST   355.00			
7		54482100BAAS   DESKTOP WINDOWS 10   182.00			
8		54482200BAAS   DESKTOP WINDOWS DESKTOP OS   255.00			
9		54482500BAAS   DESKTOP WINDOWS OS   354.00			
10		54483000BAAS   MINITOWER NO OS   1840.00			
11		54483000KEBB   MINI TOWER   2550.00			



3. Select cell C3 and click **Flash Fill** in the **Data Tools** group on the **Data** tab. All the values for ProductID get filled.



4. Repeat the above given steps for Product\_Description and Price. The data is filled.



## Formatting Data with Text Functions

Excel has several built-in text functions that you can use for formatting data containing text. These include-

**Functions that format the Text as per your need-**

Function	Description
LOWER	Converts text to lowercase

Function	Description
UPPER	Converts text to uppercase
PROPER	Capitalizes the first letter in each word of a text value

### Functions that convert and/or format the Numbers as Text-

Function	Description
DOLLAR	Converts a number to text, using the \$ (dollar) currency format
FIXED	Formats a number as text with a fixed number of decimals
TEXT	Formats a number and converts it to text

### Functions that convert the Text to Numbers-

Function	Description
VALUE	Converts a text argument to a number

### Executing Data Operations with the Text Functions

You might have to perform certain Text Operations on your Data. For example, if Login-IDs for the Employees are changed to a New Format in an Organization, based on the Format Change, Text Replacements might have to be done.

Following Text Functions help you in performing Text Operations on your data containing Text:

Function	Description
REPLACE	Replaces characters within text
SUBSTITUTE	Substitutes new text for old text in a text string
CONCATENATE	Joins several text items into one text item
CONCAT	Combines the text from multiple ranges and/or strings, but it does not provide the delimiter or IgnoreEmpty arguments.
TEXTJOIN	Combines the text from multiple ranges and/or strings, and includes a delimiter you specify between each text value that will be combined. If the delimiter is an empty text string, this function will effectively concatenate the ranges.
REPT	Repeats text a given number of times

# 7. Cleaning Data Containing Date Values

The data that you obtain from different sources might contain date values. In this chapter, you will understand how to prepare your data that contains data values for analysis.

You will learn about-

- Date Formats
  - Date in Serial Format
  - Date in different Month-Day-Year Formats
- Converting Dates in Serial Format to Month-Day-Year Format
- Converting Dates in Month-Day-Year Format to Serial Format
- Obtaining Today's Date
- Finding a Workday after specified Days
- Customizing the Definition of a Weekend
- Number of Workdays between two given Dates
- Extracting Year, Month, Day from Date
- Extracting Day of the Week from Date
- Obtaining Date from Year, Month and Day
- Calculating Number of Years, Months and Days between two Dates

## Date Formats

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Excel supports **Date** values in two ways-

- Serial Format
- In different Year-Month-Day Formats

You can convert-

- A **Date** in Serial Format to a **Date** in Year-Month-Day Format
- A **Date** in Year-Month-Day Format to a **Date** in Serial Format

### Date in Serial Format

A **Date** in serial format is a positive integer that represents the number of days between the given date and January 1, 1900. Both the current **Date** and January 1, 1900 are included in the count. For example, 42354 is a **Date** that represents 12/16/2015.



## Date in Month-Day-Year Formats

Excel supports different **Date** Formats based on the **Locale** (Location) you choose. Hence, you need to first determine the compatibility of your **Date** formats and the Data Analysis at hand. Note that certain **Date** formats are prefixed with \*(asterisk) –

- **Date** formats that begin with \*(asterisk) respond to changes in regional date and time settings that are specified for the operating system
- **Date** formats without an \*(asterisk) are not affected by operating system settings

For understanding purpose, you can assume United States as the Locale. You find the following **Date** formats to choose for the **Date** - 8<sup>th</sup> June, 2016-

- \*6/8/2016 (affected by operating system settings)
- \*Wednesday, June 8, 2016 (affected by operating system settings)
- 6/8
- 6/8/16
- 06/08/16
- 8-Jun
- 8-Jun-16
- 08-Jun-16
- Jun-16
- June-16
- J
- J-16
- 6/8/2016
- 8-Jun-2016

If you enter only two digits to represent a year and if-

- The digits are 30 or higher, Excel assumes the digits represent years in the twentieth century.
- The digits are lower than 30, Excel assumes the digits represent years in the twenty-first century.

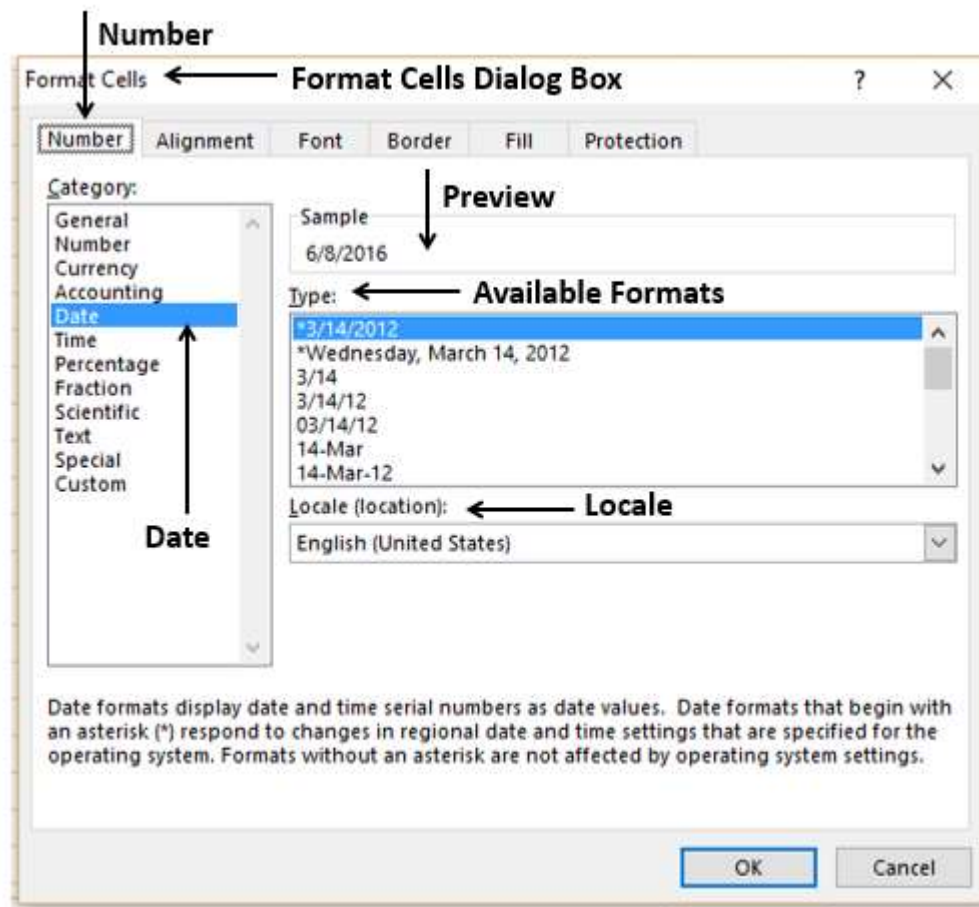
For example, 1/1/29 is treated as January 1, 2029 and 1/1/30 is treated as January 1, 1930.

## Converting Dates in Serial Format to Month-Day-Year Format

---

To convert dates from serial format to Month-Day-Year format, follow the steps given below-

- Click the **Number** tab in the **Format Cells** dialog box.
- Click **Date** under **Category**.
- Select **Locale**. The available **Date** formats will be displayed as a list under **Type**.
- Click on a **Format** under **Type** to look at the preview in the box adjacent to **Sample**.



After choosing the Format, click **OK**.

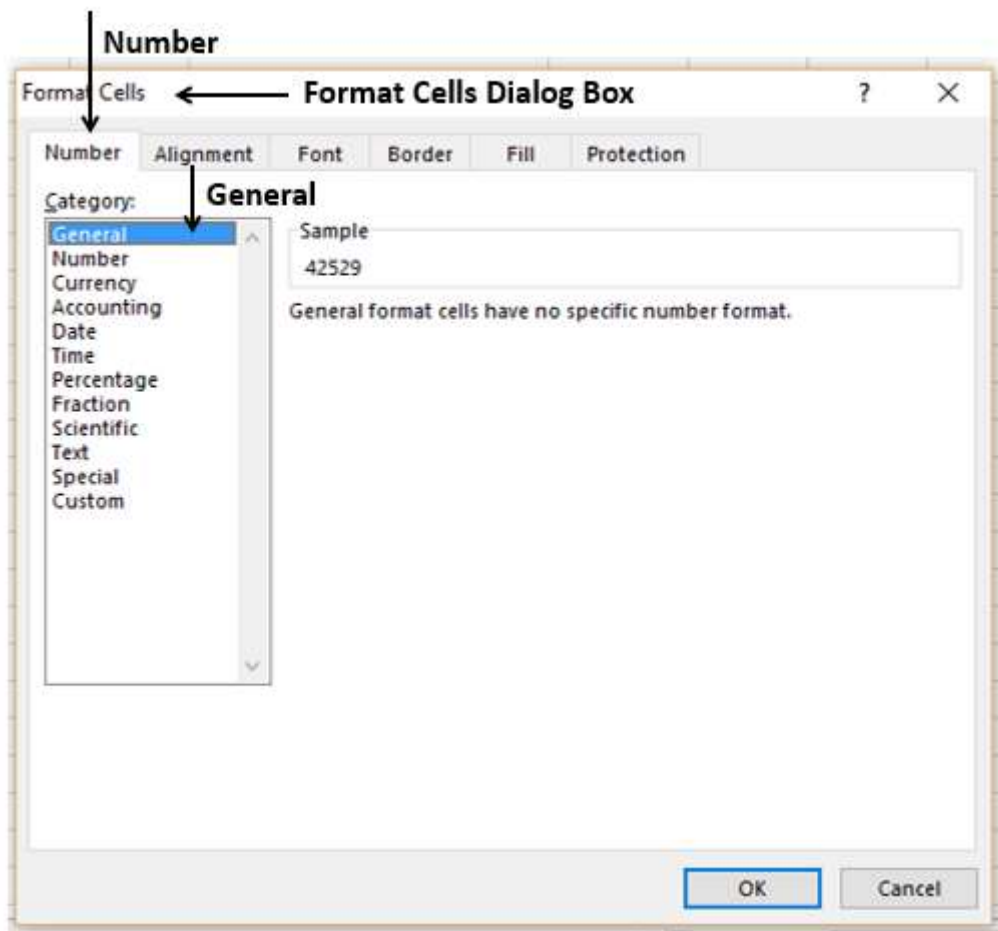
## Converting Dates in Month-Day-Year Format to Serial Format

You can convert dates in Month-Day-Year format to Serial format in two ways-

- Using **Format Cells** dialog box
- Using Excel **DATEVALUE** function

### Using Format Cells dialog box

- Click the **Number** tab in the **Format Cells** dialog box.
- Click **General** under **Category**.



## Using Excel DATEVALUE Function

You can use Excel **DATEVALUE** function to convert a **Date** to **Serial Number** format. You need to enclose the **Date** argument in "". For example,

=DATEVALUE ("6/8/2016") results in 42529

## Obtaining Today's Date

If you need to perform calculations based on today's date, simply use the Excel function TODAY (). The result reflects the date when it is used.

The following screenshot of TODAY () function usage has been taken on 16<sup>th</sup> May, 2016-

Calculation			Result		
A	B	C	A	B	C
1			1		
2	Today's Date	=TODAY()	2	Today's Date	5/16/2016

## Finding a Workday after Specified Days

You might have to perform certain calculations based on your workdays.

Workdays exclude weekend days and any holidays. This means if you can define your weekend and holidays, whatever calculations you do will be based on workdays. For example, you can calculate invoice due dates, expected delivery times, the next meeting date, etc.

You can use Excel **WORKDAY** and **WORKDAY.INTL** functions for such operations.

Function	Description
WORKDAY	Returns the serial number of the date before or after a specified number of workdays
WORKDAY.INTL	Returns the serial number of the date before or after a specified number of workdays using parameters to indicate which and how many days are weekend days

For example, you can specify the 15<sup>th</sup> working day from today (the screenshot below is taken on 16<sup>th</sup> May 2016) using the Functions TODAY and WORKDAY.

Calculation			Result		
A	B	C	A	B	C
1			1		
2	Today	=TODAY()	2	Today	5/16/2016
3	No. of Days	15	3	No. of Days	15
4	Workday	=WORKDAY(C2,C3)	4	Workday	6/6/2016

Suppose 25<sup>th</sup> May 2016 and 1<sup>st</sup> June 2016 are holidays. Then, your calculation will be as follows-

Calculation			Result		
A	B	C	A	B	C
1			1		
2	Today	=TODAY()	2	Today	5/16/2016
3	No. of Days	15	3	No. of Days	15
4	Holidays	42515	4	Holidays	5/25/2016
5		42522	5		6/1/2016
6	Workday	=WORKDAY(C2,C3,C4:C5)	6	Workday	6/8/2016

## Customizing the Definition of a Weekend

By default, weekend is Saturday and Sunday, i.e. two days. You can also optionally define your weekend with the **WORKDAY.INTL** function. You can specify your own weekend by a weekend-number that corresponds to the weekend days as given in the table below. You need not remember these numbers, because when you start typing the function, you get a list of numbers and the weekend days in the drop-down list.

Weekend Days	Weekend-number
Saturday, Sunday	1 or omitted
Sunday, Monday	2
Monday, Tuesday	3
Tuesday, Wednesday	4
Wednesday, Thursday	5
Thursday, Friday	6
Friday, Saturday	7
Sunday only	11
Monday only	12
Tuesday only	13
Wednesday only	14
Thursday only	15
Friday only	16
Saturday only	17

Suppose, if weekend is Friday only, you need to use the number 16 in the WORKDAY.INTL function.

Calculation			Result		
A	B	C	A	B	C
1			1		
2	Today	=TODAY()	2	Today	5/16/2016
3	No. of Days	15	3	No. of Days	15
4	Holidays	42515	4	Holidays	5/25/2016
5		42522	5		6/1/2016
6	Workday	=WORKDAY.INTL(C2,C3,16,C4:C5)	6	Workday	6/5/2016

## Number of Workdays between two given Dates

There might be a requirement to calculate the number of workdays between two dates, for example, in the case of calculating payment to a contract employee who is paid on per day basis.

You can find the number of workdays between two dates with the Excel functions **NETWORKDAYS** and **NETWORKDAYS.INTL**. Just as in the case of **WORKDAYS** and **WORKDAYS.INTL**, **NETWORKDAYS** and **NETWORKDAYS.INTL** allow you to specify holidays and with **NETWORKDAYS.INTL** you can additionally specify the weekend.

Function	Description
NETWORKDAYS	Returns the number of whole workdays between two dates
NETWORKDAYS.INTL	Returns the number of whole workdays between two dates using parameters to indicate which and how many days are weekend days

You can calculate the number of workdays between today and another date with the functions **TODAY** and **NETWORKDAYS**. In the screen shot given below, today is 16<sup>th</sup> May 2016 and end date is 16<sup>th</sup> June 2016. 25<sup>th</sup> May 2016 and 1<sup>st</sup> June 2016 are holidays.

Calculation			Result		
A	B	C	A	B	C
1			1		
2	Today	=TODAY()	2	Today	5/16/2016
3	End Date	42537	3	End Date	6/16/2016
4	Holidays	42515	4	Holidays	5/25/2016
5		42522	5		6/1/2016
6	No. of Work Days	=NETWORKDAYS(C2,C3,C4:C5)	6	No. of Work Days	22

Again, the weekend is assumed to be Saturday and Sunday. You can have your own definition for weekend and calculate the number of workdays between two dates with the **NETWORKDAYS.INTL** function. In the screen shot given below, only Friday is defined as weekend.


Calculation			Result		
A	B	C	A	B	C
1			1		
2	Today	=TODAY()	2	Today	5/16/2016
3	End Date	42537	3	End Date	6/16/2016
4	Holidays	42515	4	Holidays	5/25/2016
5		42522	5		6/1/2016
6	No. of Work Days	=NETWORKDAYS.INTL(C2,C3,16,C4:C5)	6	No. of Work Days	26

## Extracting Year, Month, Day from Date

You can extract from each date in a list of dates, the corresponding day, month and year using the excel functions DAY, MONTH and YEAR.

For example, consider the following dates-

**Dates**



	A	B
1		
2		<b>Date</b>
3		1/1/2015
4		2/10/2014
5		3/13/2016
6		4/15/2015
7		5/18/2011
8		6/21/2015
9		7/25/2012
10		8/27/2013
11		9/30/2014
12		10/8/2015
13		11/4/2011
14		12/7/2010

From each of these dates, you can extract day, month and year as follows-

Calculation					Result						
	A	B	C	D	E		A	B	C	D	E
		Date	Day	Month	Year	1		Date	Day	Month	Year
1		42005	=DAY(B3)	=MONTH(B3:B14)	=YEAR(B3:B14)	3		1/1/2015	1	1	2015
2		41680	=DAY(B4)	=MONTH(B4:B15)	=YEAR(B4:B15)	4		2/10/2014	10	2	2014
3		42442	=DAY(B5)	=MONTH(B5:B16)	=YEAR(B5:B16)	5		3/13/2016	13	3	2016
4		42109	=DAY(B6)	=MONTH(B6:B17)	=YEAR(B6:B17)	6		4/15/2015	15	4	2015
5		40681	=DAY(B7)	=MONTH(B7:B18)	=YEAR(B7:B18)	7		5/18/2011	18	5	2011
6		42176	=DAY(B8)	=MONTH(B8:B19)	=YEAR(B8:B19)	8		6/21/2015	21	6	2015
7		41115	=DAY(B9)	=MONTH(B9:B20)	=YEAR(B9:B20)	9		7/25/2012	25	7	2012
8		41513	=DAY(B10)	=MONTH(B10:B21)	=YEAR(B10:B21)	10		8/27/2013	27	8	2013
9		41912	=DAY(B11)	=MONTH(B11:B22)	=YEAR(B11:B22)	11		9/30/2014	30	9	2014
10		42285	=DAY(B12)	=MONTH(B12:B23)	=YEAR(B12:B23)	12		10/8/2015	8	10	2015
11		40851	=DAY(B13)	=MONTH(B13:B24)	=YEAR(B13:B24)	13		11/4/2011	4	11	2011
12		40519	=DAY(B14)	=MONTH(B14:B25)	=YEAR(B14:B25)	14		12/7/2010	7	12	2010



## Extracting Day of the Week from Date

You can extract from each date in a list of dates, the corresponding day of the week with Excel WEEKDAY function.

Consider the same example given above.

Calculation			Result		
A	B	C	A	B	C
1			1		
2	Date	Day of the Week	2	Date	Day of the Week
3	42005	=WEEKDAY(B3)	3	1/1/2015	5
4	41680	=WEEKDAY(B4)	4	2/10/2014	2
5	42442	=WEEKDAY(B5)	5	3/13/2016	1
6	42109	=WEEKDAY(B6)	6	4/15/2015	4
7	40681	=WEEKDAY(B7)	7	5/18/2011	4
8	42176	=WEEKDAY(B8)	8	6/21/2015	1
9	41115	=WEEKDAY(B9)	9	7/25/2012	4
10	41513	=WEEKDAY(B10)	10	8/27/2013	3
11	41912	=WEEKDAY(B11)	11	9/30/2014	3
12	42285	=WEEKDAY(B12)	12	10/8/2015	5
13	40851	=WEEKDAY(B13)	13	11/4/2011	6
14	40519	=WEEKDAY(B14)	14	12/7/2010	3

## Obtaining Date from Year, Month and Day

You data might have the information about Year, Month and Day separately. You need to get the date combining these three values to perform any calculation. You can use the DATE function for getting the date values.

Consider the following data-

A	B	C	D
1			
2	Year	Month	Day
3	2015	1	1
4	2014	2	10
5	2016	3	13
6	2015	4	15
7	2011	5	18
8	2015	6	21
9	2012	7	25
10	2013	8	27
11	2014	9	30
12	2015	10	8
13	2011	11	4
14	2010	12	7

Use the DATE function to obtain DATE values.

Calculation

	A	B	C	D	E
1					
2		Year	Month	Day	Date
3		2015	1	1	=DATE(B3,C3,D3)
4		2014	2	10	=DATE(B4,C4,D4)
5		2016	3	13	=DATE(B5,C5,D5)
6		2015	4	15	=DATE(B6,C6,D6)
7		2011	5	18	=DATE(B7,C7,D7)
8		2015	6	21	=DATE(B8,C8,D8)
9		2012	7	25	=DATE(B9,C9,D9)
10		2013	8	27	=DATE(B10,C10,D10)
11		2014	9	30	=DATE(B11,C11,D11)
12		2015	10	8	=DATE(B12,C12,D12)
13		2011	11	4	=DATE(B13,C13,D13)
14		2010	12	7	=DATE(B14,C14,D14)

Result

	A	B	C	D	E
1					
2		Year	Month	Day	Date
3		2015	1	1	1/1/2015
4		2014	2	10	2/10/2014
5		2016	3	13	3/13/2016
6		2015	4	15	4/15/2015
7		2011	5	18	5/18/2011
8		2015	6	21	6/21/2015
9		2012	7	25	7/25/2012
10		2013	8	27	8/27/2013
11		2014	9	30	9/30/2014
12		2015	10	8	10/8/2015
13		2011	11	4	11/4/2011
14		2010	12	7	12/7/2010

## Calculating Years, Months and Days between two Dates

You might have to calculate the time lapsed from a given date. You might need this information in the form of years, months and days. A simple example would be calculating the current age of a person. It is effectively the difference between the birth date and today. You can use Excel DATEDIF, TODAY and CONCATENATE functions for this purpose.

Calculation				
A	B	C	D	E
1				
2	BirthDate	Years	Months	Age
3	25232	=DATEDIF(B3,TODAY(),"Y")	=MOD(DATEDIF(B3,TODAY(),"m"),12)	=CONCATENATE(C3," Yrs., ",D3," Months")
4	26146	=DATEDIF(B4,TODAY(),"Y")	=MOD(DATEDIF(B4,TODAY(),"m"),12)	=CONCATENATE(C4," Yrs., ",D4," Months")
5	27345	=DATEDIF(B5,TODAY(),"Y")	=MOD(DATEDIF(B5,TODAY(),"m"),12)	=CONCATENATE(C5," Yrs., ",D5," Months")
6	27386	=DATEDIF(B6,TODAY(),"Y")	=MOD(DATEDIF(B6,TODAY(),"m"),12)	=CONCATENATE(C6," Yrs., ",D6," Months")
7	19264	=DATEDIF(B7,TODAY(),"Y")	=MOD(DATEDIF(B7,TODAY(),"m"),12)	=CONCATENATE(C7," Yrs., ",D7," Months")
8	21620	=DATEDIF(B8,TODAY(),"Y")	=MOD(DATEDIF(B8,TODAY(),"m"),12)	=CONCATENATE(C8," Yrs., ",D8," Months")
9	31832	=DATEDIF(B9,TODAY(),"Y")	=MOD(DATEDIF(B9,TODAY(),"m"),12)	=CONCATENATE(C9," Yrs., ",D9," Months")
10	31568	=DATEDIF(B10,TODAY(),"Y")	=MOD(DATEDIF(B10,TODAY(),"m"),12)	=CONCATENATE(C10," Yrs., ",D10," Months")
11	28876	=DATEDIF(B11,TODAY(),"Y")	=MOD(DATEDIF(B11,TODAY(),"m"),12)	=CONCATENATE(C11," Yrs., ",D11," Months")
12	31016	=DATEDIF(B12,TODAY(),"Y")	=MOD(DATEDIF(B12,TODAY(),"m"),12)	=CONCATENATE(C12," Yrs., ",D12," Months")
13	28507	=DATEDIF(B13,TODAY(),"Y")	=MOD(DATEDIF(B13,TODAY(),"m"),12)	=CONCATENATE(C13," Yrs., ",D13," Months")
14	21760	=DATEDIF(B14,TODAY(),"Y")	=MOD(DATEDIF(B14,TODAY(),"m"),12)	=CONCATENATE(C14," Yrs., ",D14," Months")
15	32656	=DATEDIF(B15,TODAY(),"Y")	=MOD(DATEDIF(B15,TODAY(),"m"),12)	=CONCATENATE(C15," Yrs., ",D15," Months")
16	42430	=DATEDIF(B16,TODAY(),"Y")	=MOD(DATEDIF(B16,TODAY(),"m"),12)	=CONCATENATE(C16," Yrs., ",D16," Months")

The output is as follows-

↓  
**Result**

	A	B	C	D	E
1					
2		<b>BirthDate</b>	<b>Years</b>	<b>Months</b>	<b>Age</b>
3		1/29/1969	47	3	47 Yrs., 3 Months
4		8/1/1971	44	9	44 Yrs., 9 Months
5		11/12/1974	41	6	41 Yrs., 6 Months
6		12/23/1974	41	4	41 Yrs., 4 Months
7		9/27/1952	63	7	63 Yrs., 7 Months
8		3/11/1959	57	2	57 Yrs., 2 Months
9		2/24/1987	29	2	29 Yrs., 2 Months
10		6/5/1986	29	11	29 Yrs., 11 Months
11		1/21/1979	37	3	37 Yrs., 3 Months
12		11/30/1984	31	5	31 Yrs., 5 Months
13		1/17/1978	38	3	38 Yrs., 3 Months
14		7/29/1959	56	9	56 Yrs., 9 Months
15		5/28/1989	26	11	26 Yrs., 11 Months
16		3/1/2016	0	2	0 Yrs., 2 Months

# 8. Working with Time Values

The data that you obtain from different sources might contain time values. In this chapter, you will understand how to prepare your data that contains time values for analysis.

You will learn about-

- Time Formats
  - Time in Serial Format
  - Time in Hour-Minute-Second Format
- Converting Times in Serial Format to Hour-Minute-Second Format
- Converting Times in Hour-Minute-Second Format to Serial Format
- Obtaining the Current Time
- Obtaining Time from Hour, Minute and Second
- Extracting Hour, Minute and Second from Time
- Number of hours between Start Time and End Time

## Time Formats

---

Excel supports **Time** Values in two ways-

- Serial Format
- In various Hour-Minute-Second Formats

You can convert-

- **Time** in Serial Format to **Time** in Hour-Minute-Second Format
- **Time** in Hour-Minute-Second Format to **Time** in Serial Format

### Time in Serial Format

**Time** in serial format is a positive number that represents the **Time** as a fraction of a 24-hour day, the starting point being midnight. For example, 0.29 represents 7 AM and 0.5 represents 12 PM.

You can also combine **Date** and **Time** in the same cell. The serial number is the number of days after January 1, 1900, and the time fraction associated with the given time. For example, if you type May 17, 2016 6 AM, it gets converted to 42507.25 when you format the cell as **General**.

### Time in Hour-Minute-Second Format

Excel allows you to specify time in Hour-Minute-Second Format with a colon (:) after the hour and another colon before the seconds. Example, 8:50 AM, 8:50 PM or just 8:50 using

the 12-Hour Format or as 8:50, 20:50 in 24-Hour format. The time 8:50:55 AM represents 8 hours, 50 minutes and 55 seconds.

You can also specify date and time together. For example, if you type May 17, 2016 7:25 in a cell, it will be displayed as 5/17/2016 7:25 and it represents 5/17/2016 7:25:00 AM.

Excel supports different **Time** formats based on the **Locale** (Location) you choose. Hence, you need to first determine the compatibility of your **Time** formats and data analysis at hand.

For understanding purpose, you can assume United States as the Locale. You find the following **Time** formats to choose for **Date** and **Time** – 17<sup>th</sup> May, 2016 4 PM-

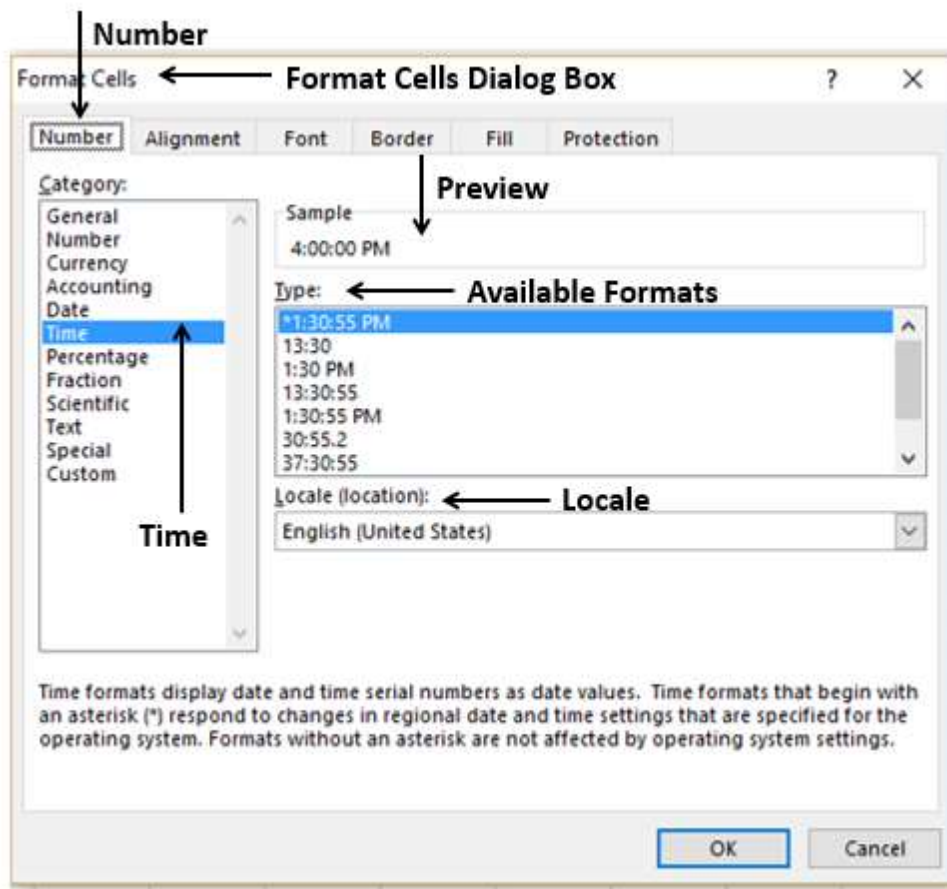
- 4:00:00 PM
- 16:00
- 4:00 PM
- 16:00:00
- 5/17/16 4:00 PM
- 5/17/16 16:00

## Converting Times in Serial Format to Hour-Minute-Second Format

---

To convert serial time format to hour-min-sec format follow the steps given below-

- Click the **Number** tab in the **Format Cells** dialog box
- Click **Time** under **Category**.
- Select the **Locale**. Available **Time** formats will be displayed as a list under **Type**-
- Click on a **Format** under **Type** to look at the Preview in the box adjacent to **Sample**.



After choosing the Format, click **OK**

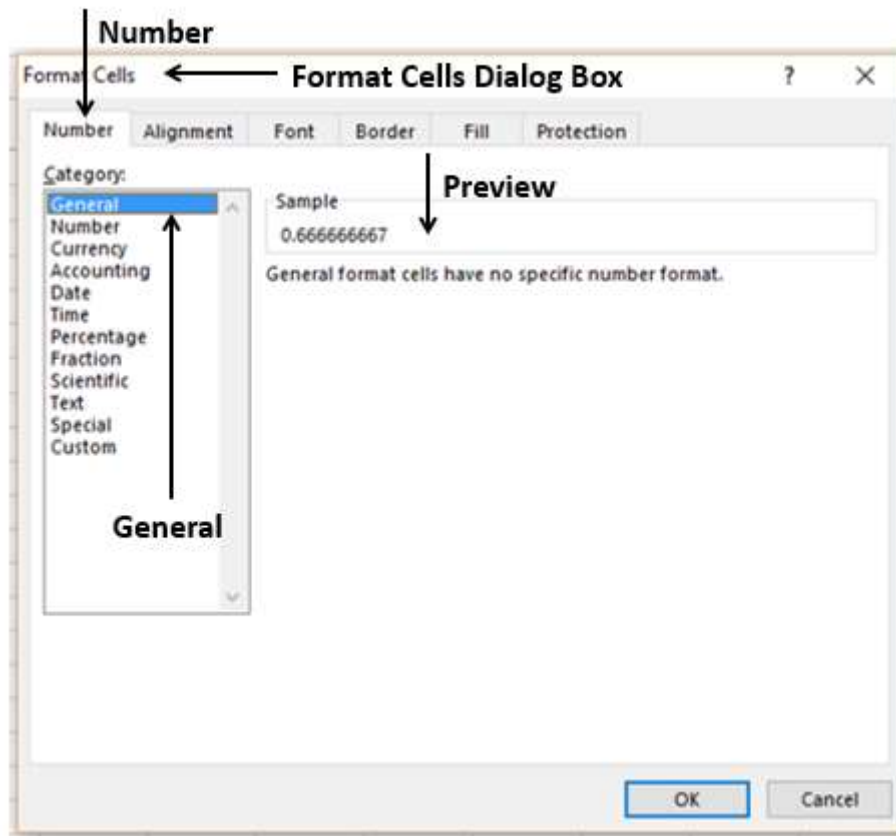
## Converting Times in Hour-Minute-Second Format to Serial Format

You can convert Time in **Hour-Minute-Second** format to serial format in two ways-

- Using **Format Cells** dialog box
- Using Excel **TIMEVALUE** function

### Using Format Cells dialog box

- Click the **Number** tab in the **Format Cells** dialog box.
- Click **General** under **Category**.



## Using Excel TIMEVALUE Function

You can use Excel **TIMEVALUE** function to convert **Time** to **Serial Number** format. You need to enclose the **Time** argument in "". For example,

**TIMEVALUE ("16:55:15")** results in 0.70503472

## Obtaining the Current Time

If you need to perform calculations based on current time, simply use the Excel function **NOW ()**. The result reflects the date and time when it is used.

The following screen shot of Now () function usage has been taken on 17<sup>th</sup> May, 2016 at 12:22 PM.

Calculation			Result		
A	B	C	A	B	C
1			1		
2	Current Time	=NOW()	2	Current Time	5/17/2016 12:22



## Obtaining Time from Hour, Minute and Second

Your data might have the information about hours, minutes and seconds separately. Suppose, you need to get the Time combining these 3 values to perform any calculation. You can use Excel Function Time for getting the Time values.

Calculation					Result				
A	B	C	D	E	A	B	C	D	E
1					1				
2	Hour	Minute	Second	Time	2	Hour	Minute	Second	Time
3	15	25	30	=TIME(B3,C3,D3)	3	15	25	30	3:25:30 PM

## Extracting Hour, Minute and Second from Time

You can extract hour, minute and second from a given time using the Excel functions HOUR, MINUTE and SECOND.

Calculation					Result				
A	B	C	D	E	A	B	C	D	E
1					1				
2	Time	Hour	Minute	Second	2	Time	Hour	Minute	Second
3	0.642708333333333	=HOUR(B3)	=MINUTE(B3)	=SECOND(B3)	3	3:25:30 PM	15	25	30

## Number of hours between Start Time and End Time

When you perform computations on Time values, the result displayed depends on the format used in the cell. For example, you can compute the number of hours between 9:30 AM and 6 PM as follows-

Calculation				Result			
A	B	C	D	A	B	C	D
1				1			
2	Start Time	0.3958333		2	Start Time	9:30 AM	
3	End Time	0.75		3	End Time	6:00 PM	
4		=C3-C2		4		8:30 AM	
5	Time Difference	=C3-C2	Days	5	Time Difference	0.35	Days
6		=C5*24	Hours	6		8.5	Hours

- C4 is formatted as Time
- C5 and C6 are formatted as Number.

You get the time difference as days. To convert to hours you need to multiply by 24.

# 9. Conditional Formatting

In Microsoft Excel, you can use **Conditional Formatting** for data visualization. You have to specify formatting for a cell range based on the contents of the cell range. The cells that meet the specified conditions would be formatted as you have defined.

## Example

In a range containing the sales figures of the past quarter for a set of salespersons, you can highlight those cells representing who have met the defined target, say, \$2500.

You can set the condition as total sales of the person **>= \$2500** and specify a color code green. Excel checks each cell in the range to determine whether the condition you specified, i.e., total sales of the person **>= \$2500** is satisfied.

Excel applies the format you chose, i.e. the green color to all the cells that satisfy the condition. If the content of a cell does not satisfy the condition, the formatting of the cell remains unchanged. The result is as expected, only for the salespersons who have met the target, the cells are highlighted in green – a quick visualization of the analysis results.

You can specify any number of conditions for formatting by specifying **Rules**. You can pick up the rules that match your conditions from-

- Highlight cells rules
- Top / Bottom rules

You can also define your own rules. You can-

- Add a rule
- Clear an existing rule
- Manage the defined rules

Further, you have several formatting options in Excel to choose the ones that are appropriate for your Data Visualization-

- Data Bars
- Color Scales
- Icon Sets

Conditional formatting has been promoted over the versions Excel 2007, Excel 2010, Excel 2013. The examples you find in this chapter are from Excel 2013.

In the following sections, you will understand the conditional formatting rules, formatting options and how to work with rules.

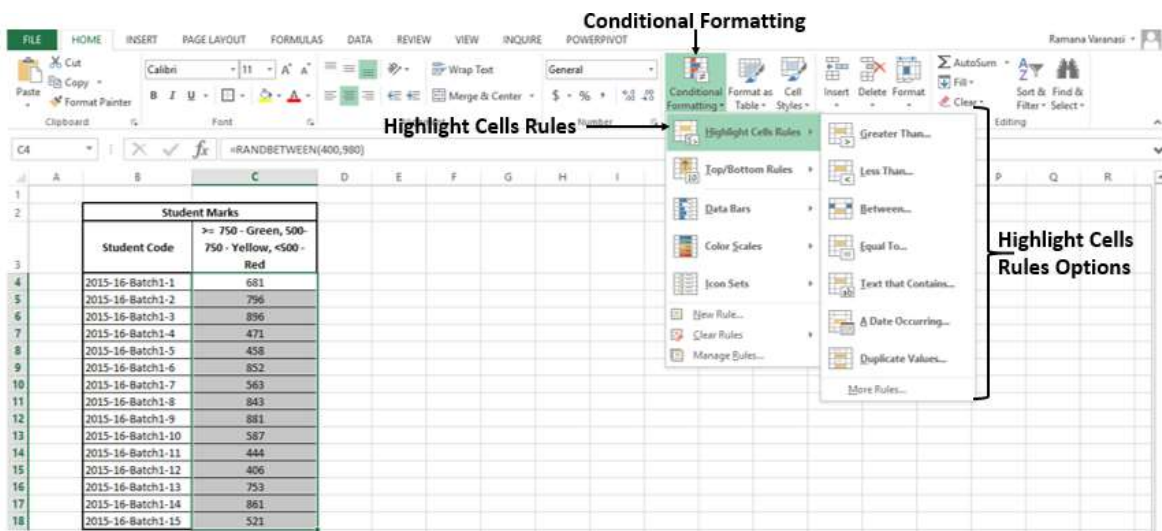
## Highlight Cells Rules

You can use **Highlight Cells** rule to assign a format to cells whose contents meet any of the following criteria-

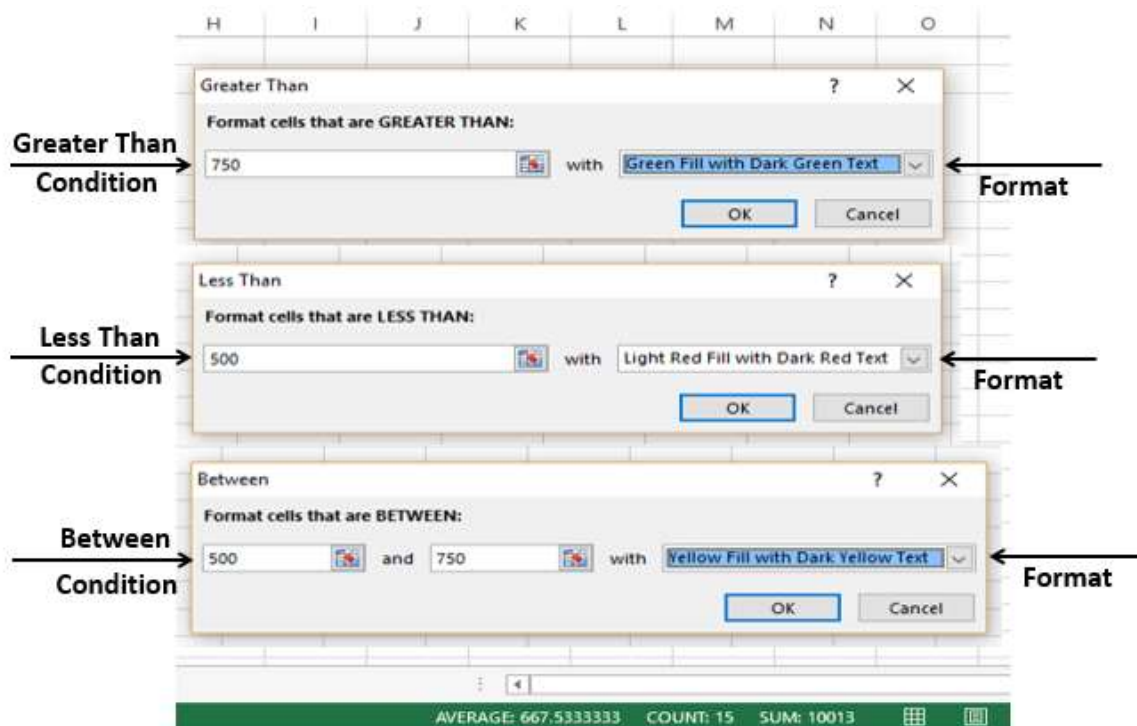
- Numbers within a given numerical range-
  - Greater Than
  - Less Than
  - Between
  - Equal To
- Text that contains a given text string.
- Date occurring within a given range of dates relative to the current date-
  - Yesterday
  - Today
  - Tomorrow
  - In the last 7 days
  - Last week
  - This week
  - Next week
  - Last month
  - This Month
  - Next month
- Values that are duplicate or unique.

Follow the steps to conditionally format cells-

- Select the range to be conditionally formatted.
- Click **Conditional Formatting** in the **Styles** group under **Home** tab.
- Click **Highlight Cells Rules** from the drop-down menu.



- Click **Greater Than** and specify >750. Choose green color.
- Click **Less Than** and specify < 500. Choose red color.
- Click **Between** and specify 500 and 750. Choose yellow color.



The data will be highlighted based on the given conditions and the corresponding formatting.

	A	B	C
1			
2		Student Marks	
3		Student Code	>= 750 - Green, 500-750 - Yellow, <500 - Red
4		2015-16-Batch1-1	681
5		2015-16-Batch1-2	796
6		2015-16-Batch1-3	896
7		2015-16-Batch1-4	471
8		2015-16-Batch1-5	458
9		2015-16-Batch1-6	852
10		2015-16-Batch1-7	563
11		2015-16-Batch1-8	843
12		2015-16-Batch1-9	881
13		2015-16-Batch1-10	587
14		2015-16-Batch1-11	444
15		2015-16-Batch1-12	406
16		2015-16-Batch1-13	753
17		2015-16-Batch1-14	861
18		2015-16-Batch1-15	521
19			

## Top / Bottom Rules

You can use **Top / Bottom Rules** to assign a format to cells whose contents meet any of the following criteria:

- **Top 10 items:** Cells that rank in the top N, where  $1 \leq N \leq 1000$ .
- **Top 10%:** Cells that rank in the top n%, where  $1 \leq n \leq 100$ .
- **Bottom 10 items:** Cells that rank in the bottom N, where  $1 \leq N \leq 1000$ .
- **Bottom 10%:** Cells that rank in the bottom n%, where  $1 \leq n \leq 100$ .
- **Above average:** Cells that are above average for the selected range.
- **Below average:** Cells that are below average for the selected range.

Follow the steps given below to assign the Top/Bottom rules.

- Select the range to be conditionally formatted.
- Click **Conditional Formatting** in the **Styles** group under **Home** tab.
- Click **Top/Bottom Rules** from the drop-down menu. Top/Bottom rules options appear.

**Conditional Formatting**

**Top/Bottom Rules**

**Top/Bottom Rules Options**

Student Marks			
Student Code	Top 5 and Bottom 5	Top 5% and Bottom 5%	Above Average and Below Average
2015-16-Batch1-1	635	635	635
2015-16-Batch1-2	494	494	494
2015-16-Batch1-3	510	510	510
2015-16-Batch1-4	408	408	408
2015-16-Batch1-5	465	465	465
2015-16-Batch1-6	548	548	548
2015-16-Batch1-7	540	540	540
2015-16-Batch1-8	615	615	615
2015-16-Batch1-9	836	836	836
2015-16-Batch1-10	903	903	903
2015-16-Batch1-11	637	637	637
2015-16-Batch1-12	655	655	655
2015-16-Batch1-13	432	432	432
2015-16-Batch1-14	618	618	618
2015-16-Batch1-15	420	420	420

- Click **Top Ten Items** and specify 5. Choose green color.
- Click **Bottom Ten Items** and specify 5. Choose red color.

Student Marks				
Student Code	Top 5 and Bottom 5	Top 5% and Bottom 5%	Above Average and Below Average	
2015-16-Batch1-1	635	635	635	
2015-16-Batch1-2	494	494	494	
2015-16-Batch1-3	510	510	510	
2015-16-Batch1-4	408	408	408	
2015-16-Batch1-5	465	465	465	
2015-16-Batch1-6	548	548	548	
2015-16-Batch1-7	540	540	540	
2015-16-Batch1-8	615	615	615	
2015-16-Batch1-9	836	836	836	
2015-16-Batch1-10	903	903	903	
2015-16-Batch1-11	637	637	637	
2015-16-Batch1-12	655	655	655	
2015-16-Batch1-13	432	432	432	
2015-16-Batch1-14	618	618	618	
2015-16-Batch1-15	420	420	420	

**Top 10 Items**

Format cells that rank in the TOP:

5 with Green Fill with Dark Green Text

**Bottom 10 Items**

Format cells that rank in the BOTTOM:

5 with Light Red Fill with Dark Red Text



The data will be highlighted based on the given conditions and the corresponding formatting.

### Formatted Conditionally

	A	B	C	D	E
1					
2		Student Marks			
3		Student Code	Top 5 and Bottom 5	Top 5% and Bottom 5%	Above Average and Below Average
4		2015-16-Batch1-1	635	635	635
5		2015-16-Batch1-2	494	494	494
6		2015-16-Batch1-3	510	510	510
7		2015-16-Batch1-4	408	408	408
8		2015-16-Batch1-5	465	465	465
9		2015-16-Batch1-6	548	548	548
10		2015-16-Batch1-7	540	540	540
11		2015-16-Batch1-8	615	615	615
12		2015-16-Batch1-9	836	836	836
13		2015-16-Batch1-10	903	903	903
14		2015-16-Batch1-11	637	637	637
15		2015-16-Batch1-12	655	655	655
16		2015-16-Batch1-13	432	432	432
17		2015-16-Batch1-14	618	618	618
18		2015-16-Batch1-15	420	420	420

- Repeat the first three steps given above.
- Click **Top Ten%** and specify 5. Choose green color.
- Click **Bottom Ten%** and specify 5. Choose red color.



	A	B	C	D	E	F	G	H	I	J
1										
2		<b>Student Marks</b>								
3		<b>Student Code</b>	<b>Top 5 and Bottom 5</b>	<b>Top 5% and Bottom 5%</b>	<b>Above Average and Below Average</b>					
4		2015-16-Batch1-1	635	635	635					
5		2015-16-Batch1-2	494	494	494					
6		2015-16-Batch1-3	510	510	510					
7		2015-16-Batch1-4	408	408	408					
8		2015-16-Batch1-5	465	465	465					
9		2015-16-Batch1-6	548	548	548					
10		2015-16-Batch1-7	540	540	540					
11		2015-16-Batch1-8	615	615	615					
12		2015-16-Batch1-9	836	836	836					
13		2015-16-Batch1-10	903	903	903					
14		2015-16-Batch1-11	637	637	637					
15		2015-16-Batch1-12	655	655	655					
16		2015-16-Batch1-13	432	432	432					
17		2015-16-Batch1-14	618	618	618					
18		2015-16-Batch1-15	420	420	420					

Top 10%

Format cells that rank in the TOP:

5 % with Green Fill with Dark Green Text

OK Cancel

Bottom 10%

Format cells that rank in the BOTTOM:

5 % with Light Red Fill with Dark Red Text

OK Cancel

The data will be highlighted based on the given conditions and the corresponding formatting.

### Formatted Conditionally

	A	B	C	D	E
1					
2		<b>Student Marks</b>			
3		<b>Student Code</b>	<b>Top 5 and Bottom 5</b>	<b>Top 5% and Bottom 5%</b>	<b>Above Average and Below Average</b>
4		2015-16-Batch1-1	635	635	635
5		2015-16-Batch1-2	494	494	494
6		2015-16-Batch1-3	510	510	510
7		2015-16-Batch1-4	408	408	408
8		2015-16-Batch1-5	465	465	465
9		2015-16-Batch1-6	548	548	548
10		2015-16-Batch1-7	540	540	540
11		2015-16-Batch1-8	615	615	615
12		2015-16-Batch1-9	836	836	836
13		2015-16-Batch1-10	903	903	903
14		2015-16-Batch1-11	637	637	637
15		2015-16-Batch1-12	655	655	655
16		2015-16-Batch1-13	432	432	432
17		2015-16-Batch1-14	618	618	618
18		2015-16-Batch1-15	420	420	420

- Repeat the first three steps given above.
- Click **Above Average**. Choose green color.
- Click **Below Average**. Choose red color.

	A	B	C	D	E	F	G	H	I	J	K
1											
2		Student Marks									
3		Student Code	Top 5 and Bottom 5	Top 5% and Bottom 5%	Above Average and Below Average						
4		2015-16-Batch1-1	635	635	635						
5		2015-16-Batch1-2	494	494	494						
6		2015-16-Batch1-3	510	510	510						
7		2015-16-Batch1-4	408	408	408						
8		2015-16-Batch1-5	465	465	465						
9		2015-16-Batch1-6	548	548	548						
10		2015-16-Batch1-7	540	540	540						
11		2015-16-Batch1-8	615	615	615						
12		2015-16-Batch1-9	836	836	836						
13		2015-16-Batch1-10	903	903	903						
14		2015-16-Batch1-11	637	637	637						
15		2015-16-Batch1-12	655	655	655						
16		2015-16-Batch1-13	432	432	432						
17		2015-16-Batch1-14	618	618	618						
18		2015-16-Batch1-15	420	420	420						

Above Average ? X

Format cells that are ABOVE AVERAGE:

for the selected range with Green Fill with Dark Green Text

OK Cancel

Below Average ? X

Format cells that are BELOW AVERAGE:

for the selected range with Light Red Fill with Dark Red Text

OK Cancel

The data will be highlighted based on the given conditions and the corresponding formatting.

## Formatted Conditionally

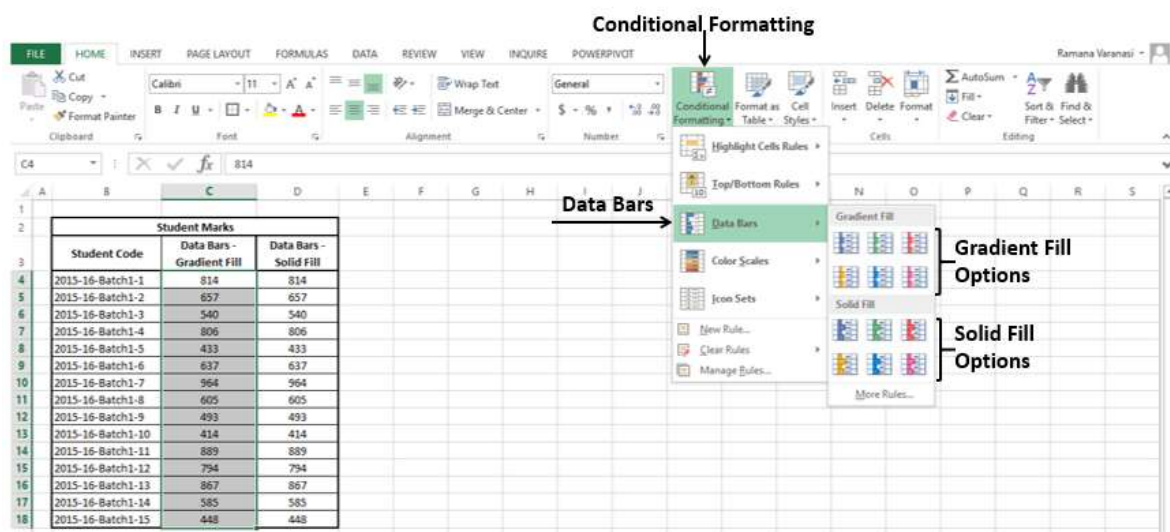
	A	B	C	D	E
1					
2		Student Marks			
3		Student Code	Top 5 and Bottom 5	Top 5% and Bottom 5%	Above Average and Below Average
4		2015-16-Batch1-1	635	635	635
5		2015-16-Batch1-2	494	494	494
6		2015-16-Batch1-3	510	510	510
7		2015-16-Batch1-4	408	408	408
8		2015-16-Batch1-5	465	465	465
9		2015-16-Batch1-6	548	548	548
10		2015-16-Batch1-7	540	540	540
11		2015-16-Batch1-8	615	615	615
12		2015-16-Batch1-9	836	836	836
13		2015-16-Batch1-10	903	903	903
14		2015-16-Batch1-11	637	637	637
15		2015-16-Batch1-12	655	655	655
16		2015-16-Batch1-13	432	432	432
17		2015-16-Batch1-14	618	618	618
18		2015-16-Batch1-15	420	420	420

## Data Bars

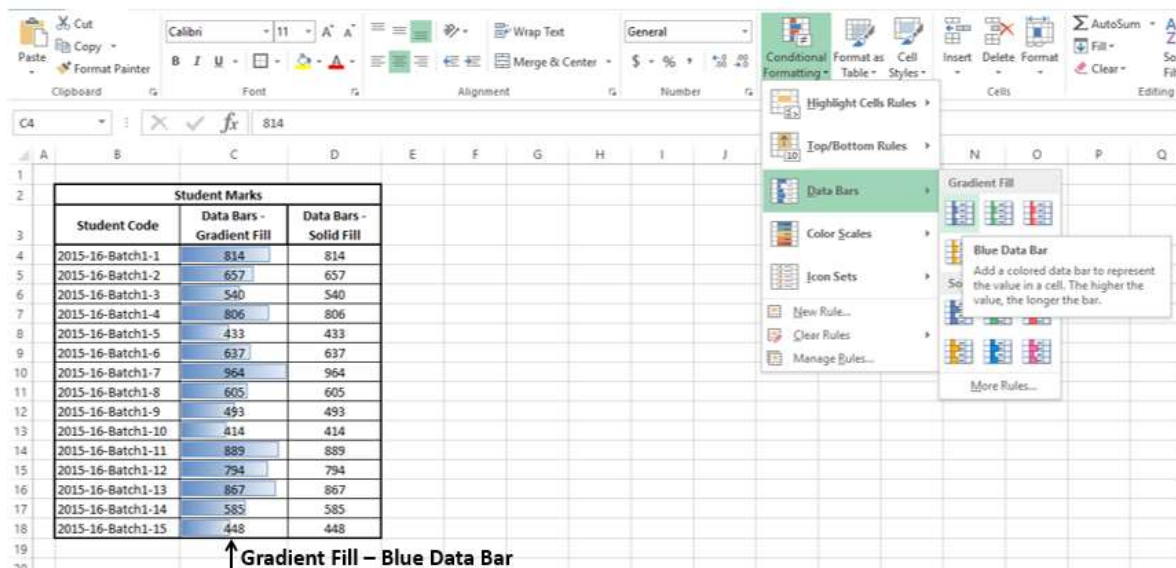
You can use colored **Data Bars** to see the value in a cell relative to the values in the other cells. The length of the data bar represents the value in the cell. A longer bar represents a higher value, and a shorter bar represents a lower value. You have six solid colors to choose from for the data bars – blue, green, red, yellow, light blue and purple.

Data bars are helpful in visualizing the higher, lower and intermediate values when you have large amounts of data. Example- Day temperatures across regions in a particular month. You can use gradient fill color bars to visualize the value in a cell relative to the values in other cells. You have six **Gradient Colors** to choose from for the Data Bars – Blue, Green, Red, Yellow, Light Blue and Purple.

- Select the range to be formatted conditionally.
- Click **Conditional Formatting** in the **Styles** group under **Home** tab.
- Click **Data Bars** from the drop-down menu. The **Gradient Fill** options and **Solid Fill** options appear.

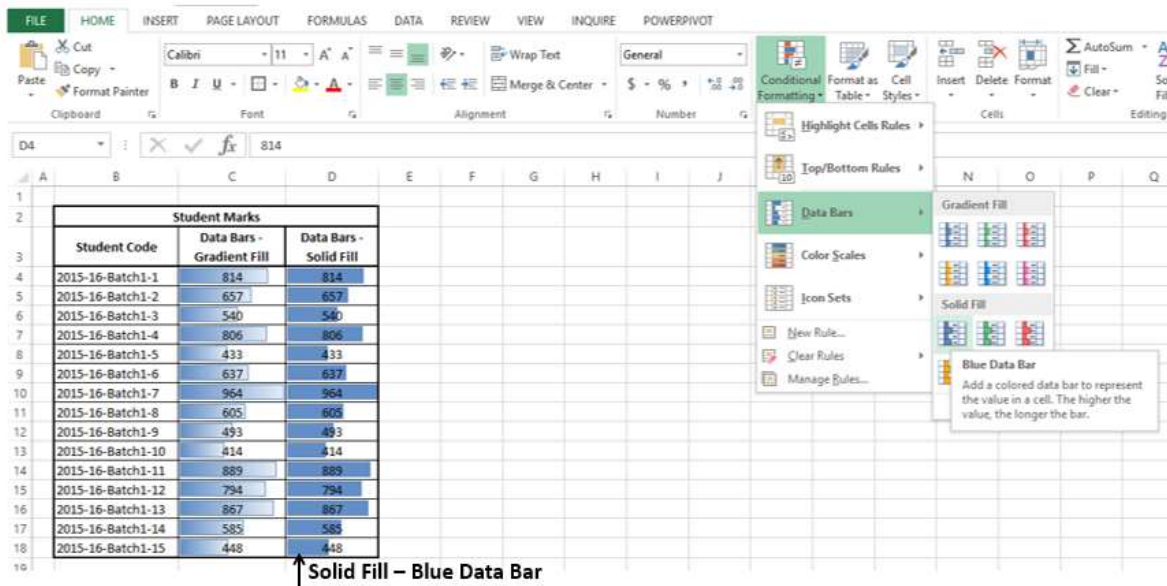


Click the blue data bar in the **Gradient Fill** options.

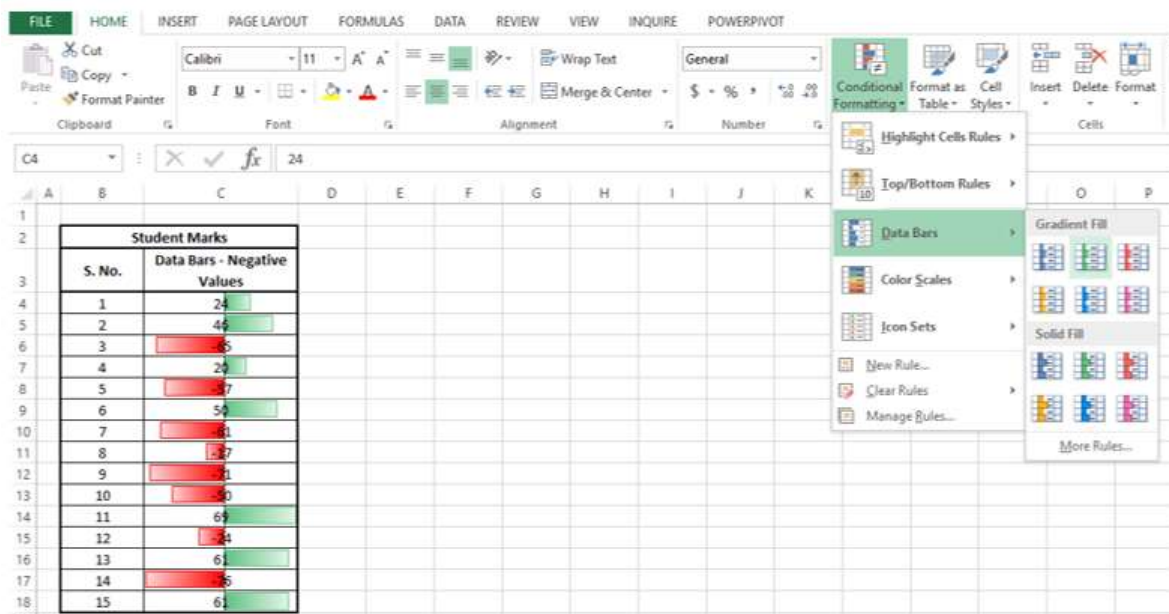


- Repeat the first three steps.
- Click the blue data bar in the **Solid Fill** options.





You can also format data bars such that the data bar starts in the middle of the cell, and stretches to the left for negative values and stretches to the right for positive values.



## Color Scales

You can use **Color Scales** to see the value in a cell relative to the values in the other cells in a given range. As in the case of **Highlight Cells Rules**, a **Color Scale** uses cell shading to display the differences in cell values. A color gradient will be applied to a range of cells. The color indicates where each cell value falls within that range.

You can choose from-

- Three - Color Scale-
  - Green – Yellow – Red Color Scale
  - Red – Yellow – Green Color Scale
  - Green – White – Red Color Scale
  - Red – White –Green Color Scale
  - Blue – White – Red Color Scale
  - Red – White –Blue Color Scale
- Two-Color Scale-
  - White – Red Color Scale
  - Red – White Color Scale
  - Green – White Color Scale
  - White –Green Color Scale
  - Green – Yellow Color Scale
  - Yellow – Green Color Scale

Follow the steps given below-

- Select the Range to be conditionally formatted.
- Click **Conditional Formatting** in the **Styles** group under **Home** tab.
- Click **Color Scales** from the drop-down menu. The **Color Scale** options appear.
- Click the Green – Yellow – Red Color Scale.

The Data will be highlighted based on the Green – Yellow – Red color scale in the selected range.

**Conditional Formatting**

**Color Scales**

**Color Scale Options**

Student Marks			
Student Code	Three-Color Scale	Two-Color Scale	
2015-16-Batch1-1	814	814	
2015-16-Batch1-2	657	657	
2015-16-Batch1-3	540	540	
2015-16-Batch1-4	806	806	
2015-16-Batch1-5	433	433	
2015-16-Batch1-6	637	637	
2015-16-Batch1-7	964	964	
2015-16-Batch1-8	605	605	
2015-16-Batch1-9	493	493	
2015-16-Batch1-10	414	414	
2015-16-Batch1-11	889	889	
2015-16-Batch1-12	794	794	
2015-16-Batch1-13	867	867	
2015-16-Batch1-14	585	585	
2015-16-Batch1-15	448	448	

- Repeat the first three steps.
- Click the Green – White color scale.




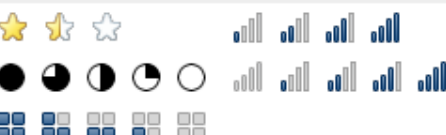
The data will be highlighted based on the Green – White color scale in the selected range.

Student Marks		
Student Code	Three-Color Scale	Two-Color Scale
2015-16-Batch1-1	814	814
2015-16-Batch1-2	657	657
2015-16-Batch1-3	540	540
2015-16-Batch1-4	806	806
2015-16-Batch1-5	433	433
2015-16-Batch1-6	637	637
2015-16-Batch1-7	964	964
2015-16-Batch1-8	605	605
2015-16-Batch1-9	493	493
2015-16-Batch1-10	414	414
2015-16-Batch1-11	889	889
2015-16-Batch1-12	794	794
2015-16-Batch1-13	867	867
2015-16-Batch1-14	585	585
2015-16-Batch1-15	448	448

## Icon Sets

You can use the icon sets to visualize numerical differences. The following icon sets are available-

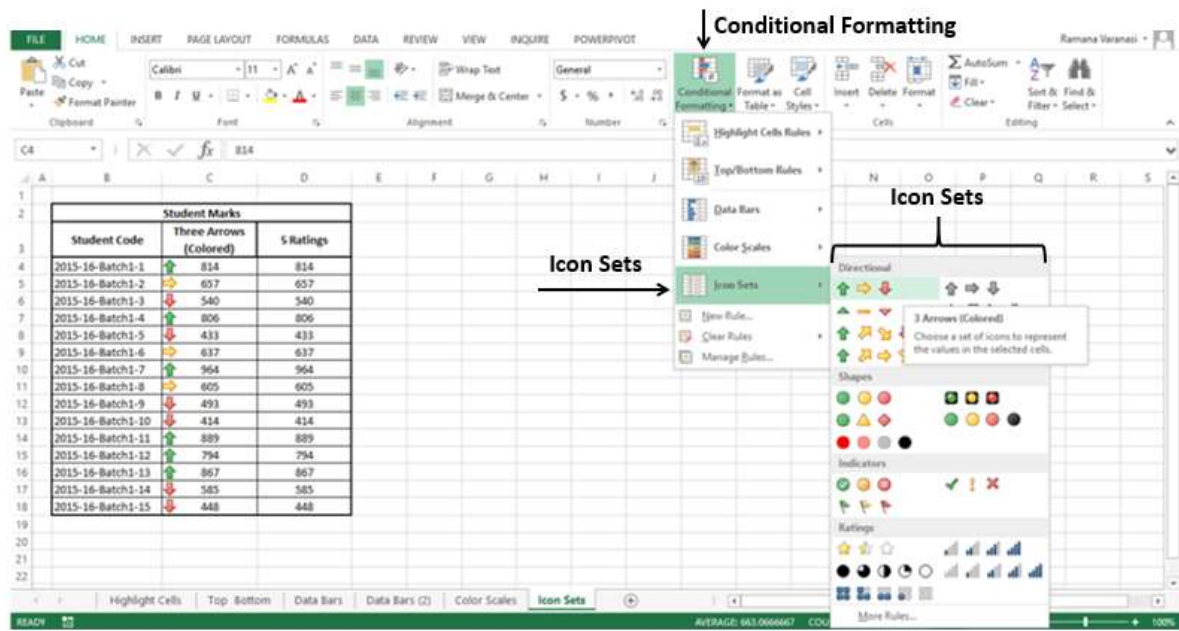


Icon Set Type	Icon Sets
Directional	<p><b>Directional</b></p> 
Shapes	<p><b>Shapes</b></p> 
Indicators	<p><b>Indicators</b></p> 
Ratings	<p><b>Ratings</b></p> 

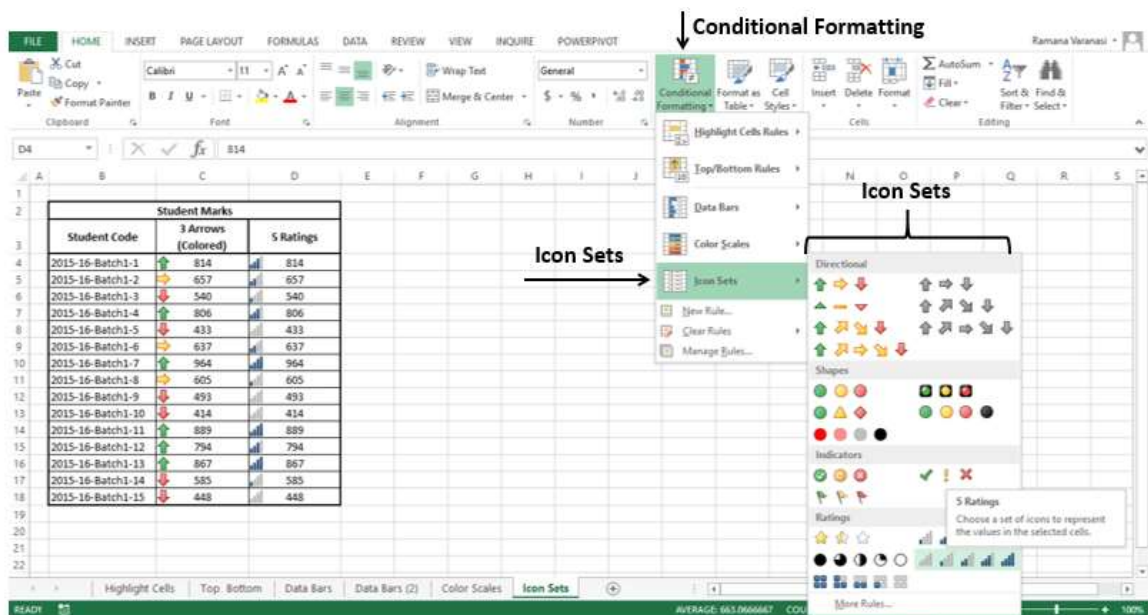
As you observe, an icon set consists of three to five symbols. You can define criteria to associate an icon with each value in a cell range. For example, a red down arrow for small numbers, a green up arrow for large numbers, and a yellow horizontal arrow for intermediate values.

- Select the range to be conditionally formatted.
- Click **Conditional Formatting** in the **Styles** group under **Home** tab.
- Click **Icon Sets** from the drop-down menu. The **Icon Sets** options appear.
- Click the colored three arrows.

Colored Arrows appear next to the Data based on the Values in the selected range.



- Repeat the first three steps. The **Icon Sets** options appear.
- Select 5 Ratings. The Rating Icons appear next to the data based on the values in the selected range.



## New Rule

You can use **New Rule** to create your own formula as a condition to format a cell as you define.

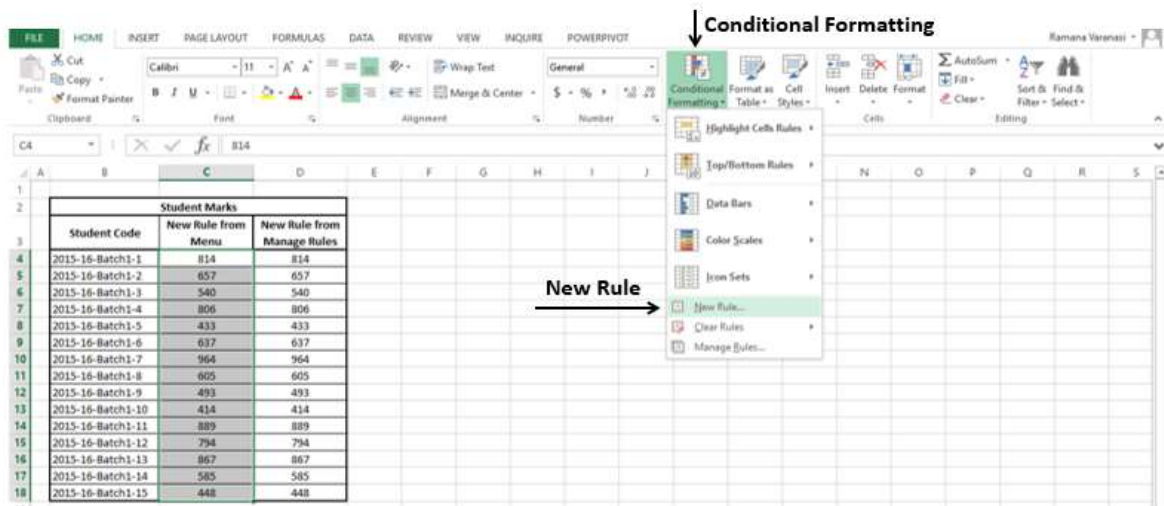
There are two ways to use New Rule-

- With **New Rule** option from the drop-down menu

- With **New Rule** button in **Manage Rules** dialog box

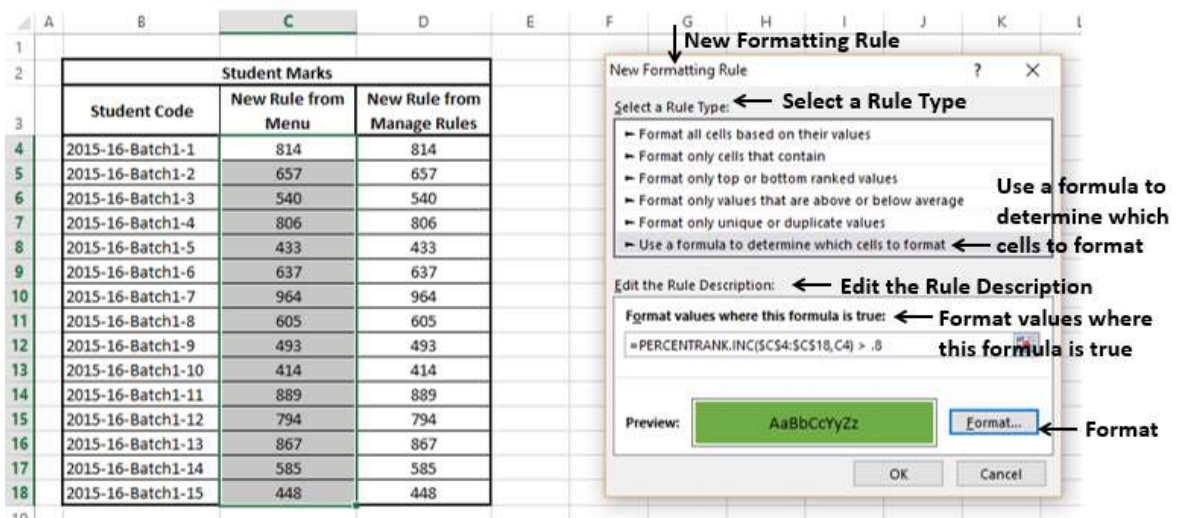
### With New Rule option from the Drop-Down Menu

- Select the Range to be conditionally formatted.
- Click **Conditional Formatting** in the **Styles** group under **Home** tab.
- Click **New Rule** from the drop-down menu.



The **New Formatting Rule** dialog box appears.

- From the Select a Rule Type Box, select Use a formula to determine which cells to format. **Edit the Rule Description** box appears.
- In the format values where this formula is true: type the formula.
- Click the format button and click OK.

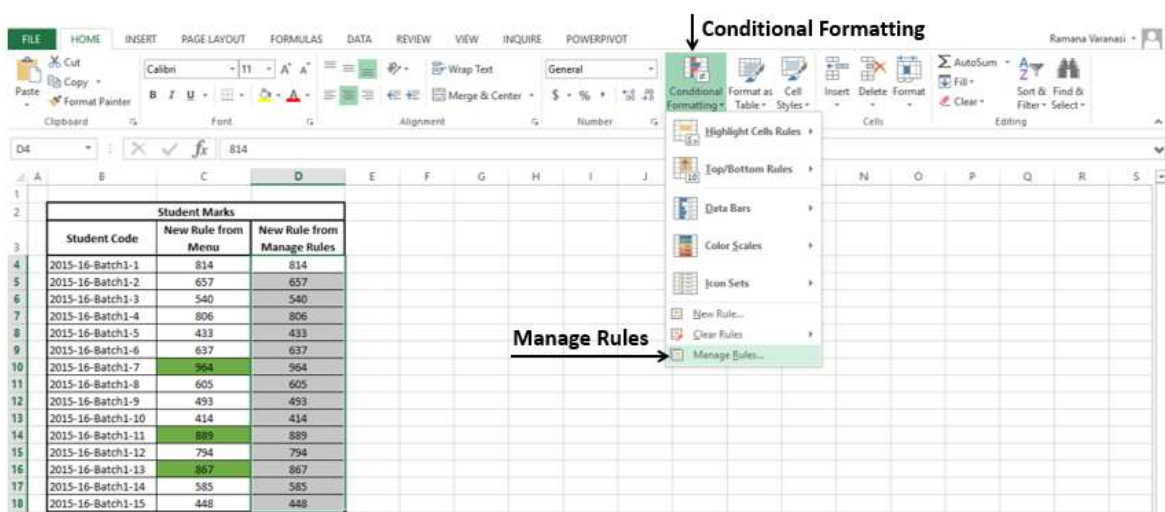


Cells that contain values with the formula TRUE, are formatted as defined.

	A	B	C	D
1				
2		<b>Student Marks</b>		
3		<b>Student Code</b>	<b>New Rule from Menu</b>	<b>New Rule from Manage Rules</b>
4		2015-16-Batch1-1	814	814
5		2015-16-Batch1-2	657	657
6		2015-16-Batch1-3	540	540
7		2015-16-Batch1-4	806	806
8		2015-16-Batch1-5	433	433
9		2015-16-Batch1-6	637	637
10		2015-16-Batch1-7	964	964
11		2015-16-Batch1-8	605	605
12		2015-16-Batch1-9	493	493
13		2015-16-Batch1-10	414	414
14		2015-16-Batch1-11	889	889
15		2015-16-Batch1-12	794	794
16		2015-16-Batch1-13	867	867
17		2015-16-Batch1-14	585	585
18		2015-16-Batch1-15	448	448

### With New Rule Button in Manage Rules dialog box

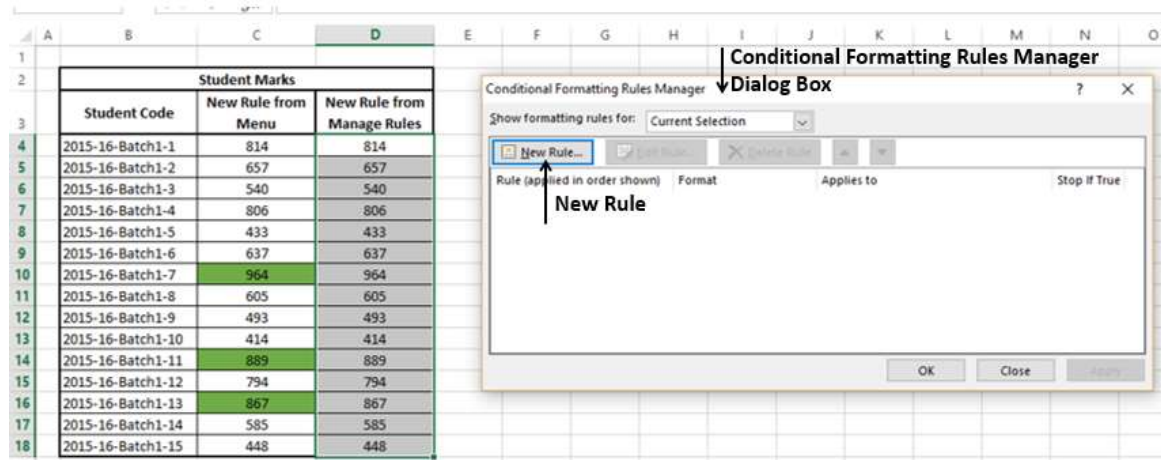
- Select the range to be conditionally formatted.
- Click **Conditional Formatting** in the **Styles** group under **Home** tab.
- Click **Manage Rules** from the drop-down menu.





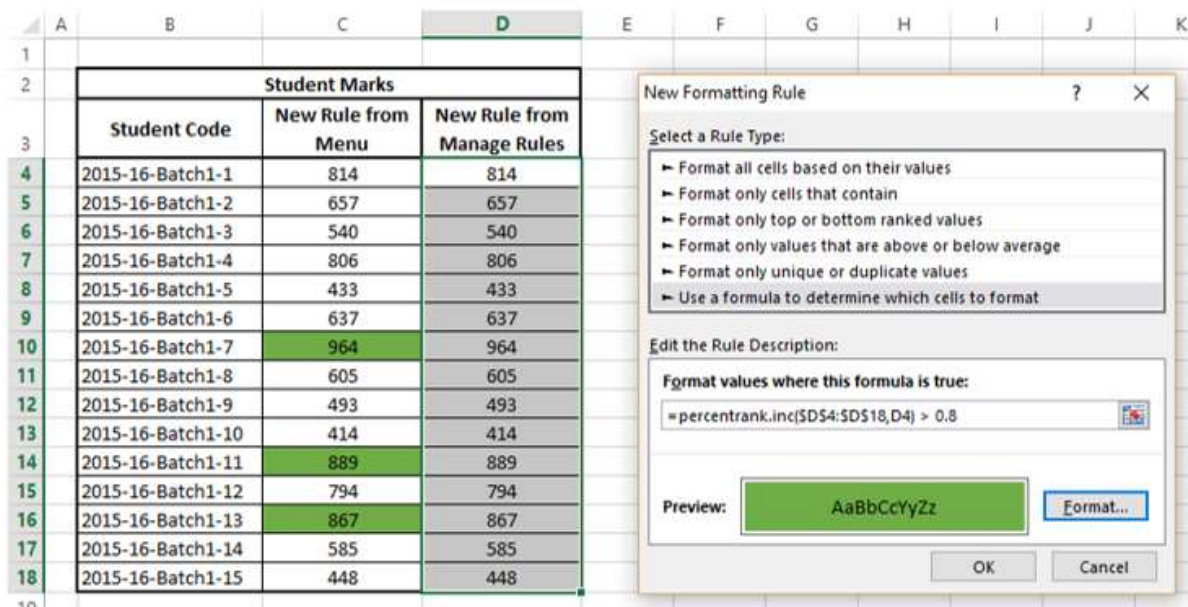
The **Conditional Formatting Rules Manager** dialog box appears.

Click the **New Rule** button.

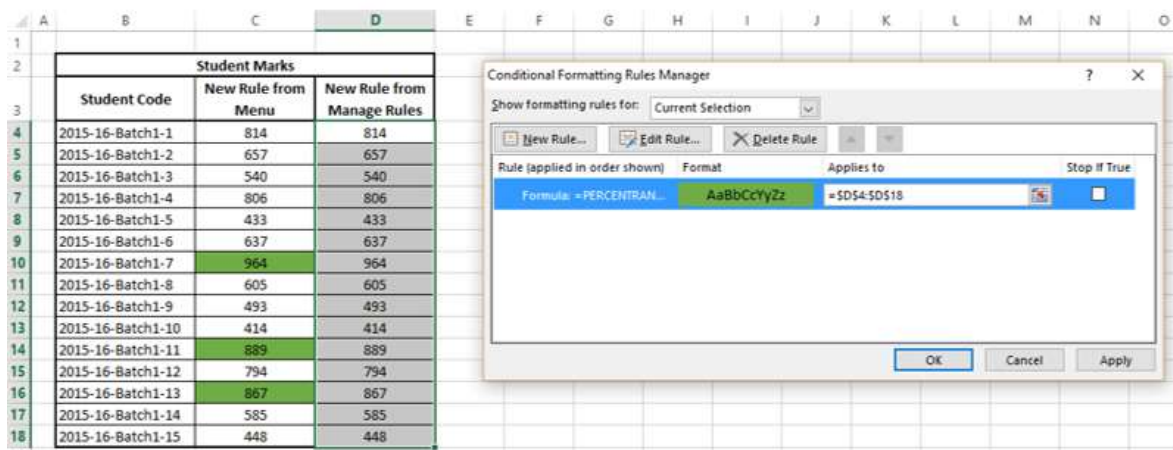


The **New Formatting Rule** dialog box appears.

Repeat the Steps given above to define your formula and format.



The **Conditional Formatting Rules Manager** dialog box appears with defined **New Rule** highlighted. Click the **Apply** button.



Cells that contain values with the formula TRUE, are formatted as defined.

	A	B	C	D
1				
2		Student Marks		
3		Student Code	New Rule from Menu	New Rule from Manage Rules
4		2015-16-Batch1-1	814	814
5		2015-16-Batch1-2	657	657
6		2015-16-Batch1-3	540	540
7		2015-16-Batch1-4	806	806
8		2015-16-Batch1-5	433	433
9		2015-16-Batch1-6	637	637
10		2015-16-Batch1-7	964	964
11		2015-16-Batch1-8	605	605
12		2015-16-Batch1-9	493	493
13		2015-16-Batch1-10	414	414
14		2015-16-Batch1-11	889	889
15		2015-16-Batch1-12	794	794
16		2015-16-Batch1-13	867	867
17		2015-16-Batch1-14	585	585
18		2015-16-Batch1-15	448	448

## Clear Rules

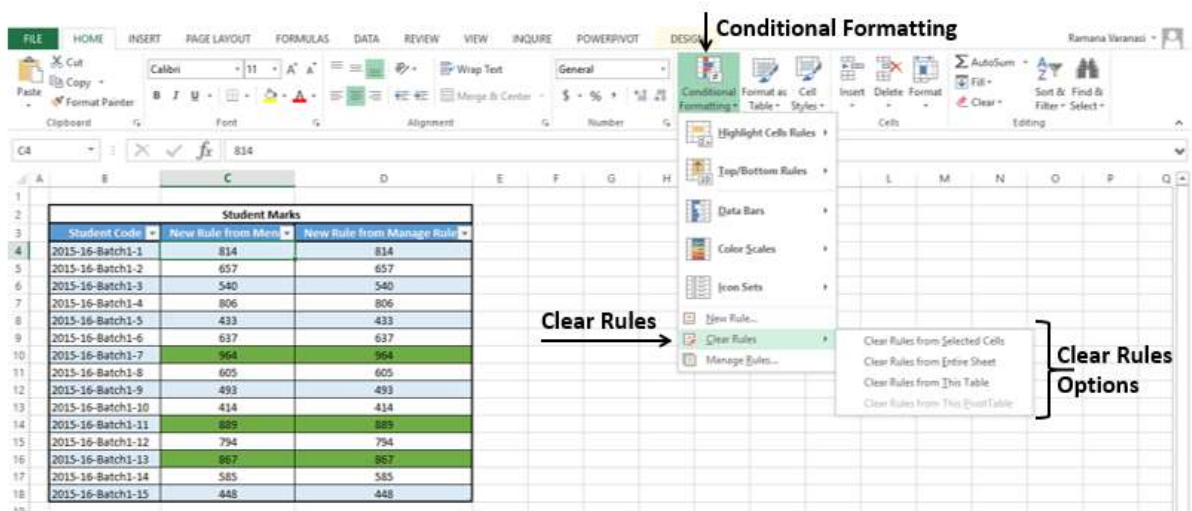
You can Clear Rules to delete all conditional formats you have created for

- Selected cells
- Current Worksheet
- Selected Table

- Selected PivotTable

Follow the given steps-

- Select the Range / Click on a Worksheet / Click the table > PivotTable where conditional formatting rules need to be removed.
- Click **Conditional Formatting** in the **Styles** group under **Home** tab.
- Click **Clear Rules** from the drop-down menu. The Clear rules options appear.



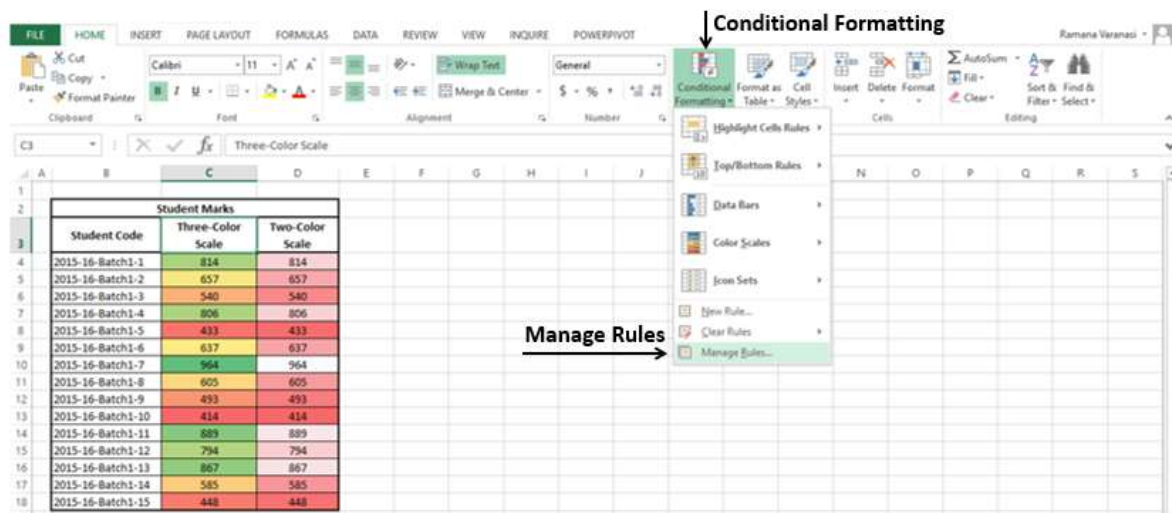
Select the appropriate option. The conditional formatting is cleared from the Range / Worksheet / Table / PivotTable.

## Manage Rules

You can **Manage Rules** from the **Conditional Formatting Rules Manager** window. You can see formatting rules for the current selection, for the entire current worksheet, for the other worksheets in the workbook or the tables or PivotTables in the workbook.

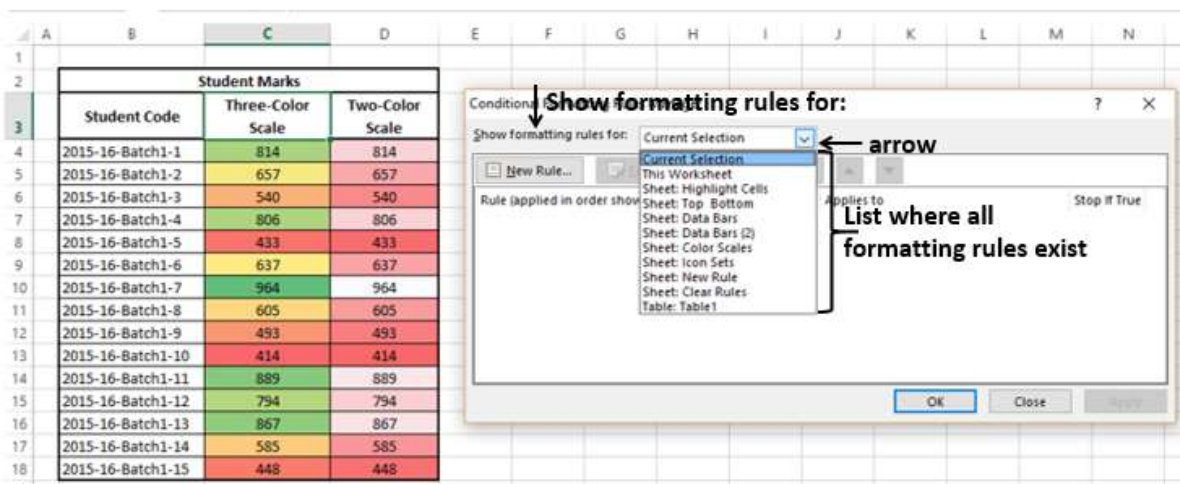
- Click **Conditional Formatting** in the **Styles** group under **Home** tab.
- Click **Manage Rules** from the drop-down menu.





The **Conditional Formatting Rules Manager** dialog box appears.

Click the arrow in the List Box next to **Show formatting rules for:** Current Selection, This Worksheet and other Sheets, Tables, PivotTable if exist with Conditional Formatting Rules, appear.



Select **This Worksheet** from the drop-down list. Formatting Rules on the current Worksheet appear in the order that they will be applied. You can change this order by using the up and down arrows.

Conditional Formatting Rules Manager

Show formatting rules for: This Worksheet

New Rule... Edit Rule... Delete Rule

Rule (applied in order shown)	Format	Applies to	Stop if True
Graded Color Scale	[Color Scale]	=D\$4:D\$18	<input checked="" type="checkbox"/>
Graded Color Scale	[Color Scale]	=C\$4:C\$18	<input type="checkbox"/>

OK Close Apply

You can add a New Rule, Edit a Rule and Delete a Rule.

Conditional Formatting Rules Manager

Show formatting rules for: This Worksheet

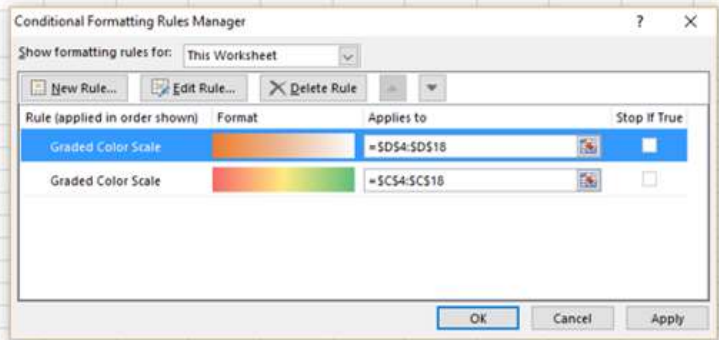
New Rule... Edit Rule... Delete Rule

Rule (applied in order shown)	Format	Applies to	Stop if True
Graded Color Scale	[Color Scale]	=D\$4:D\$18	<input checked="" type="checkbox"/>
Graded Color Scale	[Color Scale]	=C\$4:C\$18	<input type="checkbox"/>

OK Close Apply

- You have already seen **New Rule** in the earlier section. You can delete a rule by selecting the Rule and clicking **Delete Rule**. The highlighted Rule is deleted.
- To edit a Rule, select the RULE and click on **Edit Rule**. **Edit Formatting Rule** dialog box appears.
- You can
  - Select a Rule Type
  - Edit the Rule Description
  - Edit Formatting
- Once you are done with the changes, click OK.
- The changes for the Rule will be reflected in the **Conditional Formatting Rules Manager** dialog box. Click **Apply**.
- The data will be highlighted based on the modified **Conditional Formatting Rules**.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1															
2			Student Marks												
3			Student Code	Three-Color Scale	Two-Color Scale										
4			2015-16-Batch1-1	814	814										
5			2015-16-Batch1-2	657	657										
6			2015-16-Batch1-3	540	540										
7			2015-16-Batch1-4	806	806										
8			2015-16-Batch1-5	433	433										
9			2015-16-Batch1-6	637	637										
10			2015-16-Batch1-7	964	964										
11			2015-16-Batch1-8	605	605										
12			2015-16-Batch1-9	493	493										
13			2015-16-Batch1-10	414	414										
14			2015-16-Batch1-11	889	889										
15			2015-16-Batch1-12	794	794										
16			2015-16-Batch1-13	867	867										
17			2015-16-Batch1-14	585	585										
18			2015-16-Batch1-15	448	448										



# 10. Sorting

Sorting data is an integral part of Data Analysis. You can arrange a list of names in alphabetical order, compile a list of sales figures from highest to lowest, or order rows by colors or icons. Sorting data helps you quickly visualize and understand your data better, organize and find the data that you want, and ultimately make more effective decisions.

You can sort by columns or by rows. Most of the sorts that you use will be column sorts.

You can sort data in one or more columns by

- text (A to Z or Z to A)
- numbers (smallest to largest or largest to smallest)
- dates and times (oldest to newest and newest to oldest)
- a custom list (E.g. Large, Medium, and Small)
- format, including cell color, font color, or icon set

Sort criteria for a table are saved with the workbook such that you can reapply the sort to that table every time you open the workbook. Sort criteria are not saved for a range of cells. For multicolumn sorts or for sorts that take a long time to create, you can convert the range to a table. Then, you can reapply the sort when you open a workbook.

In all the examples in the following sections, you will find tables only, since it is more meaningful to sort a table.

## Sort by Text

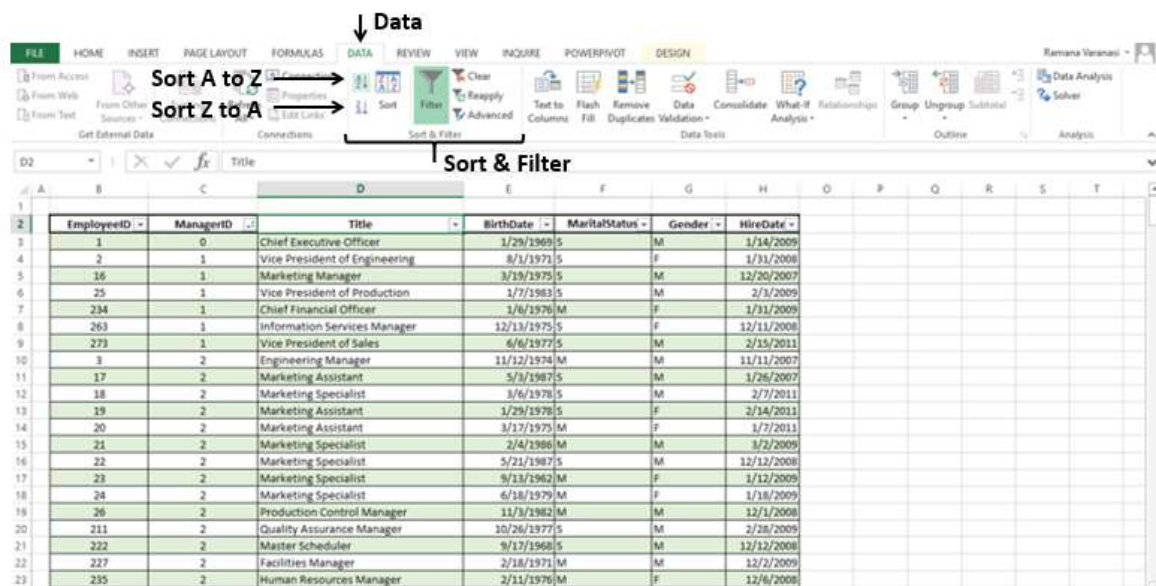
---

You can sort a table using a column containing text.

The following table has information about employees in an organization (You are able to see only the first few rows in the data).

	A	B	C	D	E	F	G	H
1								
2		EmployeeID	ManagerID	Title	BirthDate	MaritalStatus	Gender	HireDate
3		1	0	Chief Executive Officer	1/29/1969	S	M	1/14/2009
4		2	1	Vice President of Engineering	8/1/1971	S	F	1/31/2008
5		3	2	Engineering Manager	11/12/1974	M	M	11/11/2007
6		4	3	Senior Tool Designer	12/23/1974	S	M	12/5/2007
7		5	3	Design Engineer	9/27/1952	M	F	1/6/2008
8		6	3	Design Engineer	3/11/1959	M	M	1/24/2008
9		7	3	Research and Development Manager	2/24/1987	M	M	2/8/2009
10		8	4	Research and Development Engineer	6/5/1986	S	F	12/29/2008
11		9	4	Research and Development Engineer	1/21/1979	M	F	1/16/2009
12		10	4	Research and Development Manager	11/30/1984	M	M	5/3/2009
13		11	3	Senior Tool Designer	1/17/1978	S	M	12/5/2010
14		12	4	Tool Designer	7/29/1959	M	M	12/11/2007
15		13	4	Tool Designer	5/28/1989	M	F	12/23/2010
16		14	3	Senior Design Engineer	6/16/1979	S	M	12/30/2010
17		15	3	Design Engineer	5/2/1961	M	F	1/18/2011
18		16	1	Marketing Manager	3/19/1975	S	M	12/20/2007
19		17	2	Marketing Assistant	5/3/1987	S	M	1/26/2007
20		18	2	Marketing Specialist	3/6/1978	S	M	2/7/2011
21		19	2	Marketing Assistant	1/29/1978	S	F	2/14/2011
22		20	2	Marketing Assistant	3/17/1975	M	F	1/7/2011
23		21	2	Marketing Specialist	2/4/1986	M	M	3/2/2009

- To sort the table by the column title that contains text, click the header of the column – **Title**.
- Click the **Data** tab.
- In the **Sort & Filter** group, click **Sort A to Z**



The table will be sorted by the column – Title in the ascending alphanumeric order.

**Note:** You can sort in the descending alphanumeric order, by clicking **Sort Z to A**. You can also sort with case-sensitive option. Go through the **Sort by a Custom List** section given below.



	A	B	C	D	E	F	G	H
1								
2		EmployeeID	ManagerID	Title	BirthDate	MaritalStatus	Gender	HireDate
3		245	3	Accountant	1/4/1976	M	F	2/18/2009
4		248	3	Accountant	7/1/1979	S	M	3/8/2009
5		241	2	Accounts Manager	7/8/1983	M	M	1/30/2009
6		246	3	Accounts Payable Specialist	2/14/1977	M	M	2/11/2009
7		247	3	Accounts Payable Specialist	3/9/1979	M	F	3/1/2009
8		242	3	Accounts Receivable Specialist	3/6/1976	M	F	12/18/2008
9		243	3	Accounts Receivable Specialist	2/23/1976	S	F	1/6/2009
10		244	3	Accounts Receivable Specialist	9/20/1984	S	M	1/24/2009
11		267	2	Application Specialist	5/19/1978	S	F	2/16/2009
12		268	2	Application Specialist	3/13/1988	S	M	2/3/2009
13		269	2	Application Specialist	5/26/1987	M	M	1/11/2009
14		272	2	Application Specialist	1/30/1985	M	F	12/23/2008
15		262	2	Assistant to the Chief Financial Officer	6/21/1964	S	M	1/12/2009
16		239	3	Benefits Specialist	11/20/1984	M	F	12/25/2008
17		251	4	Buyer	8/17/1984	S	M	2/10/2009
18		252	4	Buyer	8/21/1974	M	M	2/28/2009
19		253	4	Buyer	11/30/1970	M	F	12/17/2009
20		254	4	Buyer	11/24/1970	M	M	1/4/2010
21		255	4	Buyer	11/29/1966	M	M	1/11/2010
22		256	4	Buyer	5/12/1952	M	M	1/23/2010
23		257	4	Buyer	9/17/1972	S	M	1/27/2010

## Sort by Numbers

To sort the table by the column ManagerID that contains numbers, follow the steps given below-

- Click the header of the column – ManagerID.
- Click the **Data** tab.
- In the **Sort & Filter** group, click **Sort A to Z**

The screenshot shows the Excel interface with the **Data** tab selected. In the **Sort & Filter** group, the **Sort A to Z** button is highlighted with a red arrow. Below the ribbon, the spreadsheet data is shown, sorted by ManagerID. The data is as follows:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1																				
2		EmployeeID	ManagerID	Title	BirthDate	MaritalStatus	Gender	HireDate												
3		1	0	Chief Executive Officer	1/29/1969	S	M	1/14/2009												
4		2	1	Vice President of Engineering	8/1/1971	S	F	1/31/2008												
5		16	1	Marketing Manager	3/19/1975	S	M	12/20/2007												
6		25	1	Vice President of Production	1/7/1983	S	M	2/1/2009												
7		234	1	Chief Financial Officer	1/6/1976	M	F	1/31/2009												
8		263	1	Information Services Manager	12/13/1975	S	F	12/11/2008												
9		273	1	Vice President of Sales	6/6/1977	S	M	2/15/2011												
10		3	2	Engineering Manager	11/12/1974	M	M	11/11/2007												
11		17	2	Marketing Assistant	5/3/1987	S	M	1/26/2007												
12		18	2	Marketing Specialist	3/6/1978	S	M	2/7/2011												
13		19	2	Marketing Assistant	1/29/1978	S	F	2/14/2011												
14		20	2	Marketing Assistant	3/17/1975	M	F	1/7/2011												
15		21	2	Marketing Specialist	2/4/1986	M	M	3/2/2009												
16		22	2	Marketing Specialist	5/21/1987	S	M	12/12/2008												
17		23	2	Marketing Specialist	9/13/1982	M	F	1/12/2009												
18		24	2	Marketing Specialist	6/18/1979	M	F	1/11/2009												
19		26	2	Production Control Manager	11/3/1982	M	M	12/1/2008												
20		211	2	Quality Assurance Manager	10/26/1977	S	M	2/28/2009												
21		222	2	Master Scheduler	9/17/1968	S	M	12/12/2008												
22		227	2	Facilities Manager	2/18/1971	M	M	12/2/2009												
23		235	2	Human Resources Manager	2/11/1976	M	F	12/6/2008												

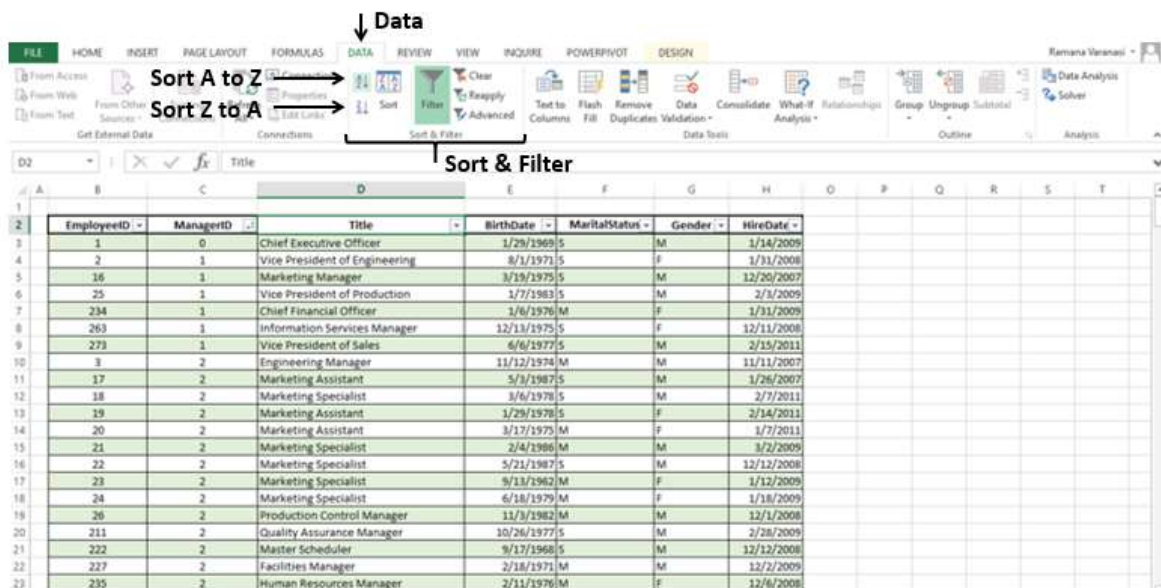
The column, ManagerID will be sorted in the ascending numeric order. You can sort in the descending numeric order, by clicking Sort Z to A.

	A	B	C	D	E	F	G	H
1								
2		EmployeeID	ManagerID	Title	BirthDate	MaritalStatus	Gender	HireDate
3		1	0	Chief Executive Officer	1/29/1969	S	M	1/14/2009
4		2	1	Vice President of Engineering	8/1/1971	S	F	1/31/2008
5		16	1	Marketing Manager	3/19/1975	S	M	12/20/2007
6		25	1	Vice President of Production	1/7/1983	S	M	2/3/2009
7		234	1	Chief Financial Officer	1/6/1976	M	F	1/31/2009
8		263	1	Information Services Manager	12/13/1975	S	F	12/11/2008
9		273	1	Vice President of Sales	6/6/1977	S	M	2/15/2011
10		3	2	Engineering Manager	11/12/1974	M	M	11/11/2007
11		17	2	Marketing Assistant	5/3/1987	S	M	1/26/2007
12		18	2	Marketing Specialist	3/6/1978	S	M	2/7/2011
13		19	2	Marketing Assistant	1/29/1978	S	F	2/14/2011
14		20	2	Marketing Assistant	3/17/1975	M	F	1/7/2011
15		21	2	Marketing Specialist	2/4/1986	M	M	3/2/2009
16		22	2	Marketing Specialist	5/21/1987	S	M	12/12/2008
17		23	2	Marketing Specialist	9/13/1962	M	F	1/12/2009
18		24	2	Marketing Specialist	6/18/1979	M	F	1/18/2009
19		26	2	Production Control Manager	11/3/1982	M	M	12/1/2008
20		211	2	Quality Assurance Manager	10/26/1977	S	M	2/28/2009
21		222	2	Master Scheduler	9/17/1968	S	M	12/12/2008
22		227	2	Facilities Manager	2/18/1971	M	M	12/2/2009
23		235	2	Human Resources Manager	2/11/1976	M	F	12/6/2008

## Sort by Dates or Times

To sort the Table by the column HireDate that contains Dates, follow the steps given below-

- Click the Header of the column – HireDate.
- Click **Data** tab.
- In the **Sort & Filter** group, click **Sort A to Z** as shown in the screen shot given below-





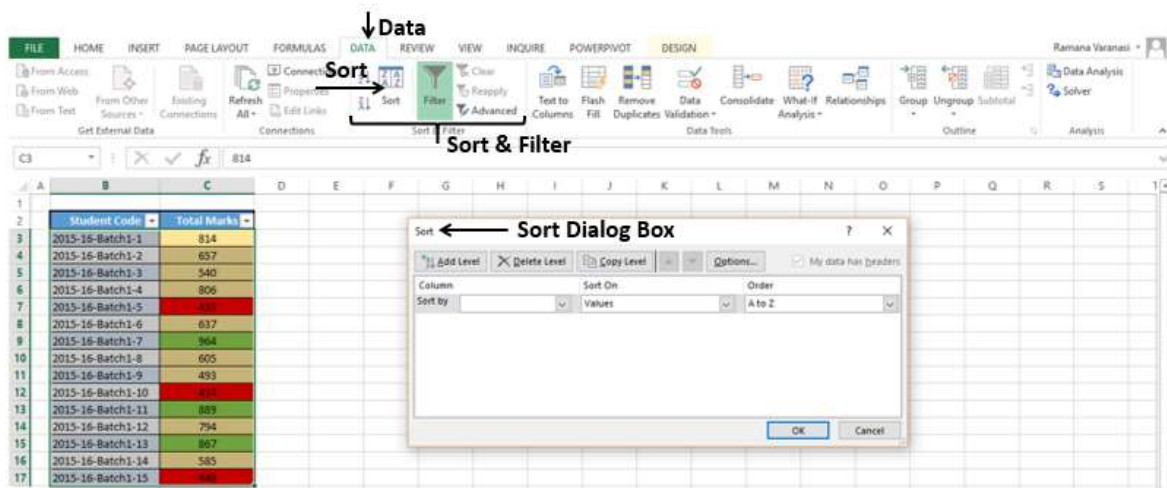
The column – HireDate will be sorted with the dates sorted from oldest to newest. You can sort the dates from newest to oldest, by clicking **Sort Z to A**.

	A	B	C	D	E	F	G	H
1								
2		EmployeeID	ManagerID	Title	BirthDate	MaritalStatus	Gender	HireDate
3		28	4	Production Technician - WC60	3/13/1988	M	M	6/30/2006
4		17	2	Marketing Assistant	5/3/1987	S	M	1/26/2007
5		3	2	Engineering Manager	11/12/1974	M	M	11/11/2007
6		4	3	Senior Tool Designer	12/23/1974	S	M	12/5/2007
7		12	4	Tool Designer	7/29/1959	M	M	12/11/2007
8		16	1	Marketing Manager	3/19/1975	S	M	12/20/2007
9		40	3	Production Supervisor - WC60	1/16/1956	S	F	12/26/2007
10		5	3	Design Engineer	9/27/1952	M	F	1/6/2008
11		48	4	Production Technician - WC10	6/4/1956	M	F	1/6/2008
12		49	4	Production Technician - WC10	3/26/1956	S	M	1/7/2008
13		6	3	Design Engineer	3/11/1959	M	M	1/24/2008
14		2	1	Vice President of Engineering	8/1/1971	S	F	1/31/2008
15		50	4	Production Technician - WC10	8/30/1956	M	M	2/2/2008
16		55	3	Production Supervisor - WC50	4/1/1956	M	M	2/8/2008
17		51	4	Production Technician - WC10	7/11/1956	S	M	2/20/2008
18		27	3	Production Supervisor - WC60	10/8/1956	S	F	2/27/2008
19		52	4	Production Technician - WC10	4/4/1956	M	F	3/10/2008
20		62	3	Production Supervisor - WC60	8/7/1956	M	M	3/17/2008
21		53	4	Production Technician - WC10	3/29/1956	M	F	3/28/2008
22		26	2	Production Control Manager	11/3/1982	M	M	12/1/2008
23		72	4	Production Technician - WC30	5/14/1977	M	M	12/1/2008

## Sort by Cell Color

To sort the table by the column total marks that contains cells with colors (Conditionally Formatted)-

- Click the Header of the column – Total Marks.
- Click **Data** tab.
- In the **Sort & Filter** group, click **Sort**. The Sort dialog box appears.



- Choose **Sort By** as Total Marks, **Sort on** as **Cell Color** and specify the color green in **Order**. Click Add Level.
- Choose **Sort By** as Total Marks, **Sort on** as **Cell Color** and specify the color Yellow in **Order**. Click Add Level.
- Choose **Sort By** as Total Marks, **Sort on** as **Cell Color** and specify the color Red in **Order**.

The screenshot shows the 'Sort' dialog box in Excel. It has three levels of sorting defined. Each level has 'Sort by' set to 'Total Marks', 'Sort on' set to 'Cell Color', and a specific 'Order' (Green, Yellow, and Red respectively). The 'Add Level' button is highlighted with an arrow.

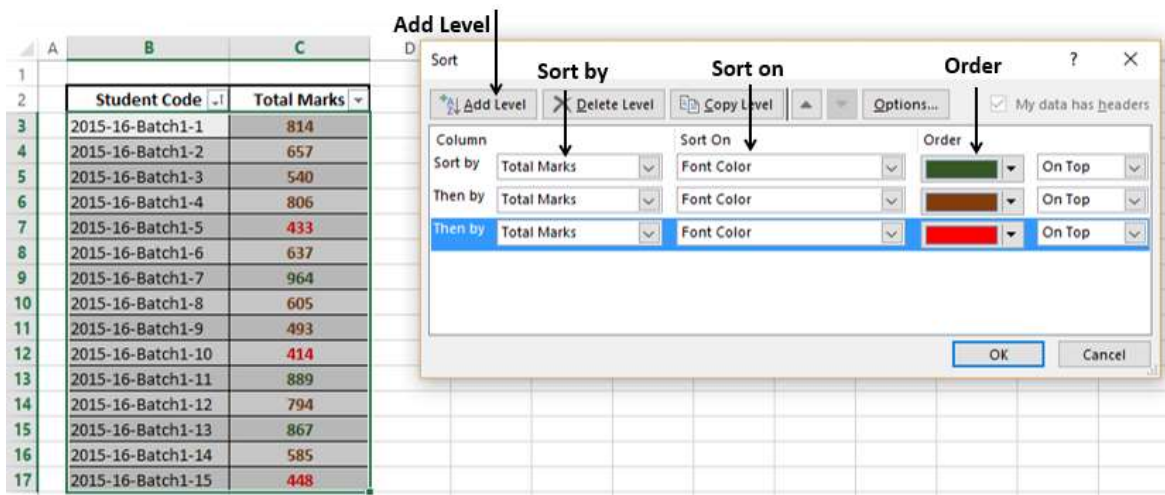
The column – Total Marks will be sorted by the cell color as specified in the Order.

	A	B	C
1			
2		Student Code	Total Marks
3		2015-16-Batch1-7	964
4		2015-16-Batch1-11	889
5		2015-16-Batch1-13	867
6		2015-16-Batch1-1	814
7		2015-16-Batch1-2	657
8		2015-16-Batch1-3	540
9		2015-16-Batch1-4	806
10		2015-16-Batch1-6	637
11		2015-16-Batch1-8	605
12		2015-16-Batch1-9	493
13		2015-16-Batch1-12	794
14		2015-16-Batch1-14	585
15		2015-16-Batch1-5	433
16		2015-16-Batch1-10	414
17		2015-16-Batch1-15	448

## Sort by Font Color

To sort the column Total Marks in the table, that contains cells with font colors (conditionally formatted)-

- Click the header of the column – Total Marks.
- Click **Data** tab.
- In the **Sort & Filter** group, click **Sort**. The Sort dialog box appears.
- Choose **Sort By** as Total Marks, **Sort On** as **Font Color** and specify the color green in **Order**. Click Add Level.
- Choose **Sort By** as Total Marks, **Sort On** as **Font Color** and specify the color yellow in **Order**. Click Add Level.
- Choose **Sort By** as Total Marks, **Sort On** as **Font Color** and specify the color red in **Order**.






The column – Total Marks is sorted by the font color as specified in the Order.

	A	B	C
1			
2		Student Code ▼	Total Marks ▼
3		2015-16-Batch1-7	964
4		2015-16-Batch1-11	889
5		2015-16-Batch1-13	867
6		2015-16-Batch1-1	814
7		2015-16-Batch1-2	657
8		2015-16-Batch1-3	540
9		2015-16-Batch1-4	806
10		2015-16-Batch1-6	637
11		2015-16-Batch1-8	605
12		2015-16-Batch1-9	493
13		2015-16-Batch1-12	794
14		2015-16-Batch1-14	585
15		2015-16-Batch1-5	433
16		2015-16-Batch1-10	414
17		2015-16-Batch1-15	448

## Sort by Cell Icon

To sort the table by the column Total Marks that contains cells with Cell Icons (Conditionally Formatted), follow the steps given below-

- Click the Header of the column – Total Marks.
- Click **Data** tab.
- In the **Sort & Filter** group, click **Sort**. The Sort dialog box appears.
- Choose **Sort By** as Total Marks, **Sort On** as **Cell Icon** and specify  in **Order**. Click Add Level.
- Choose **Sort By** as Total Marks, **Sort On** as **Cell Icon** and specify  in **Order**. Click Add Level.
- Choose **Sort By** as Total Marks, **Sort On** as **Cell Icon** and specify  in **Order**.

The screenshot shows an Excel spreadsheet with a table of student marks. The 'Sort' dialog box is open, and the 'Add Level' button is highlighted. The dialog box shows the following settings:

Column	Sort By	Sort On	Order
Total Marks	Total Marks	Cell Icon	Ascending
Total Marks	Total Marks	Cell Icon	Ascending
Total Marks	Total Marks	Cell Icon	Ascending

The column – Total Marks will be sorted by Cell Icon as specified in the Order.

	A	B	C
1			
2		Student Code	Total Marks
3		2015-16-Batch1-7	964
4		2015-16-Batch1-11	889
5		2015-16-Batch1-13	867
6		2015-16-Batch1-1	814
7		2015-16-Batch1-4	806
8		2015-16-Batch1-12	794
9		2015-16-Batch1-2	657
10		2015-16-Batch1-6	637
11		2015-16-Batch1-8	605
12		2015-16-Batch1-3	540
13		2015-16-Batch1-9	493
14		2015-16-Batch1-14	585
15		2015-16-Batch1-5	433
16		2015-16-Batch1-10	414
17		2015-16-Batch1-15	448

## Sort by a Custom List

You can create a custom list and sort the table by the custom list.

In the table given below, you find an indicator column with title – Position. It has the values high, medium and low based on the position of total marks with respect to the entire range.



	A	B	C	D
1				
2		<b>Student Code</b>	<b>Total Marks</b>	<b>Position</b>
3		2015-16-Batch1-1	814	High
4		2015-16-Batch1-2	657	Medium
5		2015-16-Batch1-3	540	Medium
6		2015-16-Batch1-4	806	High
7		2015-16-Batch1-5	433	Low
8		2015-16-Batch1-6	637	Medium
9		2015-16-Batch1-7	964	High
10		2015-16-Batch1-8	605	Medium
11		2015-16-Batch1-9	493	Low
12		2015-16-Batch1-10	414	Low
13		2015-16-Batch1-11	889	High
14		2015-16-Batch1-12	794	Medium
15		2015-16-Batch1-13	867	High
16		2015-16-Batch1-14	585	Medium
17		2015-16-Batch1-15	448	Low

Now, suppose you want to sort the column - Position, with all High values on top, all low values at bottom, and all medium values in between. That means the order you want is low, medium and high. With **Sort A to Z**, you get the order high, low and medium. On the other hand, with **Sort Z to A**, you get the order medium, low and high.

You can resolve this is to create a custom list.

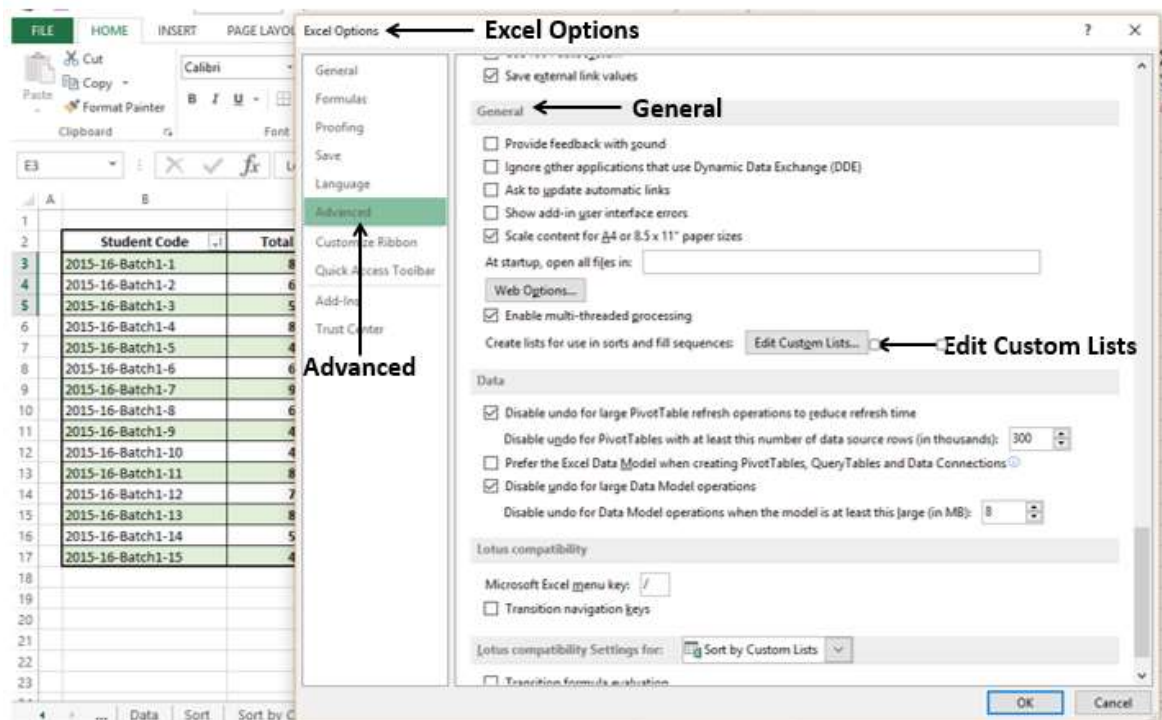
- Define the order for the custom list as high, medium and low in a range of cells as shown below.
- Select that Range.

	A	B	C	D	E
1					
2		Student Code	Total Marks	Position	Custom List
3		2015-16-Batch1-1	814	High	High
4		2015-16-Batch1-2	657	Medium	Medium
5		2015-16-Batch1-3	540	Medium	Low
6		2015-16-Batch1-4	806	High	
7		2015-16-Batch1-5	433	Low	
8		2015-16-Batch1-6	637	Medium	
9		2015-16-Batch1-7	964	High	
10		2015-16-Batch1-8	605	Medium	
11		2015-16-Batch1-9	493	Low	
12		2015-16-Batch1-10	414	Low	
13		2015-16-Batch1-11	889	High	
14		2015-16-Batch1-12	794	Medium	
15		2015-16-Batch1-13	867	High	
16		2015-16-Batch1-14	585	Medium	
17		2015-16-Batch1-15	448	Low	

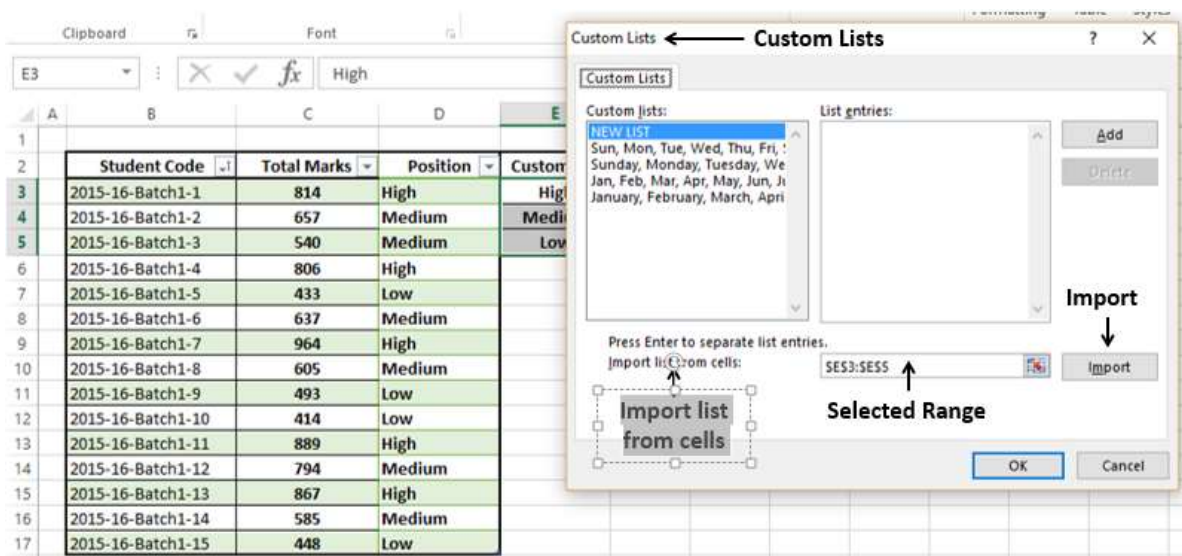
Custom List Range

- Click the **File** tab.
- Click **Options**. In the **Excel Options** dialog box, Click **Advanced**.
- Scroll to the **General**.
- Click **Edit Custom Lists**.

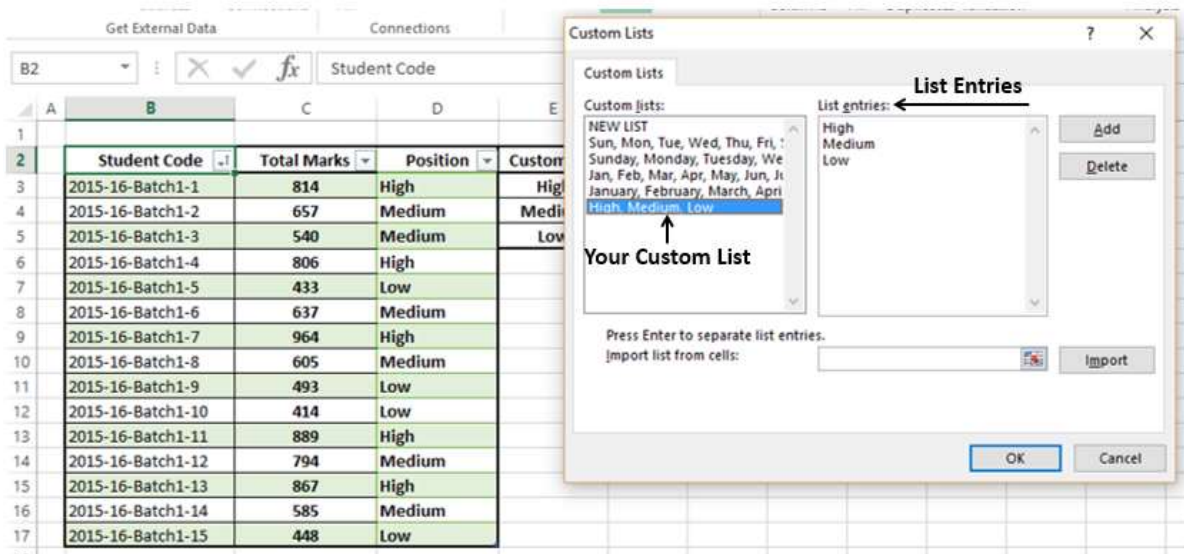




**Custom Lists** dialog box appears. The select range in worksheet appears in the **Import list from cells** box. Click **Import**.

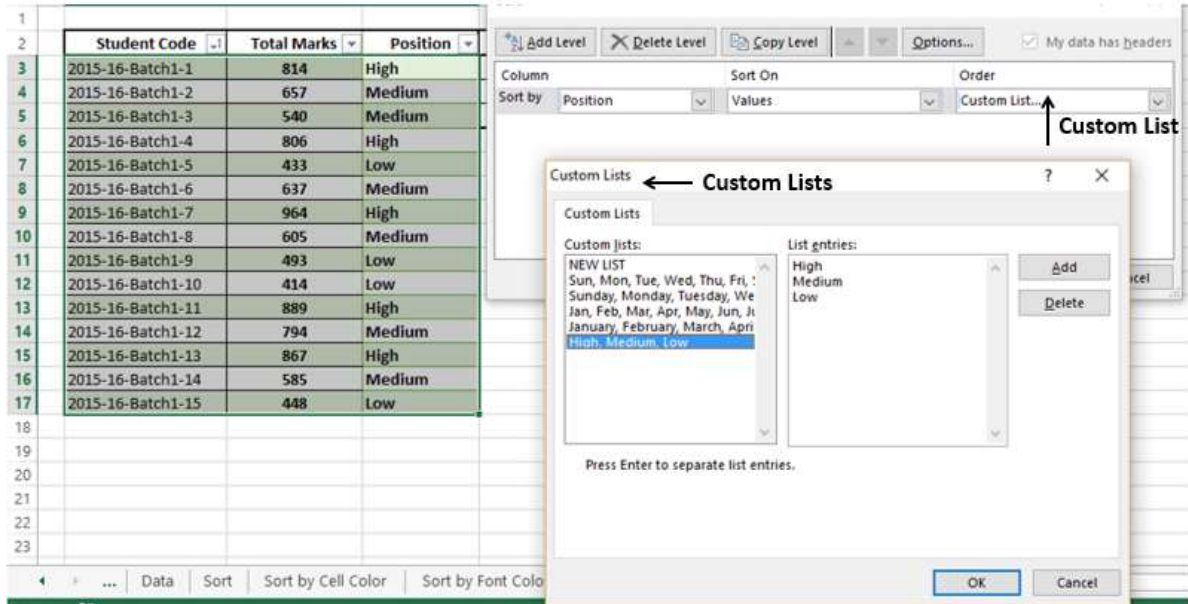


Your custom list is added to the **Custom Lists**. Click OK.



The next step is to sort the table with this Custom List.

- Click the Column – Position. Click on **Sort**. In the **Sort** dialog box, ensure **Sort By** is Position, **Sort On** is Values.
- Click on **Order**. Select **Custom List**. Custom Lists dialog box appears.
- Click on the **High, Medium, Low** Custom List. Click on OK.



In the **Sort** dialog box, in the **Order** Box, **High, Medium, Low** appears. Click on OK.

The screenshot shows the 'Sort' dialog box in Excel. The 'Sort by' dropdown is set to 'Position', 'Sort On' is 'Values', and 'Order' is 'High, Medium, Low'. An arrow points to the 'Order' dropdown with the text 'High, Medium, Low'.

Student Code	Total Marks	Position
2015-16-Batch1-1	814	High
2015-16-Batch1-2	657	Medium
2015-16-Batch1-3	540	Medium
2015-16-Batch1-4	806	High
2015-16-Batch1-5	433	Low
2015-16-Batch1-6	637	Medium
2015-16-Batch1-7	964	High
2015-16-Batch1-8	605	Medium
2015-16-Batch1-9	493	Low
2015-16-Batch1-10	414	Low
2015-16-Batch1-11	889	High
2015-16-Batch1-12	794	Medium
2015-16-Batch1-13	867	High
2015-16-Batch1-14	585	Medium
2015-16-Batch1-15	448	Low

The table will be sorted in the defined order – high, medium, low.

2	Student Code	Total Marks	Position	Custom List
3	2015-16-Batch1-1	814	High	High
4	2015-16-Batch1-4	806	High	Medium
5	2015-16-Batch1-7	964	High	Low
6	2015-16-Batch1-11	889	High	
7	2015-16-Batch1-13	867	High	
8	2015-16-Batch1-2	657	Medium	
9	2015-16-Batch1-3	540	Medium	
10	2015-16-Batch1-6	637	Medium	
11	2015-16-Batch1-8	605	Medium	
12	2015-16-Batch1-12	794	Medium	
13	2015-16-Batch1-14	585	Medium	
14	2015-16-Batch1-5	433	Low	
15	2015-16-Batch1-9	493	Low	
16	2015-16-Batch1-10	414	Low	
17	2015-16-Batch1-15	448	Low	

You can create Custom Lists based on the following values-

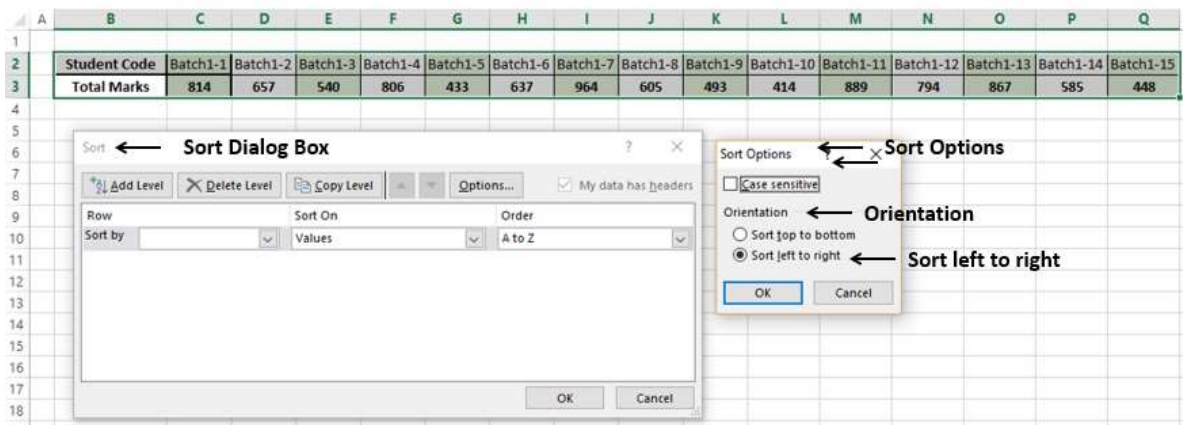
- Text
- Number
- Date
- Time

You cannot create custom lists based on format, i.e. by cell / font color, or cell icon.

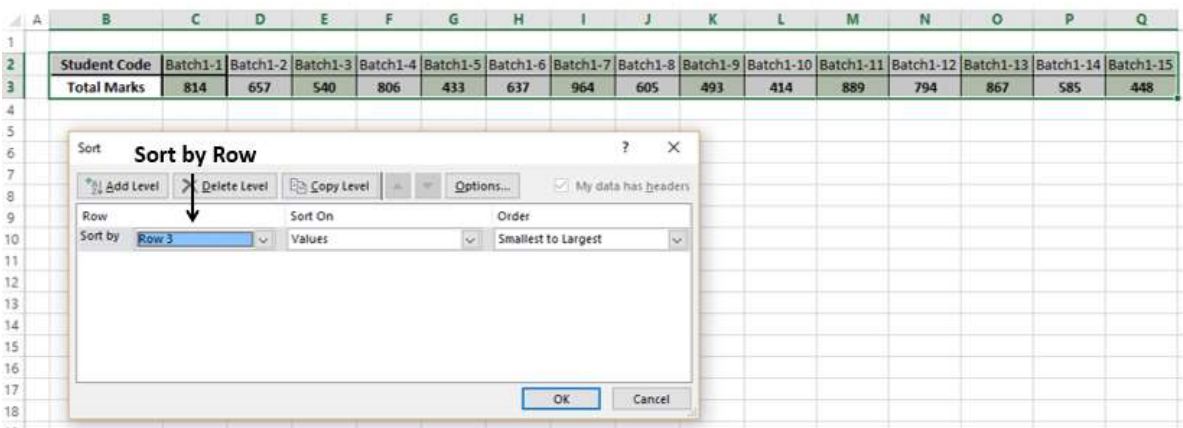
## Sort by Rows

You can sort a table by rows also. Follow the steps given below-

- Click the row you want to sort the data.
- Click **Sort**.
- In the **Sort** dialog box, Click **Options**. The **Sort Options** dialog box opens.
- Under **Orientation**, click **Sort from left to right**. Click OK.



- Click **Sort by row**. Select the row.
- Choose values for Sort **On** and Largest to Smallest for **Order**.



The data will be sorted by the selected row in a descending order.

Student Code	Batch1-7	Batch1-11	Batch1-11	Batch1-11	Batch1-4	Batch1-12	Batch1-2	Batch1-6	Batch1-8	Batch1-14	Batch1-3	Batch1-9	Batch1-15	Batch1-5	Batch1-10
Total Marks	964	889	867	814	806	794	657	637	605	585	540	493	448	433	414

## Sort by more than one Column or Row

You can sort a table by more than one column or row.

- Click the Table.



- Click **Sort**.
- In the **Sort** dialog box, specify the column by which you want to sort first.

In the screen shot given below, **Sort By** Title, **Sort On** Values, **Order** A – Z are chosen.

	A	B	C	D	E	F	G	H
1								
2		EmployeeID	ManagerID	Title	BirthDate	MaritalStatus	Gender	HireDate
3		28	4	Production Technician - WC60	3/13/1988	M	M	6/30/2006
4		17	2	Marketing Assistant	5/3/1987	S	M	1/26/2007
5		3	2	Engineering Manager	11/12/1974	M	M	11/11/2007
6		4	3	Senior Tool Designer	12/23/1974	S	M	12/5/2007
7		12	4	Tool Designer				
8		16	1	Marketing Assistant				
9		40	3	Production Technician - WC60				
10		5	3	Design Engineer				
11		48	4	Production Technician - WC60				
12		49	4	Production Technician - WC60				
13		6	3	Design Engineer				
14		2	1	Vice President				
15		50	4	Production Technician - WC60				
16		55	3	Production Technician - WC60				
17		51	4	Production Technician - WC60				
18		27	3	Production Technician - WC60				
19		52	4	Production Technician - WC60				
20		62	3	Production Supervisor - WC60	8/7/1956	M	M	3/17/2008
21		53	4	Production Technician - WC10	3/29/1956	M	F	3/28/2008
22		26	2	Production Control Manager	11/3/1982	M	M	12/1/2008
23		72	4	Production Technician - WC30	5/14/1977	M	M	12/1/2008

- Click **Add Level** in the **Sort** dialog box. The **Then By** dialog appears.
- Specify the column by which you want to sort next.
- In the screen shot given below, **Then By** HireDate, **Sort On** Values, **Order** Oldest to Newest are chosen.
- Click OK.

	A	B	C	D	E	F	G	H
2		EmployeeID	ManagerID	Title	BirthDate	MaritalStatus	Gender	HireDate
3		28	4	Production Technician - WC60	3/13/1988	M	M	6/30/2006
4		17	2	Marketing Assistant	5/3/1987	S	M	1/26/2007
5		3	2	Engineering Manager	11/12/1974	M	M	11/11/2007
6		4	3	Senior Tool Designer	12/23/1974	S	M	12/5/2007
7		12	4	Tool Designer				
8		16	1	Marketing Assistant				
9		40	3	Production Technician - WC60				
10		5	3	Design Engineer				
11		48	4	Production Technician - WC60				
12		49	4	Production Technician - WC60				
13		6	3	Design Engineer				
14		2	1	Vice President				
15		50	4	Production Technician - WC60				
16		55	3	Production Technician - WC60				
17		51	4	Production Technician - WC60				
18		27	3	Production Technician - WC60				
19		52	4	Production Technician - WC60				
20		62	3	Production Supervisor - WC60	8/7/1956	M	M	3/17/2008
21		53	4	Production Technician - WC10	3/29/1956	M	F	3/28/2008
22		26	2	Production Control Manager	11/3/1982	M	M	12/1/2008
23		72	4	Production Technician - WC30	5/14/1977	M	M	12/1/2008

The data will be sorted for Title in the ascending alphanumeric order and then by HireDate. You will see the employee data sorted by title, and in each title category, in the seniority order.

	A	B	C	D	E	F	G	H
1								
2		EmployeeID	ManagerID	Title	BirthDate	MaritalStatus	Gender	HireDate
3		245	3	Accountant	1/4/1976	M	F	2/18/2009
4		248	3	Accountant	7/1/1979	S	M	3/8/2009
5		241	2	Accounts Manager	7/8/1983	M	M	1/30/2009
6		246	3	Accounts Payable Specialist	2/14/1977	M	M	2/11/2009
7		247	3	Accounts Payable Specialist	3/9/1979	M	F	3/1/2009
8		242	3	Accounts Receivable Specialist	3/6/1976	M	F	12/18/2008
9		243	3	Accounts Receivable Specialist	2/23/1976	S	F	1/6/2009
10		244	3	Accounts Receivable Specialist	9/20/1984	S	M	1/24/2009
11		272	2	Application Specialist	1/30/1985	M	F	12/23/2008
12		269	2	Application Specialist	5/26/1987	M	M	1/11/2009
13		268	2	Application Specialist	3/13/1988	S	M	2/3/2009
14		267	2	Application Specialist	5/19/1978	S	F	2/16/2009
15		262	2	Assistant to the Chief Financial Officer	6/21/1964	S	M	1/12/2009
16		239	3	Benefits Specialist	11/20/1984	M	F	12/25/2008
17		251	4	Buyer	8/17/1984	S	M	2/10/2009
18		252	4	Buyer	8/21/1974	M	M	2/28/2009
19		253	4	Buyer	11/30/1970	M	F	12/17/2009
20		254	4	Buyer	11/24/1970	M	M	1/4/2010
21		255	4	Buyer	11/29/1966	M	M	1/11/2010
22		256	4	Buyer	5/12/1952	M	M	1/23/2010
23		257	4	Buyer	9/17/1972	S	M	1/27/2010





Filtering allows you to extract data that meets the defined criteria from a given Range or table. This is a quick way to display only the information that is needed by you.

You can Filter data in a Range, table or PivotTable.

You can filter data by-

- Selected values
- Text filters if the column you selected contains text
- Date filters if the column you selected contains dates
- Number filters if the column you selected contains numbers
- Cell color if the column you selected contains cells with color
- Font color if the column you selected contains font with color
- Cell icon if the column you selected contains cell icons
- Advanced filter
- Using slicers

In a table, the column headers are automatically tagged to filters, known as **AutoFilters**. **AutoFilter** is represented by the arrow  next to column header. Each **AutoFilter** has filter options based on the type of data you have in that column. For example, if the column contains numbers, when you click on the arrow  next to the column header, **Number Filter Options** appear.

When you click a Filter option or when you click on **Custom Filter** that appears at the end of the Filter options, **Custom AutoFilter** dialog box appears, wherein you can customize your filtering options.

In case of a Range, you can provide the column headers in the first row of the range and click on filter in the **Editing** group on **Home** tab. This will make the **AutoFilter** on for the Range. You can remove the filters that you have in your data. You can also reapply the filters when data changes occur.

## Filter by Selected Values

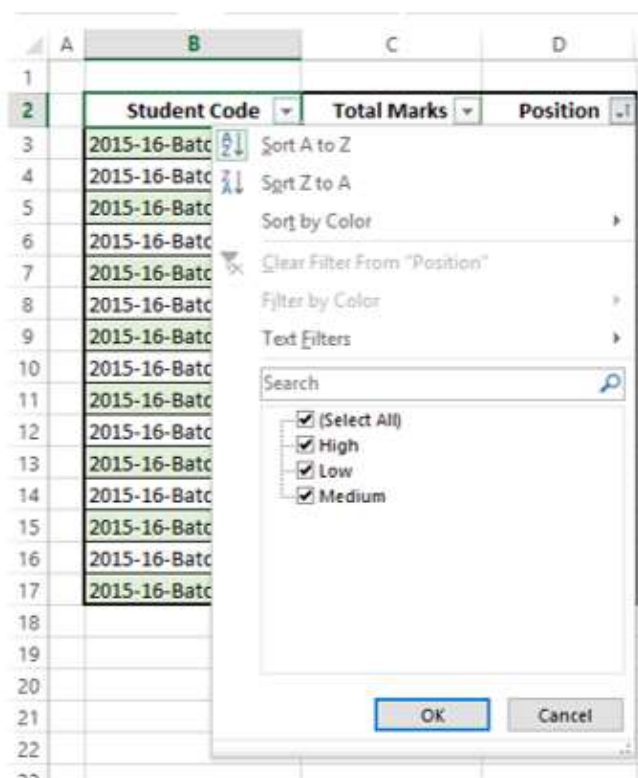
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You can choose what data is to be displayed by clicking the arrow next to a column header and selecting the Values in the column. Only those rows containing the selected values in the chosen column will be displayed.

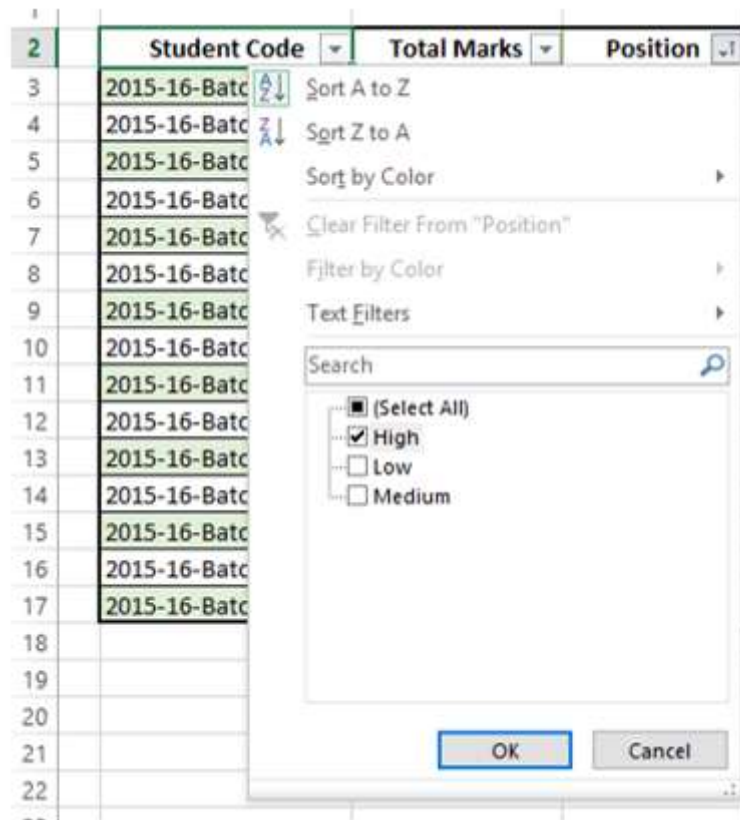
Consider the following data-

	Student Code	Total Marks	Position
3	2015-16-Batch1-1	814	High
4	2015-16-Batch1-4	806	High
5	2015-16-Batch1-7	964	High
6	2015-16-Batch1-11	889	High
7	2015-16-Batch1-13	867	High
8	2015-16-Batch1-2	657	Medium
9	2015-16-Batch1-3	540	Medium
10	2015-16-Batch1-6	637	Medium
11	2015-16-Batch1-8	605	Medium
12	2015-16-Batch1-12	794	Medium
13	2015-16-Batch1-14	585	Medium
14	2015-16-Batch1-5	433	Low
15	2015-16-Batch1-9	493	Low
16	2015-16-Batch1-10	414	Low
17	2015-16-Batch1-15	448	Low

If you want to display the data only for Position = High, click the arrow next to Position. A drop-down box appears with all the values in the position column. By default, all the values will be selected.



- Click Select All. All the boxes are cleared.
- Select High as shown in the following screen shot.



Click OK. Only those Rows, which have the value High as Position, will be displayed.

	A	B	C	D
1				
2		<b>Student Code</b>	<b>Total Marks</b>	<b>Position</b>
3		2015-16-Batch1-1	814	High
4		2015-16-Batch1-4	806	High
5		2015-16-Batch1-7	964	High
6		2015-16-Batch1-11	889	High
7		2015-16-Batch1-13	867	High

## Filter by Text

Consider the following data-

	A	B	C	D	E	F	G	H
1								
2		EmployeeID	ManagerID	Title	BirthDate	MaritalStatus	Gender	HireDate
3		245	3	Accountant	1/4/1976	M	F	2/18/2009
4		248	3	Accountant	7/1/1979	S	M	3/8/2009
5		241	2	Accounts Manager	7/8/1983	M	M	1/30/2009
6		246	3	Accounts Payable Specialist	2/14/1977	M	M	2/11/2009
7		247	3	Accounts Payable Specialist	3/9/1979	M	F	3/1/2009
8		242	3	Accounts Receivable Specialist	3/6/1976	M	F	12/18/2008
9		243	3	Accounts Receivable Specialist	2/23/1976	S	F	1/6/2009
10		244	3	Accounts Receivable Specialist	9/20/1984	S	M	1/24/2009
11		272	2	Application Specialist	1/30/1985	M	F	12/23/2008
12		269	2	Application Specialist	5/26/1987	M	M	1/11/2009
13		268	2	Application Specialist	3/13/1988	S	M	2/3/2009
14		267	2	Application Specialist	5/19/1978	S	F	2/16/2009
15		262	2	Assistant to the Chief Financial Officer	6/21/1964	S	M	1/12/2009
16		239	3	Benefits Specialist	11/20/1984	M	F	12/25/2008
17		251	4	Buyer	8/17/1984	S	M	2/10/2009
18		252	4	Buyer	8/21/1974	M	M	2/28/2009
19		253	4	Buyer	11/30/1970	M	F	12/17/2009
20		254	4	Buyer	11/24/1970	M	M	1/4/2010
21		255	4	Buyer	11/29/1966	M	M	1/11/2010
22		256	4	Buyer	5/12/1952	M	M	1/23/2010
23		257	4	Buyer	9/17/1972	S	M	1/27/2010

You can filter this data such that only those Rows wherein the Title is "Manager" will be displayed.

Click the arrow next to the column header Title. From the drop-down list, click **Text Filters**. Text filter options appear.

	A	B	C	D	E	F	G	H
2		EmployeeID	ManagerID	Title	BirthDate	MaritalStatus	Gender	HireDate
3		28	4	Sort A to Z	3/13/1988	M	M	6/30/2006
4		17	2	Sort Z to A	5/3/1987	S	M	1/26/2007
5		3	2	Sort by Color	11/12/1974	M	M	11/11/2007
6		4	3	Clear Filter From "Title"	12/23/1974	S	M	12/5/2007
7		12	4	Filter by Color	7/29/1959	M	M	12/11/2007
8		16	1	Text Filters	3/19/1975	S	M	12/20/2007
9		40	3	Text Filters			F	12/26/2007
10		5	3	Search			F	1/6/2008
11		48	4				F	1/6/2008
12		49	4				M	1/7/2008
13		6	3				M	1/24/2008
14		2	1				F	1/31/2008
15		50	4				M	2/2/2008
16		55	3				M	2/8/2008
17		51	4				M	2/20/2008
18		27	3		10/8/1956	S	F	2/27/2008
19		52	4		4/4/1956	M	F	3/10/2008
20		62	3		8/7/1956	M	M	3/17/2008
21		53	4		3/29/1956	M	F	3/28/2008
22		26	2		11/3/1982	M	M	12/1/2008

Select **Contains** from the available options. The **Custom AutoFilter** dialog box opens. Type Manager in the Box next to Contains.



	Title	BirthDate	MaritalStatus	Gender	HireDate
	Production Technician - WC60	3/13/1988	M	M	6/30/2006
	Marketing Assistant	5/3/1987	S	M	1/26/2007
	Engineering Manager	11/12/1974	M	M	11/11/2007
	Senior Tool Designer				12/5/2007
	Tool Designer				12/11/2007
	Marketing Manager				12/20/2007
	Production Control Manager				12/26/2007
	Design Engineer				1/6/2008
	Production Supervisor				1/6/2008
	Production Technician - WC10				1/7/2008
	Design Engineer				1/24/2008
	Vice President				1/31/2008
	Production Supervisor				2/2/2008
	Production Technician - WC10	7/11/1956	S	M	2/20/2008
	Production Supervisor - WC60	10/8/1956	S	F	2/27/2008
	Production Technician - WC10	4/4/1956	M	F	3/10/2008
	Production Supervisor - WC60	8/7/1956	M	M	3/17/2008

Custom AutoFilter

Show rows where:

Title

contains

Manager

☒ And ☐ Or

Use ? to represent any single character

Use \* to represent any series of characters

OK Cancel

Click OK. Only the Rows where Title contains Manager will be displayed.

EmployeeID	ManagerID	Title	BirthDate	MaritalStatus	Gender	HireDate
3	2	Engineering Manager	11/12/1974	M	M	11/11/2007
16	1	Marketing Manager	3/19/1975	S	M	12/20/2007
26	2	Production Control Manager	11/3/1982	M	M	12/1/2008
235	2	Human Resources Manager	2/11/1976	M	F	12/6/2008
263	1	Information Services Manager	12/13/1975	S	F	12/11/2008
249	2	Finance Manager	10/11/1984	S	F	12/25/2008
217	3	Document Control Manager	1/30/1976	M	M	1/4/2009
241	2	Accounts Manager	7/8/1983	M	M	1/30/2009
264	2	Network Manager	3/25/1984	S	F	2/4/2009
7	3	Research and Development Manager	2/24/1987	M	M	2/8/2009
211	2	Quality Assurance Manager	10/26/1977	S	M	2/28/2009
10	4	Research and Development Manager	11/30/1984	M	M	5/3/2009
227	2	Facilities Manager	2/18/1971	M	M	12/2/2009
274	2	North American Sales Manager	10/17/1951	M	M	1/4/2011
250	3	Purchasing Manager	2/10/1978	S	F	2/25/2011
287	2	European Sales Manager	9/20/1957	M	F	4/16/2012
285	2	Pacific Sales Manager	1/11/1975	M	M	3/14/2013

## Filter by Date

You can filter this data further such that only those Rows wherein the Title is "Manager" and HireDate is prior to 2011 can be displayed. That means you will display the Employee information for all the managers who have been with the organization from before 2011.

Click the arrow next to the column header HireDate. From the drop-down list, click **Date Filters**. The Date filter options appear. Select **Before** from the drop-down list.

**Date Filters**

**Custom AutoFilter** dialog box opens. Type 1/1/2011 in the box next to **is before**. You can also select the date from the date picker next to the box.

**Custom AutoFilter**

Show rows where:

HireDate

is before 1/1/2011

☒ And ☐ Or

Use ? to represent any single character

Use \* to represent any series of characters

OK Cancel

Click OK. Only the rows where Title contains Manager and HireDate is prior to 1/1/2011 will be displayed.

EmployeeID	ManagerID	Title	BirthDate	MaritalStatus	Gender	HireDate
3	2	Engineering Manager	11/12/1974	M	M	11/11/2007
16	1	Marketing Manager	3/19/1975	S	M	12/20/2007
26	2	Production Control Manager	11/3/1982	M	M	12/1/2008
235	2	Human Resources Manager	2/11/1976	M	F	12/6/2008
263	1	Information Services Manager	12/13/1975	S	F	12/11/2008
249	2	Finance Manager	10/11/1984	S	F	12/25/2008
217	3	Document Control Manager	1/30/1976	M	M	1/4/2009
241	2	Accounts Manager	7/8/1983	M	M	1/30/2009
264	2	Network Manager	3/25/1984	S	F	2/4/2009
7	3	Research and Development Manager	2/24/1987	M	M	2/8/2009
211	2	Quality Assurance Manager	10/26/1977	S	M	2/28/2009
10	4	Research and Development Manager	11/30/1984	M	M	5/3/2009
227	2	Facilities Manager	2/18/1971	M	M	12/2/2009
274	2	North American Sales Manager				1/4/2011
250	3	Purchasing Manager	2/10/1978	S	F	2/25/2011
287	2	European Sales Manager	9/20/1957	M	F	4/16/2012
285	2	Pacific Sales Manager	1/11/1975	M	M	3/14/2013



## Filter by Numbers

Consider the following data-

2	Student Code	Total Marks	Position
3	2015-16-Batch1-1	814	High
4	2015-16-Batch1-4	806	High
5	2015-16-Batch1-7	964	High
6	2015-16-Batch1-11	889	High
7	2015-16-Batch1-13	867	High
8	2015-16-Batch1-2	657	Medium
9	2015-16-Batch1-3	540	Medium
10	2015-16-Batch1-6	637	Medium
11	2015-16-Batch1-8	605	Medium
12	2015-16-Batch1-12	794	Medium
13	2015-16-Batch1-14	585	Medium
14	2015-16-Batch1-5	433	Low
15	2015-16-Batch1-9	493	Low
16	2015-16-Batch1-10	414	Low
17	2015-16-Batch1-15	448	Low

You can filter this data such that only those rows where Total Marks > 850 can be displayed.

Click the arrow next to the column header Total Marks. From the drop-down list, click **Number Filters**. The Number Filter options appear.

**Number Filters**

**Number Filter Options**

Student Code	Total Marks	Position
2015-16-Batch1-1	814	High
2015-16-Batch1-4	806	High
2015-16-Batch1-7	964	High
2015-16-Batch1-11	889	High
2015-16-Batch1-13	867	High
2015-16-Batch1-2	657	Medium
2015-16-Batch1-3	540	Medium
2015-16-Batch1-6	637	Medium
2015-16-Batch1-8	605	Medium
2015-16-Batch1-12	794	Medium
2015-16-Batch1-14	585	Medium
2015-16-Batch1-5	433	Low
2015-16-Batch1-9	493	Low
2015-16-Batch1-10	414	Low
2015-16-Batch1-15	448	Low

Number Filters menu options:

- Sort Smallest to Largest
- Sort Largest to Smallest
- Sort by Color
- Clear Filter From "Total Marks"
- Number Filters

Number Filter Options:

- Equals...
- Does Not Equal...
- Greater Than...
- Greater Than Or Equal To...
- Less Than...
- Less Than Or Equal To...
- Between...
- Top 10...
- Above Average
- Below Average
- Custom Filter...

Click **Greater Than**. **Custom AutoFilter** dialog box opens. Type 850 in the box next to **Greater Than**.

**Custom AutoFilter**

Show rows where:

Total Marks

is greater than 850

☒ And ☐ Or

Use ? to represent any single character  
Use \* to represent any series of characters

OK Cancel

Student Code	Total Marks	Position
2015-16-Batch1-1	814	High
2015-16-Batch1-4	806	High
2015-16-Batch1-7	964	High
2015-16-Batch1-11	889	High
2015-16-Batch1-13	867	High
2015-16-Batch1-2	657	Medium
2015-16-Batch1-3	540	Medium
2015-16-Batch1-6	637	Medium
2015-16-Batch1-8	605	Medium
2015-16-Batch1-12	794	Medium
2015-16-Batch1-14	585	Medium
2015-16-Batch1-5	433	Low
2015-16-Batch1-9	493	Low
2015-16-Batch1-10	414	Low
2015-16-Batch1-15	448	Low

Click OK. Only the rows wherein the total marks are greater than 850 will be displayed.


	A	B	C	D
1				
2		<b>Student Code</b> ▼	<b>Total Marks</b> ▼	<b>Position</b> ▼
5		2015-16-Batch1-7	964	High
6		2015-16-Batch1-11	889	High
7		2015-16-Batch1-13	867	High
10				

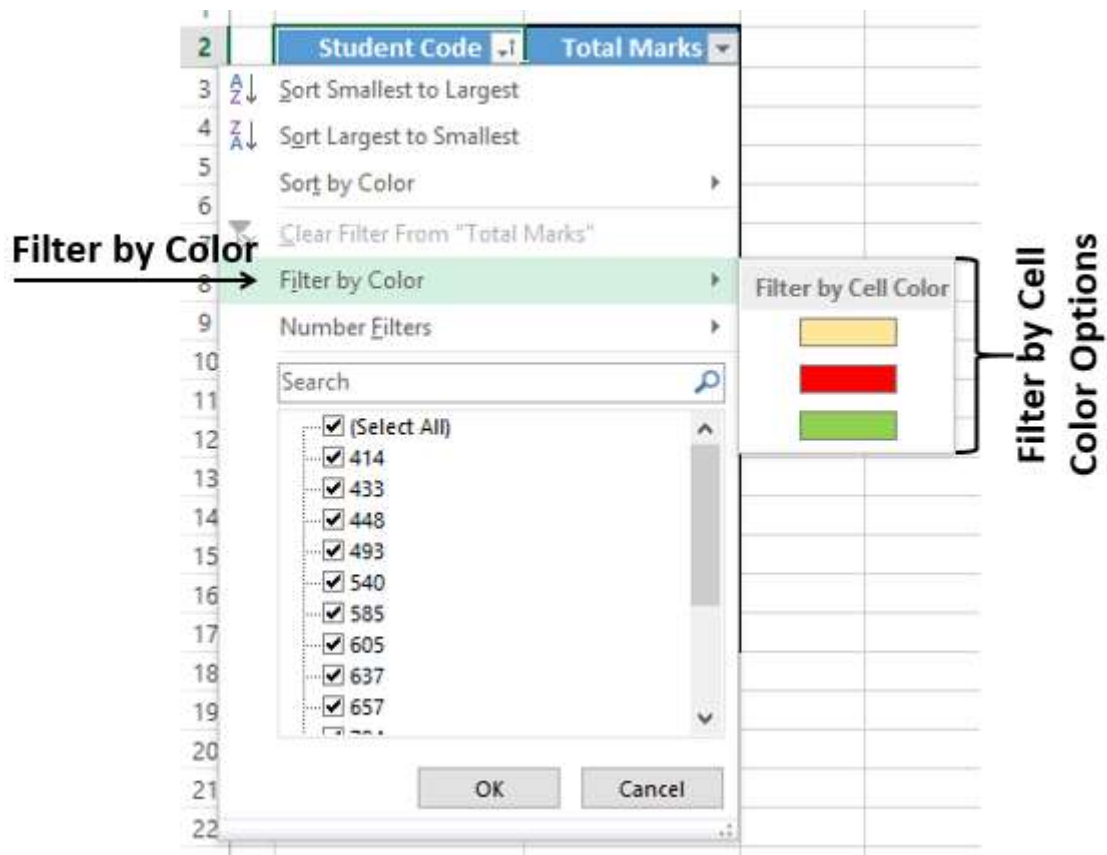
## Filter by Cell Color

If the data has different cell colors or is conditionally formatted, you can filter by the colors that are displayed in your table.

Consider the following data. The column Total Marks has conditional formatting with different cell colors.

<b>Student Code</b> ▼	<b>Total Marks</b> ▼
2015-16-Batch1-1	814
2015-16-Batch1-2	657
2015-16-Batch1-3	540
2015-16-Batch1-4	806
2015-16-Batch1-5	433
2015-16-Batch1-6	637
2015-16-Batch1-7	964
2015-16-Batch1-8	605
2015-16-Batch1-9	493
2015-16-Batch1-10	414
2015-16-Batch1-11	889
2015-16-Batch1-12	794
2015-16-Batch1-13	867
2015-16-Batch1-14	585
2015-16-Batch1-15	448

Click the arrow  in the header Total Marks. From the drop-down list, click **Filter by Color**. The **Filter by Cell Color** options appear.



Select the green color and click OK. Only the rows wherein the total marks column has green color cells will be displayed.


	A	B	C
1			
2		Student Code	Total Marks
9		2015-16-Batch1-7	964
13		2015-16-Batch1-11	889
15		2015-16-Batch1-13	867

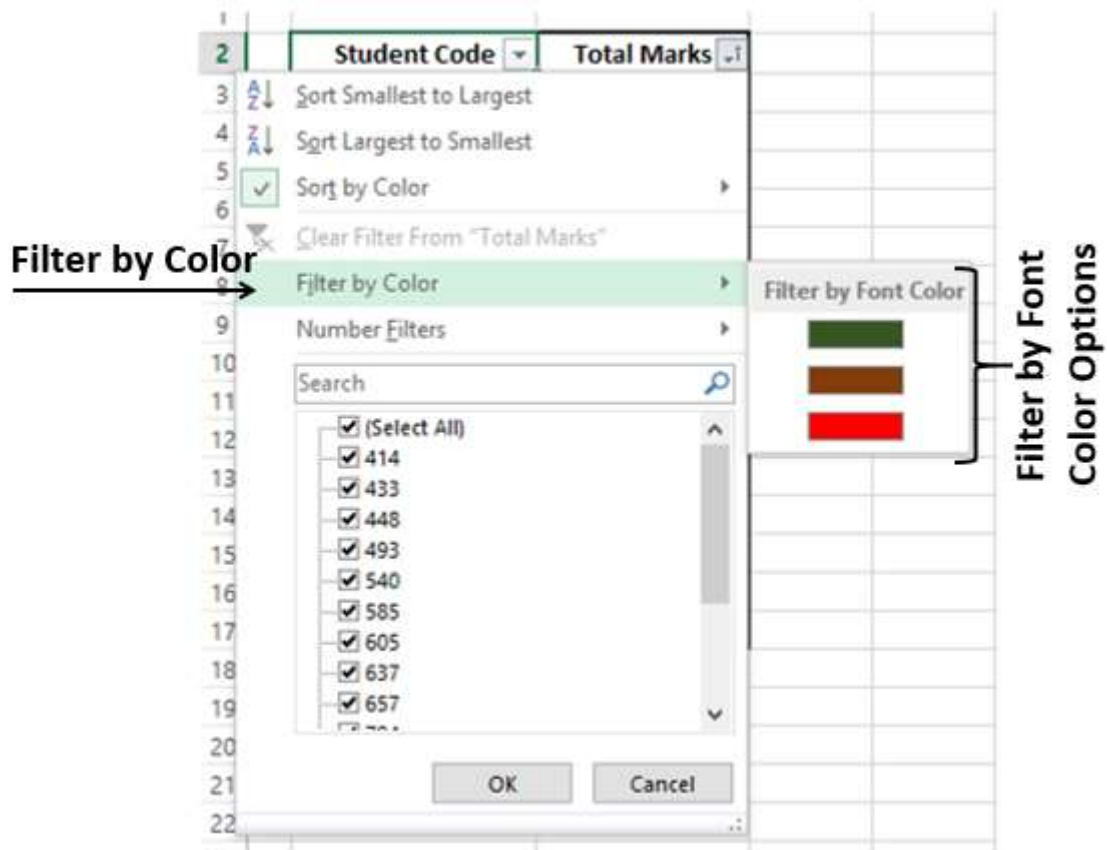
## Filter by Font Color

If the data has different font colors or is conditionally formatted, you can filter by the colors that are displayed in your table.

Consider the following data. The column - Total Marks has conditional formatting with font color applied.

B	C
Student Code	Total Marks
2015-16-Batch1-1	814
2015-16-Batch1-2	657
2015-16-Batch1-3	540
2015-16-Batch1-4	806
2015-16-Batch1-5	433
2015-16-Batch1-6	637
2015-16-Batch1-7	964
2015-16-Batch1-8	605
2015-16-Batch1-9	493
2015-16-Batch1-10	414
2015-16-Batch1-11	889
2015-16-Batch1-12	794
2015-16-Batch1-13	867
2015-16-Batch1-14	585
2015-16-Batch1-15	448

Click the arrow  in the header Total Marks. From the Drop-Down List, click **Filter by Color. Filter by Font Color** options appear.



Select the green color and click OK. Only the rows wherein the Total Marks column has green color font will be displayed.

Student Code	Total Marks
2015-16-Batch1-7	964
2015-16-Batch1-11	889
2015-16-Batch1-13	867


## Filter by Cell Icon

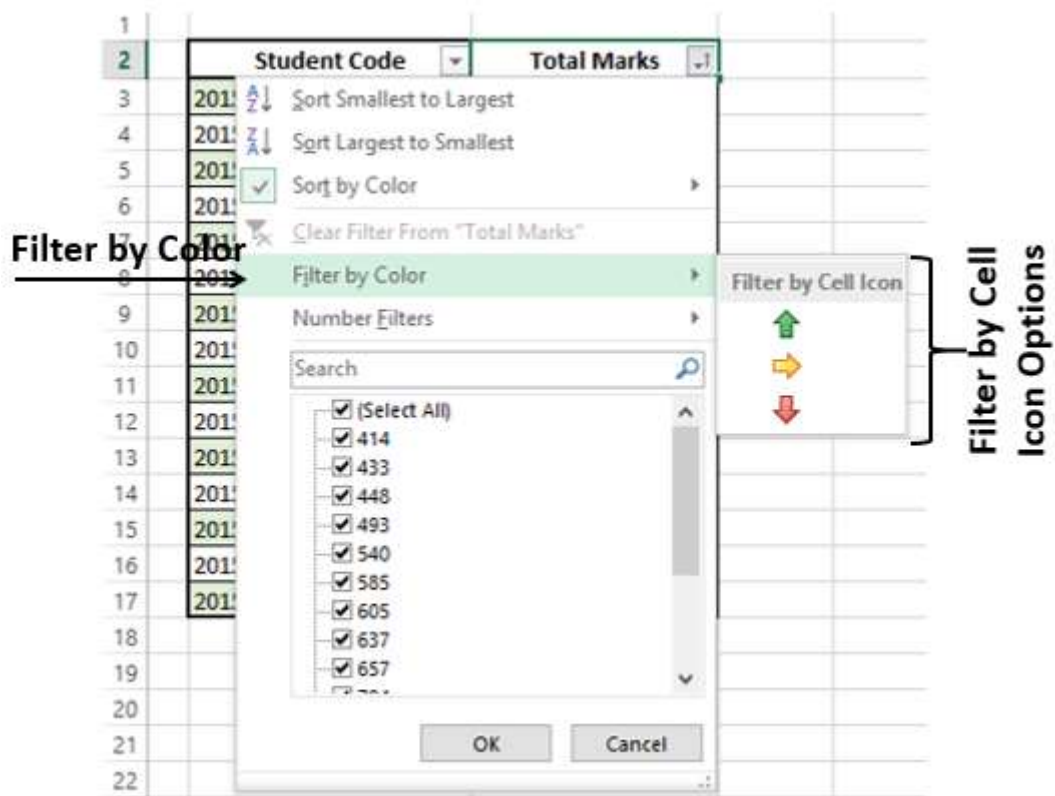
If the data has different icons or a conditional format, you can filter by the icons that are shown in your table.

Consider the following data. The column Total Marks has conditional formatting with icons applied.




	A	B	C
1			
2		Student Code	Total Marks
3		2015-16-Batch1-7	964
4		2015-16-Batch1-11	889
5		2015-16-Batch1-13	867
6		2015-16-Batch1-1	814
7		2015-16-Batch1-2	657
8		2015-16-Batch1-3	540
9		2015-16-Batch1-4	806
10		2015-16-Batch1-6	637
11		2015-16-Batch1-8	605
12		2015-16-Batch1-9	493
13		2015-16-Batch1-12	794
14		2015-16-Batch1-14	585
15		2015-16-Batch1-5	433
16		2015-16-Batch1-10	414
17		2015-16-Batch1-15	448







Click the arrow  in the header Total Marks. From the drop-down list, select **Filter by Color**. The **Filter by Cell Icon** options appear.



The screenshot shows the 'Total Marks' column header with a dropdown arrow. The dropdown menu is open, displaying options: 'Sort Smallest to Largest', 'Sort Largest to Smallest', 'Sort by Color' (checked), 'Clear Filter From "Total Marks"', and 'Filter by Color'. The 'Filter by Color' option is highlighted, and a secondary menu is visible showing 'Filter by Cell Icon' with three icons: a green up arrow, a yellow right arrow, and a red down arrow. A third menu is open, titled 'Filter by Cell Icon', showing a list of marks with checkboxes: (Select All), 414, 433, 448, 493, 540, 585, 605, 637, and 657. The 'Filter by Color' option is also highlighted in the main dropdown menu.

Select the icon  and click OK.

Only the rows wherein the Total Marks column has the  icon will be displayed.

Student Code	Total Marks
2015-16-Batch1-1	 814
2015-16-Batch1-4	 806
2015-16-Batch1-7	 964
2015-16-Batch1-11	 889
2015-16-Batch1-12	 794
2015-16-Batch1-13	 867

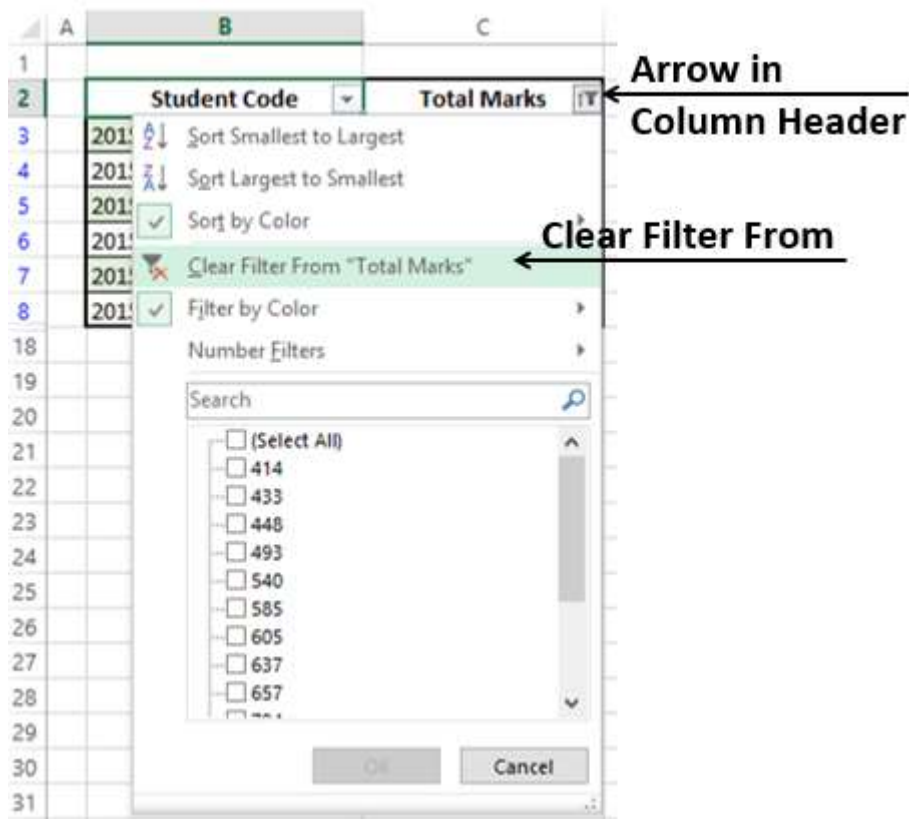
## Clear Filter

Removing filters is termed as **Clear Filter** in Excel.

You can remove

- A filter from a specific column, or
- All of the filters in the worksheet at once.


To remove a filter from a specific column, click the arrow in the table header of that column. From the drop-down menu, click **Clear Filter From "<specific Column Name>"**.



The filter in the column is removed. To remove filtering from the entire worksheet, select

 **Clear** in the

- **Editing** group on the **Home** tab, or
- **Sort & Filter** group in the **Data** tab.

All the filters in the worksheet are removed at once. Click **Undo Show All**  if you have removed the Filters by mistake.

## Reapply Filter

When changes occur in your data, click **Reapply** in **Sort & Filter** group on the **Data** tab. The defined filter will be applied again on the modified data.

## Advanced Filtering

You can use Advance Filtering if you want to filter the data of more than one column.

You need to define your filtering criteria as a range. Suppose you want to display the information of those employees who are specialists or whose EmployeeID is 2, define the Criteria as follows-

	A	B	C	D	E	F	G	H
1								
2		ManagerID	Title					
3		2						
4			*Specialist					
5								
6		EmployeeID	ManagerID	Title	BirthDate	MaritalStatus	Gender	HireDate
9		3	2	Engineering Manager	11/12/1974	M	M	11/11/2007
23		17	2	Marketing Assistant	5/3/1987	S	M	1/26/2007
24		18	2	Marketing Specialist	3/6/1978	S	M	2/7/2011
25		19	2	Marketing Assistant	1/29/1978	S	F	2/14/2011
26		20	2	Marketing Assistant	3/17/1975	M	F	1/7/2011
27		21	2	Marketing Specialist	2/4/1986	M	M	3/2/2015
28		22	2	Marketing Specialist	5/21/1987	S	M	12/12/2014
29		23	2	Marketing Specialist	9/13/1962	M	F	1/12/2015
30		24	2	Marketing Specialist	6/18/1979	M	F	1/18/2015
32		26	2	Production Control Manager	11/3/1982	M	M	12/1/2014
217		211	2	Quality Assurance Manager	10/26/1977	S	M	2/28/2015
224		218	4	Control Specialist	4/28/1990	S	M	12/16/2014
227		221	4	Control Specialist	5/26/1987	M	M	3/6/2015
228		222	2	Master Scheduler	9/17/1968	S	M	12/12/2014
233		227	2	Facilities Manager	2/18/1971	M	M	12/2/2015
241		235	2	Human Resources Manager	2/11/1976	M	F	12/6/2014
245		239	3	Benefits Specialist	11/20/1984	M	F	12/25/2014

- Next, click **Advanced** in the **Sort & Filter** group on the **Data** tab. The **Advanced Filter** dialog box appears.
- Specify the **List Range** and the **Criteria Range**.
- You can either **filter the list**, in place or copy to another location.
- In the filtering given below, **filter the data in place** is chosen.

	A	B	C	D	E	F	G	H
1								
2		ManagerID	Title					
3		2						
4			*Specialist					
5								
6		EmployeeID	ManagerID	Title	BirthDate	MaritalStatus	Gender	HireDate
9		3	2	Engineering Manager	11/12/1974	M	M	11/11/2007
23		17	2	Marketing Assistant	5/3/1987	S	M	1/26/2007
24		18	2	Marketing Specialist	3/6/1978	S	M	2/7/2011
25		19	2	Marketing Assistant	1/29/1978	S	F	2/14/2011
26		20	2	Marketing Assistant	3/17/1975	M	F	1/7/2011
27		21	2	Marketing Specialist	2/4/1986	M	M	3/2/2015
28		22	2	Marketing Specialist	5/21/1987	S	M	12/12/2014
29		23	2	Marketing Specialist	9/13/1962	M	F	1/12/2015
30		24	2	Marketing Specialist	6/18/1979	M	F	1/18/2015
32		26	2	Production Control Manager	11/3/1982	M	M	12/1/2014
217		211	2	Quality Assurance Manager	10/26/1977	S	M	2/28/2015
224		218	4	Control Specialist	4/28/1990	S	M	12/16/2014
227		221	4	Control Specialist	5/26/1987	M	M	3/6/2015
228		222	2	Master Scheduler	9/17/1968	S	M	12/12/2014
233		227	2	Facilities Manager	2/18/1971	M	M	12/2/2015
241		235	2	Human Resources Manager	2/11/1976	M	F	12/6/2014
245		239	3	Benefits Specialist	11/20/1984	M	F	12/25/2014

Advanced Filter

Action

☒ Filter the list, in-place

☐ Copy to another location

List range: \$B\$6:\$H\$296

Criteria range: \$B\$2:\$C\$4

Copy to:

☐ Unique records only

OK Cancel



The employee information where ManagerID = 2 **OR** Title = "\*Specialist" is displayed.

	A	B	C	D	E	F	G	H
1								
2		ManagerID	Title					
3		2						
4			*Specialist					
5								
6		EmployeeID	ManagerID	Title	BirthDate	MaritalStatus	Gender	HireDate
9		3	2	Engineering Manager	11/12/1974	M	M	11/11/2007
23		17	2	Marketing Assistant	5/3/1987	S	M	1/26/2007
24		18	2	Marketing Specialist	3/6/1978	S	M	2/7/2011
25		19	2	Marketing Assistant	1/29/1978	S	F	2/14/2011
26		20	2	Marketing Assistant	3/17/1975	M	F	1/7/2011
27		21	2	Marketing Specialist	2/4/1986	M	M	3/2/2015
28		22	2	Marketing Specialist	5/21/1987	S	M	12/12/2014
29		23	2	Marketing Specialist	9/13/1962	M	F	1/12/2015
30		24	2	Marketing Specialist	6/18/1979	M	F	1/18/2015
32		26	2	Production Control Manager	11/3/1982	M	M	12/1/2014
217		211	2	Quality Assurance Manager	10/26/1977	S	M	2/28/2015
224		218	4	Control Specialist	4/28/1990	S	M	12/16/2014
227		221	4	Control Specialist	5/26/1987	M	M	3/6/2015
228		222	2	Master Scheduler	9/17/1968	S	M	12/12/2014
233		227	2	Facilities Manager	2/18/1971	M	M	12/2/2015
241		235	2	Human Resources Manager	2/11/1976	M	F	12/6/2014
245		239	3	Benefits Specialist	11/20/1984	M	F	12/25/2014

Suppose you want to display information about specialists and vice presidents. You can define the criteria and filter as follows-

	A	B	C	D	E	F	G	H
1								
2		ManagerID	Title					
3		2	Vice President*					
4			*Specialist					
5								
6		EmployeeID	ManagerID	Title	BirthDate	MaritalStatus	Gender	HireDate
7		1	0	Chief Executive Officer	1/19/1950	M	M	1/14/2015
8		2	1	Vice President of Engineering	1/29/1950	F	F	1/31/2014
9		3	2	Engineering Manager	11/12/1974	M	M	11/11/2007
10		4	3	Senior Tool Designer	12/5/2007	M	M	12/5/2007
11		5	3	Design Engineer	1/6/2014	F	F	1/6/2014
12		6	3	Design Engineer	1/24/2014	M	M	1/24/2014
13		7	3	Research and Development Manager	2/8/2015	M	M	2/8/2015
14		8	4	Research and Development Engineer	12/29/2014	F	F	12/29/2014
15		9	4	Research and Development Engineer	1/16/2015	F	F	1/16/2015
16		10	4	Research and Development Manager	5/3/2015	M	M	5/3/2015
17		11	3	Senior Tool Designer	12/5/2010	M	M	12/5/2010
18		12	4	Tool Designer	12/11/2007	M	M	12/11/2007
19		13	4	Tool Designer	12/23/2010	F	F	12/23/2010
20		14	3	Senior Design Engineer	12/30/2010	M	M	12/30/2010
21		15	3	Design Engineer	1/18/2011	F	F	1/18/2011
22		16	1	Marketing Manager	12/20/2007	M	M	12/20/2007
23		17	2	Marketing Assistant	1/26/2007	M	M	1/26/2007

The criteria you applied is Title = "\*Specialist" OR Title = "Vice President". The employee information of specialists and vice presidents will be displayed.

	A	B	C	D	E	F	G	H
1								
2		ManagerID	Title					
3		2	Vice President*					
4			*Specialist					
5								
6		EmployeeID	ManagerID	Title	BirthDate	MaritalStatus	Gender	HireDate
8		2	1	Vice President of Engineering	8/1/1971	S	F	1/31/2014
24		18	2	Marketing Specialist	3/6/1978	S	M	2/7/2011
27		21	2	Marketing Specialist	2/4/1986	M	M	3/2/2015
28		22	2	Marketing Specialist	5/21/1987	S	M	12/12/2014
29		23	2	Marketing Specialist	9/13/1962	M	F	1/12/2015
30		24	2	Marketing Specialist	6/18/1979	M	F	1/18/2015
31		25	1	Vice President of Production	1/7/1983	S	M	2/3/2015
24		218	4	Control Specialist	4/28/1990	S	M	12/16/2014
27		221	4	Control Specialist	5/26/1987	M	M	3/6/2015
45		239	3	Benefits Specialist	11/20/1984	M	F	12/25/2014
48		242	3	Accounts Receivable Specialist	3/6/1976	M	F	12/18/2014
49		243	3	Accounts Receivable Specialist	2/23/1976	S	F	1/6/2015
50		244	3	Accounts Receivable Specialist	9/20/1984	S	M	1/24/2015
52		246	3	Accounts Payable Specialist	2/14/1977	M	M	2/11/2015
53		247	3	Accounts Payable Specialist	3/9/1979	M	F	3/1/2015
73		267	2	Application Specialist	5/19/1978	S	F	2/16/2015
74		268	2	Application Specialist	3/13/1988	S	M	2/3/2015

You **can copy the filtered data to another location**. You can also select only few columns to include in the copy operation.

- Copy EmployeeID, Title and SalariedFlag to the Cells Q2, R2, S2. This will be the first Row of your filtered data.
- Click on Advanced and in the Advanced Filter dialog box, click on Copy to another location. In the Copy to box, specify reference to the Headers you copied in another location, i.e. Q2:S2.

	A	B	C	D	E	F	G	H		Q	R	S
1												
2		ManagerID	Title							EmployeeID	Title	SalariedFlag
3		2	Vice President*									
4			*Specialist									
5												
6		EmployeeID	ManagerID	Title	BirthDate	MaritalStatus	Gender	HireDate				
7		1	0	Chief Executive Officer	1/29/1969	S	M	1/14/2015				
8		2	1	Vice President of Engineering			F	1/31/2014				
9		3	2	Engineering Manager			M	11/11/2007				
10		4	3	Senior Tool Designer			M	12/5/2007				
11		5	3	Design Engineer			F	1/6/2014				
12		6	3	Design Engineer			M	1/24/2014				
13		7	3	Research and Development Manager			M	2/8/2015				
14		8	4	Research and Development Engineer			F	12/29/2014				
15		9	4	Research and Development Engineer			F	1/16/2015				
16		10	4	Research and Development Manager			M	5/3/2015				
17		11	3	Senior Tool Designer			M	12/5/2010				
18		12	4	Tool Designer			M	12/11/2007				
19		13	4	Tool Designer			F	12/23/2010				
20		14	3	Senior Design Engineer	6/16/1979	S	M	12/30/2010				
21		15	3	Design Engineer	5/2/1961	M	F	1/18/2011				
22		16	1	Marketing Manager	3/19/1975	S	M	12/20/2007				
23		17	2	Marketing Assistant	5/3/1987	S	M	1/26/2007				

Click OK after specifying the **List Range** and **Criteria Range**. The selected columns in the filtered data will be copied to the location you specified.



Q	R	S
EmployeeID	Title	SalariedFlag
2	Vice President of Engineering	1
18	Marketing Specialist	0
21	Marketing Specialist	0
22	Marketing Specialist	0
23	Marketing Specialist	0
24	Marketing Specialist	0
25	Vice President of Production	1
218	Control Specialist	0
221	Control Specialist	0
239	Benefits Specialist	0
242	Accounts Receivable Specialist	0
243	Accounts Receivable Specialist	0
244	Accounts Receivable Specialist	0
246	Accounts Payable Specialist	0
247	Accounts Payable Specialist	0
267	Application Specialist	1
268	Application Specialist	1
269	Application Specialist	1
272	Application Specialist	1
273	Vice President of Sales	1

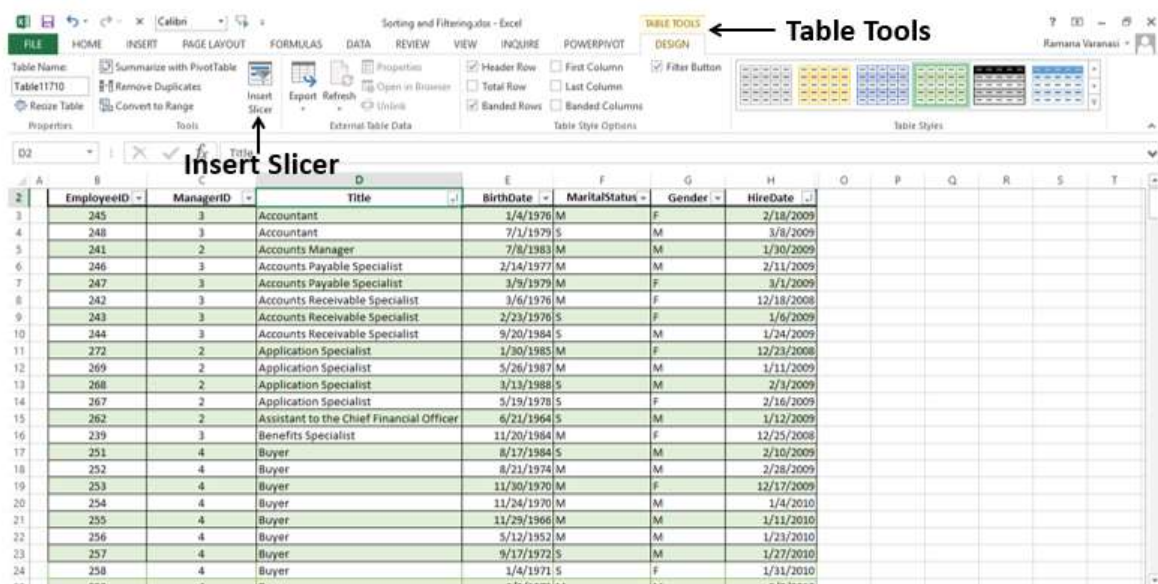
## Filter Using Slicers

**Slicers** to filter data in PivotTables were introduced in Excel 2010. In Excel 2013, you can use **Slicers** to filter data in tables also.

Consider the data in the following table.

	A	B	C	D	E	F	G	H
1								
2		<b>EmployeeID</b>	<b>ManagerID</b>	<b>Title</b>	<b>BirthDate</b>	<b>MaritalStatus</b>	<b>Gender</b>	<b>HireDate</b>
3		245	3	Accountant	1/4/1976	M	F	2/18/2009
4		248	3	Accountant	7/1/1979	S	M	3/8/2009
5		241	2	Accounts Manager	7/8/1983	M	M	1/30/2009
6		246	3	Accounts Payable Specialist	2/14/1977	M	M	2/11/2009
7		247	3	Accounts Payable Specialist	3/9/1979	M	F	3/1/2009
8		242	3	Accounts Receivable Specialist	3/6/1976	M	F	12/18/2008
9		243	3	Accounts Receivable Specialist	2/23/1976	S	F	1/6/2009
10		244	3	Accounts Receivable Specialist	9/20/1984	S	M	1/24/2009
11		272	2	Application Specialist	1/30/1985	M	F	12/23/2008
12		269	2	Application Specialist	5/26/1987	M	M	1/11/2009
13		268	2	Application Specialist	3/13/1988	S	M	2/3/2009
14		267	2	Application Specialist	5/19/1978	S	F	2/16/2009
15		262	2	Assistant to the Chief Financial Officer	6/21/1964	S	M	1/12/2009
16		239	3	Benefits Specialist	11/20/1984	M	F	12/25/2008
17		251	4	Buyer	8/17/1984	S	M	2/10/2009
18		252	4	Buyer	8/21/1974	M	M	2/28/2009
19		253	4	Buyer	11/30/1970	M	F	12/17/2009
20		254	4	Buyer	11/24/1970	M	M	1/4/2010
21		255	4	Buyer	11/29/1966	M	M	1/11/2010
22		256	4	Buyer	5/12/1952	M	M	1/23/2010
23		257	4	Buyer	9/17/1972	S	M	1/27/2010

- Click the Table.
- Click **Table Tools** that appear on the Ribbon.
- The **Design** Ribbon appears.
- Click **Insert Slicer**.



- **Insert Slicers** dialog box appears as shown in the screen shot given below.
- In the **Insert Slicers** dialog box, you will find all the column headers including those columns that are hidden.
- Check the boxes Title and HireDate. Click **OK**.

EmployeeID	ManagerID	Title	BirthDate	MaritalStatus
245	3	Accountant	1/4/1976	M
248	3	Accountant	7/1/1979	S
241	2	Accounts Manager	7/8/1983	M
246	3	Accounts Payable Specialist	2/14/1977	M
247	3	Accounts Payable Specialist	3/9/1979	M
242	3	Accounts Receivable Specialist	3/6/1976	M
243	3	Accounts Receivable Specialist	2/23/1976	S
244	3	Accounts Receivable Specialist	9/20/1984	S
272	2	Application Specialist	1/30/1985	M
269	2	Application Specialist	5/26/1987	M
268	2	Application Specialist	3/13/1988	S
267	2	Application Specialist	5/19/1978	S
262	2	Assistant to the Chief Financial Officer	6/21/1964	S
239	3	Benefits Specialist	11/20/1984	M
251	4	Buyer	8/17/1984	S
252	4	Buyer	8/21/1974	M
253	4	Buyer	11/30/1970	M
254	4	Buyer	11/24/1970	M
255	4	Buyer	11/29/1966	M
256	4	Buyer	5/12/1952	M
257	4	Buyer	9/17/1972	S

Insert Slicers

☐ EmployeeID  
☐ ManagerID  
☒ Title  
☐ BirthDate  
☐ MaritalStatus  
☐ Gender  
☒ HireDate  
☐ SalariedFlag  
☐ VacationHours  
☐ SickLeaveHours  
☐ CurrentFlag  
☐ rowguid  
☐ ModifiedDate

OK Cancel

A **Slicer** appears for each of the table headers you checked in the **Insert Slicers** dialog box. In each **Slicer**, all the values of that column will be highlighted.

EmployeeID	ManagerID	Title	BirthDate	MaritalStatus	Gender	HireDate
245	3	Accountant	1/4/1976	M	F	2/18/2009
248	3	Accountant	7/1/1979	S	M	3/8/2009
241	2	Accounts Manager				1/30/2009
246	3	Accounts Payable Specialist				2/11/2009
247	3	Accounts Payable Specialist				3/1/2009
242	3	Accounts Receivable Specialist				2/18/2008
243	3	Accounts Receivable Specialist				1/6/2009
244	3	Accounts Receivable Specialist				1/24/2009
272	2	Application Specialist				2/23/2008
269	2	Application Specialist				1/11/2009
268	2	Application Specialist				2/3/2009
267	2	Application Specialist				2/16/2009
262	2	Assistant to the Chief Financial Officer				1/12/2009
239	3	Benefits Specialist				2/25/2008
251	4	Buyer				2/10/2009
252	4	Buyer	8/21/1974	M	M	2/28/2009
253	4	Buyer	11/30/1970	M	F	12/17/2009
254	4	Buyer	11/24/1970	M	M	1/4/2010
255	4	Buyer	11/29/1966	M	M	1/11/2010
256	4	Buyer	5/12/1952	M	M	1/23/2010
257	4	Buyer	9/17/1972	S	M	1/27/2010
258	4	Buyer	1/4/1971	S	F	1/31/2010

In the **Title Slicer**, click the first value. Only that value will be highlighted and the rest of the values get unselected. Further, you will find the values in **HireDate Slicer** that are corresponding to the value in the **Title Slicer** also get highlighted.

In the table, only the selected values are displayed.

EmployeeID	ManagerID	Title	BirthDate	MaritalStatus	Gender	HireDate
245	3	Accountant	1/4/1976	M	F	2/18/2009
248	3	Accountant	7/1/1979	S	M	3/8/2009

**Title**

- Accountant
- Accounts Manager
- Accounts Payable S...
- Accounts Receivabl...
- Application Specialist
- Assistant to the Chi...
- Benefits Specialist
- Buyer

**HireDate**

- 2/18/2009
- 3/8/2009
- 6/30/2006
- 1/26/2007
- 11/11/2007
- 12/5/2007
- 12/11/2007
- 12/20/2007

You can select / deselect the values in the Slicers and you find that the data is automatically updated in the table. To choose more than one value, hold down the Ctrl key, and pick the values that you want to display.

Select the Title values that belong to the Accounts department and the HireDate values in the year 2015 from the two Slicers.

EmployeeID	ManagerID	Title	BirthDate	MaritalStatus	Gender	HireDate
245	3	Accountant	1/4/1976	M	F	2/18/2015
248	3	Accountant	7/1/1979	S	M	3/8/2015
246	3	Accounts Payable Specialist	2/14/1977	M	M	2/11/2015
247	3	Accounts Payable Specialist	3/9/1979	M	F	3/1/2015


  

**Title**

- Accountant
- Accounts Payable S...
- Application Specialist
- Buyer
- Control Specialist
- Document Control ...
- Facilities Administr...
- Facilities Manager

**HireDate**

- 2/11/2015
- 2/18/2015
- 3/1/2015
- 3/8/2015
- 6/30/2006
- 1/26/2007
- 11/11/2007
- 12/5/2007

You can clear the selections in any Slicer by clicking the Clear Filter  at the right end corner of the Slicer header.



# 12. Subtotals with Ranges

If you have a list of data that you want to group and summarize, you can use Excel **Subtotal** and **Outline** to display summary rows or columns. You can use **PivotTable** also for this purpose, but using **Subtotal** and **Outline** is the quickest way to analyze a range of data. Note that **Subtotal** and **Outline** can be used only on a range and not on a table.

You can create an **Outline** of up to eight levels, one for each group. Outer Levels are represented by Lower Numbers and Inner Levels by Higher Numbers. Each inner level displays detailed data for the preceding outer level.

To understand how to use **Subtotal** and **Outline**, consider the following example wherein the sales data of various items is given salesperson wise and location wise. In total, there are 1891 rows of data.

	A	B	C	D	E	F	G	H
1								
2		Invoice Number	Name	Date	Product	Units	Amount	Location
3		NOVIHW0001	Vicky	1/10/2013	Detergent Powder	35	406.52	North
4		SOMAF0002	Mathew	1/10/2013	Floor Cleaner	10	91.90	South
5		NORIDP0003	Ritchie	1/10/2013	Air Purifier	61	330.79	North
6		SOJAHW0004	Jane	1/10/2013	Floor Cleaner	89	54.40	South
7		SOSADP0005	Sara	1/10/2013	Floor Cleaner	32	126.15	South
8		SOVIAP0006	Vicky	1/10/2013	Soap	76	172.80	South
9		EAANH0007	Andy	1/10/2013	Hand Wash	85	379.65	East
10		EABODP0008	Bob	1/10/2013	Hand Wash	43	345.39	East
11		EAJADP0009	James	1/10/2013	Soap	20	55.30	East
12		EAMAAP0010	Mathew	1/10/2013	Floor Cleaner	14	72.67	East
13		EASASO0011	Sara	1/10/2013	Floor Cleaner	68	218.70	East
14		EAVIFC0012	Vicky	1/10/2013	Hand Wash	34	263.90	East
15		NOBODP0013	Bob	1/10/2013	Soap	88	233.74	North
16		WEBOAP0014	Bob	1/10/2013	Detergent Powder	30	166.71	West
17		WEJAHW0015	James	1/10/2013	Detergent Powder	60	305.43	West
18		WERIDP0016	Ritchie	1/10/2013	Hand Wash	7	72.57	West
19		WEVIDP0017	Vicky	1/10/2013	Hand Wash	42	367.21	West
20		SOKADP0018	Katherine	1/21/2013	Hand Wash	47	372.12	South
21		SORIAP0019	Ritchie	1/21/2013	Floor Cleaner	80	271.40	South
22		SOMAF0020	Mathew	1/21/2013	Detergent Powder	25	177.10	South
23		SOMAF0021	Mathew	1/21/2013	Hand Wash	67	151.34	South
24		SOMADP0022	Mathew	1/21/2013	Floor Cleaner	43	205.15	South
25		SOKADP0023	Katherine	1/21/2013	Floor Cleaner	96	65.51	South

Data

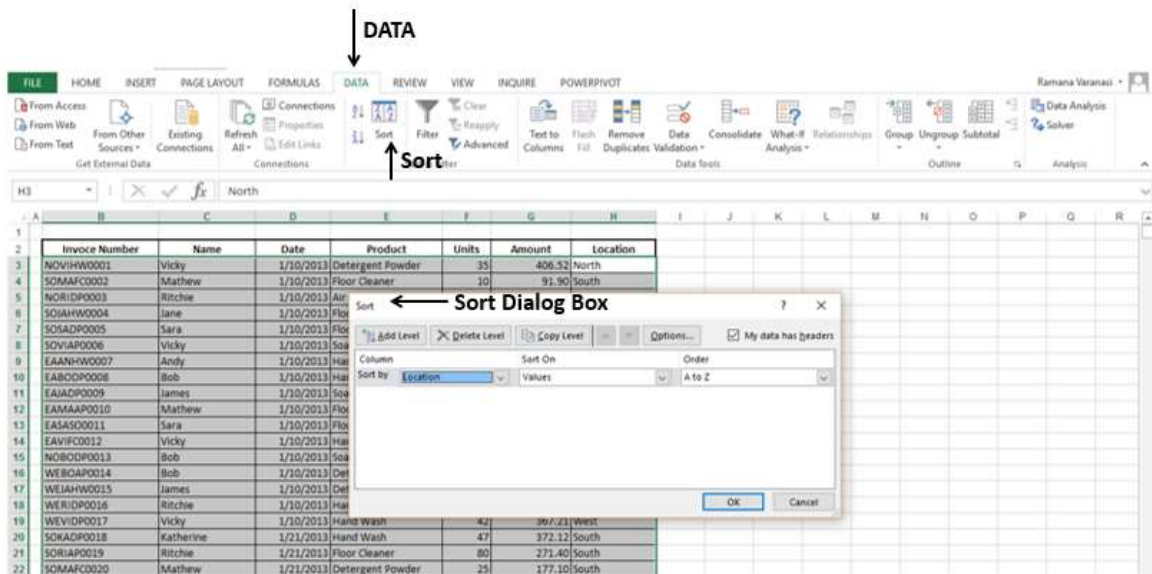
## Subtotals

You can obtain the sum of sales location wise using **Subtotal**.

First, sort the data location wise.

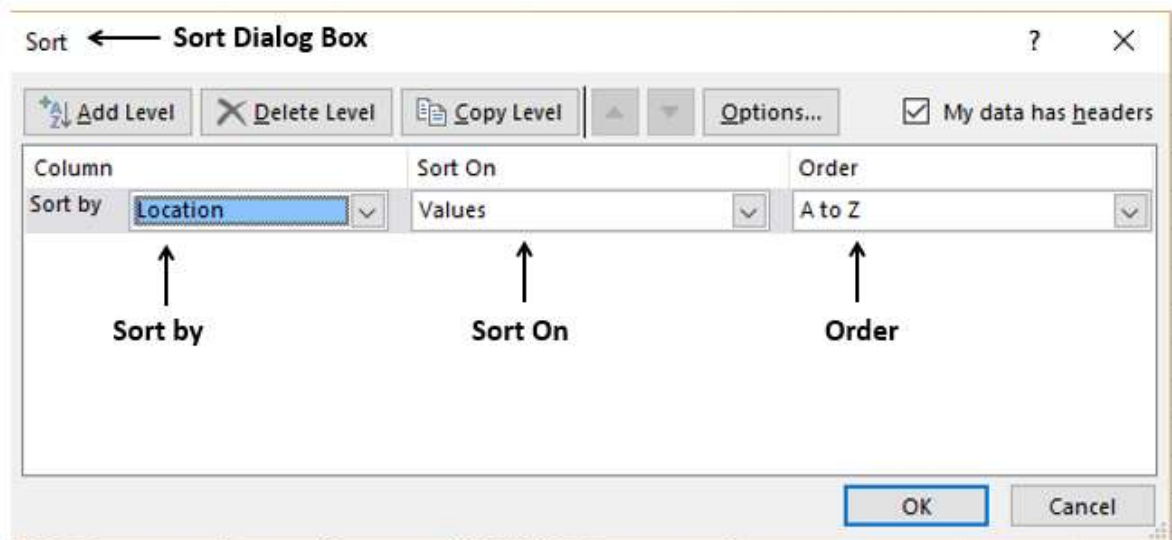
- Click anywhere on the data range.
- Click the **DATA** tab.
- Click **Sort**.

Data is selected. The **Sort** dialog box appears.



In the **Sort** dialog box,

- Select Location for **Sort by**
- Select Values for **Sort On**
- Select A to Z for **Order**



Click **OK**. The data is sorted location wise.



	A	B	C	D	E	F	G	H
1								
2		Invoice Number	Name	Date	Product	Units	Amount	Location
3		EAANHW0007	Andy	1/10/2013	Hand Wash	85	379.65	East
4		EABODP0008	Bob	1/10/2013	Hand Wash	43	345.39	East
5		EAIADP0009	James	1/10/2013	Soap	20	55.30	East
6		EAMAAP0010	Mathew	1/10/2013	Floor Cleaner	14	72.67	East
7		EASASO0011	Sara	1/10/2013	Floor Cleaner	68	218.70	East
8		EAVIFC0012	Vicky	1/10/2013	Hand Wash	34	263.90	East
9		EAKAFC0030	Katherine	1/21/2013	Hand Wash	69	293.97	East
10		EAKAFC0031	Katherine	1/21/2013	Soap	13	322.24	East
11		EASASO0032	Sara	1/21/2013	Detergent Powder	66	383.70	East
12		EAVIDP0033	Vicky	1/21/2013	Hand Wash	90	491.30	East
13		EAHASO0048	Hardley	2/1/2013	Floor Cleaner	79	437.35	East
14		EAMADP0049	Mathew	2/1/2013	Detergent Powder	88	175.54	East
15		EAVIFC0050	Vicky	2/1/2013	Air Purifier	52	301.80	East
16		EAANAP0069	Andy	2/12/2013	Floor Cleaner	42	97.30	East
17		EASAF00070	Sara	2/12/2013	Air Purifier	48	373.45	East
18		EAVIHW0071	Vicky	2/12/2013	Hand Wash	68	457.58	East
19		EAVIAP0072	Vicky	2/12/2013	Air Purifier	90	136.96	East
20		EAVISO0073	Vicky	2/12/2013	Soap	64	436.85	East
21		EAANSO0090	Andy	2/23/2013	Air Purifier	84	480.80	East
22		EAMAAP0091	Mathew	2/23/2013	Air Purifier	68	280.19	East
23		EARIDP0092	Ritchie	2/23/2013	Detergent Powder	62	160.83	East
24		EAANFC0106	Andy	3/6/2013	Air Purifier	47	290.15	East
25		EAANHW0107	Andy	3/6/2013	Soap	20	449.33	East

- Click anywhere on the Data Range.
- Click **DATA** tab.
- Click **Subtotal** in the **Outline** group. The data gets selected and the **Subtotal** dialog box appears.

The screenshot shows the Excel 2016 interface with the **DATA** tab selected. The **Outline** group in the ribbon contains the **Subtotal** button. The **Subtotal** dialog box is open, showing the following settings:

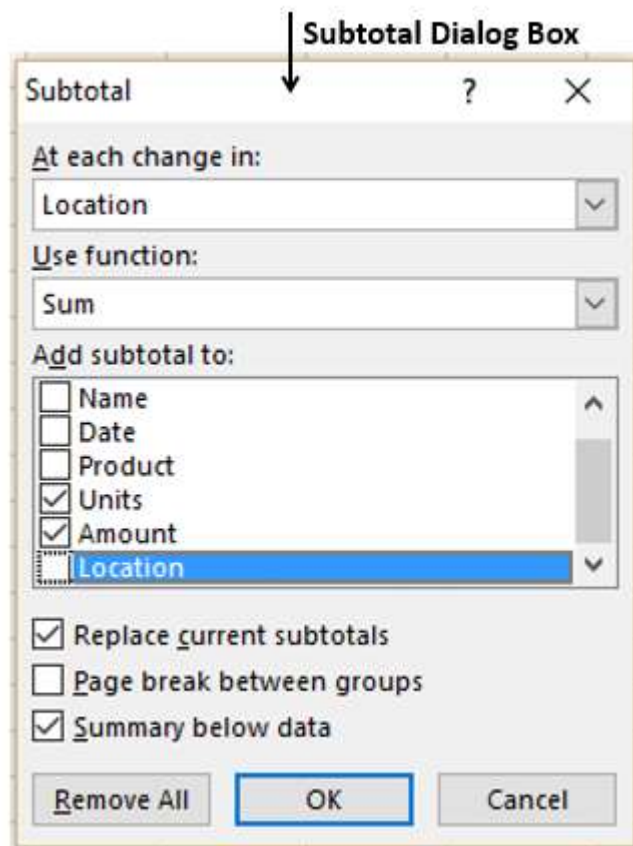
- At each change in:** Location
- Use function:** Sum
- Add subtotal to:** Name, Date, Product, Units, Amount, Location (all checked)
- ☒ Replace current subtotals
- ☐ Page break between groups
- ☒ Summary below data

The dialog box also has **Remove All**, **OK**, and **Cancel** buttons.

In the **Subtotal** dialog box,

- Select **Location** under **At each change in:**
- Select **Sum** under **Use function:**
- Select **Unit and Amount** under **Add subtotal to:**

- Select **Replace current subtotals**
- Select **Summary below data**



Click **OK**. The data is grouped with three levels and the subtotals are calculated location wise.

**Note:** The data that is displayed is of Level 3 – i.e. entire data.

**Outline Levels**

	A	B	C	D	E	F	G	H
1								
2		<b>Invoice Number</b>	<b>Name</b>	<b>Date</b>	<b>Product</b>	<b>Units</b>	<b>Amount</b>	<b>Location</b>
3		EAAHWW0007	Andy	1/10/2013	Hand Wash	85	379.65	East
4		EABODP0008	Bob	1/10/2013	Hand Wash	43	345.39	East
5		EAJADP0009	James	1/10/2013	Soap	20	55.30	East
6		EAMAAP0010	Mathew	1/10/2013	Floor Cleaner	14	72.67	East
7		EASASO0011	Sara	1/10/2013	Floor Cleaner	68	218.70	East
8		EAVIFC0012	Vicky	1/10/2013	Hand Wash	34	263.90	East
9		EAKAFC0030	Katherine	1/21/2013	Hand Wash	69	293.97	East
10		EAKAFC0031	Katherine	1/21/2013	Soap	13	322.24	East
11		EASASO0032	Sara	1/21/2013	Detergent Powder	66	383.70	East
12		EAVIFC0033	Vicky	1/21/2013	Hand Wash	90	491.30	East
13		EAHASO0048	Hardley	2/1/2013	Floor Cleaner	79	437.35	East
14		EAMADP0049	Mathew	2/1/2013	Detergent Powder	88	175.54	East
15		EAVIFC0050	Vicky	2/1/2013	Air Purifier	52	301.80	East
16		EAAAP0069	Andy	2/12/2013	Floor Cleaner	42	97.30	East
17		EASAF0070	Sara	2/12/2013	Air Purifier	48	373.45	East
18		EAVIHW0071	Vicky	2/12/2013	Hand Wash	68	457.58	East
19		EAVIAP0072	Vicky	2/12/2013	Air Purifier	90	136.96	East
20		EAVISO0073	Vicky	2/12/2013	Soap	64	436.85	East
21		EAANSO0090	Andy	2/23/2013	Air Purifier	84	480.80	East
22		EAMAAP0091	Mathew	2/23/2013	Air Purifier	68	280.19	East
23		EARIDP0092	Ritchie	2/23/2013	Detergent Powder	62	160.83	East
24		EAAANFC0106	Andy	3/6/2013	Air Purifier	47	290.15	East
25		EAAHWW0107	Andy	3/6/2013	Soap	20	449.33	East

Click the Outline Level 2. The **Totals** will be displayed location wise for units and amount.

**Outline Level 2**

	A	B	C	D	E	F	G	H
1								
2		<b>Invoice Number</b>	<b>Name</b>	<b>Date</b>	<b>Product</b>	<b>Units</b>	<b>Amount</b>	<b>Location</b>
459						24280	128759.20	East Total
884						22476	118859.28	North Total
1406						27270	139869.66	South Total
1897						25852	135168.00	West Total
1898						99878	522656.14	Grand Total
1899								
1900								

Click Outline Level 1. The **Grand Totals** will be displayed for units and amount.

**Outline Level 1**

	A	B	C	D	E	F	G	H
1								
2		<b>Invoice Number</b>	<b>Name</b>	<b>Date</b>	<b>Product</b>	<b>Units</b>	<b>Amount</b>	<b>Location</b>
1898						99878	522656.14	Grand Total

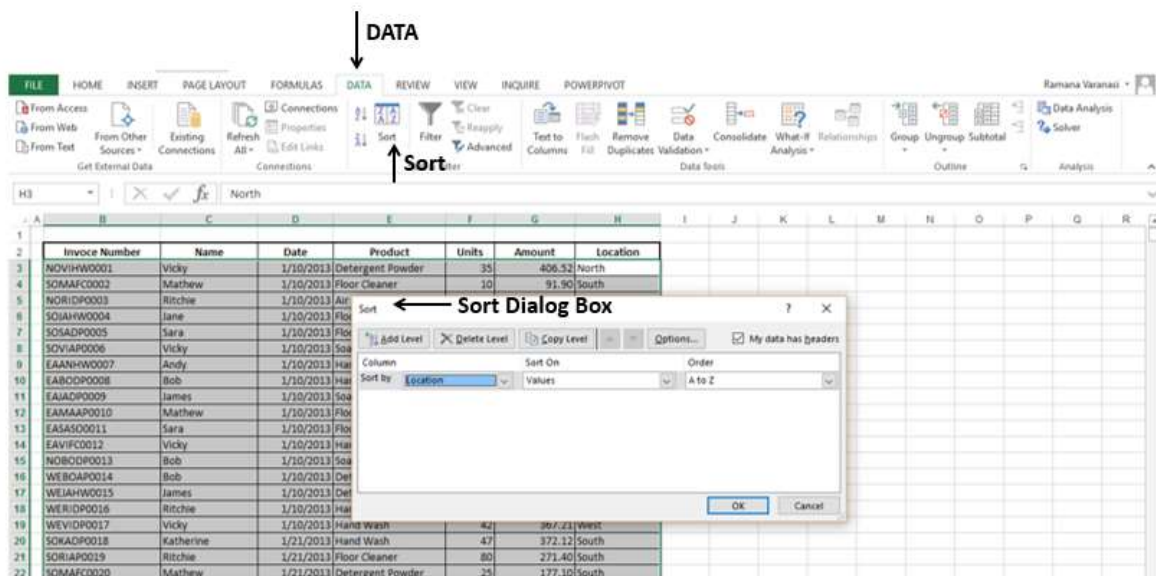
You can zoom-in or zoom-out the data by clicking the **Outline Levels** or by clicking the **+** Symbols to the left of the data.

## Nested Subtotals

You can obtain the sum of sales by each salesperson, location wise using **Nested Subtotals**.

**Sort** the data location wise and then salesperson wise.

- Click anywhere on the data range.
- Click the **DATA** tab.
- Click **Sort**. The data is selected and the **Sort** dialog box appears.

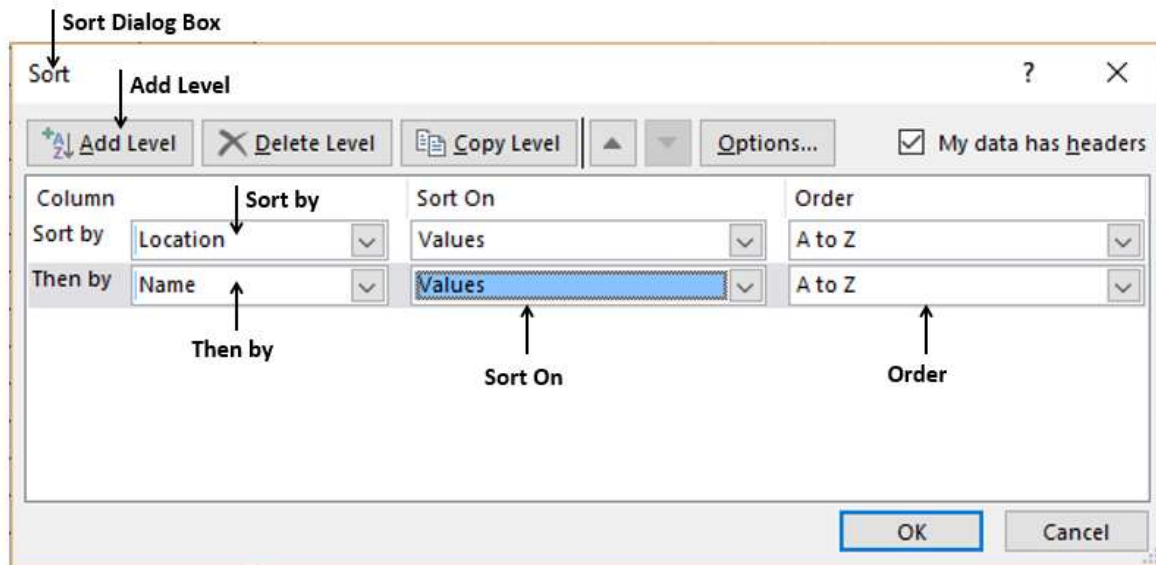


In the **Sort** dialog box,

- Select Location for **Sort by**
- Select Values for **Sort On**
- Select A to Z for **Order**
- Click on **Add Level**

**Then by** row appears.

- Select Name for **Then by**
- Select Values for **Sort On**
- Select A to Z for **Order**



Click **OK**. The data is sorted by location and then by name.

	A	B	C	D	E	F	G	H
1								
2		Invoice Number	Name	Date	Product	Units	Amount	Location
3		EAANHW0007	Andy	1/10/2013	Hand Wash	85	379.65	East
4		EAANAP0069	Andy	2/12/2013	Floor Cleaner	42	97.30	East
5		EAANSO0090	Andy	2/23/2013	Air Purifier	84	480.80	East
6		EAANFC0106	Andy	3/6/2013	Air Purifier	47	290.15	East
7		EAANHW0107	Andy	3/6/2013	Soap	20	449.33	East
8		EAANFC0196	Andy	4/30/2013	Detergent Powder	18	126.12	East
9		EAANFC0236	Andy	5/22/2013	Soap	67	123.58	East
10		EAANHW0283	Andy	6/13/2013	Hand Wash	60	498.63	East
11		EAANDP0296	Andy	6/24/2013	Hand Wash	47	465.86	East
12		EAANDP0317	Andy	7/5/2013	Hand Wash	93	210.97	East
13		EAANAP0351	Andy	7/27/2013	Soap	95	431.48	East
14		EAANAP0352	Andy	7/27/2013	Detergent Powder	73	376.30	East
15		EAANHW0384	Andy	8/18/2013	Detergent Powder	98	167.15	East
16		EAANHW0417	Andy	9/9/2013	Detergent Powder	74	176.59	East
17		EAANSO0452	Andy	10/1/2013	Hand Wash	45	205.37	East
18		EAANAP0453	Andy	10/1/2013	Floor Cleaner	85	55.54	East
19		EAANFC0454	Andy	10/1/2013	Floor Cleaner	50	223.53	East
20		EAANDP0651	Andy	1/26/2014	Air Purifier	94	231.98	East
21		EAANAP0691	Andy	2/17/2014	Soap	19	52.38	East
22		EAANFC0805	Andy	4/12/2014	Hand Wash	66	72.83	East
23		EAANFC0875	Andy	5/15/2014	Detergent Powder	91	62.44	East
24		EAANAP0876	Andy	5/15/2014	Detergent Powder	62	111.50	East
25		EAANAP0936	Andy	6/17/2014	Hand Wash	44	54.60	East

- Click anywhere on the Data Range
- Click on **DATA** tab
- Click on **Subtotal** in the **Outline** group

Data gets selected. **Subtotal** dialog box appears.



The screenshot shows the Excel 2016 interface with the **DATA** tab selected. The **Subtotal** button in the **Outline** group is highlighted. The **Subtotal** dialog box is open, showing the following settings:

- At each change in:** Location
- Use function:** Sum
- Add subtotal to:** Name, Date, Product, Units, Amount, Location (all checked)
- Replace current subtotals:** ☒
- Page break between groups:** ☐
- Summary below data:** ☒

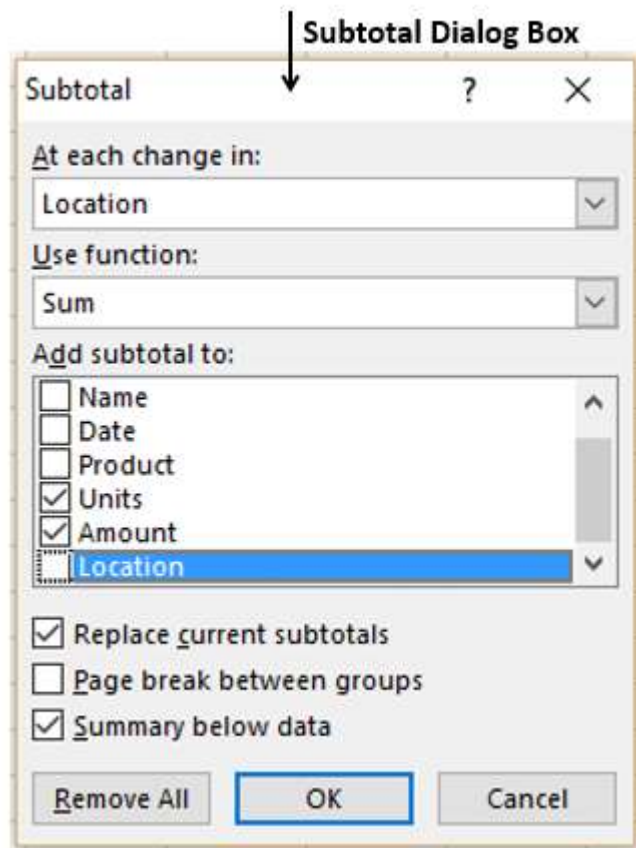
The data table below shows the following columns: Invoice Number, Name, Date, Product, Units, Amount, Location.

Invoice Number	Name	Date	Product	Units	Amount	Location
EAANH0007	Andy	1/10/2013	Hand Wash	85	379.65	East
EABOP0008	Bob	1/10/2013	Hand Wash	43	345.39	East
EAIAD0009	James	1/10/2013	Soap	20	55.30	East
EAMAP0010	Mathew	1/10/2013	Floor Cleaner	14	72.67	East
EASAS00011	Sara	1/10/2013	Floor Cleaner	68	218.70	East
EAVIF00012	Vicky	1/10/2013	Hand Wash	34	263.90	East
EAKAF00013	Katherine	1/21/2013	Hand Wash	69	293.97	East
EAKAF00014	Katherine	1/21/2013	Soap	13	322.24	East
EASAS00015	Sara	1/21/2013	Detergent Powder	66	383.70	East
EAVIF00016	Vicky	1/21/2013	Hand Wash	90	491.30	East
EAMAP00017	Mathew	2/1/2013	Floor Cleaner	79	437.35	East
EAMAP00018	Mathew	2/1/2013	Detergent Powder	88	175.54	East
EAVIF00019	Vicky	2/1/2013	Air Purifier	52	301.80	East
EAMAP00020	Andy	2/12/2013	Floor Cleaner	42	97.30	East
EASAF00021	Sara	2/12/2013	Air Purifier	48	373.45	East
EAVIF00022	Vicky	2/12/2013	Hand Wash	68	457.58	East
EAVIF00023	Vicky	2/12/2013	Air Purifier	90	136.96	East
EAVIF00024	Vicky	2/12/2013	Soap	64	436.85	East
EAMAP00025	Andy	2/23/2013	Air Purifier	84	480.80	East

In the **Subtotal** dialog box,

- Select Location under **At each change in:**
- Select Sum under **Use function:**
- Select Unit and Amount under **Add subtotal to:**
- Select **Replace current subtotals**
- Select **Summary below data**





Click **OK**. The data is grouped with three Levels and the subtotals are calculated location wise as described earlier.

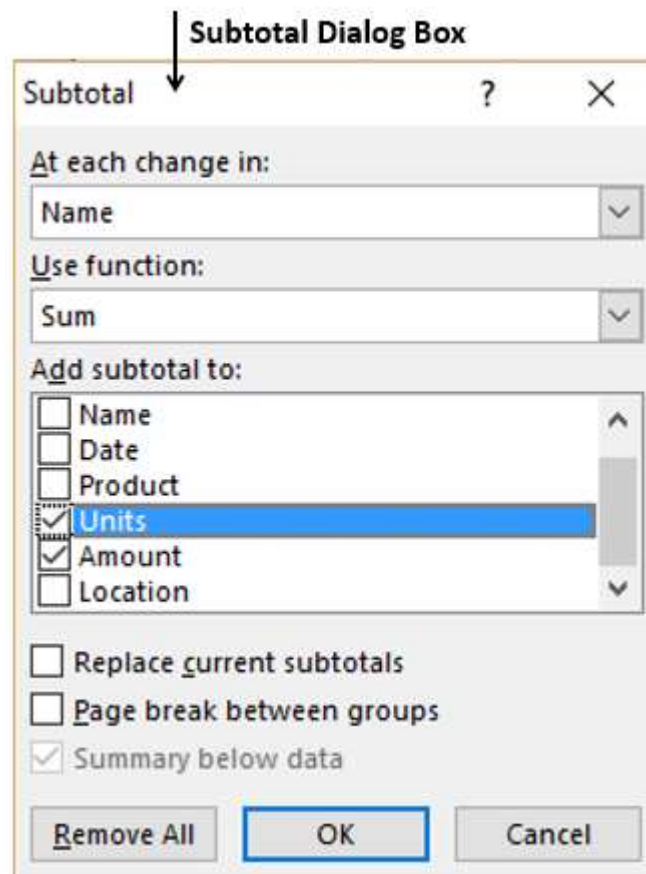
**Outline Levels**

	A	B	C	D	E	F	G	H
1								
2		<b>Invoice Number</b>	<b>Name</b>	<b>Date</b>	<b>Product</b>	<b>Units</b>	<b>Amount</b>	<b>Location</b>
3		EAANHW0007	Andy	1/10/2013	Hand Wash	85	379.65	East
4		EABODP0008	Bob	1/10/2013	Hand Wash	43	345.39	East
5		EAJADP0009	James	1/10/2013	Soap	20	55.30	East
6		EAMAAP0010	Mathew	1/10/2013	Floor Cleaner	14	72.67	East
7		EASASO0011	Sara	1/10/2013	Floor Cleaner	68	218.70	East
8		EAVIFC0012	Vicky	1/10/2013	Hand Wash	34	263.90	East
9		EAKAFC0030	Katherine	1/21/2013	Hand Wash	69	293.97	East
10		EAKAFC0031	Katherine	1/21/2013	Soap	13	322.24	East
11		EASASO0032	Sara	1/21/2013	Detergent Powder	66	383.70	East
12		EAVIDP0033	Vicky	1/21/2013	Hand Wash	90	491.30	East
13		EAHASO0048	Hardley	2/1/2013	Floor Cleaner	79	437.35	East
14		EAMADP0049	Mathew	2/1/2013	Detergent Powder	88	175.54	East
15		EAVIFC0050	Vicky	2/1/2013	Air Purifier	52	301.80	East
16		EAANAP0069	Andy	2/12/2013	Floor Cleaner	42	97.30	East
17		EASAF00070	Sara	2/12/2013	Air Purifier	48	373.45	East
18		EAVIHW0071	Vicky	2/12/2013	Hand Wash	68	457.58	East
19		EAVIAP0072	Vicky	2/12/2013	Air Purifier	90	136.96	East
20		EAVIS00073	Vicky	2/12/2013	Soap	64	436.85	East
21		EAANSO0090	Andy	2/23/2013	Air Purifier	84	480.80	East
22		EAMAAP0091	Mathew	2/23/2013	Air Purifier	68	280.19	East
23		EARIDP0092	Ritchie	2/23/2013	Detergent Powder	62	160.83	East
24		EAANFC0106	Andy	3/6/2013	Air Purifier	47	290.15	East
25		EAANHW0107	Andy	3/6/2013	Soap	20	449.33	East

- Click **Subtotal**.

In the **Subtotal** dialog box,

- Select Name under **At each change in:**
- Select Sum under **Use function:**
- Select Unit and Amount under **Add subtotal to:**
- Unselect Replace current subtotals**
- Select **Summary below data**



Click **OK**. The data is grouped with four levels and the subtotals are calculated location wise and name wise.

**Outline Levels**

	A	B	C	D	E	F	G	H
1								
2		<b>Invoice Number</b>	<b>Name</b>	<b>Date</b>	<b>Product</b>	<b>Units</b>	<b>Amount</b>	<b>Location</b>
3		EAANHW0007	Andy	1/10/2013	Hand Wash	85	379.65	East
4		EAANAP0069	Andy	2/12/2013	Floor Cleaner	42	97.30	East
5		EAANSO0090	Andy	2/23/2013	Air Purifier	84	480.80	East
6		EAANFC0106	Andy	3/6/2013	Air Purifier	47	290.15	East
7		EAANHW0107	Andy	3/6/2013	Soap	20	449.33	East
8		EAANFC0196	Andy	4/30/2013	Detergent Powder	18	126.12	East
9		EAANFC0236	Andy	5/22/2013	Soap	67	123.58	East
10		EAANHW0283	Andy	6/13/2013	Hand Wash	60	498.63	East
11		EAANDP0296	Andy	6/24/2013	Hand Wash	47	465.86	East
12		EAANDP0317	Andy	7/5/2013	Hand Wash	93	210.97	East
13		EAANAP0351	Andy	7/27/2013	Soap	95	431.48	East
14		EAANAP0352	Andy	7/27/2013	Detergent Powder	73	376.30	East
15		EAANHW0384	Andy	8/18/2013	Detergent Powder	98	167.15	East
16		EAANHW0417	Andy	9/9/2013	Detergent Powder	74	176.59	East
17		EAANSO0452	Andy	10/1/2013	Hand Wash	45	205.37	East
18		EAANAP0453	Andy	10/1/2013	Floor Cleaner	85	55.54	East
19		EAANFC0454	Andy	10/1/2013	Floor Cleaner	50	223.53	East
20		EAANDP0651	Andy	1/26/2014	Air Purifier	94	231.98	East
21		EAANAP0691	Andy	2/17/2014	Soap	19	52.38	East
22		EAANFC0805	Andy	4/12/2014	Hand Wash	66	72.83	East
23		EAANFC0875	Andy	5/15/2014	Detergent Powder	91	62.44	East
24		EAANAP0876	Andy	5/15/2014	Detergent Powder	62	111.50	East
25		EAANAP0936	Andy	6/17/2014	Hand Wash	44	54.60	East

Click **Outline Level 3**. The **Totals** will be displayed name wise and location wise for Units and Amount.

**Outline Level 3**

	A	B	C	D	E	F	G	H
1								
2		<b>Invoice Number</b>	<b>Name</b>	<b>Date</b>	<b>Product</b>	<b>Units</b>	<b>Amount</b>	<b>Location</b>
56			Andy Total			2911	13541.27	
97			Bob Total			2099	9795.11	
157			Hardley Total			3292	17047.29	
209			James Total			2684	15132.08	
256			Katherine Total			2611	13372.32	
299			Mathew Total			2255	10826.06	
350			Ritchie Total			2503	14497.89	
401			Sara Total			2481	16200.47	
467			Vicky Total			3444	18346.71	
488						24280	128759.20	East Total
519			Bob Total			3067	13322.73	
580			Hardley Total			2276	12018.48	
601			James Total			2204	10915.33	
654			Jane Total			2676	15103.03	
708			Katherine Total			2740	15391.27	
751			Mathew Total			2000	10914.86	
796			Ritchie Total			2645	13404.44	
857			Sara Total			2785	15307.51	
901			Vicky Total			2083	12481.63	
902						22476	118859.28	North Total
962			Bob Total			2957	13964.40	
1017			Hardley Total			3047	14726.47	
1076			James Total			2654	17528.85	

**Location-wise Totals**

Click on **Outline Level 2**. The **Totals** will be displayed location wise for Units and Amount.

↓ **Outline Level 2**

	A	B	C	D	E	F	G	H
1								
2		Invoice Number	Name	Date	Product	Units	Amount	Location
+	468					24280	128759.20	East Total
+	902					22476	118859.28	North Total
+	1433					27270	139869.66	South Total
+	1933					25852	135168.00	West Total
-	1934					99878	522656.14	Grand Total

Click **Outline Level 1**. The **Grand Totals** will be displayed for Units and Amount.

↓ **Outline Level 1**


	A	B	C	D	E	F	G	H
1								
2		Invoice Number	Name	Date	Product	Units	Amount	Location
+	1934					99878	522656.14	Grand Total

Units Grand Total ↓      Amount Grand Total ↓


You can zoom-in or zoom-out the data by clicking the **Outline Levels** or by clicking the **+** symbol to the Left of the data.

# 13. Quick Analysis

In Microsoft Excel 2013, the **Quick Analysis** tool makes it possible to analyze your data quickly and easily using different Excel tools.

You can use **Quick Analysis** with a range or a table of data. To access **Quick Access** tool, select the cells that contain the data you want to analyze. The **Quick Analysis** tool button  appears at the bottom right of your selected data.

	A	B	C	D	E	F
1	First Quarter Exam Scores					
2						
3	Student	Exam 1	Exam 2	Exam 3	Exam 4	
4	Kreiger, Doris	87	90	79	96	
5	Oliviera, Manuel	92	94	85	97	
6	Kodeda, Adam	88	95	75	80	
7	Lange, Michael	85	87	87	88	
8	Taylor, Maurice	81	88	82	85	
9						
10						

Quick Analysis Tool 

Click the **Quick Analysis**  button. The Quick Analysis toolbar appears with the options **FORMATTING**, **CHARTS**, **TOTALS**, **TABLES**, **SPARKLINES**.

	A	B	C	D	E	F	G	H	I
1	First Quarter Exam Scores								
2									
3	Student	Exam 1	Exam 2	Exam 3	Exam 4				
4	Kreiger, Doris	87	90	79	96				
5	Oliviera, Manuel	92	94	85	97				
6	Kodeda, Adam	88	95	75	80				
7	Lange, Michael	85	87	87	88				
8	Taylor, Maurice	81	88	82	85				
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									

Quick Analysis Toolbar

**FORMATTING** CHARTS TOTALS TABLES SPARKLINES

Data Bars Color... Icon Set Greater... Top 10% Clear...

Conditional Formatting uses rules to highlight interesting data.



**Quick Analysis** tool is handy and quick to use as you can also have a preview of applying different options, before selecting the one you want.

## Formatting

**Conditional Formatting** allows you to highlight parts of your data by adding Data Bars, Colors, etc. This lets you quickly visualize the values in your data.

You have learnt about formatting rules in the **Conditional Formatting** chapter in this tutorial. The difference is that you can have a quick preview and select the option you want. However, if you want to utilize all the features of **Conditional Formatting**, you rather go through the main menu on the Ribbon. The same thing holds for all the options in the **Quick Analysis** tool.

Click **Formatting** on the **Quick Analysis** toolbar. The **Conditional Formatting** options appear in the toolbar. Move your mouse on the options. You will see the previews. You can then select the option you want by clicking it.

First Quarter Exam Scores					
Student	Exam 1	Exam 2	Exam 3	Exam 4	
Kreiger, Doris	87	90	79	96	
Oliviera, Manuel	92	94	85	97	
Kodeda, Adam	88	95	75	80	
Lange, Michael	85	87	87	88	
Taylor, Maurice	81	88	82	85	

**FORMATTING**

CHARTS

TOTALS

TABLES

SPARKLINES

Data Bars

Color...

Icon Set

Greater...

Top 10%

Clear...

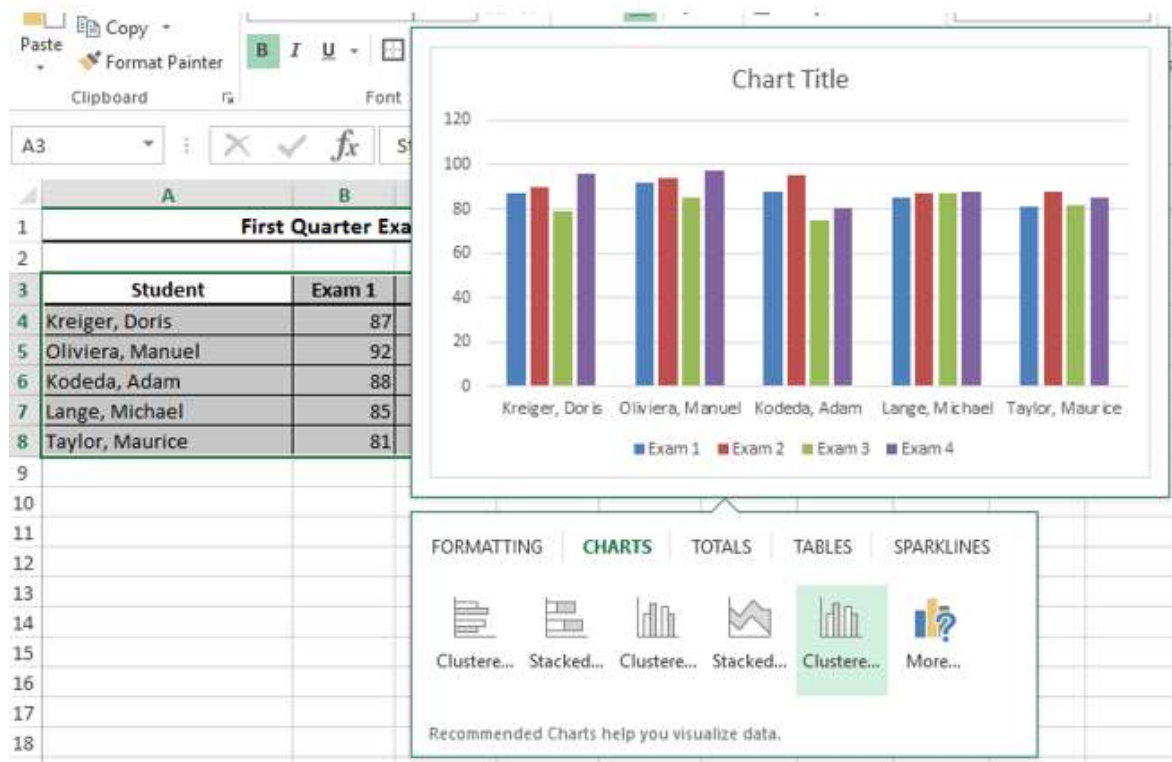
Conditional Formatting uses rules to highlight interesting data.

## Charts

**Charts** are used to depict the data pictorially. There are several types of **Charts** to suit different types of data.

If you click **CHARTS** on the **Quick Analysis** toolbar, the recommended charts for the data you have selected will be displayed. You can always choose **More Charts** option if you want to go to the main **Charts** on the Ribbon.

Hover your mouse on the options. You will see the previews. You can then select the option you want by clicking it.



## Totals

**Totals** can be used to calculate the numbers in columns and rows. You will have functions such as Sum, Average, Count, etc.

We will go into the details on how to use **Quick Analysis** tool with **TOTALS** later in this chapter. You can use the other options in **Quick Analysis** with the same ease, as you observe.

## Tables

**Tables** help you to filter, sort and summarize your data, as you have already learnt in the **Tables** chapter. In the **Quick Analysis** tool, both the **Table** and **PivotTable** options are available under **TABLES**. However, you can have a preview for the table, but in the case of **PivotTable** no preview is available as by clicking you will get an empty **PivotTable** which you need to populate with the data.

	A	B	C	D	E	F	G	H	I
1	<b>First Quarter Exam Scores</b>								
2									
3	<b>Student</b>	<b>Exam 1</b>							
4	Kreiger, Doris	87							
5	Oliviera, Manuel	92							
6	Kodeda, Adam	88							
7	Lange, Michael	85							
8	Taylor, Maurice	81							

Student	Exam 1	Exam 2	Exam 3	Exam 4
Kreiger, Doris	87	90	79	96
Oliviera, Manuel	92	94	85	97
Kodeda, Adam	88	95	75	80
Lange, Michael	85	87	87	88
Taylor, Maurice	81	88	82	85

FORMATTING | CHARTS | TOTALS | **TABLES** | SPARKLINES

Table Blank...

Tables help you sort, filter, and summarize data.

## Sparklines

**Sparklines** are tiny charts that you can show alongside your data in single cells. They provide a quick way to see trends.

Student	Exam 1	Exam 2	Exam 3	Exam 4
Kreiger, Doris	87	90	79	96
Oliviera, Manuel	92	94	85	97
Kodeda, Adam	88	95	75	80
Lange, Michael	85	87	87	88
Taylor, Maurice	81	88	82	85

FORMATTING | CHARTS | TOTALS | TABLES | **SPARKLINES**

Line Column Win/Loss






Sparklines are mini charts placed in single cells.






## Quick Analysis with TOTALS

Click on **TOTALS** in the **Quick Analysis** Toolbar.

In **Quick Analysis** with **TOTALS**, you can analyze

- Row-wise
 

 Sum
  Average
  Count
  % Total
  Running...
- Column-wise
 

 Sum
  Average
  Count
  % Total
  Running...

For row wise calculations, ensure that you have an empty row below the selected data.

### Example

We will analyze the data of the votes polled in an election for five candidates. The counting is done in four rounds. Following is the data.

	A	B	C	D	E
1	<b>Candidate Votes</b>				
2					
3	<b>Candidate</b>	<b>Round 1</b>	<b>Round 2</b>	<b>Round 3</b>	<b>Round 4</b>
4	Kreiger, Doris	870	1500	7900	9600
5	Oliviera, Manuel	920	1800	8500	9700
6	Kodeda, Adam	880	950	7500	8000
7	Lange, Michael	850	870	8700	8800
8	Taylor, Maurice	810	1880	8200	8500

### Sum



Select the data and Click **Sum** on the **Quick Analysis** toolbar under **TOTALS**.

Ensure that the row below the data is empty. Otherwise, you will get a message saying that there is already data present there and you will only have two options, either replace the existing data or cancel the operation.

In the row below the selected data, the sum of each column of the data is displayed. The caption **Sum** is also automatically provided. This means the total count of votes in each round for all the candidates is displayed.

	A	B	C	D	E
1	<b>Candidate Votes</b>				
2					
3	<b>Candidate</b>	<b>Round 1</b>	<b>Round 2</b>	<b>Round 3</b>	<b>Round 4</b>
4	Kreiger, Doris	870	1500	7900	9600
5	Oliviera, Manuel	920	1800	8500	9700
6	Kodeda, Adam	880	950	7500	8000
7	Lange, Michael	850	870	8700	8800
8	Taylor, Maurice	810	1880	8200	8500
9	<b>Sum</b>	<b>4330</b>	<b>7000</b>	<b>40800</b>	<b>44600</b>

Caption (points to cell A9)  
 Results (bracketed under columns B-E, row 9)

## Average



Select the data and click **Average** on the **Quick Analysis** Toolbar under **TOTALS**.

The average of each column of the data appears in the row below the data. The caption **Average** is also automatically provided. The average number of votes polled in each round is displayed.

	A	B	C	D	E
1	<b>Candidate Votes</b>				
2					
3	<b>Candidate</b>	<b>Round 1</b>	<b>Round 2</b>	<b>Round 3</b>	<b>Round 4</b>
4	Kreiger, Doris	870	1500	7900	9600
5	Oliviera, Manuel	920	1800	8500	9700
6	Kodeda, Adam	880	950	7500	8000
7	Lange, Michael	850	870	8700	8800
8	Taylor, Maurice	810	1880	8200	8500
9	<b>Average</b>	<b>866</b>	<b>1400</b>	<b>8160</b>	<b>8920</b>

Caption (points to cell A9)  
 Results (bracketed under columns B-E, row 9)

## Count



Select the data and click **Count** on the **Quick Analysis** Toolbar under **TOTALS**.

The count of each column of the data appears in the row below the data. The caption **Count** is also automatically provided. This means the count of candidates in each round is displayed.

	A	B	C	D	E
1	<b>Candidate Votes</b>				
2					
3	<b>Candidate</b>	<b>Round 1</b>	<b>Round 2</b>	<b>Round 3</b>	<b>Round 4</b>
4	Kreiger, Doris	870	1500	7900	9600
5	Oliviera, Manuel	920	1800	8500	9700
6	Kodeda, Adam	880	950	7500	8000
7	Lange, Michael	850	870	8700	8800
8	Taylor, Maurice	810	1880	8200	8500
9	<b>Count</b>	5	5	5	5

Caption
Results

## %Total



Select the data and click **% Total** on the **Quick Analysis** Toolbar under **TOTALS**.

The **%Total** of each column of the data appears in the row below the data. The caption **%Total** is also automatically provided. This means the **%Total** of votes in each round is displayed.



	A	B	C	D	E
1	<b>Candidate Votes</b>				
2					
3	<b>Candidate</b>	<b>Round 1</b>	<b>Round 2</b>	<b>Round 3</b>	<b>Round 4</b>
4	Kreiger, Doris	870	1500	7900	9600
5	Oliviera, Manuel	920	1800	8500	9700
6	Kodeda, Adam	880	950	7500	8000
7	Lange, Michael	850	870	8700	8800
8	Taylor, Maurice	810	1880	8200	8500
9	<b>% Total</b>	<b>4.48%</b>	<b>7.24%</b>	<b>42.18%</b>	<b>46.11%</b>

Caption
Results

## Running Total



Select the data and Click **Running...** on the **Quick Analysis** Toolbar under **TOTALS**.

The running total of each column of the data appears in the row below the data. The caption **Running Total** is also automatically provided. This means the running total of votes across the rounds is displayed.

	A	B	C	D	E
1	<b>Candidate Votes</b>				
2					
3	<b>Candidate</b>	<b>Round 1</b>	<b>Round 2</b>	<b>Round 3</b>	<b>Round 4</b>
4	Kreiger, Doris	870	1500	7900	9600
5	Oliviera, Manuel	920	1800	8500	9700
6	Kodeda, Adam	880	950	7500	8000
7	Lange, Michael	850	870	8700	8800
8	Taylor, Maurice	810	1880	8200	8500
9	<b>Running Total</b>	<b>4330</b>	<b>11330</b>	<b>52130</b>	<b>96730</b>

Caption
Results

## Sum of Columns



Select the data and click **Sum** on the **Quick Analysis** toolbar under **TOTALS**.

Ensure that the column next to the data is empty. Otherwise, you will get a message saying that there is already data present there and you will only have two options, either replace the existing data or cancel the operation.

In the column next to the selected data, the sum of each row of the data is displayed. The column header **Sum** is also automatically provided. This means the total number of votes polled for each candidate in all the rounds is displayed.

	A	B	C	D	E	F
1	<b>Candidate Votes</b>					
2						
3	<b>Candidate</b>	<b>Round 1</b>	<b>Round 2</b>	<b>Round 3</b>	<b>Round 4</b>	<b>Sum</b>
4	Kreiger, Doris	870	1500	7900	9600	19870
5	Oliviera, Manuel	920	1800	8500	9700	20920
6	Kodeda, Adam	880	950	7500	8000	17330
7	Lange, Michael	850	870	8700	8800	19220
8	Taylor, Maurice	810	1880	8200	8500	19390

Column  
Header

Results

# 14. Lookup Functions

You can use Excel functions to-

- Find values in a range of data - VLOOKUP and HLOOKUP
- Obtain a value or the reference to a value from within a table or range - INDEX
- Obtain the relative position of a specified item in a range of cells - MATCH

You can also combine these functions to get the required results based on the inputs you have.

## Using VLOOKUP Function

---

The syntax of the VLOOKUP function is

VLOOKUP (lookup_value, table_array, col_index_num, [range_lookup])
--

Where

- **lookup\_value** - is the value you want to look up. Lookup\_value can be a value or a reference to a cell. Lookup\_value must be in the first column of the range of cells you specify in table\_array
- **table\_array** - is the range of cells in which the VLOOKUP will search for the lookup\_value and the return value. table\_array must contain
  - the lookup\_value in the first column, and
  - the return value you want to find

**Note:** The first column containing the lookup\_value can either be sorted in ascending order or not. However, the result will be based on the order of this column.

- **col\_index\_num** - is the column number in the table\_array that contains the return value. The numbers start with 1 for the left-most column of table-array
- **range\_lookup** - is an optional logical value that specifies whether you want VLOOKUP to find an exact match or an approximate match. range\_lookup can be
  - omitted, in which case it is assumed to be TRUE and VLOOKUP tries to find an approximate match
  - TRUE, in which case VLOOKUP tries to find an approximate match. In other words, if an exact match is not found, the next largest value that is less than lookup\_value is returned
  - FALSE, in which case VLOOKUP tries to find an exact match

- 1, in which case it is assumed to be TRUE and VLOOKUP tries to find an approximate match
- 0, in which case it is assumed to be FALSE and VLOOKUP tries to find an exact match

**Note:** If range\_lookup is omitted or TRUE or 1, VLOOKUP works correctly only when the first column in table\_array is sorted in ascending order. Otherwise, it may result in incorrect values. In such a case, use FALSE for range\_lookup.

## Using VLOOKUP Function with range\_lookup TRUE

Consider a list of student marks. You can obtain the corresponding grades with VLOOKUP from an array containing the marks intervals and pass category.

table\_array:

Student Grades	
Marks	Pass Category
0	Fail
35	Third Class
50	Second Class
60	First Class
75	First Class with Distinction

Note that the first column marks based on which the grades are obtained is sorted in ascending order. Hence, using TRUE for range\_lookup argument you can get approximate match that is what is required.

Name this array as **Grades**.

It is a good practice to name arrays in this way so that you need not remember the cell ranges. Now, you are ready to look up the grade for the list of marks you have as follows

	A	B	C	D	E	F
1						
2		<b>Exam Results</b>			<b>Student Grades</b>	
3		<b>Marks</b>	<b>Pass Category</b>		<b>Marks</b>	<b>Pass Category</b>
4		85	=VLOOKUP(B4,Grades,2,TRUE)		0	Fail
5		75	=VLOOKUP(B5,Grades,2,TRUE)		35	Third Class
6		72	=VLOOKUP(B6,Grades,2,TRUE)		50	Second Class
7		55	=VLOOKUP(B7,Grades,2,TRUE)		60	First Class
8		68	=VLOOKUP(B8,Grades,2,TRUE)		75	First Class with Distinction
9		34	=VLOOKUP(B9,Grades,2,TRUE)			
10		60	=VLOOKUP(B10,Grades,2,TRUE)			
11		50	=VLOOKUP(B11,Grades,2,TRUE)			
12		98	=VLOOKUP(B12,Grades,2,TRUE)			
13		59	=VLOOKUP(B13,Grades,2,TRUE)			
14		74	=VLOOKUP(B14,Grades,2,TRUE)			
15		99	=VLOOKUP(B15,Grades,2,TRUE)			
16		40	=VLOOKUP(B16,Grades,2,TRUE)			
17		35	=VLOOKUP(B17,Grades,2,TRUE)			

table\_array

← VLOOKUP Function

As you can observe,

- **col\_index\_num** - indicates the column of the return value in table\_array is 2
- **the range\_lookup** is TRUE
  - The first column containing the lookup value in the table\_array grades is in ascending order. Hence, the results will be correct.
  - You can get the return value for approximate matches also. i.e. VLOOKUP computes as follows-

<b>Marks</b>	<b>Pass Category</b>
< 35	Fail
>= 35 and < 50	Third Class
>= 50 and < 60	Second Class
>=60 and < 75	First Class
>= 75	First Class with Distinction

You will get the following results-

	A	B	C	D	E	F
1						
2		<b>Exam Results</b>			<b>Student Grades</b>	
3		<b>Marks</b>	<b>Pass Category</b>		<b>Marks</b>	<b>Pass Category</b>
4		85	First Class with Distinction		0	Fail
5		75	First Class with Distinction		35	Third Class
6		72	First Class		50	Second Class
7		55	Second Class		60	First Class
8		68	First Class		75	First Class with Distinction
9		34	Fail			
10		60	First Class			
11		50	Second Class			
12		98	First Class with Distinction			
13		59	Second Class			
14		74	First Class			
15		99	First Class with Distinction			
16		40	Third Class			
17		35	Third Class			

## Using VLOOKUP Function with range\_lookup FALSE

Consider a list of products containing the Product ID and price for each of the products. The product ID and price will be added to the end of the list whenever a new product is launched. This would mean that the product IDs need not be in ascending order. The product list might be as shown below-

table\_array-

Product ID	Product	Price
FC0002	Floor Cleaner	191.90
HW0007	Hand Wash	179.65
AP0024	Air Purifier	254.28
DP0026	Detergent Powder	182.63
ISO0073	Soap	85.85

1. Name this array as ProductInfo.

You can obtain the price of a product given the product ID with the VLOOKUP function as the product ID is in the first column. The price is in column 3 and hence col\_index\_num should be 3.

- Use VLOOKUP Function with range\_lookup as TRUE



- Use VLOOKUP Function with range\_lookup as FALSE

	A	B	C	D
1				
2		<b>Product ID</b>	<b>Product</b>	<b>Price</b>
3		FC0002	Floor Cleaner	191.9
4		HW0007	Hand Wash	179.65
5		AP0024	Air Purifier	254.28
6		DP0026	Detergent Powder	182.63
7		ISO0073	Soap	85.85
8				
9		<b>Product ID</b>	<b>Price</b>	
10		HW0007	=VLOOKUP(B10,ProductInfo,3,TRUE)	← VLOOKUP with TRUE
11			=VLOOKUP(B10,ProductInfo,3,FALSE)	← VLOOKUP with FALSE

The correct answer is from the ProductInfo array is 171.65. You can check the results.

	A	B	C	D
1				
2		<b>Product ID</b>	<b>Product</b>	<b>Price</b>
3		FC0002	Floor Cleaner	191.90
4		HW0007	Hand Wash	179.65
5		AP0024	Air Purifier	254.28
6		DP0026	Detergent Powder	182.63
7		ISO0073	Soap	85.85
8				
9		<b>Product ID</b>	<b>Price</b>	
10		HW0007	182.63	← Wrong Result
11			179.65	← Correct Result

Look up Value

You observe that you got-

- The correct result when range\_lookup is FALSE, and
- A wrong result when range\_lookup is TRUE.

This is because, the first column in the ProductInfo array is not sorted in ascending order. Hence, remember to use FALSE whenever the data is not sorted.

## Using HLOOKUP Function

You can use **HLOOKUP** function if the data is in rows rather than columns.

### Example

Let us take the example of product information. Suppose the array looks as follows-

	A	B	C	D	E	F	G
1							
2		Product ID	FC0002	HW0007	AP0024	DP0026	ISO0073
3		Product	Floor Cleaner	Hand Wash	Air Purifier	Detergent Powder	Soap
4		Price	191.9	179.65	254.28	182.63	85.85

- Name this Array ProductRange. You can find the price of a product given the product ID with HLOOKUP function.

The Syntax of HLOOKUP function is

HLOOKUP (lookup\_value, table\_array, row\_index\_num, [range\_lookup])

Where

- **lookup\_value** - is the value to be found in the first row of the table
- **table\_array** - is a table of information in which data is looked up
- **row\_index\_num** - is the row number in table\_array from which the matching value will be returned
- **range\_lookup** - is a logical value that specifies whether you want HLOOKUP to find an exact match or an approximate match
- **range\_lookup** can be
  - omitted, in which case it is assumed to be TRUE and HLOOKUP tries to find an approximate match
  - TRUE, in which case HLOOKUP tries to find an approximate match. In other words, if an exact match is not found, the next largest value that is less than lookup\_value is returned
  - FALSE, in which case HLOOKUP tries to find an exact match
  - 1, in which case it is assumed to be TRUE and HLOOKUP tries to find an approximate match
  - 0, in which case it is assumed to be FALSE and HLOOKUP tries to find an exact match

**Note:** If range\_lookup is Omitted or TRUE or 1, HLOOKUP works correctly only when the first column in table\_array is sorted in ascending order. Otherwise, it may result in incorrect values. In such a case, use FALSE for range\_lookup.

## Using HLOOKUP Function with range\_lookup FALSE

You can obtain the price of a product given the product ID with the HLOOKUP function as the product ID is in the first row. The price is in row 3 and hence row\_index\_num should be 3.

- Use HLOOKUP Function with range\_lookup as TRUE.
- Use HLOOKUP Function with range\_lookup as FALSE.

	A	B	C	D	E	F	G
1							
2		Product ID	FC0002	HW0007	AP0024	DP0026	ISO0073
3		Product	Floor Cleaner	Hand Wash	Air Purifier	Detergent Powder	Soap
4		Price	191.9	179.65	254.28	182.63	85.85
5							
6							
7		Product ID	HW0007				
8		Price	=HLOOKUP(C7,ProductRange,3,TRUE)				← HLOOKUP with TRUE
9			=HLOOKUP(C7,ProductRange,3,FALSE)				← HLOOKUP with FALSE

The correct answer from the ProductRange array is 171.65. You can check the results.

	A	B	C	D	E	F	G
1							
2		Product ID	FC0002	HW0007	AP0024	DP0026	ISO0073
3		Product	Floor Cleaner	Hand Wash	Air Purifier	Detergent Powder	Soap
4		Price	191.90	179.65	254.28	182.63	85.85
5							
6							
7		Product ID	HW0007				← Look up Value
8		Price	182.63				← Wrong Result
9			179.65				← Correct Result

You observe that as in the case of VLOOKUP, you got

- The correct result when range\_lookup is FALSE, and
- A wrong result when range\_lookup is TRUE.

This is because the first row in the ProductRange array is not sorted in ascending order. Hence, remember to use FALSE whenever the data is not sorted.

## Using HLOOKUP Function with range\_lookup TRUE

Consider the example of student marks used in VLOOKUP. Suppose you have the data in rows instead of columns as shown in the table given below-

table\_array:

Student Grades					
Marks	0	35	50	60	75
Pass Category	Fail	Third Class	Second Class	First Class	First Class with Distinction

Name this array as GradesRange.

Note that the first row marks based on which the grades are obtained is sorted in ascending order. Hence, using HLOOKUP with TRUE for range\_lookup argument, you can get the Grades with approximate match and that is what is required.

A	B	C	D	E	F	G
1						
2						
3						
4	Marks	0	35	50	60	75
5	Pass Category	Fail	Third Class	Second Class	First Class	First Class with Distinction
6						
7	Exam Results					
8	Marks	Pass Category				
9	85	=HLOOKUP(B9,GradesRange,2,TRUE)				
10	75	=HLOOKUP(B10,GradesRange,2,TRUE)				
11	72	=HLOOKUP(B11,GradesRange,2,TRUE)				
12	55	=HLOOKUP(B12,GradesRange,2,TRUE)				
13	68	=HLOOKUP(B13,GradesRange,2,TRUE)				
14	34	=HLOOKUP(B14,GradesRange,2,TRUE)				
15	60	=HLOOKUP(B15,GradesRange,2,TRUE)				
16	50	=HLOOKUP(B16,GradesRange,2,TRUE)				
17	98	=HLOOKUP(B17,GradesRange,2,TRUE)				
18	59	=HLOOKUP(B18,GradesRange,2,TRUE)				
19	74	=HLOOKUP(B19,GradesRange,2,TRUE)				
20	99	=HLOOKUP(B20,GradesRange,2,TRUE)				
21	40	=HLOOKUP(B21,GradesRange,2,TRUE)				
22	35	=HLOOKUP(B22,GradesRange,2,TRUE)				

As you can observe,

- **row\_index\_num** - indicates the column of the return value in table\_array is 2
- the **range\_lookup** is TRUE
  - The first column containing the lookup value in the table\_array Grades is in ascending order. Hence, the results will be correct.
  - You can get the return value for approximate matches also. i.e. HLOOKUP computes as follows-

Marks	< 35	>= 35 and < 50	>= 50 and < 60	>=60 and < 75	>= 75
Pass Category	Fail	Third Class	Second Class	First Class	First Class with Distinction

You will get the following results-

	A	B	C	D	E	F	G
1							
2		Student Grades					
3		Marks	0	35	50	60	75
4		Pass Category	Fail	Third Class	Second Class	First Class	First Class with Distinction
5							
6		Exam Results					
7		Marks	Pass Category				
8		85	First Class with Distinction				
9		75	First Class with Distinction				
10		72	First Class				
11		55	Second Class				
12		68	First Class				
13		34	Fail				
14		60	First Class				
15		50	Second Class				
16		98	First Class with Distinction				
17		59	Second Class				
18		74	First Class				
19		99	First Class with Distinction				
20		40	Third Class				
21		35	Third Class				

## Using INDEX Function

When you have an array of data, you can retrieve a value in the array by specifying the row number and column number of that value in the array.

Consider the following sales data, wherein you find the sales in each of the North, South, East and West regions by the salespersons who are listed.



	A	B	C	D	E	F
1						
2			North	South	East	West
3		Vicky	406	107	251	562
4		Mathew	433	192	464	536
5		Ritchie	330	433	597	577
6		Jane	435	103	549	600
7		Sara	446	126	344	109
8		Andy	289	515	379	529
9		Bob	424	349	345	147
10		James	175	194	581	141
11		Katherine	179	372	431	215
12		Hardley	279	464	120	442

- Name the array as SalesData.

Using INDEX Function, you can find-

- The Sales of any of the Salespersons in a certain Region.
- Total Sales in a Region by all the Salespersons.
- Total Sales by a Salesperson in all the Regions.

	A	B	C	D	E	F
1						
2			North	South	East	West
3		Vicky	406	107	251	562
4		Mathew	433	192	464	536
5		Ritchie	330	433	597	577
6		Jane	435	103	549	600
7		Sara	446	126	344	109
8		Andy	289	515	379	529
9		Bob	424	349	345	147
10		James	175	194	581	141
11		Katherine	179	372	431	215
12		Hardley	279	464	120	442
13						
14		Vicky - South Sales	=INDEX(SalesData,1,2)			
15		Andy - West Sales	=INDEX(SalesData,6,4)			
16		Total North Sales	=SUM(INDEX(SalesData,0,1))			
17		James Total Sales	=SUM(INDEX(SalesData,8,0))			



You will get the following results-

	A	B	C	D	E	F
1						
2			North	South	East	West
3		Vicky	406	107	251	562
4		Mathew	433	192	464	536
5		Ritchie	330	433	597	577
6		Jane	435	103	549	600
7		Sara	446	126	344	109
8		Andy	289	515	379	529
9		Bob	424	349	345	147
10		James	175	194	581	141
11		Katherine	179	372	431	215
12		Hardley	279	464	120	442
13						
14		Vicky - South Sales	107			
15		Andy - West Sales	529			
16		Total North Sales	3396			
17		James Total Sales	1091			

Suppose you do not know the row numbers for the salespersons and column numbers for the regions. Then, you need to find the row number and column number first before you retrieve the value with the index function.

You can do it with the MATCH function as explained in the next section.

## Using MATCH Function

If you need the position of an item in a range, you can use the MATCH function. You can combine MATCH and INDEX functions as follows-

	A	B	C	D	E	F	G	H	I	J	K	L
1												
2			North	South	East	West		Name	Region	Row-Num of Name	Col Num of Region	Result
3		Vicky	406	107	251	562		Vicky	South	=MATCH(H3,B3:B12,0)	=MATCH(I3,C2:F2,0)	=INDEX(C3:F12,I3,K3)
4		Mathew	433	192	464	536		Andy	West	=MATCH(H4,B3:B12,0)	=MATCH(I4,C2:F2,0)	=INDEX(C3:F12,I4,K4)
5		Ritchie	330	433	597	577		All	North	0	=MATCH(I5,C2:F2,0)	=SUM(INDEX(C3:F12,I5,K5))
6		Jane	435	103	549	600		James	All	=MATCH(H6,B3:B12,0)	0	=SUM(INDEX(C3:F12,I6,K6))
7		Sara	446	126	344	109						
8		Andy	289	515	379	529						
9		Bob	424	349	345	147						
10		James	175	194	581	141						
11		Katherine	179	372	431	215						
12		Hardley	279	464	120	442						

You will get the following results-

	A	B	C	D	E	F	G	H	I	J	K	L
1												
2			North	South	East	West		Name	Region	Row-Num of Name	Col_Num of Region	Result
3		Vicky	406	107	251	562		Vicky	South	1	2	107
4		Mathew	433	192	464	536		Andy	West	6	4	529
5		Ritchie	330	433	597	577		All	North	0	1	3396
6		Jane	435	103	549	600		James	All	8	0	1091
7		Sara	446	126	344	109						
8		Andy	289	515	379	529						
9		Bob	424	349	345	147						
10		James	175	194	581	141						
11		Katherine	179	372	431	215						
12		Hardley	279	464	120	442						

# 15. PivotTables

Data analysis on a large set of data is quite often necessary and important. It involves summarizing the data, obtaining the needed values and presenting the results.

Excel provides PivotTable to enable you summarize thousands of data values easily and quickly so as to obtain the required results.

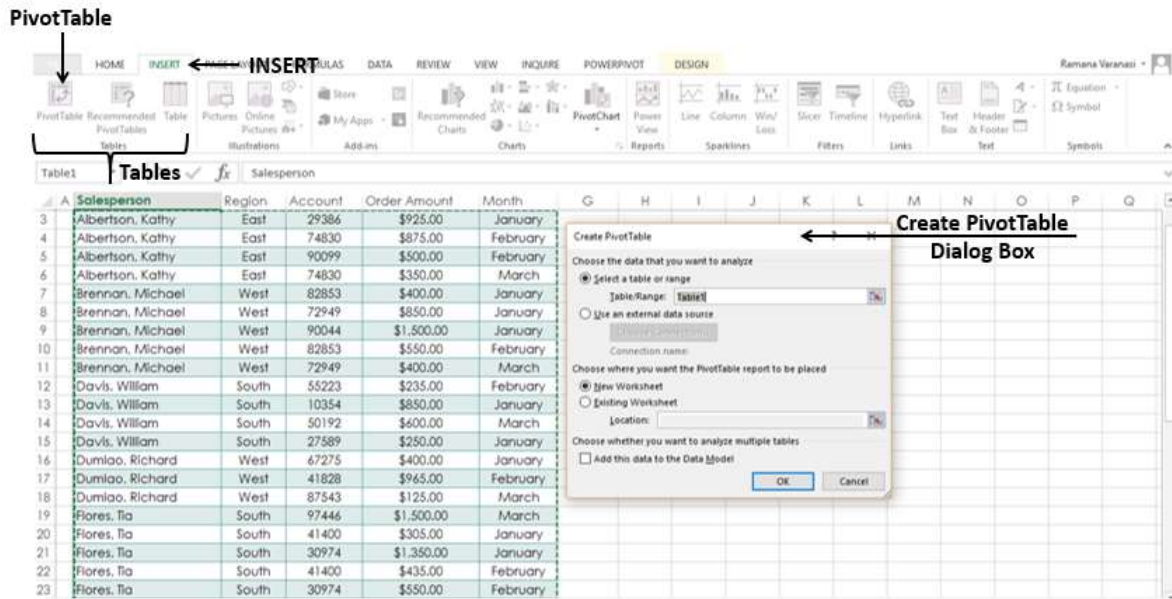
Consider the following table of sales data. From this data, you might have to summarize total sales region wise, month wise, or salesperson wise. The easy way to handle these tasks is to create a PivotTable that you can dynamically modify to summarize the results the way you want.

	A	B	C	D	E	F
1						
2		Salesperson	Region	Account	Order Amount	Month
3		Albertson, Kathy	East	29386	\$925.00	January
4		Albertson, Kathy	East	74830	\$875.00	February
5		Albertson, Kathy	East	90099	\$500.00	February
6		Albertson, Kathy	East	74830	\$350.00	March
7		Brennan, Michael	West	82853	\$400.00	January
8		Brennan, Michael	West	72949	\$850.00	January
9		Brennan, Michael	West	90044	\$1,500.00	January
10		Brennan, Michael	West	82853	\$550.00	February
11		Brennan, Michael	West	72949	\$400.00	March
12		Davis, William	South	55223	\$235.00	February
13		Davis, William	South	10354	\$850.00	January
14		Davis, William	South	50192	\$600.00	March
15		Davis, William	South	27589	\$250.00	January
16		Dumlao, Richard	West	67275	\$400.00	January
17		Dumlao, Richard	West	41828	\$965.00	February
18		Dumlao, Richard	West	87543	\$125.00	March
19		Flores, Tia	South	97446	\$1,500.00	March
20		Flores, Tia	South	41400	\$305.00	January
21		Flores, Tia	South	30974	\$1,350.00	January

## Creating PivotTable

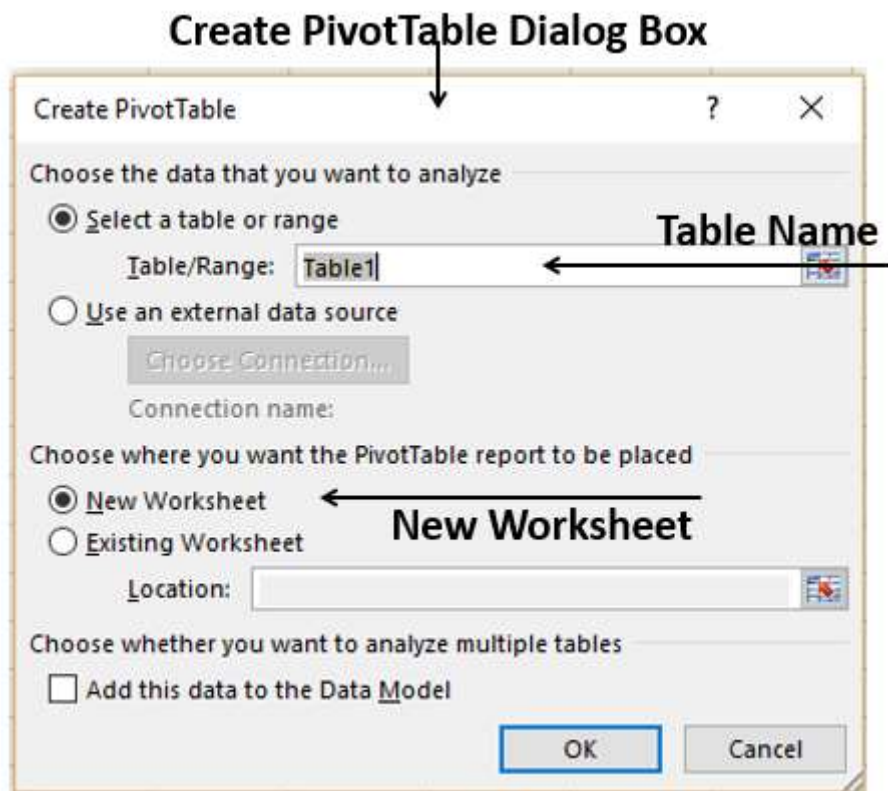
To create PivotTables, ensure the first row has headers.

- Click the table.
- Click the INSERT tab on the Ribbon.
- Click PivotTable in the Tables group. The PivotTable dialog box appears.

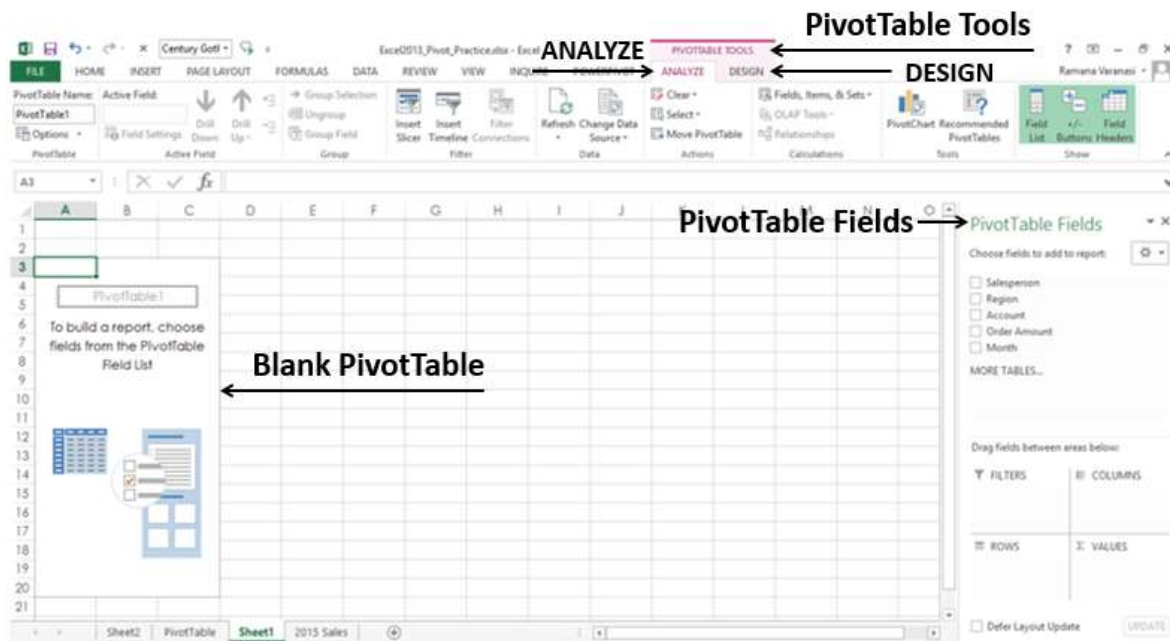


As you can see in the dialog box, you can use either a Table or Range from the current workbook or use an external data source.

- In the Table / Range Box, type the table name.
- Click New Worksheet to tell Excel where to keep the PivotTable.
- Click OK.



A Blank PivotTable and a PivotTable fields list appear.



## Recommended PivotTables

In case you are new to PivotTables or you do not know which fields to select from the data, you can use the **Recommended PivotTables** that Excel provides.

- Click the data table.
- Click the INSERT tab.
- Click on Recommended PivotTables in the Tables group. The Recommended PivotTables dialog box appears.



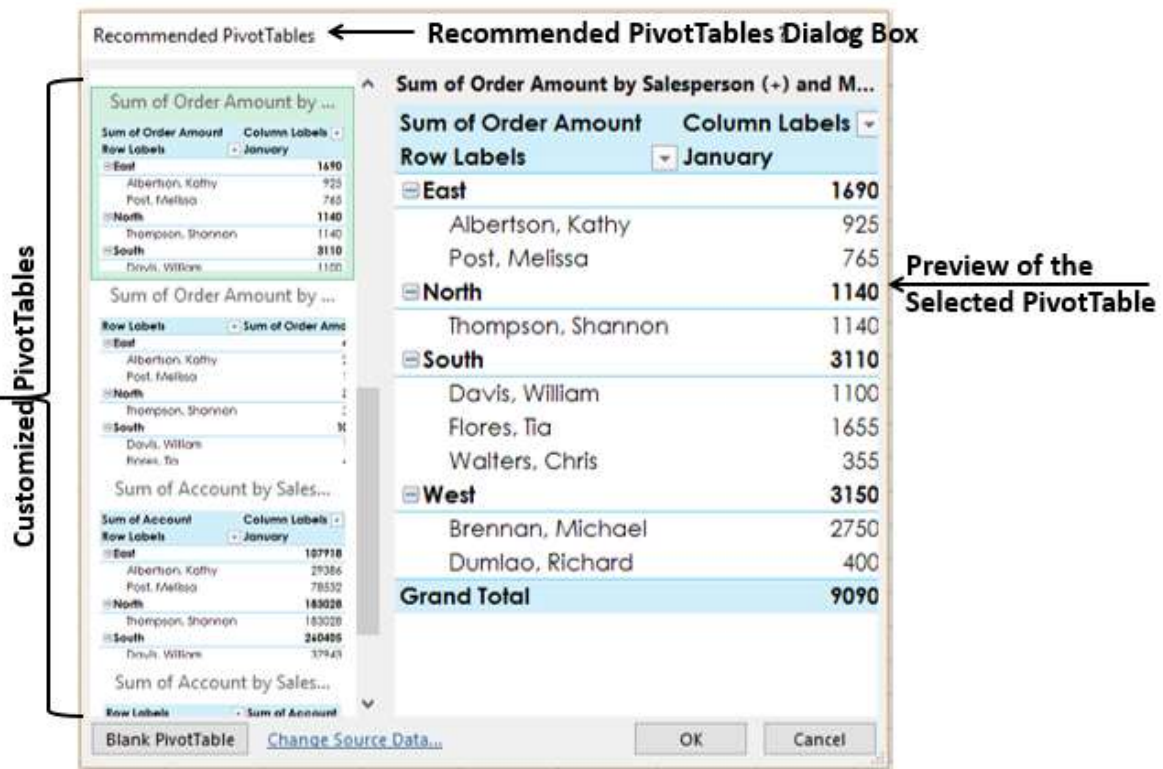
The screenshot shows the 'Recommended PivotTables' dialog box in Excel 2016. The dialog box is open over a data table. The data table has columns: Salesperson, Region, Account, Order Amount, and Month. The dialog box shows a preview of a PivotTable for 'Sum of Order Amount by Salesperson (+) and M...'. The Row Labels are 'Salesperson' and the Column Labels are 'Month'. The preview shows a table with salesperson names as rows and months as columns, with a Grand Total of 9090. The dialog box also shows a list of recommended PivotTables on the left side.

Salesperson	Region	Account	Order Amount	Month
Albertson, Kathy	East	29386	\$925.00	January
Albertson, Kathy	East	74830	\$875.00	February
Albertson, Kathy	East	90099	\$500.00	February
Albertson, Kathy	East	74830	\$350.00	March
Brennan, Michael	West	82853	\$400.00	January
Brennan, Michael	West	72949	\$850.00	January
Brennan, Michael	West	90044	\$1,500.00	January
Brennan, Michael	West	82853	\$550.00	February
Brennan, Michael	West	72949	\$400.00	March
Davis, William	South	55223	\$235.00	February
Davis, William	South	10354	\$850.00	January
Davis, William	South	50192	\$600.00	March
Davis, William	South	27589	\$250.00	January
Dumlao, Richard	West	67275	\$400.00	January
Dumlao, Richard	West	41828	\$965.00	February
Dumlao, Richard	West	87543	\$125.00	March
Flores, Tia	South	97446	\$1,500.00	March
Flores, Tia	South	41400	\$305.00	January

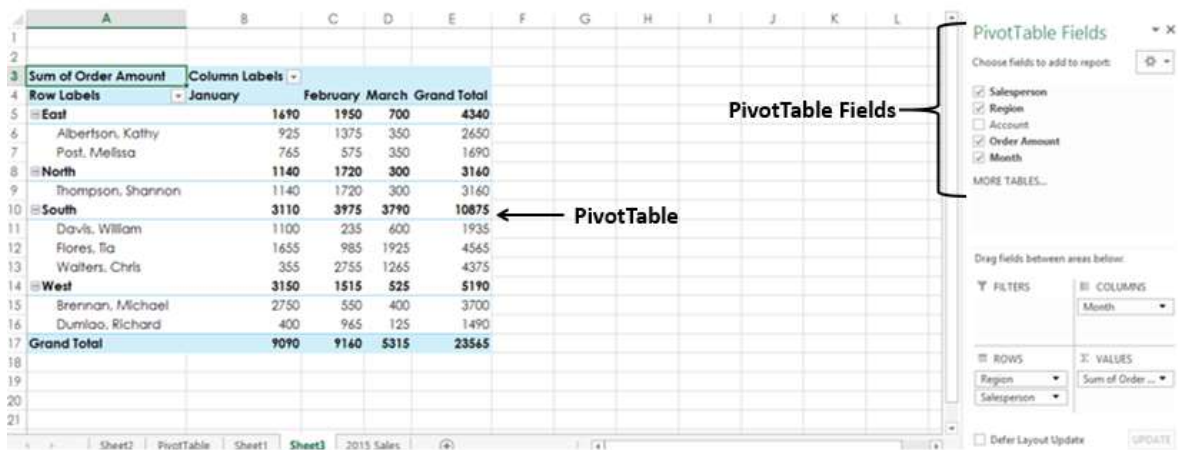
In the recommended PivotTables dialog box, the possible customized PivotTables that suit your data are displayed.

- Click each of the PivotTable options to see the preview on the right side.
- Click the PivotTable Sum of Order Amount by Salesperson and month.





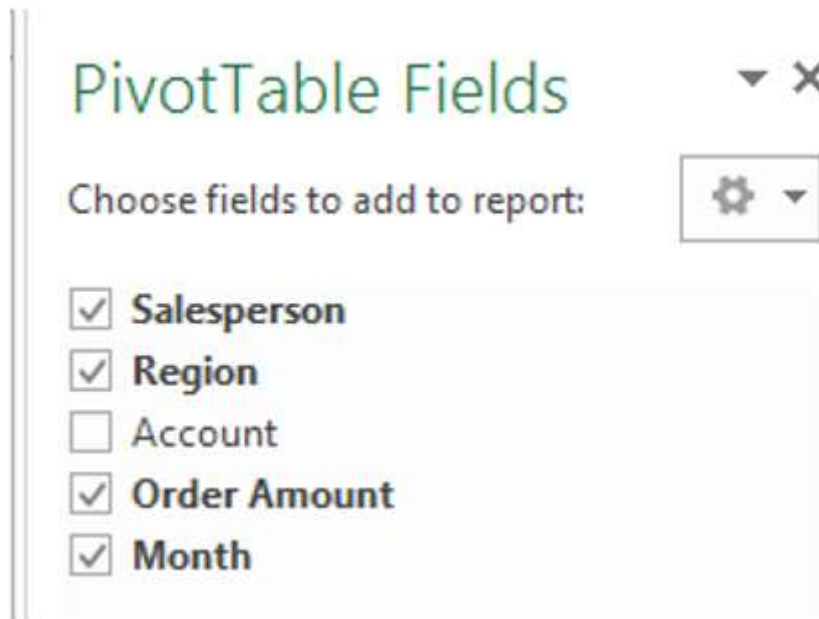
Click OK. The selected PivotTable appears on a new worksheet. You can observe the PivotTable fields that was selected in the PivotTable fields list.



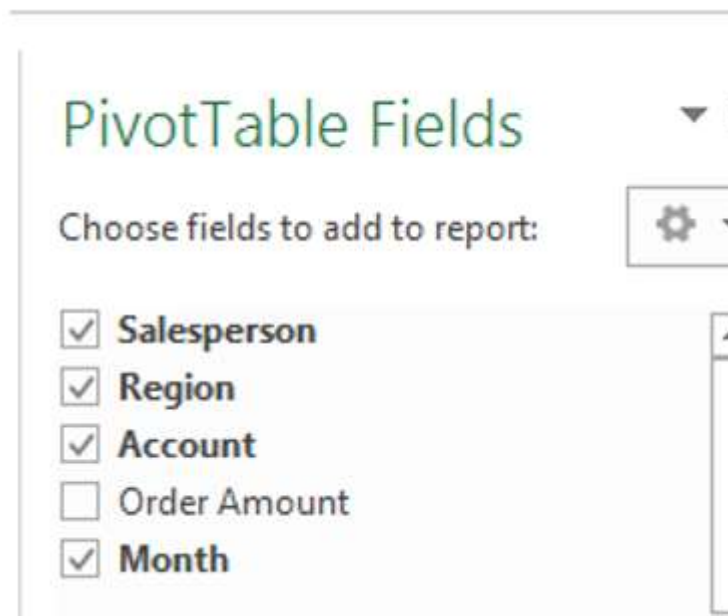
## PivotTable Fields

---

The headers in your data table will appear as the fields in the PivotTable.



You can select / deselect them to instantly change your PivotTable to display only the information you want and in a way that you want. For example, if you want to display the account information instead of order amount information, deselect Order Amount and select Account.



## PivotTable Areas

You can even change the Layout of your PivotTable instantly. You can use the PivotTable Areas to accomplish this.

**PivotTable Fields**

Choose fields to add to report:

- ☒ Salesperson
- ☒ Region
- ☐ Account
- ☒ Order Amount
- ☒ Month

MORE TABLES...

Drag fields between areas below:

**Filters:**

**Columns:** Month

**Rows:** Region

**Values:** Sum of Order Amount

**PivotTable Areas**

**PivotTable**

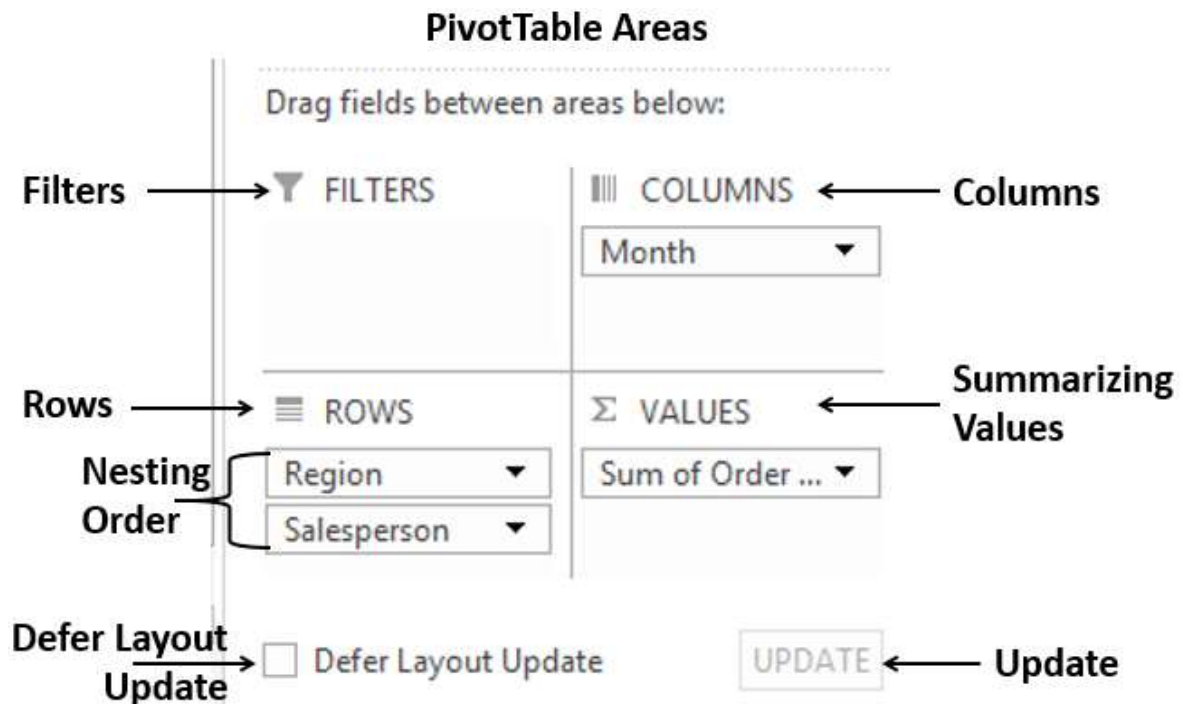
Row Labels	January	February	March	Grand Total
<b>East</b>	1690	1950	700	4340
Albertson, Kathy	925	1375	350	2650
Post, Melissa	765	575	350	1690
<b>North</b>	1140	1720	300	3160
Thompson, Shannon	1140	1720	300	3160
<b>South</b>	3110	3975	3790	10875
Davis, William	1100	235	600	1935
Flores, Ila	1655	985	1925	4565
Walters, Chris	355	2755	1265	4375
<b>West</b>	3150	1515	525	5190
Brennan, Michael	2750	550	400	3700
Dumiao, Richard	400	965	125	1490
<b>Grand Total</b>	9090	9160	5315	23565

In PivotTable areas, you can choose-

- What fields to display as rows
- What fields to display as columns
- How to summarize your data
- Filters for any of the fields
- When to update your PivotTable Layout
  - You can update it instantly as you drag the fields across areas, or
  - You can defer the update and get it updated only when you click on UPDATE

An instant update helps you to play around with the different Layouts and pick the one that suits your report requirement.

You can just drag the fields across these areas and observe the PivotTable layout as you do it.



## Nesting in the PivotTable

If you have more than one field in any of the areas, then nesting happens in the order you place the fields in that area. You can change the order by dragging the fields and observe how nesting changes. In the above layout options, you can observe that

- Months are in columns.
- Region and salesperson in rows in that order. i.e. salesperson values are nested under region values.
- Summarizing is by Sum of Order Amount.
- No filters are chosen.

The resulting PivotTable is as follows-

Summarizing Value

Columns

3	Sum of Order Amount	Column Labels				
4	Row Labels	January	February	March	Grand Total	
5	East	1690	1950	700	4340	
6	Albertson, Kathy	925	1375	350	2650	
7	Post, Melissa	765	575	350	1690	
8	North	1140	1720	300	3160	
9	Thompson, Shannon	1140	1720	300	3160	
10	South	3110	3975	3790	10875	
11	Davis, William	1100	235	600	1935	
12	Flores, Tia	1655	985	1925	4565	
13	Walters, Chris	355	2755	1265	4375	
14	West	3150	1515	525	5190	
15	Brennan, Michael	2750	550	400	3700	
16	Dumlao, Richard	400	965	125	1490	
17	Grand Total	9090	9160	5315	23565	
18						

Rows – Level 1

Rows – Level 2

In the PivotTable Areas, in rows, click region and drag it below salesperson such that it looks as follows-

Drag fields between areas below:

FILTERS		COLUMNS	
		Month	
ROWS		VALUES	
<b>Rows</b> → <b>Nesting Order</b> {	Salesperson	Sum of Order ...	
	Region		
<input type="checkbox"/> Defer Layout Update		<input type="button" value="UPDATE"/>	

The nesting order changes and the resulting PivotTable is as follows-

**Summarizing Value**                      **Columns**

3 Sum of Order Amount		Column Labels ▾			
4 Row Labels ▾		January	February	March	Grand Total
<b>Rows - Level 1</b>	5 Albertson, Kathy	925	1375	350	2650
	6 East	925	1375	350	2650
	7 Brennan, Michael	2750	550	400	3700
	8 West	2750	550	400	3700
	9 Davis, William	1100	235	600	1935
	10 South	1100	235	600	1935
	11 Dumlao, Richard	400	965	125	1490
	12 West	400	965	125	1490
	13 Flores, Tia	1655	985	1925	4565
	14 South	1655	985	1925	4565
	15 Post, Melissa	765	575	350	1690
	16 East	765	575	350	1690
	17 Thompson, Shannon	1140	1720	300	3160
	18 North	1140	1720	300	3160
	19 Walters, Chris	355	2755	1265	4375
	20 South	355	2755	1265	4375
21 Grand Total		9090	9160	5315	23565

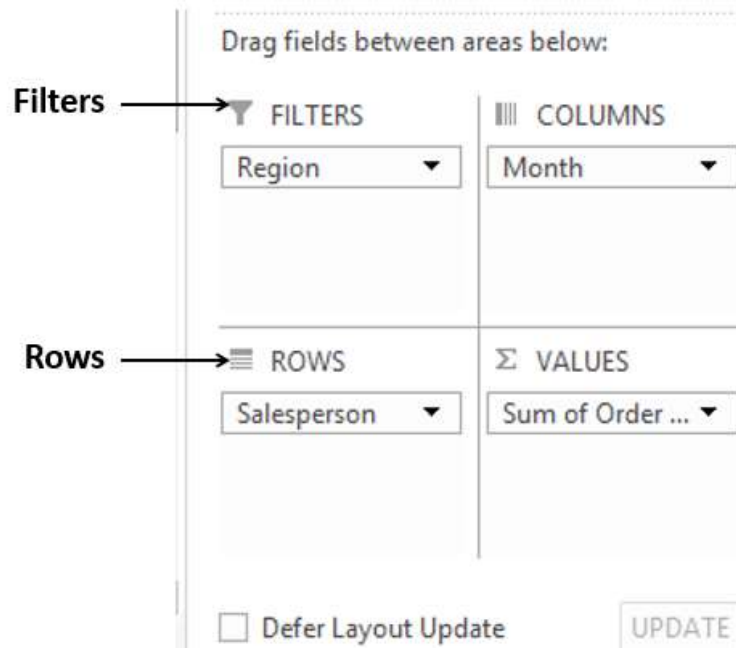
**Note:** You can clearly observe that the layout with the nesting order – Region and then Salesperson yields a better and compact report than the one with the nesting order – Salesperson and then Region. In case Salesperson represents more than one area and you need to summarize the sales by Salesperson, then the second layout would have been a better option.

## Filters

You can assign a Filter to one of the fields so that you can dynamically change the PivotTable based on the values of that field.

Drag Region from Rows to Filters in the PivotTable Areas.





The filter with the label as Region appears above the PivotTable (in case you do not have empty rows above your PivotTable, PivotTable gets pushed down to make space for the Filter).

Filter					
Region (All) ▼					
Sum of Order Amount					
Column Labels ▼					
Row Labels ▼					
January February March Grand Total					
Albertson, Kathy	925	1375	350	2650	
Brennan, Michael	2750	550	400	3700	
Davis, William	1100	235	600	1935	
Dumlao, Richard	400	965	125	1490	
Flores, Tia	1655	985	1925	4565	
Post, Melissa	765	575	350	1690	
Thompson, Shannon	1140	1720	300	3160	
Walters, Chris	355	2755	1265	4375	
<b>Grand Total</b>	<b>9090</b>	<b>9160</b>	<b>5315</b>	<b>23565</b>	

You can see that-

- Salesperson values appear in rows.
- Month values appear in columns.
- Region Filter appears on the top with default selected as ALL.
- Summarizing value is Sum of Order Amount
  - Sum of Order Amount Salesperson-wise appears in the column Grand Total
  - Sum of Order Amount Month-wise appears in the row Grand Total

Click the arrow in the box to the right of the filter region. A drop-down list with the values of the field region appears.

	A	B	C	D	E
1	Region	(All)			
2					
3	Sum of				
4	Row Labels				
5	Alberts		February	March	Grand Total
6	Brenna		1375	350	2650
7	Davis, V		550	400	3700
8	Dumla		235	600	1935
9	Flores, T		965	125	1490
10	Post, M		985	1925	4565
11	Thomps		575	350	1690
12	Walters		1720	300	3160
13	Grand		2755	1265	4375
14			9160	5315	23565

- Check the option **Select Multiple Items**. Check boxes appear for all the values.
- Select South and West and deselect the other values and click OK.

	A	B	C	D	E
1	Region	(All)			
2					
3	Sum of				
4	Row Labels		February	March	Grand Total
5	Alberts		1375	350	2650
6	Brenna		550	400	3700
7	Davis, W		235	600	1935
8	Dumlac		965	125	1490
9	Flores, T		985	1925	4565
10	Post, M		575	350	1690
11	Thomps		1720	300	3160
12	Walters		2755	1265	4375
13	Grand		9160	5315	23565
14					

The data pertaining to South and West Regions only will be summarized as shown in the screen shot given below-

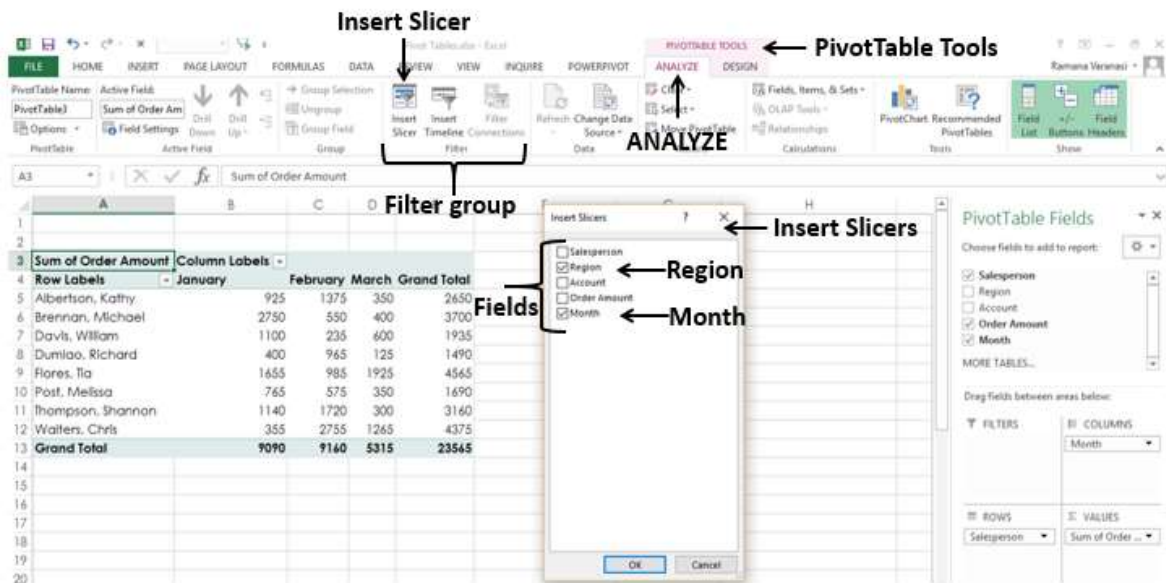
	A	B	C	D	E
1	Region	(Multiple Items)			
2					
3	Sum of Order Amount	Column Labels			
4	Row Labels	January	February	March	Grand Total
5	Brennan, Michael	2750	550	400	3700
6	Davis, William	1100	235	600	1935
7	Dumlao, Richard	400	965	125	1490
8	Flores, Tia	1655	985	1925	4565
9	Walters, Chris	355	2755	1265	4375
10	Grand Total	6260	5490	4315	16065

You can see that next to the Filter Region, **Multiple Items** is displayed, indicating that you have selected more than one item. However, how many items and / or which items are selected is not known from the report that is displayed. In such a case, using Slicers is a better option for filtering.

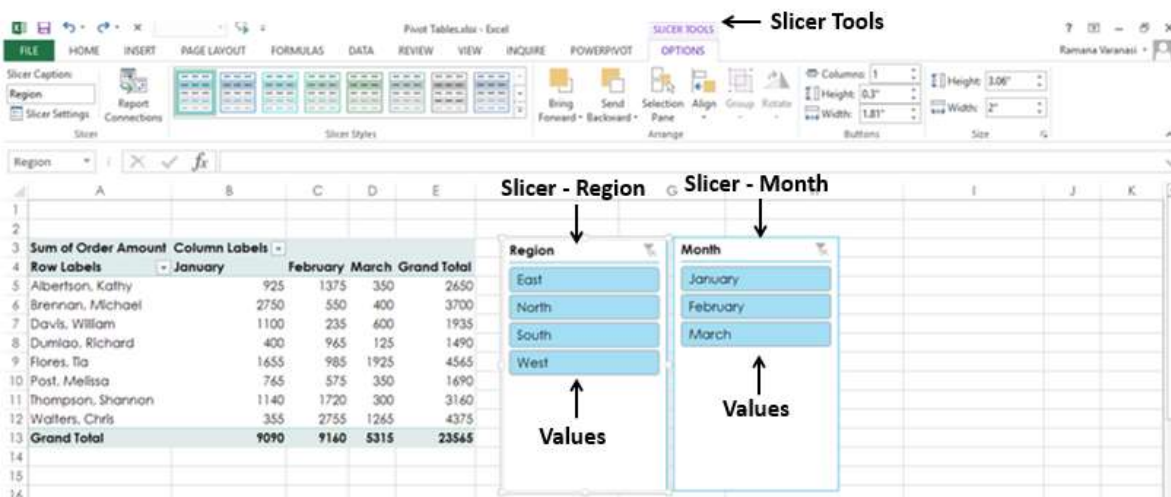
## Slicers

You can use Slicers to have a better view clarity on which items the data was filtered.

- Click ANALYZE under PIVOTTABLE TOOLS on the Ribbon.
- Click Insert Slicer in the Filter group. The Insert Slicers box appears. It contains all the fields from your data.
- Select the fields Region and month. Click OK.



Slicers for each of the selected fields appear with all the values selected by default. Slicer Tools appear on the Ribbon to work on the Slicer settings, look and feel.



- Select South and West in the Slicer for Region.
- Select February and March in the Slicer for month.
- Keep Ctrl key pressed while selecting multiple values in a Slicer.

Selected items in the Slicers are highlighted. PivotTable with summarized values for the selected items will be displayed.

	A	B	C	D	E	F	G	H
1								
2								
3	Sum of Order Amount		Column Labels					
4	Row Labels	February	March	Grand Total				
5	Brennan, Michael	550	400	950				
6	Davis, William	235	600	835				
7	Dumlao, Richard	965	125	1090				
8	Flores, Tia	985	1925	2910				
9	Walters, Chris	2755	1265	4020				
10	Grand Total	5490	4315	9805				
11								
12								
13								
14								
15								
16								

Region

East

North

South

West

Month

January

February

March

## Summarizing Values by other Calculations

In the examples so far, you have seen summarizing values by Sum. However, you can use other calculations also if necessary.

In the PivotTable Fields List

- Select the Field Account.
- Unselect the Field Order Amount.

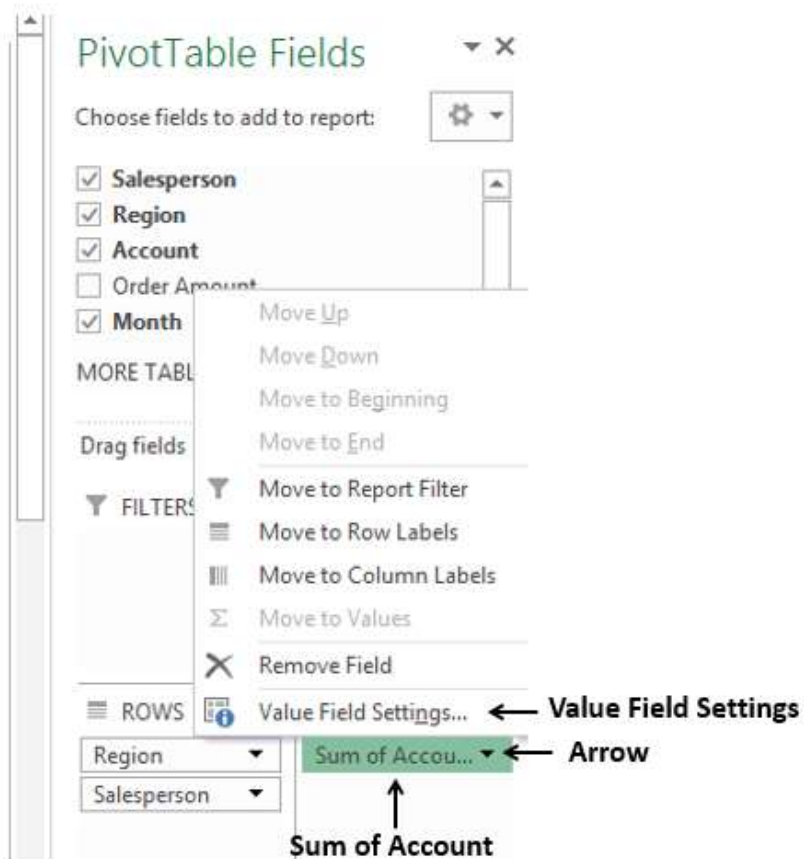
PivotTable Fields

Choose fields to add to report:

☒ Salesperson
☒ Region
☒ Account
☐ Order Amount
☒ Month

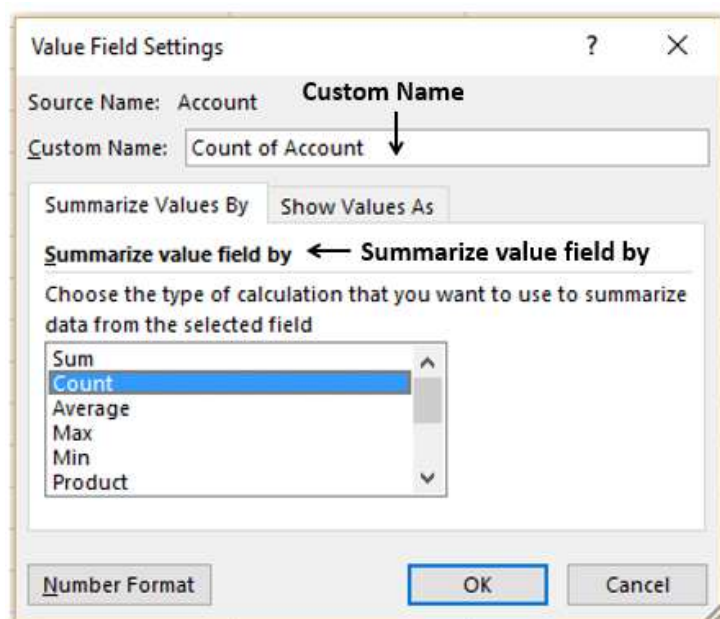
- Drag the field Account to Summarizing Values area. By default, Sum of Account will be displayed.
- Click the arrow on the right side of the box.
- In the drop-down that appears, click Value Field Settings.





The Value Field Settings box appears. Several types of calculations appear as a list under Summarize value field by-

- Select Count in the list.
- The Custom Name automatically changes to Count of Account. Click OK.





The PivotTable summarizes the Account values by Count.

3	Count of Account	Column Labels			
4	Row Labels	January	February	March	Grand Total
5	East	2	4	2	8
6	Albertson, Kathy	1	2	1	4
7	Post, Melissa	1	2	1	4
8	North	2	2	1	5
9	Thompson, Shannon	2	2	1	5
10	South	7	5	6	18
11	Davis, William	2	1	1	4
12	Flores, Tia	2	2	2	6
13	Walters, Chris	3	2	3	8
14	West	4	2	2	8
15	Brennan, Michael	3	1	1	5
16	Dumlao, Richard	1	1	1	3
17	Grand Total	15	13	11	39

## PivotTable Tools

Follow the steps given below to learn to use the PivotTable Tools.

- Select the PivotTable.

The following PivotTable Tools appear on the Ribbon-

- ANALYZE
- DESIGN

The screenshot shows the Excel interface with the PivotTable Tools ribbon active. The ANALYZE and DESIGN tabs are highlighted. The PivotTable Fields task pane on the right shows the following configuration:

- Choose fields to add to report:**
  - ☒ Salesperson
  - ☒ Region
  - ☐ Account
  - ☒ Order Amount
  - ☒ Month
- Drag fields between areas below:**
  - FILTERS:** (Empty)
  - COLUMNS:** Month
  - ROWS:** (Empty)
  - VALUES:** Sum of Order

The PivotTable in the background shows the sum of order amounts by salesperson and region, categorized by month.

## ANALYZE

---

Some of the **ANALYZE** Ribbon commands are-

- Set PivotTable Options
- Value Field Settings for the selected Field
- Expand Field
- Collapse Field
- Insert Slicer
- Insert Timeline
- Refresh Data
- Change Data Source
- Move PivotTable
- Solve Order (If there are more calculations)
- PivotChart

## DESIGN

---



Some of the **DESIGN** Ribbon commands are-



- PivotTable Layout
  - Options for Sub Totals
  - Options for Grand Totals
  - Report Layout Forms
  - Options for Blank Rows
- PivotTable Style Options
- PivotTable Styles


## Expanding and Collapsing Field

---



You can either expand or collapse all items of a selected field in two ways-

- By selecting the symbol  or  to the left of the selected field.
- By clicking the Expand Field or Collapse Field on the ANALYZE Ribbon.

**By selecting the Expand symbol  or Collapse symbol  to the left of the selected field**


- Select the cell containing East in the PivotTable.
- Click on the Collapse symbol  to the left of East.

3	Sum of Order Amount	Column Labels ▾			
4	Row Labels ▾	January	February	March	Grand Total
5	[-] East	1690	1950	700	4340
6	Albertson, Kathy	925	1375	350	2650
7	Post, Melissa	765	575	350	1690
8	[-] North	1140	1720	300	3160
9	Thompson, Shannon	1140	1720	300	3160
10	[-] South	3110	3975	3790	10875
11	Davis, William	1100	235	600	1935
12	Flores, Tia	1655	985	1925	4565
13	Walters, Chris	355	2755	1265	4375
14	[-] West	3150	1515	525	5190
15	Brennan, Michael	2750	550	400	3700
16	Dumlao, Richard	400	965	125	1490
17	Grand Total	9090	9160	5315	23565

All the items under East will be collapsed. The Collapse symbol  to the left of East changes to the Expand symbol .

3	Sum of Order Amount	Column Labels ▾			
4	Row Labels ▾	January	February	March	Grand Total
5	[+] East	1690	1950	700	4340
6	[-] North	1140	1720	300	3160
7	Thompson, Shannon	1140	1720	300	3160
8	[-] South	3110	3975	3790	10875
9	Davis, William	1100	235	600	1935
10	Flores, Tia	1655	985	1925	4565
11	Walters, Chris	355	2755	1265	4375
12	[-] West	3150	1515	525	5190
13	Brennan, Michael	2750	550	400	3700
14	Dumlao, Richard	400	965	125	1490
15	Grand Total	9090	9160	5315	23565

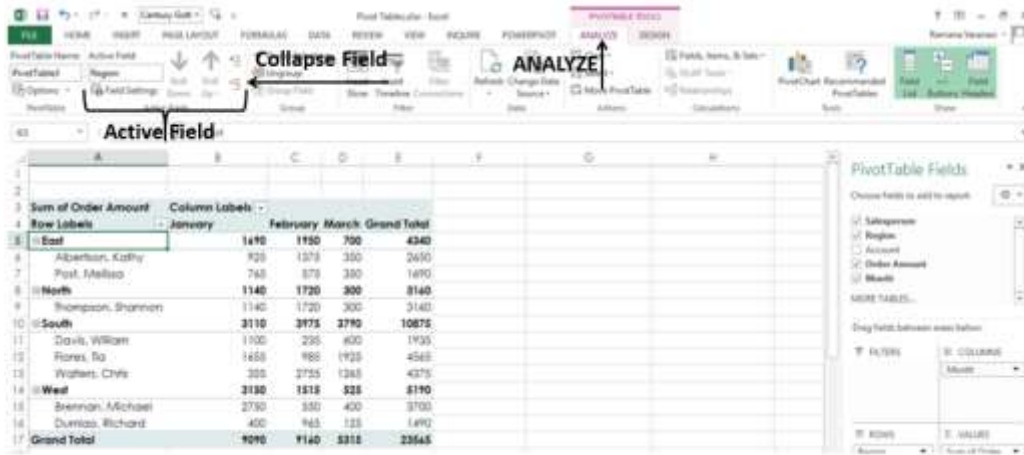
You can observe that only the items below East are collapsed. The rest of the PivotTable items are as they are.

Click the Expand symbol  to the left of East. All the items below East will be displayed.

### Using ANALYZE on the Ribbon-

You can collapse or expand all items in the PivotTable at once with the Expand Field and Collapse Field commands on the Ribbon.

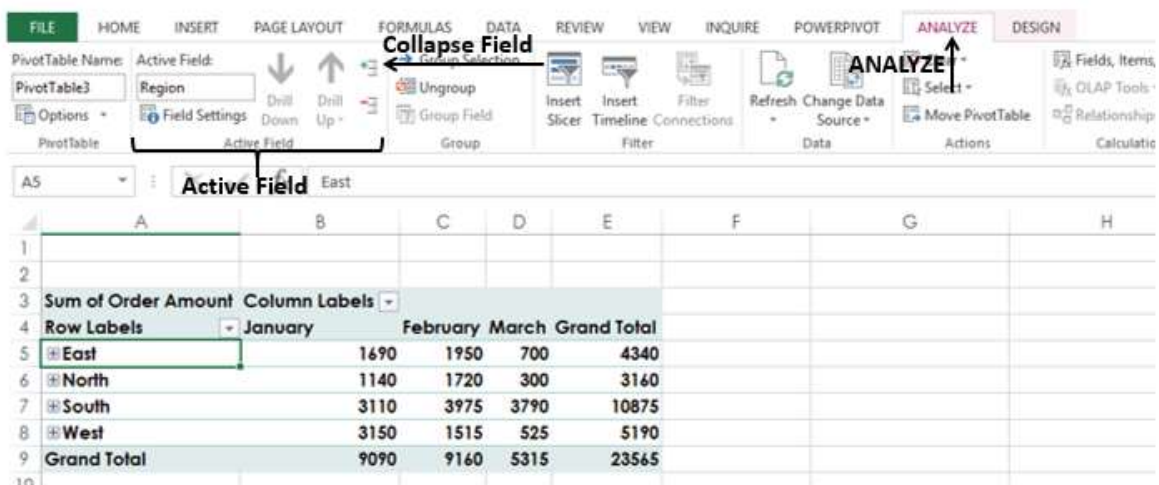
- Click the cell containing East in the PivotTable.
- Click the ANALYZE tab on the Ribbon.
- Click Collapse Field in the Active Field group.



All the items of the field East in the PivotTable will collapse.

3	Sum of Order Amount	Column Labels				
4	Row Labels	January	February	March	Grand Total	
5	East	1690	1950	700	4340	
6	North	1140	1720	300	3160	
7	South	3110	3975	3790	10875	
8	West	3150	1515	525	5190	
9	Grand Total	9090	9160	5315	23565	

Click Expand Field in the Active Field group.



All the items will be displayed.

## Report Presentation Styles

You can choose the presentation style for your PivotTable as you would be including it as a report. Select a style that fits into the rest of your presentation or report. However, do not get over bored with the styles because a report that gives an impact in showing the results is always better than a colorful one, which does not highlight the important data points.

- Click East in the PivotTable.
- Click ANALYZE.
- Click Field Settings in Active Field group. The Field Settings dialog box appears.
- Click the Layout & Print tab.
- Check Insert blank line after each item label.

The screenshot shows the Excel interface with the PivotTable and the Field Settings dialog box. The PivotTable data is as follows:

Row Labels	January	February	March	Grand Total
<b>East</b>	1690	1950	700	4340
Albertson, Kathy	925	1375	350	2650
Post, Melissa	765	575	350	1690
<b>North</b>	1140	1720	300	3160
Thompson, Shannon	1140	1720	300	3160
<b>South</b>	3110	3975	3790	10875
Davis, William	1100	235	600	1935
Flores, Tia	1655	985	1925	4565
Walters, Chris	355	2755	1265	4375
<b>West</b>	3150	1515	525	5190
Brennan, Michael	2750	550	400	3700
Dumiao, Richard	400	965	125	1490
<b>Grand Total</b>	9090	9160	5315	23565

The Field Settings dialog box is open, showing the 'Layout & Print' tab. The 'Insert blank line after each item label' checkbox is checked. The 'ANALYZE' ribbon tab is also visible.

Blank rows will be displayed after each value of the Region field.

You can insert blank rows from the **DESIGN** tab also.



	A	B	C	D	E
2					
3	<b>Sum of Order Amount</b>	<b>Column Labels</b>			
4	<b>Row Labels</b>	<b>January</b>	<b>February</b>	<b>March</b>	<b>Grand Total</b>
5	<b>East</b>	<b>1690</b>	<b>1950</b>	<b>700</b>	<b>4340</b>
6	Albertson, Kathy	925	1375	350	2650
7	Post, Melissa	765	575	350	1690
8					
9	<b>North</b>	<b>1140</b>	<b>1720</b>	<b>300</b>	<b>3160</b>
10	Thompson, Shannon	1140	1720	300	3160
11					
12	<b>South</b>	<b>3110</b>	<b>3975</b>	<b>3790</b>	<b>10875</b>
13	Davis, William	1100	235	600	1935
14	Flores, Tia	1655	985	1925	4565
15	Walters, Chris	355	2755	1265	4375
16					
17	<b>West</b>	<b>3150</b>	<b>1515</b>	<b>525</b>	<b>5190</b>
18	Brennan, Michael	2750	550	400	3700
19	Dumlao, Richard	400	965	125	1490
20					
21	<b>Grand Total</b>	<b>9090</b>	<b>9160</b>	<b>5315</b>	<b>23565</b>
22					

- Click the DESIGN tab.
- Click Report Layout in Layout group.
- Select Show in Outline Form in the drop-down list.

The screenshot shows the Excel interface with the PivotTable DESIGN tab selected. The 'Report Layout' group is expanded, and the 'Show in Outline Form' option is chosen. The PivotTable data is displayed in outline form. The 'PivotTable Styles' group is also visible.

Month	January	February	March	Grand Total
East	1690	1950	700	4340
Albertson, Kathy	925	1375	350	2650
Post, Melissa	765	575	350	1690
North	1140	1720	300	3160
Thompson, Shannon	1140	1720	300	3160
South	3110	3975	3790	10875
Davis, William	1100	235	600	1935
Flores, Tia	1655	985	1925	4565
Walters, Chris	355	2755	1265	4375
West	3150	1515	525	5190
Brennan, Michael	2750	550	400	3700
Dumlao, Richard	400	965	125	1490
Grand Total	9090	9160	5315	23565



- Hover the mouse over the PivotTable Styles. A preview of the style on which the mouse is placed will appear.
- Select the Style that suits your report.

PivotTable in Outline Form with the selected Style will be displayed.

	A	B	C	D	E	F
2						
3	<b>Sum of Order Amount</b>		Month			
4	Region	Salesperson	January	February	March	Grand Total
5	<b>East</b>		<b>1690</b>	<b>1950</b>	<b>700</b>	<b>4340</b>
6		Albertson, Kathy	925	1375	350	2650
7		Post, Melissa	765	575	350	1690
8						
9	<b>North</b>		<b>1140</b>	<b>1720</b>	<b>300</b>	<b>3160</b>
10		Thompson, Shannon	1140	1720	300	3160
11						
12	<b>South</b>		<b>3110</b>	<b>3975</b>	<b>3790</b>	<b>10875</b>
13		Davis, William	1100	235	600	1935
14		Flores, Tia	1655	985	1925	4565
15		Walters, Chris	355	2755	1265	4375
16						
17	<b>West</b>		<b>3150</b>	<b>1515</b>	<b>525</b>	<b>5190</b>
18		Brennan, Michael	2750	550	400	3700
19		Dumlao, Richard	400	965	125	1490
20						
21	<b>Grand Total</b>		<b>9090</b>	<b>9160</b>	<b>5315</b>	<b>23565</b>

## Timeline in PivotTables

To understand how to use Timeline, consider the following example wherein the sales data of various items is given salesperson wise and location wise. There are total 1891 rows of data.

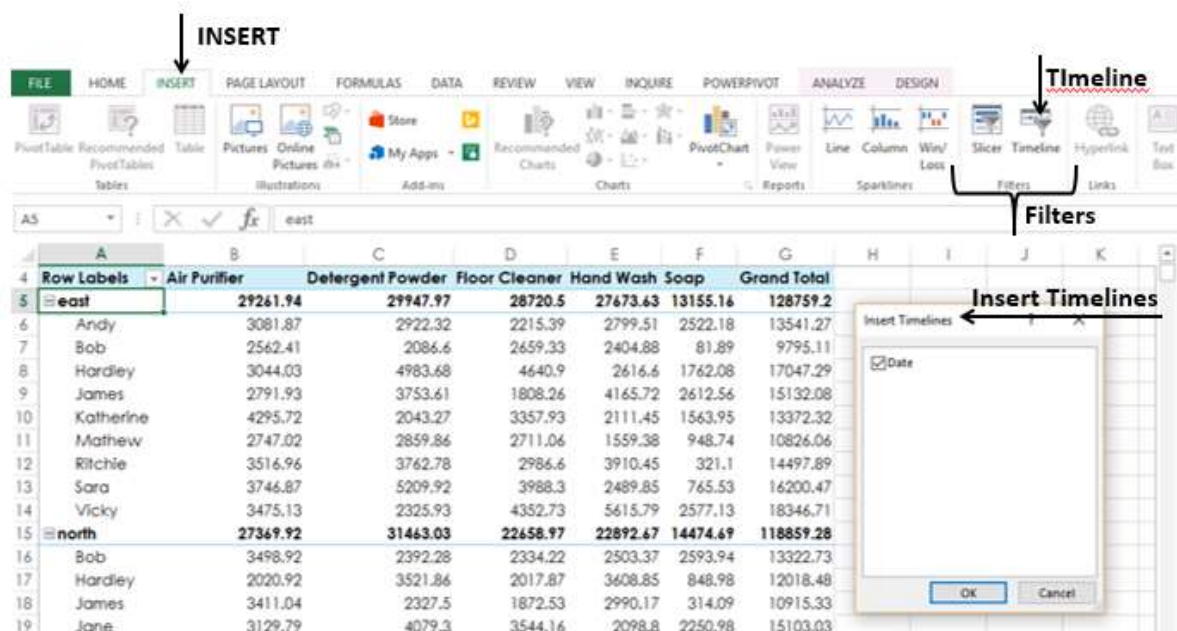
	A	B	C	D	E	F	G
1	Invoice Number	Name	Date	Product	Units	Amount	Location
2	NOVIHW0001	Vicky	1/10/2013	Detergent Powder	35	406.52	north
3	SOMAF0002	Mathew	1/10/2013	Floor Cleaner	10	91.90	south
4	NORIDP0003	Ritchie	1/10/2013	Air Purifier	61	330.79	north
5	SOJAHW0004	Jane	1/10/2013	Floor Cleaner	89	54.40	south
6	SOSADP0005	Sara	1/10/2013	Floor Cleaner	32	126.15	south
7	SOVIAP0006	Vicky	1/10/2013	Soap	76	172.80	south
8	EAANHW0007	Andy	1/10/2013	Hand Wash	85	379.65	east
9	EABODP0008	Bob	1/10/2013	Hand Wash	43	345.39	east
10	EAJADP0009	James	1/10/2013	Soap	20	55.30	east
11	EAMAAP0010	Mathew	1/10/2013	Floor Cleaner	14	72.67	east
12	EASASO0011	Sara	1/10/2013	Floor Cleaner	68	218.70	east
13	EAVIFC0012	Vicky	1/10/2013	Hand Wash	34	263.90	east
14	NOBODP0013	Bob	1/10/2013	Soap	88	233.74	north
15	WEBOAP0014	Bob	1/10/2013	Detergent Powder	30	166.71	west
16	WEJAHW0015	James	1/10/2013	Detergent Powder	60	305.43	west
17	WERIDP0016	Ritchie	1/10/2013	Hand Wash	7	72.57	west
18	WEVIDP0017	Vicky	1/10/2013	Hand Wash	42	367.21	west
19	SOKADP0018	Katherine	1/21/2013	Hand Wash	47	372.12	south
20	SORIAP0019	Ritchie	1/21/2013	Floor Cleaner	80	271.40	south
21	SOMAF0020	Mathew	1/21/2013	Detergent Powder	25	177.10	south
22	SOMAF0021	Mathew	1/21/2013	Hand Wash	67	151.34	south
23	SOMADP0022	Mathew	1/21/2013	Floor Cleaner	43	205.15	south
24	SOKADP0023	Katherine	1/21/2013	Floor Cleaner	96	65.51	south
25	SOMAAP0024	Mathew	1/21/2013	Air Purifier	70	263.28	south

Create a PivotTable from this Range with-

- Location and Salesperson in Rows in that order
- Product in Columns
- Sum of Amount in Summarizing values

	A	B	C	D	E	F	G
4	Row Labels	Air Purifier	Detergent Powder	Floor Cleaner	Hand Wash	Soap	Grand Total
5	east	29261.94	29947.97	28720.5	27673.63	13155.16	128759.2
6	Andy	3081.87	2922.32	2215.39	2799.51	2522.18	13541.27
7	Bob	2562.41	2086.6	2659.33	2404.88	81.89	9795.11
8	Hardley	3044.03	4983.68	4640.9	2616.6	1762.08	17047.29
9	James	2791.93	3753.61	1808.26	4165.72	2612.56	15132.08
10	Katherine	4295.72	2043.27	3357.93	2111.45	1563.95	13372.32
11	Mathew	2747.02	2859.86	2711.06	1559.38	948.74	10826.06
12	Ritchie	3516.96	3762.78	2986.6	3910.45	321.1	14497.89
13	Sara	3746.87	5209.92	3988.3	2489.85	765.53	16200.47
14	Vicky	3475.13	2325.93	4352.73	5615.79	2577.13	18346.71
15	north	27369.92	31463.03	22658.97	22892.67	14474.69	118859.28
16	Bob	3498.92	2392.28	2334.22	2503.37	2593.94	13322.73
17	Hardley	2020.92	3521.86	2017.87	3608.85	848.98	12018.48
18	James	3411.04	2327.5	1872.53	2990.17	314.09	10915.33
19	Jane	3129.79	4079.3	3544.16	2098.8	2250.98	15103.03
20	Katherine	2863.26	3258.92	3536.76	3207.97	2524.36	15391.27
21	Mathew	2055.3	3489.2	1708.12	1970	1692.24	10914.86
22	Ritchie	3660.37	4152.84	1935.72	2513.32	1142.19	13404.44
23	Sara	3703.66	4509.25	3972.63	1817.86	1304.11	15307.51
24	Vicky	3026.66	3731.88	1736.96	2182.33	1803.8	12481.63

- Click the PivotTable.
- Click INSERT tab.
- Click Timeline in Filters group. The Insert Timelines appears.



Click Date and click OK. The Timeline dialog box appears and the Timeline Tools appear on the Ribbon.

The screenshot shows the Excel 2016 interface with the 'PivotTable Tools - Excel' ribbon selected. The 'TIMELINE TOOLS' tab is active, showing options for 'Date' and 'Filter'. A PivotTable is displayed with the following data:

Row Labels	Air Purifier	Detergent Powder	Floor Cleaner	Hand Wash Soap	Grand Total
east	29261.94	29947.97	28720.5	27673.63	13155.16
Andy	3081.87	2922.32	2215.39	2799.51	2522.18
Bob	2562.41	2086.6	2659.33	2404.88	81.89
Hardley	3044.03	4983.68	4640.9	2616.6	1762.08
James	2791.93	3753.61	1808.26	4165.72	2612.56
Katherine	4295.72	2043.27	3357.93	2111.45	1563.95
Mathew	2747.02	2859.86	2711.06	1559.38	948.74
Ritchie	3516.96	3762.78	2986.6	3910.45	321.1
Sara	3746.87	5209.92	3988.3	2489.85	765.53
Vicky	3475.13	2325.93	4352.73	5615.79	2577.13
north	27369.92	31463.03	22658.97	22892.67	14474.69

The Timeline dialog box is open, showing the 'Date' field and the 'Filter' tab. The 'Date' field is set to 'All Periods' and the 'Filter' tab is selected. The 'Date' field is set to 'All Periods' and the 'Filter' tab is selected. The 'Date' field is set to 'All Periods' and the 'Filter' tab is selected.

- In Timeline dialog box, select MONTHS.
- From the drop-down list select QUARTERS.
- Click 2014 Q2.
- Keep the Shift key pressed and drag to 2014 Q4.

Timeline is selected to Q2 – Q4 2014.

PivotTable is filtered to this Timeline.

The screenshot shows the Excel 2016 interface with the PivotTable filtered to Q2 - Q4 2014. The PivotTable data is as follows:

Row Labels	Air Purifier	Detergent Powder	Floor Cleaner	Hand Wash Soap	Grand Total
east	8232.35	8852.68	5444	5787.43	2742.52
Andy	867.78	804.59	556.13	188.1	2416.6
Bob	249.66	1181.12	600.94	81.89	2113.61
Hardley	1076.52	668.27	1323.81	873.6	1190.6
James	1067.3	1159.24	609.11	388.26	270.87
Katherine	1104.74	476.89	965.4	597.92	575.38
Mathew	606.66	1101.46	642.34	495.73	2846.19
Ritchie	1126.39	851.58	722.32		2700.29
Sara	1163.91	2162.79	741.1	296.52	4364.32
Vicky	969.39	446.74	561.3	1856.95	435.68
north	7436.85	9493.86	5107.38	5641.41	5290.65
Bob	1273.58	227.51	182.65	370.99	1114.84
Hardley	975.44	421.55	1097.62	718.88	3213.49
James	1171.68	1028.41	428.3	1716.2	4344.59
Jane	584.01	1458.27	1012.29	76.48	761.68
Katherine	810.24	482.28	892.67	934.02	925.38
Mathew	522.7	1796.96		260.78	831.36
Ritchie	1033.44	1158.09	141.41		2332.94
Sara	951.22	1406.37	1598.57	229.25	203.78
Vicky	1089.98	960.53	429.94	956.07	734.73

The Timeline dialog box is open, showing the 'Date' field and the 'Filter' tab. The 'Date' field is set to 'Q2 - Q4 2014' and the 'Filter' tab is selected. The 'Date' field is set to 'Q2 - Q4 2014' and the 'Filter' tab is selected.

# 16. Data Visualization

You can display your data analysis reports in a number of ways in Excel. However, if your data analysis results can be visualized as charts that highlight the notable points in the data, your audience can quickly grasp what you want to project in the data. It also leaves a good impact on your presentation style.

In this chapter, you will get to know how to use Excel charts and Excel formatting features on charts that enable you to present your data analysis results with emphasis.

## Visualizing Data with Charts

In Excel, charts are used to make a graphical representation of any set of data. A chart is a visual representation of the data, in which the data is represented by symbols such as bars in a Bar Chart or lines in a Line Chart. Excel provides you with many chart types and you can choose one that suits your data or you can use the Excel Recommended Charts option to view charts customized to your data and select one of those.

Refer to the Tutorial Excel Charts for more information on chart types.

In this chapter, you will understand the different techniques that you can use with the Excel charts to highlight your data analysis results more effectively.

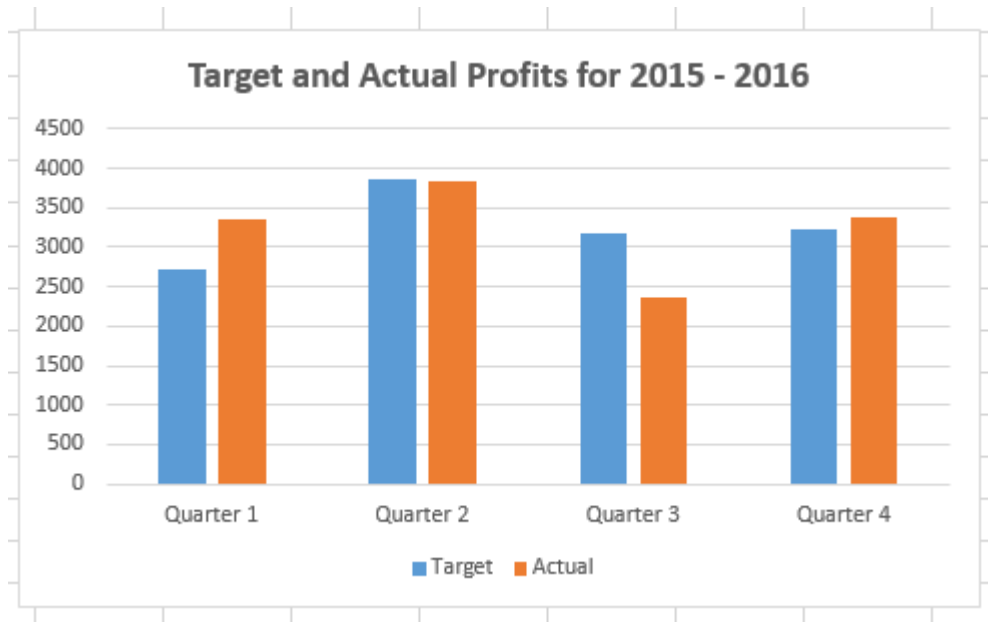
## Creating Combination Charts

Suppose you have the target and actual profits for the fiscal year 2015-2016 that you obtained from different regions.

	A	B	C	D
1				
2			Target	Actual
3		Quarter 1	2727	3358
4		Quarter 2	3860	3829
5		Quarter 3	3169	2374
6		Quarter 4	3222	3373



We will create a Clustered Column Chart for these results.



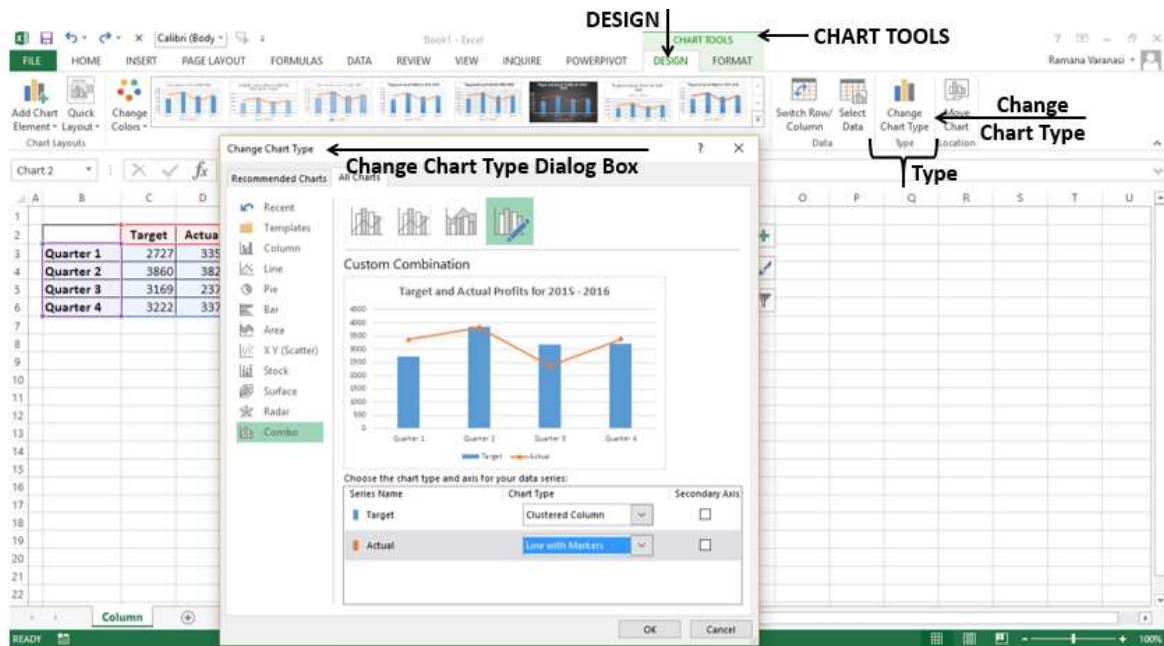
As you observe, it is difficult to visualize the comparison quickly between the targets and actual in this chart. It does not give a true impact on your results.

A better way of distinguishing two types of data to compare the values is by using Combination Charts. In Excel 2013 and versions above, you can use Combo charts for the same purpose.

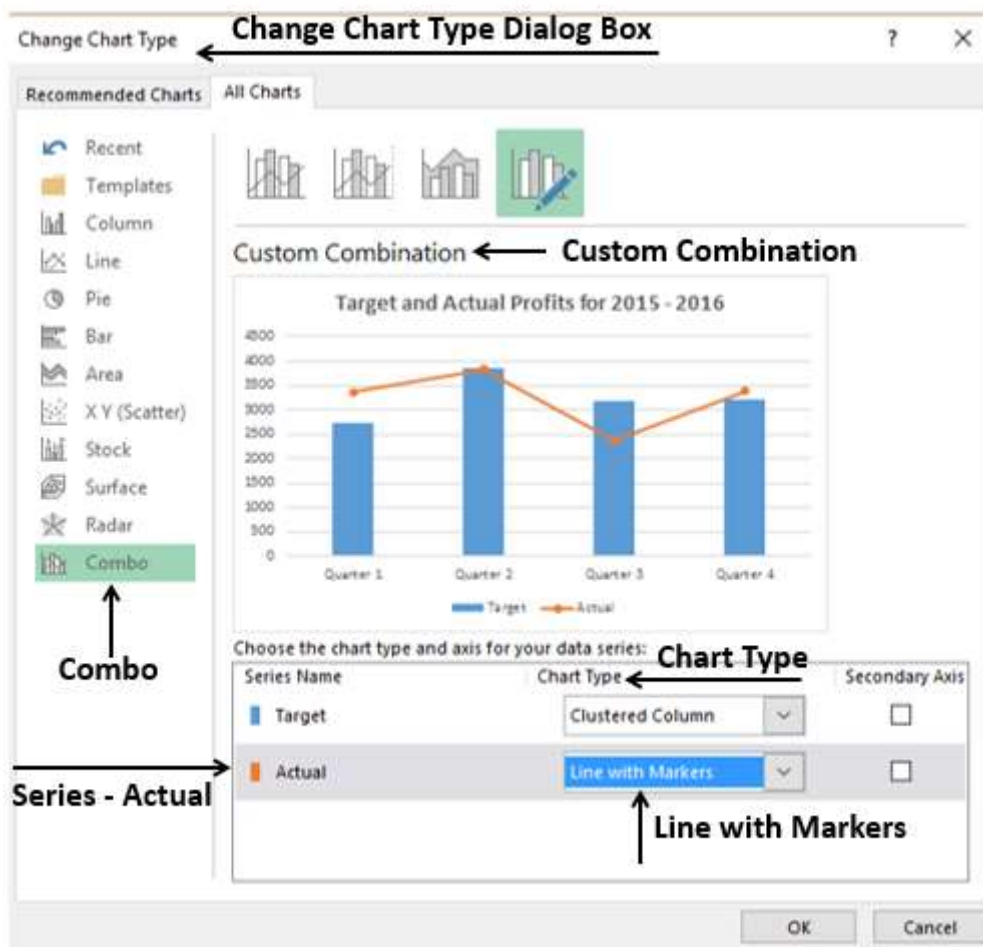
Use Vertical Columns for the target values and a Line with Markers for the actual values.

- Click the DESIGN tab under the CHART TOOLS tab on the Ribbon
- Click Change Chart Type in the Type group. The Change Chart Type dialog box appears.

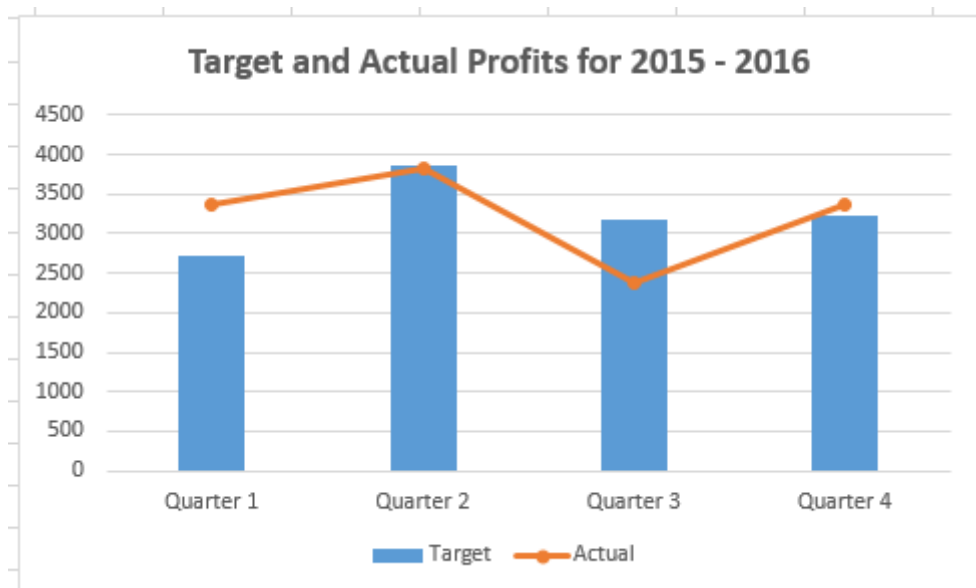




- Click Combo.
- Change the Chart Type for the series Actual to Line with Markers. The preview appears under Custom Combination.
- Click OK.



Your Customized Combination Chart will be displayed.



As you observe in the chart, the Target values are in Columns and the Actual values are marked along the line. The data visualization has become better as it also shows you the trend of your results.

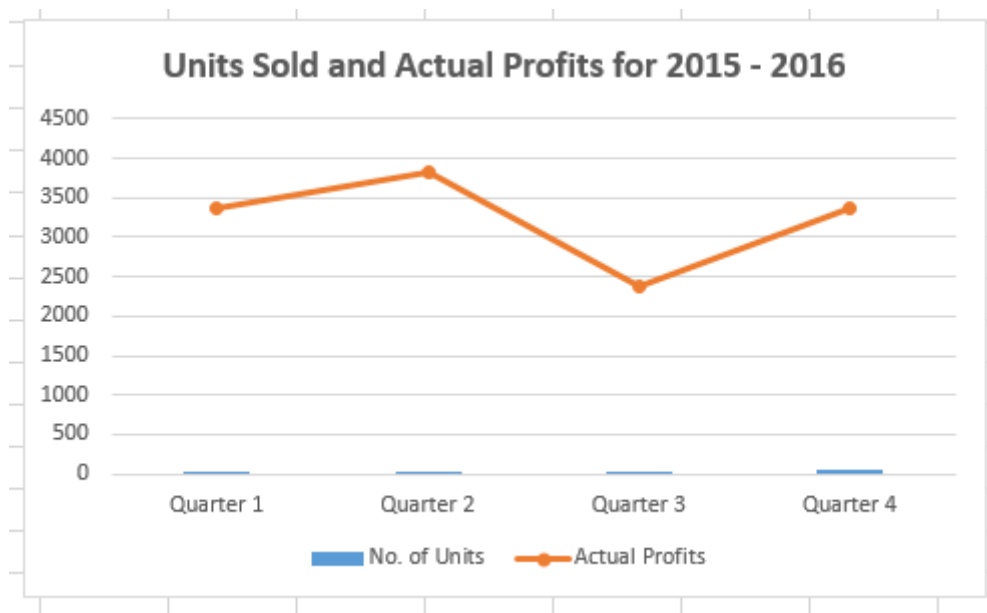
However, this type of representation does not work well when the data ranges of your two data values vary significantly.

## Creating a Combo Chart with Secondary Axis

Suppose you have the data on the number of units of your product that was shipped and the actual profits for the fiscal year 2015-2016 that you obtained from different regions.

	A	B	C	D
1				
2			<b>No. of Units</b>	<b>Actual Profits</b>
3		<b>Quarter 1</b>	23	3358
4		<b>Quarter 2</b>	27	3829
5		<b>Quarter 3</b>	15	2374
6		<b>Quarter 4</b>	43	3373

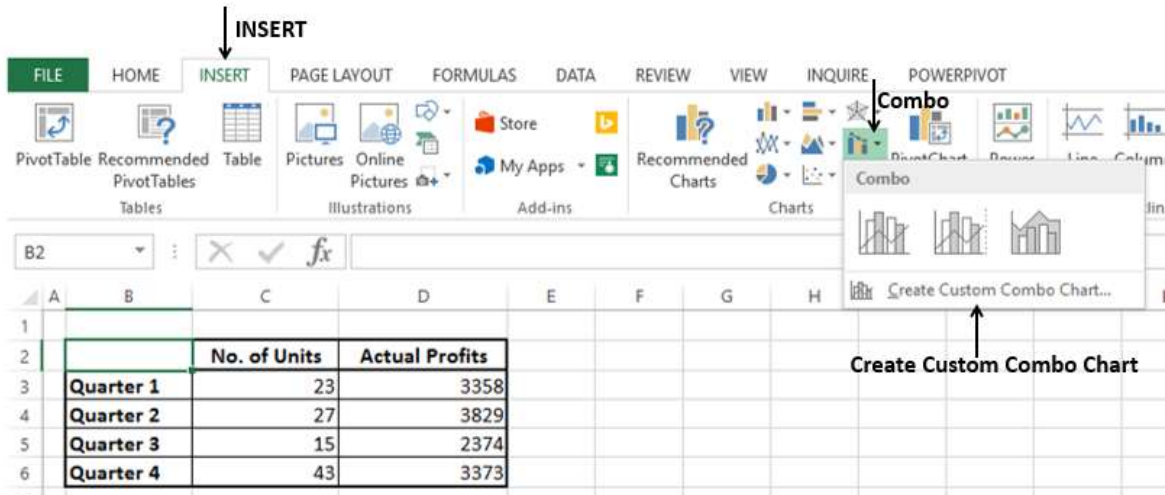
If you use the same combination chart as before, you will get the following-



In the chart, the data of **No. of Units** is not visible as the data ranges are varying significantly.

In such cases, you can create a combination chart with secondary axis, so that the primary axis displays one range and the secondary axis displays the other.

- Click the INSERT tab.
- Click Combo in Charts group.
- Click Create Custom Combo Chart from the drop-down list.

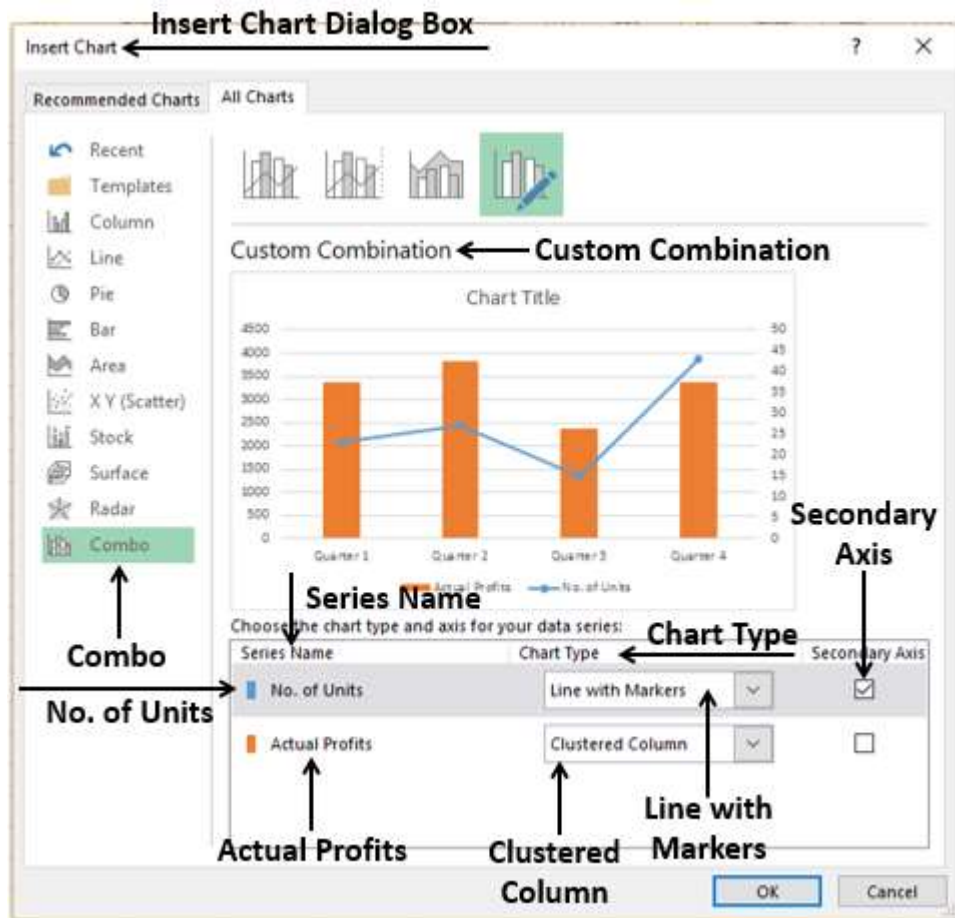


The Insert Chart dialog box appears with Combo highlighted.

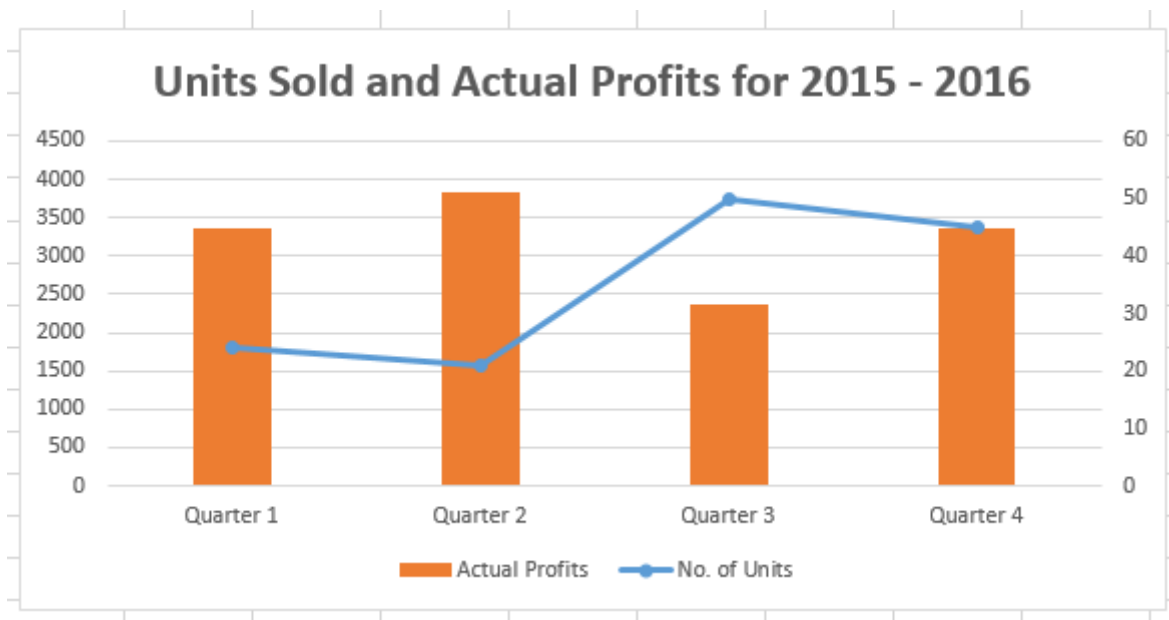
For Chart Type, choose-

- Line with Markers for the Series No. of Units
- Clustered Column for the Series Actual Profits
- Check the Box Secondary Axis to the right of the Series No. of Units and click OK.

A preview of your chart appears under Custom Combination.



Your Combo chart appears with Secondary Axis.



You can observe the values for Actual Profits on the primary axis and the values for No. of Units on the secondary axis.

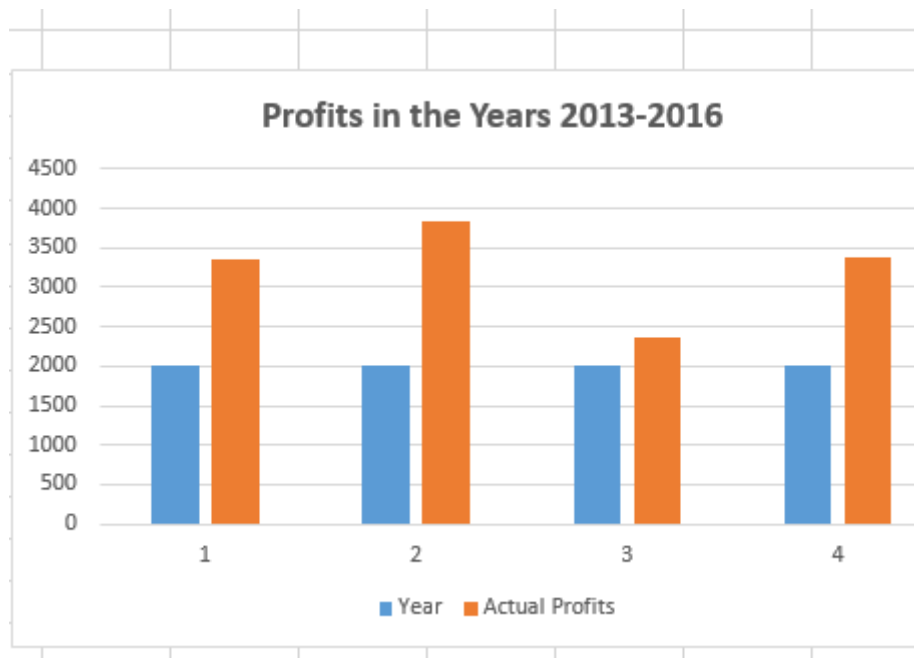
A significant observation in the above chart is for Quarter 3 where No. of Units sold is more, but the Actual Profits made are less. This could probably be assigned to the promotion costs that were incurred to increase sales. The situation is improved in Quarter 4, with a slight decrease in sales and a significant rise in the Actual Profits made.

## Discriminating Series and Category Axis

Suppose you want to project the Actual Profits made in Years 2013-2016.

	A	B	C
1			
2		<b>Year</b>	<b>Actual Profits</b>
3		2013	3358
4		2014	3829
5		2015	2374
6		2016	3373

Create a clustered column for this data.



As you observe, the data visualization is not effective as the years are not displayed. You can overcome this by changing year to category.



Remove the header year in the data range.

	A	B	C
1			
2			<b>Actual Profits</b>
3		2013	3358
4		2014	3829
5		2015	2374
6		2016	3373

Now, year is considered as a category and not a series. Your chart looks as follows-






## Chart Elements and Chart Styles

Chart Elements give more descriptions to your charts, thus helping visualizing your data more meaningfully.

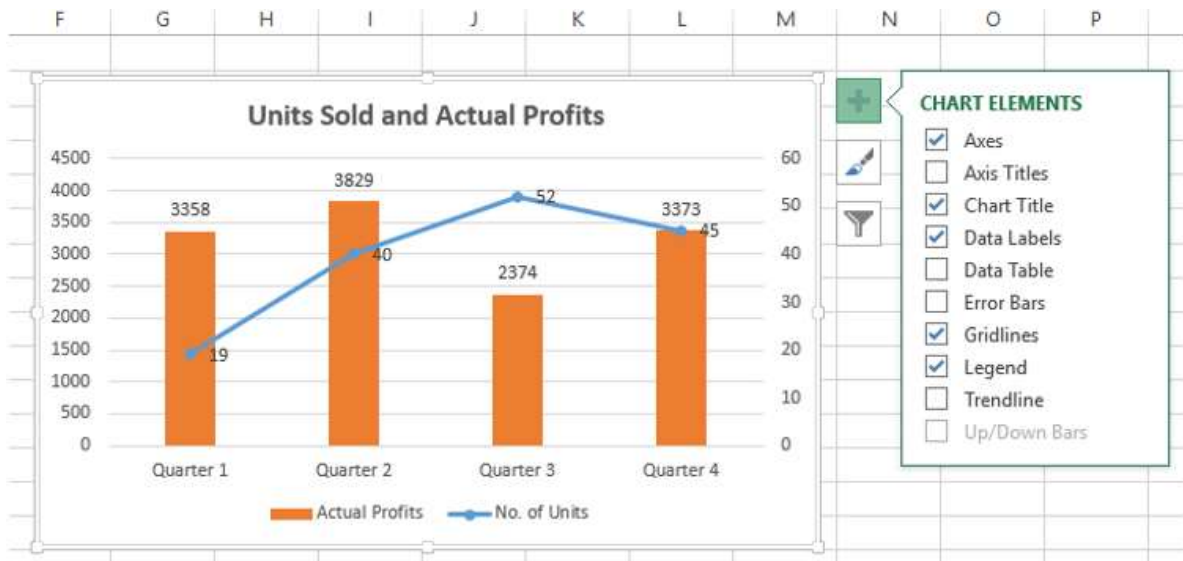
- Click the Chart

Three buttons appear next to the upper-right corner of the chart-

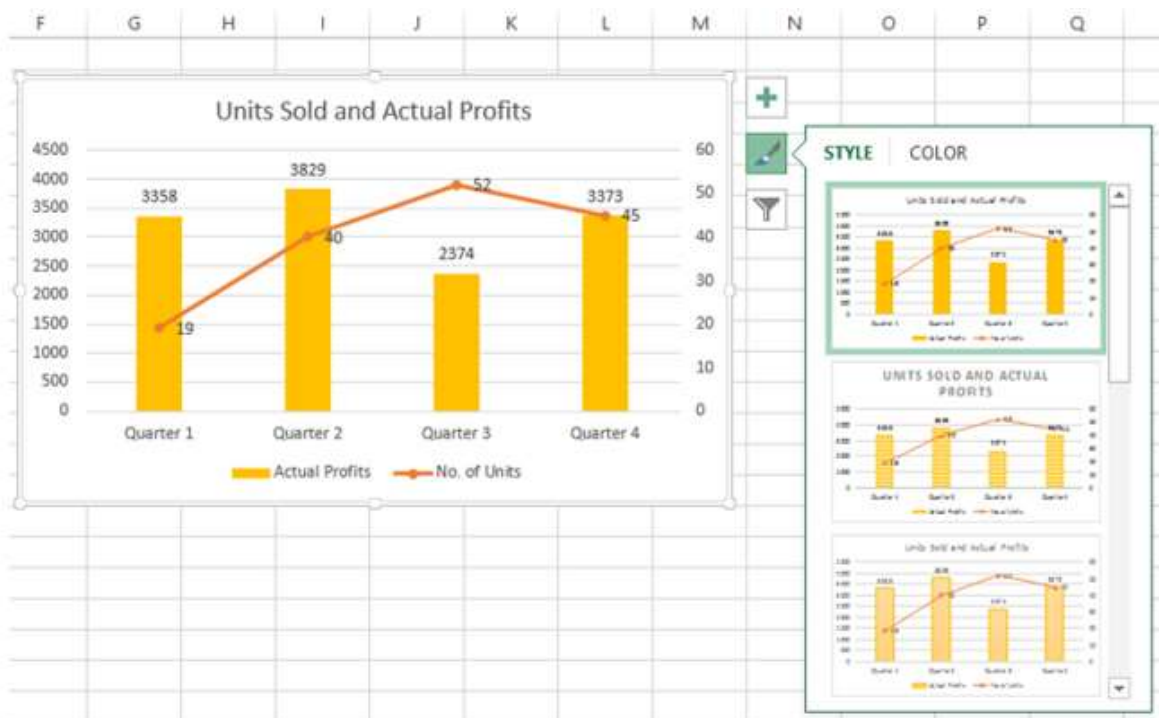
-  Chart Elements
-  Chart Styles
-  Chart Filters

For a detailed explanation of these, refer to Excel Charts tutorial.

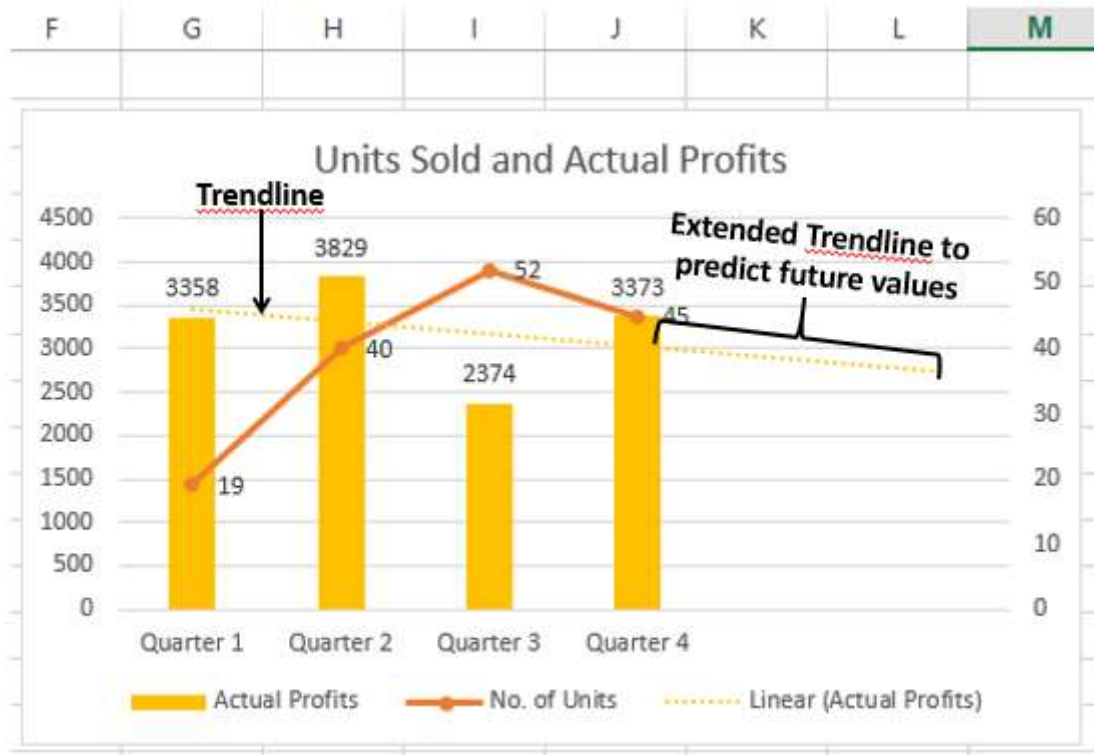
- Click Chart Elements.
- Click Data Labels.



- Click Chart Styles
- Select a Style and Color that suits your data.



You can use Trendline to graphically display trends in data. You can extend a Trendline in a chart beyond the actual data to predict future values.

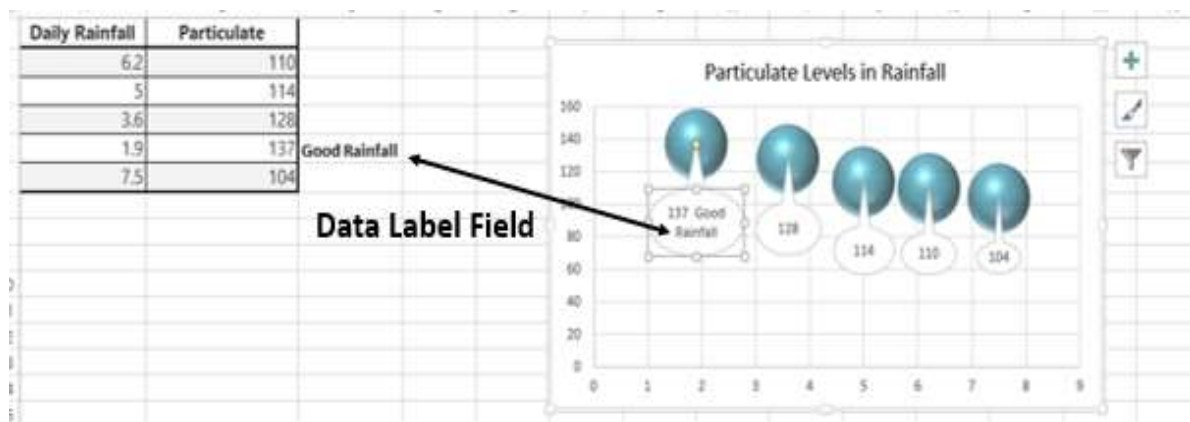


## Data Labels

Excel 2013 and later versions provide you with various options to display Data Labels. You can choose one Data Label, format it as you like, and then use Clone Current Label to copy the formatting to the rest of the Data Labels in the chart.

The Data Labels in a chart can have effects, varying shapes and sizes.

It is also possible to display the content of a cell as part of the Data Label with Insert Data Label Field.

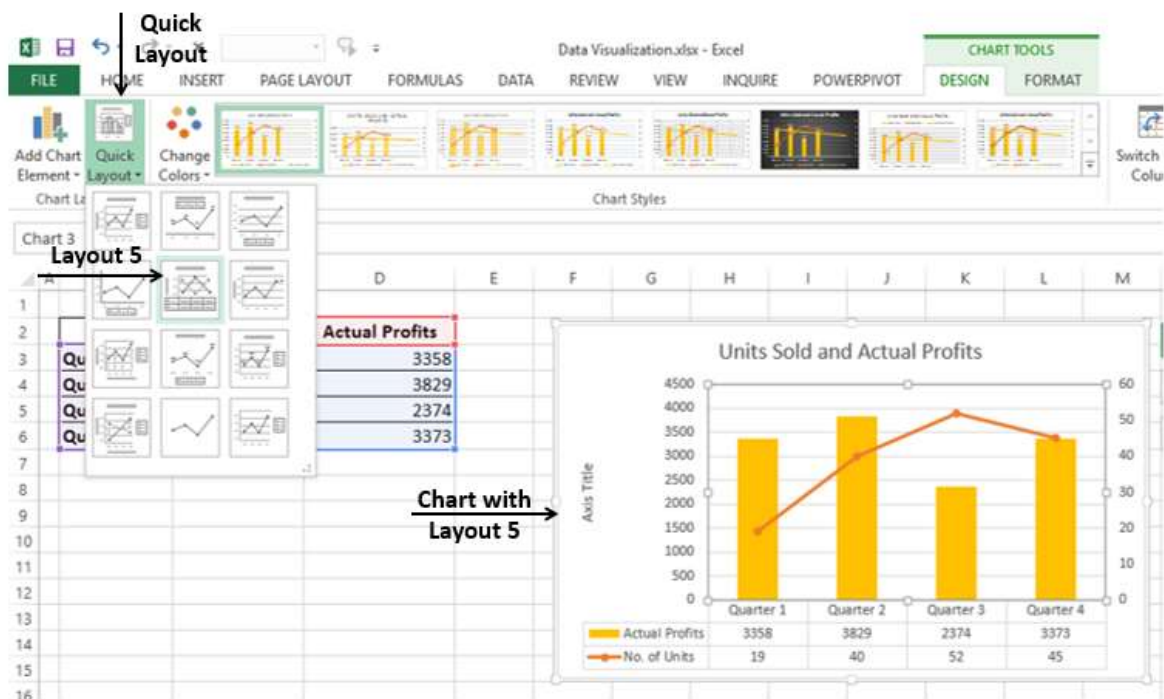


## Quick Layout

You can use Quick Layout to change the overall layout of the chart quickly by choosing one of the predefined layout options.

- Click the chart
- Click the DESIGN tab under CHART TOOLS.
- Click Quick Layout.

Different possible layouts will be displayed. As you move on the layout options, the chart layout changes to that particular option.

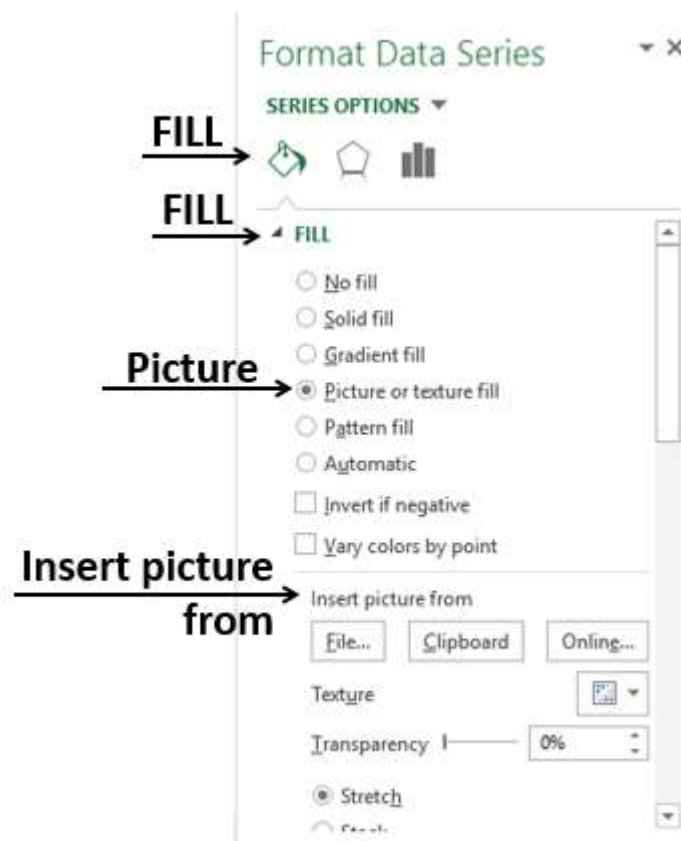


Select the layout you like. The chart will be displayed with the chosen layout.

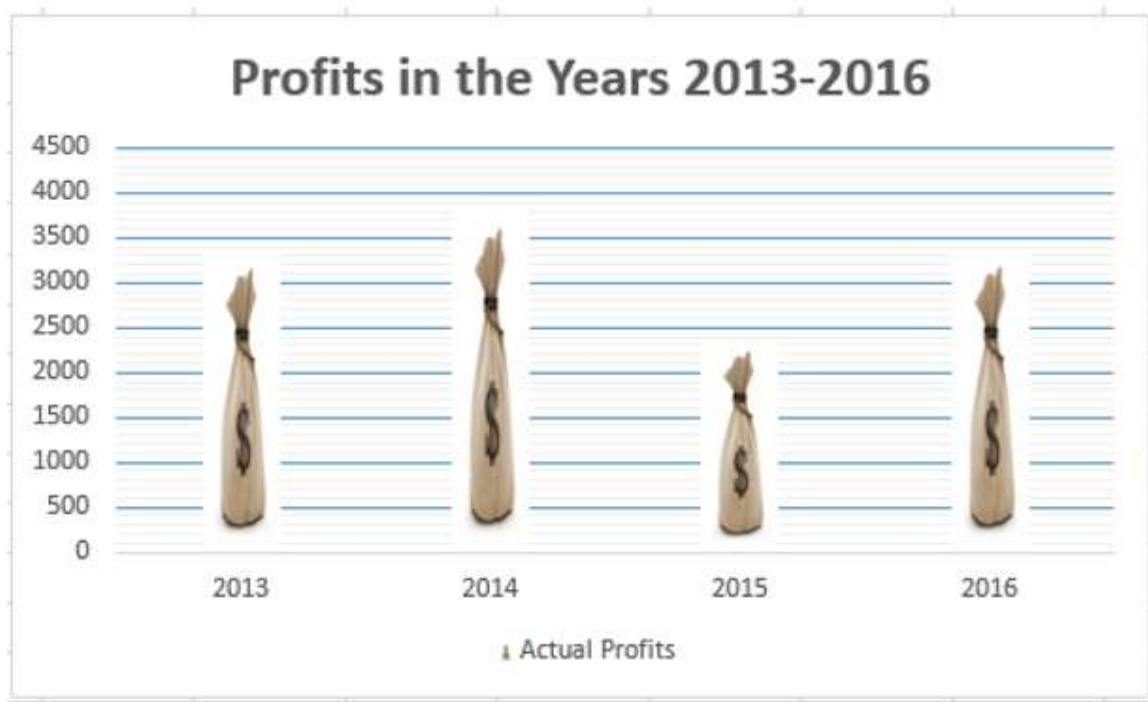
## Using Pictures in Column Charts

You can create more emphasis on your data presentation by using a picture in place of columns.

- Click on a Column on the Column Chart
- In the Format Data Series, click on Fill
- Select Picture
- Under Insert picture from, provide the filename or optionally clipboard if you had copied an image earlier.



The picture you have chosen will appear in place of columns in the chart.



## Band Chart

You might have to present customer survey results of a product from different regions. Band Chart is suitable for this purpose. A Band Chart is a Line Chart with an added shaded area to display the upper and lower boundaries of groups of data.

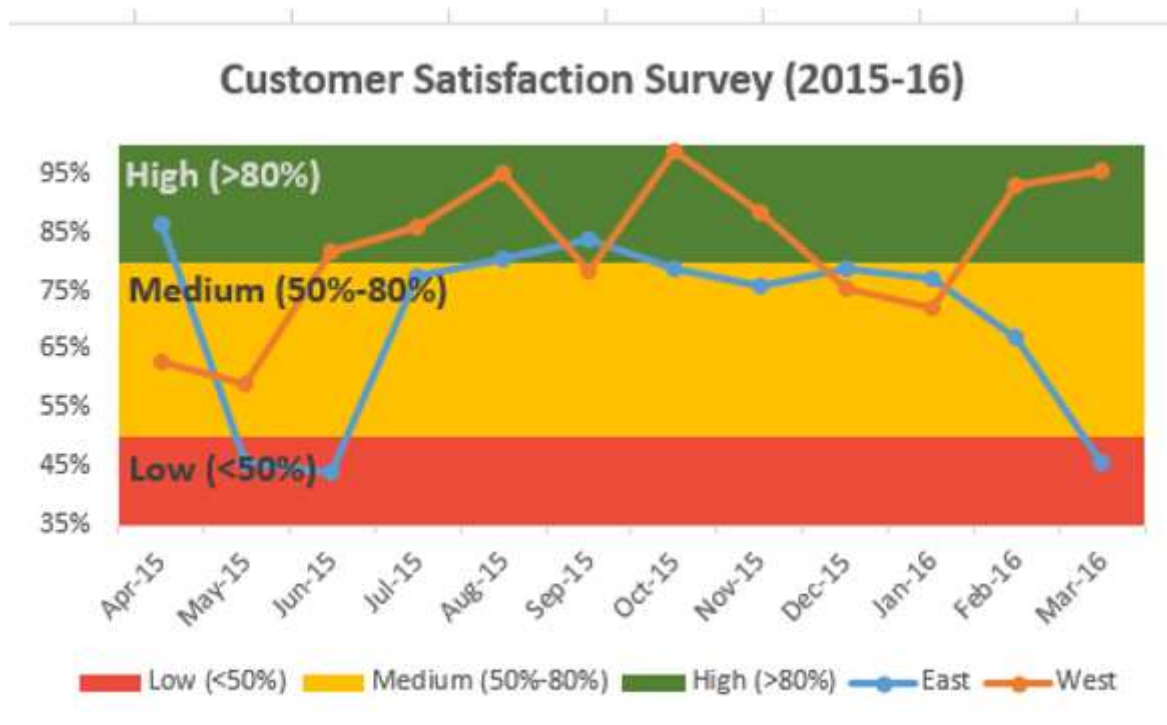
Suppose your customer survey results from the east and west regions, month wise are -

	A	B	C	D	E	F	G
1							
2		<b>Month</b>	<b>East</b>	<b>West</b>	<b>Low (&lt;50%)</b>	<b>Medium (50%-80%)</b>	<b>High (&gt;80%)</b>
3		Apr-15	86.4%	63.0%	50%	30%	20%
4		May-15	45.8%	58.9%	50%	30%	20%
5		Jun-15	44.1%	81.6%	50%	30%	20%
6		Jul-15	77.6%	86.1%	50%	30%	20%
7		Aug-15	80.7%	95.0%	50%	30%	20%
8		Sep-15	83.7%	78.2%	50%	30%	20%
9		Oct-15	78.8%	98.9%	50%	30%	20%
10		Nov-15	76.0%	88.3%	50%	30%	20%
11		Dec-15	79.0%	75.5%	50%	30%	20%
12		Jan-16	77.0%	72.1%	50%	30%	20%
13		Feb-16	67.1%	93.1%	50%	30%	20%
14		Mar-16	45.8%	95.7%	50%	30%	20%

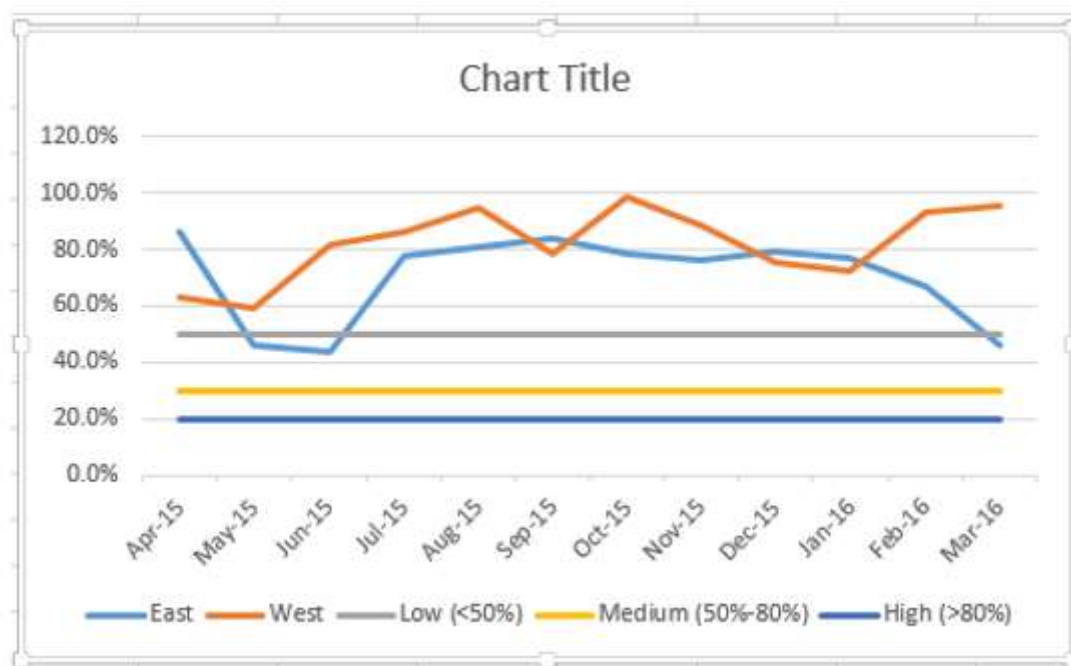
Here, in the data < 50% is Low, 50% - 80% is Medium and > 80% is High.

With Band Chart, you can display your survey results as follows-



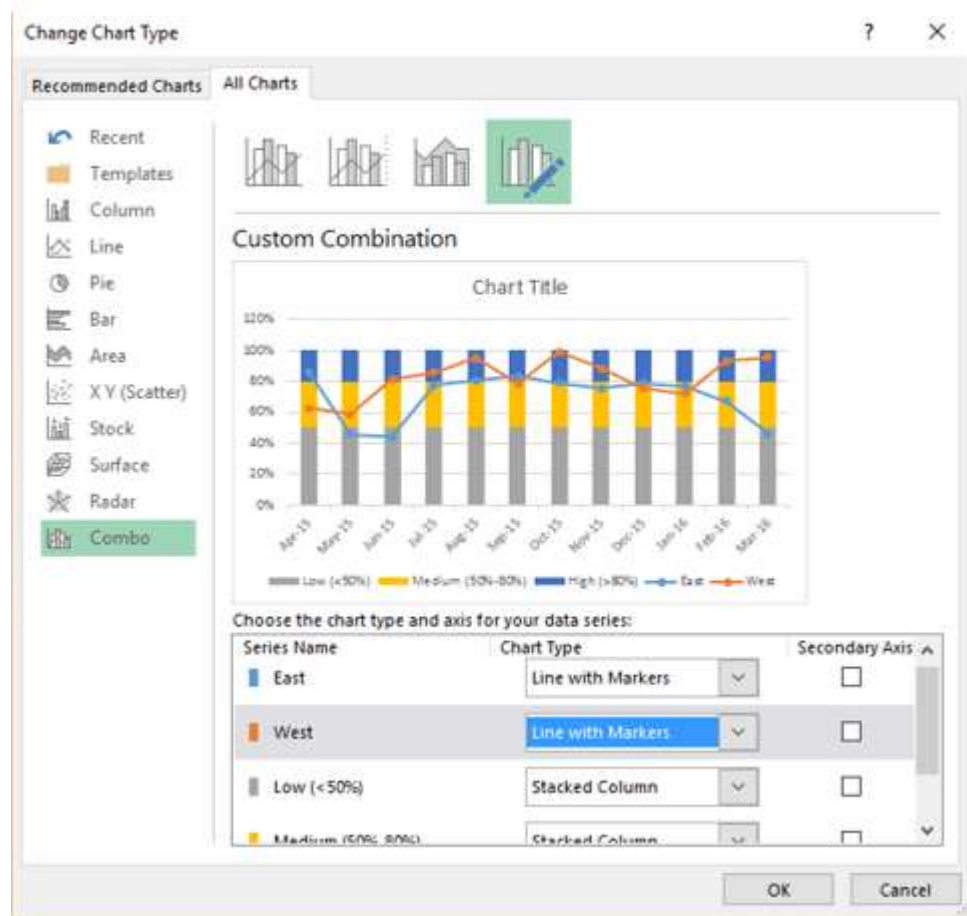


Create a Line Chart from your data.

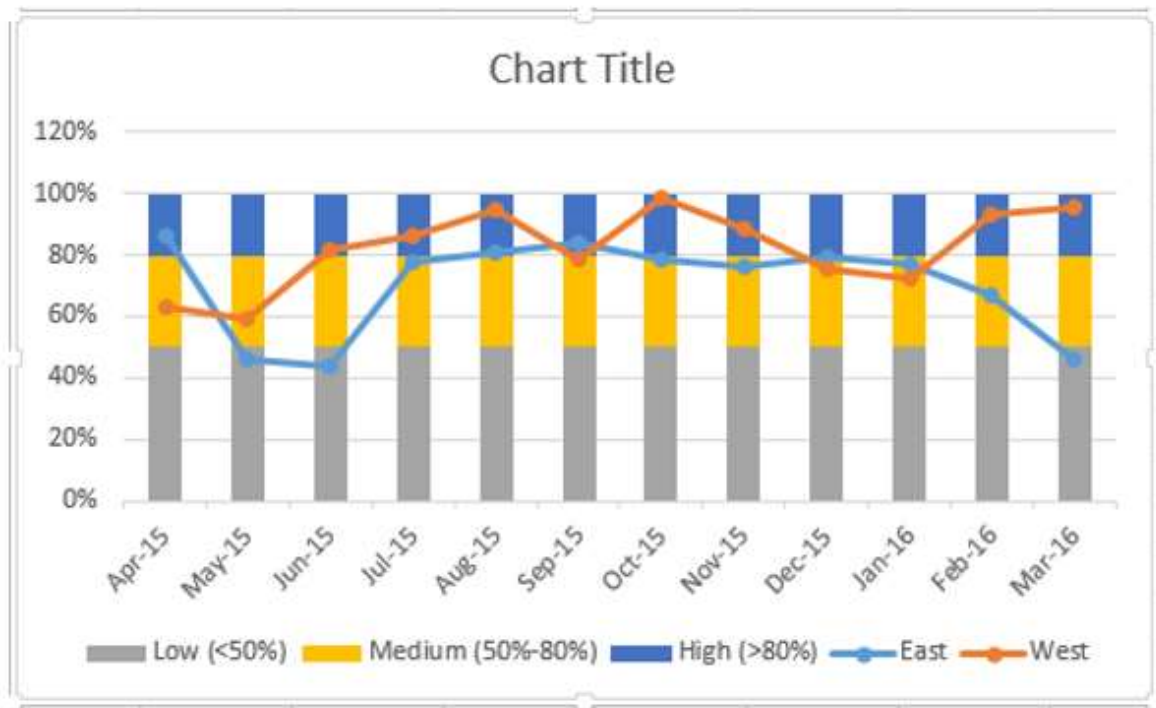


Change the chart type to-

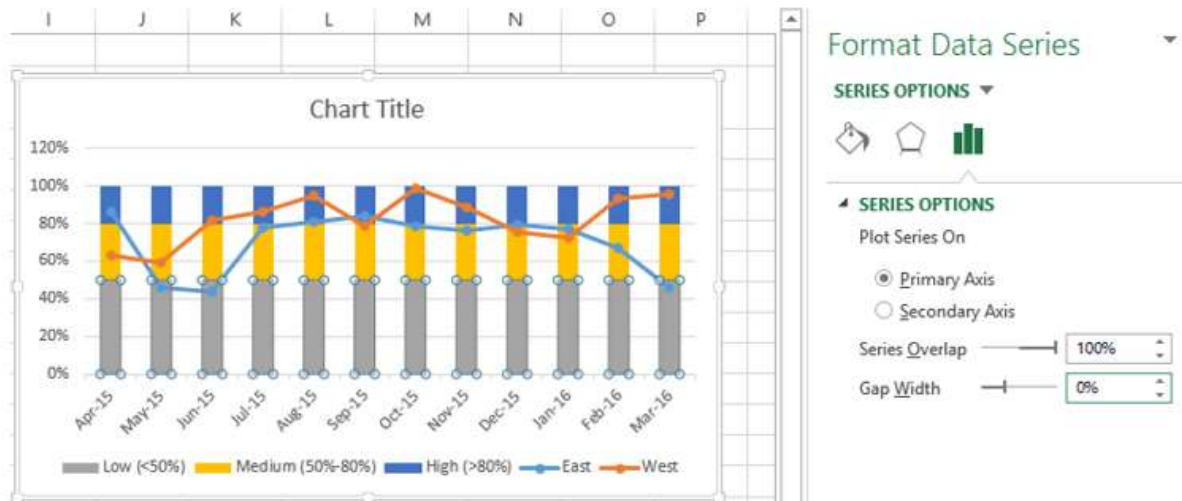
- East and West Series to Line with Markers
- Low, Medium and High Series to Stacked Column



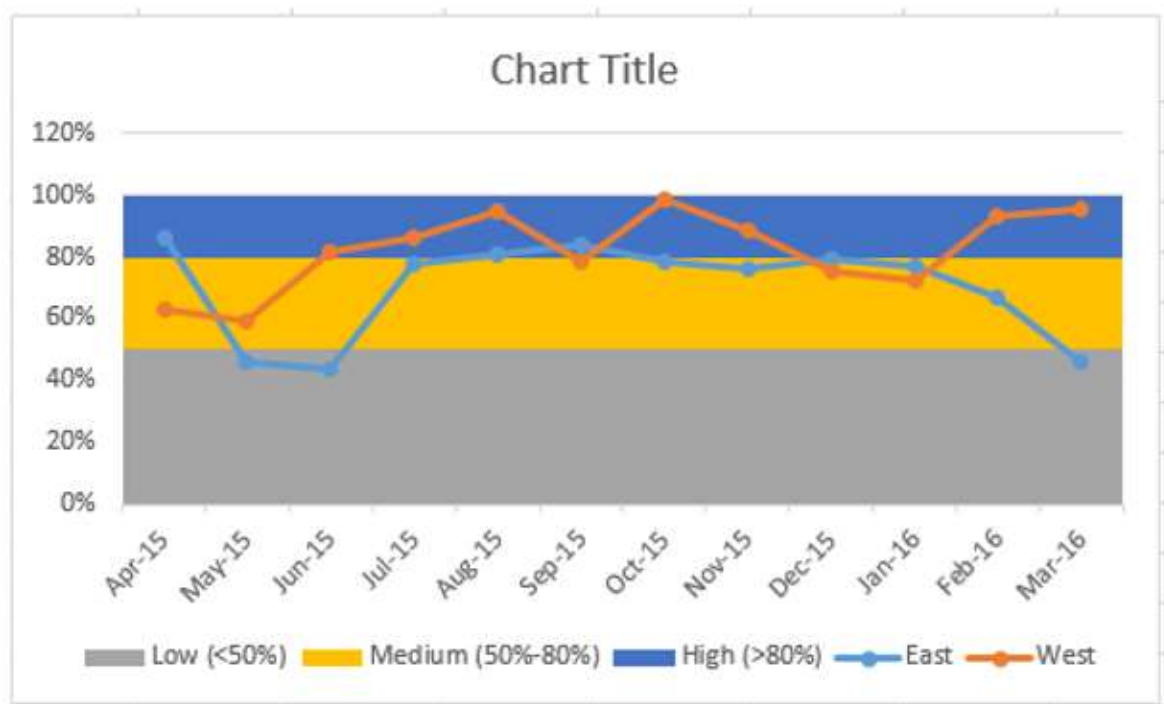
Your chart looks as follows.



- Click on one of the columns.
- Change gap width to 0% in Format Data Series



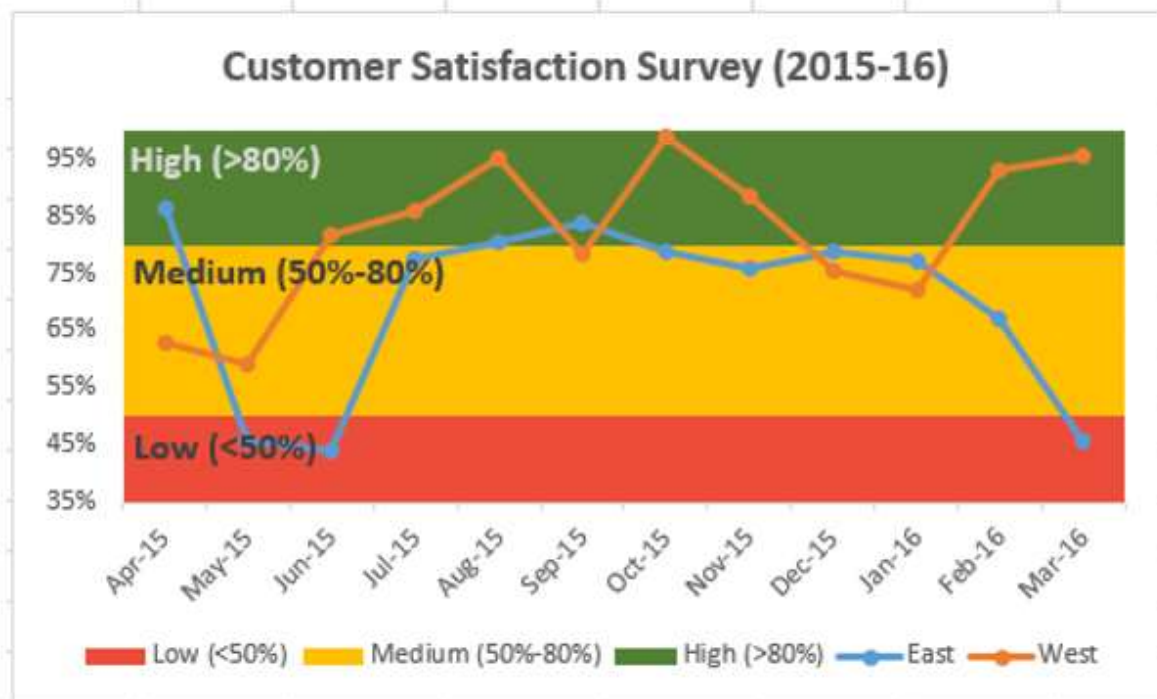
You will get Bands instead of columns.



To make the chart more presentable-

- Add Chart Title
- Adjust Vertical Axis range
- Change the colors of the bands to Green-Yellow-Red
- Add Labels to bands

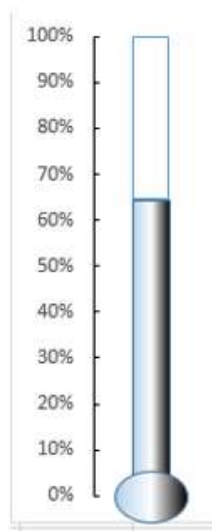
The final result is the Band Chart with the defined boundaries and the survey results represented across the bands. One can quickly and clearly make out from the chart that while the survey results for the region West are satisfactory, those for the region East have a decline in the last quarter and need attention.



## Thermometer Chart

When you have to represent a target value and an actual value, you can easily create a Thermometer Chart in Excel that emphatically shows these values.

With Thermometer chart, you can display your data as follows-



Arrange your data as shown below-

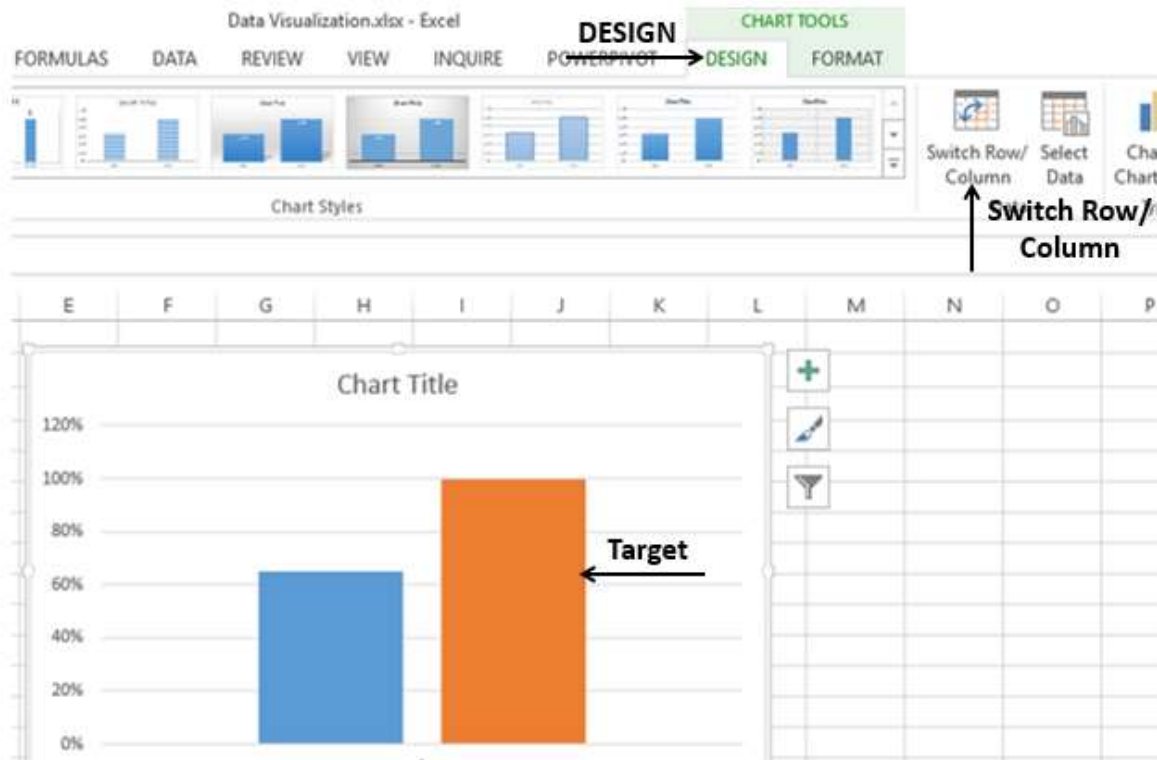
	A	B	C
1			
2		<b>Actual</b>	<b>Target</b>
3		65%	100%

- Select the data.
- Create a Clustered Column chart.

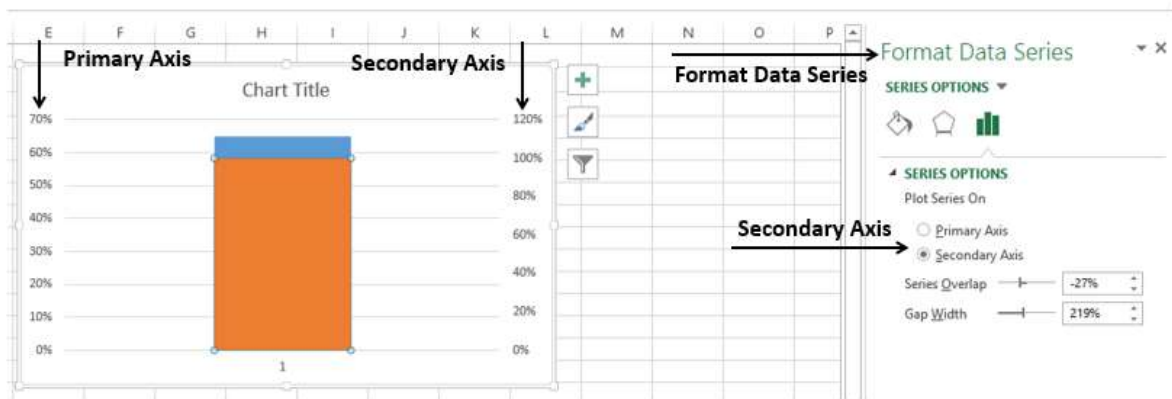


As you observe, the right side Column is Target.

- Click on a Column in the chart
- Click on Switch Row/Column on the Ribbon



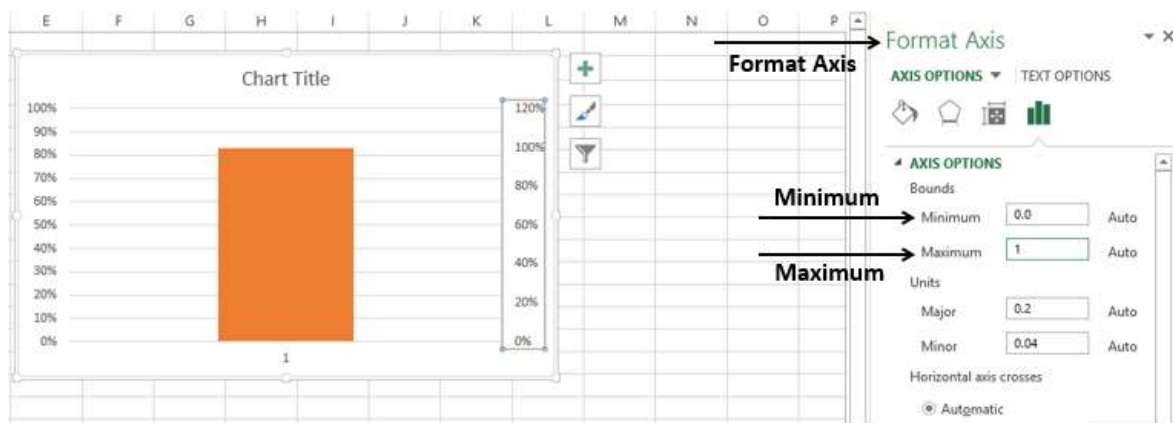
- Right click on the Target Column
- Click on Format Data Series
- Click on Secondary Axis



As you observe the Primary Axis and Secondary Axis have different ranges.

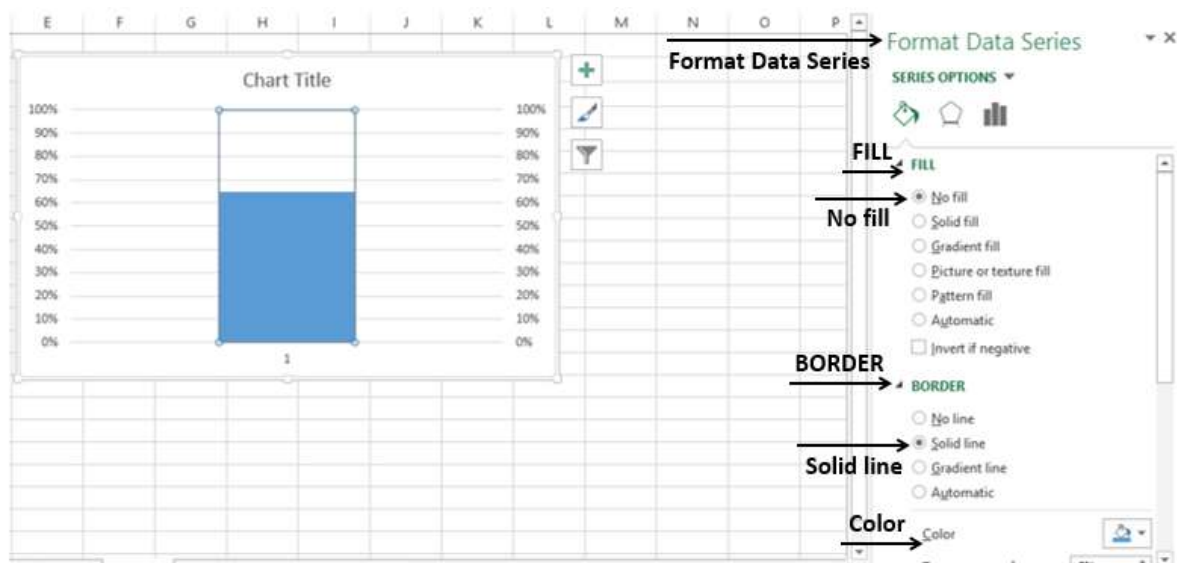
- Right click the Primary Axis.
- In the Format Axis options, under Bounds, type 0 for Minimum and 1 for Maximum.
- Repeat the same for Secondary Axis.





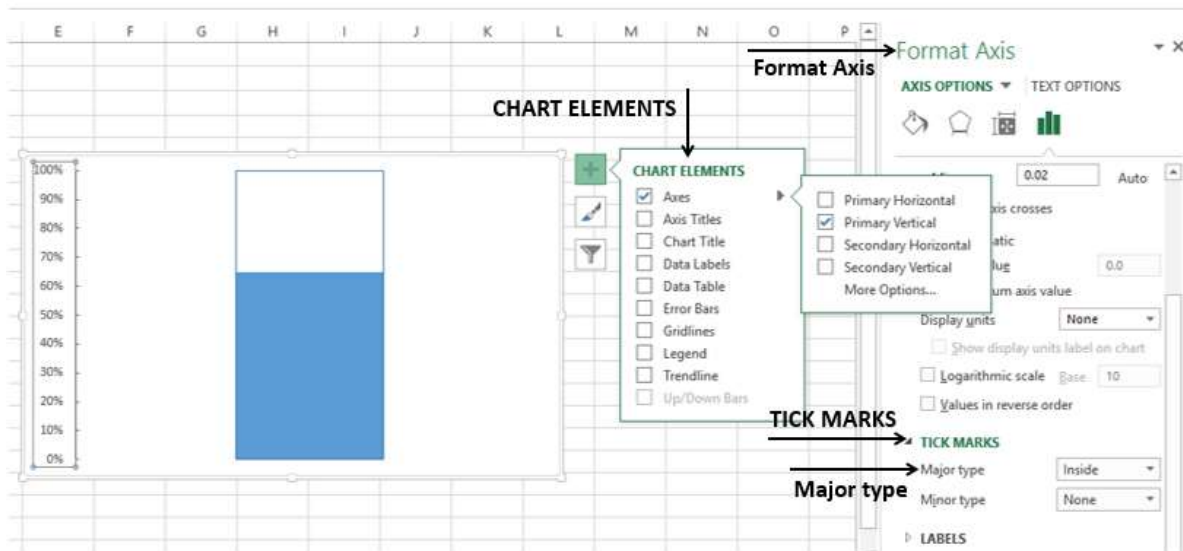
Both Primary Axis and Secondary Axis will be set to 0% - 100%. The Target Column hides the Actual Column.

- Right click the visible column (Target)
- In the Format Data Series, select
  - No fill for FILL
  - Solid line for BORDER
  - Blue for Color

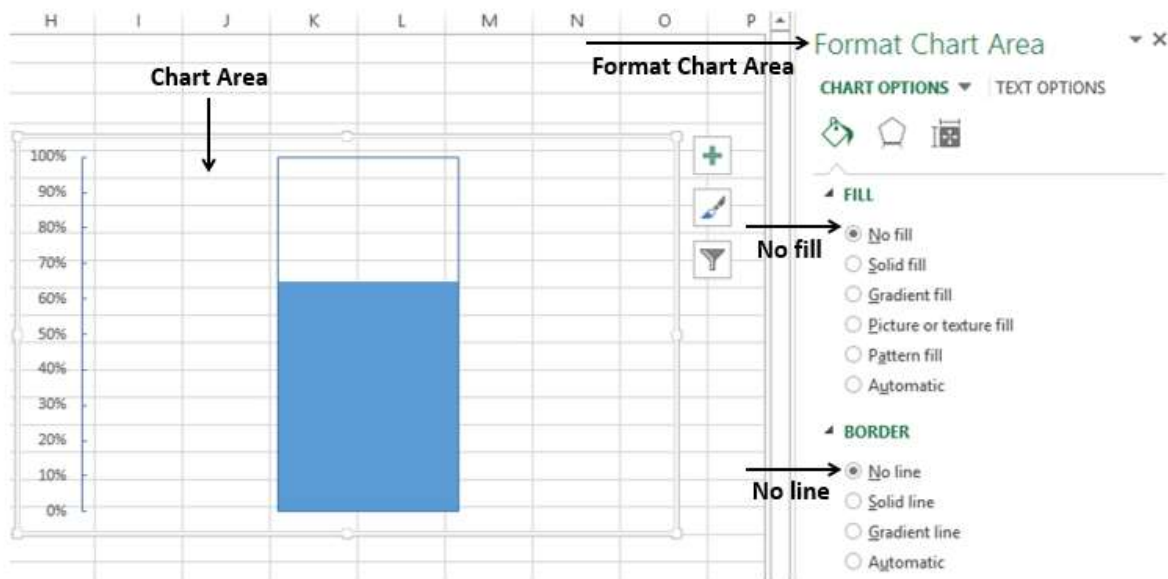


- In Chart Elements, unselect
  - Axis -> Primary Horizontal
  - Axis -> Secondary Vertical
  - Gridlines
  - Chart Title
- In the chart, right click on Primary Vertical Axis
- In Format Axis options, click on TICK MARKS

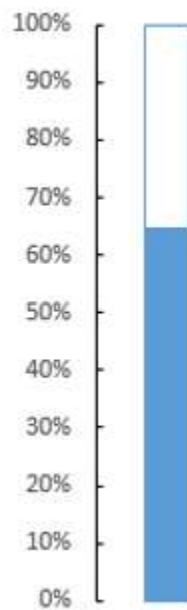
- For Major type, select Inside



- Right click on the Chart Area.
- In the Format Chart Area options, select
  - No fill for FILL
  - No line for BORDER

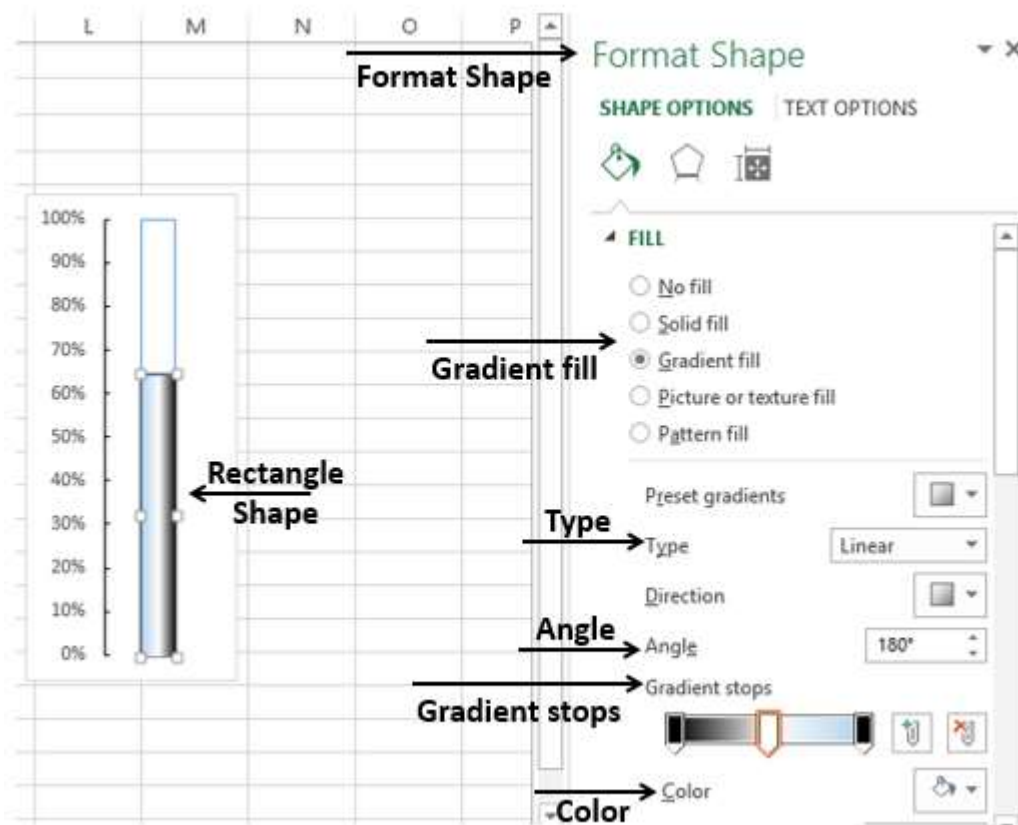


Resize the chart area, to get the shape of a thermometer.



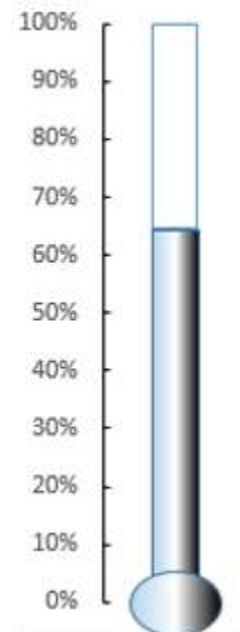
You got your thermometer chart, with the actual value as against target value being shown. You can make this thermometer chart more impressive with some formatting.

- Insert a rectangle shape superimposing the blue rectangular part in the chart.
- In Format Shape options, select-
  - Gradient fill for FILL
  - Linear for Type
  - 180° for Angle
- Set the Gradient stops at 0%, 50% and 100%.
- For the Gradient stops at 0% and 100%, choose the color black.
- For the Gradient stop at 50%, choose the color white.



- Insert an oval shape at the bottom.
- Format shape with same options.

The result is the Thermometer Chart that we started with.



## Gantt Chart

A Gantt chart is a chart in which a series of horizontal lines shows the amount of work done in certain periods of time in relation to the amount of work planned for those periods.

In Excel, you can create a Gantt chart by customizing a Stacked Bar chart type so that it depicts tasks, task duration, and hierarchy. An Excel Gantt chart typically uses days as the unit of time along the horizontal axis.

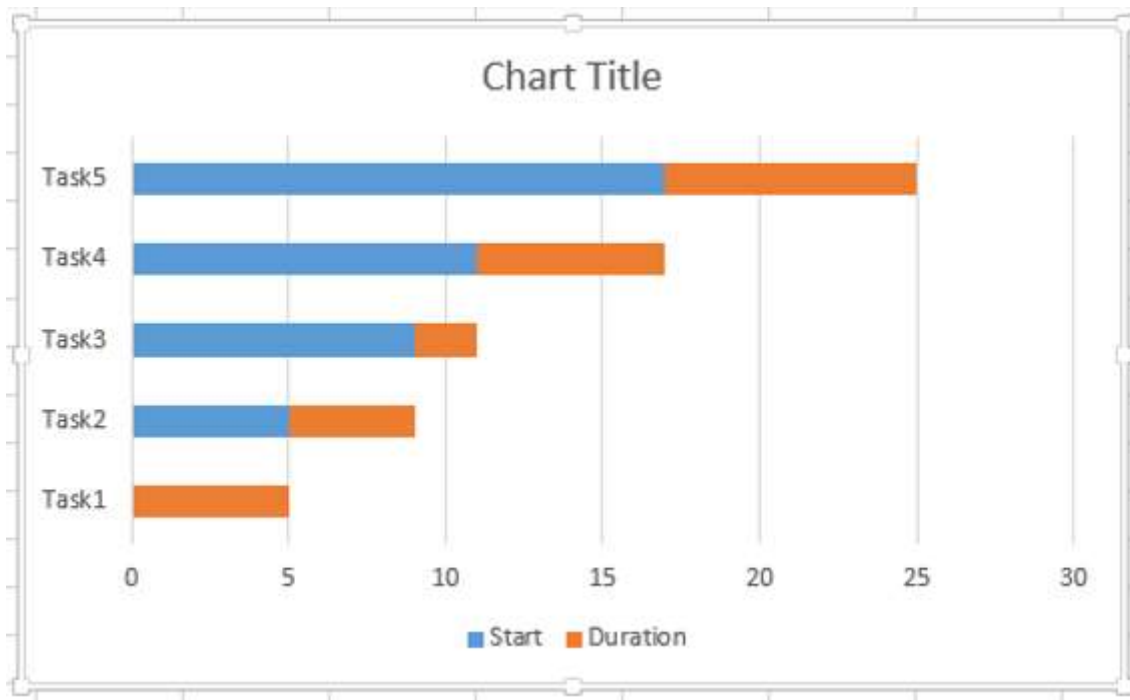
Consider the following data where the column-

- Task represents the Tasks in the project
- Start represents number of days from the Start Date of the project
- Duration represents the duration of the Task

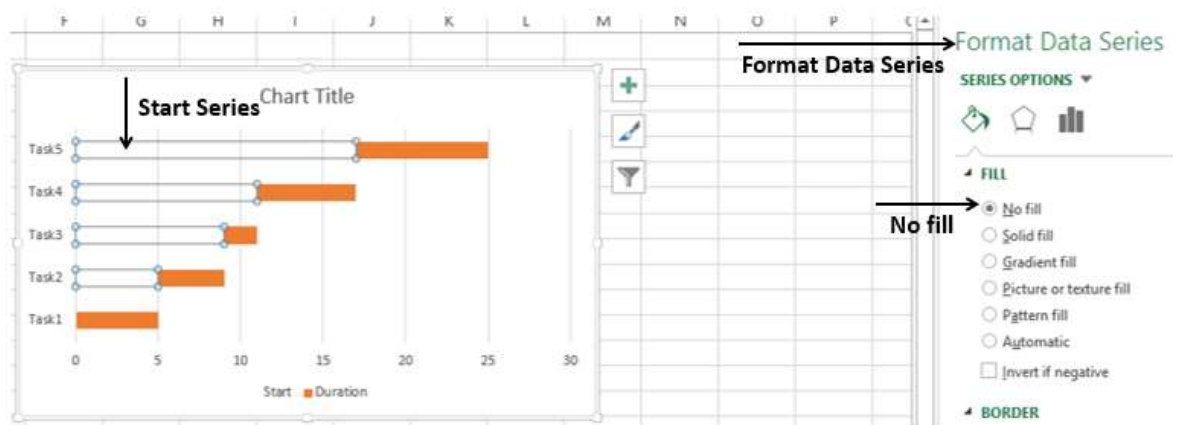
Note that Start of any Task is Start of previous Task + Duration. This is the case when the Tasks are in hierarchy.

	A	B	C	D
1				
2		<b>Task</b>	<b>Start</b>	<b>Duration</b>
3		Task1	0	5
4		Task2	5	4
5		Task3	9	2
6		Task4	11	6
7		Task5	17	8

- Select the data.
- Create Stacked Bar Chart.

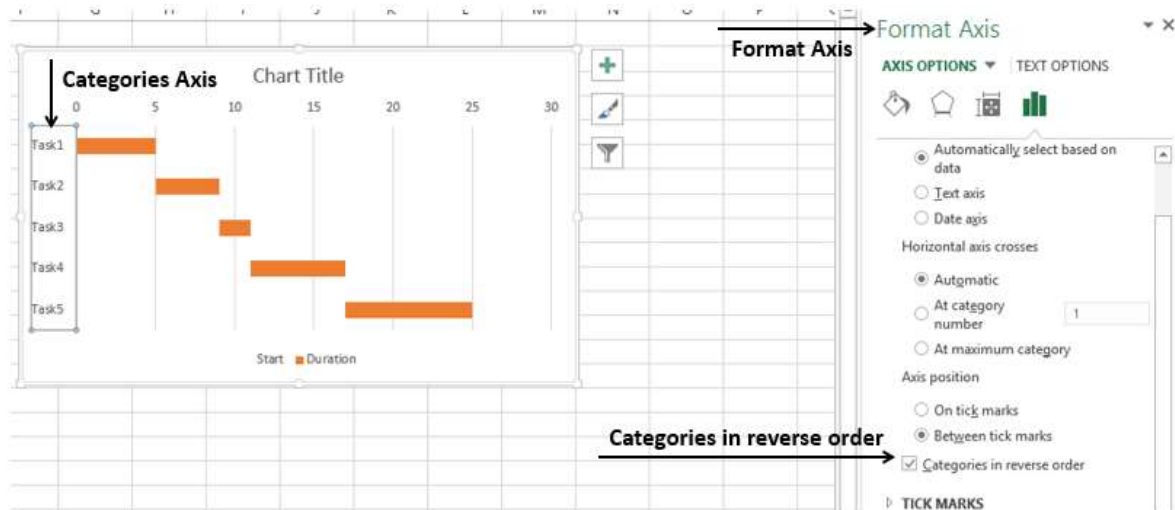


- Right-click on Start Series.
- In Format Data Series options, select No fill.

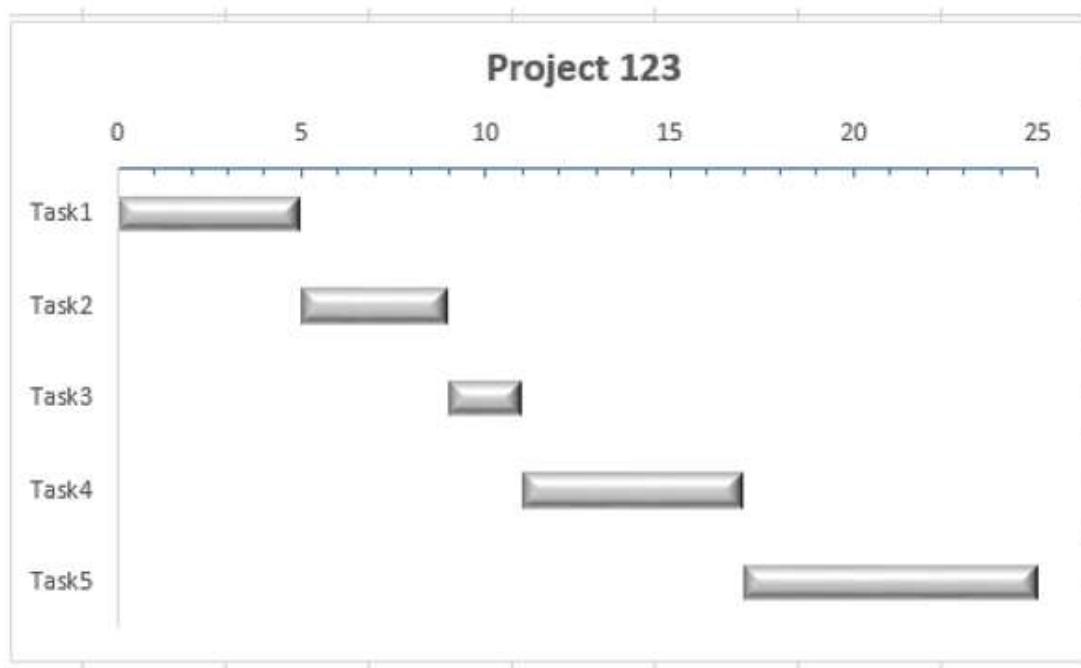


- Right-click on Categories Axis.
- In Format Axis options, select Categories in reverse order.





- In Chart Elements, deselect
  - Legend
  - Gridlines
- Format the Horizontal Axis to
  - Adjust the range
  - Major Tick Marks at 5 day intervals
  - Minor Tick Marks at 1 day intervals
- Format Data Series to make it look impressive
- Give a Chart Title



## Waterfall Chart

Waterfall Chart is one of the most popular visualization tools used in small and large businesses. Waterfall charts are ideal for showing how you have arrived at a net value such as net income, by breaking down the cumulative effect of positive and negative contributions.

Excel 2016 provides Waterfall Chart type. If you are using earlier versions of Excel, you can still create a Waterfall Chart using Stacked Column Chart.

The columns are color coded so that you can quickly tell positive from negative numbers. The initial and the final value columns start on the horizontal axis, while the intermediate values are floating columns. Because of this look, Waterfall Charts are also called Bridge Charts.

Consider the following data.

	A	B	C
1			
2		<b>Net Cash Flow</b>	
3		80000	<b>Start</b>
4		-5003	<b>Apr</b>
5		-16700	<b>May</b>
6		48802	<b>Jun</b>
7		-11198	<b>Jul</b>
8		-35260	<b>Aug</b>
9		18220	<b>Sep</b>
10		-23840	<b>Oct</b>
11		43250	<b>Nov</b>
12		-18280	<b>Dec</b>
13		26670	<b>Jan</b>
14		15000	<b>Feb</b>
15		24750	<b>Mar</b>

- Prepare the data for Waterfall Chart
- Ensure the column Net Cash Flow is to the left of the Months Column (This is because you will not include this column while creating the chart)
- Add 2 columns – Increase and Decrease for positive and negative cash flows respectively
- Add a column Start - the first column in the chart with the start value in the Net Cash Flow

- Add a column End - the last column in the chart with the end value in the Net Cash Flow
- Add a column Float – that supports the intermediate columns
- Compute the values for these columns as follows

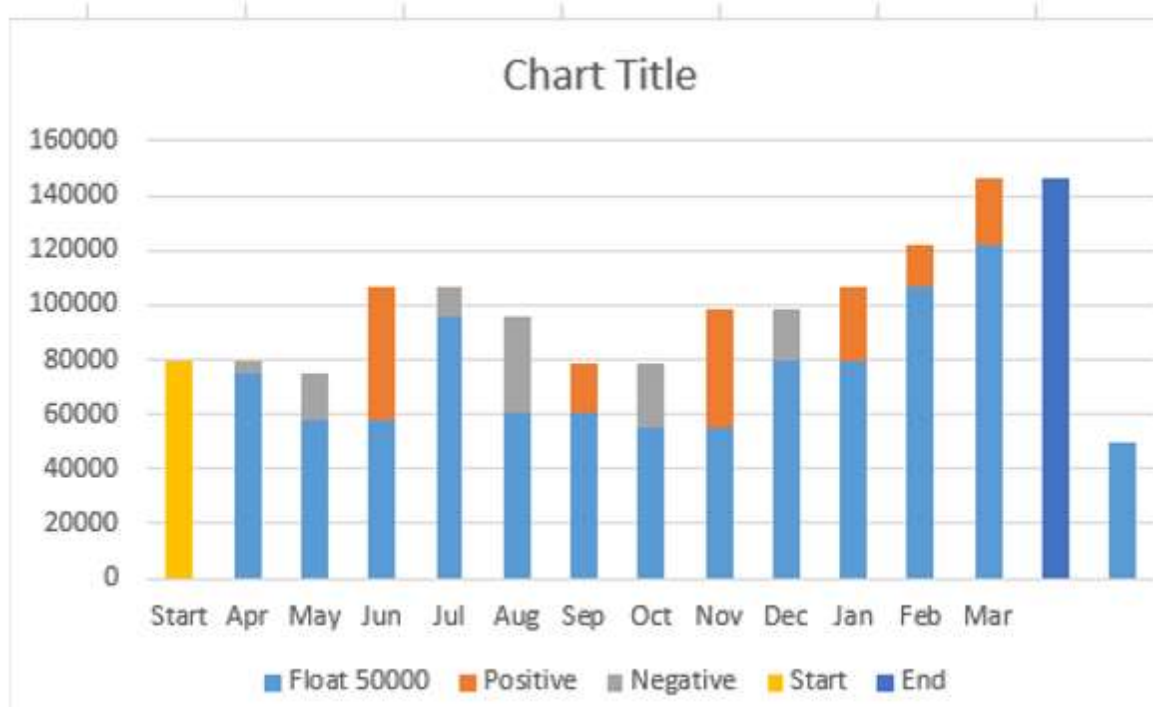
	A	B	C	D	E	F	G	H
1								
2		Net Cash Flow		Float	Positive	Negative	Start	End
3				50000				
4		80000	Start				=B4	
5		-5003	Apr	=SUM(G4,E5)-F5	=MAX(B5,0)	=-MIN(B5,0)		
6		-16700	May	=SUM(D5,E5)-F6	=MAX(B6,0)	=-MIN(B6,0)		
7		48802	Jun	=SUM(D6,E6)-F7	=MAX(B7,0)	=-MIN(B7,0)		
8		-11198	Jul	=SUM(D7,E7)-F8	=MAX(B8,0)	=-MIN(B8,0)		
9		-35260	Aug	=SUM(D8,E8)-F9	=MAX(B9,0)	=-MIN(B9,0)		
10		18220	Sep	=SUM(D9,E9)-F10	=MAX(B10,0)	=-MIN(B10,0)		
11		-23840	Oct	=SUM(D10,E10)-F11	=MAX(B11,0)	=-MIN(B11,0)		
12		43250	Nov	=SUM(D11,E11)-F12	=MAX(B12,0)	=-MIN(B12,0)		
13		-18280	Dec	=SUM(D12,E12)-F13	=MAX(B13,0)	=-MIN(B13,0)		
14		26670	Jan	=SUM(D13,E13)-F14	=MAX(B14,0)	=-MIN(B14,0)		
15		15000	Feb	=SUM(D14,E14)-F15	=MAX(B15,0)	=-MIN(B15,0)		
16		24750	Mar	=SUM(D15,E15)-F16	=MAX(B16,0)	=-MIN(B16,0)		
17								=SUM(D16,E16)-F17
18				50000				

- In the Float column, insert a row in the beginning and at the end. Place an arbitrary value 50000. This just to have some space to the left and right of the chart

The data will be as follows.

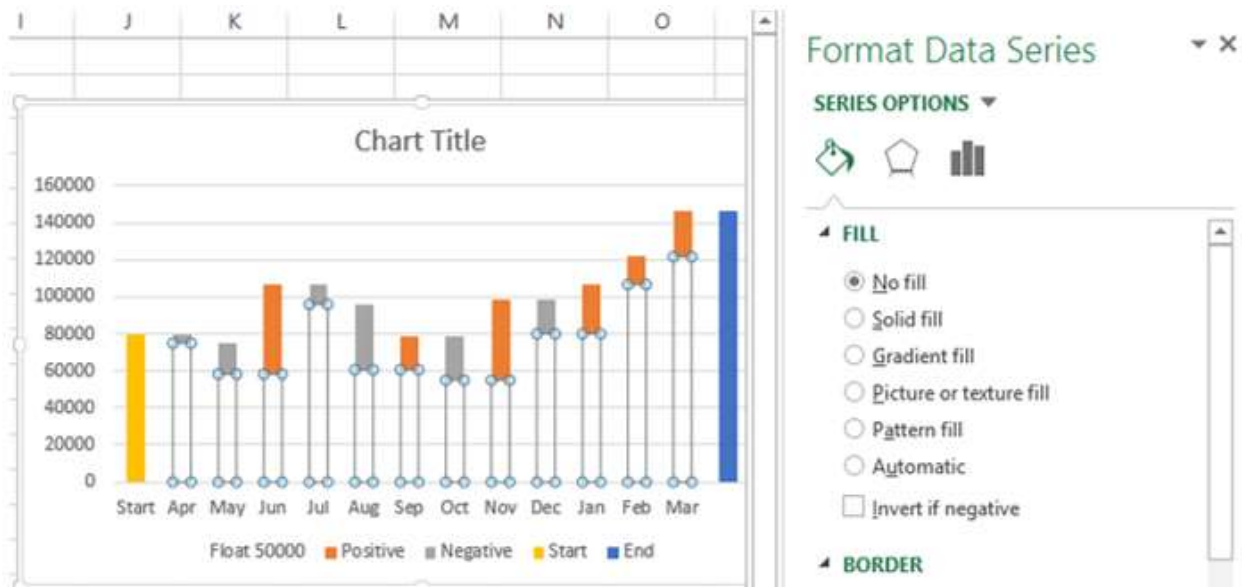
	A	B	C	D	E	F	G	H
1								
2		Net Cash Flow		Float	Positive	Negative	Start	End
3				50000				
4		80000	Start				80000	
5		-5003	Apr	74997	0	5003		
6		-16700	May	58297	0	16700		
7		48802	Jun	58297	48802	0		
8		-11198	Jul	95901	0	11198		
9		-35260	Aug	60641	0	35260		
10		18220	Sep	60641	18220	0		
11		-23840	Oct	55021	0	23840		
12		43250	Nov	55021	43250	0		
13		-18280	Dec	79991	0	18280		
14		26670	Jan	79991	26670	0		
15		15000	Feb	106661	15000	0		
16		24750	Mar	121661	24750	0		
17								146411
18				50000				

- Select the cells C2:H18 (Exclude Net Cash Flow column)
- Create Stacked Column Chart

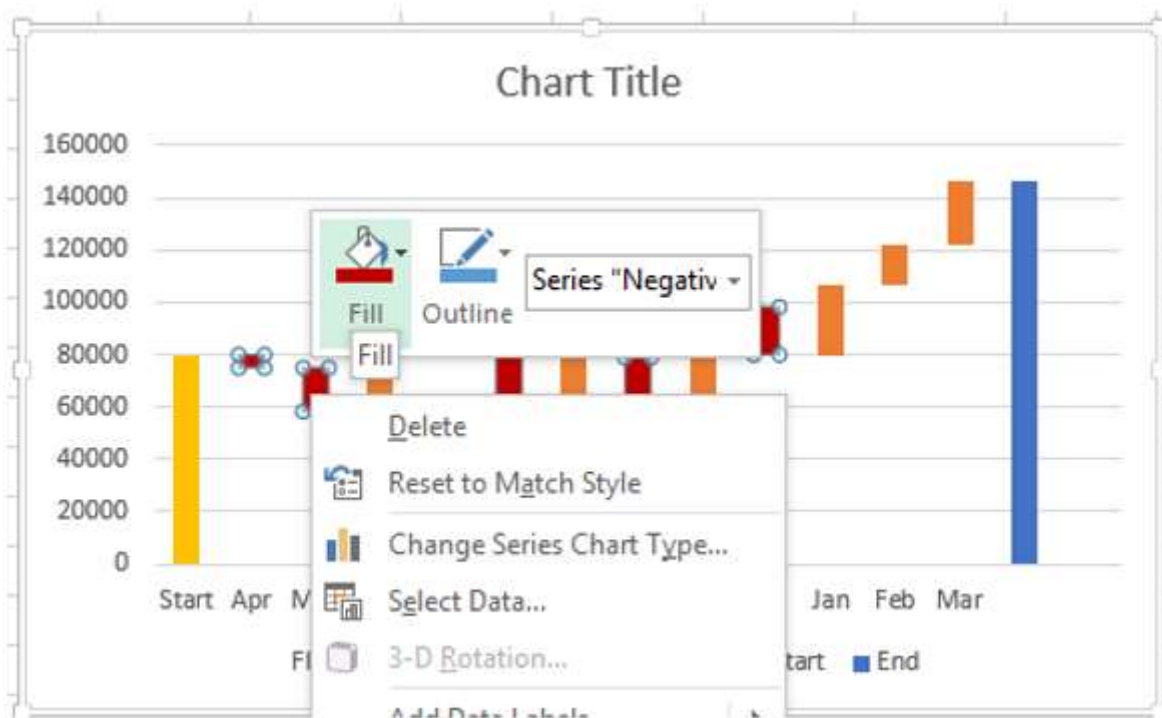


- Right click on the Float Series.

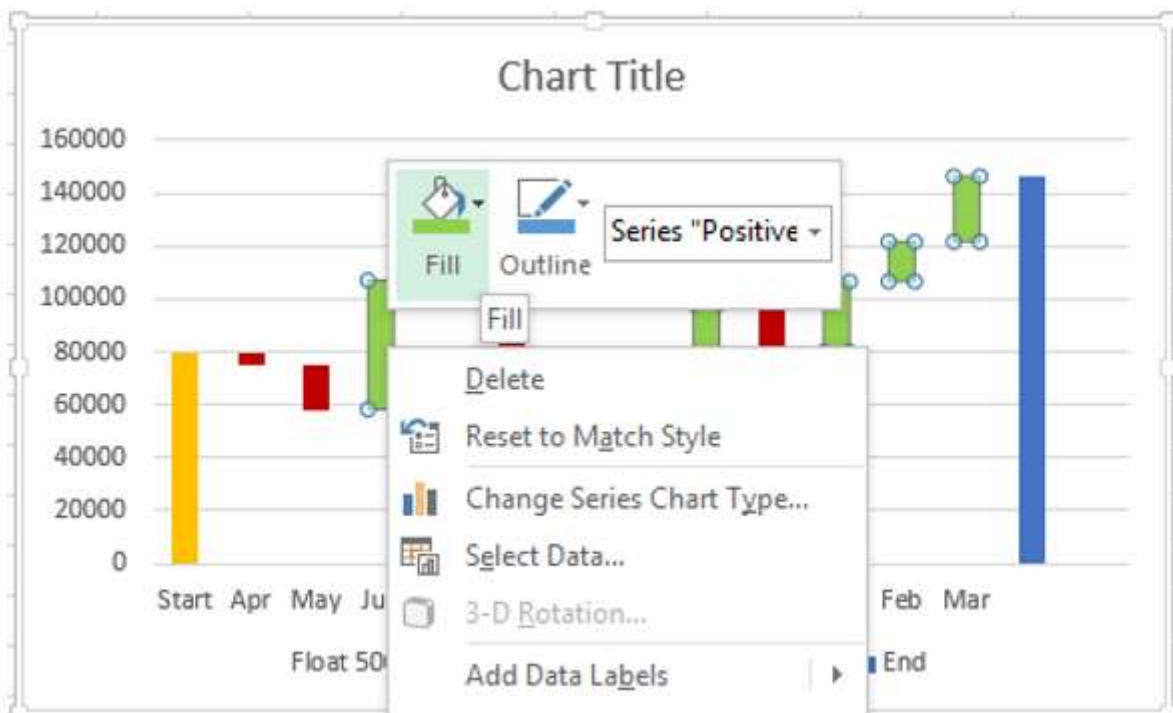
- Click Format Data Series.
- In Format Data Series options, select No fill.



- Right click on Negative Series.
- Select Fill Color as Red.



- Right click on Positive Series.
- Select Fill Color as Green.



- Right click on Start Series.
- Select Fill Color as Grey.
- Right click on End Series.
- Select Fill Color as Grey.
- Delete the Legend.





- Right click on any Series
- In Format Data Series options, select Gap Width as 10% under Series Options



Give the Chart Title. The Waterfall Chart will be displayed.

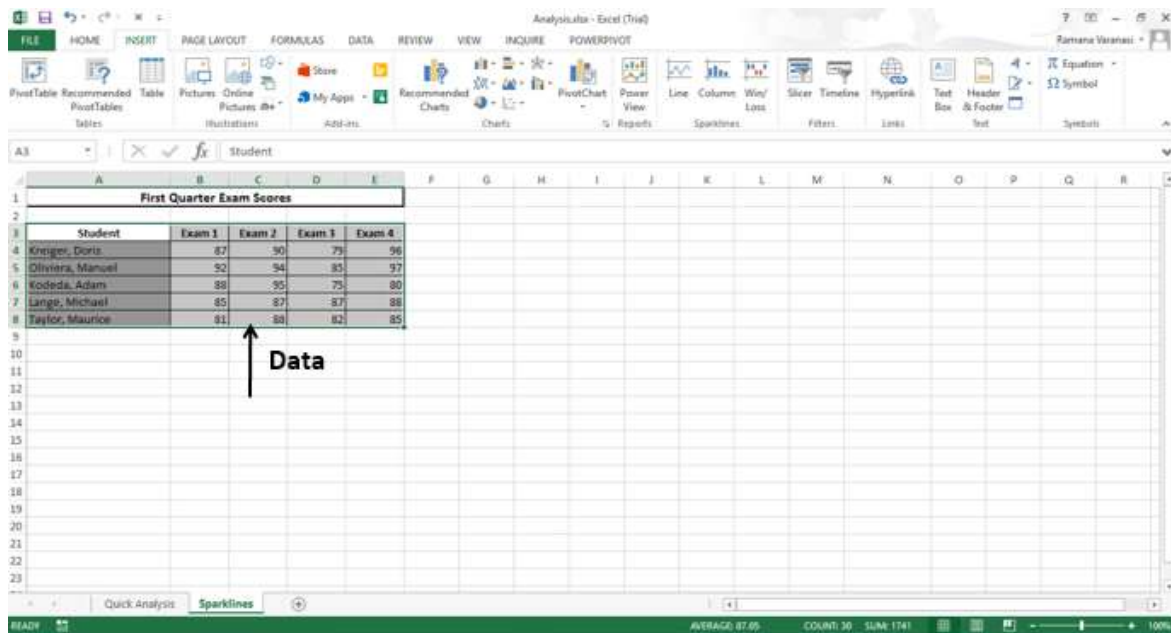



## Sparklines

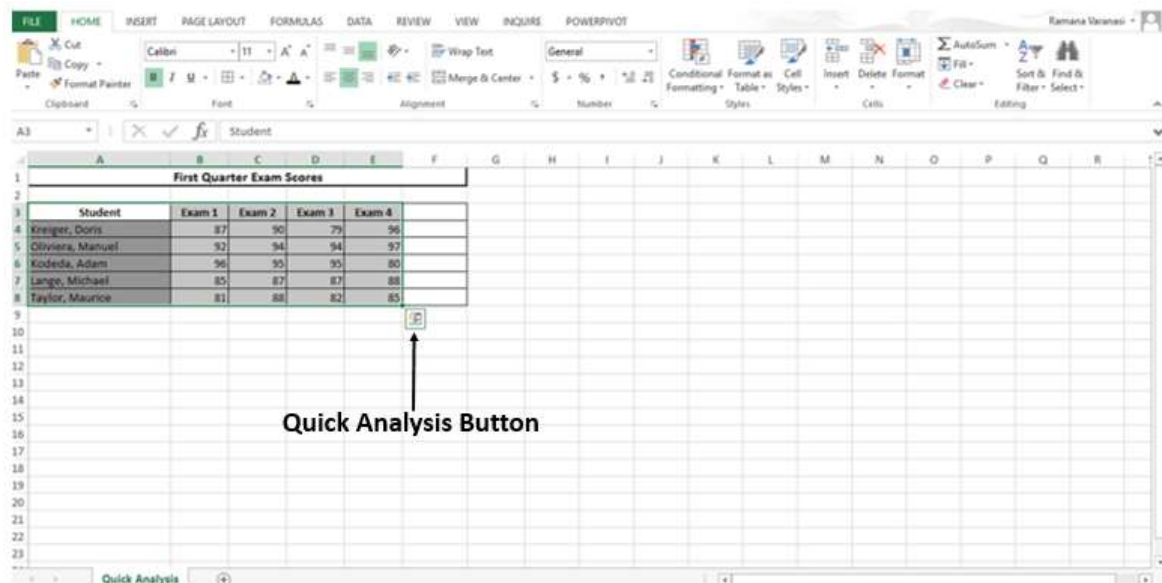
Sparklines are tiny charts placed in single cells, each representing a row of data in your selection. They provide a quick way to see trends.


You can add Sparklines with Quick Analysis tool.

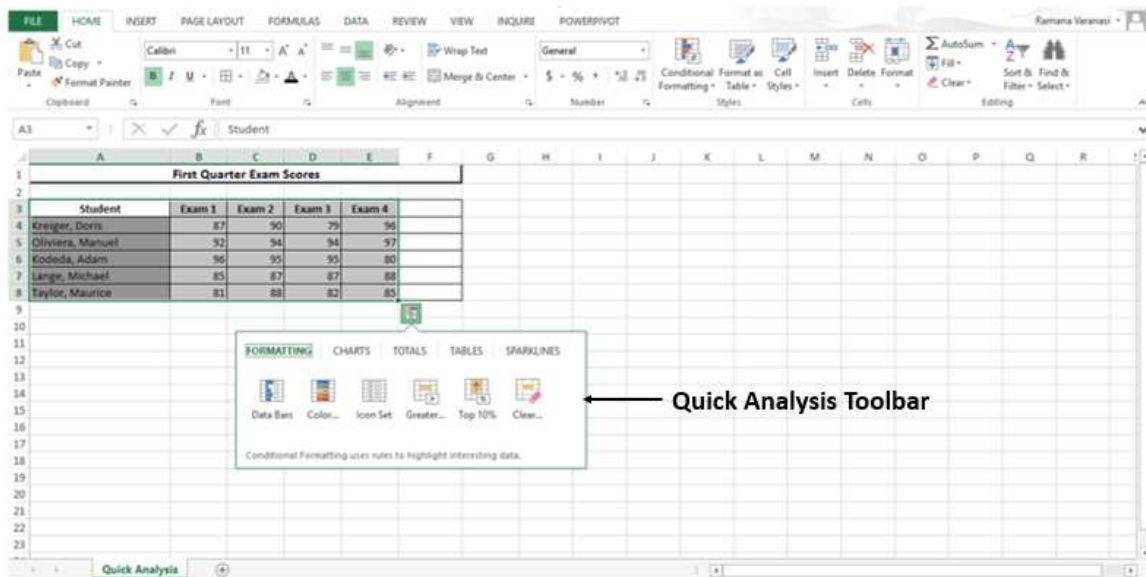
- Select the data for which you want to add Sparklines.
- Keep an empty column to the right side of the data for the Sparklines.



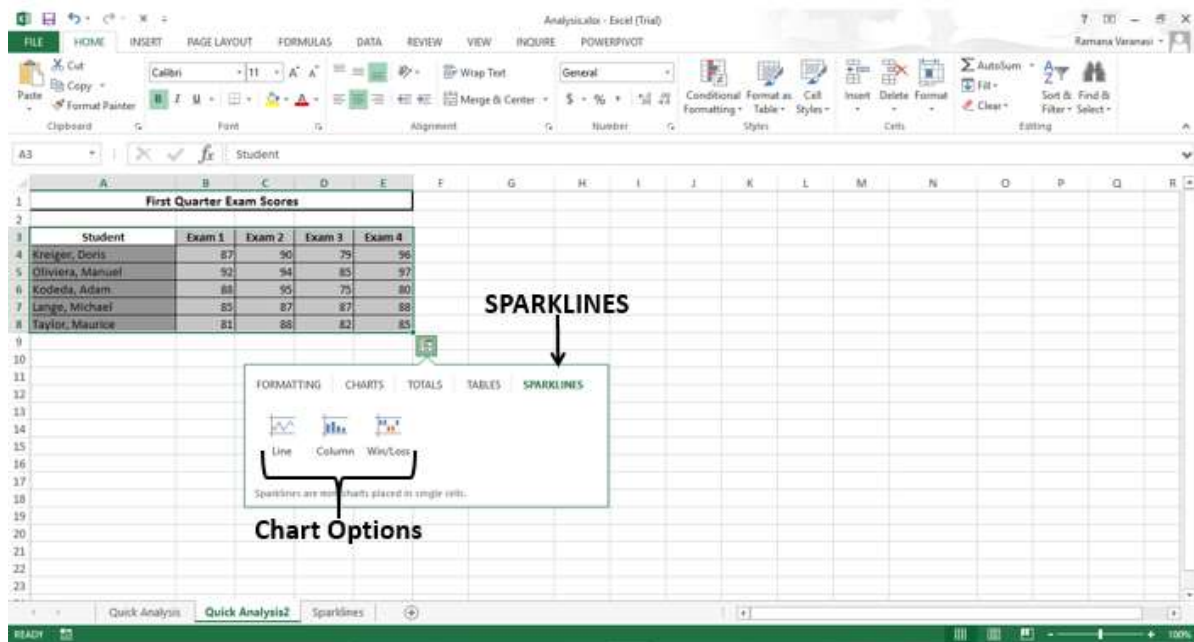
Quick Analysis button  appears at the bottom right of your selected data.



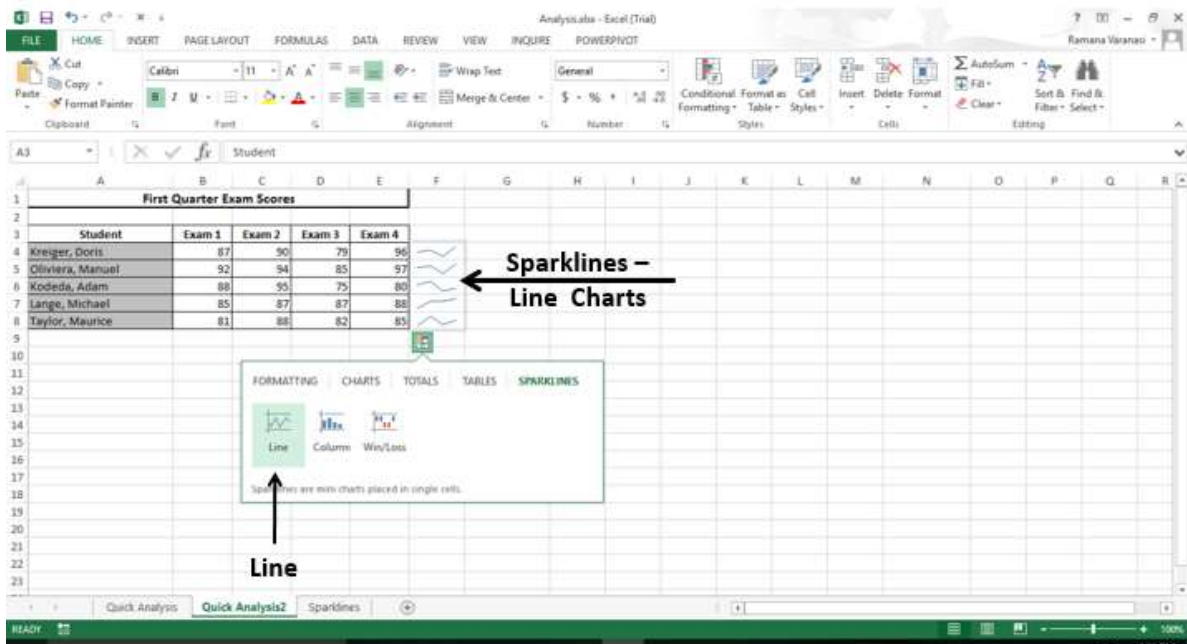
- Click on the Quick Analysis  button. The Quick Analysis Toolbar appears with various options.



Click **SPARKLINES**. The chart options displayed are based on the data and may vary.



Click **Line**. A Line Chart for each row is displayed in the column to the right of the data.



## PivotCharts

Pivot Charts are used to graphically summarize data and explore complicated data.

A PivotChart shows Data Series, Categories, and Chart Axes the same way a standard chart does. Additionally, it also gives you interactive filtering controls right on the chart so that you can quickly analyze a subset of your data.

PivotCharts are useful when you have data in a huge PivotTable, or many complex worksheet data that includes text and numbers. A PivotChart can help you make sense of this data.

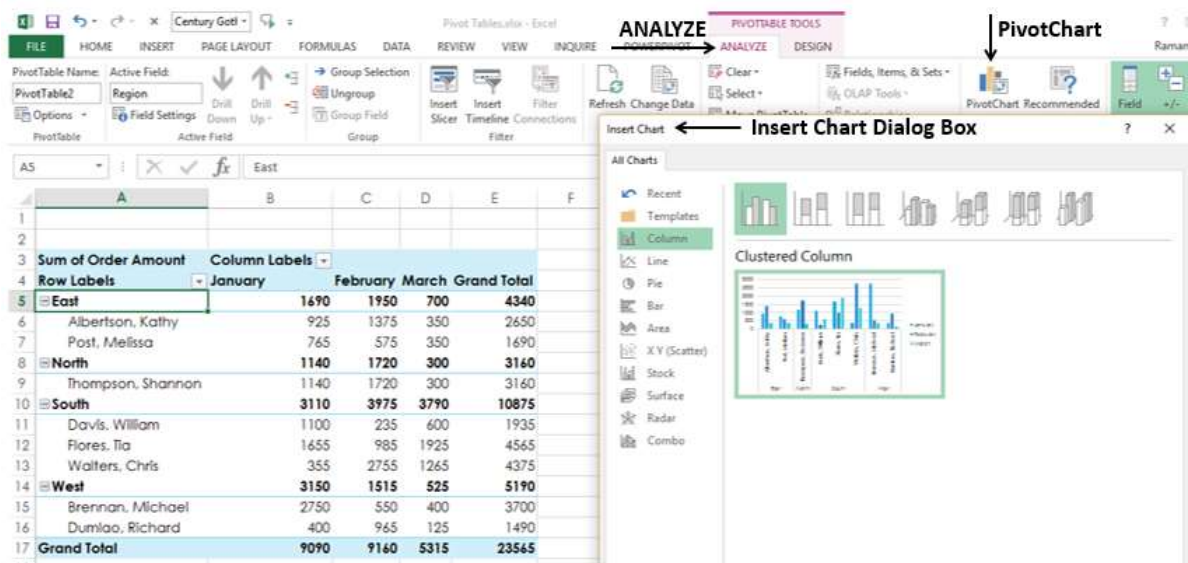
You can create a PivotChart from

- A PivotTable.
- A Data Table as a standalone without PivotTable.

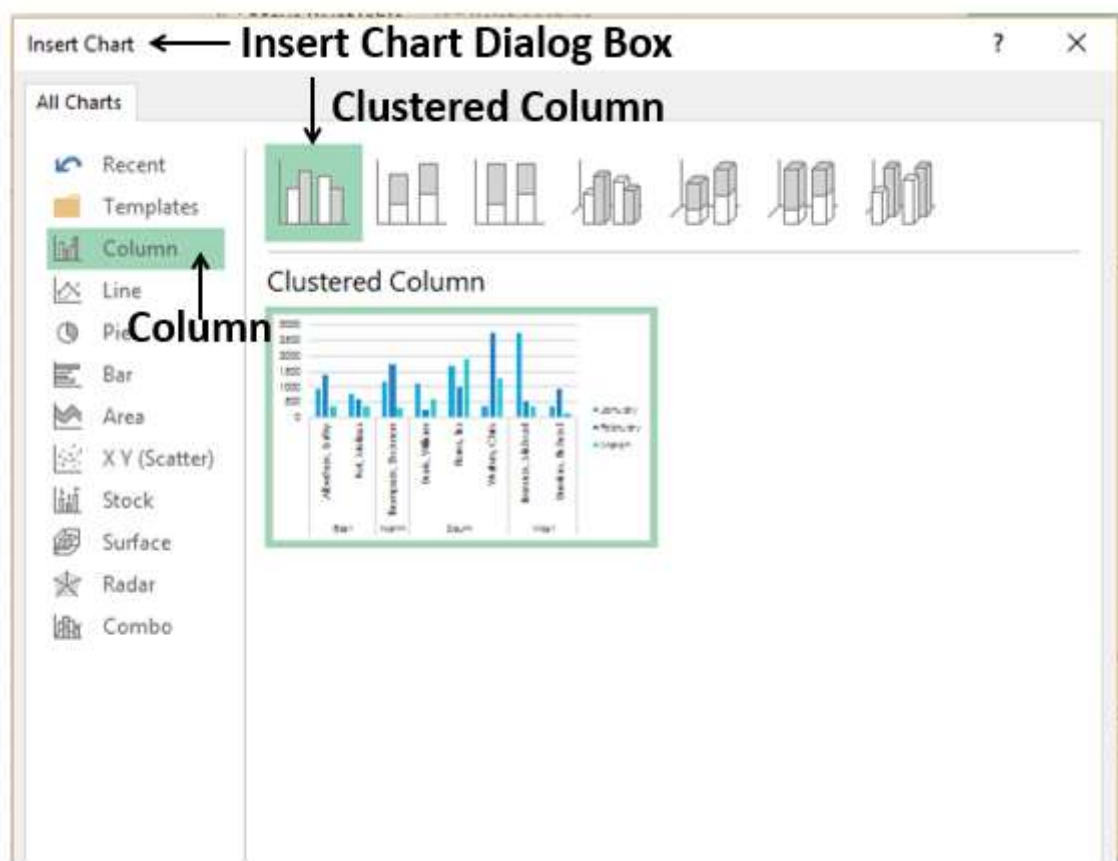
## PivotChart from PivotTable

To create a PivotChart follow the steps given below-

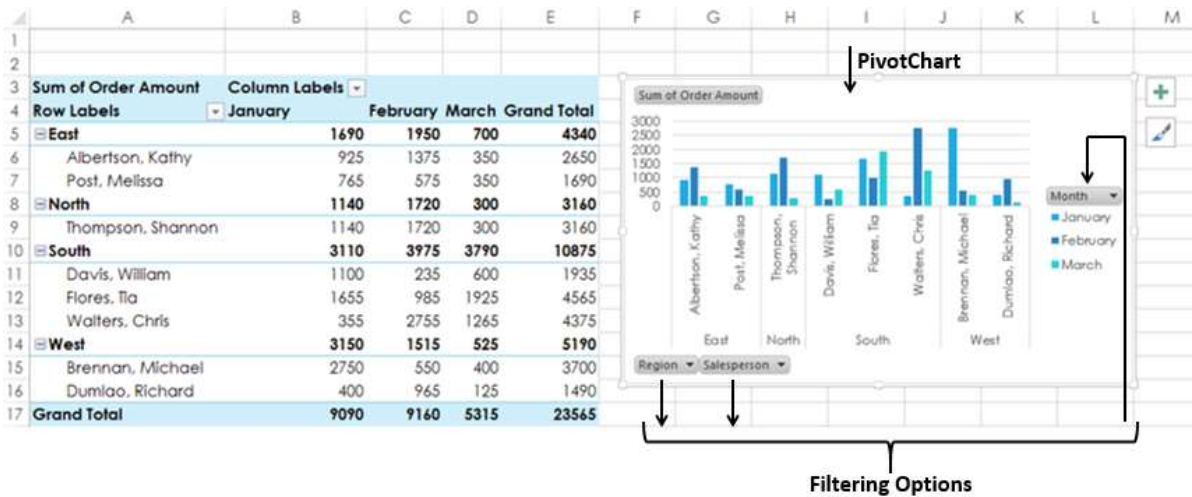
- Click the PivotTable.
- Click ANALYZE under PIVOTTABLE TOOLS on the Ribbon.
- Click on PivotChart. The Insert Chart dialog box appears.



Select Clustered Column from the option Column.

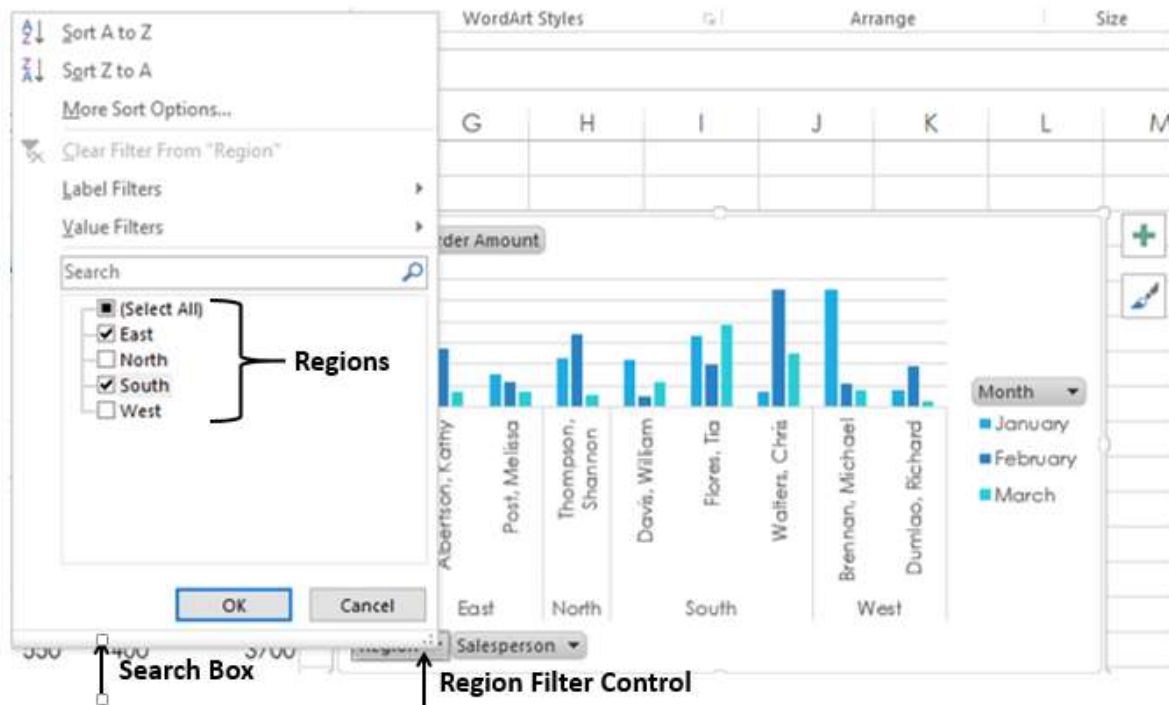


Click OK. The PivotChart is displayed.



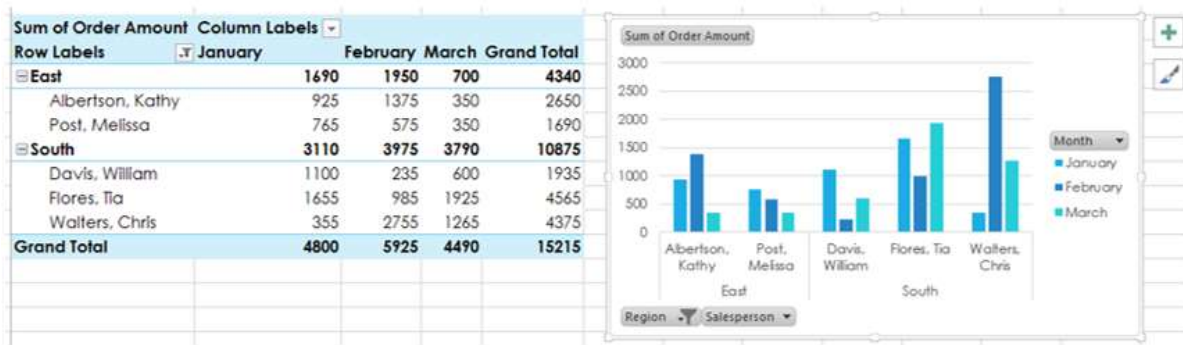
The PivotChart has three filters – Region, Salesperson and Month.

- Click the Region Filter Control option. The Search Box appears with the list of all Regions. Check boxes appear next to Regions.
- Select East and South options.



The filtered data appears on both the PivotChart and the PivotTable.



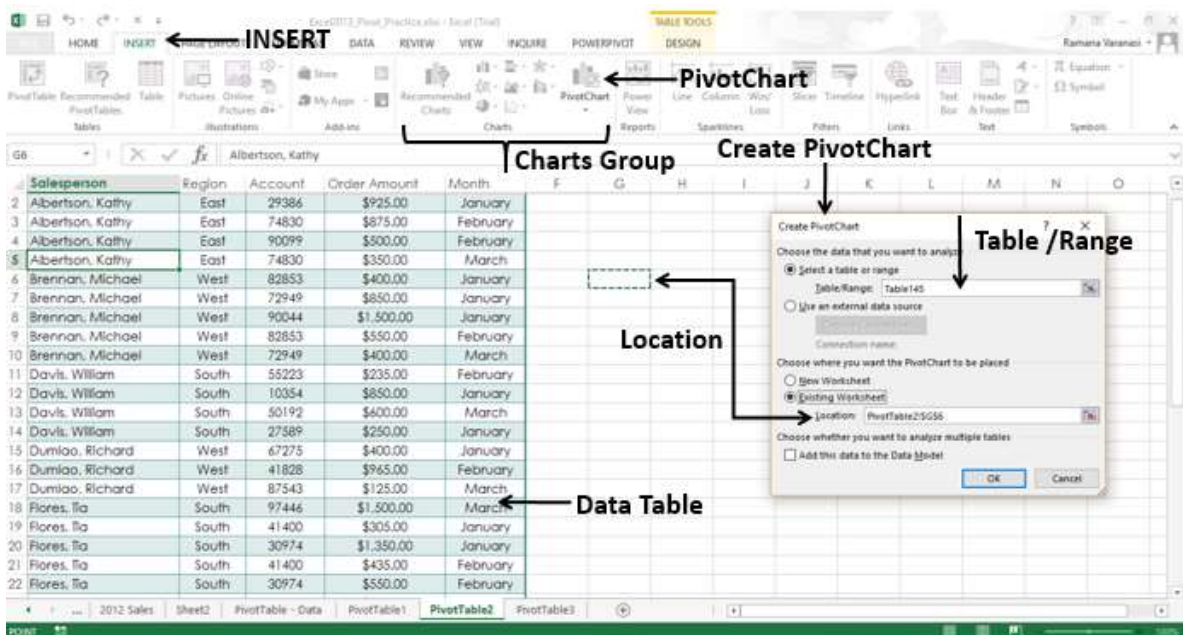


## PivotChart without a PivotTable

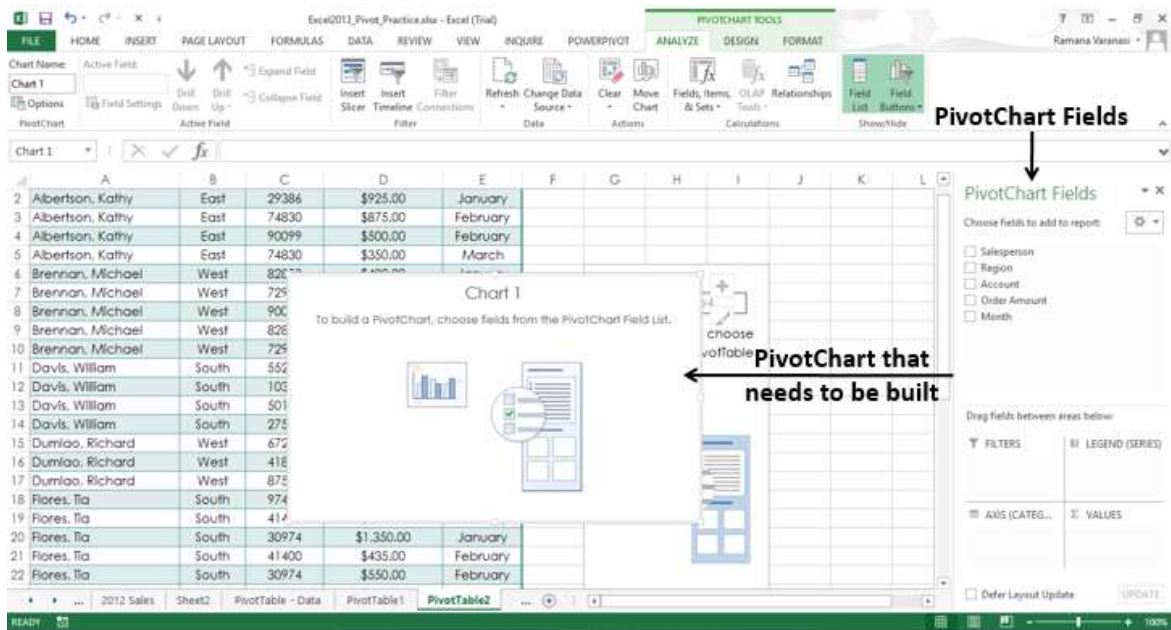
You can create a standalone PivotChart without creating a PivotTable.

- Click the Data Table.
- Click the Insert tab.
- Click PivotChart in Charts group. The Create PivotChart window appears.
- Select the Table/Range.
- Select the Location where you want the PivotChart to be placed.

You can choose a cell in the existing worksheet itself, or in a new worksheet. Click OK.

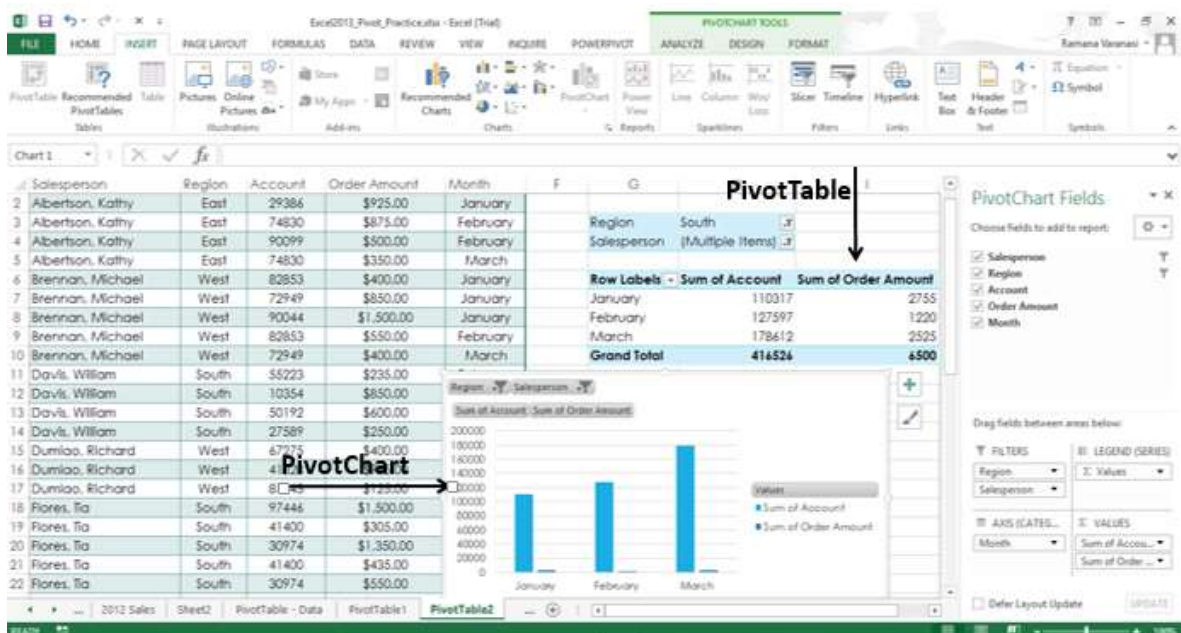


An empty PivotChart and an empty PivotTable appear along with the PivotChart Field List to build the PivotChart.



- Choose the Fields to be added to the PivotChart
- Arrange the Fields by dragging them into FILTERS, LEGEND (SERIES), AXIS (CATEGORIES) and VALUES
- Use the Filter Controls on the PivotChart to select the Data to be placed on the PivotChart

Excel will automatically create a coupled PivotTable.



# 17. Data Validation

Data Validation is a very useful and easy to use tool in Excel with which you can set data validations on the data that is entered that is entered into your Worksheet.

For any cell on the worksheet, you can

- display an input message on what needs to be entered into it
- restrict the values that get entered
- provide a list of values to choose from
- display an error message and reject an invalid data entry

Consider the following Risk Tracker that can be used to enter and track the identified Risks information.

	A	B	C	D	E	F	G	H	I	J	K	L
2		Risk Tracker										
3		S. No.	Risk Description	Date Raised	Probability	Impact	Risk Exposure	Risk Category	Risk Source	Owner	Status	
4												
5												
6		1					0					
7		2					0					
8		3					0					
9		4					0					
10		5					0					
11		6					0					
12		7					0					
13		8					0					
14		9					0					
15		10					0					

In this tracker, the data that is entered into the following columns is validated with pre-set data constraints and the entered data is accepted only when it meets the validation criteria. Otherwise, you will get an error message.

- Probability
- Impact
- Risk Category
- Risk Source
- Status

The column Risk Exposure will have calculated values and you cannot enter any data. Even the column **S. No.** is set to have calculated values that are adjusted even if you delete a row.

Now, you will learn how to set up such a worksheet.

## Prepare the Structure for the Worksheet

To prepare the structure for the worksheet-

- Start with a blank worksheet.
- Put the header in Row 2.
- Put the column headers in Row 3.
- For the column headers Probability, Impact and Risk Exposure-
  - Right click on the cell.
  - Click on Format Cells from drop down.
  - In the Format Cells dialog box, click on Alignment tab.
  - Type 90 under Orientation.
- Merge and Centre the cells in Rows 3, 4, and 5 for each of the column headers.
- Format Borders for the cells in Rows 2 – 5.
- Adjust the row and column widths.

Your worksheet will look as follows-

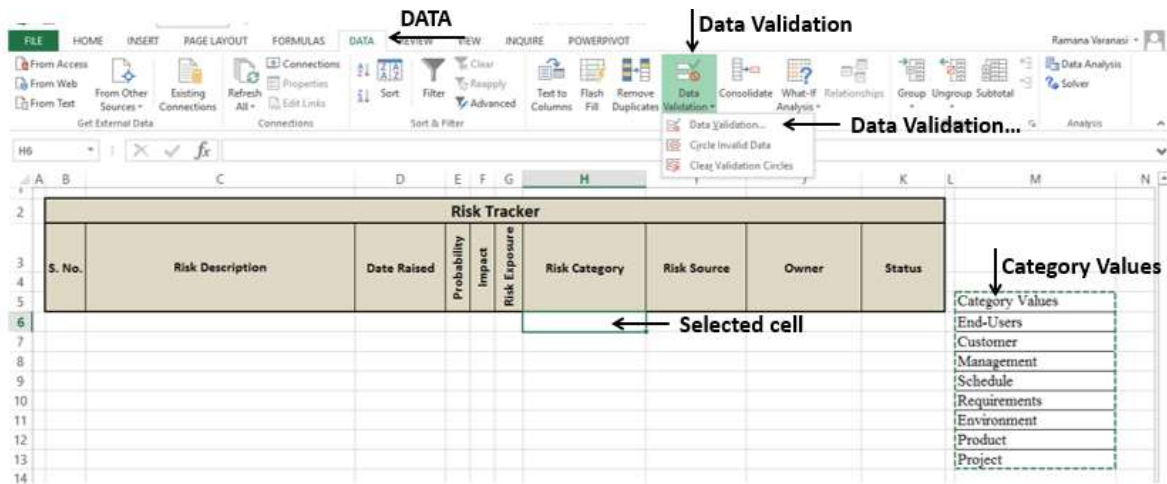
	B	C	D	E	F	G	H	I	J	K
2	Risk Tracker									
3	S. No.	Risk Description	Date Raised	Probability	Impact	Risk Exposure	Risk Category	Risk Source	Owner	Status
4										
5										
6										
7										
8										
9										
10										
11										

## Set Valid Values for Risk Category

In the cells M5 – M13 enter the following values (M5 is heading and M6-M13 are the values)

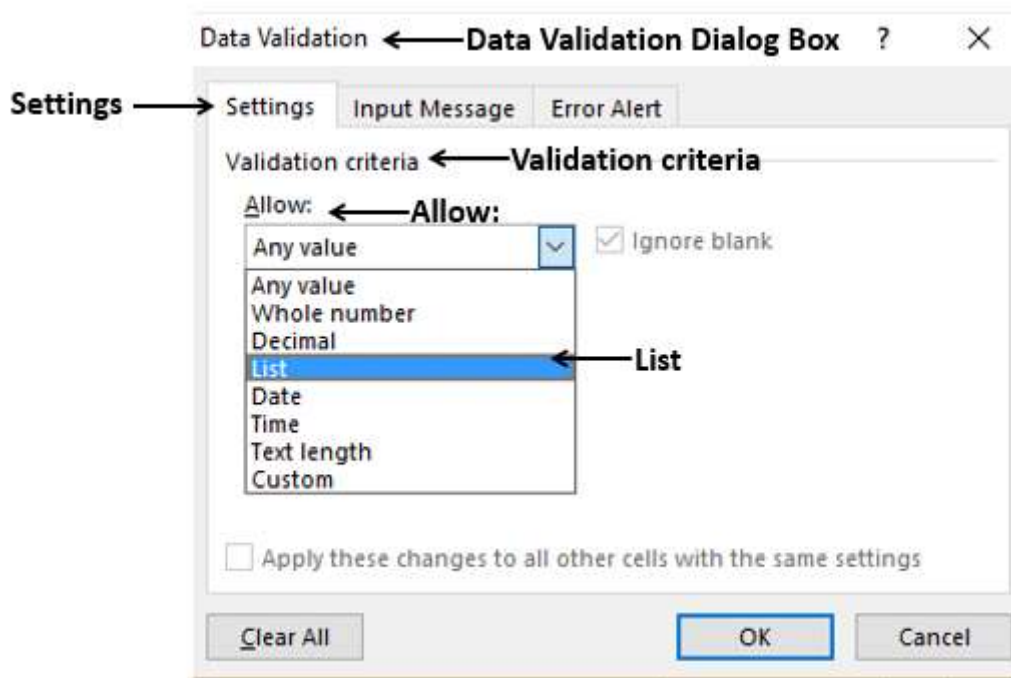
Category Values
End-Users
Customer
Management
Schedule
Requirements
Environment
Product
Project

- Click the first cell under the column Risk Category (H6).
- Click DATA tab on the Ribbon.
- Click Data Validation in the Data Tools group.
- Select Data Validation... from the drop-down list.

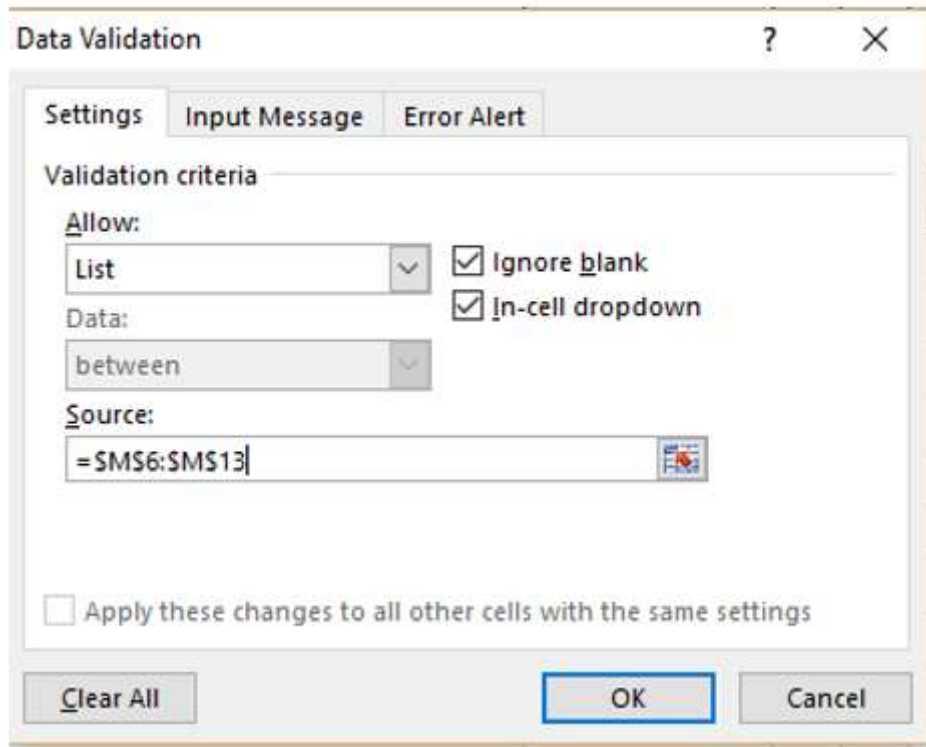


The Data Validation dialog box appears.

- Click the Settings tab.
- Under Validation criteria, in the **Allow:** drop-down list, Select the option **List**.



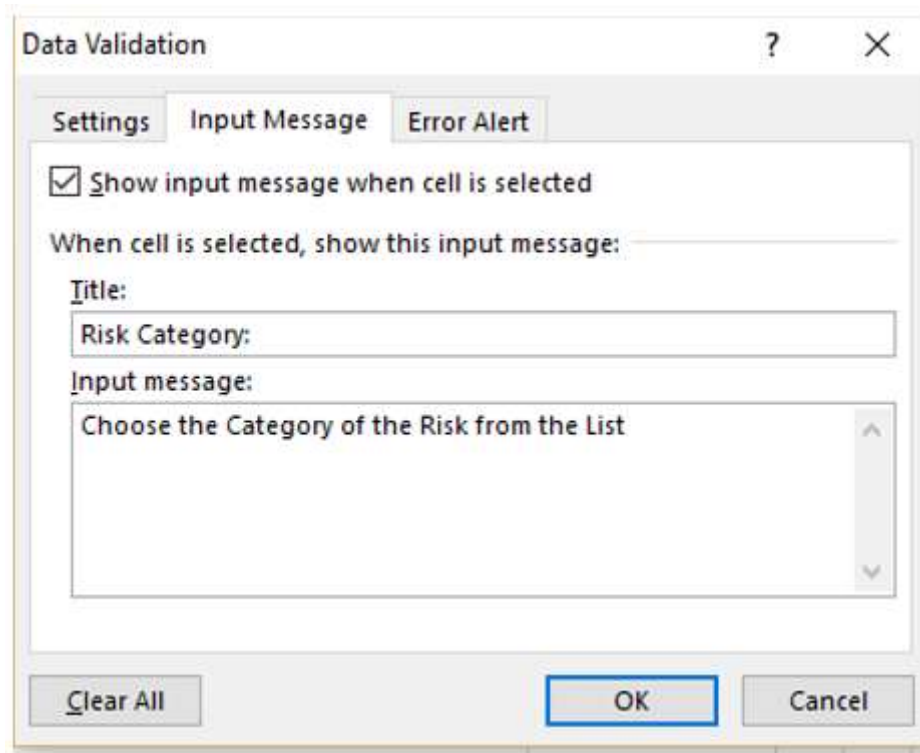
- Select the range M6:M13 in the Source: box that appears.
- Check the boxes Ignore blank and In-cell dropdown that appear.



### Set Input Message for Risk Category

- Click the Input Message tab in the Data Validation dialog box.
- Check the box **Show input message** when cell is selected.
- In the box under Title:, type Risk Category:
- In the box under Input message: Choose the Category of the Risk from the List.

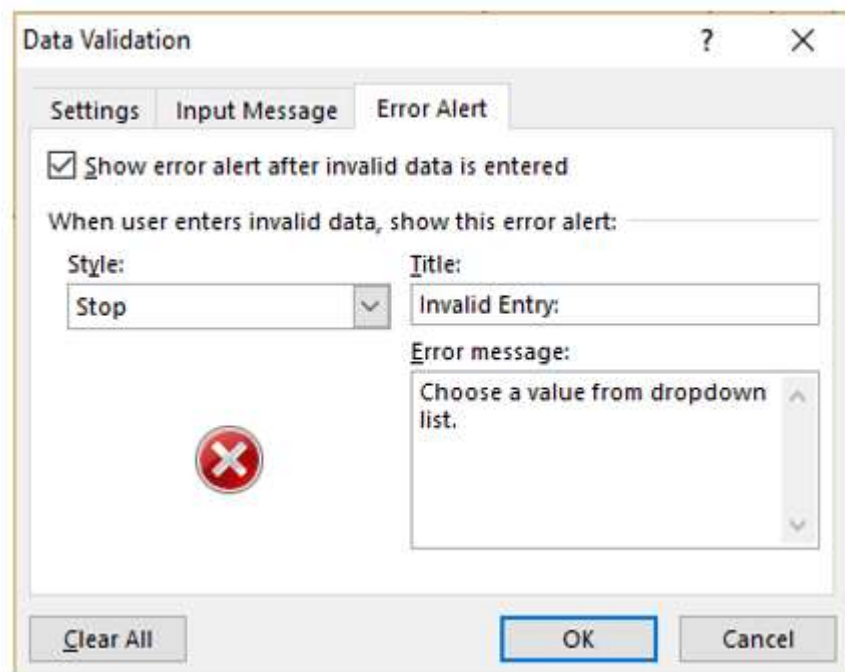




### Set Error Alert for Risk Category

To set error alert-

- Click the Error Alert tab in the Data validation dialog box.
- Check the box Show error alert after invalid data is entered.
- Select Stop under Style: dropdown
- In the box under Title:, type Invalid Entry:
- In the box under Error message: type Choose a value from dropdown list.
- Click OK.



## Verify Data Validation for Risk Category

For the selected first cell under Risk Category,

- Data Validation criteria is set
- Input message is set
- Error alert is set

Now, you can verify your settings.

Click in the cell for which you have set Data Validation criteria. The Input message appears. The dropdown button appears on the right side of the cell.

Risk Tracker					
Probability	Impact	Risk Exposure	Risk Category	Risk Source	

Dropdown Button

Input Message

Risk Category:  
Choose the  
Category of the  
Risk from the List

The input message is correctly displayed.

- Click on the dropdown button on the right side of the cell. The drop-down list appears with the values that can be selected.
- Cross-check the values in the drop-down list with those that are used to create the drop-down list.

Risk Tracker					
Impact	Risk Exposure	Risk Category	Risk Source	Owner	Status

Dropdown List

Values Used

Category Values
End-Users
Customer
Management
Schedule
Requirements
Environment
Product
Project

Both the sets of values match. Note that if the number of values is more, you will get a scroll-down bar on the right side of the dropdown list.

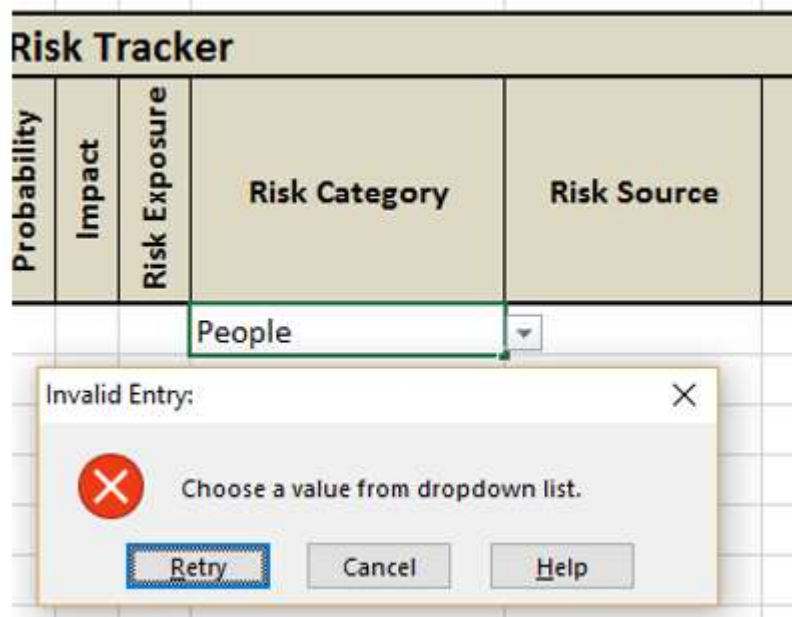
Select a value from the dropdown list. It appears in the cell.

Risk Tracker					
Probability	Impact	Risk Exposure	Risk Category	Risk Source	Overall
			Environment		

You can see that the selection of valid values is working fine.

Finally, try to enter an invalid entry and verify the Error alert.

Type People in the cell and press Enter. Error message that you have set for the cell will be displayed.



- Verify the Error message.
- You have an option to either Retry or Cancel. Verify both the options.

You have successfully set the Data Validation for the cell.

**Note:** It is very important to check the spelling and grammar of your messages.

## Set Valid Criteria for the Risk Category Column

Now, you are ready to apply the Data Validation criteria to all the cells in the Risk Category column.

At this point, you need to remember two things-

- You need to set the criteria for maximum number of cells that are possible to be used. In our example, it can vary from 10 – 100 based on where the worksheet will be used
- You should not set the criteria for unwanted range of cells or for the entire column. This will unnecessarily increases the file size. It is called excess formatting. If you get a worksheet from an outside source, you have to remove the excess formatting, which you will learn in the chapter on Inquire in this tutorial.

Follow the steps given below-

- Set the validation criteria for 10 cells under Risk Category.
- You can easily do this by clicking on the right-bottom corner of the first cell.
- Hold on the + symbol that appears and pull it down.

	A	B	C	D	E	F	G	H	I
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									

Data Validation is set for all the selected cells.

Click the last column that is selected and verify.

[illegible]

Data Validation for the column Risk Category is complete.

## Set Validation Values for Risk Source

In this case, we have only two values – Internal and External.

- Click in the first cell under the column Risk Source (I6)
- Click the DATA tab on the Ribbon
- Click Data Validation in the Data Tools group
- Select Data Validation... from the drop-down list.

Data Validation dialog box appears.

- Click the Settings tab.
- Under Validation criteria, in the Allow: drop-down list, select the option List.
- Type Internal, External in the Source: box that appears.
- Check the boxes Ignore blank and In-cell dropdown that appear.



**Data Validation** ? X

Settings Input Message Error Alert

Validation criteria

Allow:

List ☐ Ignore blank

☒ In-cell dropdown

Data:

between

Source:

Internal,External

☐ Apply these changes to all other cells with the same settings

Clear All OK Cancel

Set Input Message for Risk Source.

**Data Validation** ? X

Settings Input Message Error Alert

☒ Show input message when cell is selected

When cell is selected, show this input message:

Title:

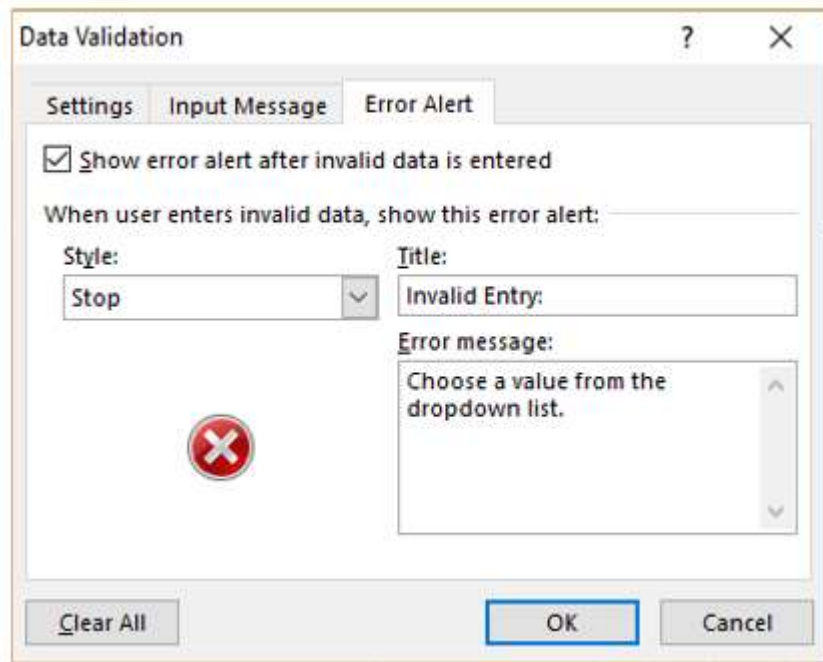
Risk Source:

Input message:

Select the Source of the Risk from the List.

Clear All OK Cancel

Set Error Alert for Risk Source.

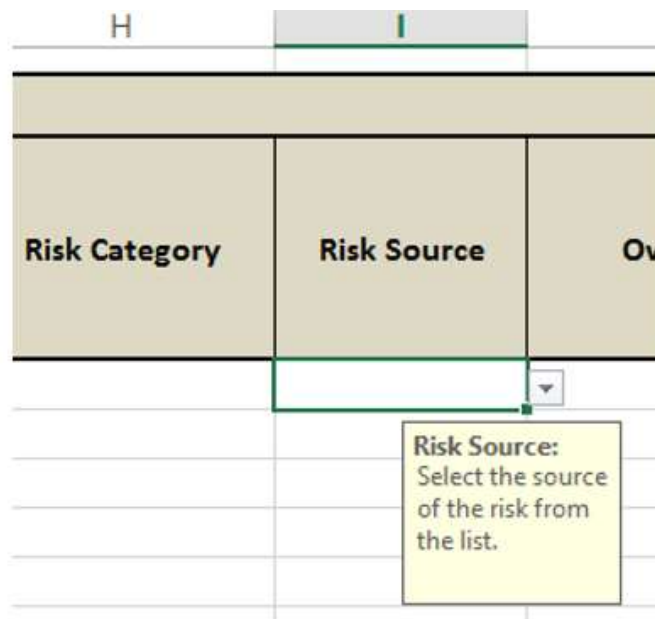


For the selected first cell under Risk Source-

- Data Validation criteria is set
- Input message is set
- Error alert is set

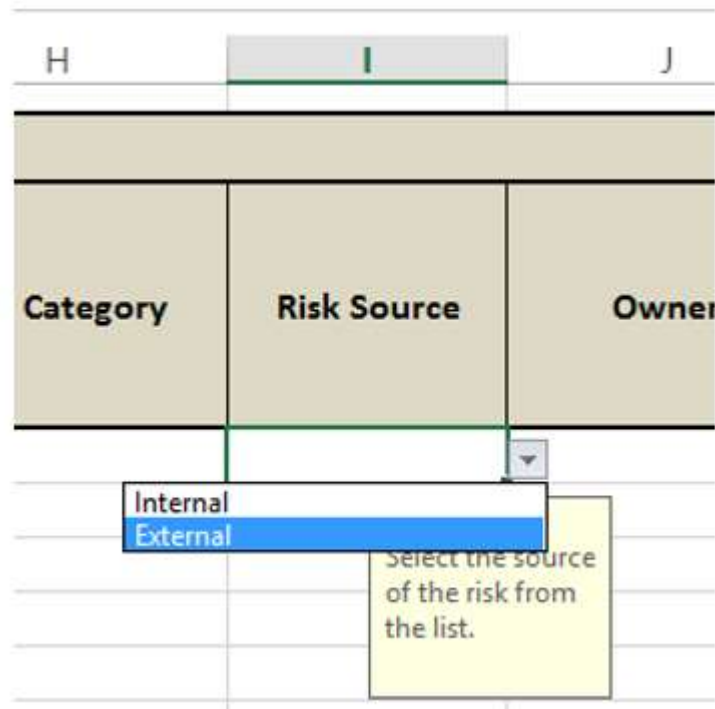
Now, you can verify your settings.

Click in the cell for which you have set Data Validation criteria. Input message appears. The drop-down button appears on the right side of the cell.

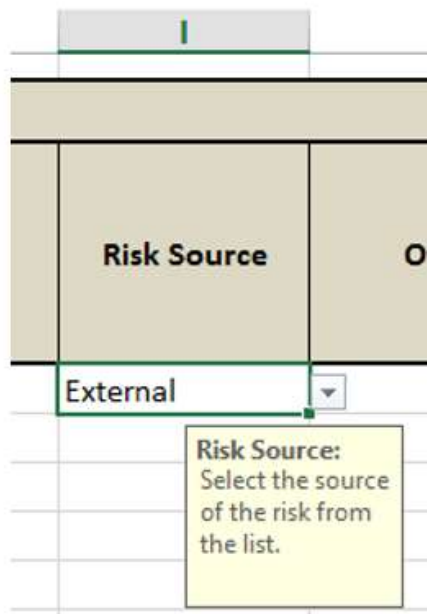


The input message is displayed correctly.

- Click the drop-down arrow button on the right side of the cell. A drop-down list appears with the values that can be selected.
- Check if the values are the same as you typed – Internal and External.

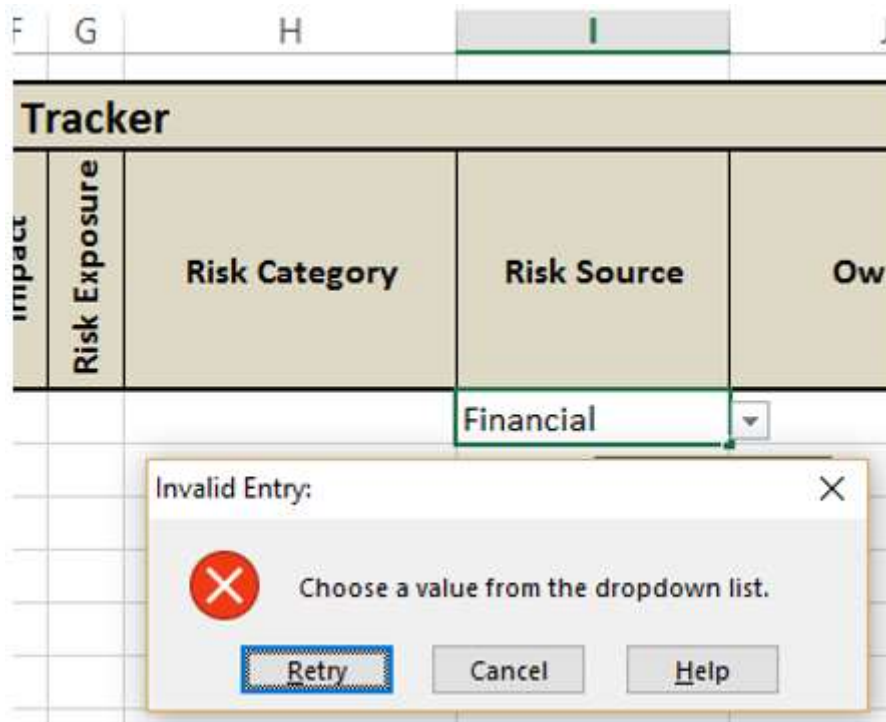


Both the sets of values match. Select a value from the drop-down list. It appears in the cell.



You can see that the selection of valid values is working fine. Finally, try to enter an invalid entry and verify the Error alert.

Type Financial in the cell and press Enter. Error message that you have set for the cell will be displayed.



- Verify the Error message. You have successfully set the Data Validation for the cell.
- Set valid criteria for the Risk Source Column
- Apply the Data Validation criteria to the cells I6-I15 in the Risk Source column (i.e. same range as that of Risk Category column)

Data Validation is set for all the selected cells. Data Validation for the column Risk Source is complete.

### Set Validation Values for Status

- Repeat the same steps that you used for setting Validation values for Risk Source.
- Set the List values as Open, Closed
- Apply the Data Validation criteria to the cells K6-K15 in the Status column (i.e. same range as that of Risk Category column)

Data Validation is set for all the selected cells. Data Validation for the column status is complete.

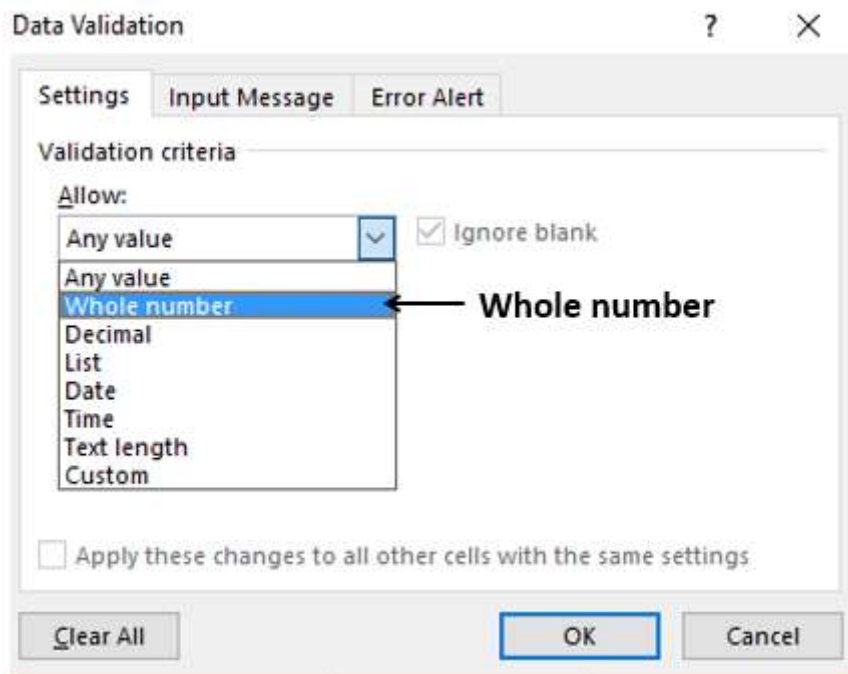
## Set Validation Values for Probability

Risk Probability Score values are in the range 1-5, 1 being low and 5 being high. The value can be any integer between 1 and 5, both inclusive.

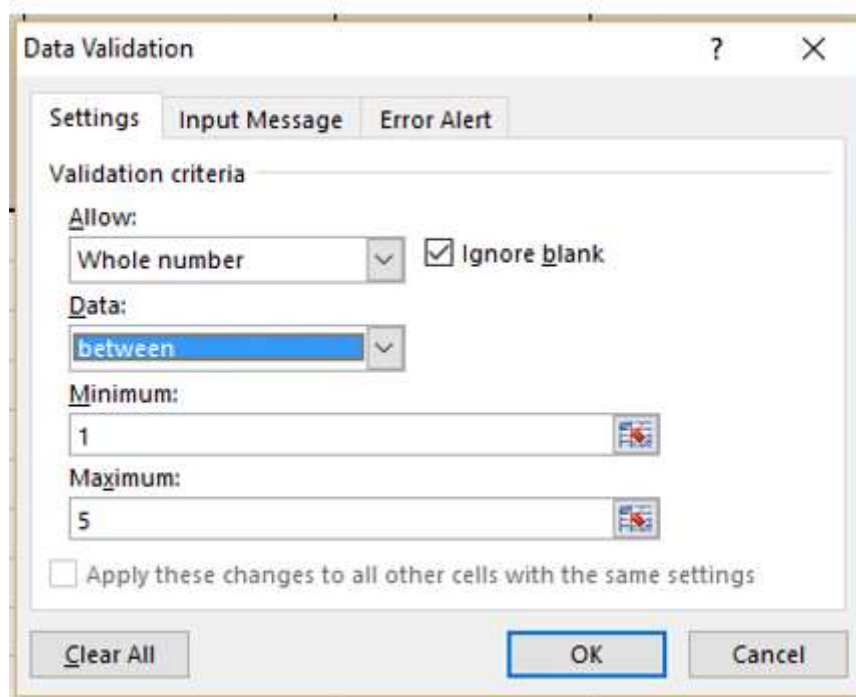
- Click in the first cell under the column Risk Source (I6).
- Click the DATA tab on the Ribbon.
- Click Data Validation in the Data Tools group.
- Select Data Validation... from the drop-down list.

The Data Validation dialog box appears.

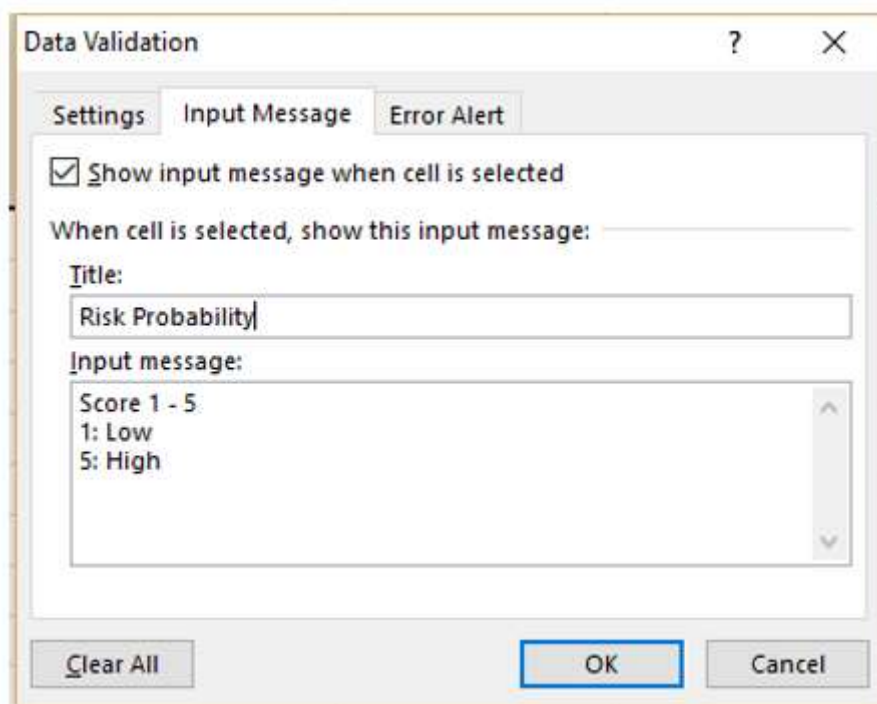
- Click the Settings tab.
- Under Validation criteria, in the Allow: drop-down list, select Whole number.



- Select between under Data:
- Type 1 in the box under Minimum:
- Type 5 in the box under Maximum:

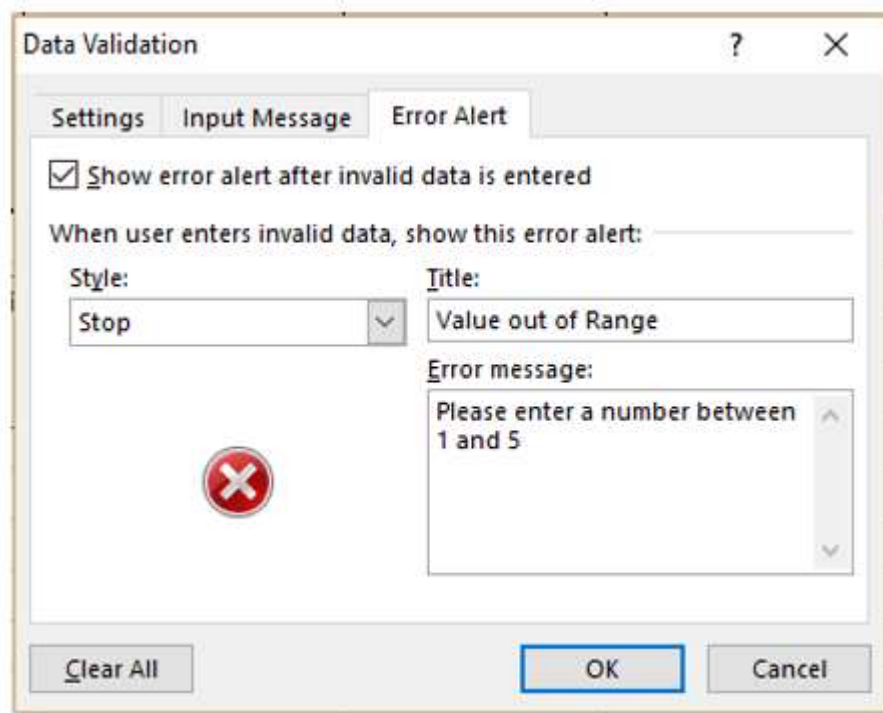


Set Input Message for Probability



Set Error Alert for Probability and click OK.





For the selected first cell under Probability,

- Data Validation criteria is set.
- Input message is set.
- Error alert is set.

Now, you can verify your settings.

Click on the cell for which you have set Data Validation criteria. Input message appears. In this case, there will not be a dropdown button because the input values are set to be in a range and not from list.

Risk Tracker				
	Probability	Impact	Risk Exposure	Risk

**Risk Probability**  
 Score 1 - 5  
 1: Low  
 5: High

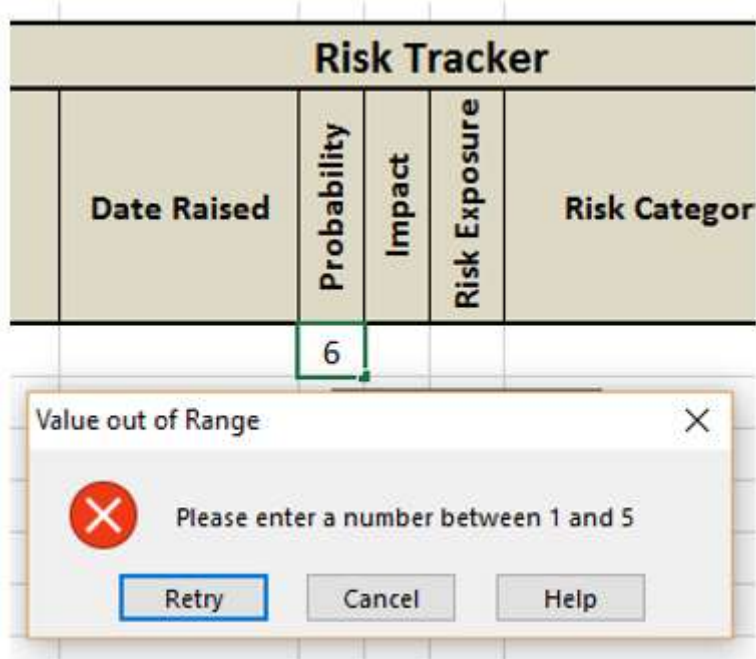
The input message is correctly displayed.

Enter an integer between 1 and 5 in the cell. It appears in the cell.

Risk Tracker				
Identified	Probability	Impact	Risk Exposure	Risk
	5			

Selection of valid values is working fine. Finally, try to enter an invalid entry and verify the Error alert.

Type 6 in the cell and press Enter. The Error message that you have set for the cell will be displayed.



You have successfully set the Data Validation for the cell.

- Set valid criteria for the Probability Column.
- Apply the Data Validation criteria to the cells E6-E15 in the Probability column (i.e. same range as that of Risk Category column).

Data Validation is set for all the selected cells. Data Validation for the column Probability is complete.

### Set Validation Values for Impact

To set the validation values for Impact, repeat the same steps that you used for setting validation values for probability.

Apply the Data Validation criteria to the cells F6-F15 in the Impact column (i.e. same range as that of Risk Category column).

Data Validation is set for all the selected cells. Data Validation for the column Impact is complete.

### Set the Column Risk Exposure with Calculated Values

Risk Exposure is calculated as a product of Risk Probability and Risk Impact.

$$\text{Risk Exposure} = \text{Probability} * \text{Impact}$$

Type `=E6*F6` in cell G6 and press Enter.

	A	B	C	D	E	F	G	H
2								
3								
4								
5								
6								
7								

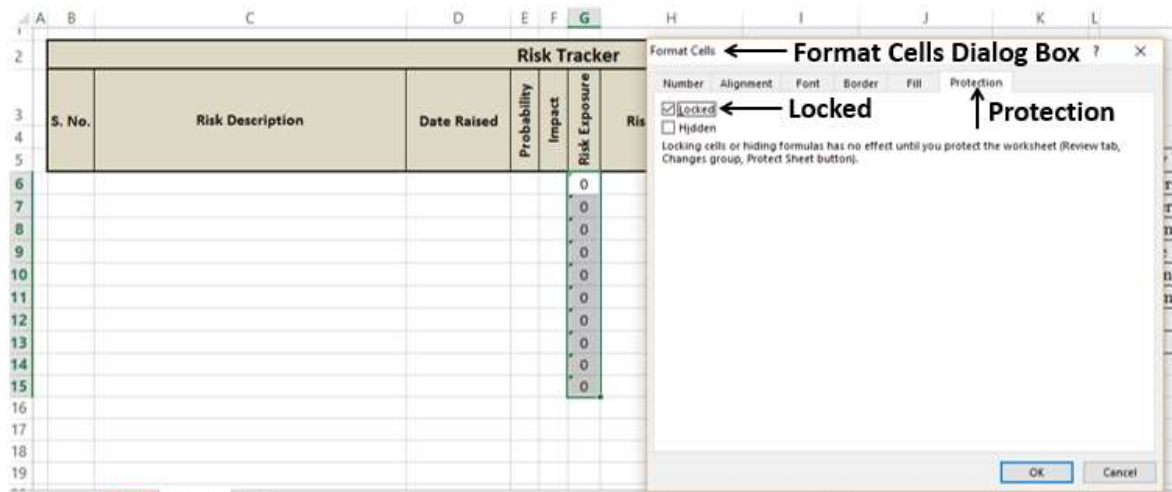
0 will be displayed in the cell G6 as E6 and F6 are empty.

Copy the formula in the cells G6–G15. 0 will be displayed in the cells G6–G15.

	A	B	C	D	E	F	G	H
2								
3								
4								
5								
6							0	
7							0	
8							0	
9							0	
10							0	
11							0	
12							0	
13							0	
14							0	
15							0	
16							0	

As the Risk Exposure column is meant for calculated values, you should not allow data entry in that column.

- Select cells G6–G15
- Right-click and in the dropdown list that appears, select Format Cells. The Format Cells dialog box appears.
- Click the Protection tab.
- Check the option **Locked**.



This is to ensure that data entry is not allowed in those cells. However, this will come into effect only when the worksheet is protected, which you will do as the last step after the worksheet is ready.

- Click OK.
- Shade the cells G6-G15 to indicate they are calculated values.

A	B	C	D	E	F	G	H	I	J	K	L	M
2	Risk Tracker											
3	S. No.	Risk Description	Date Raised	Probability	Impact	Risk Exposure	Risk Category	Risk Source	Owner	Status	Category Values	
4											End-Users	
5											Customer	
6											Management	
7											Schedule	
8											Requirements	
9											Environment	
10											Product	
11											Project	
12												
13												
14												
15												
16												

Category Values	
End-Users	
Customer	
Management	
Schedule	
Requirements	
Environment	
Product	
Project	

## Format Serial Number Values

You can leave it to the user to fill in the S. No. Column. However, if you format the S. No. values, the worksheet looks more presentable. In addition, it shows for how many rows the worksheet is formatted.

Type `=row()-5` in the cell B6 and press Enter.

	A	B	C
1			
2			
3		S. No.	Risk Description
4			
5			
6		=row()-5	
7			
8			
9			
10			
11			
12			
13			
14			
15			

1 will appear in cell B6. Copy the formula in the cells B6-B15. Values 1-10 appear.

	A	B	C	
1				
2				
3		S. No.	Risk Description	Da
4				
5				
6		1		
7		2		
8		3		
9		4		
10		5		
11		6		
12		7		
13		8		
14		9		
15		10		
16				

Shade the cells B6-B15.



## Wrap-up

You are almost done with your project.

- Hide Column M that contains Data Category values.
- Format Borders for the cells B6-K16.

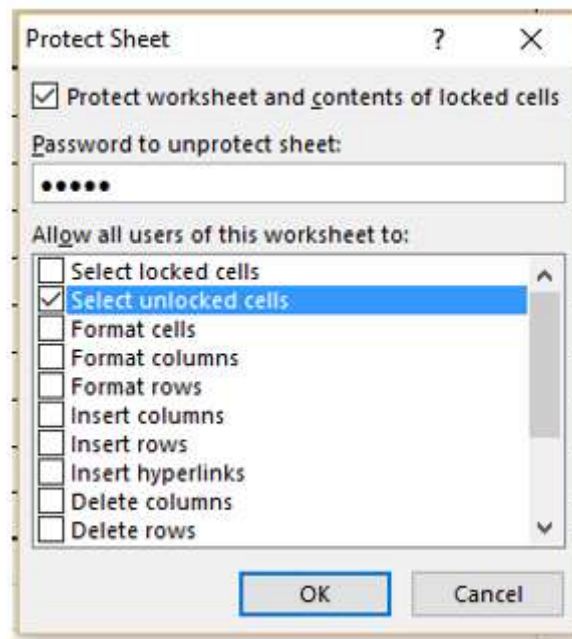
	A	B	C	D	E	F	G	H	I	J	K	L	N
2		Risk Tracker											
3		S. No.	Risk Description	Date Raised	Probability	Impact	Risk Exposure	Risk Category	Risk Source	Owner	Status		
4													
5													
6		1					0						
7		2					0						
8		3					0						
9		4					0						
10		5					0						
11		6					0						
12		7					0						
13		8					0						
14		9					0						
15		10					0						

- Right-click on the worksheet tab.
- Select Protect Sheet from the menu.

	A	B	C	D	E	F	G	H	I	J	K	L	N	O	P
2		Risk Tracker													
3		S. No.	Risk Description	Date Raised	Probability	Impact	Risk Exposure	Risk Category	Risk Source	Owner	Status				
4															
5															
6		1					0								
7		2					0								
8		3					0								
9		4					0								
10		5					0								
11		6					0								
12		7					0								
13		8					0								
14		9					0								
15		10					0								

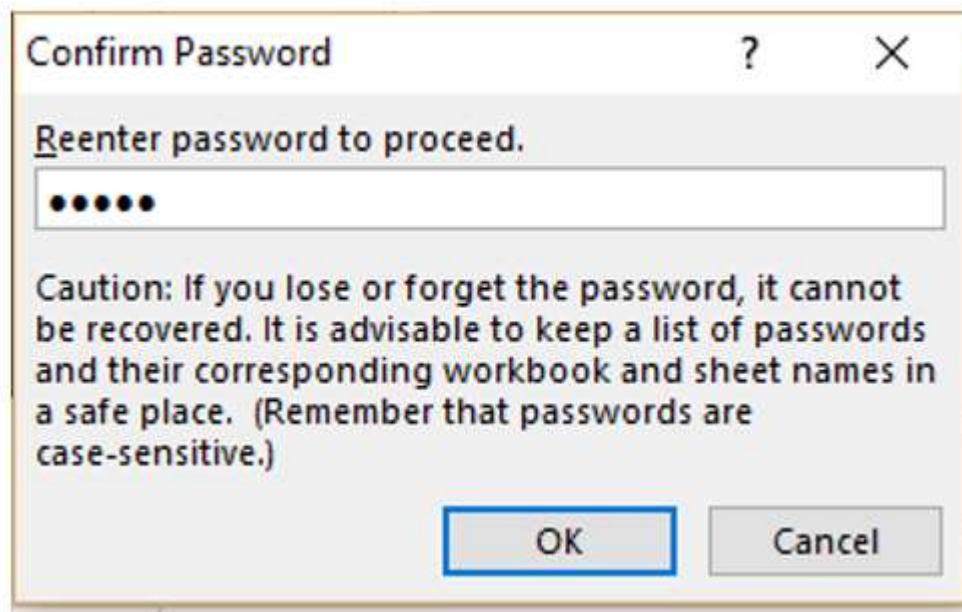
The Protect Sheet dialog box appears.

- Check the option Protect worksheet and contents of locked cells.
- Type in a password under Password to unprotect sheet:
  - Password is case sensitive
  - Protected sheet cannot be recovered if password is forgotten
  - It is a good practice to keep a list of worksheet names and passwords somewhere
- Under Allow all users of this worksheet to: check the box Select unlocked cells.



You have protected the locked cells in the column Risk Exposure from data entry and kept the rest of the unlocked cells editable. Click OK.

The **Confirm Password** dialog box appears.



- Re-enter the password.
- Click OK.

Your worksheet with Data Validation set for selected cells is ready to use.

	A	B	C	D	E	F	G	H	I	J	K	L
2		<b>Risk Tracker</b>										
3		<b>S. No.</b>	<b>Risk Description</b>	<b>Date Raised</b>	<b>Probability</b>	<b>Impact</b>	<b>Risk Exposure</b>	<b>Risk Category</b>	<b>Risk Source</b>	<b>Owner</b>	<b>Status</b>	
4												
5												
6		1					0					
7		2					0					
8		3					0					
9		4					0					
10		5					0					
11		6					0					
12		7					0					
13		8					0					
14		9					0					
15		10					0					
16												
17												
18												
19												

# 18. Financial Analysis

You can perform financial analysis with Excel in an easy way. Excel provides you several financial functions such as PMT, PV, NPV, XNPV, IRR, MIRR, XIRR, and so on that enable you to quickly arrive at the financial analysis results.

In this chapter, you will learn where and how you can use these functions for your analysis.

## What is Annuity?

An annuity is a series of constant cash payments made over a continuous period. For example, savings for retirement, insurance payments, home loan, mortgage, etc. In annuity functions-

- A positive number represents cash received.
- A negative number represents cash paid out.

## Present Value of a series of Future Payments

---

The present value is the total amount that a series of future payments is worth now. You can calculate the present value using the Excel functions -

- **PV:** Calculates the present value of an investment by using an interest rate and a series of future payments (negative values) and income (positive values). At least one of the cash flows must be positive and at least one must be negative.
- **NPV:** Calculates the net present value of an investment by using a discount rate and a series of periodic future payments (negative values) and income (positive values).
- **XNPV:** Calculates the net present value for a schedule of cash flows that is not necessarily periodic.

### Note that-

- PV cash flows must be constant whereas NPV cash flows can be variable.
- PV cash flows can be either at the beginning or at the end of the period whereas NPV cash flows must be at the end of the period.
- NPV cash flows must be periodic whereas XNPV cash flows need not be periodic.

In this section, you will understand how to work with PV. You will learn about NPV in a later section.

## Example

Suppose you are buying a refrigerator. The salesperson tells you that the price of the refrigerator is 32000, but you have an option to pay out the amount in 8 years with an interest rate of 13% per annum and yearly payments of 6000. You also have an option to make the payments either at the beginning or end of each year.

You want to know which of these options is beneficial for you.

You can use Excel function PV –

PV (rate, nper, pmt, [fv ], [type])

To calculate present value with payments at the end of each year, omit type or specify 0 for type.

To calculate present value with payments at the beginning of each year, specify 1 for type.

	A	B	C
1			
2		Price	32000
3		Interest Rate	0.13
4		No. of Payments	8
5		Payment	-6000
6		Payment at end of each year	
7		PV	=PV(C3,C4,C5)
8			
9		Price	32000
10		Interest Rate	0.13
11		No. of Payments	8
12		Payment	-6000
13		Payment at beginning of each year	
14		PV	=PV(C10,C11,C12,,1)

You will get the following results-

	A	B	C
1			
2		<b>Price</b>	32000
3		<b>Interest Rate</b>	13%
4		<b>No. of Payments</b>	8
5		<b>Payment</b>	-6000
6		<b>Payment at end of each year</b>	
7		<b>PV</b>	28,793
8			
9		<b>Price</b>	32000
10		<b>Interest Rate</b>	13%
11		<b>No. of Payments</b>	8
12		<b>Payment</b>	-6000
13		<b>Payment at beginning of each year</b>	
14		<b>PV</b>	32,536

Therefore,

- If you make the payment now, you need to pay 32,000 of present value.
- If you opt for yearly payments with payment at the end of the year, you need to pay 28, 793 of present value.
- If you opt for yearly payments with payment at the end of the year, you need to pay 32,536 of present value.

You can clearly see that option 2 is beneficial for you.

## What is EMI?

An Equated Monthly Installment (EMI) is defined by Investopedia as "A fixed payment amount made by a borrower to a lender at a specified date each calendar month. Equated monthly installments are used to pay off both interest and principal each month, so that over a specified number of years, the loan is paid off in full."

### EMI on a Loan

In Excel, you can calculate the EMI on a loan with the PMT function.

Suppose, you want to take a home loan of 5000000 with an annual interest rate of 11.5% and the term of the loan for 25 years. You can find your EMI as follows-



- Calculate interest rate per month (Interest Rate per Annum/12)
- Calculate number of monthly payments (No. of years \* 12)
- Use PMT function to calculate EMI

	A	B	C
1			
2		<b>Rate per Annum</b>	0.12
3		<b>Rate per Month</b>	=C2/12
4		<b>Term</b>	25
5		<b>No. of Monthly Payments</b>	=C4*12
6		<b>Loan Amount (PV)</b>	5000000
7		<b>FV</b>	0
8		<b>type</b>	1
9		<b>EMI</b>	=PMT(C3,C5,C6,C7,C8)

As you observe,

- Present Value (PV) is the loan amount.
- Future Value (FV) is 0 as at the end of the term the loan amount should be 0.
- Type is 1 as the EMIs are paid at the beginning of each month.

You will get the following results-

	A	B	C
1			
2		<b>Rate per Annum</b>	12%
3		<b>Rate per Month</b>	0.01
4		<b>Term</b>	25
5		<b>No. of Monthly Payments</b>	300
6		<b>Loan Amount (PV)</b>	5000000
7		<b>FV</b>	0
8		<b>type</b>	1
9		<b>EMI</b>	(\$52,139.81)

## Monthly Payment of Principal and Interest on a Loan

EMI includes both- interest and a part payment of principal. As the time increases, these two components of EMI will vary, reducing the balance.

To get

- The interest part of your monthly payments, you can use the Excel IPMT function.
- The payment of principal part of your monthly payments, you can use the Excel PPMT function.

For example, if you have taken a loan of 1,000,000 for a term of 8 months at the rate of 16% per annum. You can get values for the EMI, the decreasing interest amounts, the increasing payment of principal amounts and the diminishing loan balance over the 8 months. At the end of 8 months, loan balance will be 0.

Follow the procedure given below.

### 1. Calculate the EMI as follows-

	A	B	C
1			
2		<b>Rate per Annum</b>	0.16
3		<b>Rate per Month</b>	=C2/12
4		<b>No. of Monthly Payments</b>	8
5		<b>Loan Amount (PV)</b>	100000
6		<b>FV</b>	0
7		<b>type</b>	0
8		<b>EMI</b>	=PMT(C3,C4,C5,C6,C7)

This results in an EMI of Rs. 13261.59.

	A	B	C	D
1				
2		Rate per Annum	16%	
3		Rate per Month	0.01	
4		No. of Monthly Payments	8	
5		Loan Amount (PV)	100000	
6		FV	0	
7		type	0	
8		EMI	(13,261.59)	

2. Next calculate the interest and principal parts of the EMI for the 8 months as shown below-

	A	B	C	D	E	F	G
1							
2			Rate per Month	0.013			
3			No. of Monthly Payments	8			
4			Loan Amount (PV)	100000			
5			FV	0			
6			type	0			
7			EMI	-13242.27			
8							
9		Month	Beginning Balance	EMI	Interest	Principal	Ending Balance
10		1	=D4	=-\$D\$7	=-IPMT(\$D\$2,B10,\$D\$3,\$D\$4,,,\$D\$6)	=-PPMT(\$D\$2,B10,\$D\$3,\$D\$4,,,\$D\$6)	=C10-F10
11		2	=G10	=-\$D\$7	=-IPMT(\$D\$2,B11,\$D\$3,\$D\$4,,,\$D\$6)	=-PPMT(\$D\$2,B11,\$D\$3,\$D\$4,,,\$D\$6)	=C11-F11
12		3	=G11	=-\$D\$7	=-IPMT(\$D\$2,B12,\$D\$3,\$D\$4,,,\$D\$6)	=-PPMT(\$D\$2,B12,\$D\$3,\$D\$4,,,\$D\$6)	=C12-F12
13		4	=G12	=-\$D\$7	=-IPMT(\$D\$2,B13,\$D\$3,\$D\$4,,,\$D\$6)	=-PPMT(\$D\$2,B13,\$D\$3,\$D\$4,,,\$D\$6)	=C13-F13
14		5	=G13	=-\$D\$7	=-IPMT(\$D\$2,B14,\$D\$3,\$D\$4,,,\$D\$6)	=-PPMT(\$D\$2,B14,\$D\$3,\$D\$4,,,\$D\$6)	=C14-F14
15		6	=G14	=-\$D\$7	=-IPMT(\$D\$2,B15,\$D\$3,\$D\$4,,,\$D\$6)	=-PPMT(\$D\$2,B15,\$D\$3,\$D\$4,,,\$D\$6)	=C15-F15
16		7	=G15	=-\$D\$7	=-IPMT(\$D\$2,B16,\$D\$3,\$D\$4,,,\$D\$6)	=-PPMT(\$D\$2,B16,\$D\$3,\$D\$4,,,\$D\$6)	=C16-F16
17		8	=G16	=-\$D\$7	=-IPMT(\$D\$2,B17,\$D\$3,\$D\$4,,,\$D\$6)	=-PPMT(\$D\$2,B17,\$D\$3,\$D\$4,,,\$D\$6)	=C17-F17

You will get the following results.

	9	Month	Beginning Balance	EMI	Interest	Principal	Ending Balance
10		1	100000	13,242.27	1,300.00	11942.27	88057.73
11		2	88057.73	13,242.27	1,144.75	12097.52	75960.22
12		3	75960.22	13,242.27	987.48	12254.78	63705.43
13		4	63705.43	13,242.27	828.17	12414.10	51291.34
14		5	51291.34	13,242.27	666.79	12575.48	38715.86
15		6	38715.86	13,242.27	503.31	12738.96	25976.89
16		7	25976.89	13,242.27	337.70	12904.57	13072.33
17		8	13072.33	13,242.27	169.94	13072.33	0.00

## Interest and Principal paid between two Periods

You can compute the interest and principal paid between two periods, inclusive.

- Compute the cumulative interest paid between 2<sup>nd</sup> and 3<sup>rd</sup> months using the CUMIPMT function.
- Verify the result summing up the interest values for 2<sup>nd</sup> and 3<sup>rd</sup> months.
- Compute the cumulative principal paid between 2<sup>nd</sup> and 3<sup>rd</sup> months using the CUMPRINC function.
- Verify the result summing up the principal values for 2<sup>nd</sup> and 3<sup>rd</sup> months.

	A	B	C	D	E	F	G
1							
2			Rate per Month	0.013		Interest paid between 2nd and 3rd Months	
3			No. of Monthly Payments	8		=-CUMIPMT(D2,D3,D4,2,3,D6)	
4			Loan Amount (PV)	100000		=E11+E12	
5			FV	0		Principal paid between 2nd and 3rd Months	
6			type	0		=-CUMPRINC(D2,D3,D4,2,3,D6)	
7			EMI	-13242.27		=F11+F12	
8							
9		Month	Beginning Balance	EMI	Interest	Principal	Ending Balance
10		1	100000	13242.27	1300	11942.27	88057.73
11		2	88057.73	13242.27	1144.75	12097.52	75960.22
12		3	75960.21	13242.27	987.48	12254.78	63705.43
13		4	63705.43	13242.27	828.17	12414.09	51291.34
14		5	51291.34	13242.27	666.79	12575.48	38715.86
15		6	38715.86	13242.27	503.31	12738.96	25976.89
16		7	25976.89	13242.27	337.69	12904.57	13072.33
17		8	13072.33	13242.27	169.94	13072.33	0

You will get the following results.

	A	B	C	D	E	F	G
1							
2			Rate per Month	0.01		Interest paid between 2nd and 3rd Months	
3			No. of Monthly Payments	8		2,132.23	
4			Loan Amount (PV)	100000		2132.23	
5			FV	0		Principal paid between 2nd and 3rd Months	
6			type	0		24352.30099	
7			EMI	(13242.27)		24352.30	
8							
9		Month	Beginning Balance	EMI	Interest	Principal	Ending Balance
10		1	100000.00	13242.27	1300.00	11942.27	88057.73
11		2	88057.73	13242.27	1144.75	12097.52	75960.22
12		3	75960.21	13242.27	987.48	12254.78	63705.43
13		4	63705.43	13242.27	828.17	12414.09	51291.34
14		5	51291.34	13242.27	666.79	12575.48	38715.86
15		6	38715.86	13242.27	503.31	12738.96	25976.89
16		7	25976.89	13242.27	337.69	12904.57	13072.33
17		8	13072.33	13242.27	169.94	13072.33	0.00

You can see that your calculations match with your verification results.

## Calculating Interest Rate

Suppose you take a loan of 100,000 and you want to pay back in 15 months with a maximum monthly payment of 12000. You might want to know the interest rate at which you have to pay.

Find the interest rate with the Excel RATE function-

	A	B	C
1			
2		Loan Amount	100000
3		No. of Monthly Payments	15
4		EMI	-12000
5		Interest	=RATE(C3,C4,C2,,0,)

You will get the result as 8%.



	A	B	C
1			
2		<b>Loan Amount</b>	100000
3		<b>No. of Monthly Payments</b>	15
4		<b>EMI</b>	-12000
5		<b>Interest</b>	8%

## Calculating Term of Loan

Suppose you take a loan of 100,000 at the interest rate 10%. You want a maximum monthly payment of 15,000. You might want to know how long it will take for you to clear the loan.

Find the number of payments with Excel NPER function

	A	B	C
1			
2		<b>Loan Amount</b>	100000
3		<b>Interest</b>	0.1
4		<b>EMI</b>	-15000
5		<b>No. of Monthly Payments</b>	=NPER(C3,C4,C2,,0)

You will get the result as 12 months.

	A	B	C
1			
2		<b>Loan Amount</b>	100000
3		<b>Interest</b>	10%
4		<b>EMI</b>	-15000
5		<b>No. of Monthly Payments</b>	12



## Decisions on Investments

When you want to make an investment, you compare the different options and choose the one that yields better returns. Net present value is useful in comparing cash flows over a period of time and deciding which one is better. The cash flows can occur at regular, periodical intervals or at irregular intervals.

First, we consider the case of **regular, periodical cash flows**.

The net present value of a sequence of cash flows received at different points in time in  $n$  years from now ( $n$  can be a fraction) is  $1/(1 + r)^n$ , where  $r$  is the annual interest rate.

Consider the following two investments over a period of 3 years.

	A	B	C	D
1				
2		Interest Rate	0.2	
3			Cash Flows	
4		Time	Investment 1	Investment 2
5		1	-10000	-5000
6		2	25000	20000
7		3	-7000	-8000
8		Total	8000	7000

At face value, Investment 1 looks better than Investment 2. However, you can decide on which investment is better only when you know the true worth of the investment as of today. You can use the NPV function to calculate the returns.

The cash flows can occur

- At the end of every year.
- At the beginning of every year.
- In the middle of every year.

NPV function assumes that the cash flows are at the end of the year. If the cash flows occur at different times then you have to take into account that particular factor along with the calculation with NPV.

Suppose the cash flows occur at the end of the year. Then you can straight away use the NPV function.

	A	B	C	D
1				
2		<b>Interest Rate</b>	0.2	
3			<b>Cash Flows</b>	
4		<b>Time</b>	<b>Investment 1</b>	<b>Investment 2</b>
5	1		-10000	-5000
6	2		25000	20000
7	3		-7000	-8000
8		<b>Total</b>	=SUM(C5:C7)	=SUM(D5:D7)
9				
10		<b>NPV (End Year)</b>	=NPV(C2,C5:C7)	=NPV(C2,D5:D7)

You will get the following results-

	A	B	C	D
1				
2		<b>Interest Rate</b>	0.2	
3			<b>Cash Flows</b>	
4		<b>Time</b>	<b>Investment 1</b>	<b>Investment 2</b>
5	1		-10000	-5000
6	2		25000	20000
7	3		-7000	-8000
8		<b>Total</b>	8000	7000
9				
10		<b>NPV (End Year)</b>	4,976.85	5,092.59

As you observe NPV for Investment 2 is higher than that for Investment 1. Hence, Investment 2 is a better choice. You got this result as cash out flows for Investment 2 are at later periods as compared to that of Investment 1.

## Cash Flows at the Beginning of the Year

Suppose the cash flows occur at the beginning of every year. In such a case, you should not include the first cash flow in NPV calculation as it already represents the current value. You need to add the first cash flow to the NPV obtained from rest of the cash flows to get the net present value.

	A	B	C	D
1				
2		<b>Interest Rate</b>	0.2	
3			<b>Cash Flows</b>	
4		<b>Time</b>	<b>Investment 1</b>	<b>Investment 2</b>
5		1	-10000	-5000
6		2	25000	20000
7		3	-7000	-8000
8		<b>Total</b>	=SUM(C5:C7)	=SUM(D5:D7)
9				
10		<b>NPV (End Year)</b>	=NPV(C2,C5:C7)	=NPV(C2,D5:D7)
11				
12		<b>NPV (Beg. Year)</b>	=C5+NPV(C2,C6:C7)	=D5+NPV(C2,D6:D7)

You will get the following results-

	A	B	C	D
1				
2		<b>Interest Rate</b>	0.2	
3			<b>Cash Flows</b>	
4		<b>Time</b>	<b>Investment 1</b>	<b>Investment 2</b>
5		1	-10000	-5000
6		2	25000	20000
7		3	-7000	-8000
8		<b>Total</b>	8000	7000
9				
10		<b>NPV (End Year)</b>	4,976.85	5,092.59
11				
12		<b>NPV (Beg. Year)</b>	5,972.22	6,111.11

## Cash Flows in the Middle of the Year

Suppose the cash flows occur in the middle of every year. In such a case, you need to multiply the NPV obtained from the cash flows by  $\sqrt{1+r}$  to get the net present value.

	A	B	C	D
1				
2		Interest Rate	0.2	
3			Cash Flows	
4		Time	Investment 1	Investment 2
5		1	-10000	-5000
6		2	25000	20000
7		3	-7000	-8000
8		Total	=SUM(C5:C7)	=SUM(D5:D7)
9				
10		NPV (End Year)	=NPV(C2,C5:C7)	=NPV(C2,D5:D7)
11				
12		NPV (Beg. Year)	=C5+NPV(C2,C6:C7)	=D5+NPV(C2,D6:D7)
13				
14		NPV (Middle Year)	=SQRT(1+C2)*C10	=SQRT(1+C2)*D10

You will get the following results-

	A	B	C	D
1				
2		Interest Rate	0.2	
3			Cash Flows	
4		Time	Investment 1	Investment 2
5		1	-10000	-5000
6		2	25000	20000
7		3	-7000	-8000
8		Total	8000	7000
9				
10		NPV (End Year)	4,976.85	5,092.59
11				
12		NPV (Beg. Year)	5,972.22	6,111.11
13				
14		NPV (Middle Year)	5,451.87	5,578.66

## Cash Flows at Irregular Intervals

If you want to calculate the net present value with irregular cash flows, i.e. cash flows occurring at random times, the calculation is a bit complex.

However, in Excel, you can easily do such a calculation with XNPV function.

- Arrange your data with the dates and the cash flows.

**Note:** The first date in your data should be the earliest of all the dates. The other dates can occur in any order.

- Use the XNPV function to calculate the net present value.

	A	B	C
1			
2		Interest Rate	0.2
3		Date	Cash flows
4		42536	5000
5		42657	5143
6		42855	8838
7		42684	-4893
8		42629	-2134
9		42843	8047
10		42609	3908
11		42568	-4007
12			
13		Net Present Value	=XNPV(C2,C4:C11,B4:B11)

You will get the following results-

	A	B	C
1			
2		Interest Rate	0.2
3		Date	Cash flows
4		6/15/2016	5000
5		10/14/2016	5143
6		4/30/2017	8838
7		11/10/2016	-4893
8		9/16/2016	-2134
9		4/18/2017	8047
10		8/27/2016	3908
11		7/17/2016	-4007
12			
13		Net Present Value	17523.65



Suppose today's date is 15<sup>th</sup> March, 2015. As you observe, all the dates of cash flows are of later dates. If you want to find the net present value as of today, include it in the data at the top and specify 0 for the cash flow.

	A	B	C
1			
2		<b>Interest Rate</b>	0.2
3		<b>Date</b>	<b>Cash flows</b>
4		42078	0
5		42536	5000
6		42657	5143
7		42855	8838
8		42684	-4893
9		42629	-2134
10		42843	8047
11		42609	3908
12		42568	-4007
13			
14		<b>Net Present Value</b>	=XNPV(C2,C4:C12,B4:B12)

You will get the following results.

	A	B	C
1			
2		<b>Interest Rate</b>	0.2
3		<b>Date</b>	<b>Cash flows</b>
4		3/15/2015	0
5		6/15/2016	5000
6		10/14/2016	5143
7		4/30/2017	8838
8		11/10/2016	-4893
9		9/16/2016	-2134
10		4/18/2017	8047
11		8/27/2016	3908
12		7/17/2016	-4007
13			
14		<b>Net Present Value</b>	13940.18



## Internal Rate of Return (IRR)

Internal Rate of Return (IRR) of an investment is the rate of interest at which NPV is 0. It is the rate value for which the present values of the positive cash flows exactly compensate the negative ones. When the discount rate is the IRR, the investment is perfectly indifferent, i.e. the investor is neither gaining nor losing money.

Consider the following cash flows, different interest rates and the corresponding NPV values.

	A	B	C	D
1				
2		<b>Cash Flows</b>	<b>Interest Rate</b>	<b>NPV</b>
3		10000	8.00%	(304.95)
4		-5000	8.50%	(242.26)
5		-8500	9.00%	(180.80)
6		2000	9.50%	(120.54)
7			10.00%	(61.47)
8			10.53%	(0.12)
9			11.00%	53.23
10			11.50%	108.91
11			12.00%	163.51

As you can observe between the values of interest rate 10% and 11%, the sign of NPV changes. When you fine-tune the interest rate to 10.53%, NPV is nearly 0. Hence, IRR is 10.53%.

## Determining IRR of Cash Flows for a Project

You can calculate IRR of cash flows with Excel function IRR.

	A	B		A	B
1			1		
2		<b>Cash Flows</b>	2		<b>Cash Flows</b>
3		10000	3		10000
4		-5000	4		-5000
5		-8500	5		-8500
6		2000	6		2000
7			7		
8		<b>IRR</b>	8		<b>IRR</b>
9		=IRR(B3:B6)	9		10.53%

The IRR is 10.53% as you had seen in the previous section.

For the given cash flows, IRR may-

- exist and unique
- exist and multiple
- not exist

## Unique IRR

If IRR exists and is unique, it can be used to choose the best investment among several possibilities.

- If the first cash flow is negative, it means the investor has the money and wants to invest. Then, the higher the IRR the better, since it represents the interest rate the investor is receiving.
- If the first cash flow is positive, it means the investor needs money and is looking for a loan, the lower the IRR the better since it represents the interest rate the investor is paying.

To find if an IRR is unique or not, vary the guess value and calculate IRR. If IRR remains constant then it is unique.

	A	B	C	D	E
1					
2		<b>Cash Flows</b>		<b>Guess</b>	<b>IRR</b>
3		10000			=IRR(B3:B6)
4		-5000		0.05	=IRR(\$B\$3:\$B\$6,D4)
5		-8500		0.15	=IRR(\$B\$3:\$B\$6,D5)
6		2000		0.2	=IRR(\$B\$3:\$B\$6,D6)
7				0.25	=IRR(\$B\$3:\$B\$6,D7)
8				0.3	=IRR(\$B\$3:\$B\$6,D8)
9				0.35	=IRR(\$B\$3:\$B\$6,D9)
10				0.4	=IRR(\$B\$3:\$B\$6,D10)
11				0.45	=IRR(\$B\$3:\$B\$6,D11)
12				0.5	=IRR(\$B\$3:\$B\$6,D12)
13				0.55	=IRR(\$B\$3:\$B\$6,D13)

As you observe, the IRR has a unique value for the different guess values.

	A	B	C	D	E
1					
2		<b>Cash Flows</b>	<b>Guess</b>	<b>IRR</b>	
3		10000		10.53%	
4		-5000	5.00%	10.53%	
5		-8500	15.00%	10.53%	
6		2000	20.00%	10.53%	
7			25.00%	10.53%	
8			30.00%	10.53%	
9			35.00%	10.53%	
10			40.00%	10.53%	
11			45.00%	10.53%	
12			50.00%	10.53%	
13			55.00%	10.53%	

## Multiple IRRs

In certain cases, you may have multiple IRRs. Consider the following cash flows. Calculate IRR with different guess values.

	A	B	C	D	E
1					
2		<b>Cash Flows</b>		<b>Guess</b>	<b>IRR</b>
3		-20000			=IRR(B3:B6)
4		82000	0.15		=IRR(\$B\$3:\$B\$6,D4)
5		-60000	0.2		=IRR(\$B\$3:\$B\$6,D5)
6		2000	0.25		=IRR(\$B\$3:\$B\$6,D6)
7			0.3		=IRR(\$B\$3:\$B\$6,D7)
8			0.35		=IRR(\$B\$3:\$B\$6,D8)
9			0.4		=IRR(\$B\$3:\$B\$6,D9)
10			0.45		=IRR(\$B\$3:\$B\$6,D10)
11			0.5		=IRR(\$B\$3:\$B\$6,D11)
12			0.55		=IRR(\$B\$3:\$B\$6,D12)
13			0.6		=IRR(\$B\$3:\$B\$6,D13)

You will get the following results-

	A	B	C	D	E
1					
2		<b>Cash Flows</b>		<b>Guess</b>	<b>IRR</b>
3		-20000			-9.59%
4		82000		15.00%	-9.59%
5		-60000		20.00%	-9.59%
6		2000		25.00%	-9.59%
7				30.00%	-9.59%
8				35.00%	-9.59%
9				40.00%	-9.59%
10				45.00%	216.09%
11				50.00%	216.09%
12				55.00%	216.09%
13				60.00%	216.09%

You can observe that there are two IRRs - -9.59% and 216.09%. You can verify these two IRRs calculating NPV.

	A	B	C	D	E
1					
2		<b>Cash Flows</b>		<b>Guess</b>	<b>IRR</b>
3		-20000			-9.59%
4		82000		15.00%	-9.59%
5		-60000		20.00%	-9.59%
6		2000		25.00%	-9.59%
7				30.00%	-9.59%
8				35.00%	-9.59%
9				40.00%	-9.59%
10				45.00%	216.09%
11				50.00%	216.09%
12				55.00%	216.09%
13				60.00%	216.09%
14					
15				<b>IRR</b>	<b>NPV</b>
16				-9.59%	(\$0.00)
17				216.09%	\$0.00

For both -9.59% and 216.09%, NPV is 0.

## No IRRs

In certain cases, you may not have IRR. Consider the following cash flows. Calculate IRR with different guess values.

	A	B	C	D	E
1					
2		<b>Cash Flows</b>	<b>Guess</b>	<b>IRR</b>	
3		10000		=IRR(B3:B6)	
4		-5000	0.05	=IRR(\$B\$3:\$B\$6,D4)	
5		8500	0.15	=IRR(\$B\$3:\$B\$6,D5)	
6		2000	0.2	=IRR(\$B\$3:\$B\$6,D6)	
7			0.25	=IRR(\$B\$3:\$B\$6,D7)	
8			0.3	=IRR(\$B\$3:\$B\$6,D8)	
9			0.35	=IRR(\$B\$3:\$B\$6,D9)	
10			0.4	=IRR(\$B\$3:\$B\$6,D10)	
11			0.45	=IRR(\$B\$3:\$B\$6,D11)	
12			0.5	=IRR(\$B\$3:\$B\$6,D12)	
13			0.55	=IRR(\$B\$3:\$B\$6,D13)	

You will get the result as #NUM for all the guess values.

	A	B	C	D	E
1					
2		<b>Cash Flows</b>	<b>Guess</b>	<b>IRR</b>	
3		10000		#NUM!	
4		-5000	5.00%	#NUM!	
5		8500	15.00%	#NUM!	
6		2000	20.00%	#NUM!	
7			25.00%	#NUM!	
8			30.00%	#NUM!	
9			35.00%	#NUM!	
10			40.00%	#NUM!	
11			45.00%	#NUM!	
12			50.00%	#NUM!	
13			55.00%	#NUM!	

The result #NUM means that there is no IRR for the cash flows considered.



## Cash Flows Patterns and IRR

If there is only one sign change in the cash flows, such as from negative to positive or positive to negative, then a unique IRR is guaranteed. For example, in capital investments, the first cash flow will be negative, while the rest of the cash flows will be positive. In such cases, unique IRR exists.

If there is more than one sign change in the cash flows, IRR may not exist. Even if it exists, it may not be unique.

## Decisions based on IRRs

Many analysts prefer to use IRR and it is a popular profitability measure because, as a percentage, it is easy to understand and easy to compare to the required return. However, there are certain problems while making decisions with IRR. If you rank with IRRs and make decisions based on these ranks, you may end up with wrong decisions.

You have already seen that NPV will enable you to make financial decisions. However, IRR and NPV will not always lead to the same decision when projects are mutually exclusive.

**Mutually exclusive projects** are those for which the selection of one project precludes the acceptance of another. When projects that are being compared are mutually exclusive, a ranking conflict may arise between NPV and IRR. If you have to choose between project A and project B, NPV may suggest acceptance of project A whereas IRR may suggest project B.

This type of conflict between NPV and IRR may arise because of one of the following reasons:

- The projects are of greatly different sizes, or
- The timing of the cash flows are different.

### Projects of significant size difference-

	A	B	C	D
1				
2			Investment	IRR
3		Project A	1000	10%
4		Project B	100	50%

If you want to make a decision by IRR, project A yields a return of 100 and Project B a return of 50. Hence, investment on project A looks profitable. However, this is a wrong decision because of the difference in the scale of projects.



Consider-

- You have 1000 to invest.
- If you invest entire 1000 on project A, you get a return of 100.
- If you invest 100 on project B, you will still have 900 in your hand that you can invest on another project, say project C. Suppose you get a return of 20% on project C, then the total return on project B and project C is 230, which is way ahead in profitability.

Thus, NPV is a better way for decision making in such cases.

### Projects with different cash flows timings

	A	B	C	D
1				
2		<b>Year</b>	<b>Project A</b>	<b>Project B</b>
3		0	-1000	-1000
4		1	0	400
5		2	200	400
6		3	300	300
7		4	500	300
8		5	900	200
9		<b>IRR</b>	17%	20%
10		<b>NPV</b>	815.89	552.40

Again, if you consider IRR to decide, project B would be the choice. However, project A has a higher NPV and is an ideal choice.

### IRR of Irregularly Spaced Cash Flows (XIRR)

Your cash flows may sometimes be irregularly spaced. In such a case, you cannot use IRR as IRR requires equally spaced time intervals. You can use XIRR instead, which takes into account the dates of the cash flows along with the cash flows.

	A	B	C
1			
2		<b>Date</b>	<b>Cash Flows</b>
3		4/8/2015	-10000
4		8/15/2015	4000
5		3/15/2016	3000
6		4/25/2016	5000
7			
8		<b>XIRR</b>	=XIRR(C3:C6,B3:B6)

The Internal Rate of Return that results in is 26.42%.

<b>XIRR</b>	<b>26.42%</b>
-------------	---------------

## Modified IRR (MIRR)

Consider a case when your finance rate is different from your reinvestment rate. If you calculate Internal Rate of Return with IRR, it assumes same rate for both finance and reinvestment. Further, you might also get multiple IRRs.

For example, consider the cash flows given below-

	A	B	C	D
1				
2		<b>Finance Rate</b>		10%
3		<b>Reinvestment Rate</b>		12%
4				
5			<b>Year</b>	<b>Cash flows</b>
6			0	-1.6
7			1	10
8			2	-10
9				
10			<b>Discount Rate</b>	<b>NPV</b>
11			10%	(\$0.70)
12			25%	\$0.00
13			110%	\$0.43
14			400%	(\$0.00)
15			500%	(\$0.04)

As you observe, NPV is 0 more than once, resulting in multiple IRRs. Further, reinvestment rate is not taken into account. In such cases, you can use modified IRR (MIRR).

	A	B	C	D
1				
2		Finance Rate		0.1
3		Reinvestment Rate		0.12
4				
5			Year	Cash flows
6			0	-1.6
7			1	10
8			2	-10
9				
10			Discount Rate	NPV
11			0.1	=NPV(C11,D6:D8)
12			0.25	=NPV(C12,D6:D8)
13			1.1	=NPV(C13,D6:D8)
14			4	=NPV(C14,D6:D8)
15			5	=NPV(C15,D6:D8)
16				
17		MIRR	=MIRR(D6:D8,D2,D3)	

You will get a result of 7% as shown below-

	A	B	C	D
1				
2		Finance Rate		10%
3		Reinvestment Rate		12%
4				
5			Year	Cash flows
6			0	-1.6
7			1	10
8			2	-10
9				
10			Rate	NPV
11			10%	(\$0.70)
12			25%	\$0.00
13			110%	\$0.43
14			400%	(\$0.00)
15			500%	(\$0.04)
16				
17		MIRR	7%	

**Note:** Unlike IRR, MIRR will always be unique.

# 19. Working with Multiple Sheets

In certain situations, you might have to

- Set up workbooks in which several worksheets have a similar format or structure.
- Get information for these worksheets from another worksheet.
- Summarize the results from these worksheets into a summary worksheet.

For example, you might have to track sales information region wise and month wise in separate worksheets. The price of each product is taken from the product catalog that is set up across the company in a separate worksheet. Finally, you have to summarize the results across all the regions into a summary sheet.

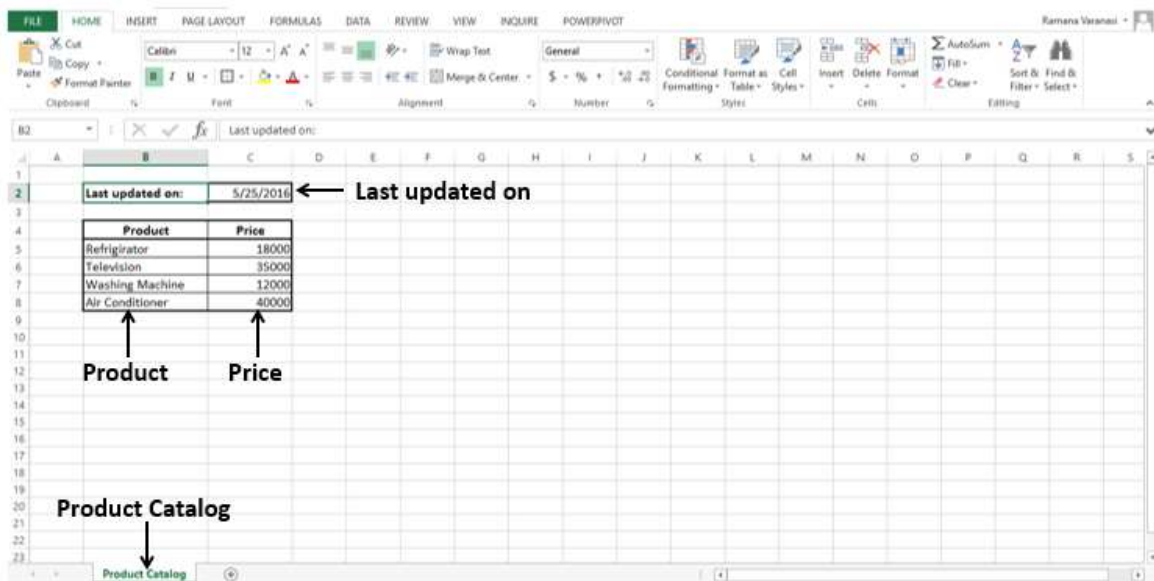
In this chapter, you will learn how you can accomplish this in easy steps. You are going to summarize results from April 2015 to March 2016, i.e. financial year 2015-16.

## The First Step

The first step is to set up a product catalog. Follow the steps given below-

- Start with a blank workbook.
- Set up product catalog worksheet with products and prices.
- Name the worksheet **Product Catalog**.
- Assume the catalog is revised on the first of every month.
- Provide a place holder for last updated on.

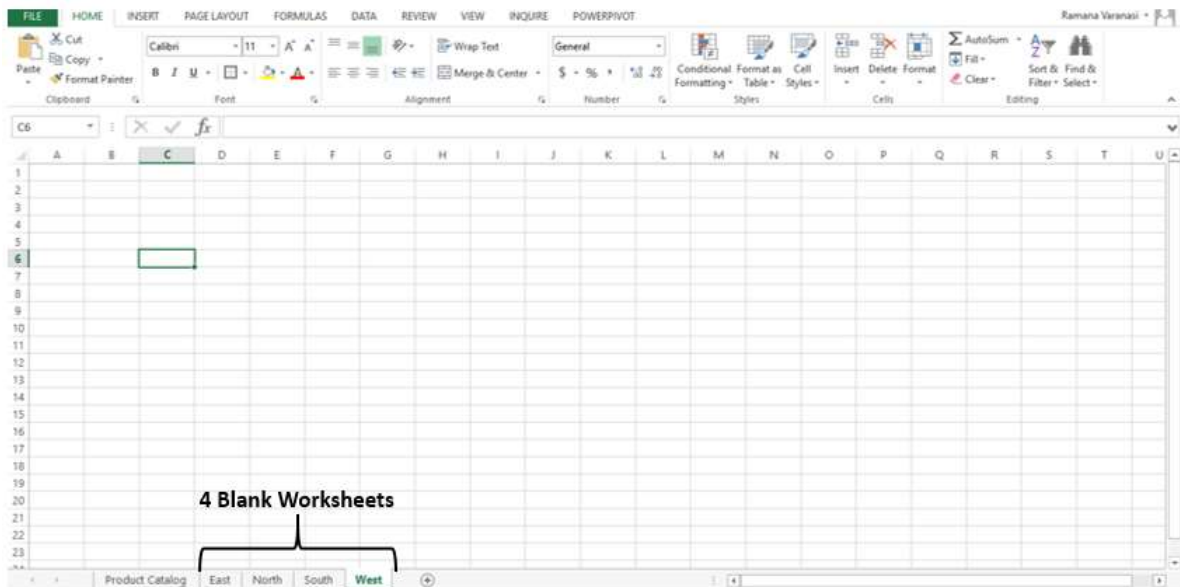
The price of a product at selling time is determined by the current cost of the product.



## Multiple Worksheets with same Structure

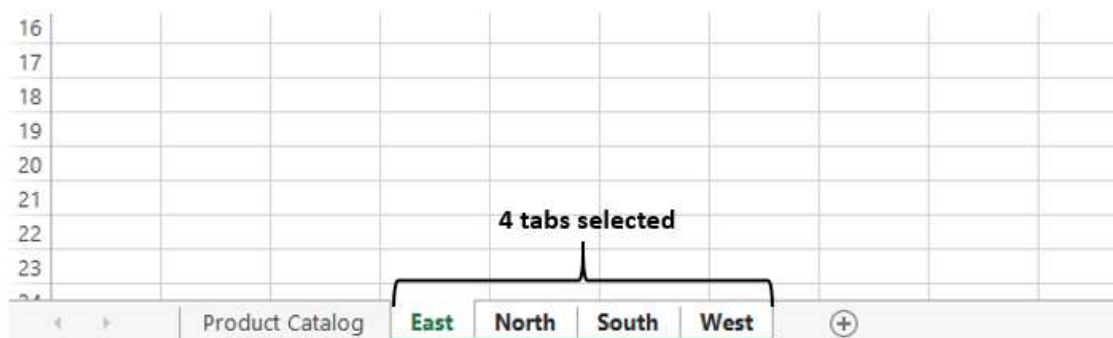
Next, you have to set up worksheets for the Regions – East, North, South, and West, in that order with same structure.

- Add 4 blank worksheets.
- Name the worksheets East, North, South and West.



These four worksheets should have the same structure.

- Click the tab East. The East worksheet opens.
- Press the shift key and click on the tab West. All the 4 tabs will be selected.



Now, whatever editing you do in the East worksheet will get automatically reflected in the other three selected worksheets.

In the East worksheet,

- Add the column headers – S. No., Month, Product, Price, No. of Units, Total Amount.
- Add the S. No., Month April and the 4 Product Names.
- Format the Table.

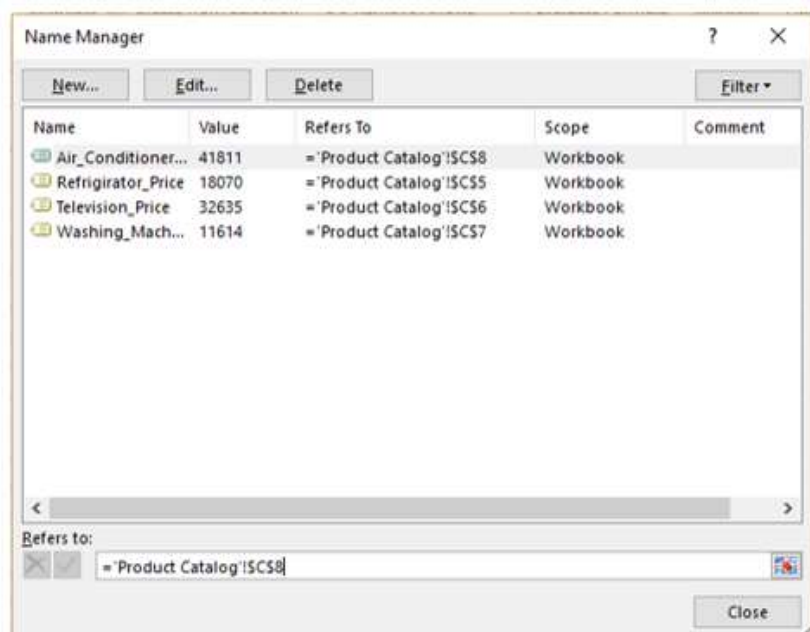
	A	B	C	D	E	F	G
1							
2		<b>S. No.</b>	<b>Month</b>	<b>Product</b>	<b>Price</b>	<b>No. of Units</b>	<b>Total Amount</b>
3		1	April	Refrigerator			
4		2	April	Television			
5		3	April	Washing Machine			
6		4	April	Air Conditioner			
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							

The same structure appears in the other worksheets North, South and West.

## Creating a Formula across Multiple Worksheets

To create a formula across multiple worksheets-

- Define names for the price values of the products in the product catalog worksheet.
- Set the Scope as Workbook for all the names.





- Once again select all the four worksheets – East, North, South and West.
- In the East worksheet, for each product, in the price column, give the formula as the Price Value Name

As we defined earlier, the price of a product is as per the product catalog that is updated on the first of every month.

	A	B	C	D	E	F	G
1							
2		<b>S. No.</b>	<b>Month</b>	<b>Product</b>	<b>Price</b>	<b>No. of Units</b>	<b>Total Amount</b>
3		1	April	Refrigerator	=Refrigerator_Price		
4		2	April	Television	=Television_Price		
5		3	April	Washing Machine	=Washing_Machine_Price		
6		4	April	Air Conditioner	=Air_Conditioner_Price		
7							
8							

- Repeat the same steps for each Month

	A	B	C	D	E	F	G
1							
2		<b>S. No.</b>	<b>Month</b>	<b>Product</b>	<b>Price</b>	<b>No. of Units</b>	<b>Total Amount</b>
3		1	April	Refrigerator	16725		
4		2	April	Television	36416		
5		3	April	Washing Machine	12337		
6		4	April	Air Conditioner	38009		
7		5	May	Refrigerator	16944		
8		6	May	Television	35437		
9		7	May	Washing Machine	12047		
10		8	May	Air Conditioner	39959		
11		9	June	Refrigerator	18648		
12		10	June	Television	33915		
13		11	June	Washing Machine	12810		
14		12	June	Air Conditioner	41062		
15		13	July	Refrigerator	17138		
16		14	July	Television	34840		
17		15	July	Washing Machine	12876		
18		16	July	Air Conditioner	38856		
19		17	August	Refrigerator	16290		
20		18	August	Television	35694		
21		19	August	Washing Machine	12252		
22		20	August	Air Conditioner	35911		

Therefore, for the worksheets for the regions East, North, South, and West, you have successfully set the same structure and placed the price information for each product based on the month from product catalog worksheet.

The Product Catalog can be in another Workbook too.

## Calculations in the Worksheets

The next step is to fill in the information of No. of Units sold for each Product in each Month and in each Region. Therefore, you need to work separately on these worksheets.

For each region, for each product -

- Fill No. of Units sold.
- Calculate the corresponding Total Amount as Price\*No. of Units.

	A	B	C	D	E	F	G
1							
2		<b>S. No.</b>	<b>Month</b>	<b>Product</b>	<b>Price</b>	<b>No. of Units</b>	<b>Total Amount</b>
3		1	April	Refrigerator	16725	16	267600
4		2	April	Television	36416	29	1056064
5		3	April	Washing Machine	12337	29	357773
6		4	April	Air Conditioner	38009	25	950225
7		5	May	Refrigerator	16944	32	542208
8		6	May	Television	35437	19	673303
9		7	May	Washing Machine	12047	16	192752
10		8	May	Air Conditioner	39959	15	599385
11		9	June	Refrigerator	18648	29	540792
12		10	June	Television	33915	24	813960
13		11	June	Washing Machine	12810	15	192150
14		12	June	Air Conditioner	41062	27	1108674
15		13	July	Refrigerator	17138	29	497002
16		14	July	Television	34840	21	731640
17		15	July	Washing Machine	12876	31	399156
18		16	July	Air Conditioner	38856	28	1087968
19		17	August	Refrigerator	16290	29	472410
20		18	August	Television	35694	22	785268
21		19	August	Washing Machine	12252	29	355308
22		20	August	Air Conditioner	35911	19	682309

In each worksheet (East, North, South and West), calculate subtotals month-wise-

The screenshot shows the Excel interface with the 'Subtotal' dialog box open. The dialog box is configured to calculate subtotals for the 'Month' column using the 'Sum' function. The 'Add subtotal to:' list includes 'S. No.', 'Month', 'Product', 'Price', and 'No. of Units', with 'No. of Units' selected. The 'Replace current subtotals' checkbox is checked. The 'Summary below data' checkbox is also checked. The 'OK' button is highlighted.

**Note:** You can use Subtotal on a single worksheet but not on multiple worksheets. Hence, you have to repeat this step for North, South and West worksheets.

	1	2	3	A	B	C	D	E	F	G
	1									
	2				<b>S. No.</b>	<b>Month</b>	<b>Product</b>	<b>Price</b>	<b>No. of Units</b>	<b>Total Amount</b>
	3				1	April	Refrigerator	16725	16	267600
	4				2	April	Television	36416	29	1056064
	5				3	April	Washing Machine	12337	29	357773
	6				4	April	Air Conditioner	38009	25	950225
	7					<b>April Total</b>				2631662
	8				5	May	Refrigerator	16944	32	542208
	9				6	May	Television	35437	19	673303
	10				7	May	Washing Machine	12047	16	192752
	11				8	May	Air Conditioner	39959	15	599385
	12					<b>May Total</b>				2007648
	13				9	June	Refrigerator	18648	29	540792
	14				10	June	Television	33915	24	813960
	15				11	June	Washing Machine	12810	15	192150
	16				12	June	Air Conditioner	41062	27	1108674
	17					<b>June Total</b>				2655576
	18				13	July	Refrigerator	17138	29	497002
	19				14	July	Television	34840	21	731640
	20				15	July	Washing Machine	12876	31	399156
	21				16	July	Air Conditioner	38856	28	1087968
	22					<b>July Total</b>				2715766

Click the Outline Level 2. You will get all month-wise Totals.

	1	2	3	A	B	C	D	E	F	G
	1									
	2				<b>S. No.</b>	<b>Month</b>	<b>Product</b>	<b>Price</b>	<b>No. of Units</b>	<b>Total Amount</b>
	7					<b>April Total</b>				2631662
	12					<b>May Total</b>				2007648
	17					<b>June Total</b>				2655576
	22					<b>July Total</b>				2715766
	27					<b>August Total</b>				2295295
	32					<b>September Total</b>				3271872
	37					<b>October Total</b>				2659952
	42					<b>November Total</b>				2475657
	47					<b>December Total</b>				2457555
	52					<b>January Total</b>				2447194
	57					<b>February Total</b>				2703515
	62					<b>March Total</b>				2878112
	63					<b>Grand Total</b>				31199804
	64									
	65									
	66									
	67									
	68									
	69									
	70									
	71									

Product Catalog

East

North

South

West

+

Now, you are ready to summarize the results from all the four worksheets – East, North, South and West.

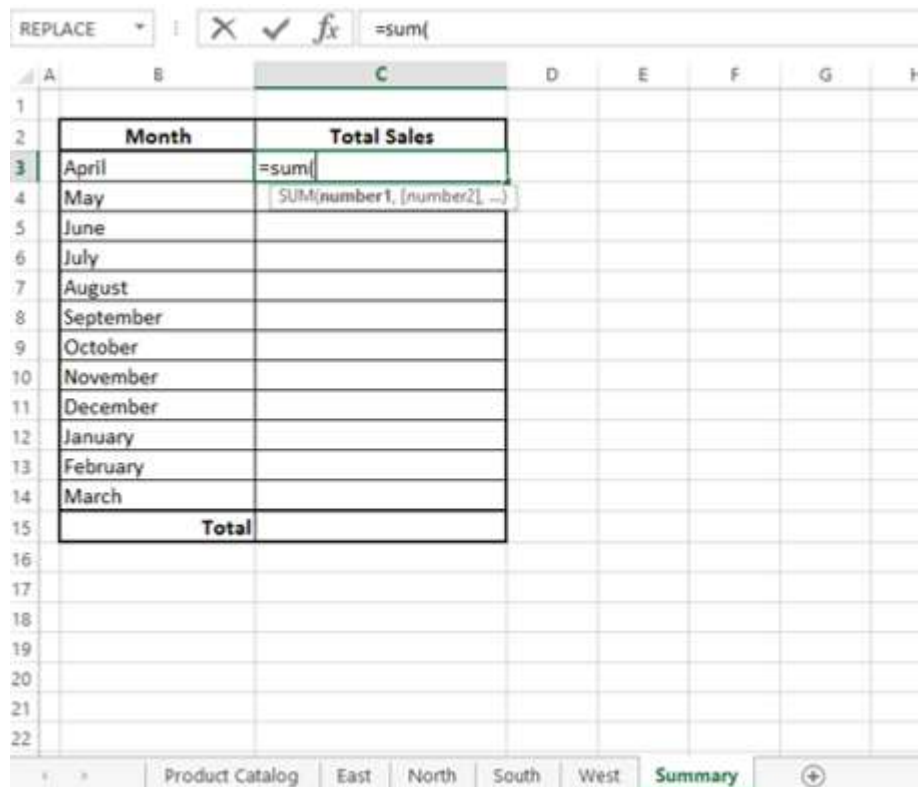
## Summarizing Data in Multiple Worksheets

The following steps will show you how to summarize data from multiple worksheets.

- Add a worksheet and name it Summary.
- Create the structure for Summary worksheet.

	A	B	C	D	E	F	G	H
1								
2		<b>Month</b>	<b>Total Sales</b>					
3		April						
4		May						
5		June						
6		July						
7		August						
8		September						
9		October						
10		November						
11		December						
12		January						
13		February						
14		March						
15		<b>Total</b>						
16								
17								
18								
19								
20								
21								
22								

In the column- **Total Sales**, in the cell C3, type **=sum(**



- Select the worksheet **East**.
- Select the cell G7.
- With East tab pressed, click the tab **West**.
- The tabs East to West get selected.
- The formula in the formula bar appears as

**=sum('East:West'!G7)**

Formula bar: `=sum('East:West'!G7)`

	A	B	C	D	E	F	G
1							
2		<b>S. No.</b>	<b>Month</b>	<b>Product</b>	<b>Price</b>	<b>No. of Units</b>	<b>Total Amount</b>
7			April Total				2631662
12			May Total				2007648
17			June Total				2655576
22			July Total				2715766
27			August Total				2295295
32			September Total				3271872
37			October Total				2659952
42			November Total				2475657
47			December Total				2457555
52			January Total				2447194
57			February Total				2703515
62			March Total				2878112
63			Grand Total				31199804
64							
65							
66							
67							
68							
69							
70							
71							

Sheet tabs: Product Catalog | **East** | North | South | West | Summary

Note that you are still in the **East** worksheet. Press Enter.

You will be in the Summary worksheet. In the formula bar, you will see the formula as

**=SUM(East:West!G7)**

The calculated value appears in the cell C3.



	A	B	C	D	E	F	G
1							
2		<b>Month</b>	<b>Total Sales</b>				
3		April	10220701				
4		May					
5		June					
6		July					
7		August					
8		September					
9		October					
10		November					
11		December					
12		January					
13		February					
14		March					
15		<b>Total</b>					
16							
17							
18							
19							
20							
21							
22							

- Copy the formula to the cells C4 to C14.
- Click Show Formulas in the Formula Auditing group under the FORMULAS tab.

All the formulas in the column Total Sales appear.

	A	B	C
1			
2		<b>Month</b>	<b>Total Sales</b>
3		April	=SUM(East:West!G7)
4		May	=SUM(East:West!G12)
5		June	=SUM(East:West!G17)
6		July	=SUM(East:West!G22)
7		August	=SUM(East:West!G27)
8		September	=SUM(East:West!G32)
9		October	=SUM(East:West!G37)
10		November	=SUM(East:West!G42)
11		December	=SUM(East:West!G47)
12		January	=SUM(East:West!G52)
13		February	=SUM(East:West!G57)
14		March	=SUM(East:West!G62)
15		<b>Total</b>	

This is exactly how you wanted to summarize the results from each region.

- Click in the cell C15.
- Type **=sum(C3:C14)**

	A	B	C
1			
2		<b>Month</b>	<b>Total Sales</b>
3		April	=SUM(East:West!G7)
4		May	=SUM(East:West!G12)
5		June	=SUM(East:West!G17)
6		July	=SUM(East:West!G22)
7		August	=SUM(East:West!G27)
8		September	=SUM(East:West!G32)
9		October	=SUM(East:West!G37)
10		November	=SUM(East:West!G42)
11		December	=SUM(East:West!G47)
12		January	=SUM(East:West!G52)
13		February	=SUM(East:West!G57)
14		March	=SUM(East:West!G62)
15		<b>Total</b>	=sum(C3:C14)

Your summarized results are ready in the Summary worksheet.

	A	B	C	D	E	F	G	H
1								
2		<b>Month</b>	<b>Total Sales</b>					
3		April	10,220,701					
4		May	9,419,796					
5		June	10,592,470					
6		July	9,927,996					
7		August	9,322,352					
8		September	10,405,543					
9		October	10,101,672					
10		November	9,830,276					
11		December	9,625,740					
12		January	10,491,556					
13		February	11,181,341					
14		March	9,247,650					
15		<b>Total</b>	120,367,093					
16								
17								
18								
19								
20								
21								
22								

Product Catalog East North South West **Summary**

## 20. Formula Auditing

You might want to check formulas for accuracy or find the source of an error. Excel Formula Auditing commands provide you an easy way to find

- Which cells are contributing in the calculation of a formula in the active cell.
- Which formulas are referring to the active cell.

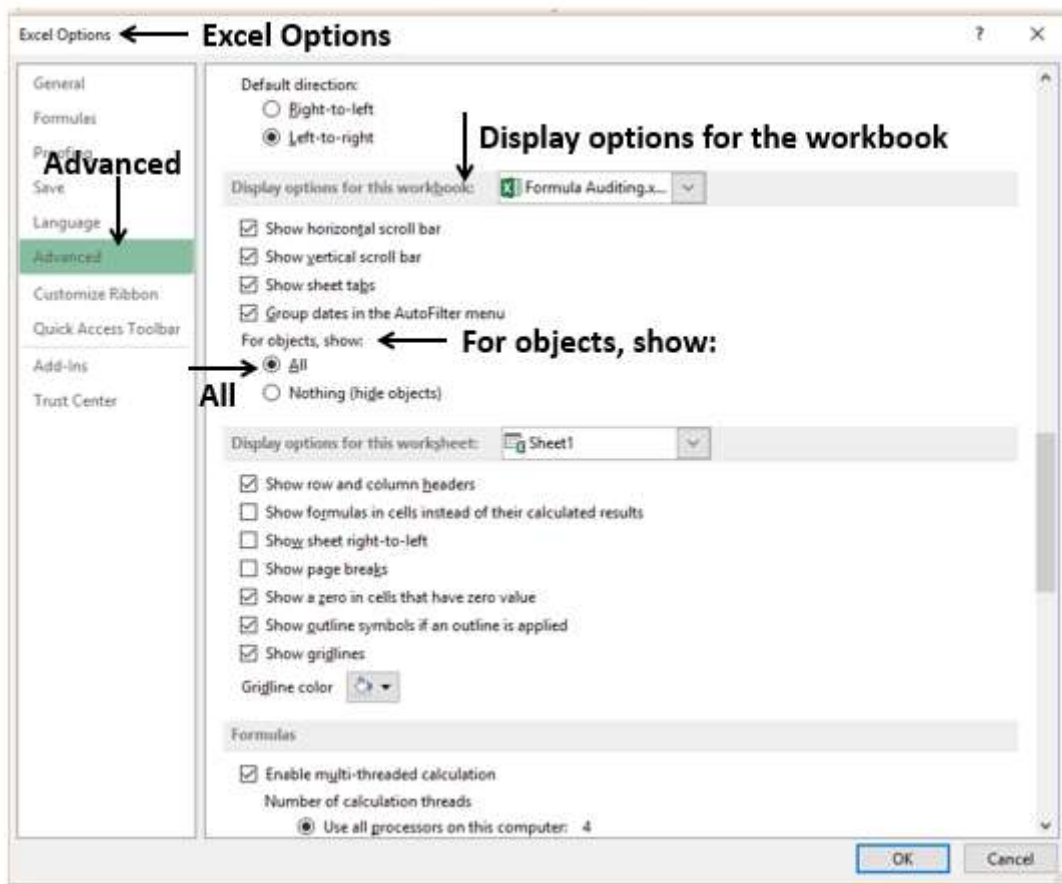
These findings are shown graphically by arrow lines that makes the visualization easy. You can display all the formulas in the active worksheet with a single command. If your formulas refer to cells in a different workbook, open that workbook also. Excel cannot go to a cell in a workbook that is not open.

### Setting the Display Options

---

You need to check whether the display options for the workbooks you are using are correctly set.

- Click **FILE > Options**.
- In the Excel Options dialog box, click Advanced.
- In Display options for the workbook-
  - Select the workbook.
  - Check that under For objects, show, All is selected.
- Repeat this step for all the workbooks you are auditing.



## Tracing Precedents

Precedent cells are those cells that are referred to by a formula in the active cell.

In the following example, the active cell is C2. In C2, you have the formula **=B2\*C4**.

B2 and C4 are precedent cells for C2.

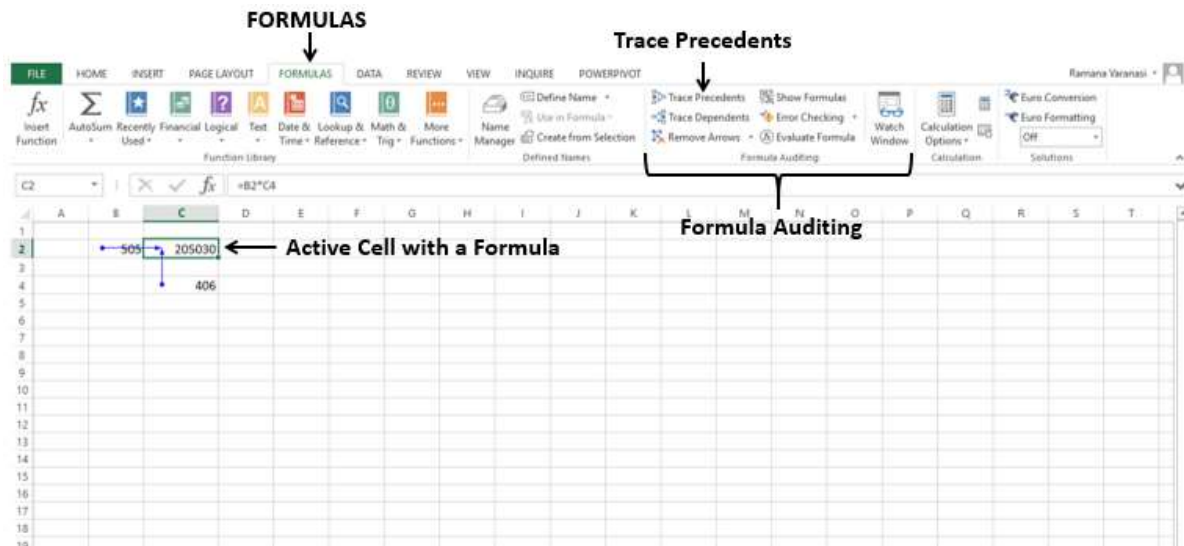
Formula in Active Cell

	A	B	C	D	E
1					
2		505	205030		
3					
4			406		
5					

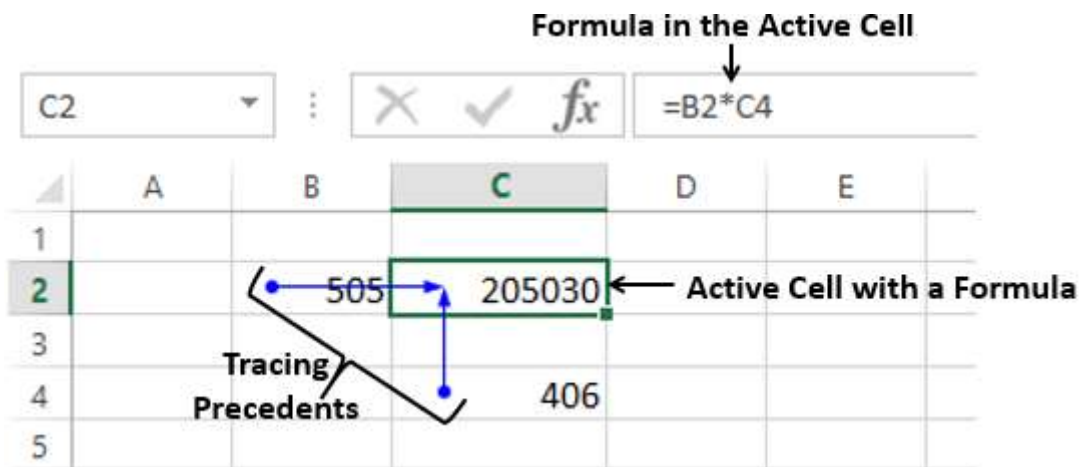
Active Cell

To trace the precedents of the cell C2,

- Click in the cell C2.
- Click the Formulas tab.
- Click Trace Precedents in the Formula Auditing group.



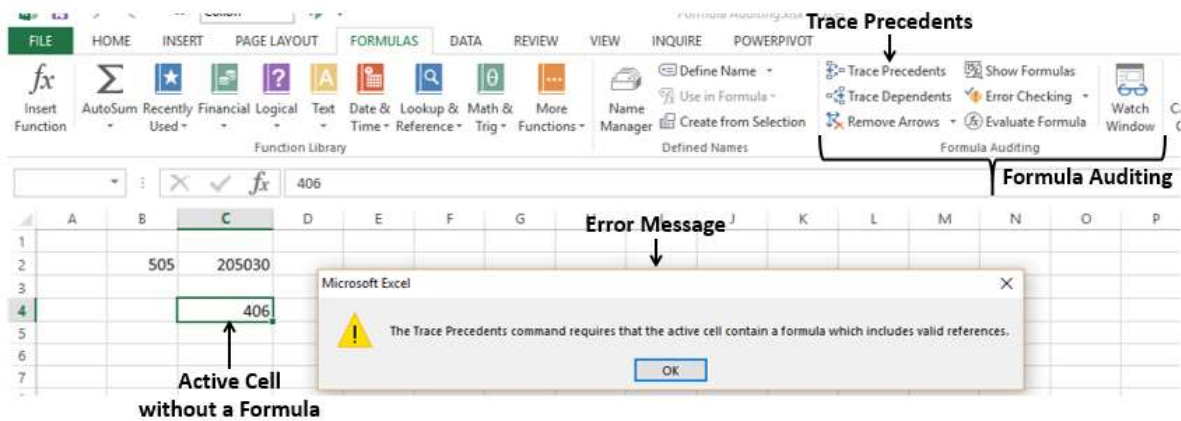
Two arrows, one from B2 to C2 and another from C4 to C2 will be displayed, tracing the precedents.



Note that for tracing precedents of a cell, the cell should have a formula with valid references. Otherwise, you will get an error message.

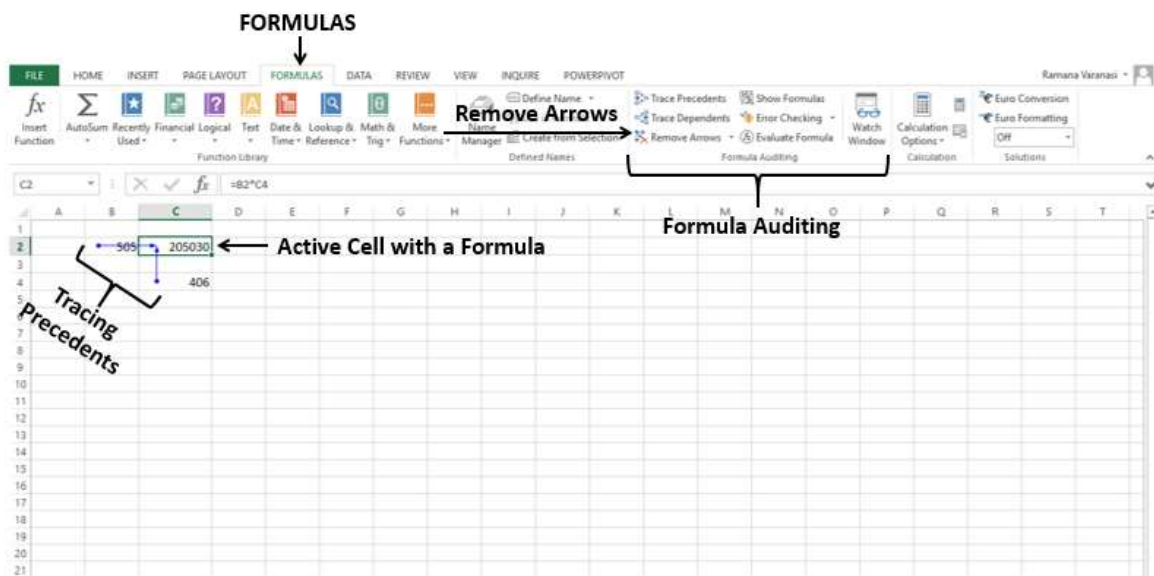
- Click in a cell that does not contain a formula or click in an empty cell.
- Click Trace Precedents in the Formula Auditing group.

You will get a message.



## Removing Arrows

Click Remove Arrows in the Formula Auditing group.



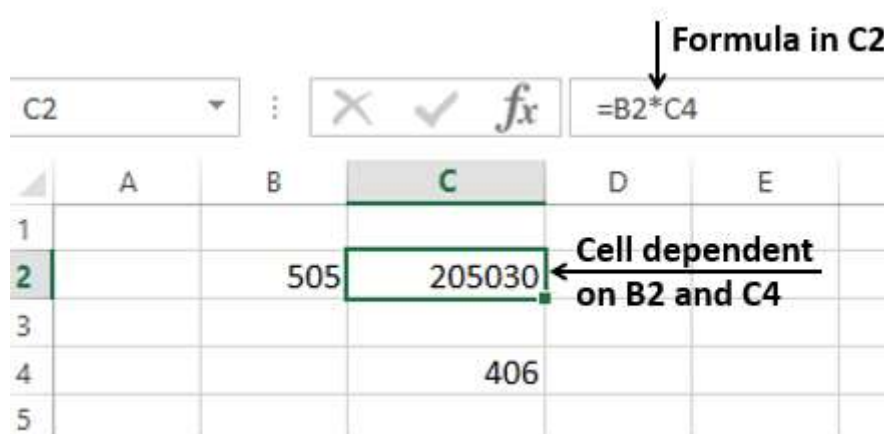
All the arrows in the worksheet will disappear.

## Tracing Dependents

Dependent cells contain formulas that refer to other cells. That means, if the active cell contributes to a formula in another cell, the other cell is a dependent cell on the active cell.

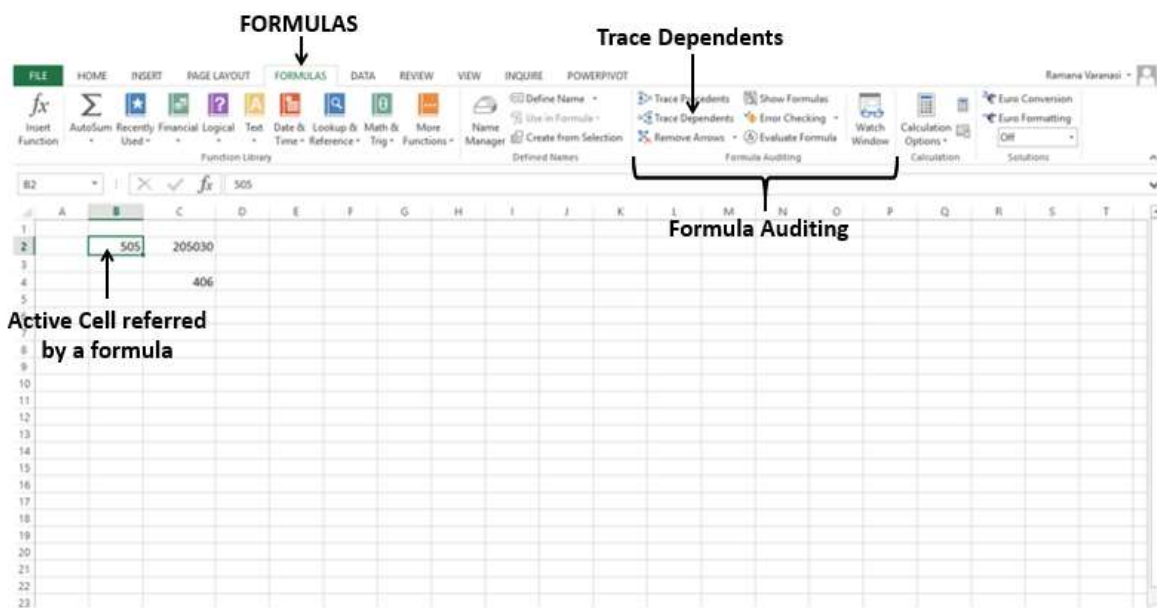
In the example below, C2 has the formula **=B2\*C4**. Therefore, C2 is a dependent cell on the cells B2 and C4.





To trace the dependents of the cell B2,

- Click in the cell B2.
- Click the Formulas tab.
- Click Trace Dependents in the Formula Auditing group.

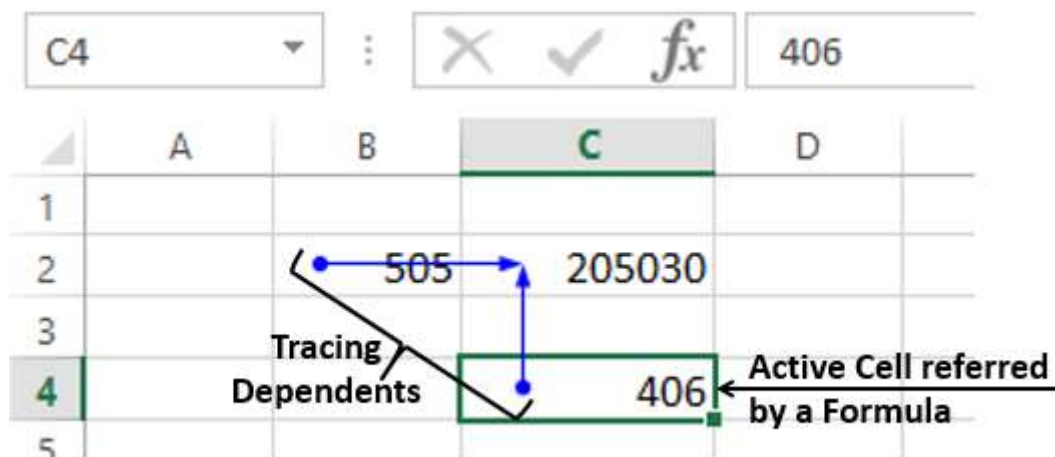


An arrow appears from B2 to C2, showing C2 is dependent on B2.

To trace the dependents of the cell C4-

- Click in the cell C4.
- Click the Formula tab > Trace Dependents in the Formula Auditing group.

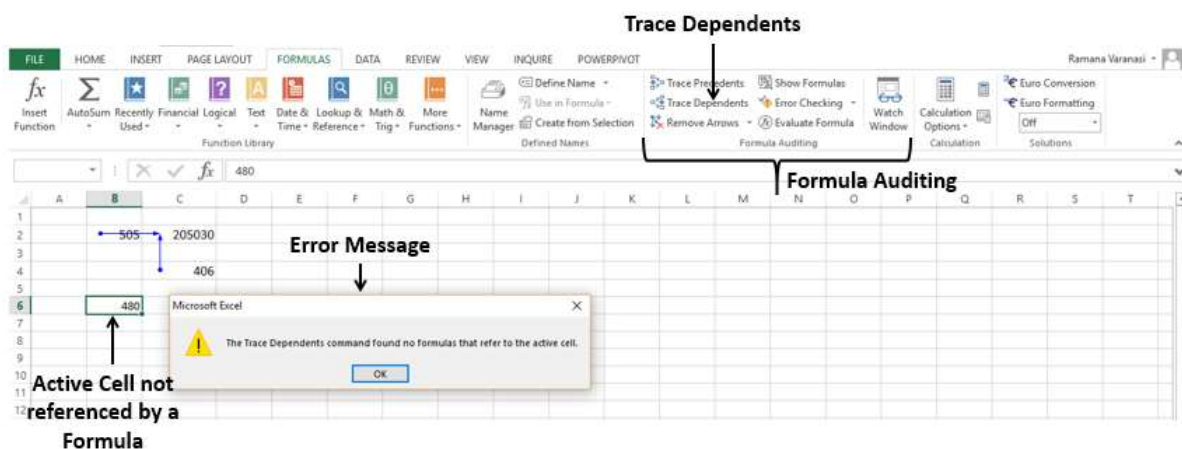
Another arrow appears from C4 to C2, showing C2 is dependent on C4 also.



Click **Remove Arrows** in the Formula Auditing group. All the arrows in the worksheet will disappear.

**Note:** For tracing dependents of a cell, the cell should be referenced by a formula in another cell. Otherwise, you will get an error message.

- Click in the cell B6 is not referenced by any formula or click in any empty cell.
- Click Trace Dependents in the Formula Auditing group. You will get a message.



## Working with Formulae

You have understood the concept of Precedents and Dependents. Now, consider a worksheet with several formulae.

	A	B	C	D	E	F
1						
2		<b>Exam Results</b>			<b>Student Grades</b>	
3		<b>Marks</b>	<b>Pass Category</b>		<b>Marks</b>	<b>Pass Category</b>
4		85	First Class with Distinction		0	Fail
5		75	First Class with Distinction		35	Third Class
6		72	First Class		50	Second Class
7		55	Second Class		60	First Class
8		68	First Class		75	First Class with Distinction
9		34	Fail			
10		60	First Class			
11		50	Second Class			
12		98	First Class with Distinction			
13		59	Second Class			
14		74	First Class			
15		99	First Class with Distinction			
16		40	Third Class			
17		35	Third Class			

- Click in a cell under Pass Category in Exam Results table.
- Click Trace Precedents. The cell to its left (Marks) and the range E4:F8 will be mapped as the precedents.
- Repeat for all the cells under Pass Category in Exam Results table.

	A	B	C	D	E	F
1						
2		<b>Exam Results</b>			<b>Student Grades</b>	
3		<b>Marks</b>	<b>Pass Category</b>		<b>Marks</b>	<b>Pass Category</b>
4		85	First Class with Distinction		0	Fail
5		75	First Class with Distinction		35	Third Class
6		72	First Class		50	Second Class
7		55	Second Class		60	First Class
8		68	First Class		75	First Class with Distinction
9		34	Fail			
10		60	First Class			
11		50	Second Class			
12		98	First Class with Distinction			
13		59	Second Class			
14		74	First Class			
15		99	First Class with Distinction			
16		40	Third Class			
17		35	Third Class			

- Click in a cell under Pass Category in Student Grades table.
- Click Trace Dependents. All the cells under Pass Category in Exam Results table will be mapped as the dependents.

	A	B	C	D	E	F
1						
2		<b>Exam Results</b>			<b>Student Grades</b>	
3		<b>Marks</b>	<b>Pass Category</b>		<b>Marks</b>	<b>Pass Category</b>
4		85	First Class with Distinction		0	Fail
5		75	First Class with Distinction		35	Third Class
6		72	First Class		50	Second Class
7		55	Second Class		60	First Class
8		68	First Class		75	First Class with Distinction
9		34	Fail			
10		60	First Class			
11		50	Second Class			
12		98	First Class with Distinction			
13		59	Second Class			
14		74	First Class			
15		99	First Class with Distinction			
16		40	Third Class			
17		35	Third Class			

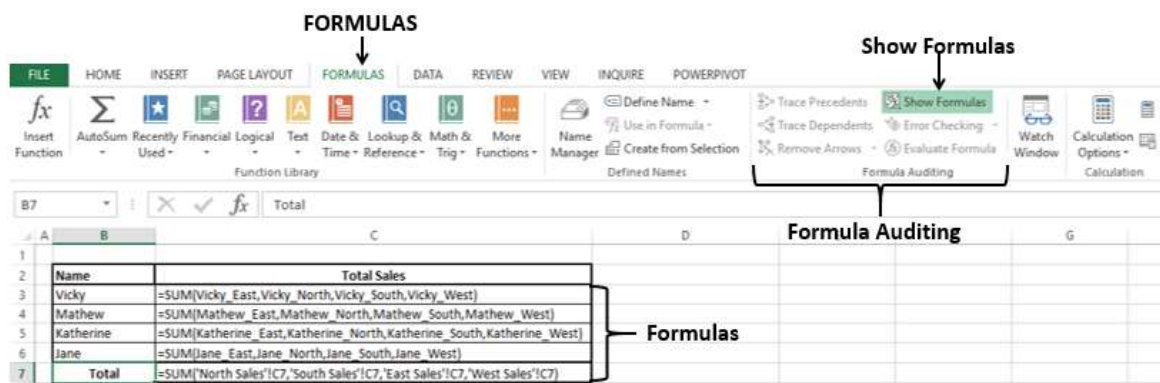
## Showing Formulas

The worksheet below contains the summary of sales by the salespersons in the regions East, North, South, and West.

	A	B	C
1			
2		<b>Name</b>	<b>Total Sales</b>
3		Vicky	1326
4		Mathew	1625
5		Katherine	1957
6		Jane	1687
7		<b>Total</b>	<b>5323</b>
8			

- Click the FORMULAS tab on the Ribbon.

- Click Show Formulas in the Formula Auditing group. The Formulas in the worksheet will appear, so that you will know which cells contain formulas and what the formulas are.



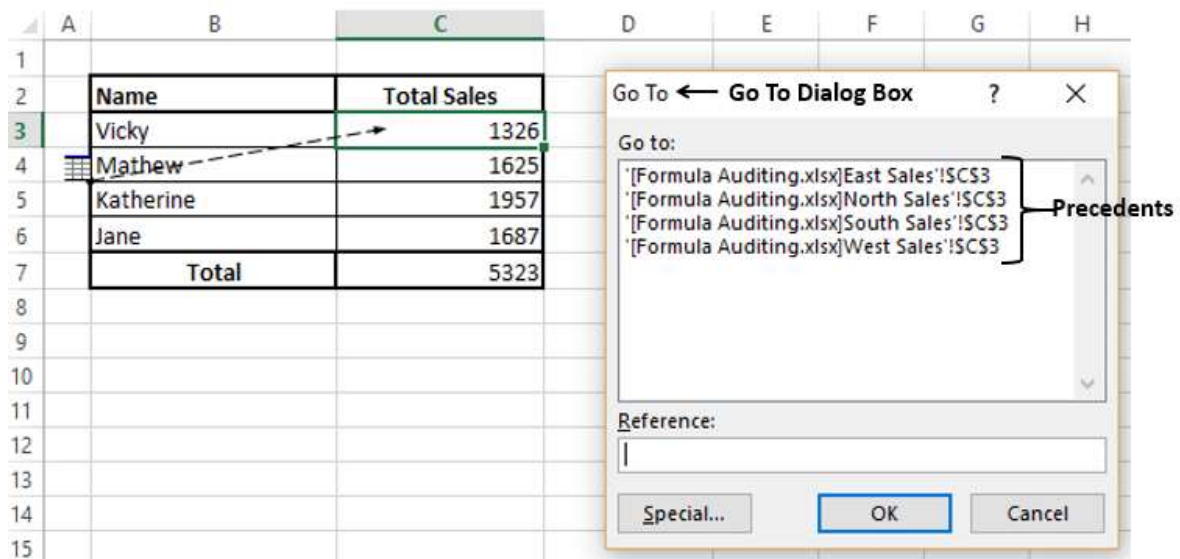
- Click in a cell under **TotalSales**.
- Click Trace Precedents. A worksheet icon appears at the end of the arrow. The worksheet icon indicates that the precedents are in a different worksheet.

The screenshot shows the same sales data table. An arrow points from the 'Total Sales' cell for Vicky (row 3, column C) to the 'Name' cell for Mathew (row 4, column B). A worksheet icon is shown at the end of the arrow, indicating that the precedent is in a different worksheet.

Name	Total Sales
Vicky	1326
Mathew	1625
Katherine	1957
Jane	1687
Total	5323

Double-click on the arrow. A **Go TO** dialog box appears, showing the precedents.





As you observe, there are four precedents, on four different worksheets.

- Click a reference of one of the precedents.
- The reference appears in the Reference box.
- Click OK. The worksheet containing that precedent appears.

## Evaluating a Formula

To find how a complex formula in a cell works step by step, you can use Evaluate Formula command.

Consider the formula NPV (Middle Year) in the cell C14. The formula is

**=SQRT (1+C2)\*C10**

- Click in the cell C14.
- Click the FORMULAS tab on the Ribbon.
- Click Evaluate Formula in the Formula Auditing group. The Evaluate Formula dialog box appears.



**FORMULAS**

**Evaluate Formula**

**Evaluate Formula Dialog Box**

**Formula Auditing**

Cell C14

Interest Rate	Cash Flows	
Time	Investment 1	Investment 2
1	-10000	-5000
2	25000	20000
3	-7000	-8000
<b>Total</b>	8000	7000
<b>NPV (End Year)</b>	4,976.85	5,092.59
<b>NPV (Beg. Year)</b>	5,972.22	6,111.11
<b>NPV (Middle Year)</b>	5,451.87	5,578.66

In the **Evaluate Formula** dialog box, the formula is displayed in the box under Evaluation. By clicking the **Evaluate** button several times, the formula gets evaluated step-wise. The expression with an underline will always be executed next.

**Evaluate Formula Dialog Box**

**Evaluate Formula**

Reference: NPV!\$C\$14

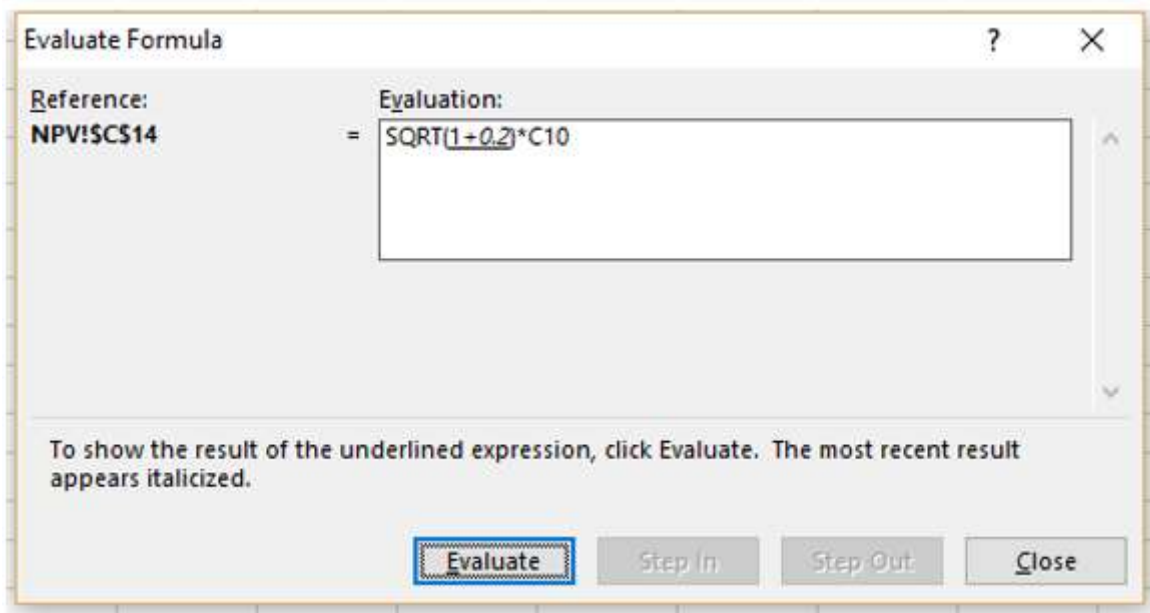
Evaluation: SQRT(1+C2)\*C10

**Formula**

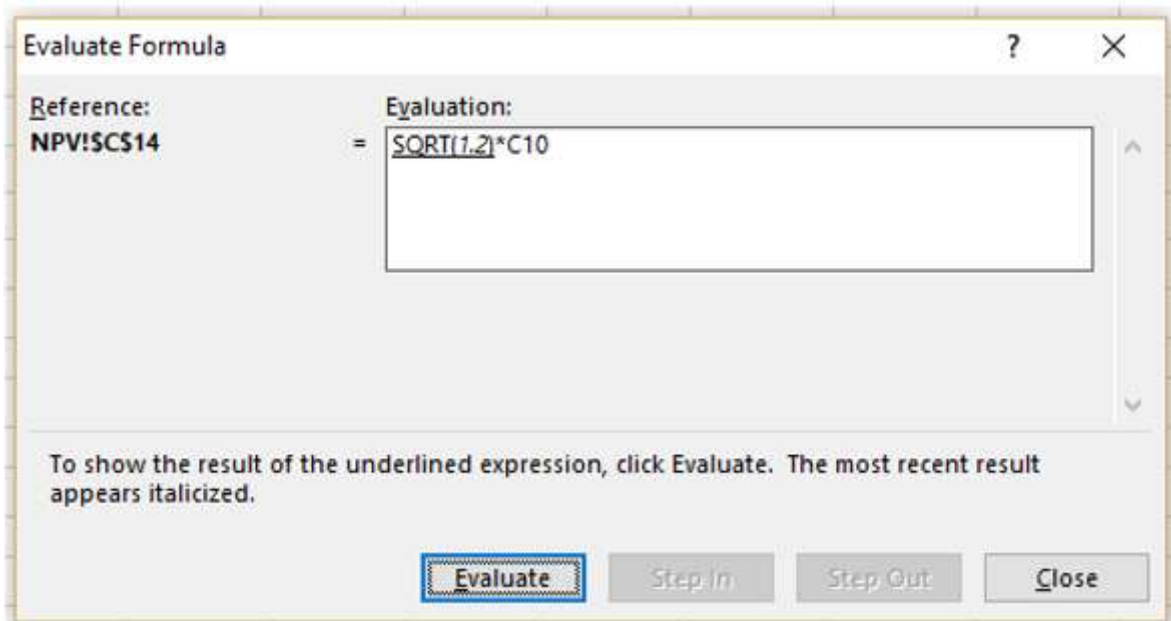
To show the result of the underlined expression, click Evaluate. The most recent result appears italicized.

**Evaluate** → **Evaluate** Step In Step Out Close

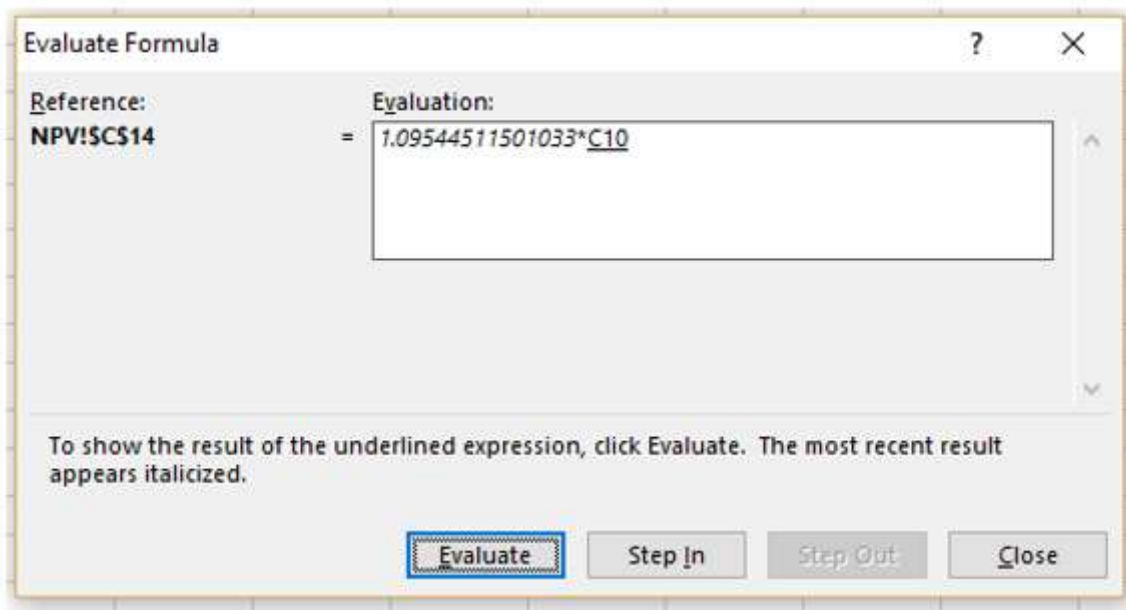
Here, C2 is underlined in the formula. So, it is evaluated in the next step. Click **Evaluate**.



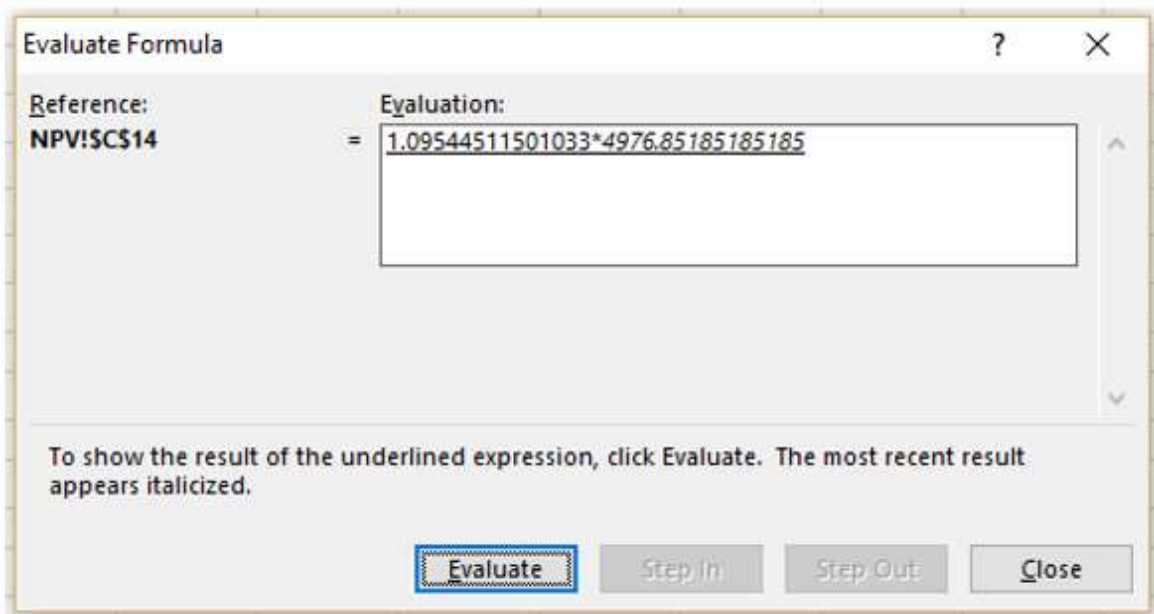
Cell C2 has value 0.2. Hence, C2 will be evaluated as 0.2. **1+0.2** is underlined showing it as the next step. Click **Evaluate**.



1+0.2 will be evaluated as 1.2. **SQRT(1.2)** is underlined showing it as next step. Click **Evaluate**.

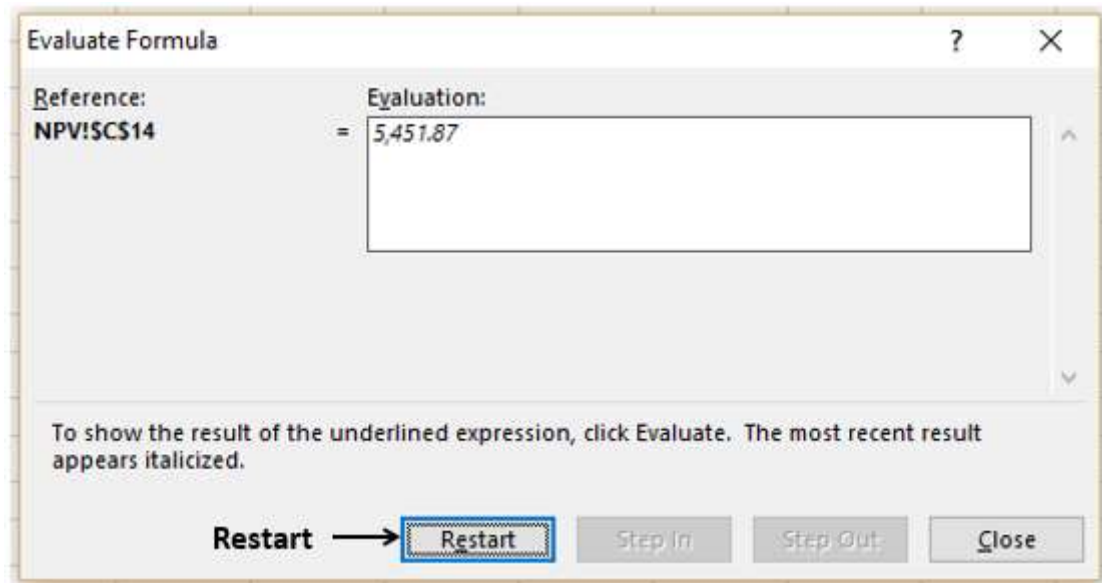


SQRT(1.2) will be evaluated as 1.09544511501033. **C10** is underlined showing it as next step. Click **Evaluate**.



C10 will be evaluated as 4976.8518518515.

1.09544511501033\*4976.8518518515 is underlined showing it as next step. Click **Evaluate**.



1.09544511501033\*4976.8518518515 will be evaluated as 5,451.87.

There are no more expressions to evaluate and this is the answer. The **Evaluate** button will be changed to **Restart** button, indicating completion of evaluation.

## Error Checking

It is a good practice to do an error check once your worksheet and/or workbook is ready with calculations.

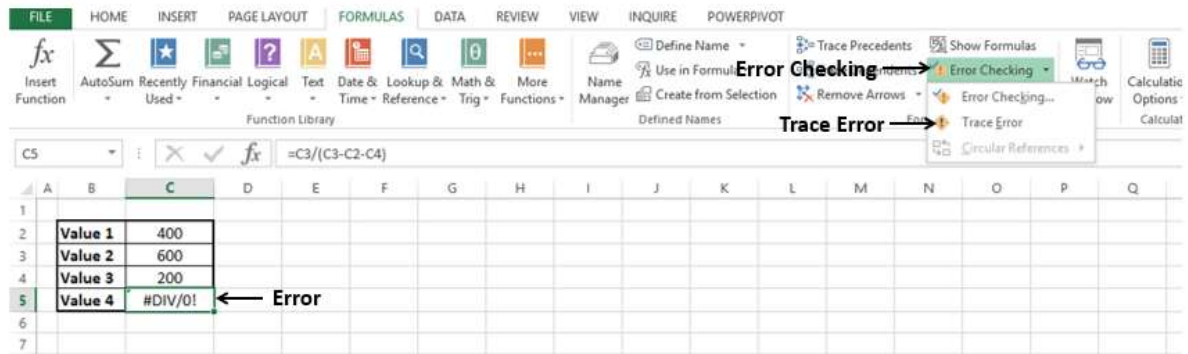
Consider the following simple calculations.

C5		:		=C3/(C3-C2-C4)			
	A	B	C	D	E	F	G
1							
2		Value 1	400				
3		Value 2	600				
4		Value 3	200				
5		Valu	#DIV/0!				
6							

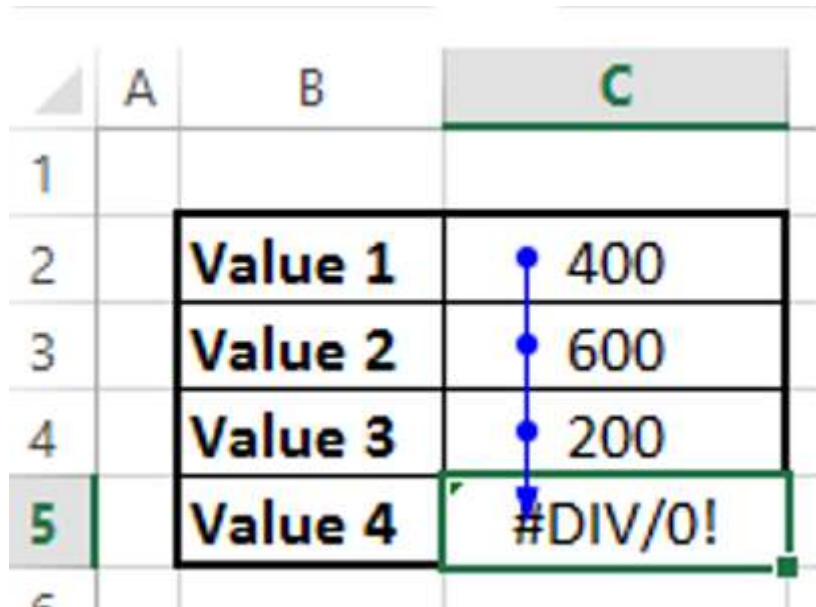
The calculation in the cell has resulted in the error #DIV/0!.

- Click in the cell C5.
- Click the FORMULAS tab on the Ribbon.

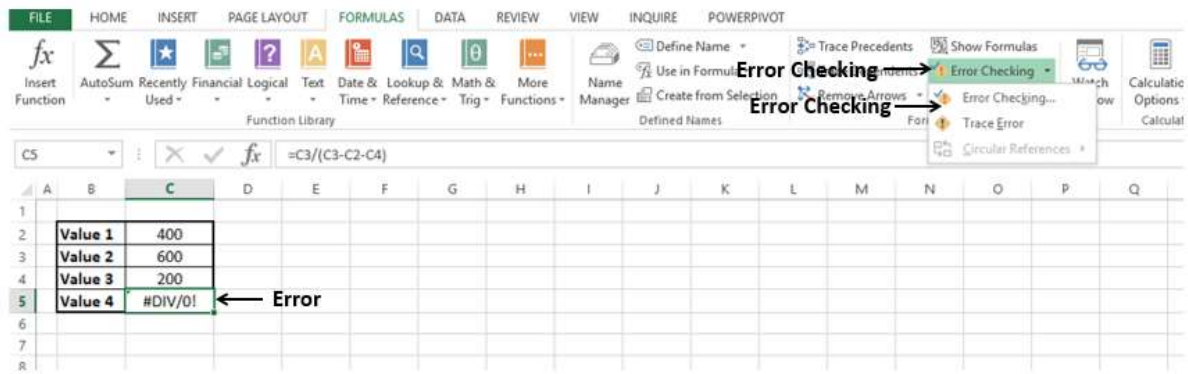
- Click the arrow next to Error Checking in the Formula Auditing group. In the drop-down list, you will find that **Circular References** is deactivated, indicating that your worksheet has no circular references.
- Select **Trace Error** from the drop-down list.



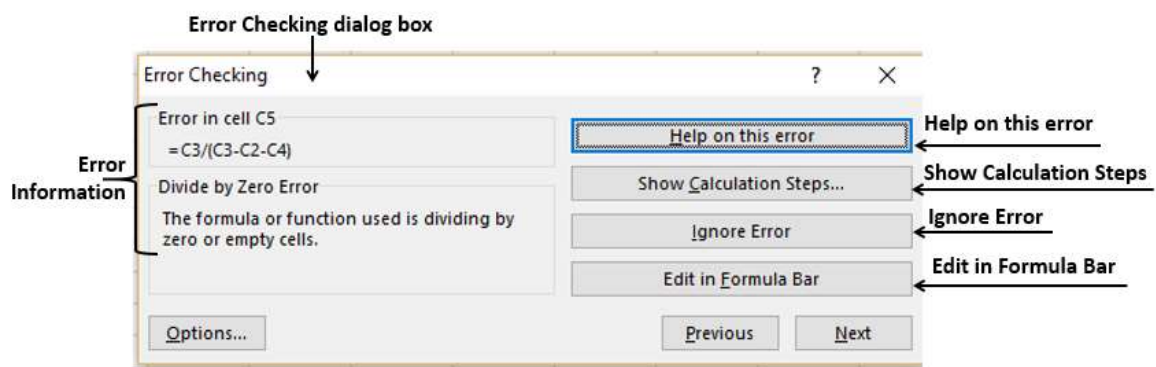
The cells needed to compute the active cell are indicated by blue arrows.



- Click Remove Arrows.
- Click the arrow next to Error Checking.
- Select Error Checking from the drop-down list.



The **Error Checking** dialog box appears.



Observe the following-

- If you click **Help on this error**, Excel help on the error will be displayed.
- If you click **Show Calculation Steps**, Evaluate Formula dialog box appears.
- If you click **Ignore Error**, the Error Checking dialog box closes and if you click **Error Checking** command again, it ignores this error.
- If you click **Edit in Formula Bar**, you will be taken to the formula in the formula bar, so that you can edit the formula in the cell.



# 21. Inquire

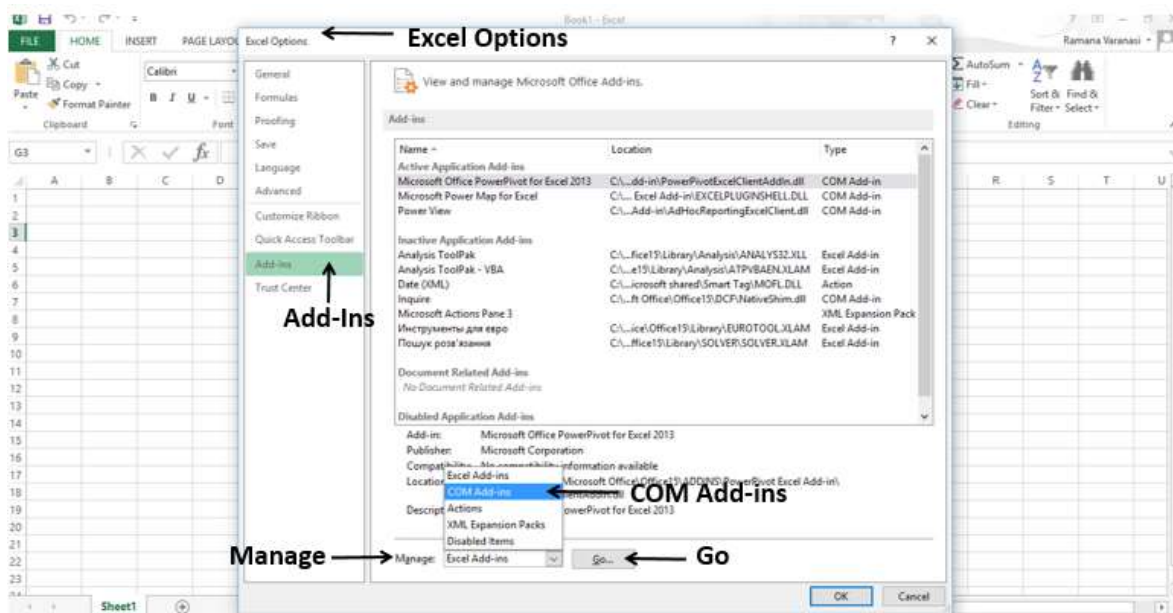
You can use Inquire to-

- Compare two workbooks.
- Analyze a workbook for problems or inconsistencies.
- View the links between workbooks.
- View the links between worksheets.
- View the relationships between cells.
- Clean excess cell formatting.
- Manage passwords.

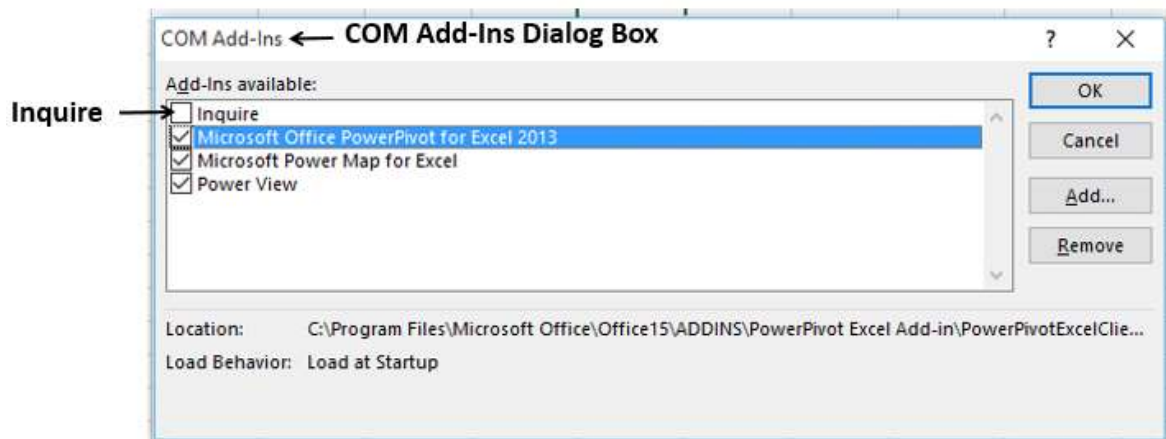
The INQUIRE tab will be on the Ribbon. If you find the INQUIRE tab on the Ribbon, you can skip to the next section.

If you do not find the INQUIRE tab on the Ribbon, make the Inquire Add-in active.

- Click **File > Options**.
- In Excel Options window, click on Add-Ins.
- In Manage box, click on COM Add-ins.
- Click Go.



COM Add-Ins dialog box appears.



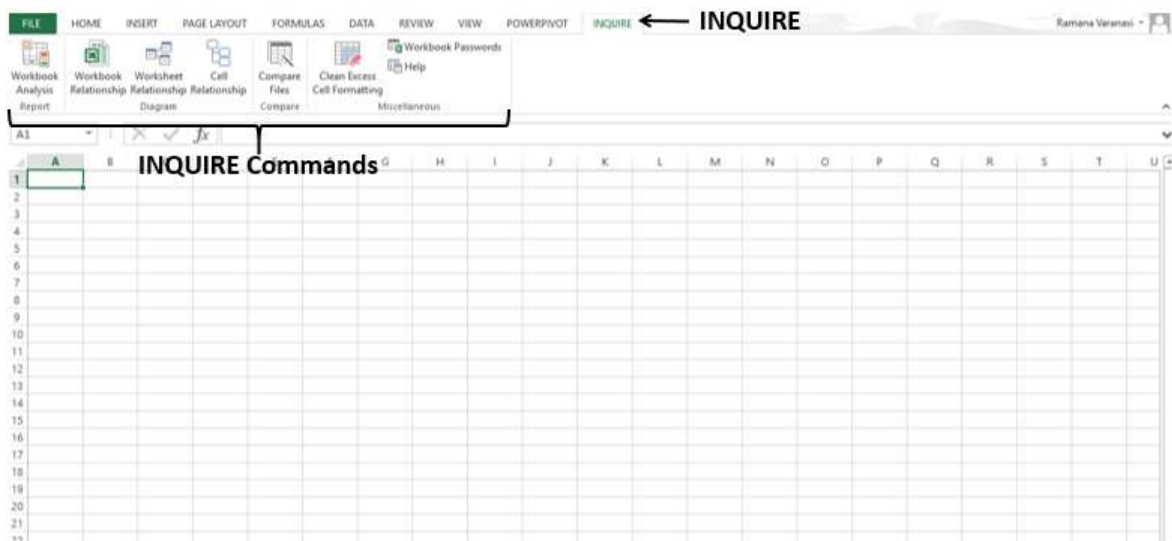
- Check the Inquire box.
- Click OK. Now, Inquire Add-In is active. You will find the INQUIRE tab on the Ribbon.

## INQUIRE Commands

Let us learn about the INQUIRE commands.

Click the INQUIRE tab. You will find the following commands-

- Workbook Analysis
- Workbook Relationship
- Worksheet Relationship
- Cell Relationship
- Compare Files
- Clean Excess Cell Formatting
- Workbook Passwords

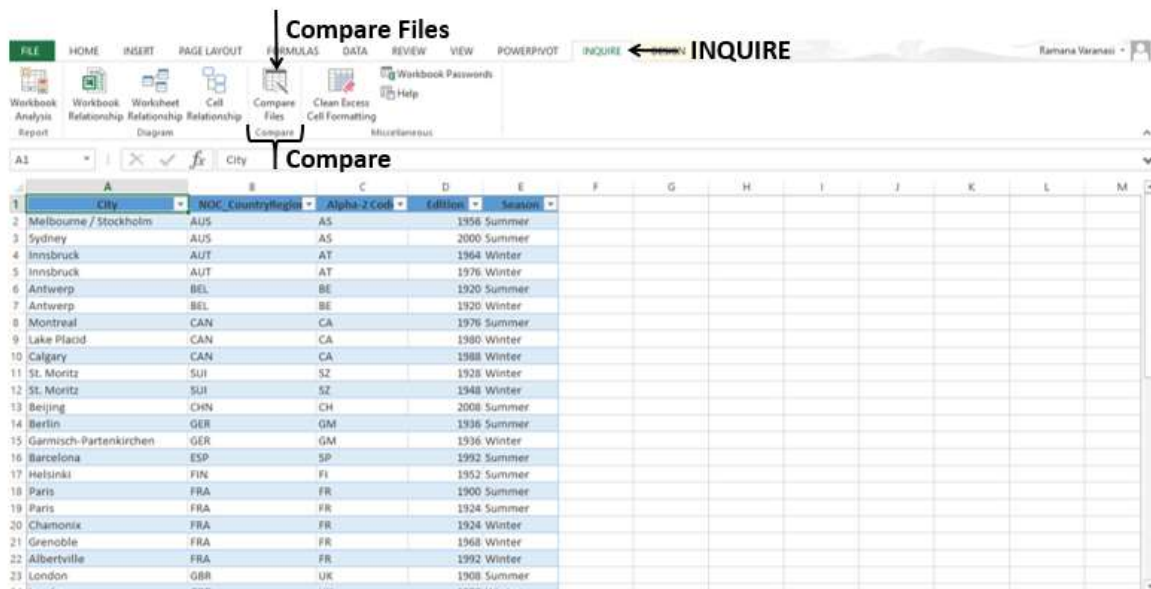


## Comparing Two Workbooks

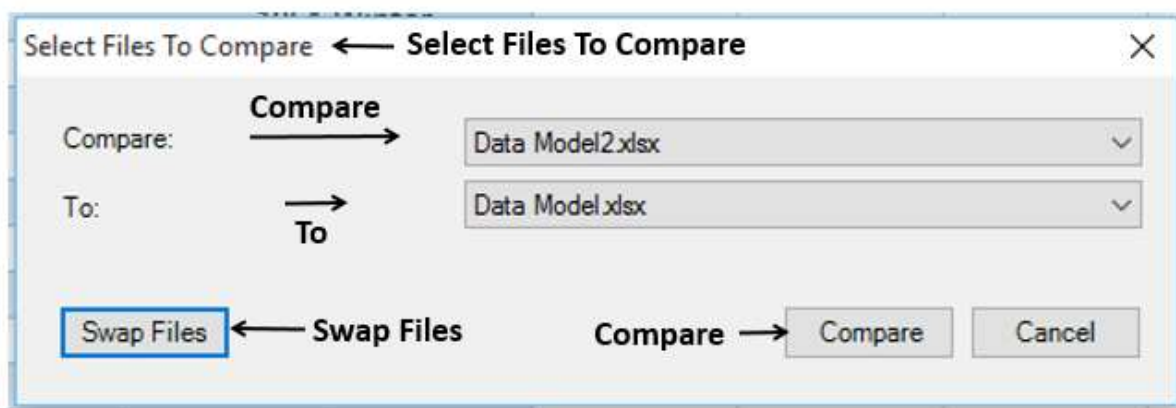
You can compare two workbooks cell by cell and find the differences, if any, in terms of changes in the second workbook as compared to the first.

Follow the below given steps-

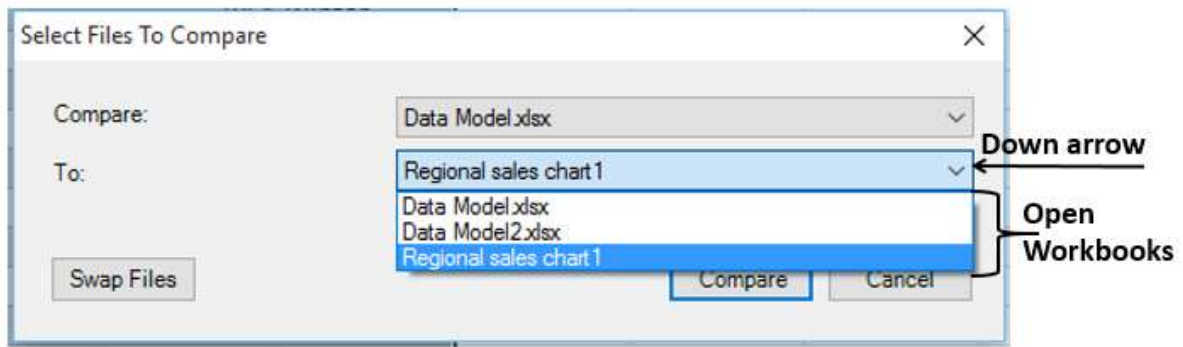
- Open two workbooks that you want to compare.
- Click on INQUIRE tab on the Ribbon.
- Click on Compare Files in the Compare group.



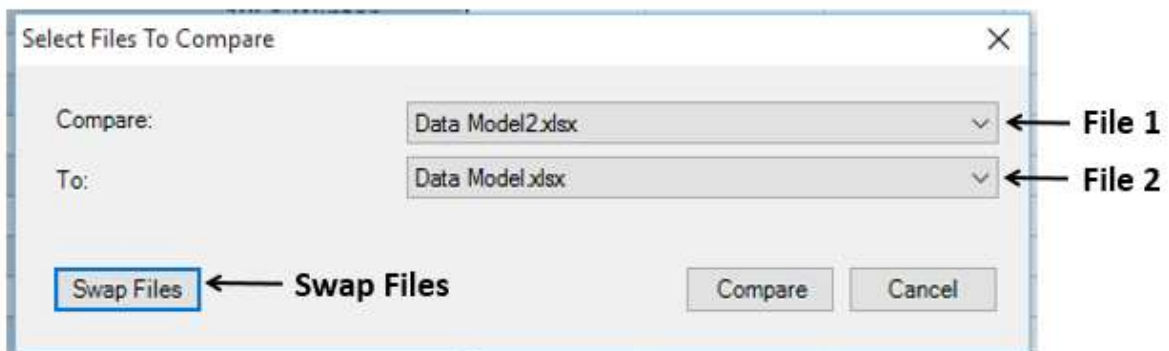
- The **Select Files To Compare** dialog box appears.
- Check the file names displayed in the boxes next to **Compare** and **To**.



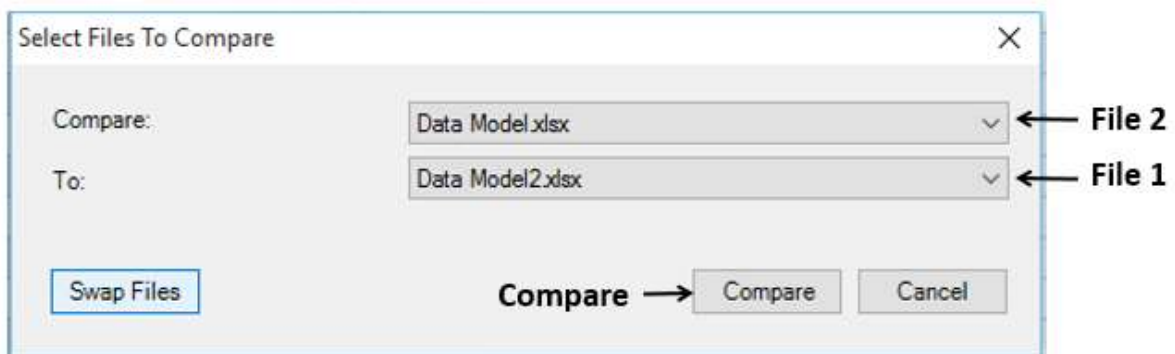
- If any File name that is displayed is not the one you wanted, click the down-arrow next to that File name.
- Only the workbooks that are open will be displayed.



- Select the File.
- Check if the order of Files in Compare and To is OK.



- If the order is not OK, click **Swap Files**. The order of Files in Compare and To gets changed.
- Click Compare.



The results of the comparison appear in a two-pane grid-

- The workbook on the left corresponds to the "Compare" file you have chosen.
- The workbook on the right corresponds to the "To" file you have chosen.

Details of changes in workbook-To as compared to Workbook-Compare appear in a pane below these two grids. The changes are highlighted by color, depending on the kind of change. The legend for the highlight colors appears in the lower-left pane.

**Workbook - Compare**

**Workbook - To**

**Details of Changes**

**Legend**

**Changes highlighted by color**

Ready - File 1: [Data Model.xlsx] - File 2: [Data Model2.xlsx] - Total Displayed Items: 26343

Click **Resize Cells to Fit** on the Ribbon to view the cell contents in the Compare and To workbooks. The cells in both the workbooks are resized so that the contents are visible.

**Workbook - Compare**

**Workbook - To**

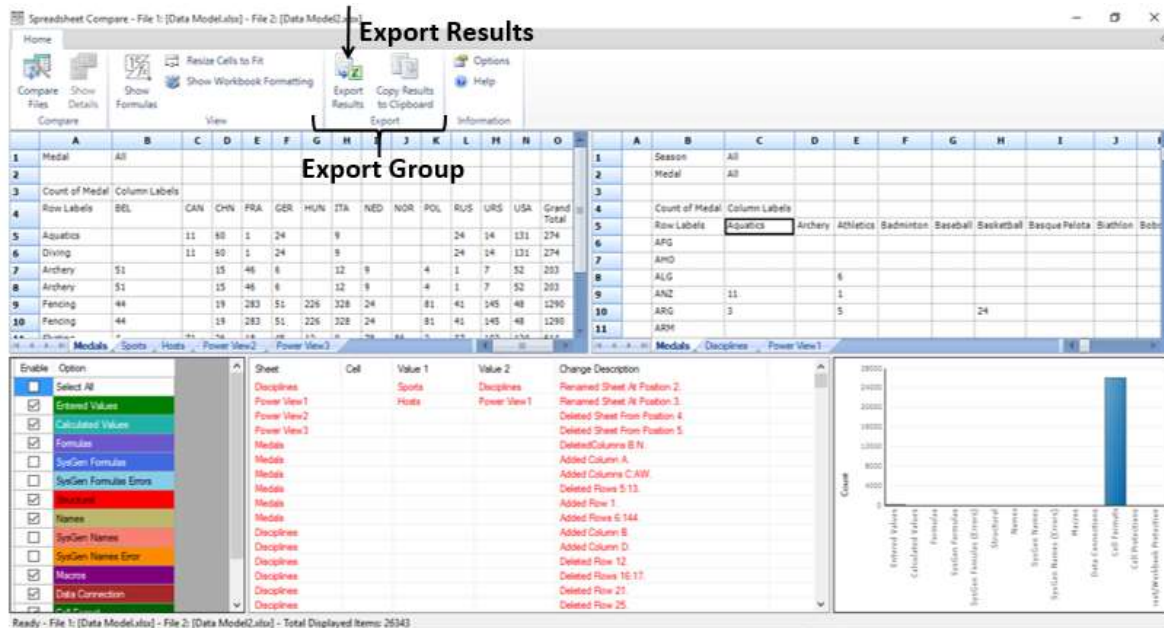
**Resize Cells to Fit**

**Resized Cells**

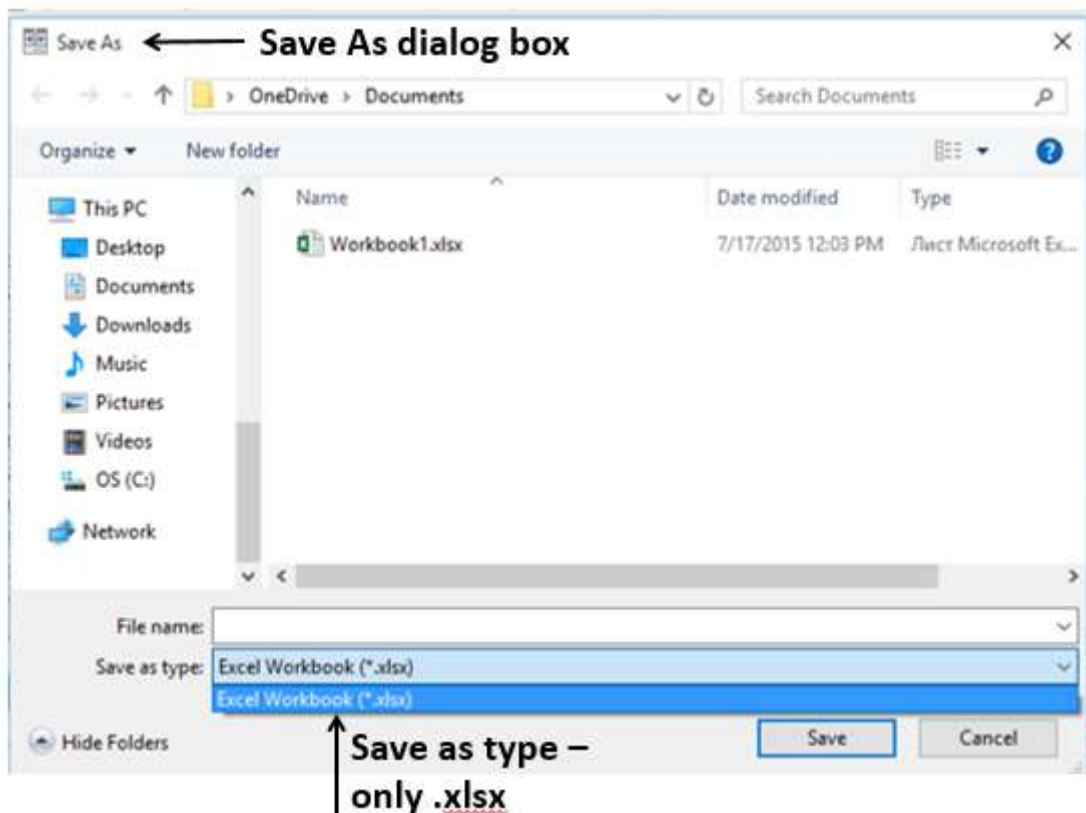
Ready - File 1: [Data Model.xlsx] - File 2: [Data Model2.xlsx] - Total Displayed Items: 26343



Click the Export Results in the Export group on the Ribbon.

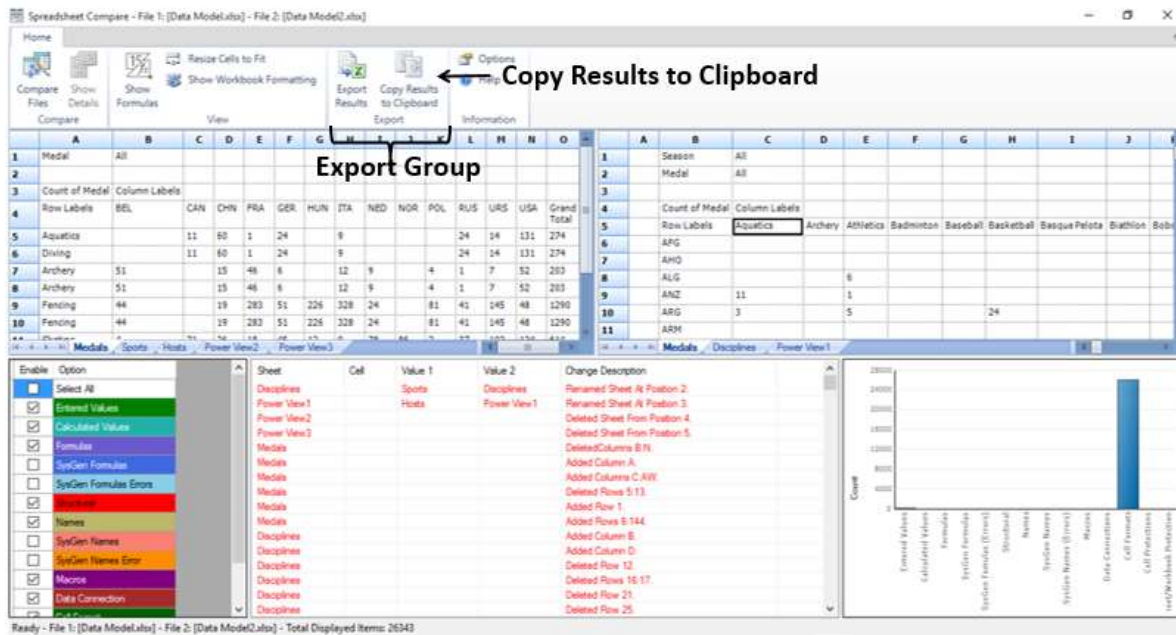


The Save As dialog box appears. You can save the results to an Excel workbook. Note that only .xlsx file type is available.





If you need the results in another application, you can do it by copying it to Clipboard. Click Copy Results to Clipboard in the Export group on the Ribbon.

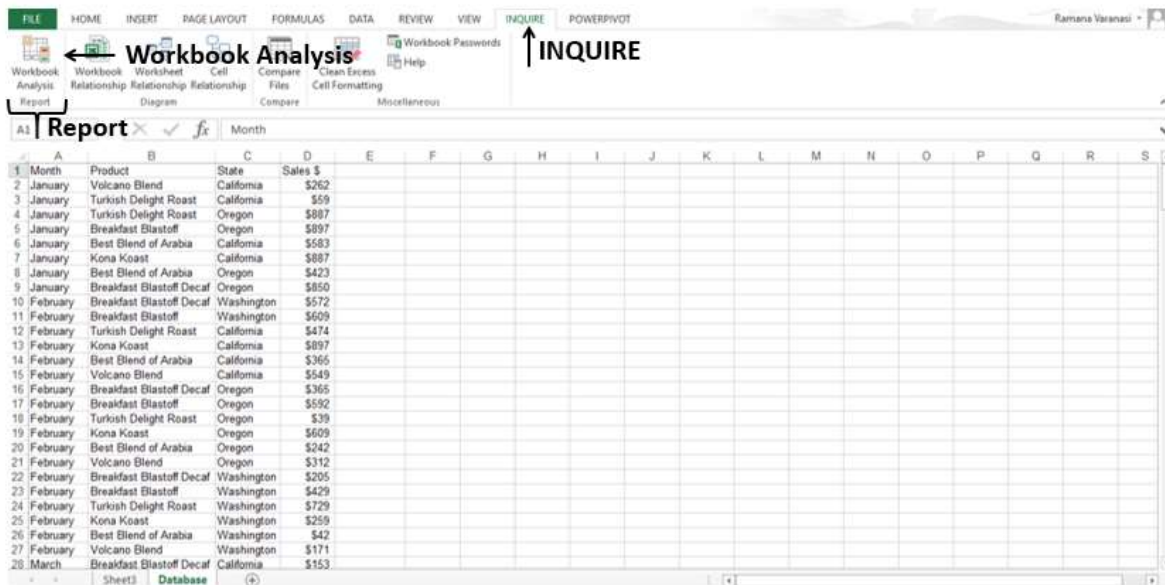


Paste in an application you want.

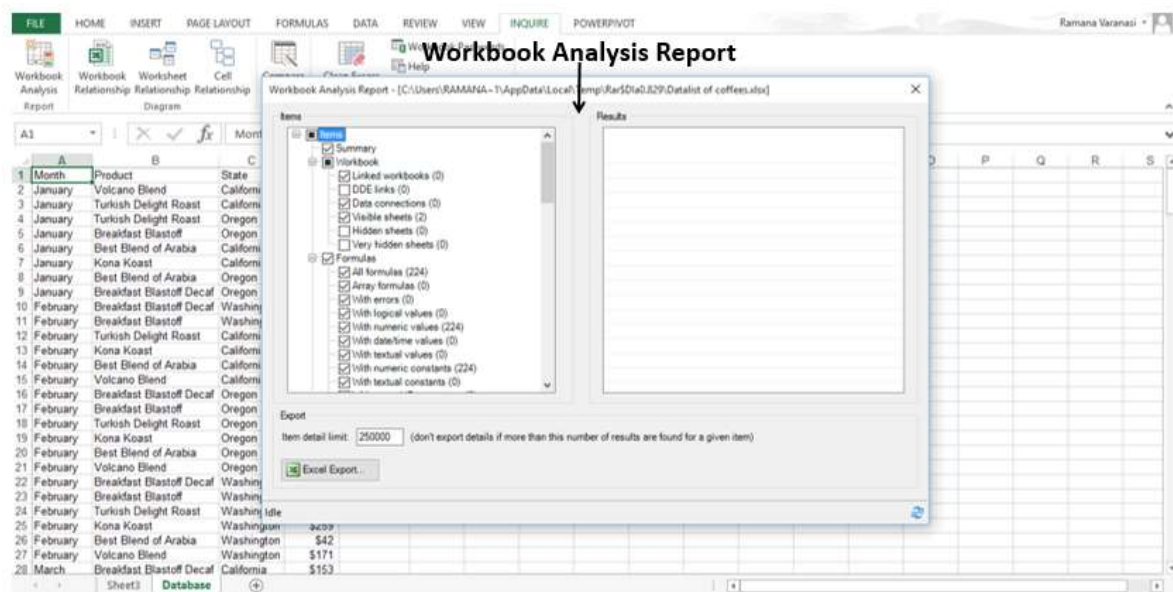
## Creating an Interactive Report

You can use the **Workbook Analysis** command to create an interactive report that can show detailed information about the workbook and its Structure, Formulas, Cells, Ranges and Warnings.

- Click the Inquire tab on the Ribbon.
- Click Workbook Analysis in the Report group.



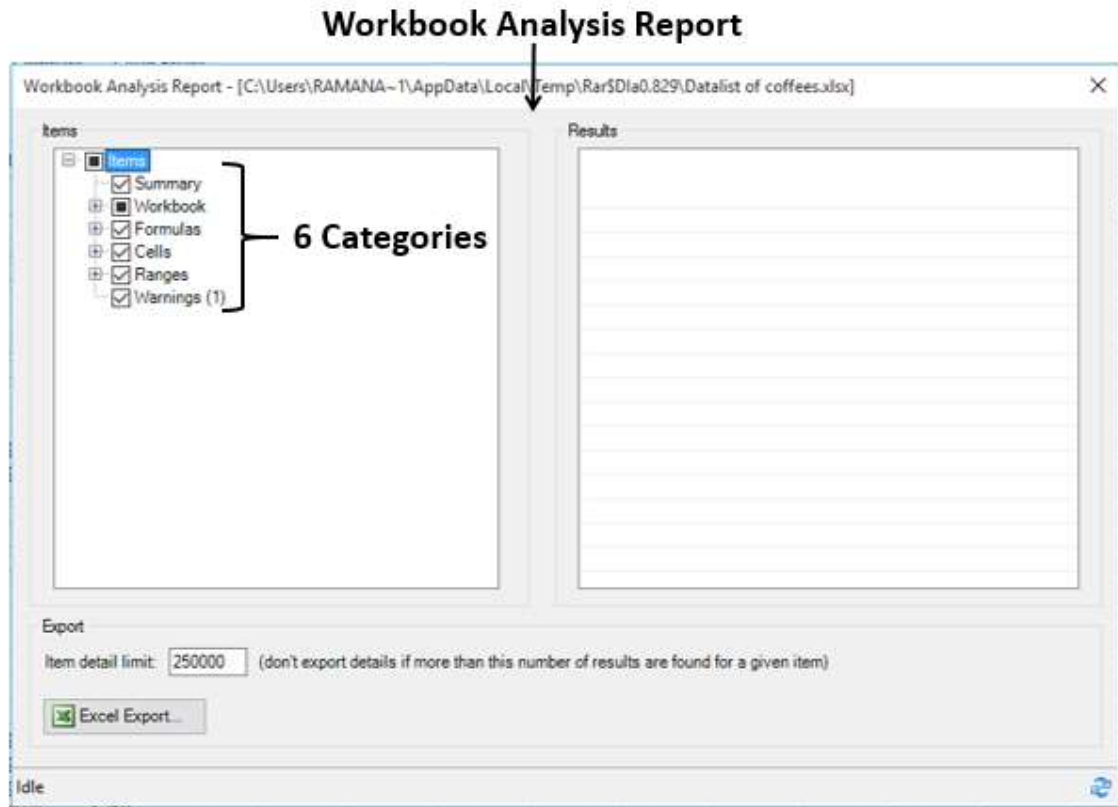
The report will be displayed after the Workbook Analysis is completed.



The Report has the following six categories-

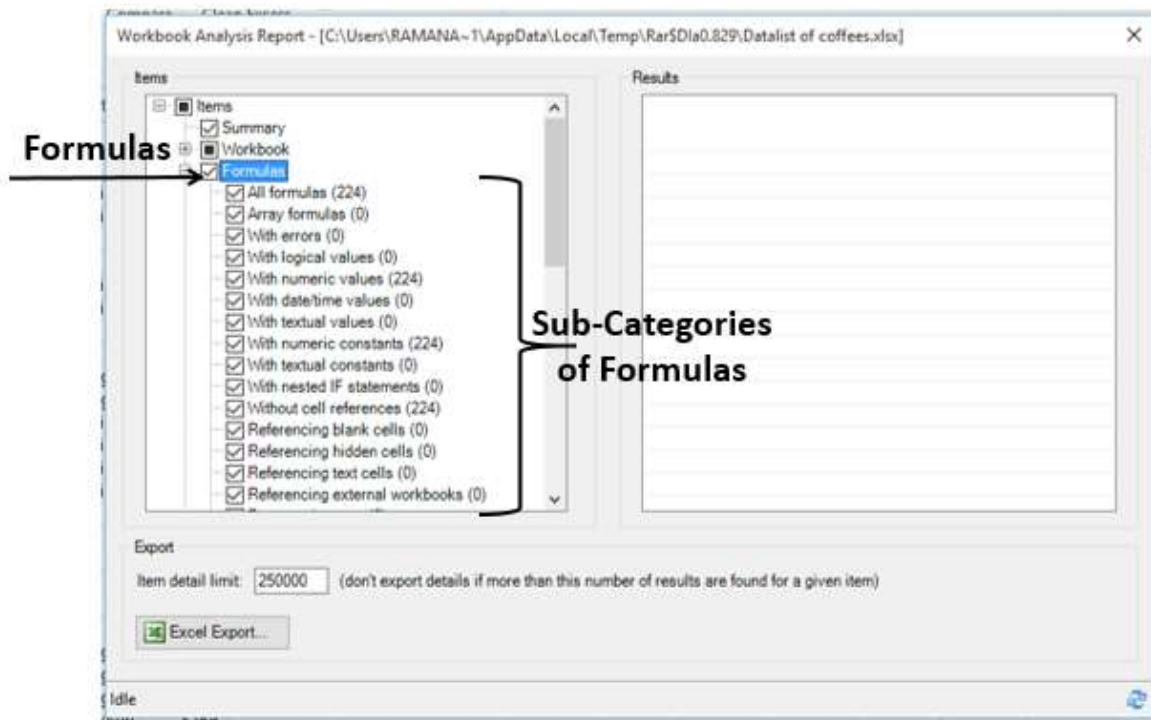
- **Summary:** General information about the structure and content of the workbook.
- **Workbook (with subcategories):** General workbook statistics.
- **Formulas (with subcategories):** Specific information about formulae in the workbook.
- **Cells (with subcategories):** Specific information about cells in the workbook.

- **Ranges (with subcategories):** Specific information about ranges in the workbook.
- **Warnings:** Several types of warnings about workbook structure and content.



Selecting a category gives you more information about that category.

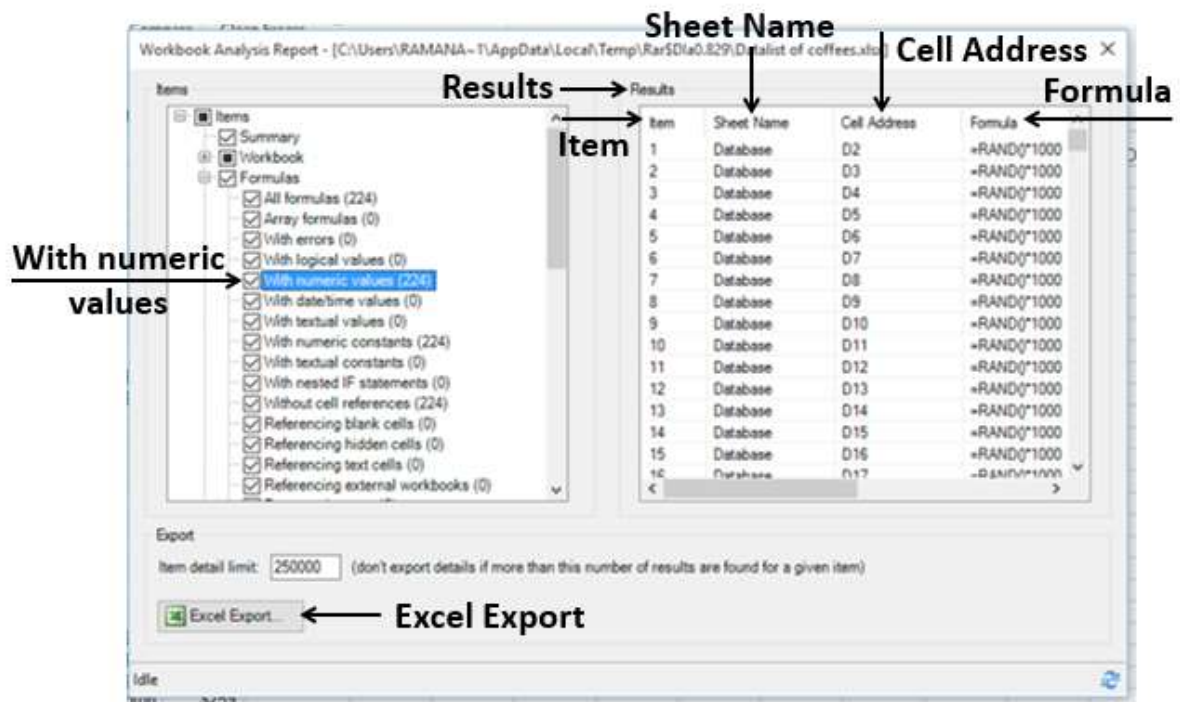
Check the Formulas option. The sub-categories of formulas will be displayed.



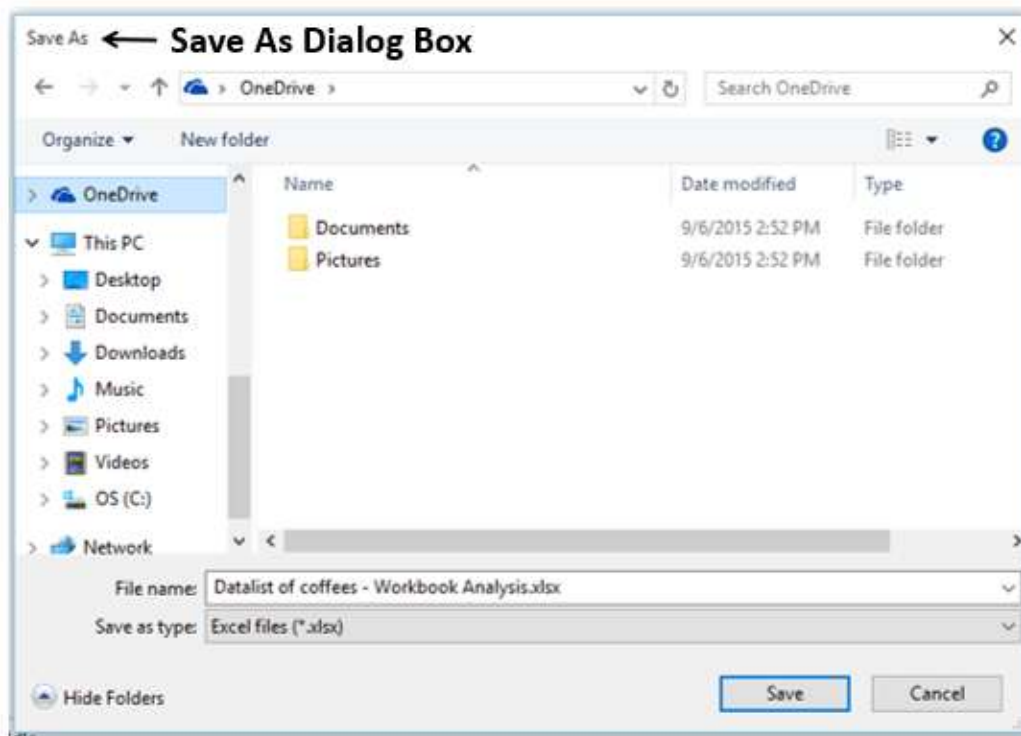
You will observe the following in the workbook that you are analyzing-

- All formulas are 224 in number.
- With numeric values, they are 224 in number.
- Click Sub-Category With numeric values.

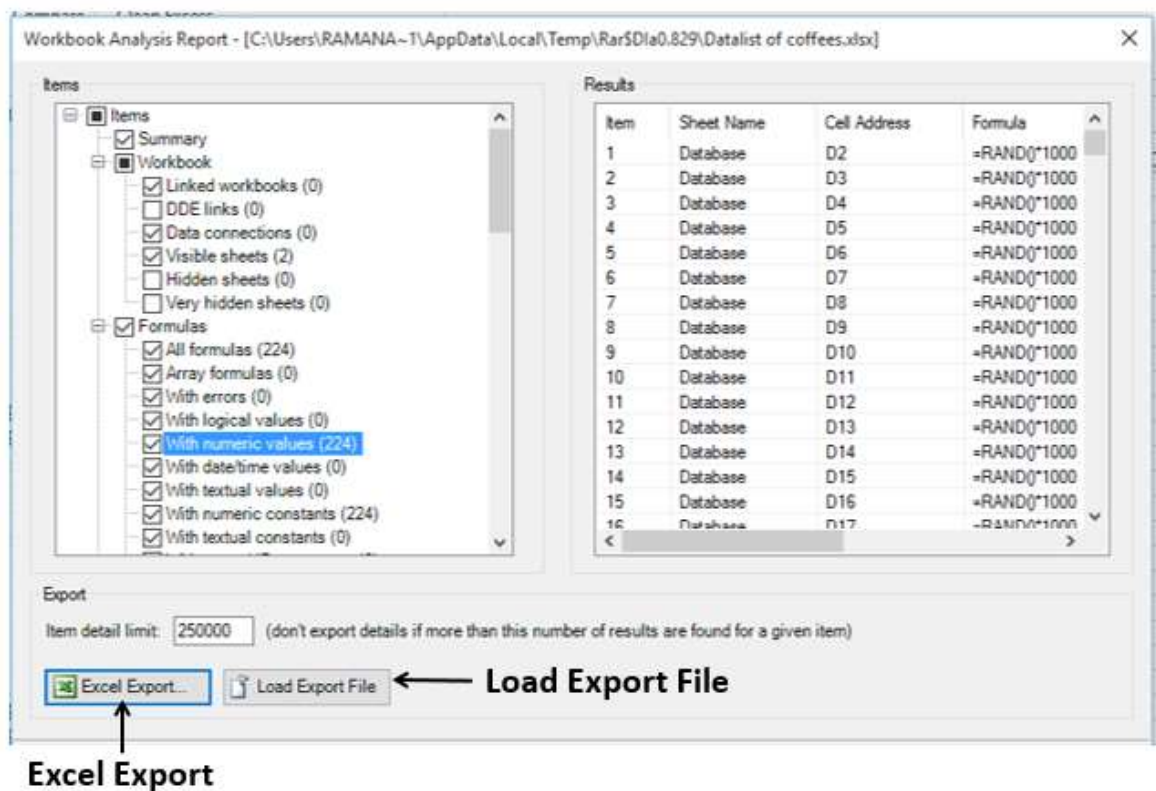
In the Results pane, for each of the cells with formula with numeric values, worksheet name, cell address and formula are displayed.



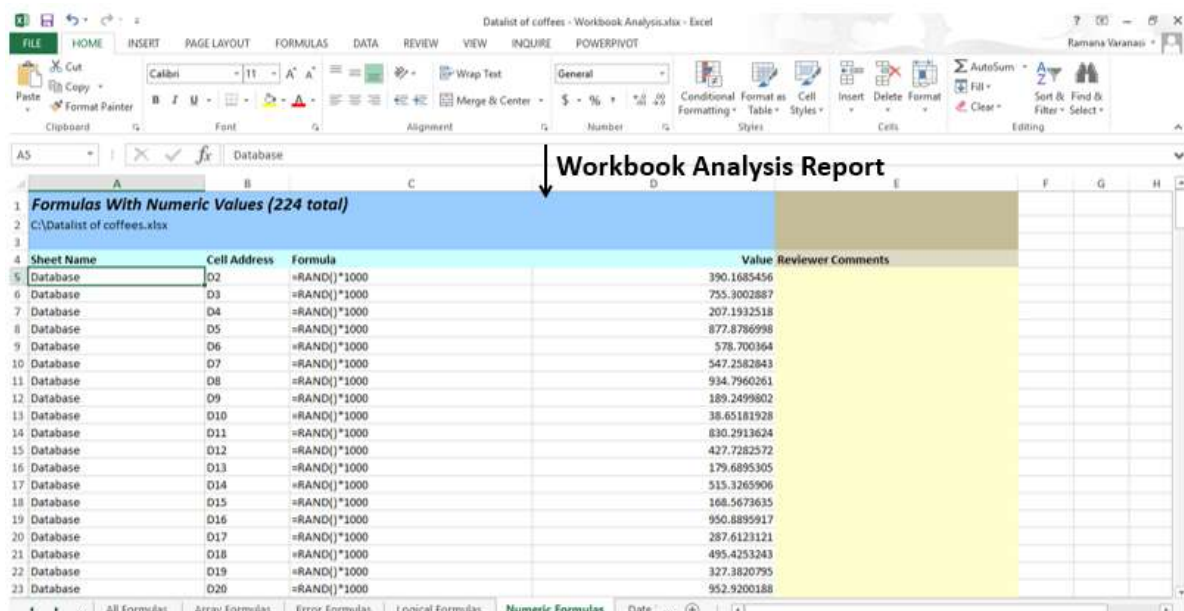
Click the Excel Export button. The Save As dialog box appears.



- Save the Report as an Excel file.
- Load Export File button appears next to Excel Export button.
- Click on Load Export File button.



The saved Report Excel workbook opens and you can clearly view the workbook analysis results.





## Viewing with Diagrams

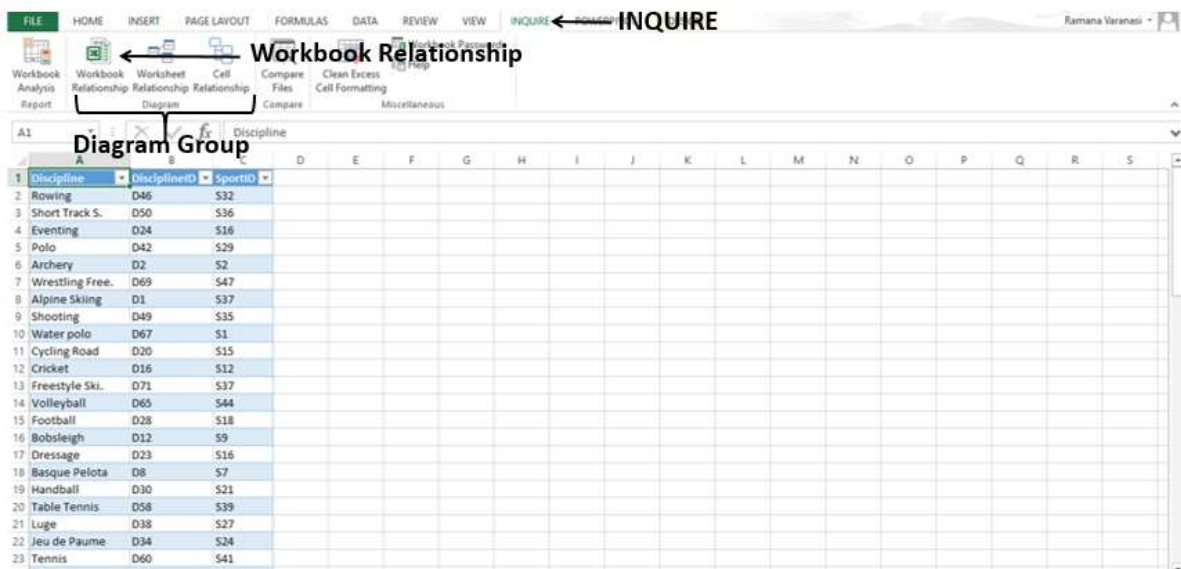
You can view workbook relationships, worksheet relationships and cell relationships with interactive diagrams created by links. The links show the dependencies between the nodes in the diagram. You can drag the links or nodes to arrange them and align them to view whatever you are looking for.

## Viewing Workbook Relationships

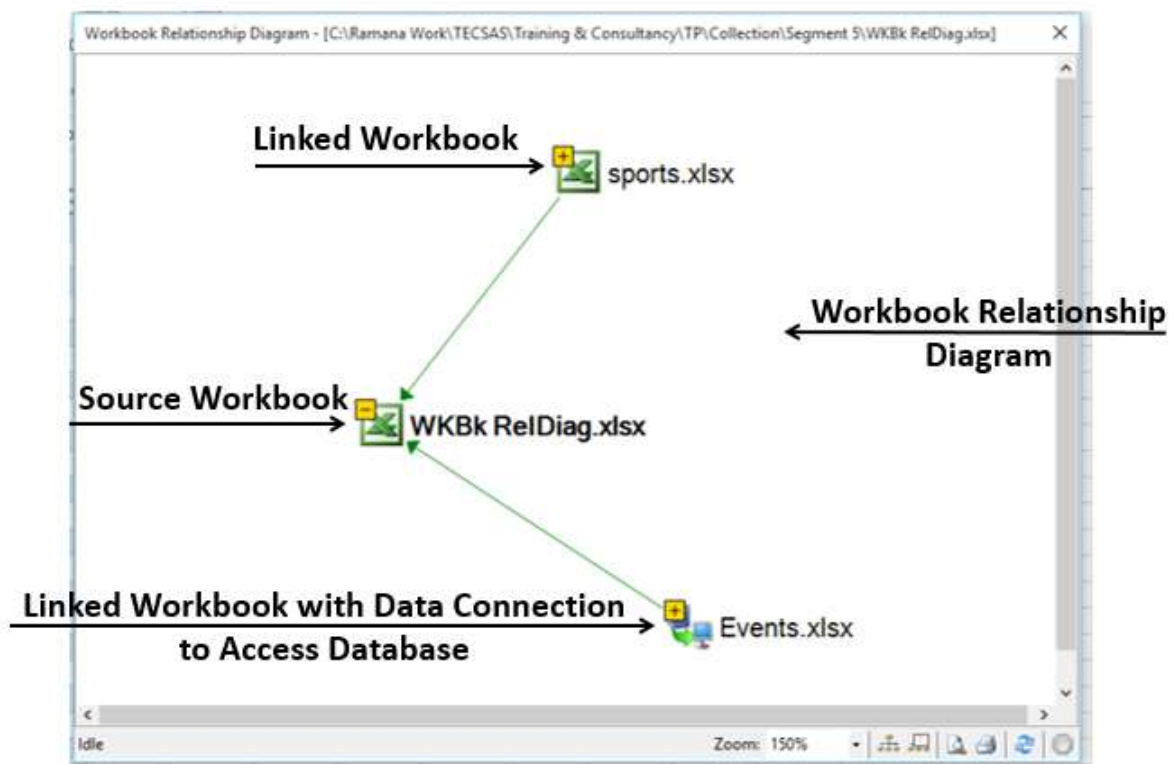
You can have an interactive, graphical map of workbook dependencies created by connections (links) between files using workbook relationship diagram.

The types of links in the diagram can include other workbooks, Access databases, text files, HTML pages, SQL Server databases and other data sources.

- Click the INQUIRE tab on the Ribbon.
- Click Workbook Relationship in the Diagram group.



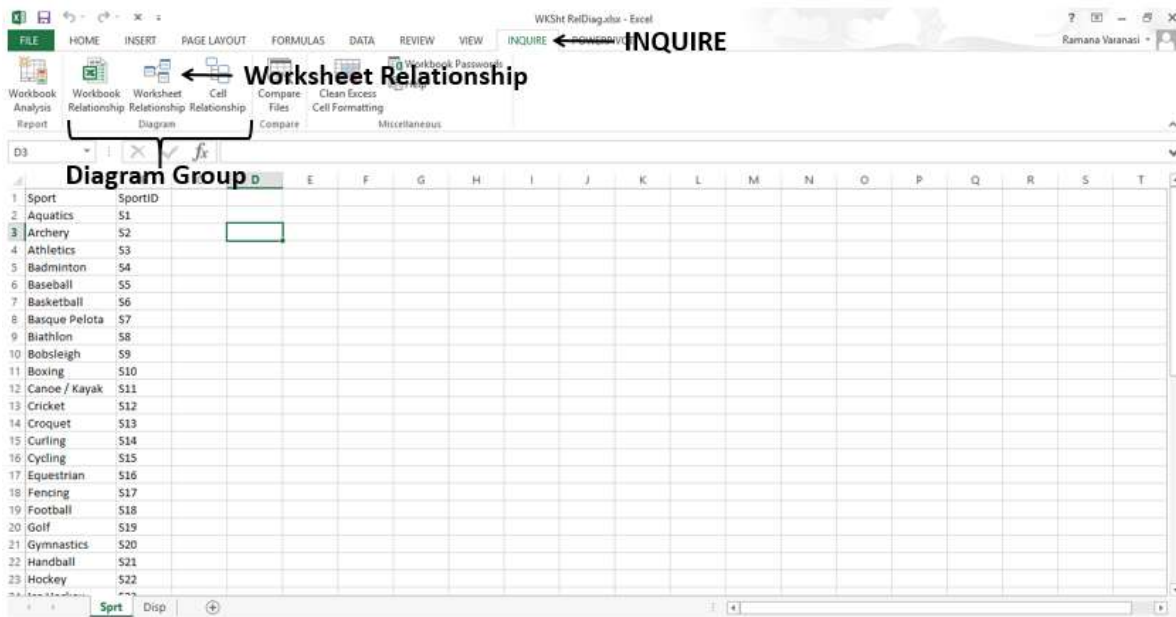
The Workbook Relationship Diagram appears, showing links of the workbook with different Data Sources.



## Viewing Worksheet Relationships

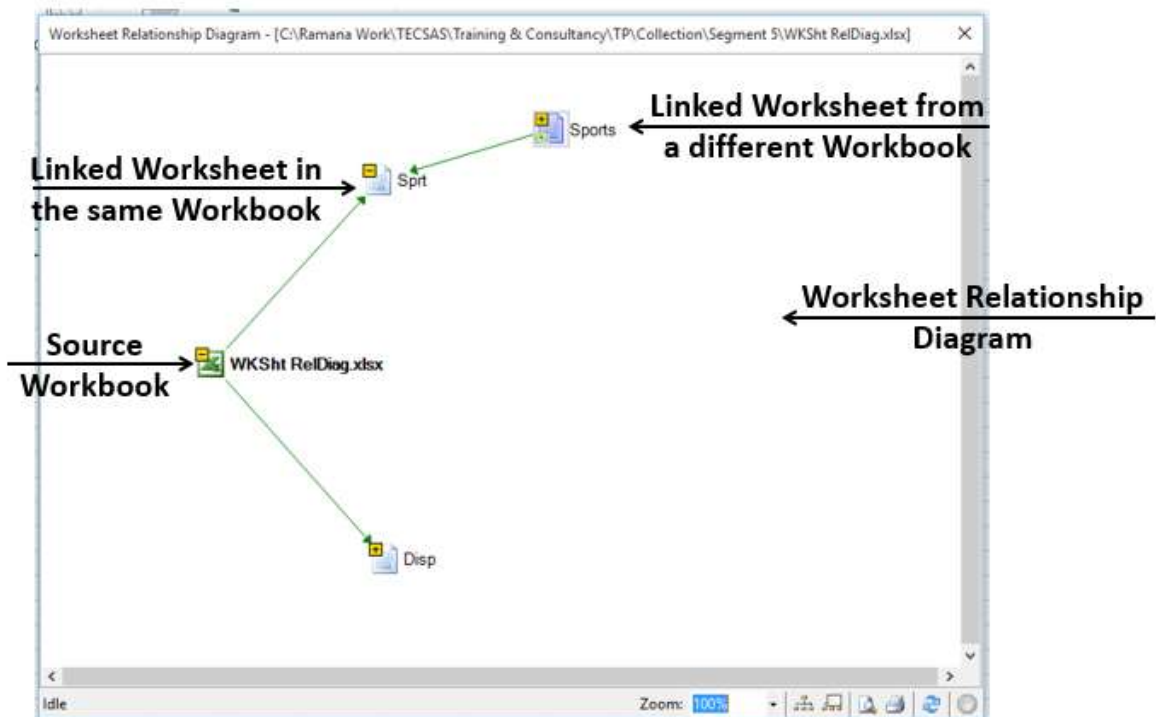
You can use Worksheet Relationship Diagram to create an interactive, graphical map of connections (links) between worksheets in the same workbook and /or worksheets in other workbooks.

- Click the INQUIRE tab on the Ribbon.
- Click Worksheet Relationship in the Diagram group.



The Worksheet Relationship Diagram appears, showing links between the worksheets in the same workbook, and in other workbooks.

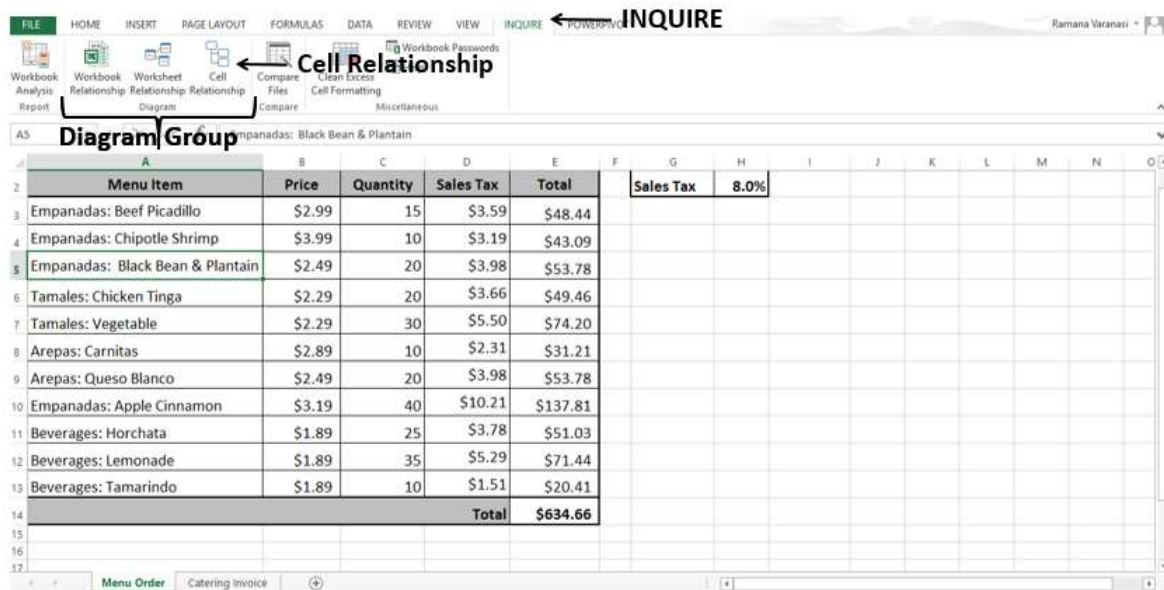
The difference between these two can be identified by the direction of the arrows.



## Viewing Cell Relationships

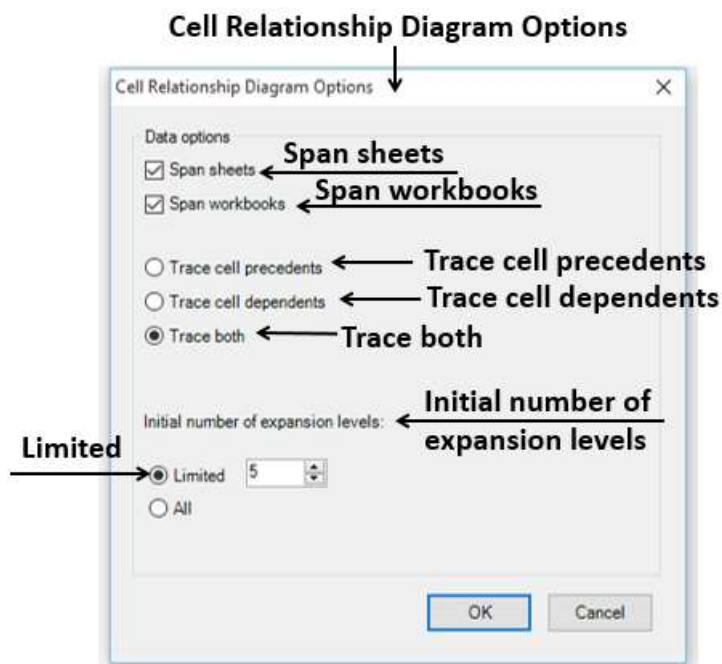
You can use the Cell Relationship Diagram to get a detailed, interactive map of all links from a selected cell to cells in other worksheets or even other workbooks.

- Click the INQUIRE tab on the Ribbon.
- Click Cell Relationship in the Diagram group.

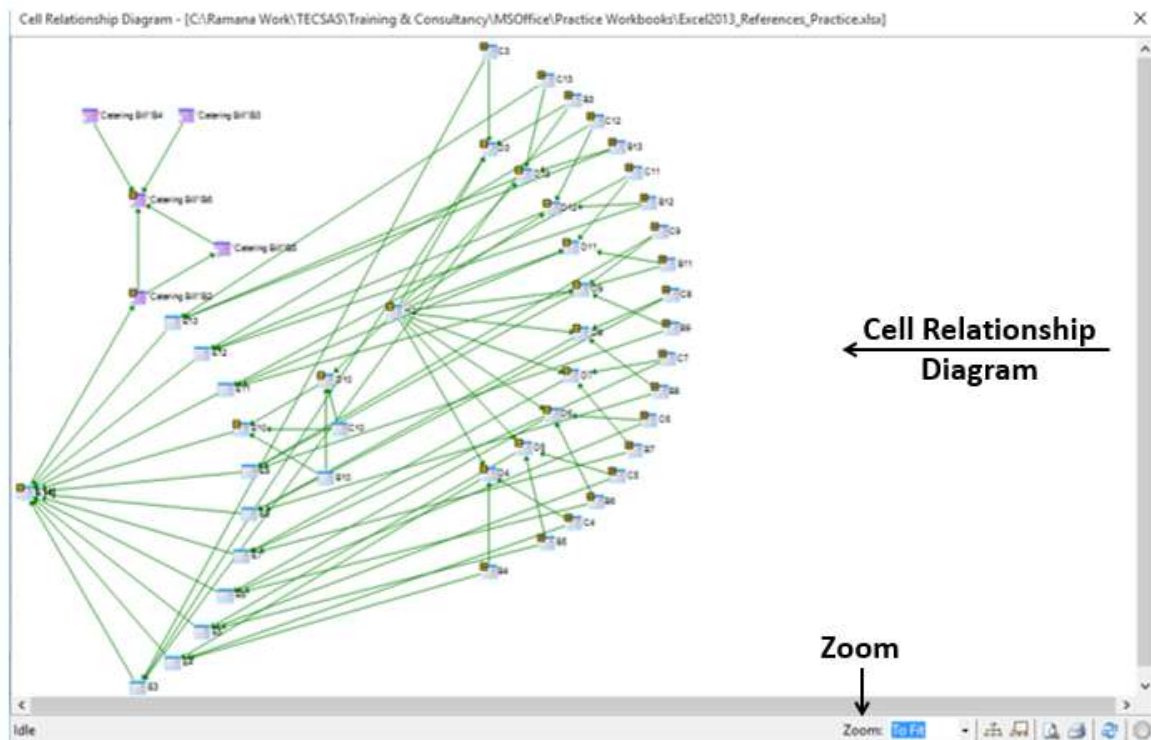


The Cell Relationship Diagram Options dialog box appears.

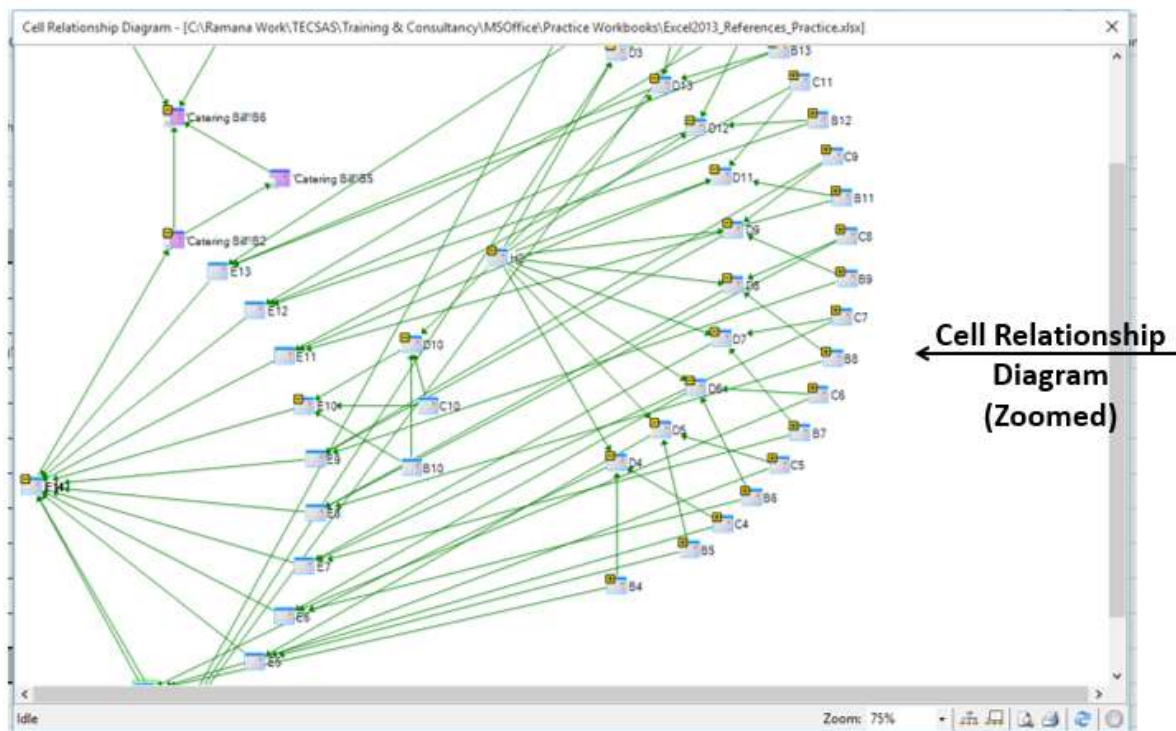
- Check Span sheets and Span workbooks.
- Select Trace both under Trace cell precedents and Trace cell dependents.
- Under Initial number of expansion levels, select **limited** and type 5 in the box next to it.
- Click OK.



The Cell Relationship Diagram appears, showing links between the selected cell and the cells in the same worksheet, same workbook and in other workbooks, based on the options you have chosen.



Click Zoom. You can view the nodes clearly.



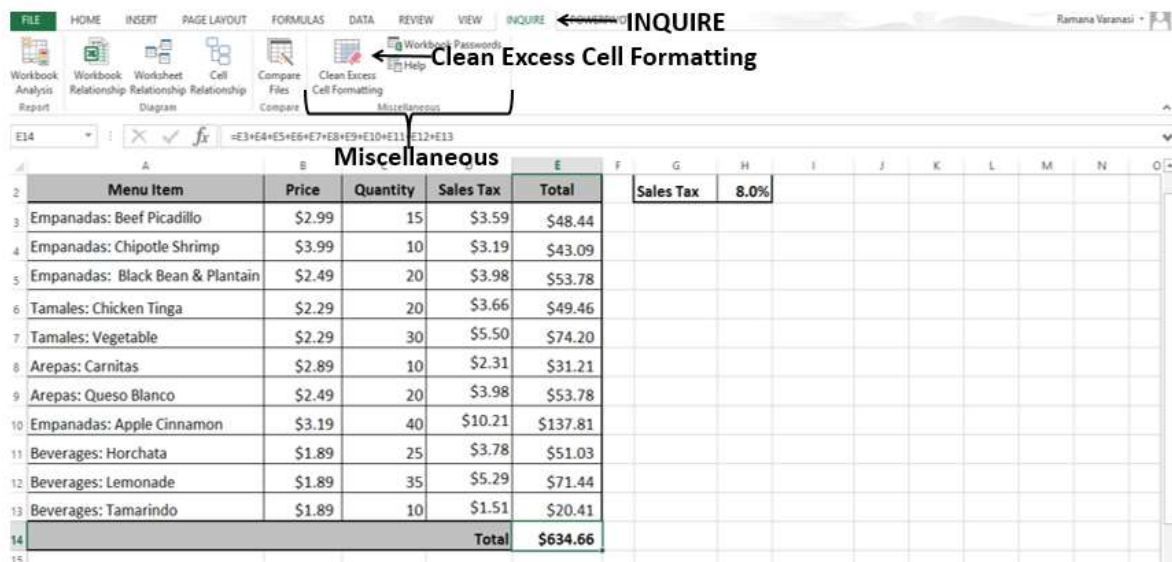
## Cleaning Excess Cell Formatting

When you find that a workbook is getting loaded slowly, or has become huge in size, it might have formatting applied to rows and/or columns that is not needed (for example, conditional formatting an entire column that has less than 15 values).

You can use the Clean Excess Cell Formatting command to remove excess formatting and greatly reduce the file size. This also results in improving Excel's speed.

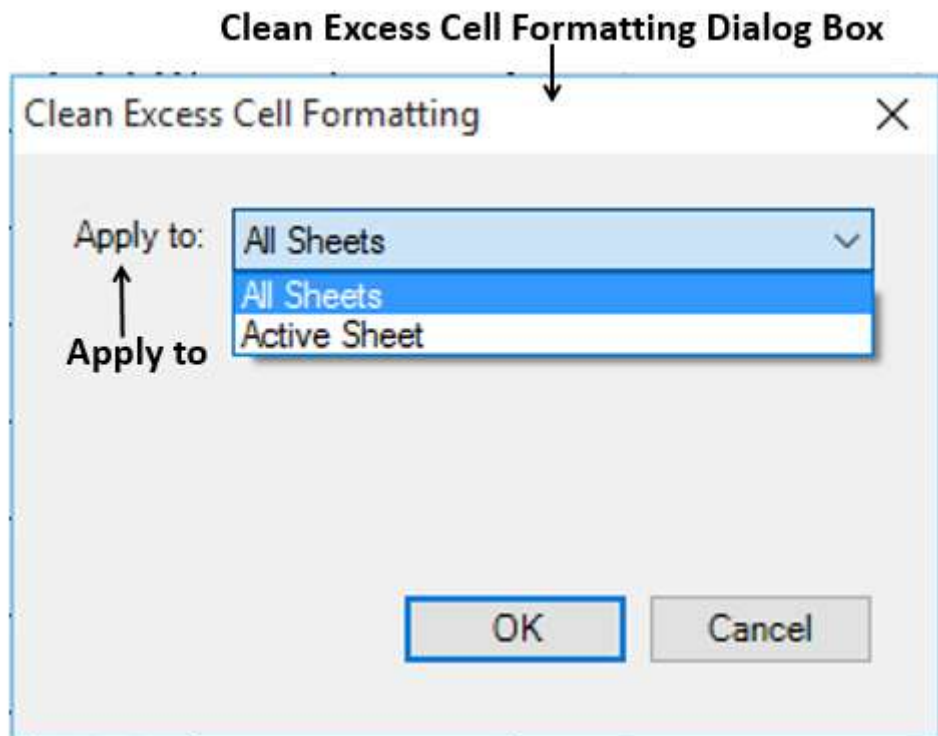
Before cleaning the excess cell formatting, create a backup copy of your Excel file because there are certain cases where this process may increase your file size, and there is no way to undo the change.

- Click the INQUIRE tab on the Ribbon.
- Click Clean Excess Cell Formatting in the Miscellaneous group.

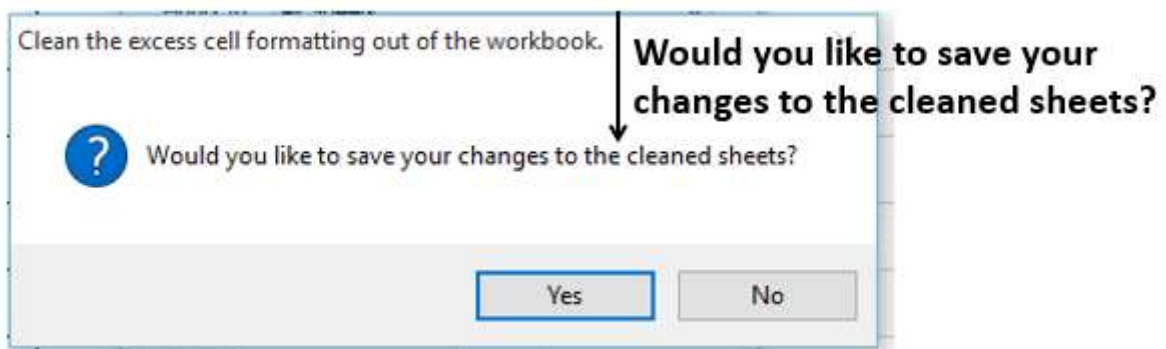


The Clean Excess Cell Formatting dialog box appears. Choose All Sheets in the **Apply to** box





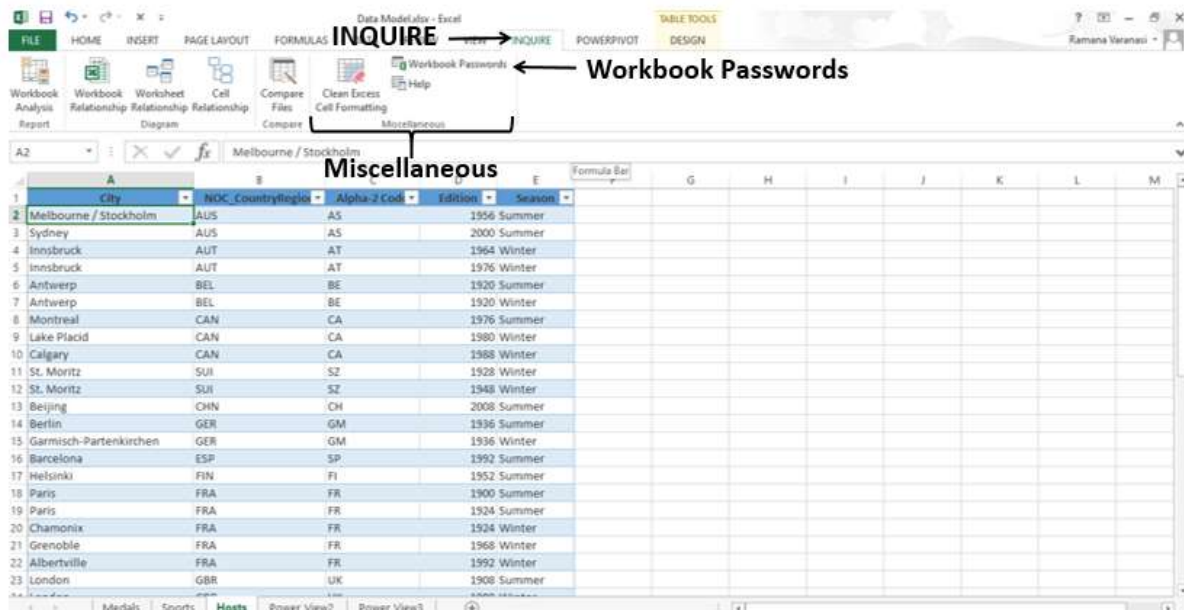
You will get a message about saving changes. Click OK.



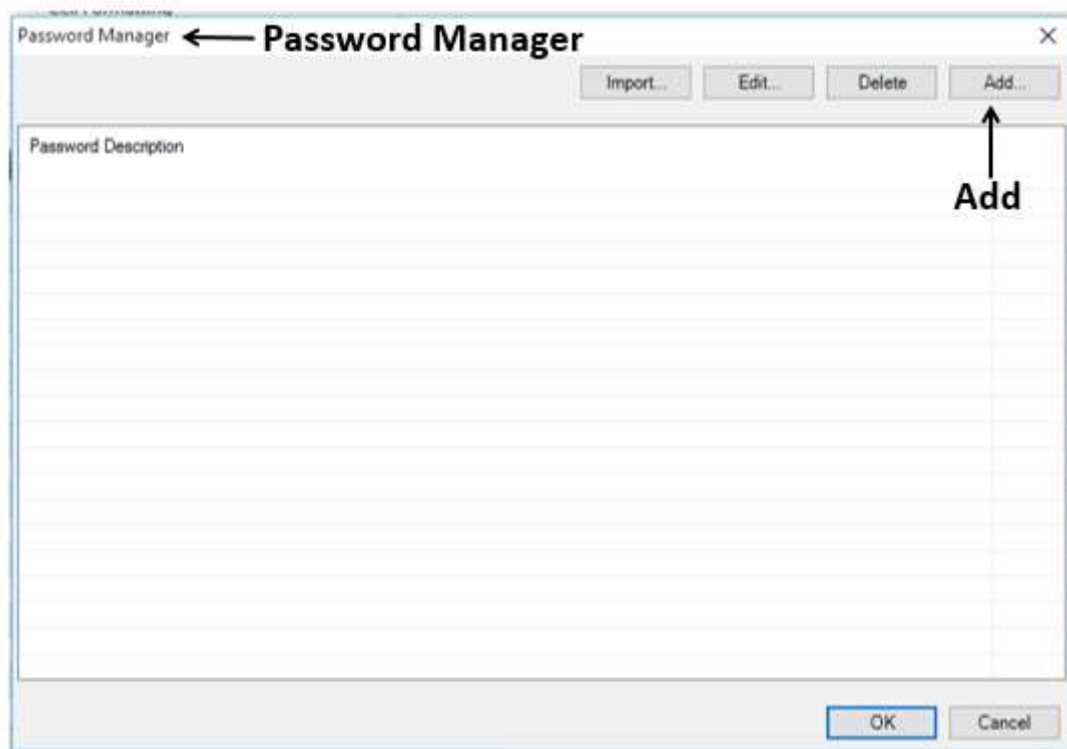
## Managing Passwords of Files

If you are using Workbook Analysis or Compare Files commands for workbooks that are password protected, you can avoid having to type the password each time those files are opened. This is possible with using Password Manager.

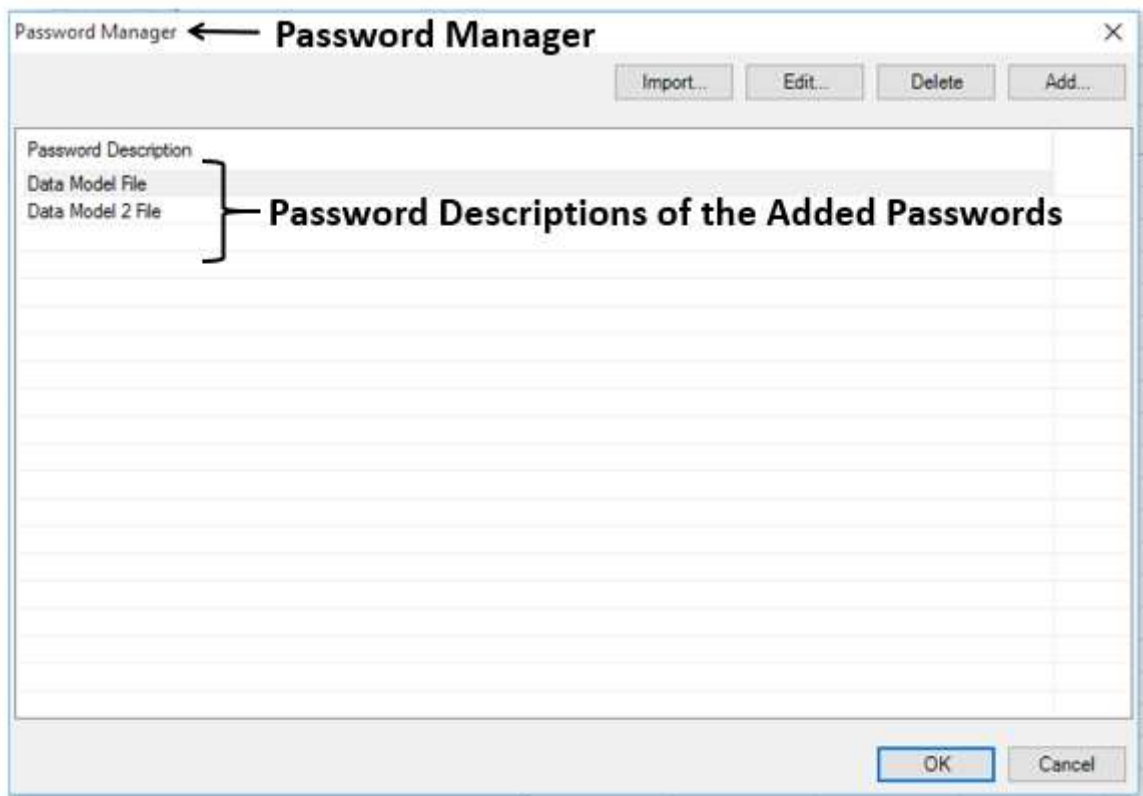
- Click the INQUIRE tab on the Ribbon.
- Click Workbook Passwords in the Miscellaneous group.



The Password Manager Dialog box appears. Click the Add button to add passwords of your workbooks.



Add password descriptions also, for the passwords you added.



Next time when you need to use any of these files for comparing or analyzing, you do not have to key in the passwords.

# **Advanced** Excel 2016

## Part 2

## 22. Overview

Excel provides several commands, functions and tools that make your complex data analysis tasks easy. Excel lets you perform various complex calculations with ease. In this tutorial, you will understand the versatile data analysis tools of Excel. You will understand data analysis with relevant examples, step by step instructions and screen shots at every step.

### Data Consolidation

You might have to consolidate the data from various sources and present a report. The data could be in the worksheets of the same workbook or in different workbooks. With Excel data tool Consolidate, you can perform this in a few easy steps.

### What-If Analysis

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What-If Analysis provides you tools to handle the following data analysis situations –

- Find the input values that result in a specified value. The result could be set up as a formula with the input values as variables. By varying the values of the input variables, Excel provides the solution with the Goal Seek Tool.
- Find the possible output values by varying the values of one or two variables. The result could be set up as a formula with one or two input values as variables. By varying the values for the input variables, Excel provides the solution with the Data Table Tool.
- Find the possible output values that are a result of varying the values of more than two variables. The result could be set up as a formula with the input values as variables. By varying the values for the input variables, Excel provides the solution with the Scenario Manager Tool.

### Optimizing with Excel Solver Add-in

Solver is used to handle complex goal seek situations. In such cases, in addition to the inputs and outputs, there will be defined constraints or limits imposed on the possible input values. Further, Solver is used to result in an optimal solution.

Excel has a Solver Add-in that helps you solve such complex problems.

### Importing Data into Excel

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Your data analysis might depend on various external data sources. In Excel, you can import data from different data sources, such as Microsoft Access Database, Web Pages, Text Files, SQL Server Table, SQL Server Analysis Cube, XML File, etc.

You can import any number of data tables simultaneously from a database. When you are importing multiple tables from a relational database such as Access, the existing

relationships among the tables will be retained in Excel also. While importing the data, you can also optionally create a PivotTable or PivotChart or Power View report based on that data.

You can just create a data connection with a data source, or import the data into Excel. If you import the data into Excel, the data tables are added to the Data Model in Excel.

## Data Model

Data Model in Excel is used to integrate data from multiple tables in the current workbook and / or from the imported data and / or from the data sources connected to the workbook through data connections. Data model is used transparently in PivotTable, PivotChart, PowerPivot and Power View reports.

- You can create a Data Model while importing data, or from the Excel tables in the workbook.
- The data tables in the Data Model can be viewed either in Data View or Diagram View.
- With a Data Model, you can create relationships among the data tables.
- You can either use the Create Relationship command or just click and drag and connect the fields in the two tables that define the relationship in the diagram view of the Data Model.

## Exploring Data with PivotTable

As you can integrate the Data Model with a PivotTable, you can do extensive data analysis by collating, connecting, summarizing and reporting data from several different sources. As you can import tables from external data sources and create a PivotTable, it is possible to have automatic updates of the values in the PivotTable whenever the data in the connected data sources is updated.

You can create a PivotTable with the fields from multiple tables, provided the tables have relationships defined. If a relationship does not exist, Excel prompts you to create one and you can do so from the PivotTable itself. The relationship that you so define is reflected in the Data Model.

## Exploring Data with PowerPivot

You can use PowerPivot to access, analyze and report data from various data sources. PowerPivot can help you handle large data with ease and produce fascinating analysis reports.

PowerPivot provides you commands to manage the Data Model, add Excel tables to Data Model, to add calculated fields in the Data Tables, to define KPIs, etc.



## Exploring Data with Power View

Power View provides interactive exploration, visualization and analysis of large data. Owing to its versatile visualization options, you can definitely find the one that gives your data the perfect platform wherein you can explore the data, summarize and report.

Ranging from Tables to Maps, it is just a play for you to visualize your data, filter it, analyze it, and report it interactively. Moreover, you can have multiple visualizations on the same Power View sheet that reflect and highlight values, when you click on a data point in any one of them.

You can explore data in Power View with a table, a matrix, a card, different chart types, multiples, maps and tiles. You will get fascinated with the versatility of these different views once you get hands-on experience. This is because it is easy to produce interactive reports highlighting significant values and dynamically switching across the views.

## Exploring Data with Hierarchies

If your data has hierarchies, they can be either defined in the Data Model that is reflected in the Power View or build the hierarchies in Power View itself.

Once a hierarchy is defined, you can drill-up and drill-down the hierarchy, displaying the required data.

## Aesthetic Power View Reports

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You can arrive at a report layout based on what you want to present in Power View. You can add a background image that reflects your company logo or your corporate view. Optionally, you can format the background of the report to give it an elegant look.

You can select a theme for your report that best portrays your data. You can change the font and text size so that your report becomes easily readable.

## Key Performance Indicators (KPIs)

Key Performance Indicators are commonly used to gauge the performance. In Excel, you define and portray KPIs in PowerPivot or Power View. The graphical presentation of KPIs will uplift your reports.

## 23. Data Consolidation

You might have come across different situations wherein you have to present consolidated data. The source of the data could be from one place, or several places. Another challenge could be that the data might be updated by other people from time to time.

You need to know how you can set up a summary worksheet that consolidates the data from the sources that you set up, whenever you want. In Excel, you can easily perform this task in a few steps with the **Data Tool – Consolidate**.

### Preparing Data for Consolidation

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Before you begin consolidating the data, make sure that there is consistency across the data sources. This means that the data is arranged as follows -

- Each range of data is on a separate worksheet.
- Each range of data is in list format, with labels in the first row.
- Additionally, you can have labels for the categories, if applicable, in the first column.
- All the ranges of data have the same layout.
- All the ranges of data contain similar facts.
- There are no blank rows or columns within each range.

In case the data sources are external, ensure usage of a predefined layout in the form of an Excel template.

Suppose you have the sales data of various commodities from each of the regions – East, North, South, and West. You might need to consolidate this data and present a product wise summary of sales from time to time. Preparation includes the following –

- One worksheet per region – i.e. four worksheets with names East, North, South, and West. These could be in the same workbook or different workbooks.
- Each worksheet has same layout, representing the details of product, number of units, and amount.
- You need to consolidate the data product wise. Hence, ensure that the column with the label Product is the first column and it contains the Product labels.

	A	B	C	D
1				
2		<b>Product</b>	<b>Units</b>	<b>Amount</b>
3		Hand Wash	85	379.65
4		Hand Wash	43	345.39
5		Soap	20	55.30
6		Floor Cleaner	14	72.67
7		Floor Cleaner	68	218.70
8		Hand Wash	34	263.90
9		Hand Wash	69	293.97
10		Soap	13	322.24
11		Detergent Powder	66	383.70
12		Hand Wash	90	491.30
13		Floor Cleaner	79	437.35
14		Detergent Powder	88	175.54
15		Air Purifier	52	301.80

## Consolidating Data in the Same Workbook

If you have all the data, that you have to consolidate, in the same workbook, proceed as follows –

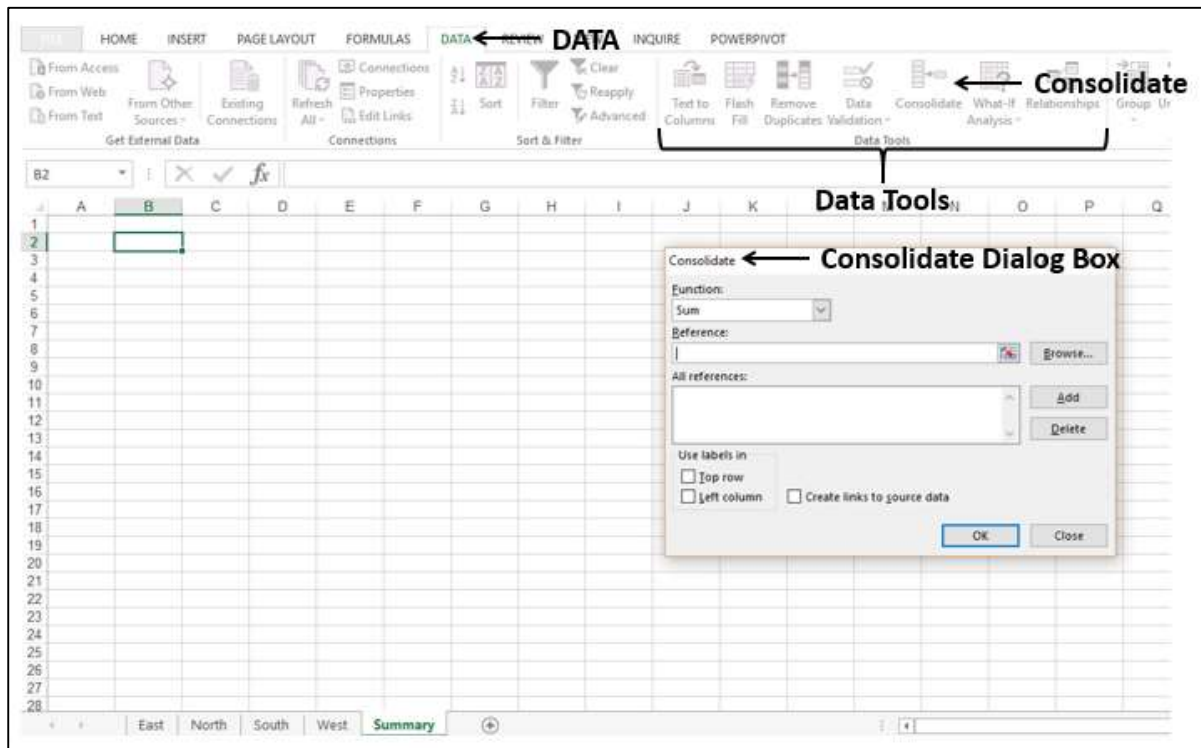
1. Ensure that data of each region is on a separate worksheet.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1																			
2		<b>Product</b>	<b>Units</b>	<b>Amount</b>															
3		Hand Wash	85	379.65															
4		Hand Wash	43	345.39															
5		Soap	20	55.30															
6		Floor Cleaner	14	72.67															
7		Floor Cleaner	68	218.70															
8		Hand Wash	34	263.90															
9		Hand Wash	69	293.97															
10		Soap	13	322.24															
11		Detergent Powder	66	383.70															
12		Hand Wash	90	491.30															
13		Floor Cleaner	79	437.35															
14		Detergent Powder	88	175.54															
15		Air Purifier	52	301.80															
16		Floor Cleaner	42	97.30															
17		Air Purifier	48	373.45															
18		Hand Wash	68	457.58															
19		Air Purifier	90	136.96															
20		Soap	64	436.85															
21		Air Purifier	84	480.80															
22		Air Purifier	68	280.19															
23		Detergent Powder	47	140.93															

2. Add a new worksheet and name it Summary.
3. Click the Summary worksheet.
4. Click the cell where you want to place the summary results.
5. Click the **DATA** tab on the Ribbon.

6. Click the **Consolidate** button in the **Data Tools** group.

The **Consolidate** dialog box appears.

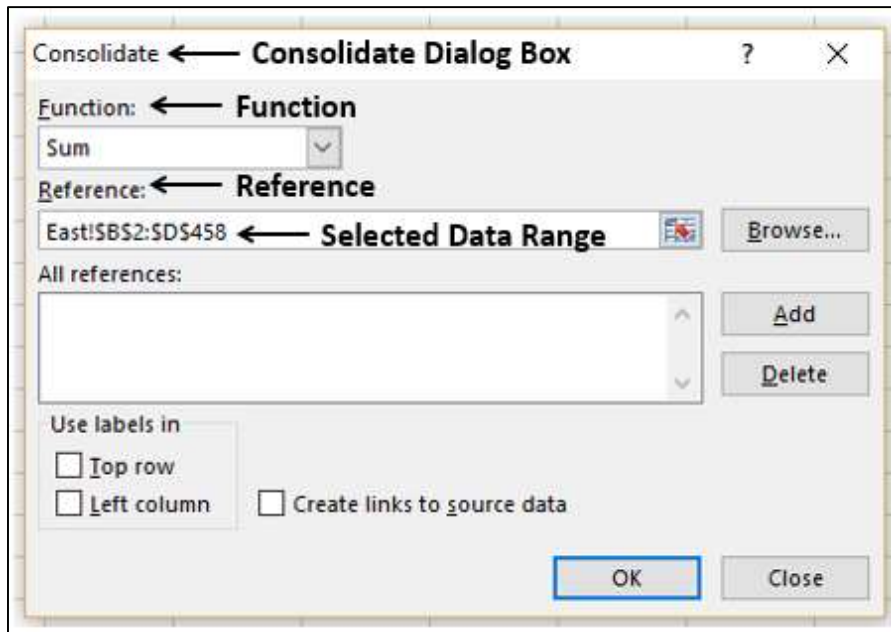


7. Select **Sum** from the dropdown list under **Function**.

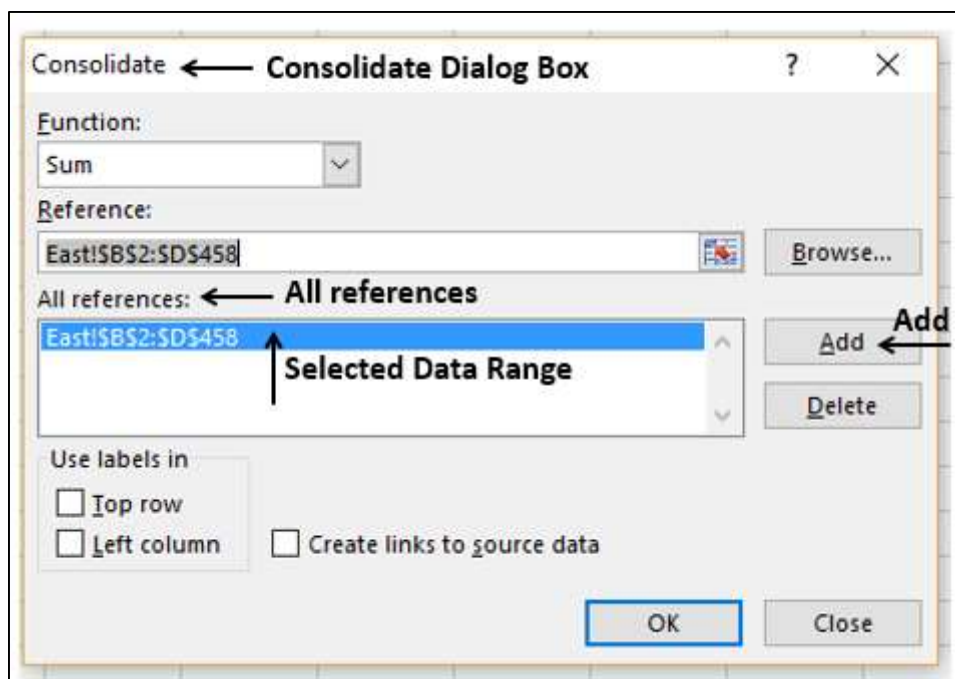
8. Select the data from each worksheet as follows -

- Click the icon in the box under Reference.
- Select the worksheet – East.
- Select the data range.
- Again, click the icon in the box under Reference.

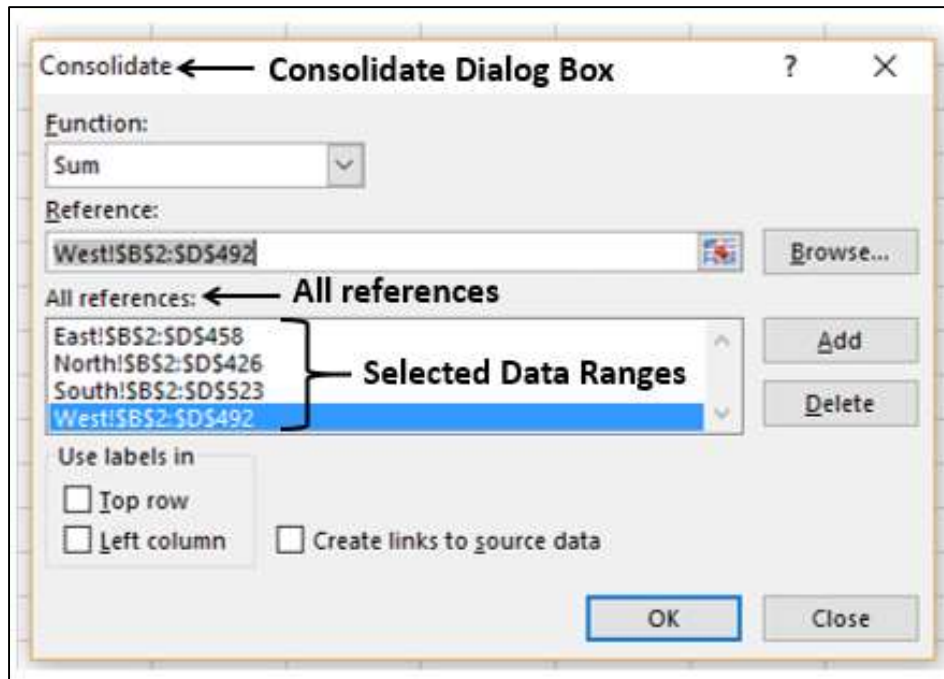
The selected range appears in the Reference box-



9. Click the **Add** button to the right of the box. The selected data range appears in the box under **All References**-

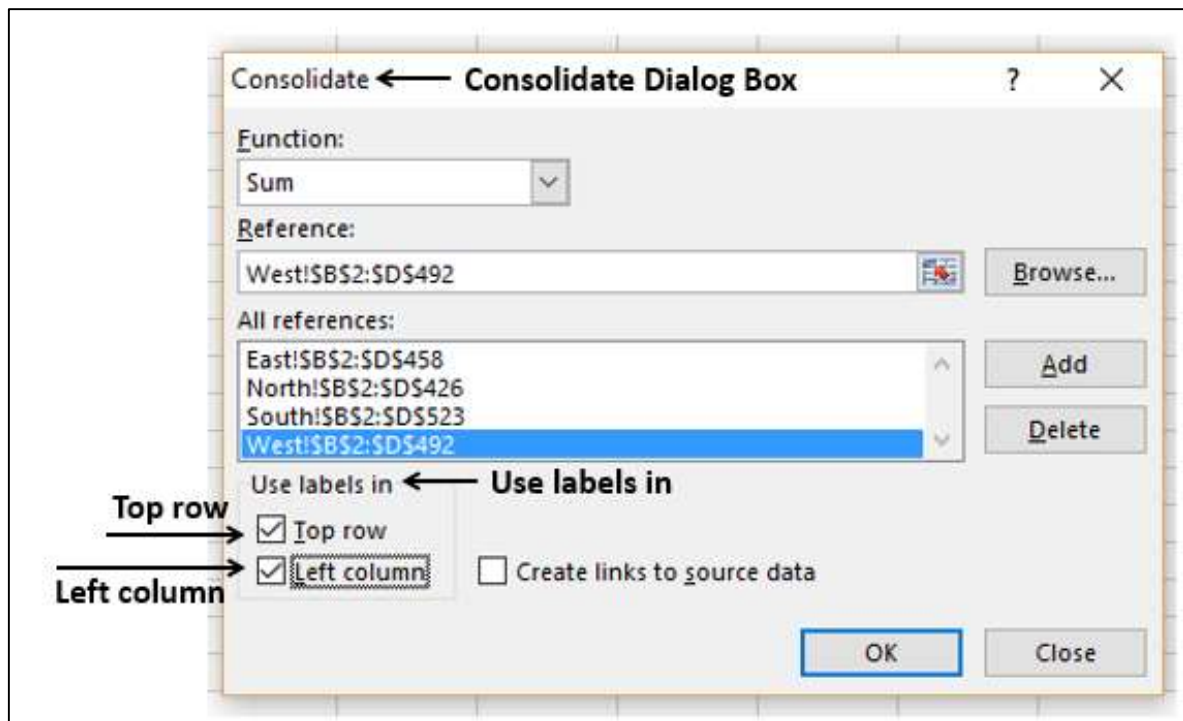


10. Repeat Steps 1-5 for the rest of the data worksheets – North, South, and West. The Consolidate dialog box looks as follows –



You can see that the data ranges appear worksheet wise in alphabetical order, in the box under **All references**.

**11.** Check the boxes **Top row** and **Left column** under **Use labels in**. Click OK.



Your data is summarized product wise for the regions – East, North, South and West.



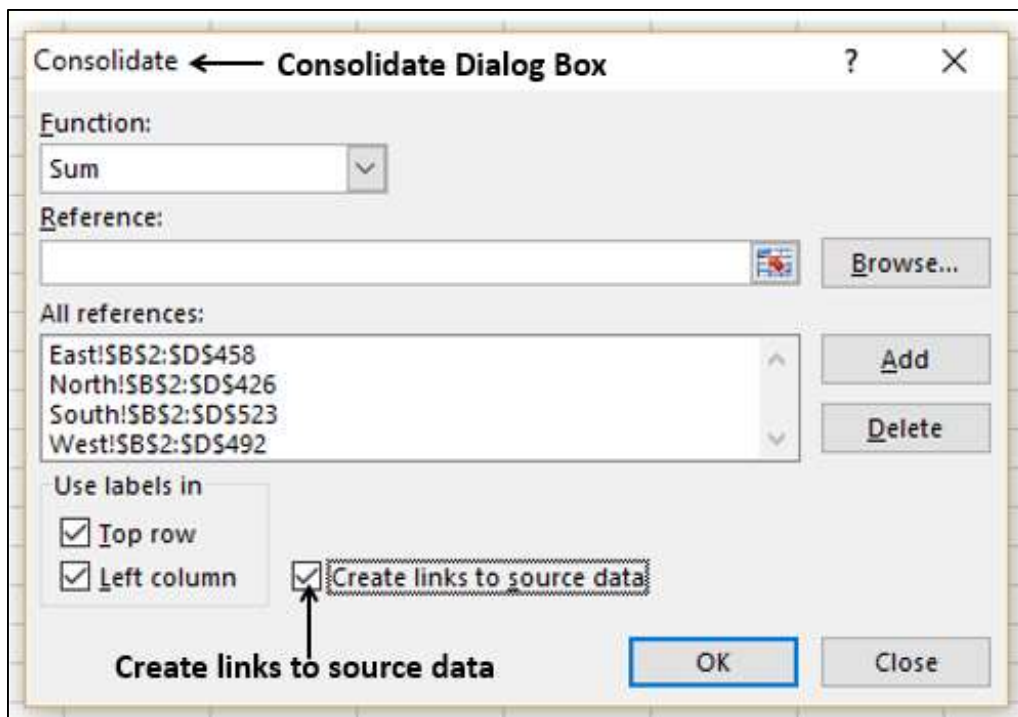
	A	B	C	D
1				
2			Units	Amount
3		Hand Wash	22100	115090.29
4		Soap	10610	57358.91
5		Floor Cleaner	21750	113661.39
6		Detergent Powder	24473	123477.93
7		Air Purifier	20886	112929.17
8				
9				
10				

You can repeat the steps given above to refresh your summary results manually, whenever you need them.

## Consolidating Data Automatically

Suppose you want your summary sheet to be updated automatically, whenever there are changes in the data. To accomplish this, you need to have links to the source data.

**Step 1:** Check the box- **Create links to source data** in the Consolidate dialog box and click OK.



Your summary results appear with an outline as follows –

	A	B	C	D	E
1					
2				Units	Amount
+	415	Hand Wash		22100	115090.29
+	623	Soap		10610	57358.91
+	1050	Floor Cleaner		21750	113661.39
+	1487	Detergent Powder		24473	123477.93
+	1898	Air Purifier		20886	112929.17
	1899				
	1900				
	1901				
	1902				
	1903				
	1904				
	1905				
	1906				
	1907				
	1908				
	1909				
	1910				
	1911				
	1912				
	1913				
	1914				
	1915				
	1916				
	1917				
	1918				
	1919				

You will observe that a new column is inserted to the right of the column named Product.

**Step 2:** Click the + sign on the outline in the row containing the Product value named Soap. You can see that the new column contains the consolidated value for each set of product values, region wise.

	A	B	C	D	E
1					
2				Units	Amount
+	415	Hand Wash		22100	115090.29
-	416		Consolidate	20	55.30
-	417			13	322.24
-	418			64	436.85
-	419			20	449.33
-	420			5	263.38
-	421			67	123.58
-	422			62	308.10
-	423			95	431.48
-	424			20	100.32
-	425			17	260.63
-	426			17	448.80
-	427			76	284.65
-	428			71	343.70
-	429			59	386.48
-	430			93	298.32
-	431			43	400.60
-	432			19	52.38
-	433			22	245.40
-	434			24	327.52
-	435			47	427.13
-	436			67	352.88
-	437			24	222.50
-	438			85	435.68
-	439			96	435.95
-	440			37	188.10

## Consolidating Data from Different Workbooks

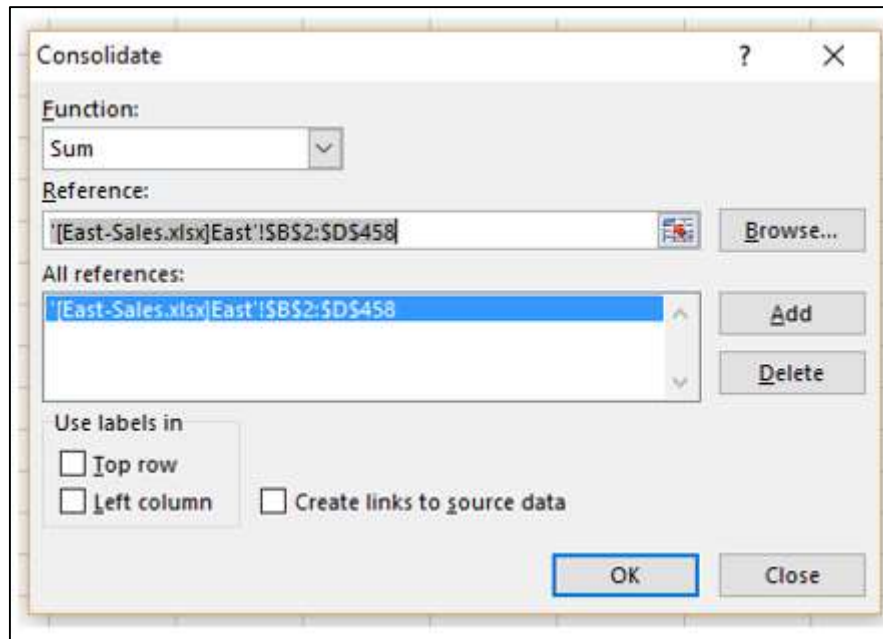
In the previous example, all the data that you need to summarize is in the same workbook. However, it is likely that the data is maintained separately for each region and is updated region wise. In such a case, you can consolidate the data as follows –

1. Open the workbooks containing the data, say, workbooks – East-Sales, North-Sales, South-Sales and West-Sales.
2. Open a new workbook.
3. On a new worksheet, click a cell where you want the summary to appear.
4. Click the DATA tab on the Ribbon.
5. Click Consolidate in the Data Tools box.

A **Consolidate** dialog box appears. In the Consolidate dialog box–

- Select Sum from the dropdown list in the box under Function:
- Click the icon in the box under **Reference**.
- Select the workbook – East-Sales.xlsx.
- Select the data range.
- Again, click the icon in the box under Reference.
- Click the **Add** button to the right.

The Consolidate dialog box looks as follows –



- Click the icon to the right of the box under References.
- Select the workbook – North-Sales.xlsx.
- Select the data range.
- Again, click the icon to the right of the box under References.
- Click Add.

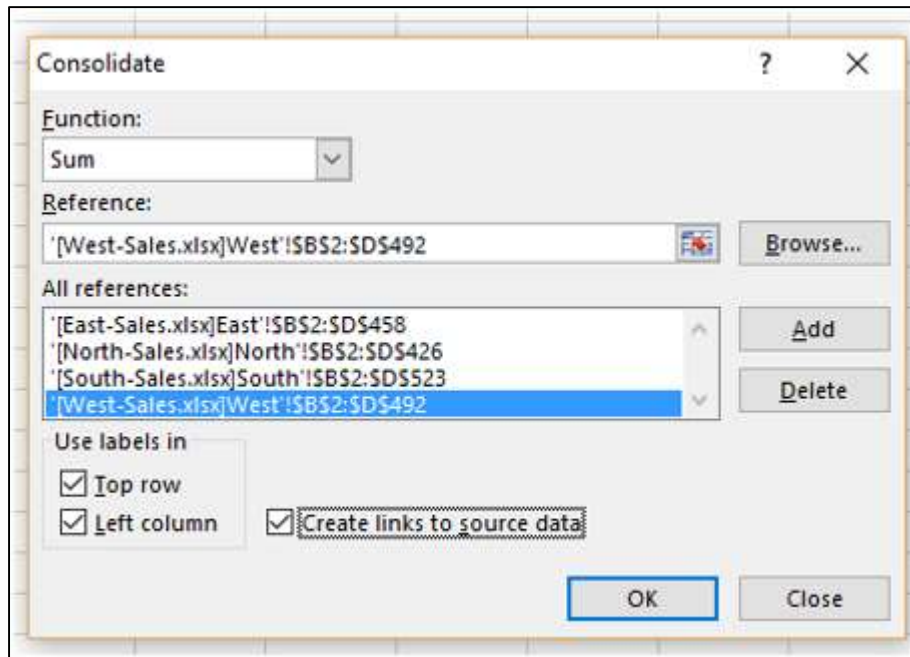
**6.** Repeat the steps 1–6 to add the data ranges from the workbooks – South-Sales.xlsx and West-Sales.xlsx.

**7.** Under **Use labels in**, check the following boxes –

- Top row.
- Left column.

**8.** Check the box **Create links to source data**.

Your Consolidate dialog box looks as follows –



Your data is summarized in your workbook.

		A	B	C	D	E	F
1							
2					Units	Amount	
+	415		Hand Wash		22100	115090.29	
+	623		Soap		10610	57358.91	
+	1050		Floor Cleaner		21750	113661.39	
+	1487		Detergent Powder		24473	123477.93	
+	1898		Air Purifier		20886	112929.17	
	1899						
	1900						
	1901						
	1902						

# 24. What-If Analysis

**What-if analysis** is the process of changing the values in cells to see how those changes will affect the outcome of formulas on the worksheet. You can use several different sets of values in one or more formulas to explore all the various results.

What-if analysis is useful in many situations while doing data analysis. For example -

- You can propose different budgets based on revenue.
- You can predict the future values based on the given historical values.
- If you are expecting a certain value as the result from a formula, you can find different sets of input values that produce the desired result.

Excel provides you with the following What-if analysis tools that can be used based on your data analysis needs –

- Data Tables
- Scenario Manager
- Goal Seek

Data Tables and Scenarios take sets of input values and project forward to determine possible results. Goal seek differs from Data Tables and Scenarios in that it takes a result and projects backwards to determine possible input values that produce that result.

In this chapter, you will understand the possible situations where you can use the What-if Analysis tools. For details on usage of these tools, refer to the later chapters in this tutorial.

## Data Tables

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A **Data Table** is a range of cells in which you can change values in some of the cells and come up with different answers to a problem. For example, you might want to know how much loan you can afford for a home by analyzing different loan amounts and interest rates. You can put these different values along with the **PMT** function in a Data Table and get the desired result.

A Data Table works only with **one or two variables**, but it can accept many different values for those variables.

For the details on Data Tables, refer to the chapter – What-If Analysis with Data Tables in this tutorial.



## Scenario Manager

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A scenario is a set of values that Excel saves and can substitute automatically in cells on a worksheet.

The key features are-

- You can create and save different groups of values on a worksheet and then switch to any of these new scenarios to view different results.
- A scenario can have multiple variables, but it can accommodate only up to 32 values.
- You can also create a scenario summary report, which combines all the scenarios on one worksheet. For example, you can create several different budget scenarios that compare various possible income levels and expenses, and then create a report that lets you compare the scenarios side-by-side.
- Scenario Manager is a dialog box that allows you to save the values as a scenario and name the scenario.

For the details on Scenarios, refer to the chapter – **What-If Analysis with Scenario Manager** in this tutorial.

## Goal Seek

---

Goal Seek is useful if you know the result that you want from a formula, but not sure what input value the formula needs, to get that result. For example, if you want to borrow a loan and you know the loan amount, tenure of loan and the EMI that you can pay, you can use Goal Seek to find the interest rate at which you can avail the loan.

Goal Seek can be used only with one variable input value. If you have more than one variable for input values, you can use the Solver add-in.

For details on the usage of Goal Seek, refer to the chapter – **What-If Analysis with Goal Seek** in this tutorial.

## Solver

---

Solver comes with Excel as an add-in. You can use Solver to find an optimal value for a formula in a cell called the target cell on a worksheet.

Solver works with a group of cells that are related to the formula in the target cell. Solver adjusts the values in the adjustable cells that you specify, to produce the result that you specify, from the target cell formula.

For the details on the usage of Excel Solver add-in, refer to the chapter - **Optimization with Excel Solver** in this tutorial.

# 25. What-If Analysis with Data Tables

With a Data Table in Excel, you can easily vary one or two inputs and perform What-if analysis. A Data Table is a range of cells in which you can change values in some of the cells and come up with different answers to a problem.

There are two types of Data Tables –

- One-variable Data Tables
- Two-variable Data Tables

If you have more than two variables in your analysis problem, you need to use Scenario Manager Tool of Excel. For details, refer to the chapter – What-If Analysis with Scenario Manager in this tutorial.

## One-variable Data Tables

---

A one-variable Data Table can be used if you want to see how different values of one variable in one or more formulas will change the results of those formulas. In other words, with a one-variable Data Table, you can determine how changing one input changes any number of outputs. You will understand this with the help of an example.

### Example

There is a loan of 5,000,000 for a tenure of 30 years. You want to know the monthly payments (EMI) for varied interest rates. You also might be interested in knowing the amount of interest and Principal that is paid in the second year.

## Analysis with One-variable Data Table

---

Analysis with one-variable Data Table needs to be done in three steps –

**Step 1:** Set the required background.

**Step 2:** Create the Data Table.

**Step 3:** Perform the Analysis.

Let us understand these steps in detail-

### Step 1: Set the required background

- Assume that the interest rate is 12%.
- List all the required values.
- Name the cells containing the values, so that the formulas will have names instead of cell references.

- Set the calculations for EMI, Cumulative Interest and Cumulative Principal with the Excel functions – PMT, CUMIPMT and CUMPRINC respectively.

Your worksheet should look as follows –

	A	B	C	D
1				
2		Rate per Annum	0.12	Interest_Rate
3		No. of Monthly Payments	360	NPER
4		Loan Amount	5000000	Loan_Amount
5		Type	0	Type
6		EMI	=PMT(Interest_Rate/12,NPER,Loan_Amount,0,Type)	EMI
7		Start Period	13	Start_Period
8		End Period	24	End_Period
9		Interest paid in the 2nd Year	=CUMIPMT(Interest_Rate/12,NPER,Loan_Amount,Start_Period,End_Period,Type)	Cum_Interest
10		Principal paid in the 2nd Year	=CUMPRINC(Interest_Rate/12,NPER,Loan_Amount,Start_Period,End_Period,Type)	Cum_Principal

You can see that the cells in column C are named as given in the corresponding cells in column D.

## Step 2: Create the Data Table

- Type the list of values i.e. interest rates that you want to substitute in the input cell down the column E as follows –

	E	F	G	H
1	Interest Rate	EMI	Cum Interest	Cum Principal
2				
3	12.0%			
4	12.2%			
5	12.4%			
6	12.6%			
7	12.8%			
8	13.0%			
9	13.2%			
10	13.4%			
11	13.6%			
12	13.8%			
13	14.0%			
14				
15				

As you observe, there is an empty row above the Interest Rate values. This row is for the formulas that you want to use.

- Type the first function (**PMT**) in the cell one row above and one cell to the right of the column of values. Type the other functions (**CUMIPMT** and **CUMPRINC**) in the cells to the right of the first function.

Now, the two rows above the Interest Rate values look as follows –

	E	F	G	H
1	Interest Rate	EMI	Cum Interest	Cum Principal
2		=EMI	=Cum_Interest	=Cum_Principal

The Data Table looks as given below –

	E	F	G	H
1	Interest Rate	EMI	Cum Interest	Cum Principal
2		-51430.63	-596722.48	-20445.08
3	12.0%			
4	12.2%			
5	12.4%			
6	12.6%			
7	12.8%			
8	13.0%			
9	13.2%			
10	13.4%			
11	13.6%			
12	13.8%			
13	14.0%			
14				
15				

### Step 3: Do the analysis with the What-If Analysis Data Table Tool

- Select the range of cells that contains the formulas and values that you want to substitute, i.e. select the range – E2:H13.
- Click the DATA tab on the Ribbon.
- Click What-if Analysis in the Data Tools group.
- Select Data Table in the dropdown list.

The screenshot shows the Excel ribbon with the **DATA** tab selected. The **What-if Analysis** dropdown menu is open, and the **Data Table...** option is highlighted. Below the ribbon, a data table is shown with columns for Interest Rate, EMI, Cum Interest, and Cum Principal. The range E2:H13 is selected, and the 'Selected Range' label points to it.

	E	F	G	H
1	Interest Rate	EMI	Cum Interest	Cum Principal
2		-51430.63	-596722.48	-20445.08
3	12.0%			
4	12.2%			
5	12.4%			
6	12.6%			
7	12.8%			
8	13.0%			
9	13.2%			
10	13.4%			
11	13.6%			
12	13.8%			
13	14.0%			

**Data Table** dialog box appears.

- Click the icon in the Column input cell box.
- Click the cell **Interest\_Rate**, which is C2.

	B	C	D	E	F	G	H
1				Interest Rate	EMI	Cum Interest	Cum Principal
2	Rate per Annum	12%	Interest_Rate		-51430.63	-596722.48	-20445.08
3	No. of Monthly Payments	360	NPER	12.0%			
4	Loan Amount	5000000	Loan_Amount	12.2%			
5	Type	0	Type	12.4%			
6	EMI	(51,430.63)	EMI	12.6%			
7	Start Period	13	Start_Period	12.8%			
8	End Period	24	End_Period	13.0%			
9	Interest paid in the 2nd Year	-596722.48	Cum_Interest	13.2%			
10	Principal paid in the 2nd Year	-20445.08	Cum_Principal	13.4%			
11				13.6%			
12				13.8%			
13				14.0%			

You can see that the Column input cell is taken as \$C\$2. Click OK.

The Data Table is filled with the calculated results for each of the input values as shown below-

	B	C	D	E	F	G	H
1				Interest Rate	EMI	Cum Interest	Cum Principal
2	Rate per Annum	12%	Interest_Rate		-51430.63	-596722.48	-20445.08
3	No. of Monthly Payments	360	NPER	12.0%	-51430.63	-596722.48	-20445.08
4	Loan Amount	5000000	Loan_Amount	12.2%	-52201.67	-606808.26	-19611.75
5	Type	0	Type	12.4%	-52975.21	-616893.14	-18809.35
6	EMI	(51,430.63)	EMI	12.6%	-53751.16	-626977.01	-18036.93
7	Start Period	13	Start_Period	12.8%	-54529.45	-637059.83	-17293.52
8	End Period	24	End_Period	13.0%	-55309.98	-647141.50	-16578.21
9	Interest paid in the 2nd Year	-596722.48	Cum_Interest	13.2%	-56092.67	-657221.99	-15890.09
10	Principal paid in the 2nd Year	-20445.08	Cum_Principal	13.4%	-56877.46	-667301.22	-15228.27
11				13.6%	-57664.25	-677379.16	-14591.88
12				13.8%	-58452.99	-687455.77	-13980.09
13				14.0%	-59243.59	-697530.99	-13392.06

If you can pay an EMI of 54,000, you can observe that the interest rate of 12.6% is suitable for you.

## Two-variable Data Tables

A two-variable Data Table can be used if you want to see how different values of two variables in a formula will change the results of that formula. In other words, with a two-variable Data Table, you can determine how changing two inputs changes a single output. You will understand this with the help of an example.

### Example

There is a loan of 50,000,000. You want to know how different combinations of interest rates and loan tenures will affect the monthly payment (EMI).

## Analysis with Two-variable Data Table

Analysis with two-variable Data Table needs to be done in three steps –

**Step 1:** Set the required background.

**Step 2:** Create the Data Table.

**Step 3:** Perform the Analysis.

### Step 1: Set the required background

- Assume that the interest rate is 12%.
- List all the required values.
- Name the cells containing the values, so that the formula will have names instead of cell references.
- Set the calculation for EMI with the Excel function – **PMT**.

Your worksheet should look as follows –

	A	B	C	D
1				
2		Rate per Annum	0.12	Interest_Rate
3		No. of Monthly Payments	360	NPER
4		Loan Amount	50000000	Loan_Amount
5		Type	0	Type
6		EMI	=PMT(Interest_Rate/12,NPER,Loan_Amount,0,Type)	EMI
7				

You can see that the cells in the column C are named as given in the corresponding cells in the column D.

### Step 2: Create the Data Table

1. Type **=EMI** in cell F2.



	E	F	G	H	I	J	K	L
1		Interest Rate	Number of Payments					
2	EMI	=EMI						
3	Interest Rate							
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								

2. Type the first list of input values, i.e. interest rates down the column F, starting with the cell below the formula, i.e. F3.

3. Type the second list of input values, i.e. number of payments across row 2, starting with the cell to the right of the formula, i.e. G2.

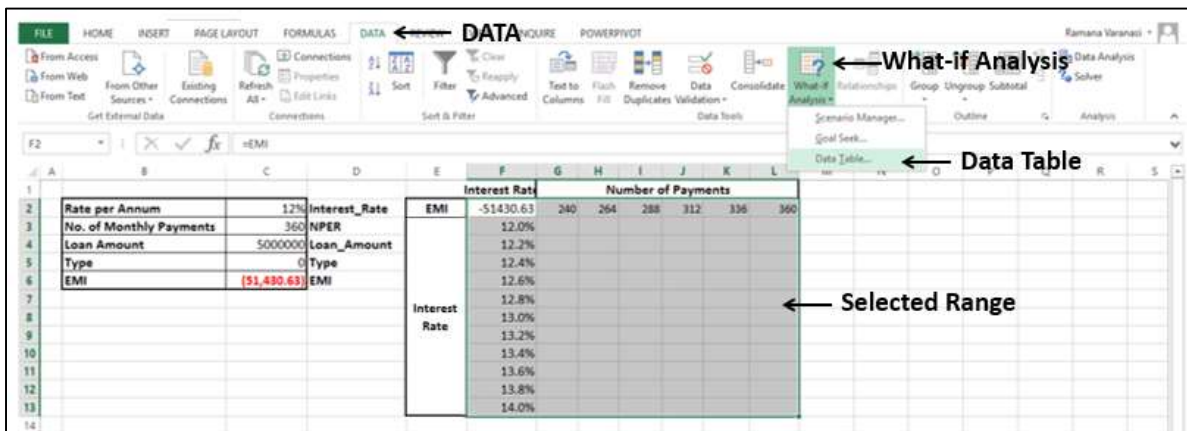
The Data Table looks as follows –

	E	F	G	H	I	J	K	L
		Interest Rate	Number of Payments					
	EMI	-51430.63	240	264	288	312	336	360
	Interest Rate	12.0%						
		12.2%						
		12.4%						
		12.6%						
		12.8%						
		13.0%						
		13.2%						
		13.4%						
		13.6%						
		13.8%						
		14.0%						

### Do the analysis with the What-If Analysis Tool Data Table

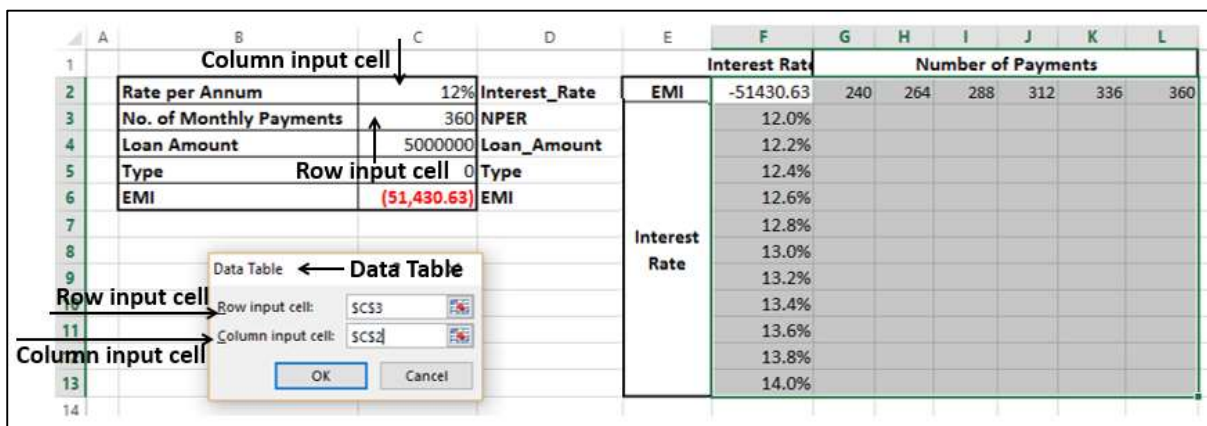
- Select the range of cells that contains the formula and the two sets of values that you want to substitute, i.e. select the range – F2:L13.
- Click the DATA tab on the Ribbon.

- Click What-if Analysis in the Data Tools group.
- Select Data Table from the dropdown list.



Data Table dialog box appears.

- Click the icon in the Row input cell box.
- Click the cell **NPER**, which is C3.
- Again, click the icon in the Row input cell box.
- Next, click the icon in the Column input cell box.
- Click the cell Interest\_Rate, which is C2.
- Again, click the icon in the Column input cell box.



You will see that the Row input cell is taken as \$C\$3 and the Column input cell is taken as \$C\$2. Click OK.

The Data Table gets filled with the calculated results for each combination of the two input values –

E	F	G	H	I	J	K	L
	Interest Rate	Number of Payments					
EMI	-51430.63	240	264	288	312	336	360
Interest Rate	12.0%	-55054.31	-53896.92	-53019.09	-52347.62	-51830.65	-51430.63
	12.2%	-55753.06	-54613.76	-53752.12	-53094.99	-52590.65	-52201.67
	12.4%	-56454.93	-55333.69	-54488.12	-53845.21	-53353.33	-52975.21
	12.6%	-57159.88	-56056.63	-55227.04	-54598.20	-54118.62	-53751.16
	12.8%	-57867.85	-56782.53	-55968.81	-55353.89	-54886.42	-54529.45
	13.0%	-58578.79	-57511.32	-56713.34	-56112.19	-55656.67	-55309.98
	13.2%	-59292.63	-58242.93	-57460.58	-56873.03	-56429.28	-56092.67
	13.4%	-60009.33	-58977.32	-58210.45	-57636.35	-57204.17	-56877.46
	13.6%	-60728.83	-59714.41	-58962.89	-58402.07	-57981.27	-57664.25
	13.8%	-61451.09	-60454.15	-59717.83	-59170.11	-58760.51	-58452.99
	14.0%	-62176.04	-61196.47	-60475.21	-59940.42	-59541.82	-59243.59

If you can pay an EMI of 54,000, the interest rate of 12.2% and 288 EMIs are suitable for you. This means the tenure of the loan would be 24 years.

## Data Table Calculations

Data Tables are recalculated each time the worksheet containing them is recalculated, even if they have not changed. To speed up the calculations in a worksheet that contains a Data Table, you need to change the calculation options to **Automatically Recalculate** the worksheet but not the Data Tables, as given in the next section.

## Speeding up the Calculations in a Worksheet

You can speed up the calculations in a worksheet containing Data Tables in two ways –

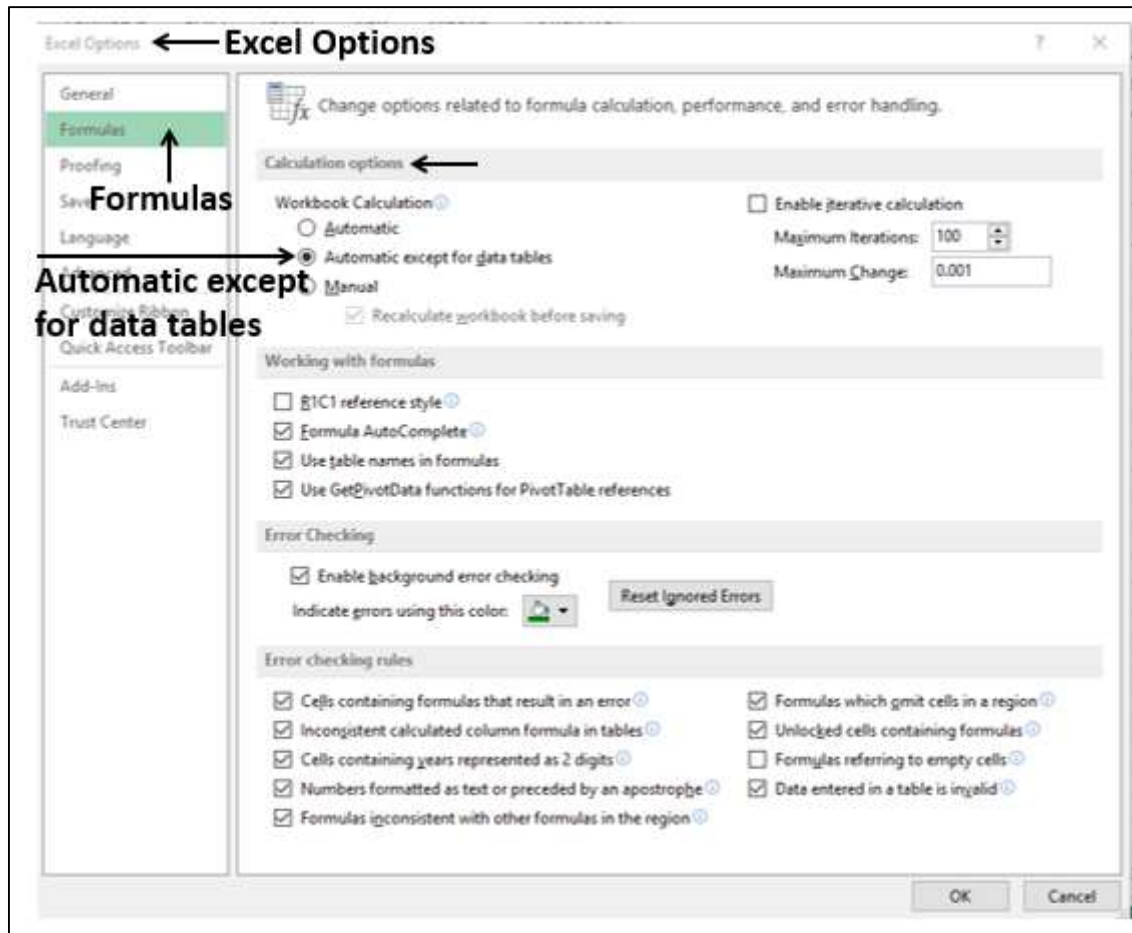
- From Excel Options.
- From the Ribbon.

### From Excel Options

- Click the FILE tab on the Ribbon.
- Select Options from the list in the left pane.

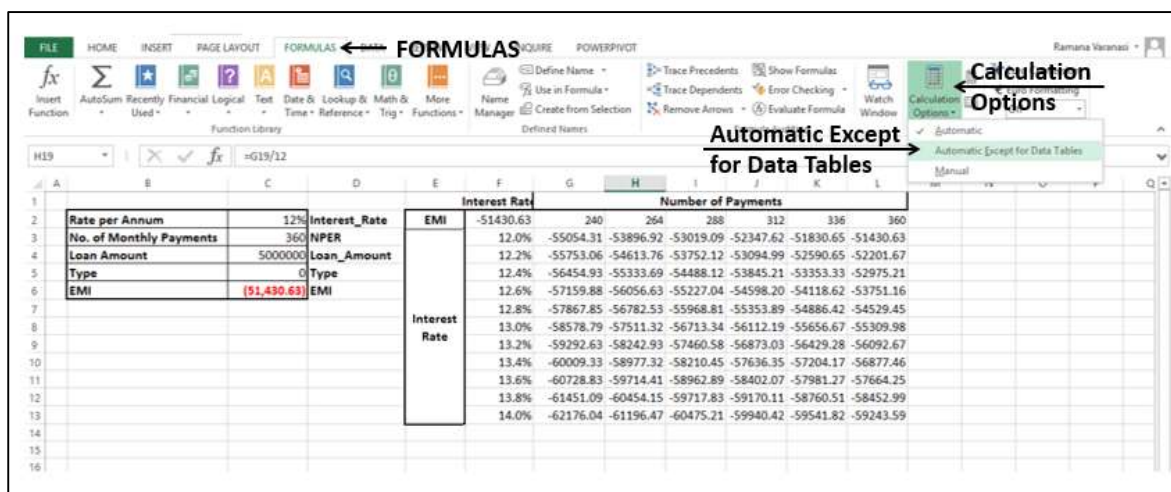
Excel Options dialog box appears.

- From the left pane, select **Formulas**.
- Select the option **Automatic except for data tables** under **Workbook Calculation** in the Calculation options section. Click OK.



## From the Ribbon

- Click the **FORMULAS** tab on the Ribbon.
- Click the **Calculation Options** in the Calculations group.
- Select **Automatic Except for Data Tables** in the dropdown list.



## 26. What-If Analysis with Scenario Manager

Scenario Manager is useful in the cases where you have more than two variables in sensitivity analysis. Scenario Manager creates scenarios for each set of the input values for the variables under consideration. Scenarios help you to explore a set of possible outcomes, supporting the following –

- Varying as many as 32 input sets.
- Merging the scenarios from several different worksheets or workbooks.

If you want to analyze more than 32 input sets, and the values represent only one or two variables, you can use Data Tables. Although it is limited to only one or two variables, a Data Table can include as many different input values as you want. Refer to What-If Analysis with Data Tables in this tutorial.

### Scenarios

---

A scenario is a set of values that Excel saves and can substitute automatically on your worksheet. You can create and save different groups of values as scenarios on a worksheet and then switch between these scenarios to view the different results.

For example, you can have several different budget scenarios that compare various possible income levels and expenses. You can also have different loan scenarios from different sources that compare various possible interest rates and loan tenures.

If the information that you want to use in scenarios is from different sources, you can collect the information in separate workbooks, and then merge the scenarios from the different workbooks into one.

After you have all the scenarios you need, you can create a scenario summary report –

- That incorporates information from all the scenarios.
- That lets you compare the scenarios side-by-side.

### Scenario Manager

---

Scenario Manager is one of the What-if Analysis tools in Excel.

To create an analysis report with Scenario Manager, you have to follow these steps -

**Step 1:** Define the set of initial values and identify the input cells that you want to vary, called the changing cells.

**Step 2:** Create each scenario, name the scenario and enter the value for each changing input cell for that scenario.

**Step 3:** Select the output cells, called the result cells that you want to track. These cells contain formulas in the initial set of values. The formulas use the changing input cells.

The Scenario Manager creates a report containing the input and the output values for each scenario.

## Initial Values for Scenarios

---

Before you create several different scenarios, you need to define a set of initial values on which the scenarios will be based.

The steps for setting up the initial values for Scenarios are–

- Define the cells that contain the input values.
- Name the input cells appropriately.
- Identify the input cells with constant values.
- Specify the values for the constant inputs.
- Identify the input cells with changing values.
- Specify the initial values for the changing inputs.
- Define the cells that contain the results. The result cells contain formulas.
- Name the result cells appropriately.
- Place the formulas in the result cells.

Consider the previous example of loan. Now, proceed as follows –

- Define a cell for Loan Amount.
  - This input value is constant for all the scenarios.
  - Name the cell Loan\_Amount.
  - Specify the value as 5,000,000.
- Define the cells for Interest Rate, No. of payments and Type (Payment at the beginning or end of the month).
  - These input values will be changing across the scenarios.
  - Name the cells Interest\_Rate, NPER and Type.
  - Specify the initial values for the analysis in these cells as 12%, 360 and 0 respectively.
- Define the cell for the EMI.
  - This is the result value.
  - Name the cell EMI.
  - Place the formula in this cell as –

**=PMT (Interest\_Rate/12, NPER, Loan\_Amount, 0, Type)**



Your worksheet looks as shown below -

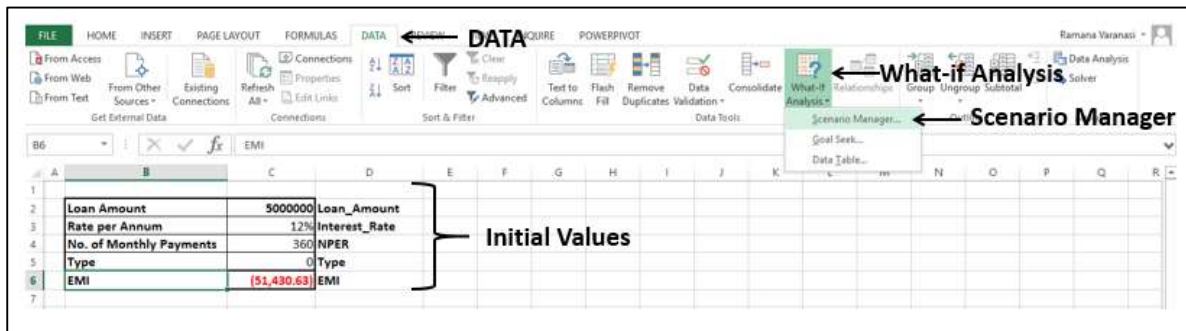
	A	B	C	D
1				
2		Loan Amount	5000000	Loan_Amount
3		Rate per Annum	0.12	Interest_Rate
4		No. of Monthly Payments	360	NPER
5		Type	0	Type
6		EMI	=PMT(Interest_Rate/12,NPER,Loan_Amount,0,Type)	EMI
7				

As you can see that the input cells and the result cells are in column C with the names as given in column D.

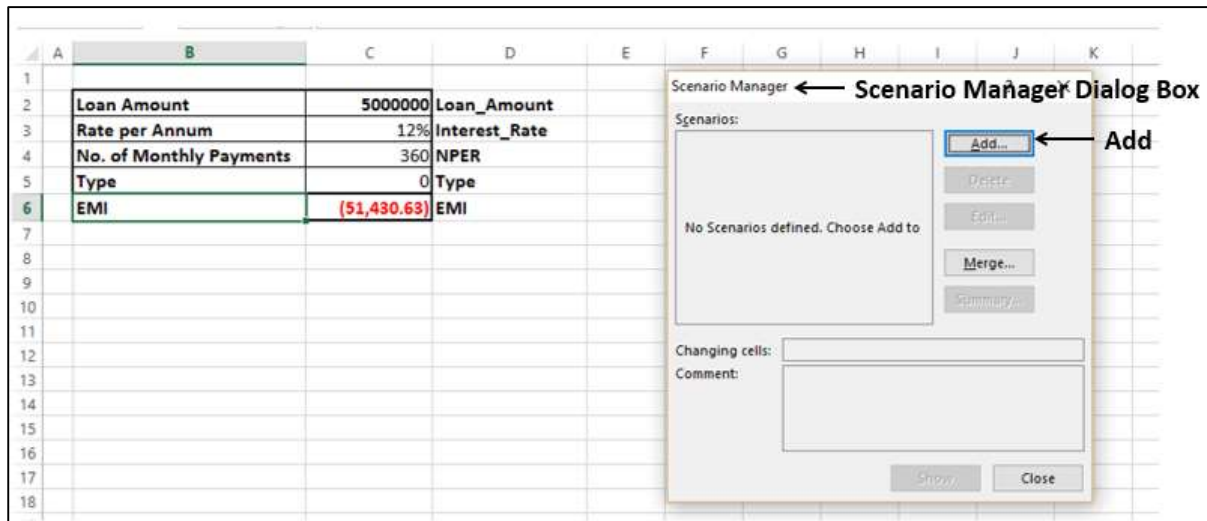
## Creating Scenarios

After setting up the initial values for the Scenarios, you can create the scenarios using Scenario Manager as follows -

- Click the DATA tab on the Ribbon.
- Click What-if Analysis in the Data Tools group.
- Select Scenario Manager from the dropdown list.



The Scenario Manager Dialog box appears. You can observe that it contains a message – **“No Scenarios defined. Choose Add to.”**



You need to create scenarios for each set of changing values in the Scenario Manager. It is good to have the first scenario defined with initial values, as it enables you to switch back to initial values whenever you want while displaying different scenarios.

Create the first scenario with the initial values as follows –

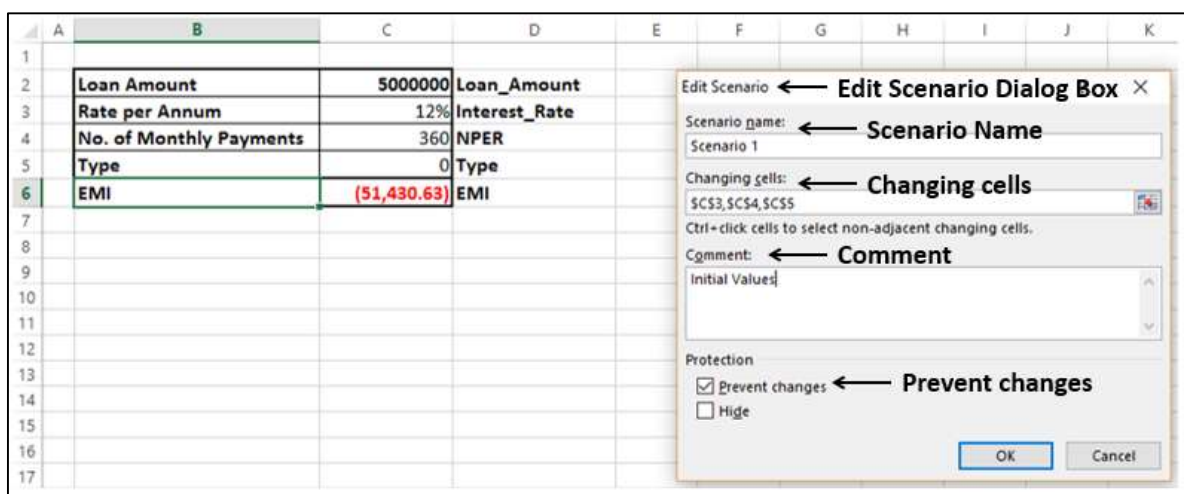
- Click the **Add** button in the Scenario Manager Dialog box.

The **Add Scenario** dialog box appears.

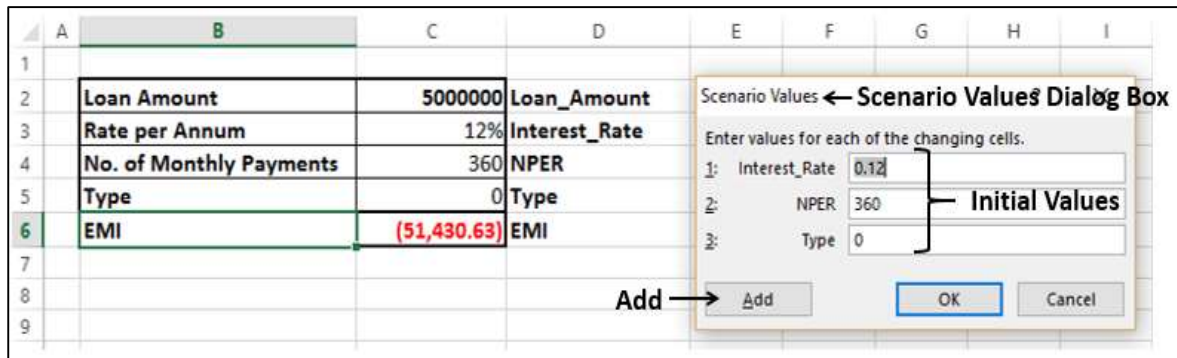
- Under Scenario Name, type Scenario 1.
- Under Changing Cells, enter the references for the cells i.e. C3, C4 and C5 with the Ctrl key pressed.

The name of the dialog box changes to Edit Scenario.

- Edit the text in the **Comment as – Initial Values** box.
- Select the option **Prevent changes** under Protection and then click OK.



The **Scenario Values** dialog box appears. The initial values that you have defined appear in each of the changing cells boxes.



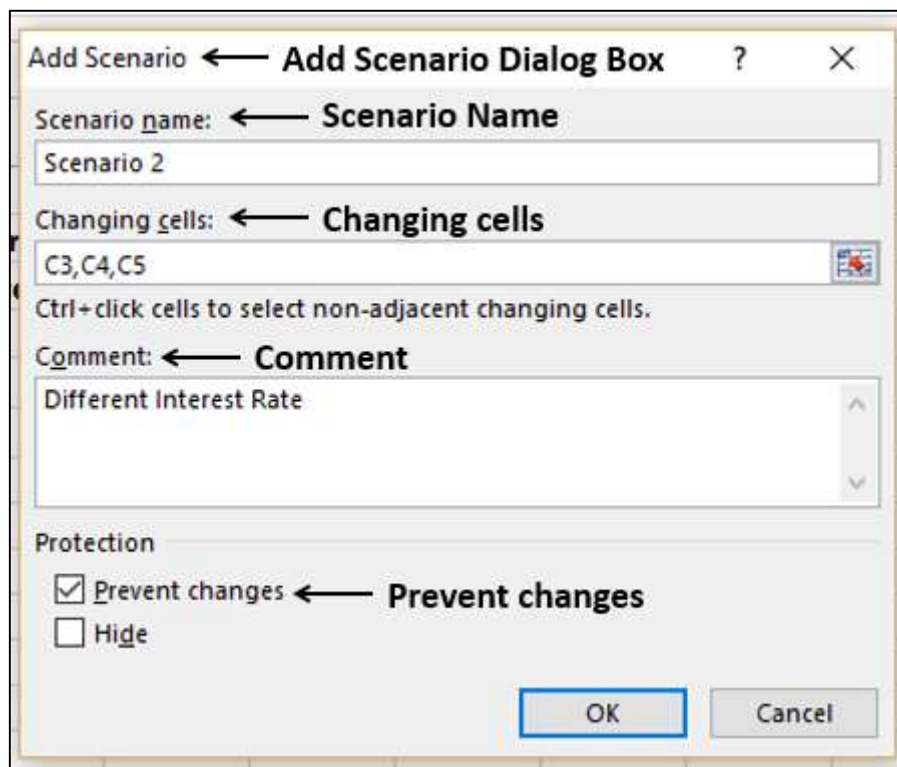
**Scenario 1** with the initial values is created.

Create three more scenarios with varying values in the changing cells as follows –

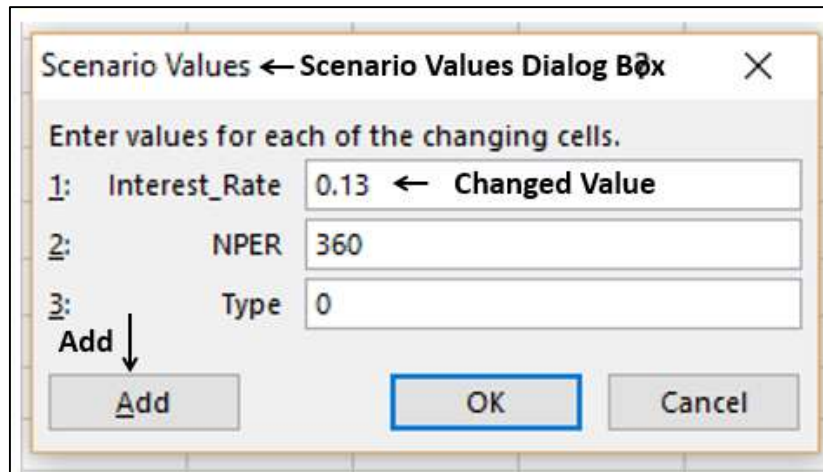
- Click the **Add** button in the Scenario Values dialog box.

Add Scenario dialog box appears. Note that C3, C4, C5 appear in the Changing cells box.

- In the Scenario Name box, type Scenario 2.
- Edit the text in the **Comment** as – Different Interest Rate.
- Select Prevent changes under Protection and click OK.



The **Scenario Values** dialog box appears. The initial values appear in the changing cells. Change the value of **Interest\_Rate** to **0.13** and click **Add**.



Scenario Values ← Scenario Values Dialog Box

Enter values for each of the changing cells.

1: Interest\_Rate 0.13 ← Changed Value

2: NPER 360

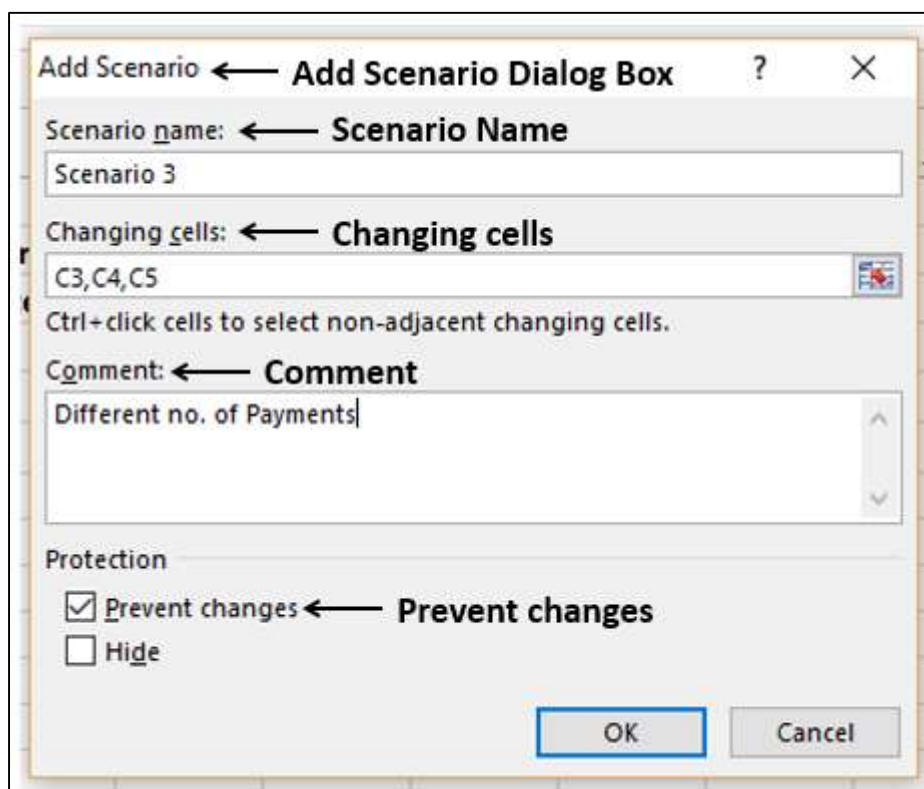
3: Type 0

Add ↓

Add OK Cancel

The **Add Scenario** dialog box appears. Note that C3, C4, C5 appear in the box under changing cells.

- In the Scenario Name box, type Scenario 3.
- Edit the text in the **Comment** box as – Different no. of Payments.
- Select Prevent changes under Protection and click OK.



Add Scenario ← Add Scenario Dialog Box

Scenario name: ← Scenario Name

Scenario 3

Changing cells: ← Changing cells

C3,C4,C5

Ctrl+click cells to select non-adjacent changing cells.

Comment: ← Comment

Different no. of Payments

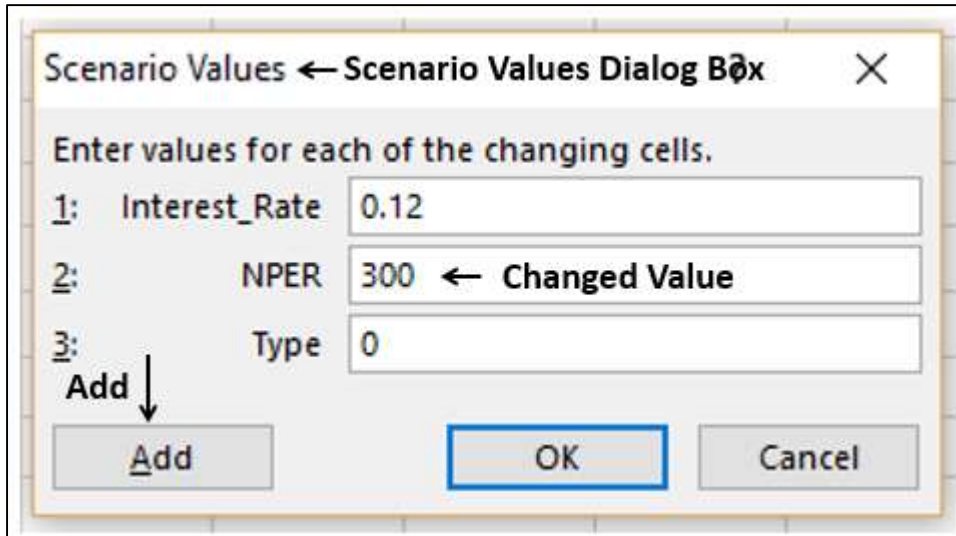
Protection

☒ Prevent changes ← Prevent changes

☐ Hide

OK Cancel

The Scenario Values dialog box appears. The initial values appear in the changing cells. Change the value of NPER to 300 and click **Add**.



**Scenario Values** ← Scenario Values Dialog Box

Enter values for each of the changing cells.

1: Interest\_Rate 0.12

2: NPER 300 ← Changed Value

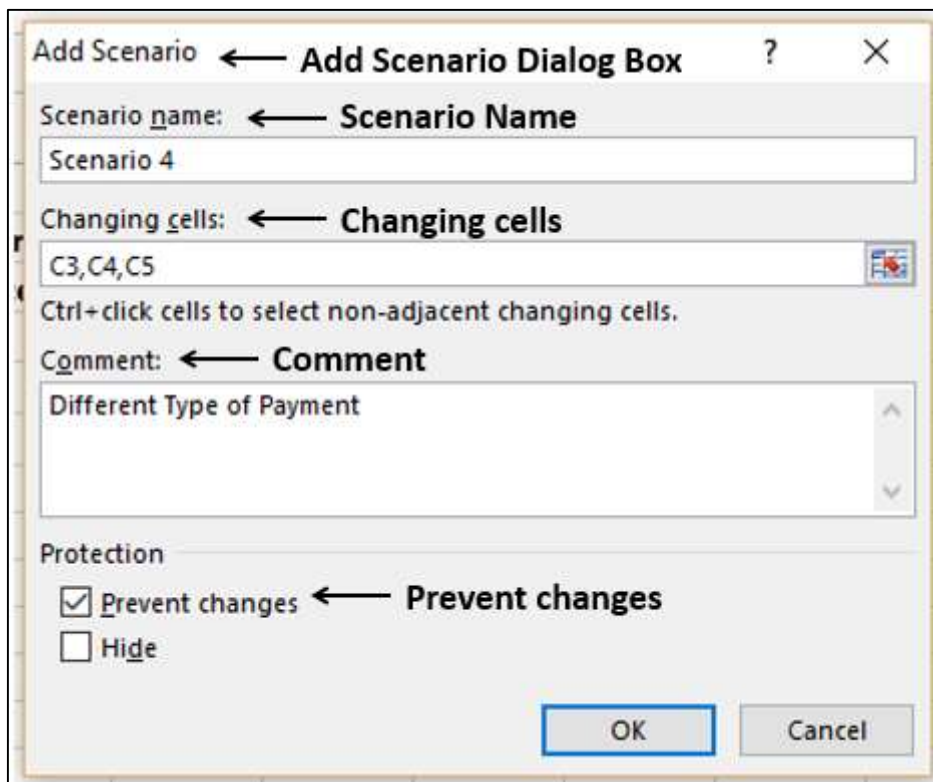
3: Type 0

Add ↓

Add OK Cancel

The **Add Scenario** dialog box appears. Note that C3, C4, C5 appear in the Changing cells box.

- In the Scenario Name box, type Scenario 4.
- Edit the text in the **Comment** box as – Different Type of Payment.
- Select Prevent changes under Protection and click OK.



**Add Scenario** ← Add Scenario Dialog Box

Scenario name: ← Scenario Name

Scenario 4

Changing cells: ← Changing cells

C3,C4,C5

Ctrl+click cells to select non-adjacent changing cells.

Comment: ← Comment

Different Type of Payment

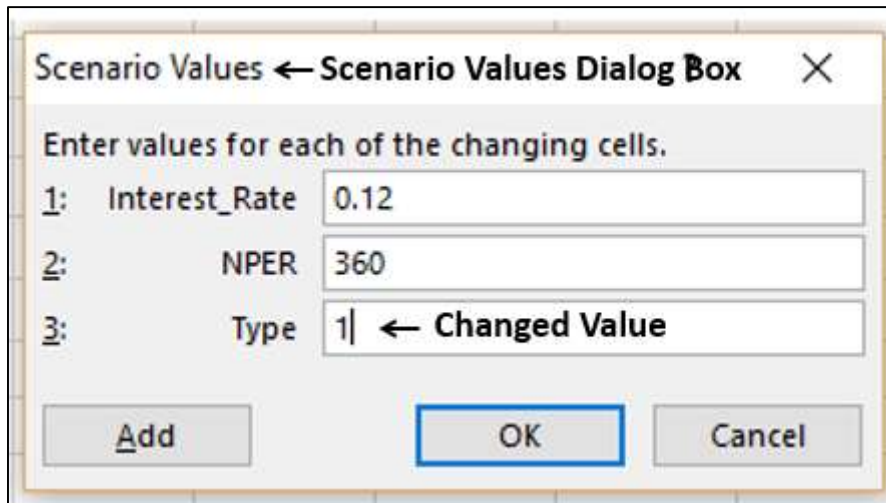
Protection

☒ Prevent changes ← Prevent changes

☐ Hide

OK Cancel

The **Scenario Values** dialog box appears. The initial values appear in the changing cells. Change the value of Type to 1. Click OK as you have added all the scenarios that you wanted to add.



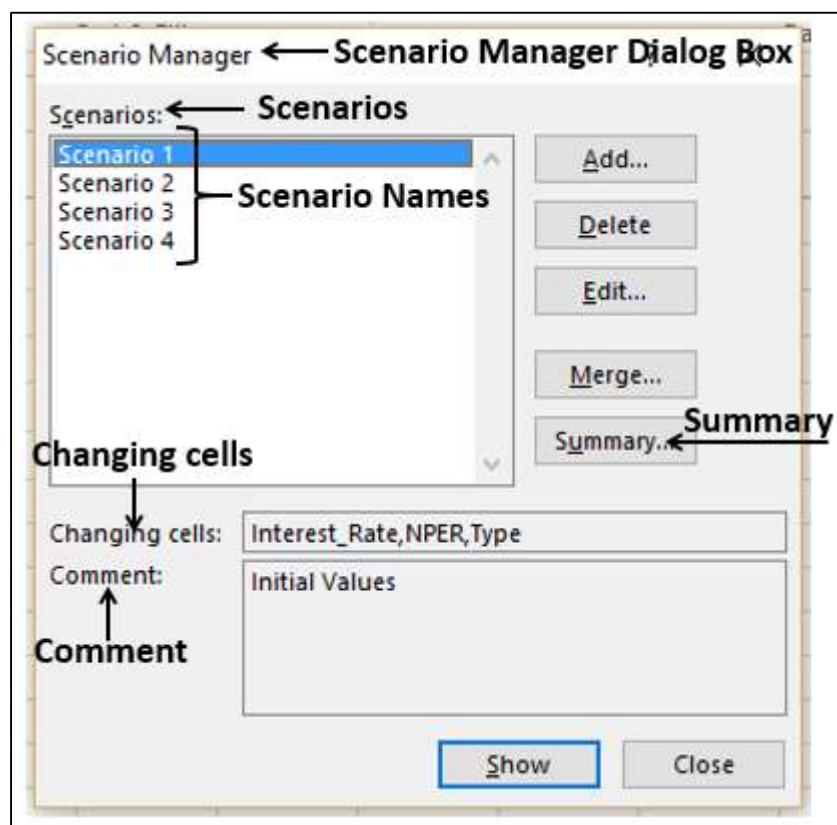
**Scenario Values** ← **Scenario Values Dialog Box** ✕

Enter values for each of the changing cells.

1:	Interest_Rate	0.12
2:	NPER	360
3:	Type	1  ← Changed Value

The **Scenario Manager** dialog box appears. In the box under Scenarios, You will find the names of all the scenarios that you have created.

- Click Scenario 1. As you are aware, Scenario 1 contains the initial values.



**Scenario Manager** ← **Scenario Manager Dialog Box**

Scenarios: ← **Scenarios**

- Scenario 1
- Scenario 2
- Scenario 3
- Scenario 4

← **Scenario Names**

← **Summary**

Changing cells: Interest\_Rate,NPER,Type

Comment: Initial Values

← **Comment**

Now, click **Summary**. The Scenario Summary dialog box appears.



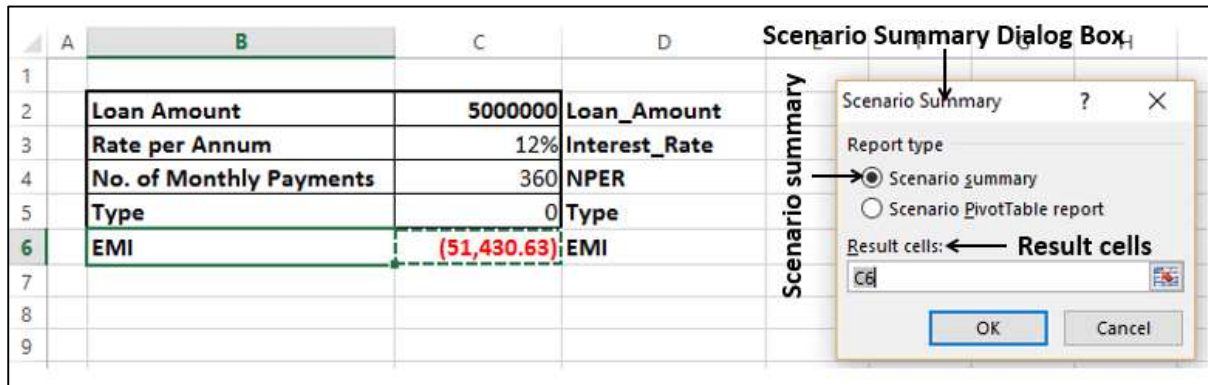
## Scenario Summary Reports

Excel provides two types of Scenario Summary reports –

- Scenario summary.
- Scenario PivotTable report.

In the Scenario Summary dialog box, you can find these two Report types.

Select Scenario summary under Report type.



## Scenario Summary

In the **Result cells** box, select the cell **C6** (Here, we had put the **PMT** function). Click OK.

Scenario Summary report appears in a new worksheet. The worksheet is named as Scenario Summary.

Current Values		Scenarios			
		Scenario 1	Scenario 2	Scenario 3	Scenario 4
<b>Changing Cells:</b>					
Interest_Rate	12%	12%	13%	12%	12%
NPER	360	360	360	300	360
Type	0	0	0	0	1
<b>Result Cells:</b>					
EMI	(51,430.63)	(51,430.63)	(55,309.98)	(52,661.21)	(50,921.42)

Notes: Current Values column represents values of changing cells at time Scenario Summary Report was created. Changing cells for each scenario are highlighted in gray.

You can observe the following in the Scenario Summary report –

- **Changing Cells:** Enlists all the cells used as changing cells. As you have named the cells, Interest\_Rate, NPER and Type, these appear to make the report meaningful. Otherwise, only cell references will be listed.
- **Result Cells:** Displays the result cell specified, i.e. EMI.

- **Current Values:** It is the first column and enlists the values of that scenario which is selected in the Scenario Manager Dialog box before creating the summary report.
- For all the scenarios you have created, the changing cells will be highlighted in gray.
- In the EMI row, the result values for each scenario will be displayed.

You can make the report more meaningful by displaying the comments that you added while creating the scenarios.

- Click the + button to the left of the row containing the scenario names. The comments for the scenarios appear in the row under the scenario names.

Scenario Summary		Current Values	Scenario 1	Scenario 2	Scenario 3	Scenario 4
<b>Comments</b>		Initial Values	Different Interest Rate	Different no. of Payments	Different Type of Payment	
<b>Changing Cells:</b>		<b>Changing Cells</b>				
Interest_Rate		12%	12%	13%	12%	12%
NPER		360	360	360	300	360
Type		0	0	0	0	1
<b>Result Cells:</b>		<b>Result Cells</b>				
EMI		(51,430.63)	(51,430.63)	(55,309.98)	(52,661.21)	(50,921.42)

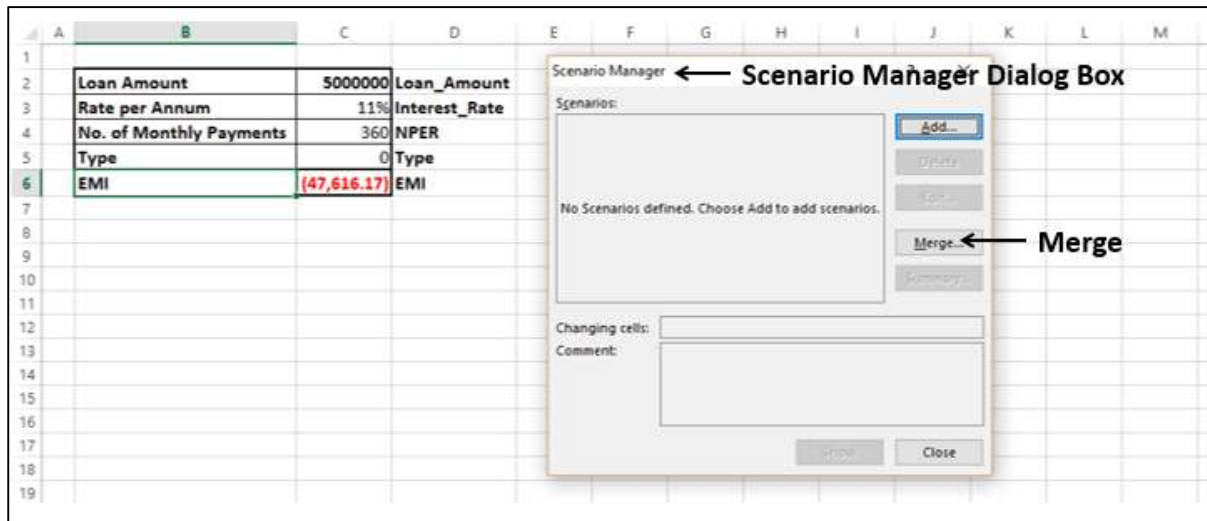
Notes: Current Values column represents values of changing cells at time Scenario Summary Report was created. Changing cells for each scenario are highlighted in gray.

## Scenarios from Different Sources

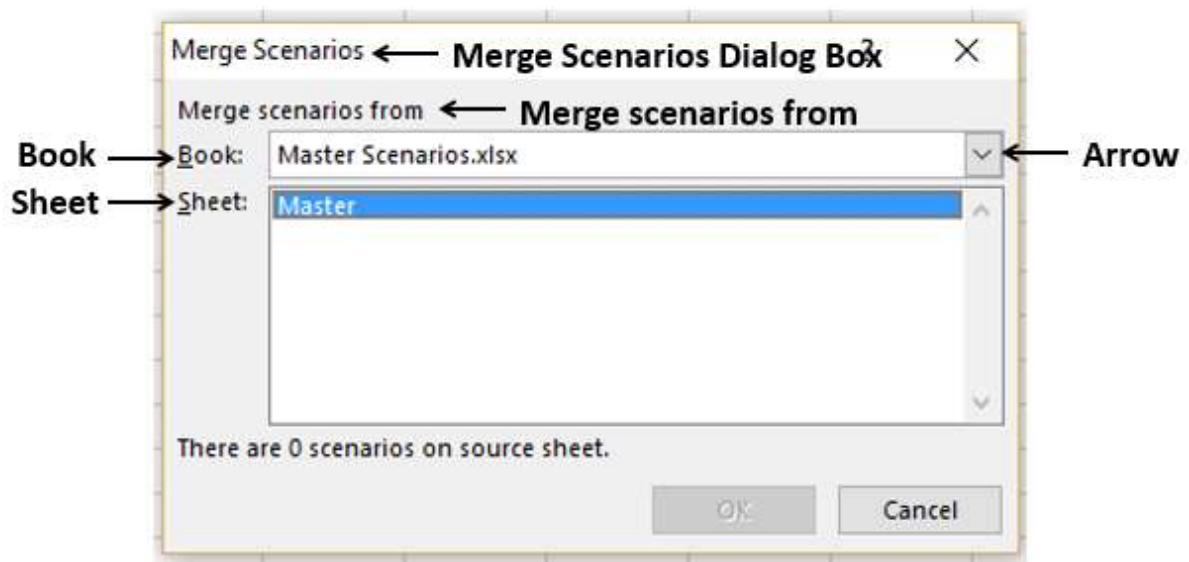
Suppose you get the scenarios from three different sources and you need to prepare the Scenario summary report in a Master workbook. You can do this by merging the scenarios from different workbooks into the Master workbook. Follow the steps given below-

- Assume that the scenarios are in the workbooks, Bank1\_Scenarios, Bank2\_Scenarios and Bank3\_Scenarios. Open the three workbooks.
- Open the Master workbook, in which you have the initial values.
- Click DATA > What-if Analysis > Scenario Manager in the Master workbook.

The **Scenario Manager** Dialog box appears.



As you can observe, there are no scenarios as you have not yet added any. Click **Merge**. The Merge Scenarios dialog box appears.

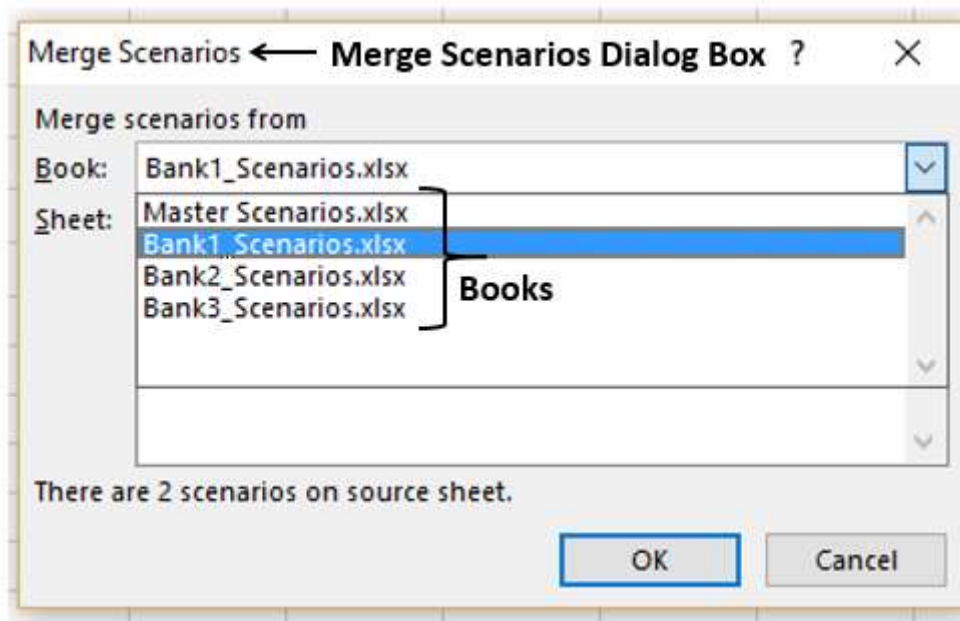


As you can see, under Merge scenarios from, you have two boxes –

- Book
- Sheet

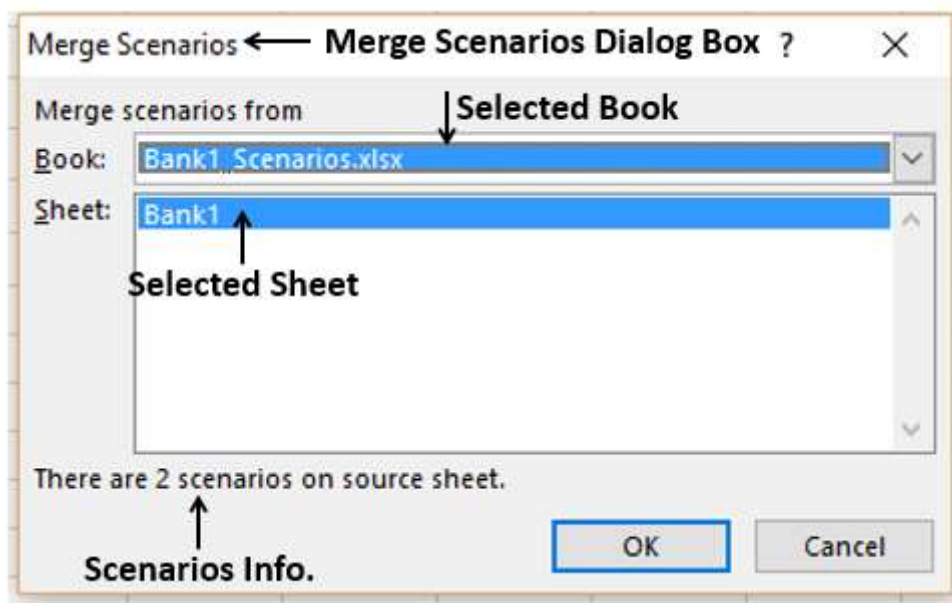
You can select specific worksheet from a specific workbook that contains the scenarios, which you want to add to your results. Click the drop-down arrow of **Book** to see the workbooks.

**Note:** The corresponding workbooks should be open to appear in this list.

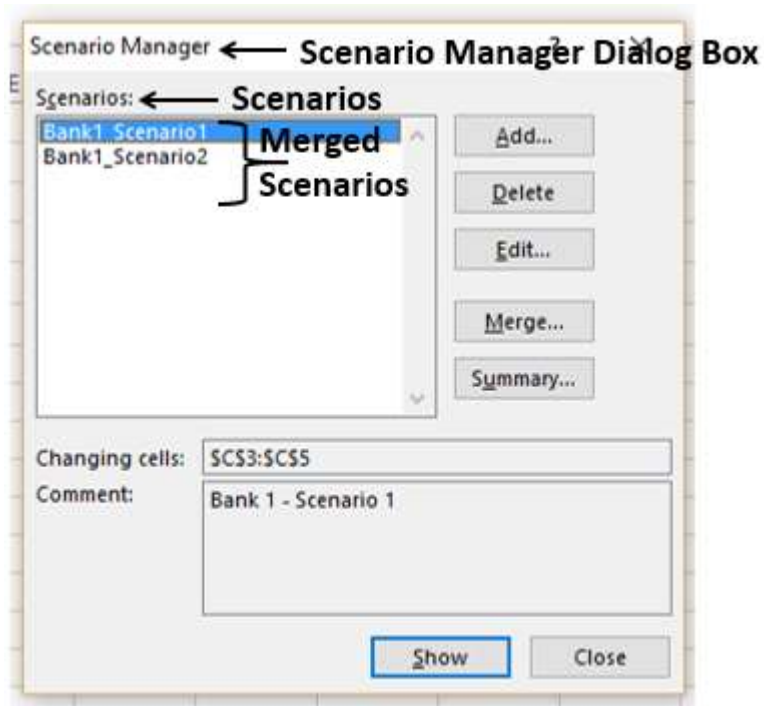


Select the book – **Bank1\_Scenarios**.

Bank1 sheet is displayed. At the bottom of the dialog box, the number of scenarios found on source sheet is displayed. Click OK.

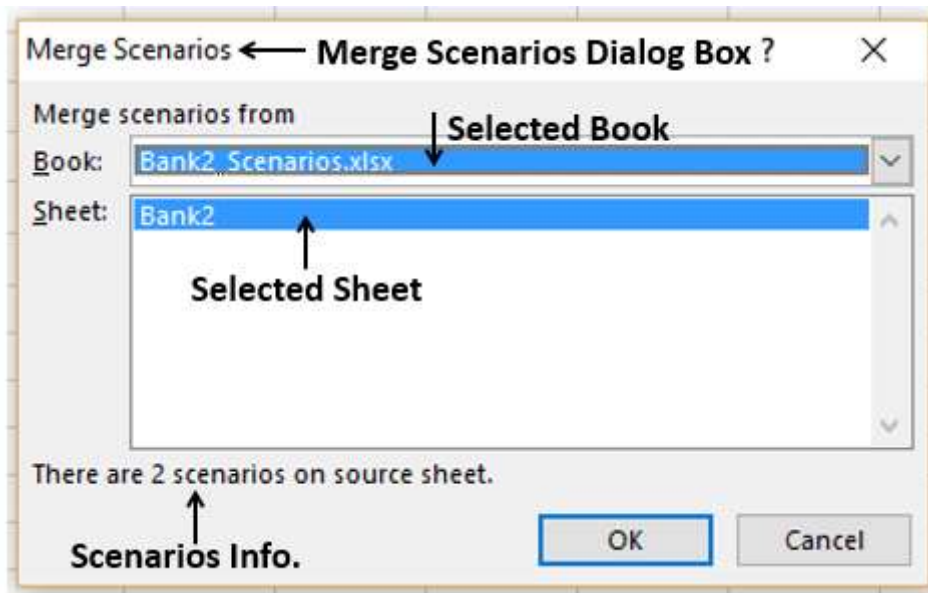


The Scenario Manager dialog box appears. The two scenarios that were merged into the Master workbook will be listed under Scenarios.

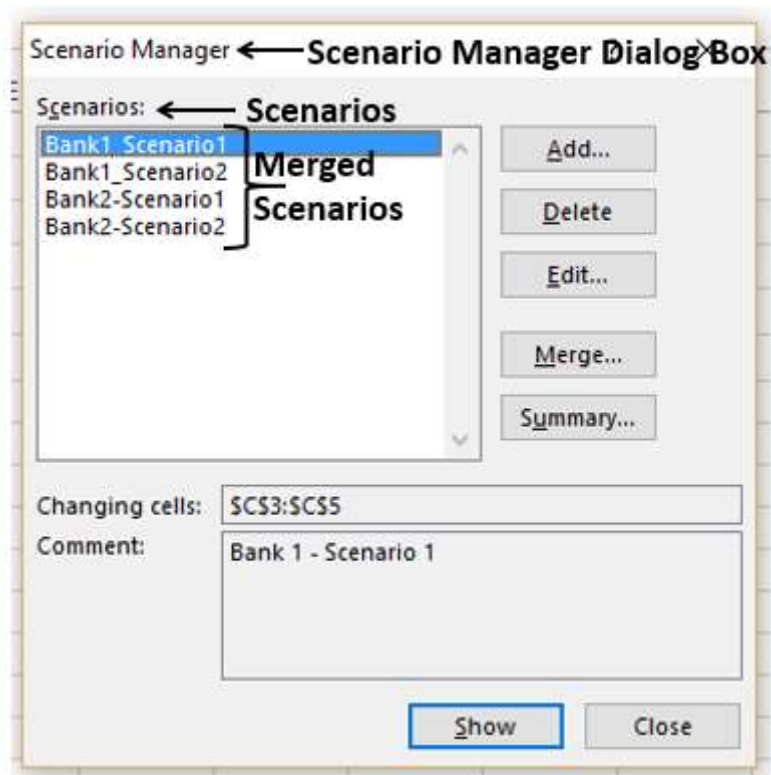


Click the **Merge** button. The **Merge Scenarios** dialog box appears. Now, select **Bank2\_Scenarios** from the drop-down list in the Book box.

Bank2 sheet is displayed. At the bottom of the dialog box, the number of scenarios found on source sheet are displayed. Click OK.

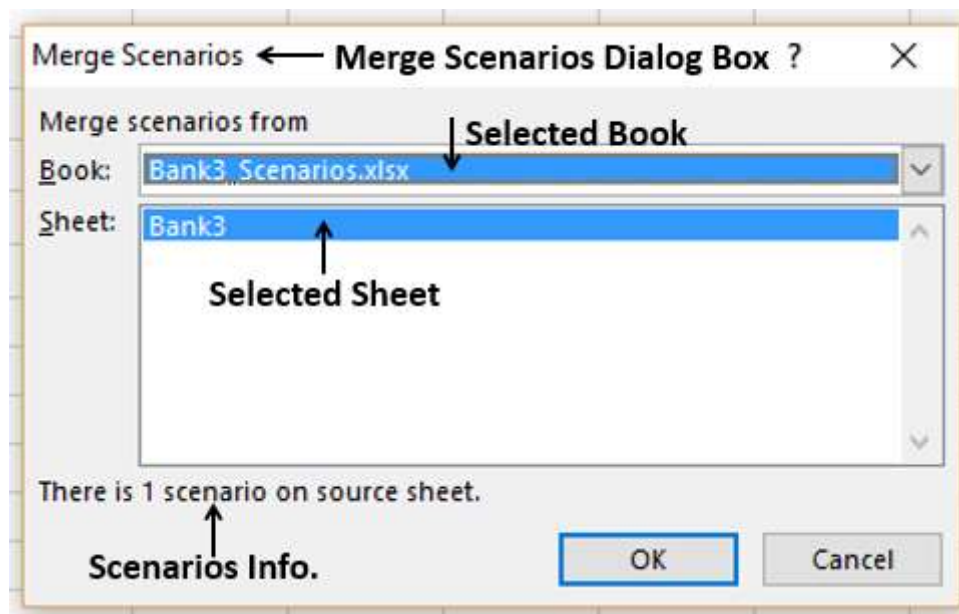


The **Scenario Manager** Dialog box appears. The four scenarios that were merged into the Master workbook are listed under Scenarios.



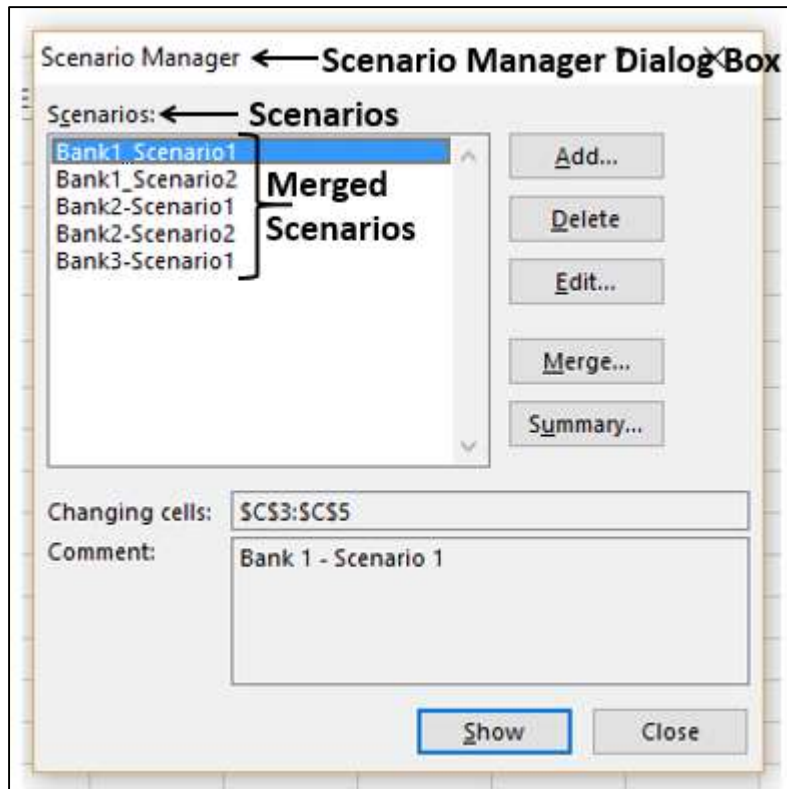
Click the **Merge** button. The **Merge Scenarios** dialog box appears. Now, select **Bank3\_Scenarios** from the drop-down list in the Book box.

Bank3 sheet is displayed. At the bottom of the dialog box, the number of scenarios found on source sheet will be displayed. Click OK.



The Scenario Manager Dialog box appears. The five scenarios that were merged into the Master workbook will be listed under Scenarios.

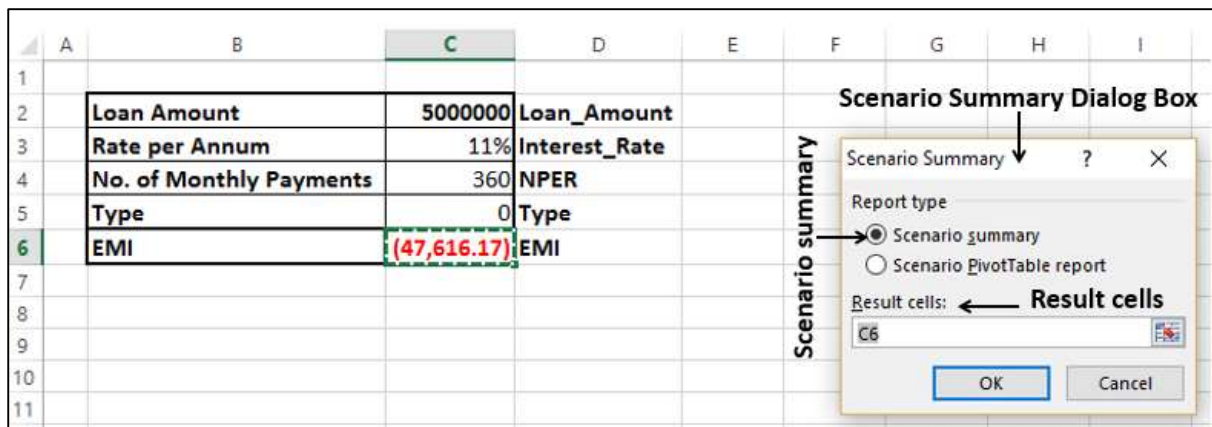




Now, you have all the required scenarios to produce the Scenario summary report.

Click the Summary button. The **Scenario Summary** dialog box appears.

- Select Scenario summary.
- In the Result cells box, type C6 and click OK.



The Scenario summary report appears on a new worksheet in the Master workbook.

Scenario Summary						
Current Values: Bank1_Scenario1 Bank1_Scenario2 Bank2-Scenario1 Bank2-Scenario2 Bank3-Scenario1						
<b>Changing Cells:</b>						
Interest_Rate	11%	10%	10%	9%	10%	12%
NPER	360	360	360	360	360	360
Type	0	0	0	0	0	0
<b>Result Cells:</b>						
EMI	(47,616.17)	(43,141.43)	(44,248.51)	(41,678.39)	(43,509.55)	(50,278.96)

Notes: Current Values column represents values of changing cells at time Scenario Summary Report was created. Changing cells for each scenario are highlighted in gray.

## Displaying Scenarios

Suppose you are presenting your scenarios and you would like to dynamically switch from one scenario to another and display the set of input values and result values of the corresponding scenario.

- Click DATA > What-if Analysis > Scenario Manager from the Data Tools group. The Scenario Manager Dialog box appears. The list of scenarios appear.
- Select the scenario you want to display. Click **Show**.

Scenario Manager ← Scenario Manager Dialog Box

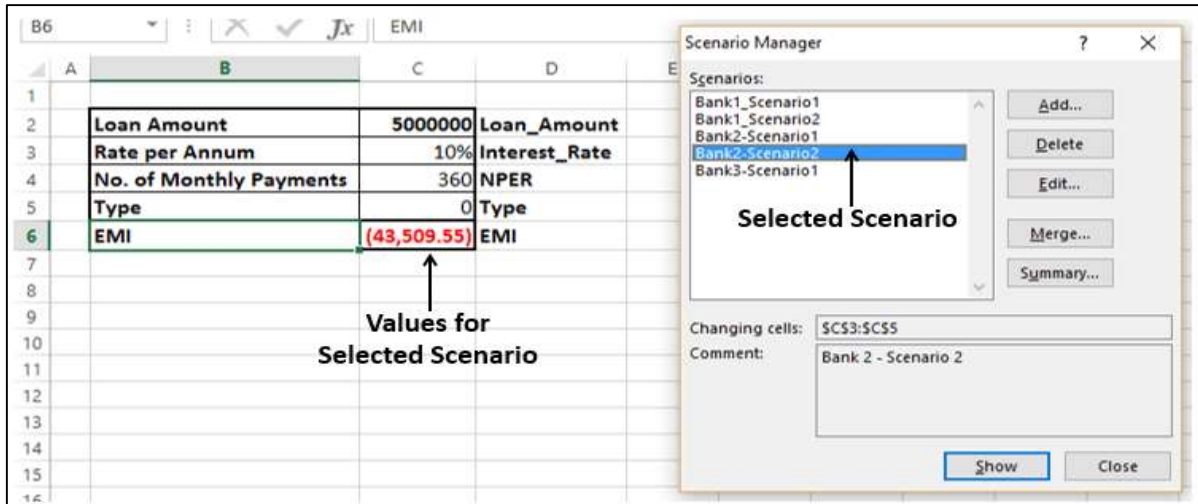
Scenarios: ← Scenarios

Bank1\_Scenario1  
Bank1\_Scenario2  
Bank2-Scenario1  
**Bank2-Scenario2** ← Selected Scenario  
Bank3-Scenario1

Changing cells: \$C\$3:\$C\$5  
Comment: Bank 2 - Scenario 2

Show → Show Close

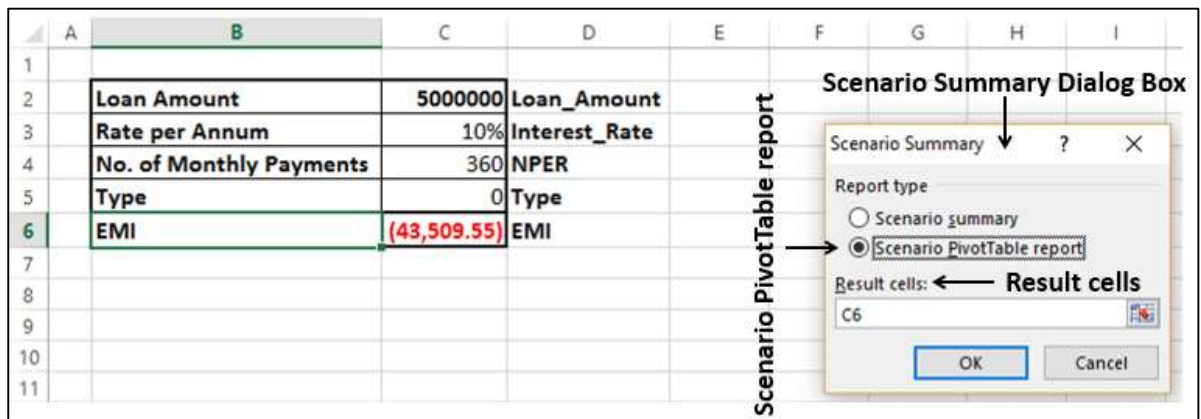
The values on the worksheet are updated to that of the selected scenario. The result values are recalculated.



## Scenario PivotTable Report

You can see the Scenario report in the form of a PivotTable also.

- Click the Summary button in the Scenario Manager Dialog box. The **Scenario Summary** dialog box appears.
- Select the **Scenario PivotTable report** under Report type.
- Type C6 in the **Result cells** box.



Scenario PivotTable report appears on a new worksheet.

	A	B	C	D	E	F
1						
2						
3		Column Labels				
4		Bank1_Scenario1	Bank1_Scenario2	Bank2-Scenario1	Bank2-Scenario2	Bank3-Scenario1
5		EMI	-43141.43	-44248.51	-41678.39	-43509.55
6						
7						

## 27. What-If Analysis with Goal Seek

Goal Seek is a What-If Analysis tool that helps you to find the input value that results in a target value that you want. **Goal Seek** requires a formula that uses the input value to give result in the target value. Then, by varying the input value in the formula, Goal Seek tries to arrive at a solution for the input value.

Goal Seek works only with one variable input value. If you have more than one input value to be determined, you have to use the Solver add-in. Refer to the chapter – Optimization with Excel Solver in this tutorial.

### Analysis with Goal Seek

Suppose you want to take a loan of 5,000,000 and you want to repay in 25 years. You can pay an EMI of 50000. You want to know at what interest rate you can borrow the loan.

You can use **Goal Seek** to find the interest rate at which you can borrow the loan as follows –

1. Set up the Excel cells for Goal Seek as given below.

	A	B	C	D
1				
2		Rate per Annum		Interest_Rate
3		No. of Monthly Payments	360	NPER
4		Loan Amount	5000000	Loan_Amount
5		Type	0	Type
6		EMI	=PMT(Interest_Rate/12,NPER,Loan_Amount,0,Type)	EMI
7				

2. Enter the values in column C corresponding to column D. The cell **Interest\_Rate** is kept empty, as you have to retrieve that value. Further, though you know the EMI that you can pay (50000), that value is not included as you have to use the Excel PMT function to arrive at it. Goal Seek requires a formula to find the result. The PMT function is placed in the cell EMI so that it can be used by Goal Seek.

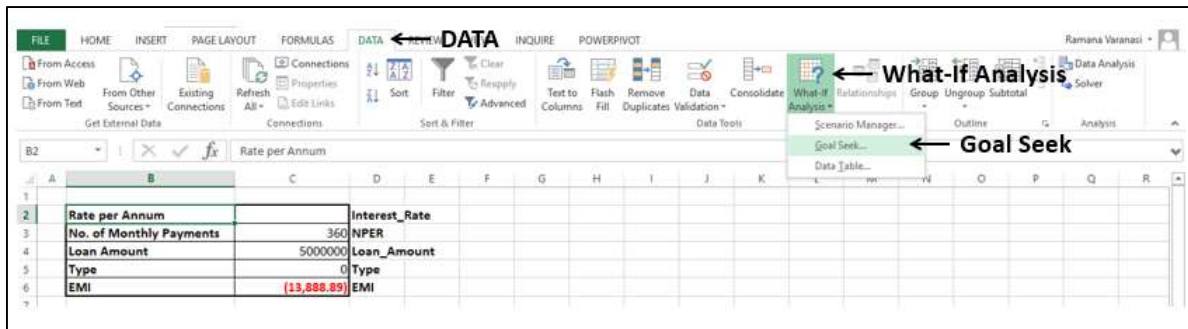
Excel computes the EMI with the PMT function. The table now looks like-

	A	B	C	D	E
1					
2		Rate per Annum		Interest_Rate	
3		No. of Monthly Payments	360	NPER	
4		Loan Amount	5000000	Loan_Amount	
5		Type	0	Type	
6		EMI	(13,888.89)	EMI	
7					

As the **Interest\_Rate** cell is empty, Excel takes that value as 0 and calculates the EMI. You can ignore the result **-13,888.89**.

Perform the Analysis with Goal Seek as follows –

1. Go to **DATA > What If Analysis > Goal Seek** on the Ribbon.



The Goal Seek dialog box appears.

2. Type EMI in the **Set cell** box. This box is the reference for the cell that contains the formula that you want to resolve, in this case the PMT function. It is the cell C6, which you named as EMI.
3. Type -50000 in the **To value** box. Here, you get the formula result, in this case, the EMI that you want to pay. The number is negative because it represents a payment.
4. Type Interest\_Rate in the **By changing cell** box. This box has the reference of the cell that contains the value you want to adjust, in this case the interest rate. It is cell C2, which you named as Interest\_Rate.
5. This cell that Goal Seek changes, must be referenced by the formula in the cell that you specified in the Set cell box. Click OK.

The spreadsheet shows the following data in columns A through F:

	A	B	C	D	E	F
1						
2		Rate per Annum		Interest_Rate		
3		No. of Monthly Payments	360	NPER		
4		Loan Amount	5000000	Loan_Amount		
5		Type	0	Type		
6		EMI	(13,888.89)	EMI		

The **Goal Seek** dialog box is open, with the following settings:

- Set cell:** EMI
- To value:** -50000
- By changing cell:** Interest\_Rate

Arrows indicate the mapping: **Set cell** points to EMI, **To value** points to -50000, and **By changing cell** points to Interest\_Rate.

Goal Seek produces a result, as shown below-

The spreadsheet now shows the updated results:

	A	B	C	D	E	F
1						
2		Rate per Annum	12%	Interest_Rate		
3		No. of Monthly Payments	360	NPER		
4		Loan Amount	5000000	Loan_Amount		
5		Type	0	Type		
6		EMI	(50,000.00)	EMI		

The **Goal Seek Status** dialog box is open, showing:

- Goal Seeking with Cell C6 found a solution.**
- Target value:** -50000
- Current value:** (50,000.00)

Arrows indicate the mapping: **Target value** points to -50000 and **Current value** points to (50,000.00).

As you can observe, Goal Seek found the solution using cell C6 (containing the formula) as 12% that is displayed in the cell C2, which is the interest rate. Click OK.



## Solving Story Problems

You can solve story problems easily with Goal Seek. Let us understand this with the help of an example.

### Example

Suppose there is a bookstore that has 100 books in storage. The original price of the book is 250 and certain number of books was sold at that price. Later, the bookstore announced a 10% discount on that book and cleared off the stock. You might want to know how many books are sold at the original price to obtain a total revenue of 24,500.

You can use Goal Seek to find the solution. Follow the steps given below-

1. Set the worksheet as given below.

Revenue $\text{fx}$ =Books_OriginalPrice*Original_Price+Books_DiscPrice*Discounted_Price			
	A	B	C
1			
2			
3		Total No. of Books	No. of Books sold at Original Price
4		100	
5			
6			
7			No. of Books Sold
8		Original Price	=Books_OriginalPrice    250
9		Discounted Price	=TotalNo_Books-Books_OriginalPrice    =Original_Price*90/100
10			Revenue    =Books_OriginalPrice*Original_Price+Books_DiscPrice*Discounted_Price

1. Go to **DATA > What If Analysis > Goal Seek** on the Ribbon.

The Goal Seek dialog box appears.

2. Type **Revenue, 24500 and Books\_OriginalPrice** in the Set cell box, To Value box and By changing cell box respectively. Click OK.

Revenue :  $\text{=Books\_OriginalPrice*Original\_Price+Books\_DiscPrice*Discounted\_Price}$

	A	B	C	D
1				
2				
3		<b>Total No. of Books</b>	<b>No. of Books sold at Original Price</b>	
4		100		
5				
6				
7			<b>No. of Books Sold</b>	<b>Price</b>
8		<b>Original Price</b>	$\text{=Books\_OriginalPrice}$	250
9		<b>Discounted Price</b>	$\text{=TotalNo\_Books-Books\_OriginalPrice}$	$\text{=Original\_Price*90/100}$
10			<b>Revenue</b>	$\text{=Books\_OriginalPrice*Original\_Price+Books\_DiscPrice*Discounted\_Price}$
11				
12				
13				
14				
15				
16				
17				
18				

Goal Seek

Set cell: Revenue

To value: 24500

By changing cell: riginalPrice

OK Cancel

Goal Seek displays the status and solution.

	A	B	C	D
1				
2				
3		<b>Total No. of Books</b>	<b>No. of Books sold at Original Price</b>	
4		100	80	
5				
6				
7			<b>No. of Books Sold</b>	<b>Price</b>
8		<b>Original Price</b>	80	250
9		<b>Discounted Price</b>	20	225
10			<b>Revenue</b>	24500
11				
12				
13				
14				
15				
16				
17				
18				

Goal Seek Status

Goal Seeking with Cell D10 found a solution.

Target value: 24500

Current value: 24500

Step Pause OK Cancel

If 80 books were sold at the original price, the revenue would be 24500.

## Performing a Break-even Analysis

In economy, break-even point is the point at which there is neither profit nor loss. This would mean –

$$\text{Revenue} = \text{Expenses, or}$$

$$\text{Revenue} - \text{Expenses} = 0$$

You can do **break-even analysis with Goal Seek** in Excel.

### Example

Suppose there is a store that sells toys. You might want to make a break-even analysis of the store. Collect the following information from the store –

- Fixed cost of the store.
- Unit cost of the toy.
- Number of toys to be sold.

You need to find at which price they should sell the toys to break even.

**1.** Set the worksheet as given below.

Brek_eve...    X    ✓    fx    =Revenue-Expenses			
	A	B	C
1			
2		Fixed Cost	5000
3		No. of Toys	500
4		Unit Cost	25
5		Unit Price	
6		Revenue	=Unit_Price*No_of_Toys
7		Expenses	=Fixed_Cost+Unit_Cost*No_of_Toys
8		Break-even Point	=Revenue-Expenses

**2.** Go to **DATA > What If Analysis > Goal Seek** on the Ribbon. The Goal Seek dialog box appears.

3. Type **Break\_even\_Point**, **0**, and **Unit\_Price** in the Set cell box, To value box and By changing cell box respectively. Click OK.

The screenshot shows an Excel spreadsheet with the following data:

	A	B	C	D
1				
2		Fixed Cost	5000	Fixed_Cost
3		No. of Toys	500	No_of_Toys
4		Unit Cost	25	Unit_Cost
5		Unit Price		Unit_Price
6		Revenue	=Unit_Price*No_of_Toys	Revenue
7		Expenses	=Fixed_Cost+Unit_Cost*No_of_Toys	Expenses
8		Break-even Point	=Revenue-Expenses	Break_even_Point
9				
10				
11				
12				
13				
14				
15				
16				
17				

The Goal Seek dialog box is open, showing the following settings:

- Set cell: k\_even\_Point
- To value: 0
- By changing cell: Unit\_Price

Buttons: OK, Cancel

As you can observe, Goal Seek gave the result that if the Unit Price is 35, the store will break even.

C8		=Revenue-Expenses	
	A	B	C
1			
2		<b>Fixed Cost</b>	5000
3		<b>No. of Toys</b>	500
4		<b>Unit Cost</b>	25
5		<b>Unit Price</b>	35
6		<b>Revenue</b>	=Unit_Price*No_of_Toys
7		<b>Expenses</b>	=Fixed_Cost+Unit_Cost*No_of_Toys
8		<b>Break-even Point</b>	=Revenue-Expenses
9			
10			
11			
12			
13			
14			
15			
16			

Goal Seek Status ? X

Goal Seeking with Cell C8 found a solution.

Target value: 0

Current value: 0

Step

Pause

OK

Cancel

## 28. Optimization with Excel Solver

**Solver** is a Microsoft Excel add-in program you can use for optimization in what-if analysis.

According to O'Brien and Marakas, **optimization analysis** is a more complex extension of goal-seeking analysis. Instead of setting a specific target value for a variable, the goal is to find the optimum value for one or more target variables, under certain constraints. Then, one or more other variables are changed repeatedly, subject to the specified constraints, until you discover the best values for the target variables.

In Excel, you can use **Solver** to find an **optimal value** (maximum or minimum, or a certain value) for a formula in one cell called the objective cell, subject to certain constraints or limits, on the values of other formula cells on the worksheet.

This means that the Solver works with a group of cells called decision variables that are used in computing the formulas in the objective and constraint cells. Solver adjusts the values in the decision variable cells to satisfy the limits on constraint cells and produce the result you want for the objective cell.

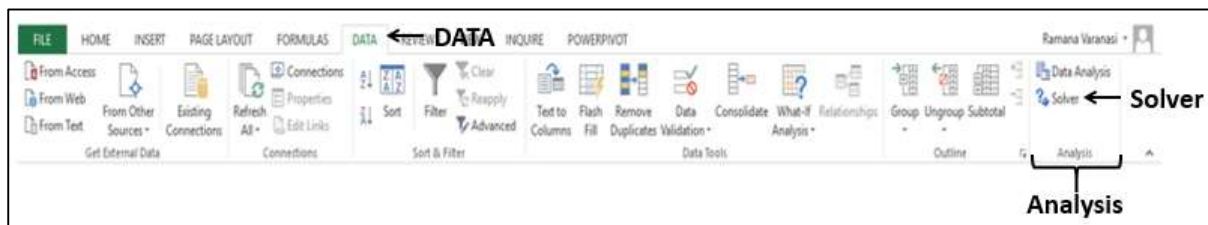
You can use Solver to find optimal solutions for diverse problems such as-

- Determining the monthly product mix for a drug manufacturing unit that maximizes the profitability.
- Scheduling workforce in an organization.
- Solving transportation problems.
- Financial planning and budgeting.

### Activating Solver Add-in

Before you proceed with finding solution for a problem with Solver, ensure that the **Solver Add-in** is activated in Excel as follows –

- Click the DATA tab on the Ribbon. The **Solver** command should appear in the Analysis group as shown below.

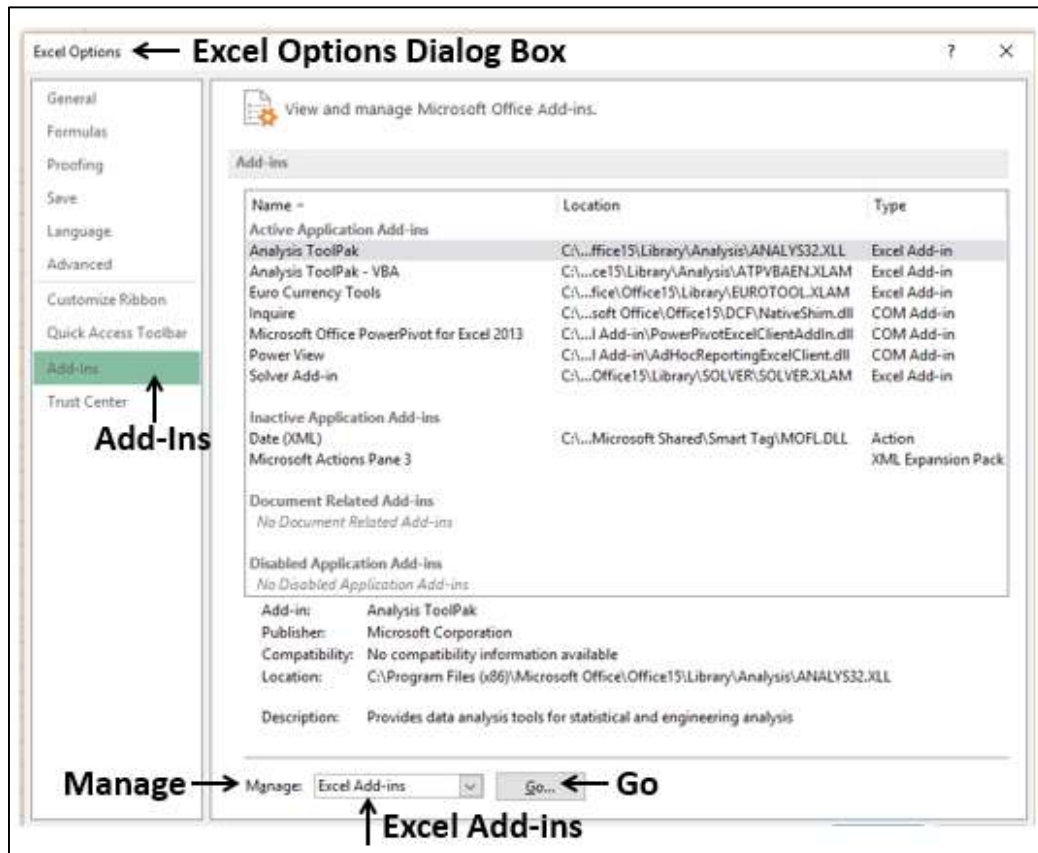


In case you do not find the Solver command, activate it as follows –

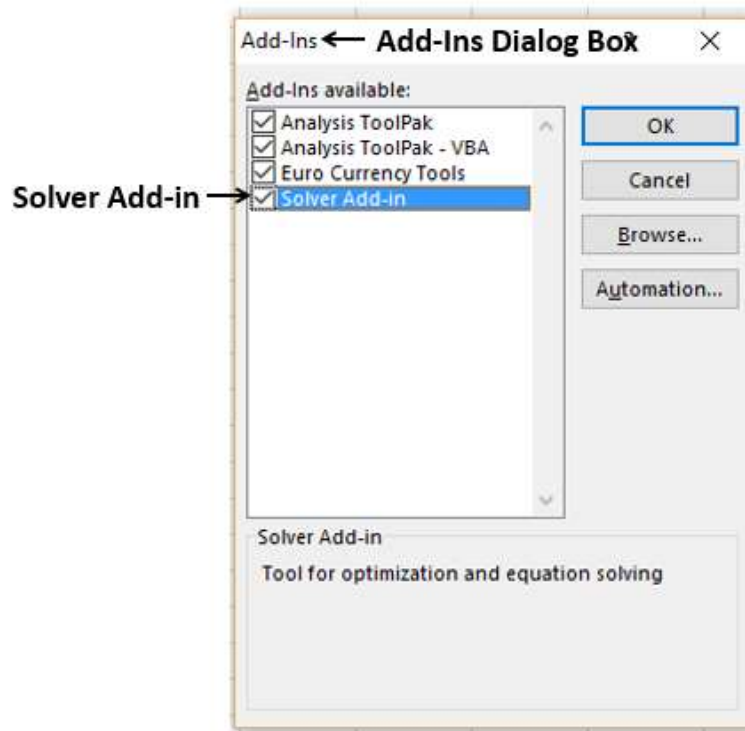
- Click the FILE tab.
- Click Options in the left pane. Excel Options dialog box appears.



- Click Add-Ins in the left pane.
- Select Excel Add-Ins in the Manage box and click Go.



The Add-Ins dialog box appears. Check **Solver Add-in** and click Ok. Now, you should be able to find the Solver command on the Ribbon under the DATA tab.



## Solving Methods used by Solver

You can choose one of the following three solving methods that Excel Solver supports, based on the type of problem-

### LP Simplex

Used for linear problems. A **Solver** model is linear under the following conditions-

- The target cell is computed by adding together the terms of the (changing cell)\*(constant) form.
- Each constraint satisfies the linear model requirement. This means that each constraint is evaluated by adding together the terms of the (changing cell)\*(constant) form and comparing the sums to a constant.

### Generalized Reduced Gradient (GRG) Nonlinear

Used for smooth nonlinear problems. If your target cell, any of your constraints, or both contain references to changing cells that are not of the (changing cell)\*(constant) form, you have a nonlinear model.

### Evolutionary

Used for non-smooth problems. Optimization problems in which the target cell, any of the constraints, or both have no slope for any changing cell values are called non-smooth optimization problems.

## Understanding Solver Evaluation

The Solver requires the following parameters –

- Decision Variable Cells
- Constraint Cells
- Objective Cells
- Solving Method

Solver evaluation is based on the following-

- The values in the decision variable cells are restricted by the values in the constraint cells.
- The calculation of the value in the objective cell includes the values in the decision variable cells.
- Solver uses the chosen Solving Method to result in the optimal value in the objective cell.

## Defining a Problem

Suppose you are analyzing the profits made by a company that manufactures and sells a certain product. You are asked to find the amount that can be spent on advertising in the next two quarters subject to a maximum of 20,000. The level of advertising in each quarter affects the following –

- The number of units sold, indirectly determining the amount of sales revenue.
- The associated expenses, and
- The profit.

You can proceed to define the problem as–

- Find Unit Cost.
- Find the advertising cost per Unit.
- Find Unit Price.

	A	B	C
1			
2		<b>Unit Cost</b>	50
3		<b>Unit Price</b>	100
4		<b>Adv. Cost per Unit</b>	20

Next, set the cells for the required calculations as given below.

	A	B	C	D
1				
2		Unit Cost	50	Total Profit
3		Unit Price	100	=C12+D12
4		Adv. Cost per Unit	20	
5				
6			Quarter1	Quarter2
7		No. of Units Available	400	600
8		Adv. Budget	10000	10000
9		No. of Units Sold	=MIN(C8/C4,C7)	=MIN(D8/C4,D7)
10		Revenue	=C3*C9	=C3*D9
11		Expenses	=C2*C7+C8	=C2*D7+D8
12		Profit	=C10-C11	=D10-D11

As you can observe, the calculations are done for Quarter1 and Quarter2 that are in consideration are-

- No. of units available for sale in Quarter1 is 400 and in Quarter2 is 600 (cells – C7 and D7).
- The initial values for advertising budget are set as 10000 per Quarter (Cells – C8 and D8).
- No. of units sold is dependent on the advertising cost per unit and hence is budget for the quarter / Adv. Cost per unit. Note that we have used the Min function to take care to see that the no. of units sold in  $\leq$  no. of units available. (Cells – C9 and D9).
- Revenue is calculated as Unit Price \* No. of Units sold (Cells – C10 and D10).
- Expenses is calculated as Unit Cost \* No. of Units Available + Adv. Cost for that quarter (Cells – C11 and D12).
- Profit is Revenue – Expenses (Cells C12 and D12).
- Total Profit is Profit in Quarter1 + Profit in Quarter2 (Cell – D3).

Next, you can set the parameters for Solver as given below-

	A	B	C	D
1				
2		Unit Cost	50	Total Profit
3		Unit Price	100	=C12+D12
4		Adv. Cost per Unit	20	
5				
6			Quarter1	Quarter2
7		No. of Units Available	400	600
8		Adv. Budget	10000	10000
9		No. of Units Sold	=MIN(C8/C4,C7)	=MIN(D8/C4,D7)
10		Revenue	=C3*C9	=C3*D9
11		Expenses	=C2*C7+C8	=C2*D7+D8
12		Profit	=C10-C11	=D10-D11
13				
14		Total Adv. Budget	=C8+D8	20000
15		No. of Units sold in Quarter1	=C9	=C7
16		No. of Units sold in Quarter2	=D9	=D7

As you can observe, the parameters for Solver are -

- Objective cell is D3 that contains Total Profit, which you want to maximize.
- Decision Variable cells are C8 and D8 that contain the budgets for the two quarters – Quarter1 and Quarter2.
- There are three Constraint cells - C14, C15 and C16.
  - Cell C14 that contains total budget is to set the constraint of 20000 (cell D14).
  - Cell C15 that contains the no. of units sold in Quarter1 is to set the constraint of  $\leq$  no. of units available in Quarter1 (cell D15).
  - Cell C16 that contains the no. of units sold in Quarter2 is to set the constraint of  $\leq$  no. of units available in Quarter2 (cell D16).

## Solving the Problem

The next step is to use Solver to find the solution as follows –

**1.** Go to DATA > Analysis > Solver on the Ribbon. The Solver Parameters dialog box appears.

**Solver Parameters** ← **Solver Parameters Dialog Box**

Set Objective:

To: ☒ Max ☐ Min ☐ Value Of:

By Changing Variable Cells:

Subject to the Constraints:

☒ Make Unconstrained Variables Non-Negative

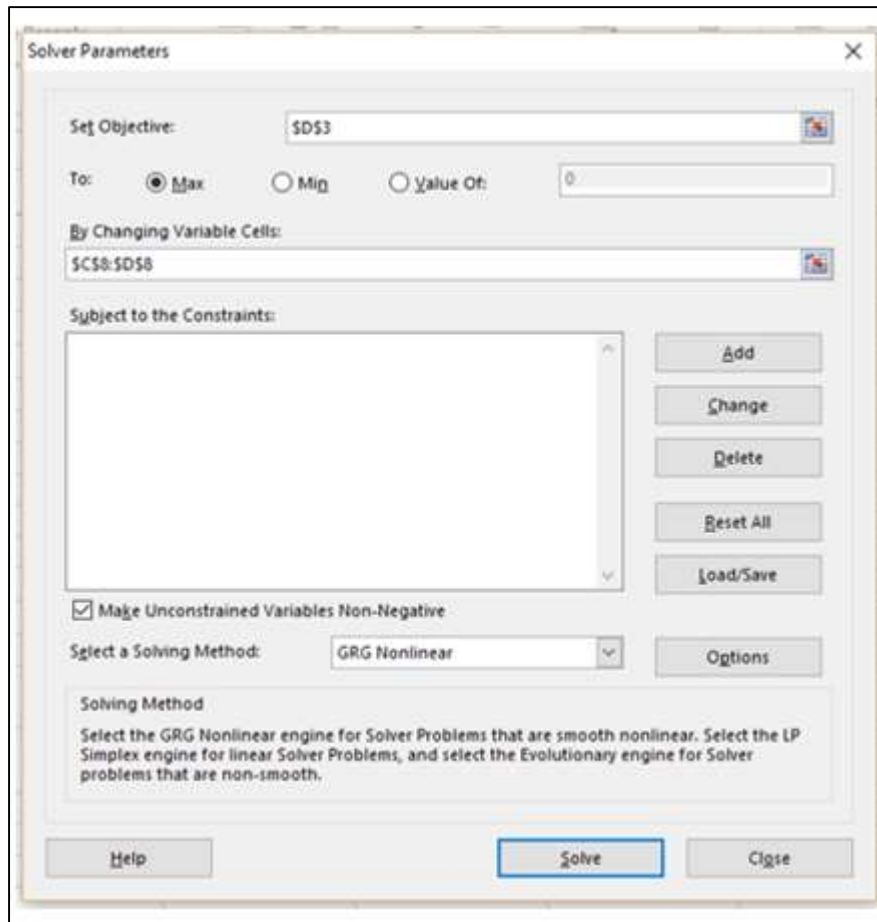
Select a Solving Method: GRG Nonlinear

**Solving Method**  
 Select the GRG Nonlinear engine for Solver Problems that are smooth nonlinear. Select the LP Simplex engine for linear Solver Problems, and select the Evolutionary engine for Solver problems that are non-smooth.

Solve

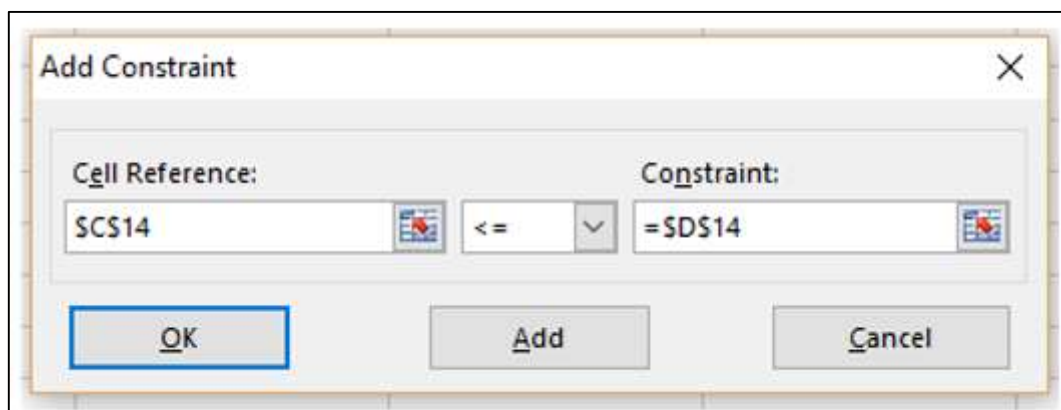
2. In the Set Objective box, select the cell D3.
3. Select Max.
4. Select range C8:D8 in the **By Changing Variable Cells** box.



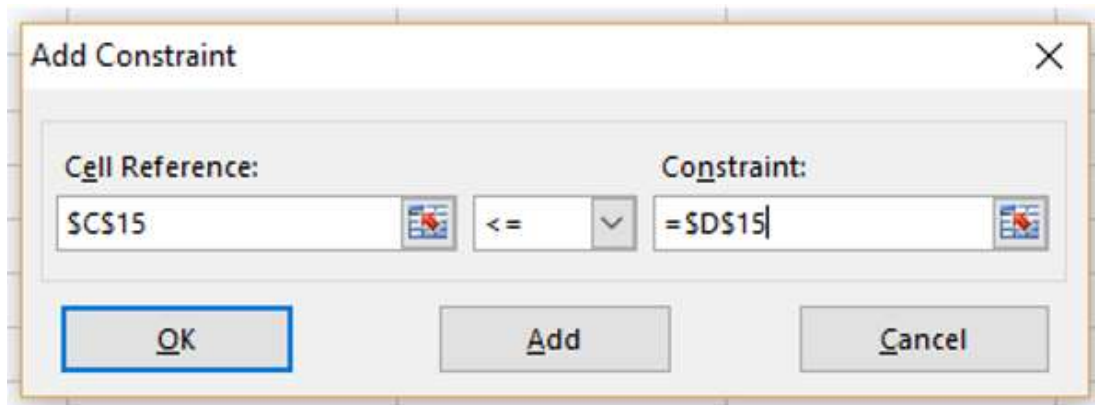


5. Next, click the Add button to add the three constraints that you have identified.

6. The Add Constraint dialog box appears. Set the constraint for total budget as given below and click Add.



7. Set the constraint for total no. of units sold in Quarter1 as given below and click Add.



The screenshot shows the 'Add Constraint' dialog box. The 'Cell Reference' field is set to '\$C\$15' and the 'Constraint' field is set to '\$D\$15'. The operator is '<='.

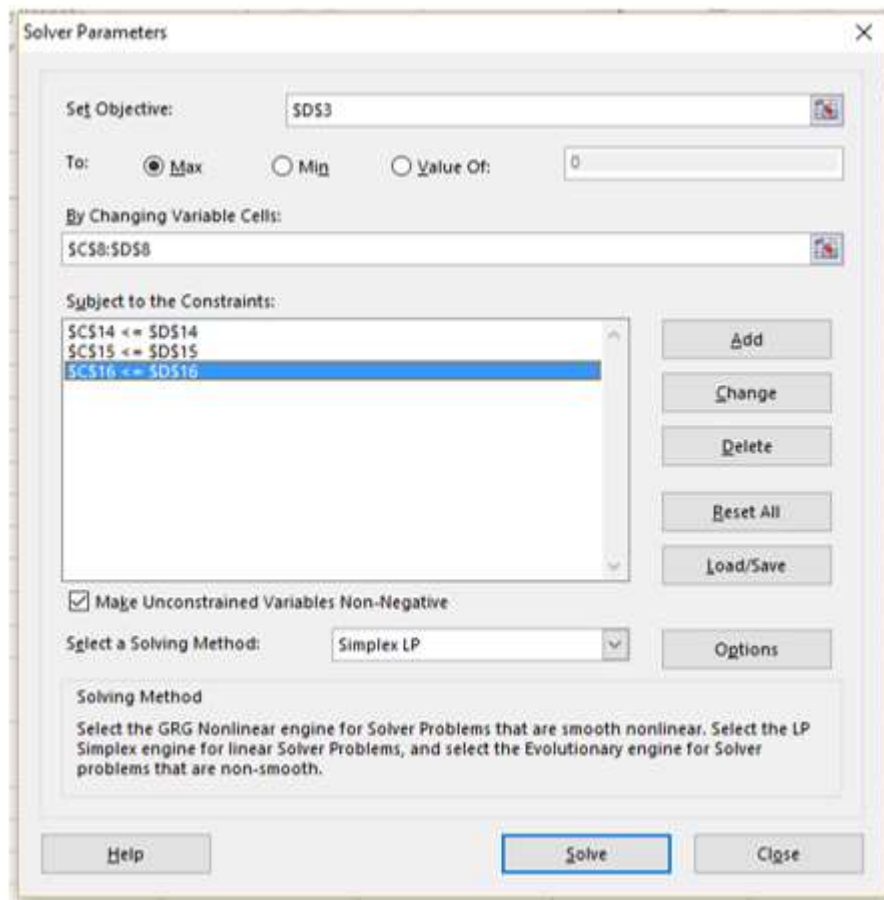
8. Set the constraint for total no. of units sold in Quarter2 as given below and click OK.



The screenshot shows the 'Add Constraint' dialog box. The 'Cell Reference' field is set to '\$C\$16' and the 'Constraint' field is set to '\$D\$16'. The operator is '<='.

The Solver Parameters dialog box appears with the three constraints added in box –Subject to the Constraints.

9. In the **Select a Solving Method** box, select Simplex LP.



**10.** Click the Solve button. The Solver Results dialog box appears. Select **Keep Solver Solution** and click OK.

**Solver Results** [X]

Solver found a solution. All Constraints and optimality conditions are satisfied.

☒ **Keep Solver Solution**  
☐ **Restore Original Values**

☐ **Return to Solver Parameters Dialog**
☐ **Outline Reports**

**Reports**

☐ **Answer**  
☐ **Sensitivity**  
☐ **Limits**

Solver found a solution. All Constraints and optimality conditions are satisfied.

When the GRG engine is used, Solver has found at least a local optimal solution. When Simplex LP is used, this means Solver has found a global optimal solution.

The results will appear in your worksheet.

	A	B	C	D
1				
2		<b>Unit Cost</b>	50	<b>Total Profit</b>
3		<b>Unit Price</b>	100	30000
4		<b>Adv. Cost per Unit</b>	20	
5				
6			<b>Quarter1</b>	<b>Quarter2</b>
7		<b>No. of Units Available</b>	400	600
8		<b>Adv. Budget</b>	8000	12000
9		<b>No. of Units Sold</b>	400	600
10		<b>Revenue</b>	40000	60000
11		<b>Expenses</b>	28000	42000
12		<b>Profit</b>	12000	18000
13				
14		<b>Total Adv. Budget</b>	20000	20000
15		<b>No. of Units sold in Quarter1</b>	400	400
16		<b>No. of Units sold in Quarter2</b>	600	600

As you can observe, the optimal solution that produces maximum total profit, subject to the given constraints, is found to be the following –

- Total Profit – 30000.
- Adv. Budget for Quarter1 – 8000.
- Adv. Budget for Quarter2 – 12000.

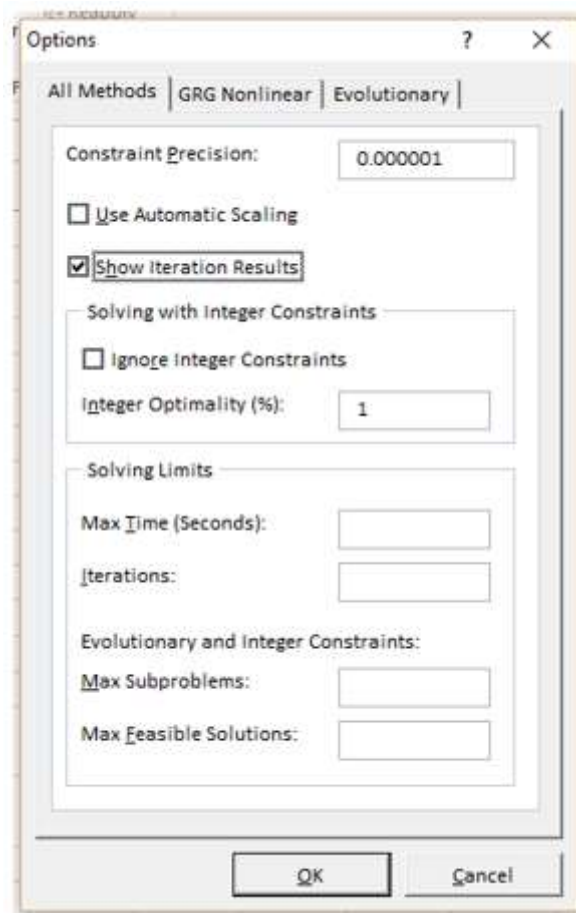
## Stepping through Solver Trial Solutions

You can step through the Solver trial solutions, looking at the iteration results.

1. Click the Options button in the Solver Parameters dialog box.

The **Options** dialog box appears.

2. Select the Show Iteration Results box and click OK.



3. The **Solver Parameters** dialog box appears. Click **Solve**.

4. The **Show Trial Solution** dialog box appears, displaying the message- **Solver paused, current solution values displayed on worksheet**.

	A	B	C	D	E	F	G	H	I	J	K	L
1												
2		Unit Cost	50	Total Profit								
3		Unit Price	100	-18000								
4		Adv. Cost per Unit	20									
5												
6			Quarter1	Quarter2								
7		No. of Units Available	400	600								
8		Adv. Budget	8000	0								
9		No. of Units Sold	400	0								
10		Revenue	40000	0								
11		Expenses	28000	30000								
12		Profit	12000	-30000								
13												
14		Total Adv. Budget	8000	20000								
15		No. of Units sold in Quarter1	400	400								
16		No. of Units sold in Quarter2	0	600								



As you can observe, the current iteration values are displayed in your working cells. You can either stop the Solver accepting the current results or continue with the Solver from finding solution in further steps.

##### 5. Click Continue.

The **Show Trial Solution** dialog box appears at every step and finally after the optimal solution is found, Solver Results dialog box appears. Your worksheet is updated at every step, finally showing the result values.

## Saving Solver Selections

You have the following saving options for the problems that you solve with Solver -

- You can save the last selections in the Solver Parameters dialog box with a worksheet by saving the workbook.
- Each worksheet in a workbook can have its own Solver selections, and all of them will be saved when you save the workbook.
- You can also define more than one problem in a worksheet, each with its own Solver selections. In such a case, you can load and save problems individually with the Load/Save in the Solver Parameters dialog box.
  1. Click the **Load/Save** button. The Load/Save dialog box appears.
  2. To save a problem model, enter the reference for the first cell of a vertical range of empty cells in which you want to place the problem model. Click Save.



	A	B	C	D	E	F	G	H	I	J	K	L	M
1													
2		<b>Unit Cost</b>	50	<b>Total Profit</b>									
3		<b>Unit Price</b>	100	20000									
4		<b>Adv. Cost per Unit</b>	20										
5													
6			<b>Quarter1</b>	<b>Quarter2</b>									
7		No. of Units Available	400	600									
8		Adv. Budget	10000	10000									
9		No. of Units Sold	400	500									
10		Revenue	40000	50000									
11		Expenses	30000	40000									
12		Profit	10000	10000									
13													
14		Total Adv. Budget	20000	20000									
15		No. of Units sold in Quarter1	400	400									
16		No. of Units sold in Quarter2	500	600									

**Load/Save Model**

To Load, select a range holding a saved model.  
To Save, select an empty range with the following number of cells: 7

\$F\$2

3. The problem model (the Solver Parameters set) appears starting at the cell that you have given as the reference.

	A	B	C	D	E	F
1						
2		<b>Unit Cost</b>	50	<b>Total Profit</b>		20000
3		<b>Unit Price</b>	100	20000		2
4		<b>Adv. Cost per Unit</b>	20			TRUE
5						TRUE
6			<b>Quarter1</b>	<b>Quarter2</b>		TRUE
7		No. of Units Available	400	600		32767
8		Adv. Budget	10000	10000		0
9		No. of Units Sold	400	500		
10		Revenue	40000	50000		
11		Expenses	30000	40000		
12		Profit	10000	10000		
13						
14		Total Adv. Budget	20000	20000		
15		No. of Units sold in Quarter1	400	400		
16		No. of Units sold in Quarter2	500	600		

4. To load a problem model, enter the reference for the entire range of cells that contains the problem model. Then, click on the Load button.

# 29. Importing Data into Excel

You might have to use data from various sources for analysis. In Excel, you can import data from different data sources. Some of the data sources are as follows-

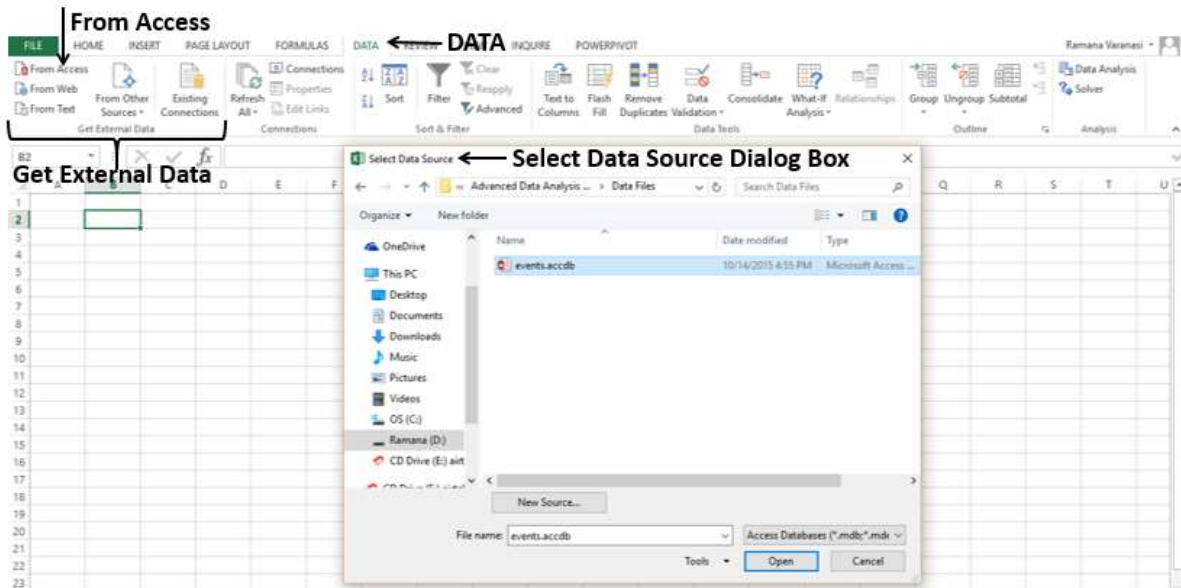
- Microsoft Access Database
- Web Page
- Text File
- SQL Server Table
- SQL Server Analysis Cube
- XML File

You can import any number of tables simultaneously from a database.

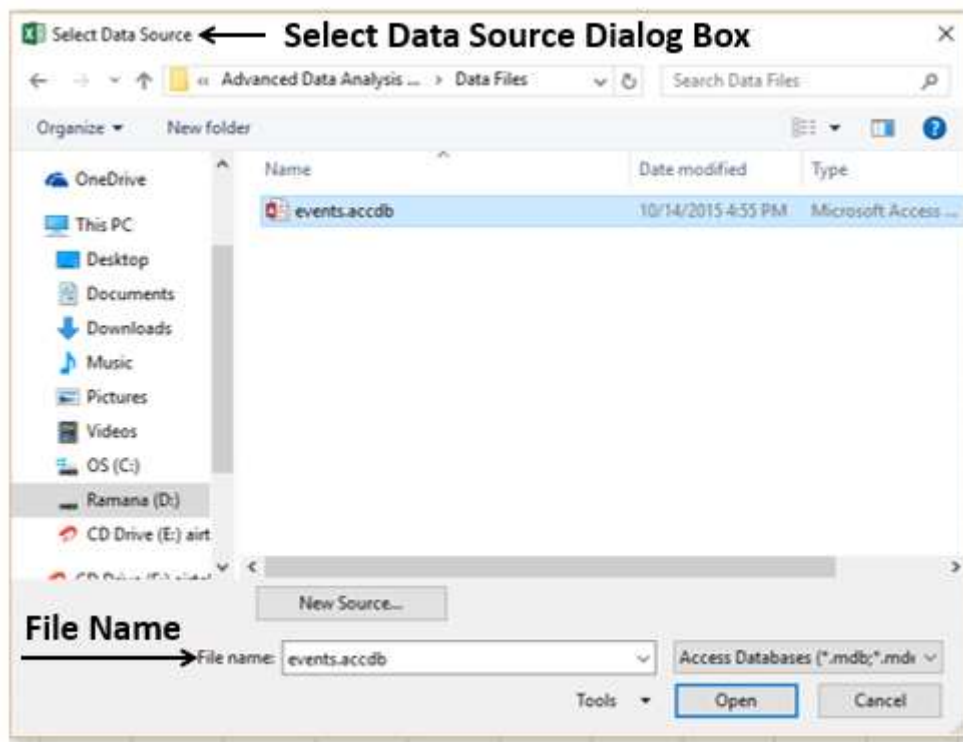
## Importing Data from Microsoft Access Database

We will learn how to import data from MS Access database. Follow the steps given below-

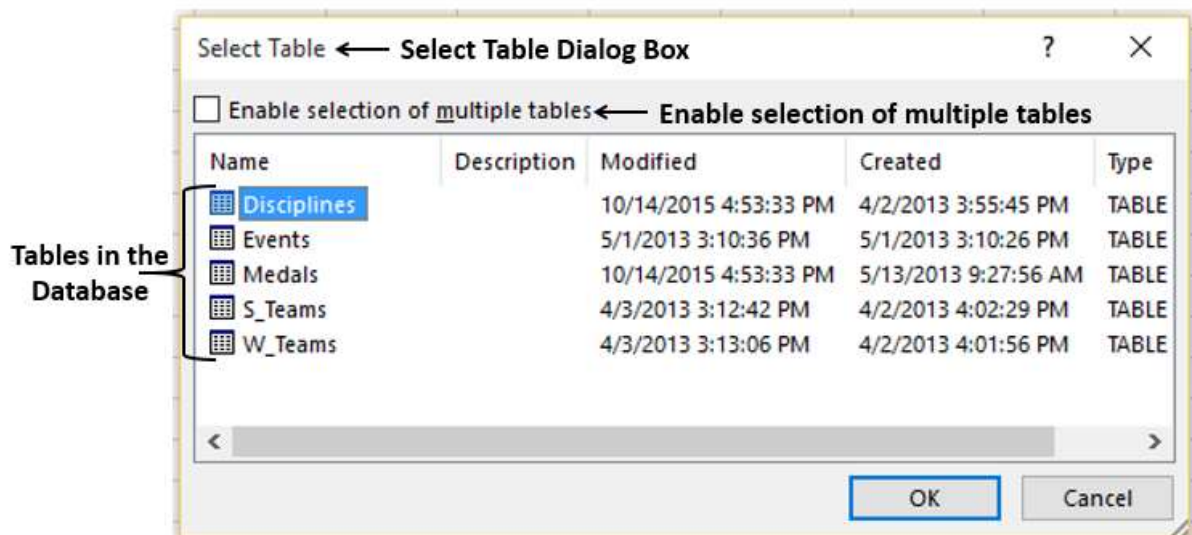
1. Open a new blank workbook in Excel.
2. Click the DATA tab on the Ribbon.
3. Click **From Access** in the Get External Data group. The **Select Data Source** dialog box appears.



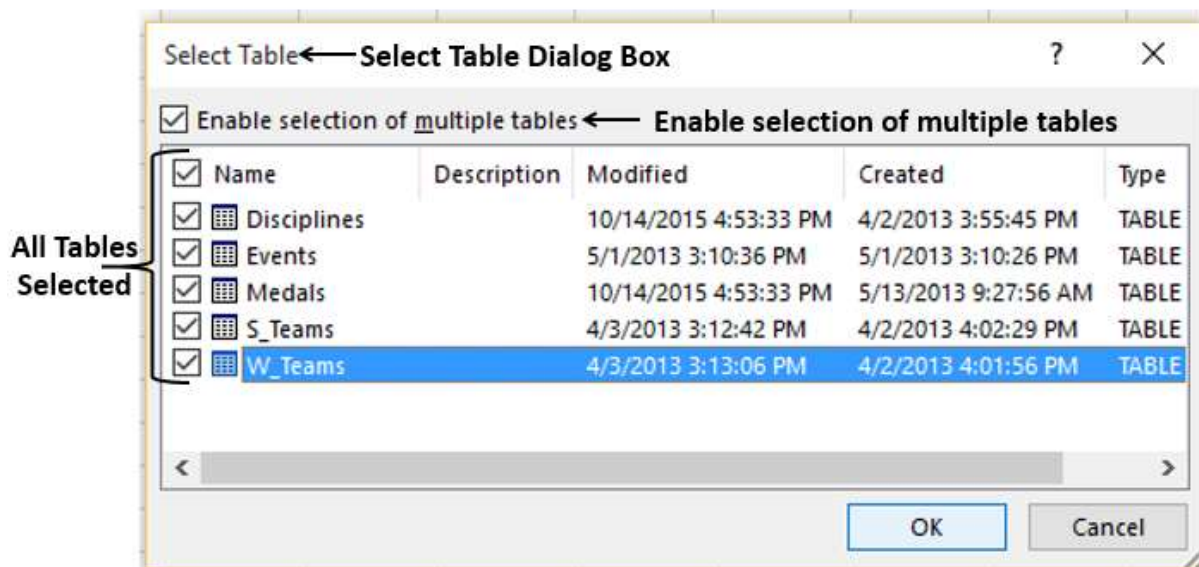
4. Select the Access database file that you want to import. Access database files will have the extension .accdb.



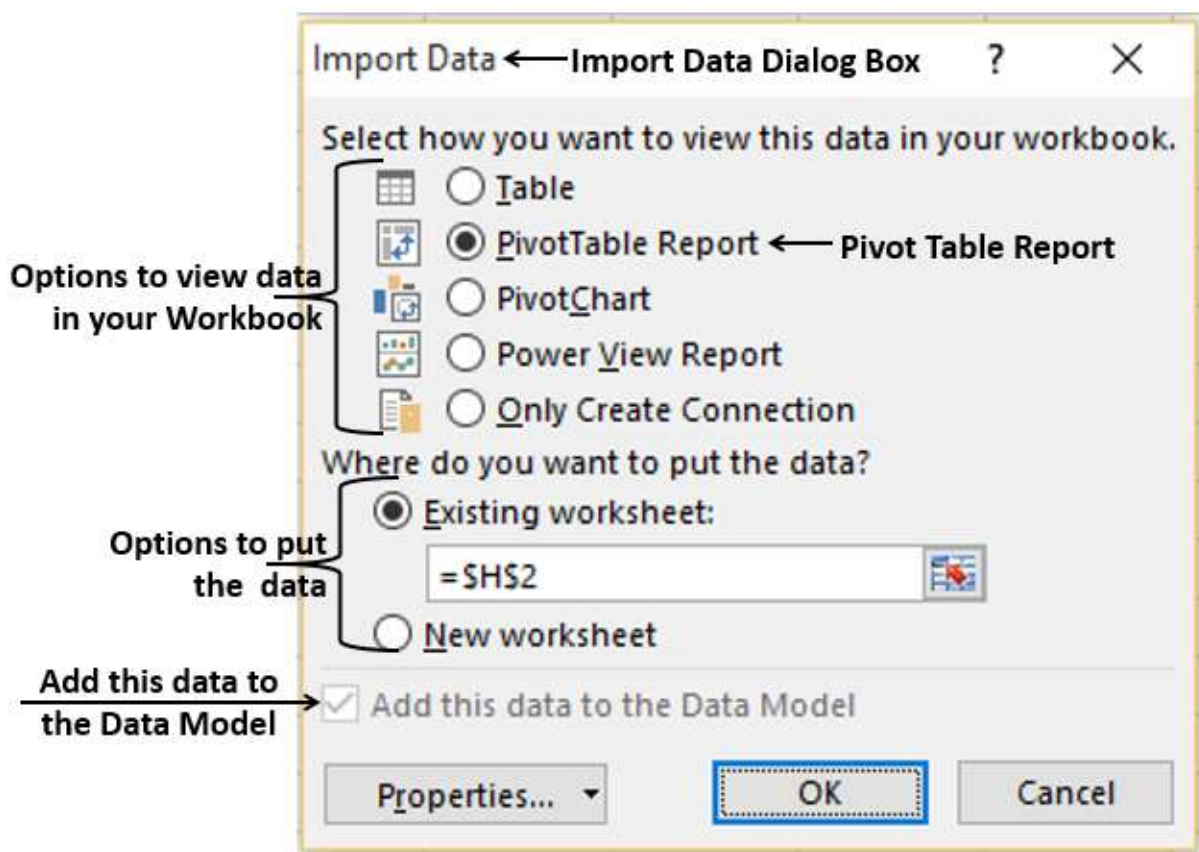
The Select Table dialog box appears displaying the tables found in the Access database. You can either import all the tables in the database at once or import only the selected tables based on your data analysis needs.



5. Select the Enable selection of multiple tables box and select all the tables.



6. Click OK. The **Import Data** dialog box appears.



As you observe, you have the following options to view the data you are importing in your workbook –

- Table
- PivotTable Report

- PivotChart
- Power View Report

You also have an option- **only create connection**. Further, PivotTable Report is selected by default.

Excel also gives you the options to put the data in your workbook –

- Existing worksheet
- New worksheet

You will find another check box that is selected and disabled – **Add this data to the Data Model**. Whenever you import data tables into your workbook, they are automatically added to the Data Model in your workbook. You will learn more about the Data Model in later chapters.

You can try each one of the options to view the data you are importing, and check how the data appears in your workbook –

- If you select **Table**, Existing worksheet option gets disabled, **New worksheet** option gets selected and Excel creates as many worksheets as the number of tables you are importing from the database. The Excel tables appear in these worksheets.
- If you select **PivotTable Report**, Excel imports the tables into the workbook and creates an empty PivotTable for analyzing the data in the imported tables. You have an option to create the PivotTable in an existing worksheet or a new worksheet.

Excel tables for the imported data tables will not appear in the workbook. However, you will find all the data tables in the PivotTable fields list, along with the fields in each table.

- If you select **PivotChart**, Excel imports the tables into the workbook and creates an empty PivotChart for displaying the data in the imported tables. You have an option to create the PivotChart in an existing worksheet or a new worksheet.

Excel tables for the imported data tables will not appear in the workbook. However, you will find all the data tables in the PivotChart fields list, along with the fields in each table.

- If you select **Power View Report**, Excel imports the tables into the workbook and creates a Power View Report in a new worksheet. You will learn how to use Power View Reports for analyzing data in later chapters.

Excel tables for the imported data tables will not appear in the workbook. However, you will find all the data tables in the Power View Report fields list, along with the fields in each table.

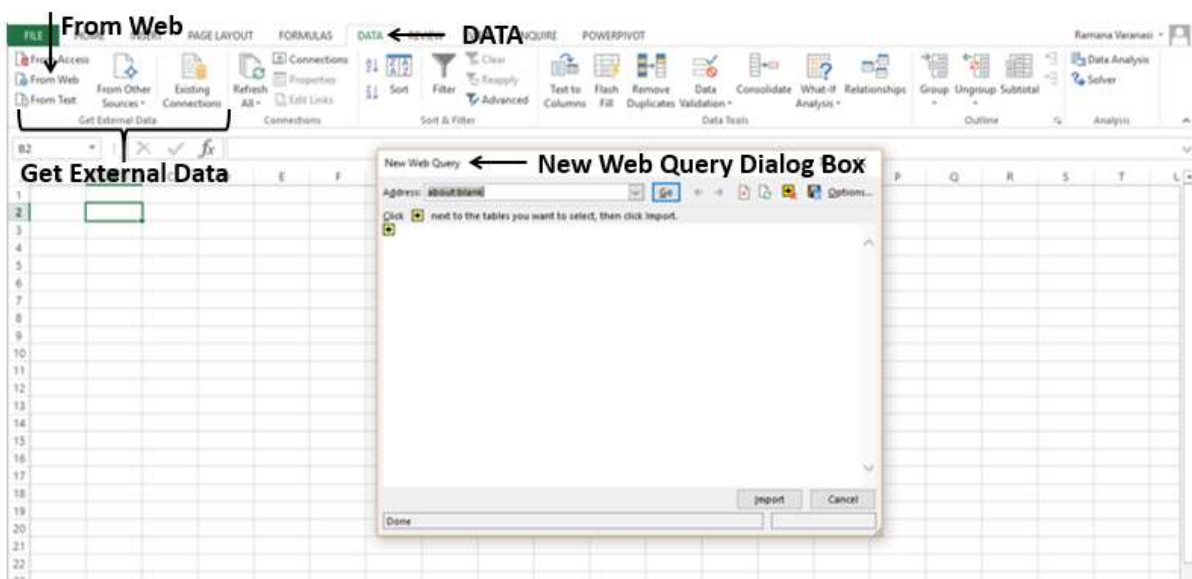
- If you select the option - **Only Create Connection**, a data connection will be established between the database and your workbook. No tables or reports appear in the workbook. However, the imported tables are added to the Data Model in your workbook by default.

You need to choose any of these options, based on your intent of importing data for data analysis. As you observed above, irrespective of the option you have chosen, the data is imported and added to the Data Model in your workbook.

## Importing Data from a Web Page

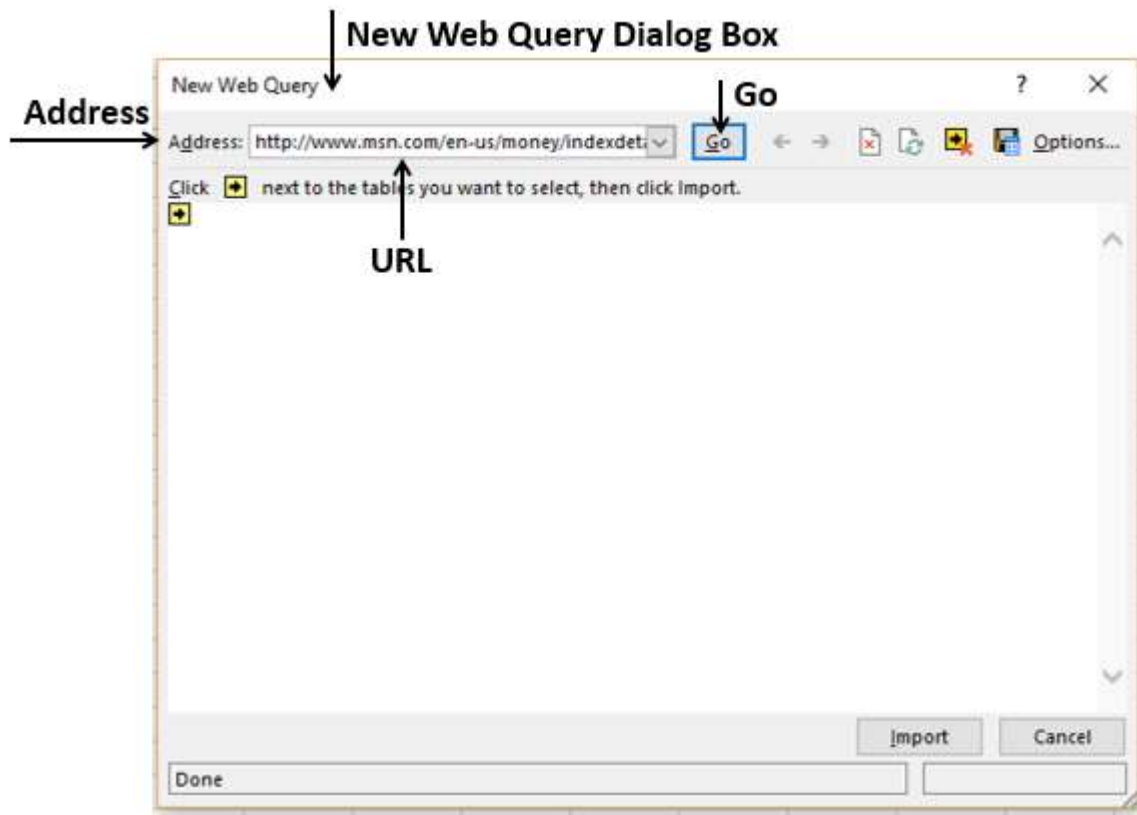
Sometimes, you might have to use the data that is refreshed on a web site. You can import data from a table on a website into Excel.

1. Open a new blank workbook in Excel.
2. Click the DATA tab on the Ribbon.
3. Click **From Web** in the **Get External Data** group. The **New Web Query** dialog box appears.

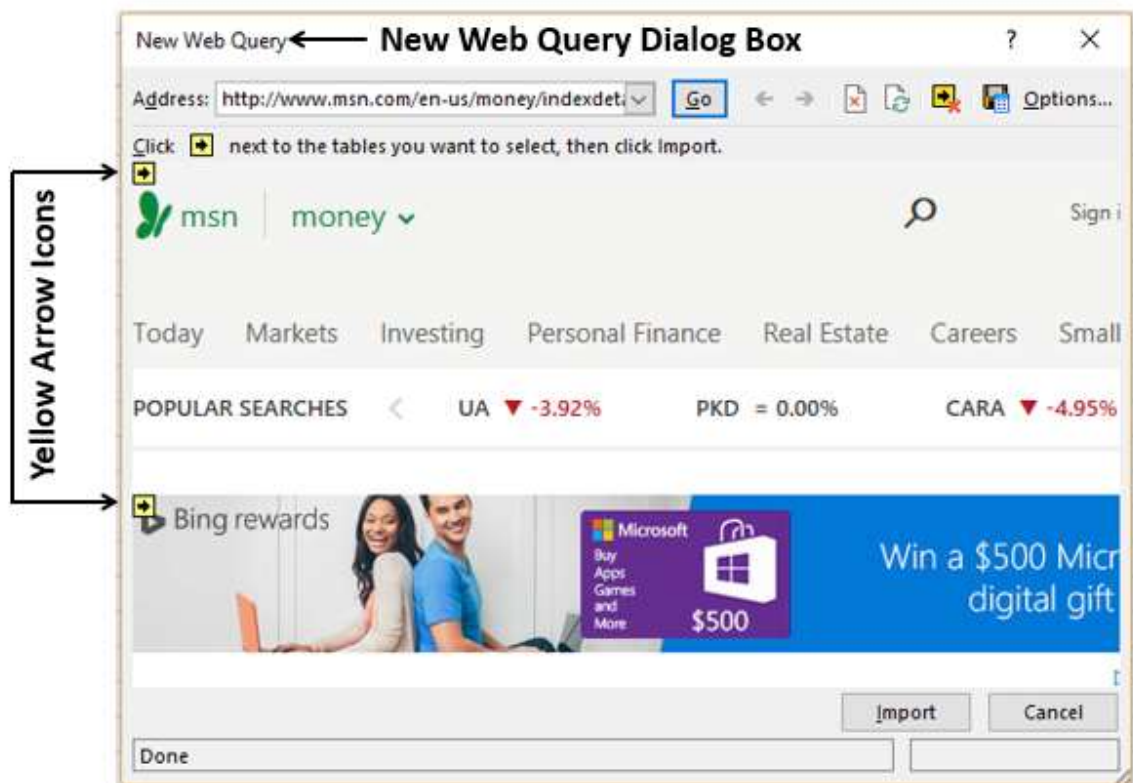




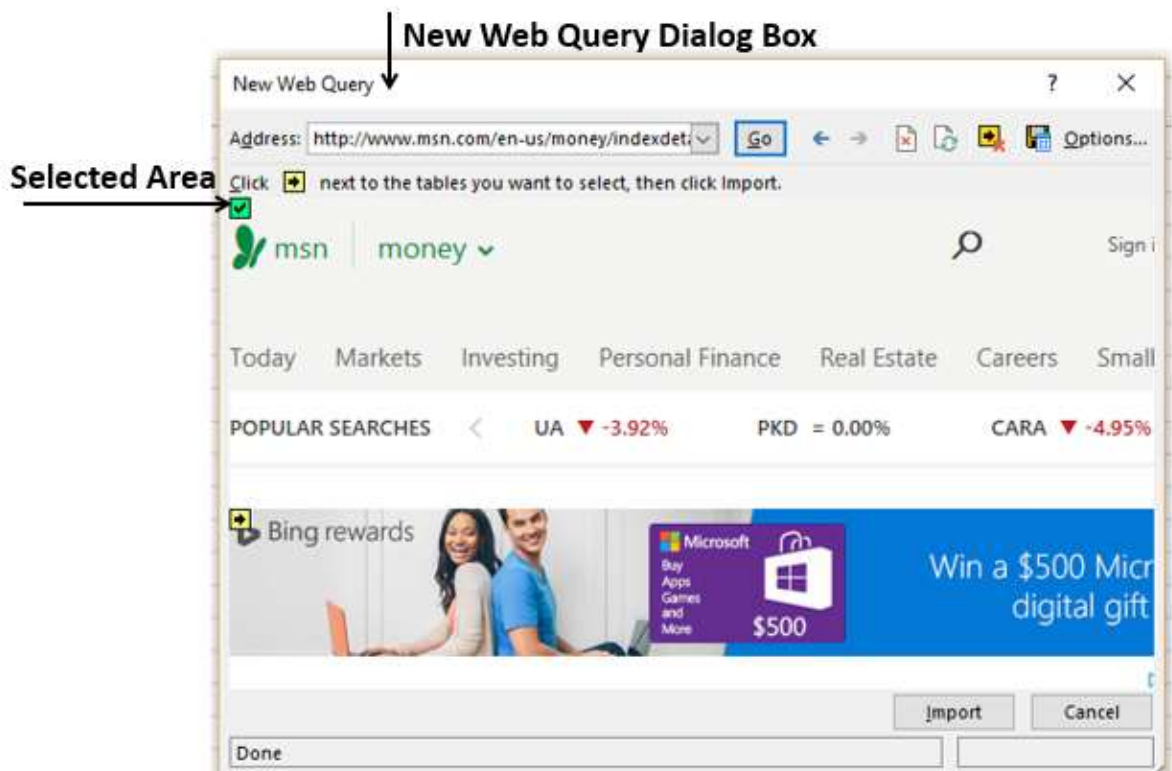
4. Enter the URL of the web site from where you want to import data, in the box next to Address and click Go.



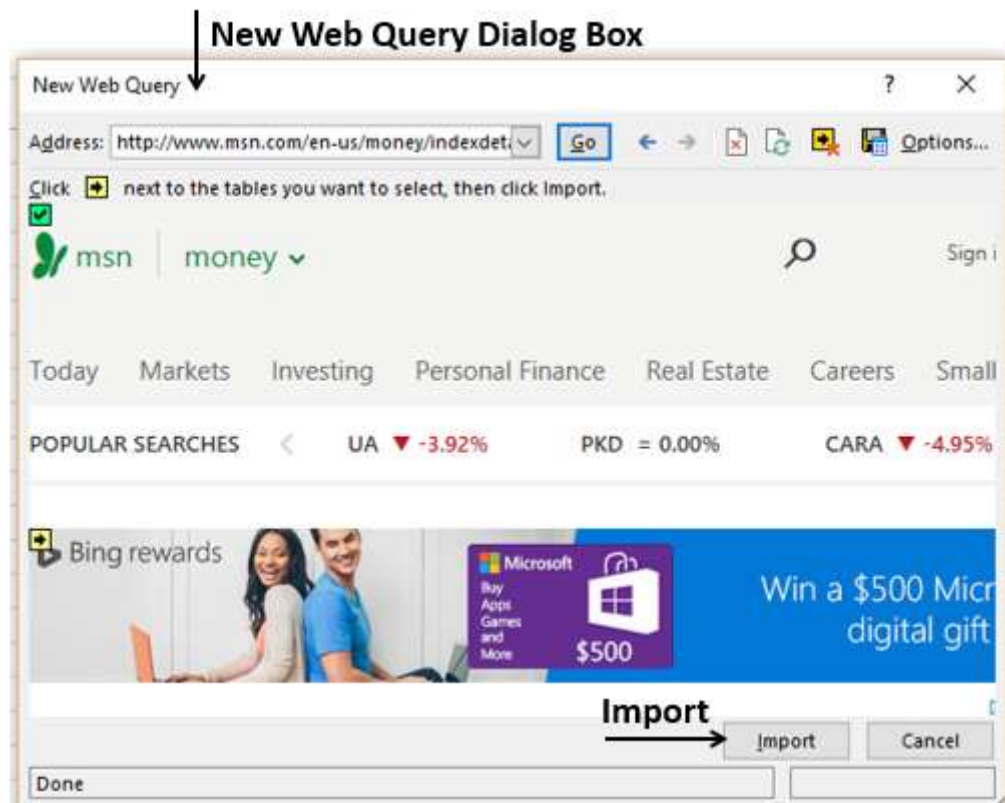
5. The data on the website appears. There will be yellow arrow icons next to the table data that can be imported.



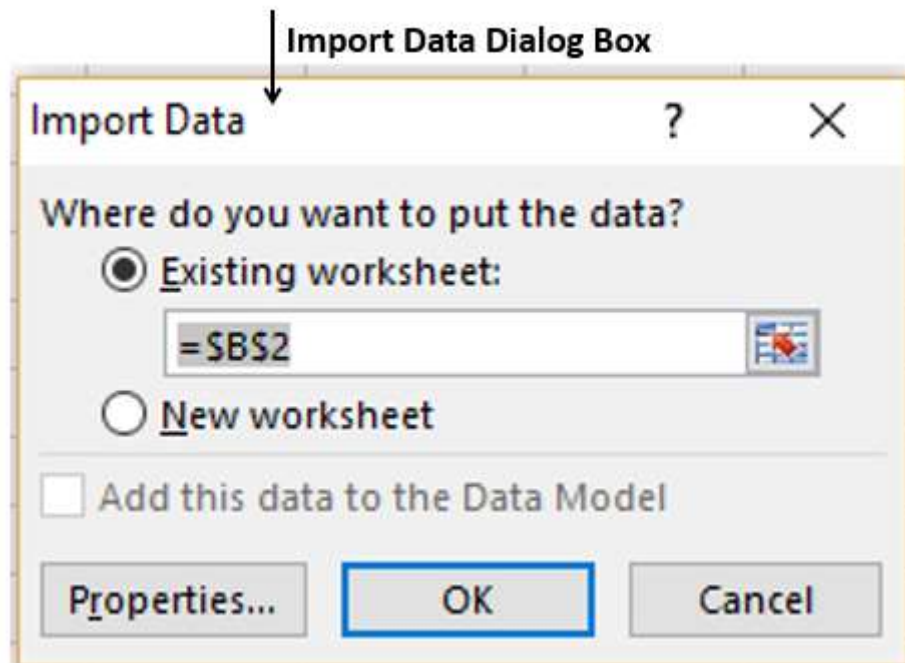
6. Click the yellow icons to select the data you want to import. This turns the yellow icons to green boxes with a checkmark as shown in the following screen shot.



7. Click the Import button after you have selected what you want.



The **Import Data** dialog box appears.



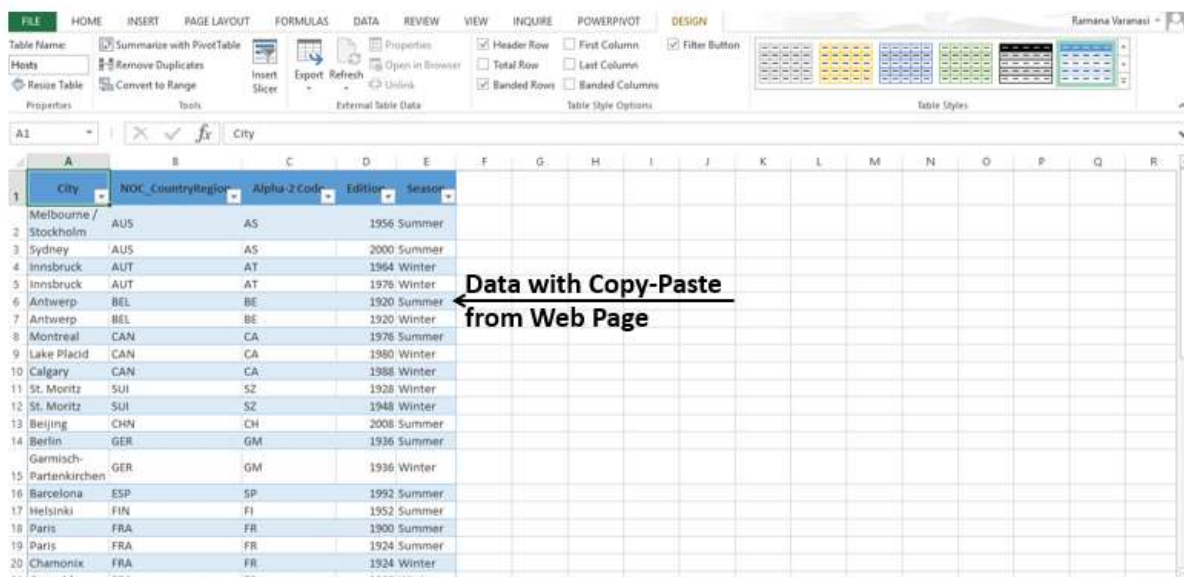
8. Specify where you want to put the data and click Ok.
9. Arrange the data for further analysis and/or presentation.

	A	B	C	D	E	F	G	H
1								
2		NASDAQ						
3		4,952.25						
4		▲						
5		4.2						
6		0.08%						
7		Largest Components (By Market Cap)						
8								
9		AAPL						
10		Apple Inc						
11		▼ 98.46						
12		-1.4						
13		-1.40%						
14		29.17M						
15		39.21M (Avg)						
16		98.33-99.54						
17		89.47-132.97						
18		539.31B						
19		10.98						
20								
21		GOOGL						
22		Alphabet Inc						
23		▼ 748.46						

### Copy-pasting data from web

Another way of getting data from a web page is by copying and pasting the required data.

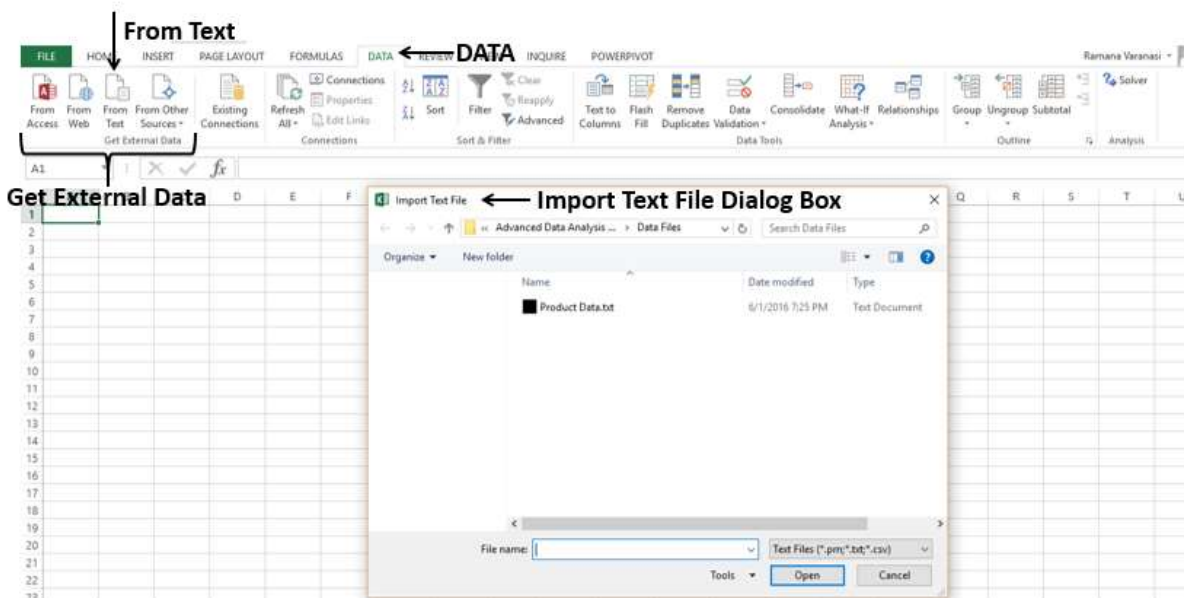
1. Insert a new worksheet.
2. Copy the data from the web page and paste it on the worksheet.
3. Create a table with the pasted data.



## Importing Data from a Text File

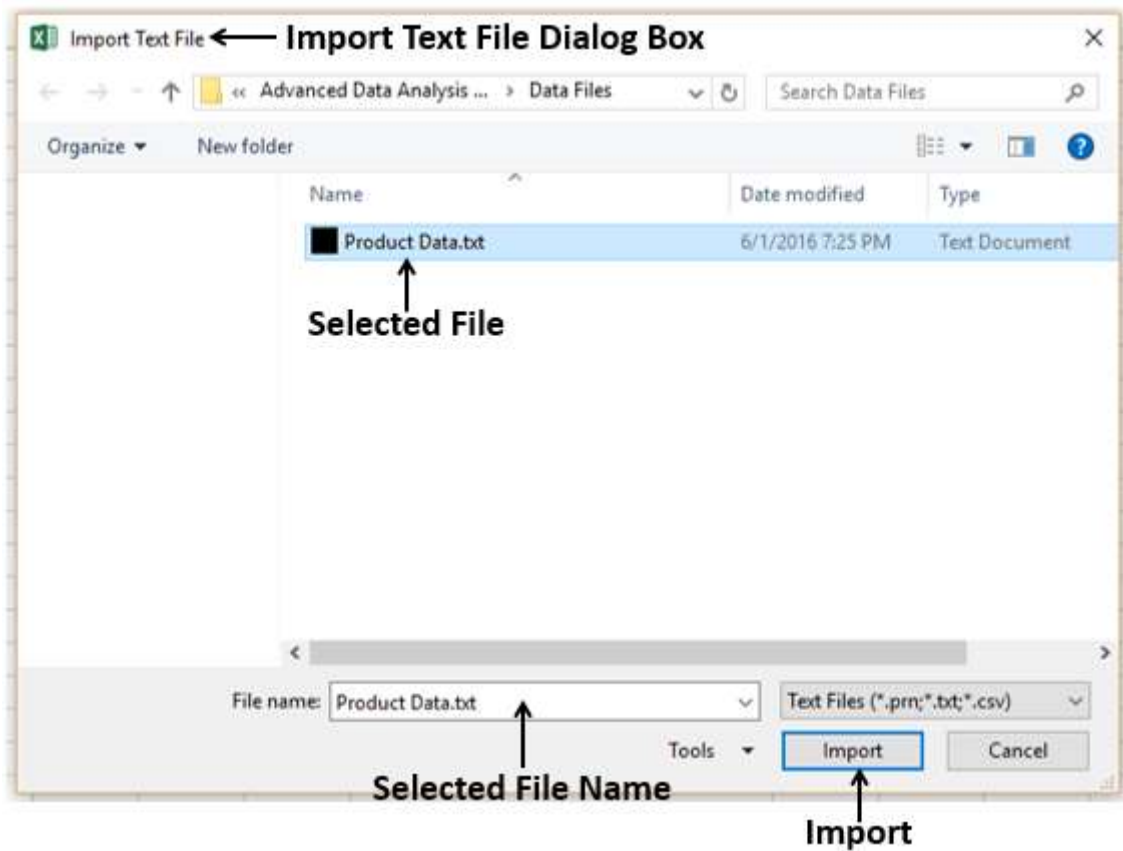
If you have data in **.txt** or **.csv** or **.prn** files, you can import data from those files treating them as text files. Follow the steps given below-

1. Open a new worksheet in Excel.
2. Click the DATA tab on the Ribbon.
3. Click **From Text** in the Get External Data group. The **Import Text File** dialog box appears.



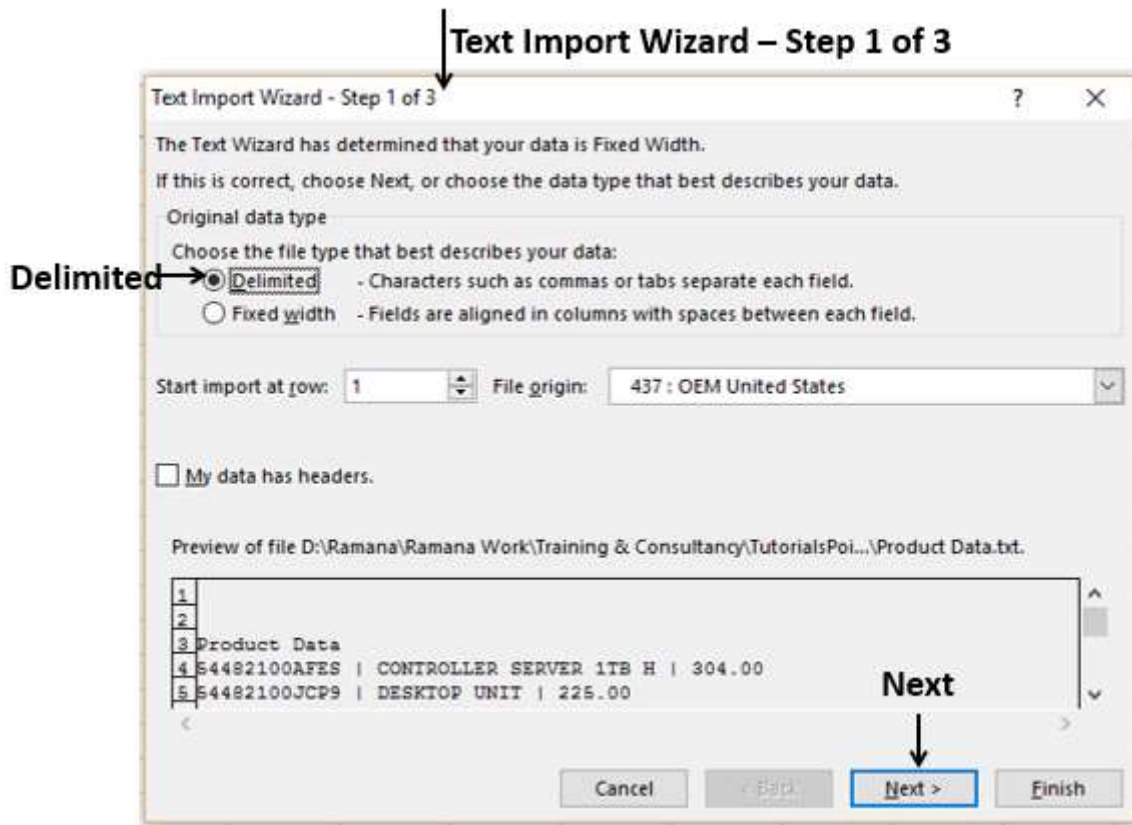
You can see that **.prn**, **.txt** and **.csv** extension text files are accepted.

4. Select the file. The selected file name appears in the File name box. The Open button changes to Import button.



5. Click the Import button. **Text Import Wizard – Step 1 of 3** dialog box appears.
6. Click the option **Delimited** to choose the file type and click Next.



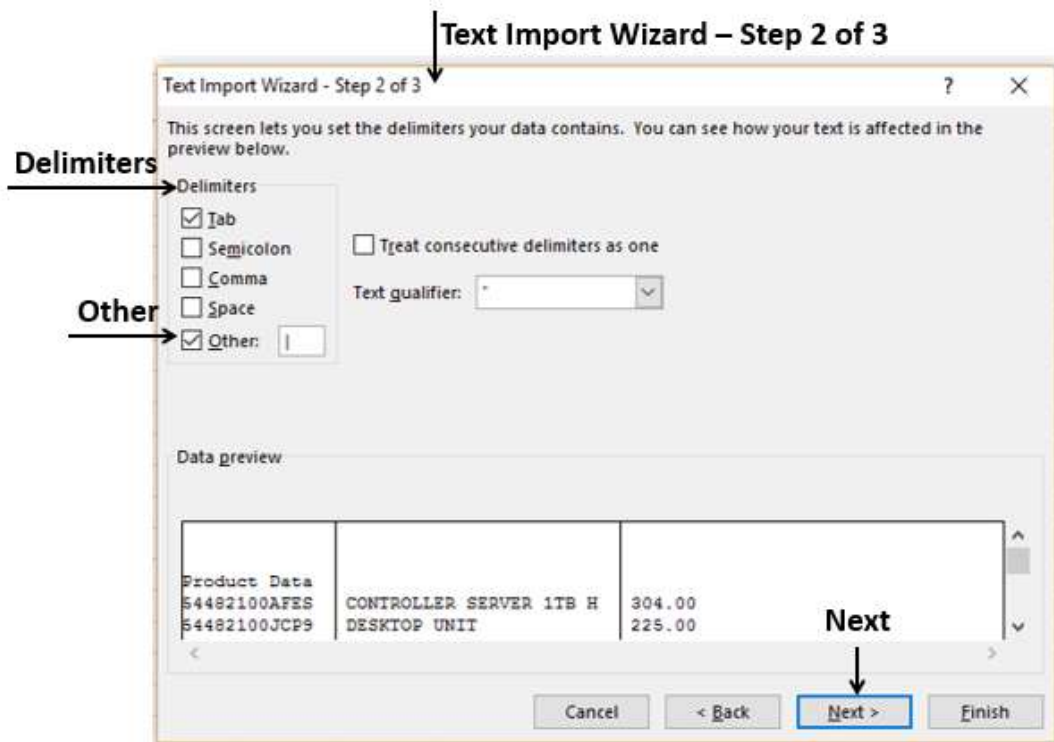


The **Text Import Wizard – Step 2 of 3** dialog box appears.

**7.** Under Delimiters, select **Other**.

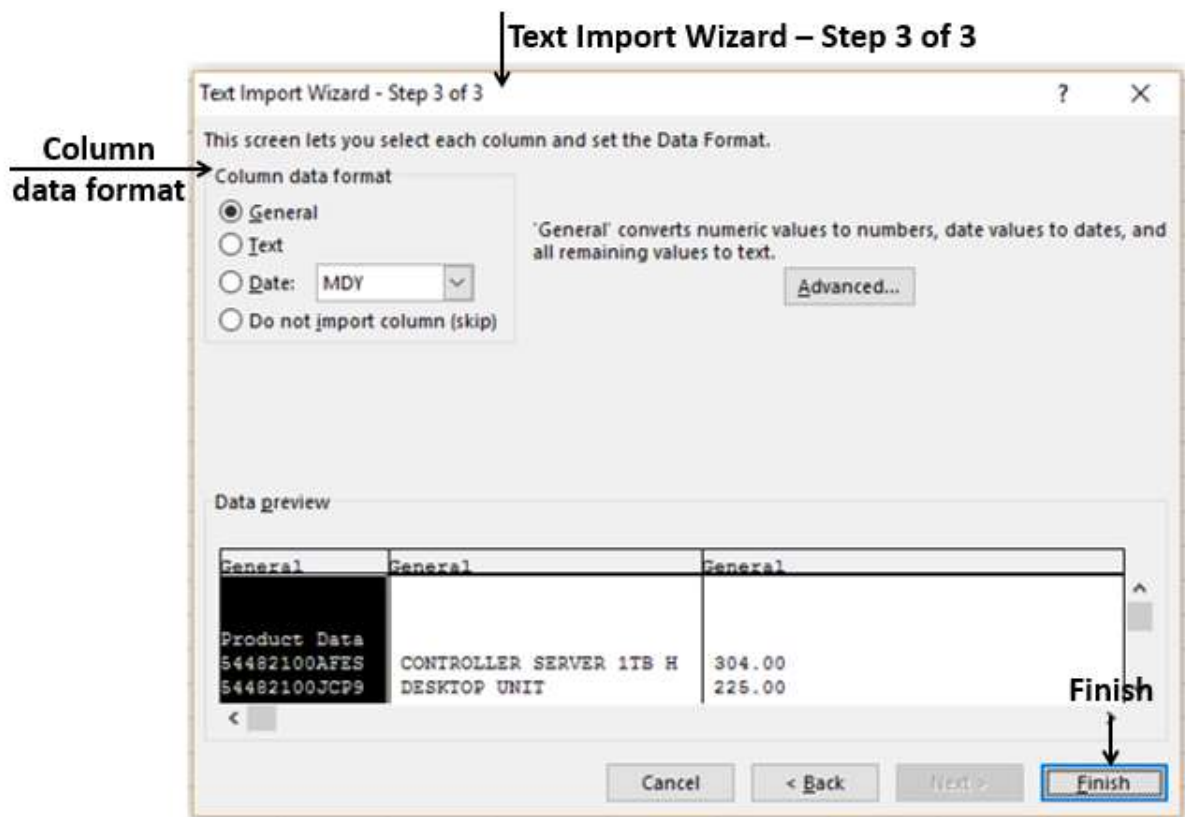
**8.** In the box next to Other, type | (That is the delimiter in the text file you are importing).

**9.** Click Next.

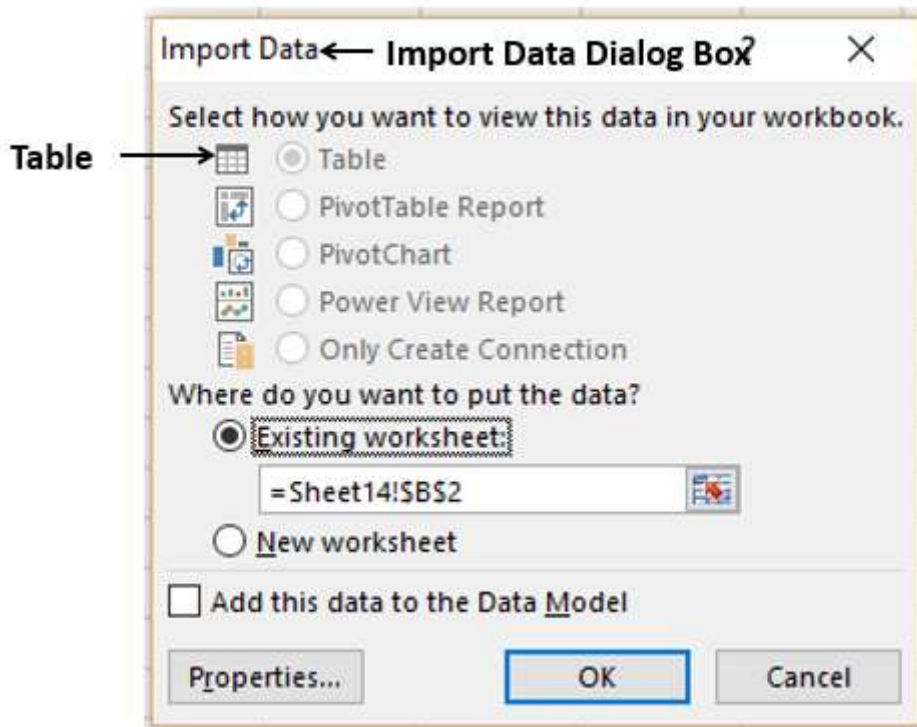


The **Text Import Wizard – Step 3 of 3** dialog box appears.

**10.** In this dialog box, you can set column data format for each of the columns.



**11.** After you complete the data formatting of columns, click Finish. The **Import Data** dialog box appears.



You will observe the following-

- Table is selected for view and is grayed. Table is the only view option you have in this case.
- You can put the data either in an existing worksheet or a New worksheet.
- You can select or not select the check box Add this data to the Data Model.
- Click OK after you have made the choices.

Data appears on the worksheet you specified. You have imported data from Text file into Excel workbook.

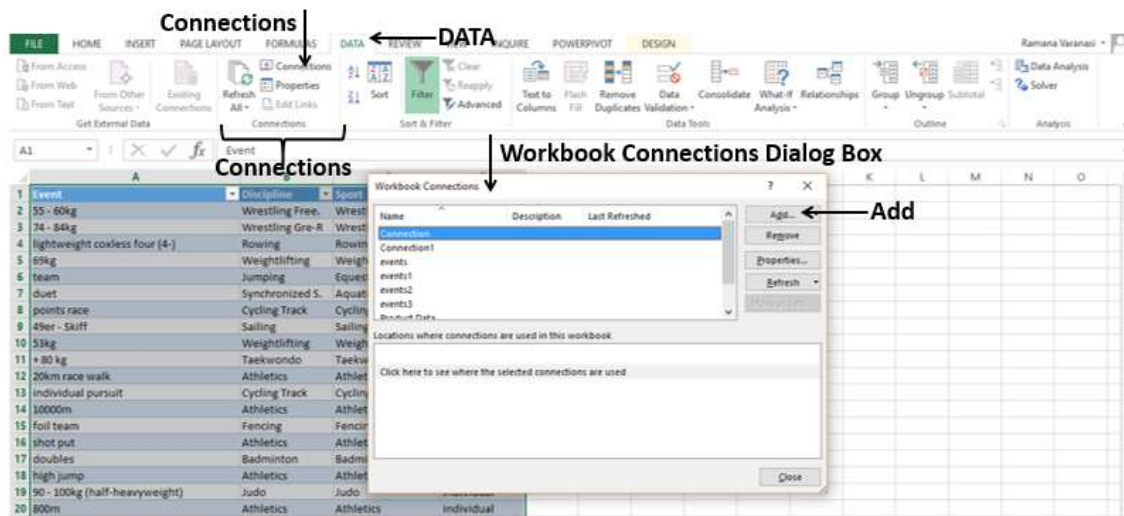
## Importing Data from another Workbook

You might have to use data from another Excel workbook for your data analysis, but someone else might maintain the other workbook.

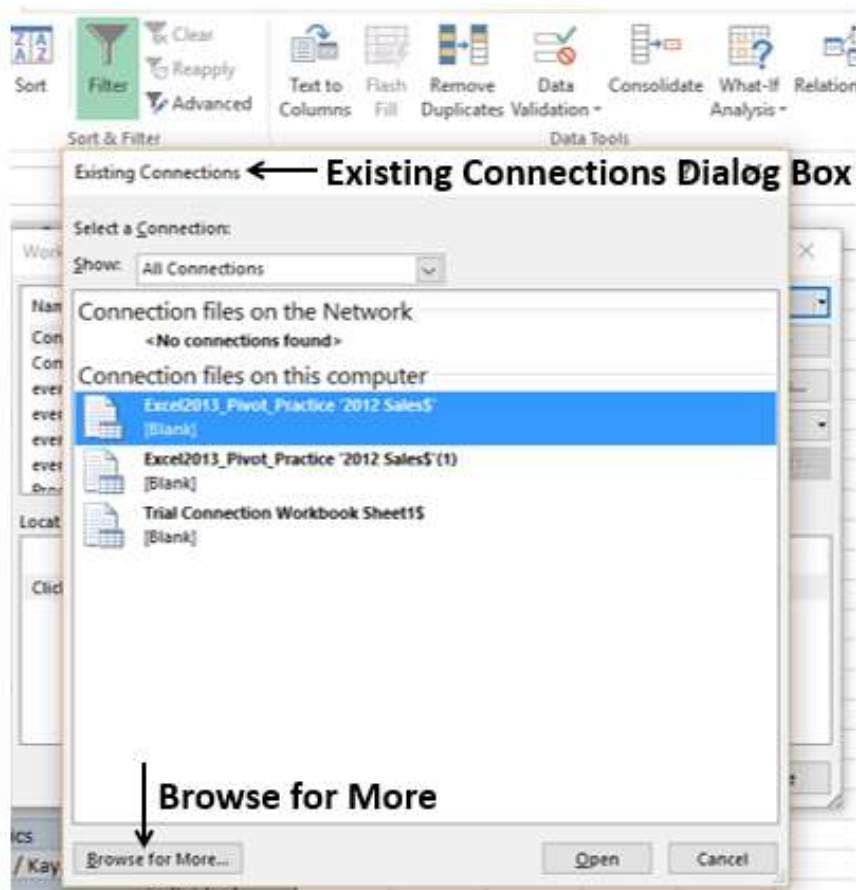
To get up to date data from another workbook, establish a data connection with that workbook.

**1.** Click **DATA > Connections** in the Connections group on the Ribbon.

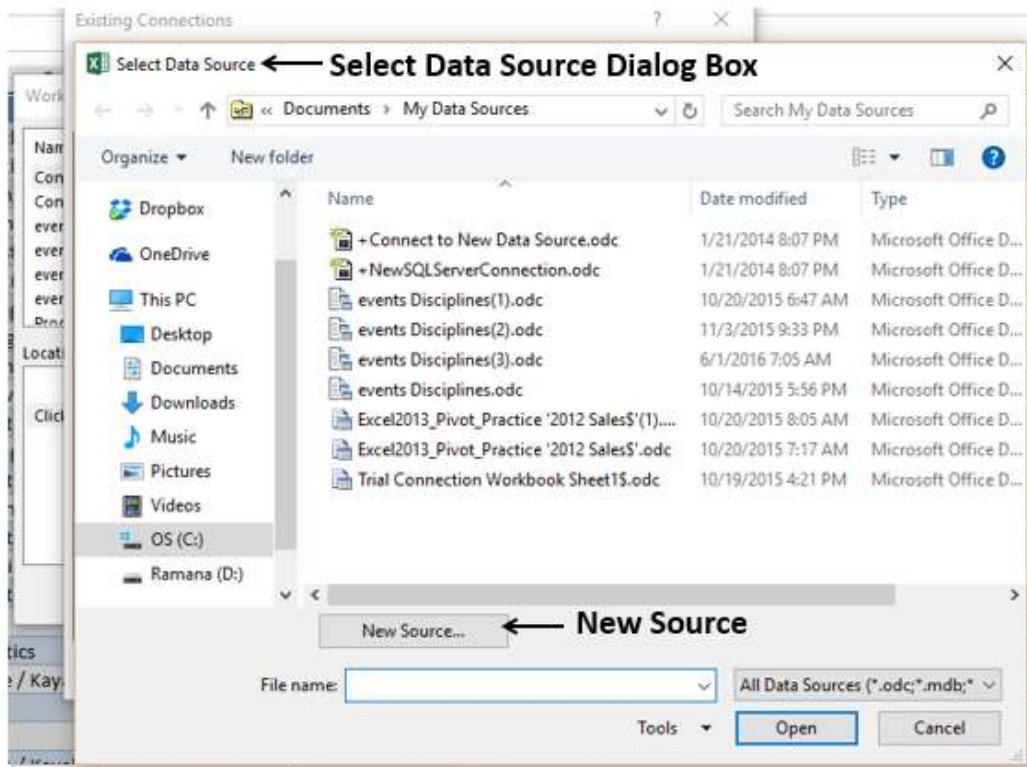
The **Workbook Connections** dialog box appears.



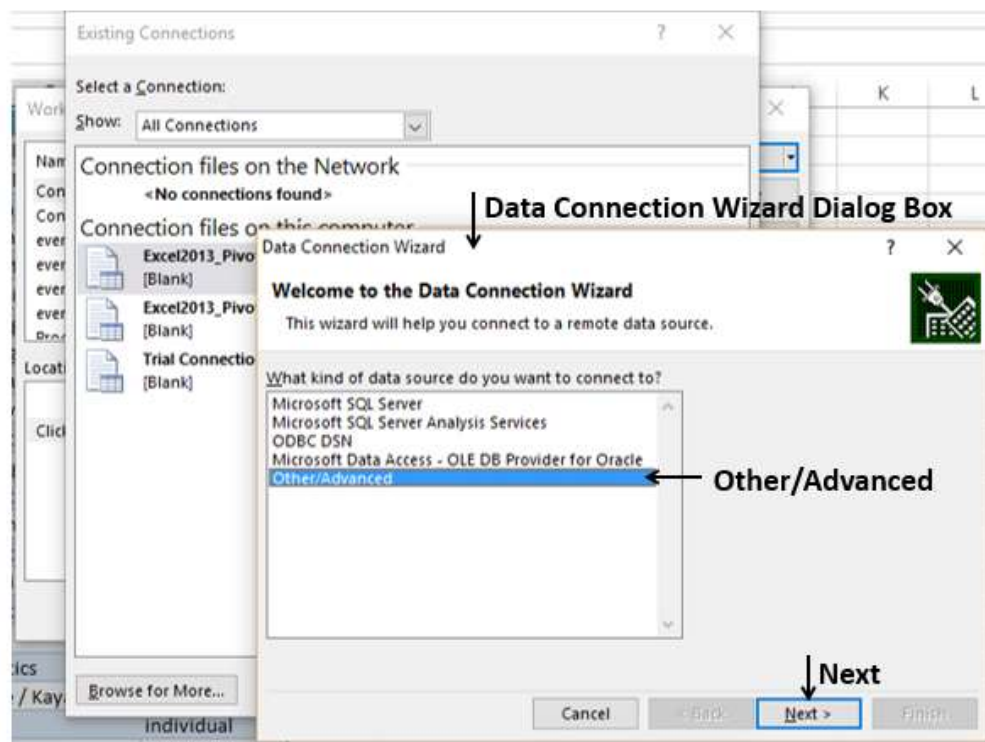
2. Click the Add button in the Workbook Connections dialog box. The **Existing Connections** dialog box appears.



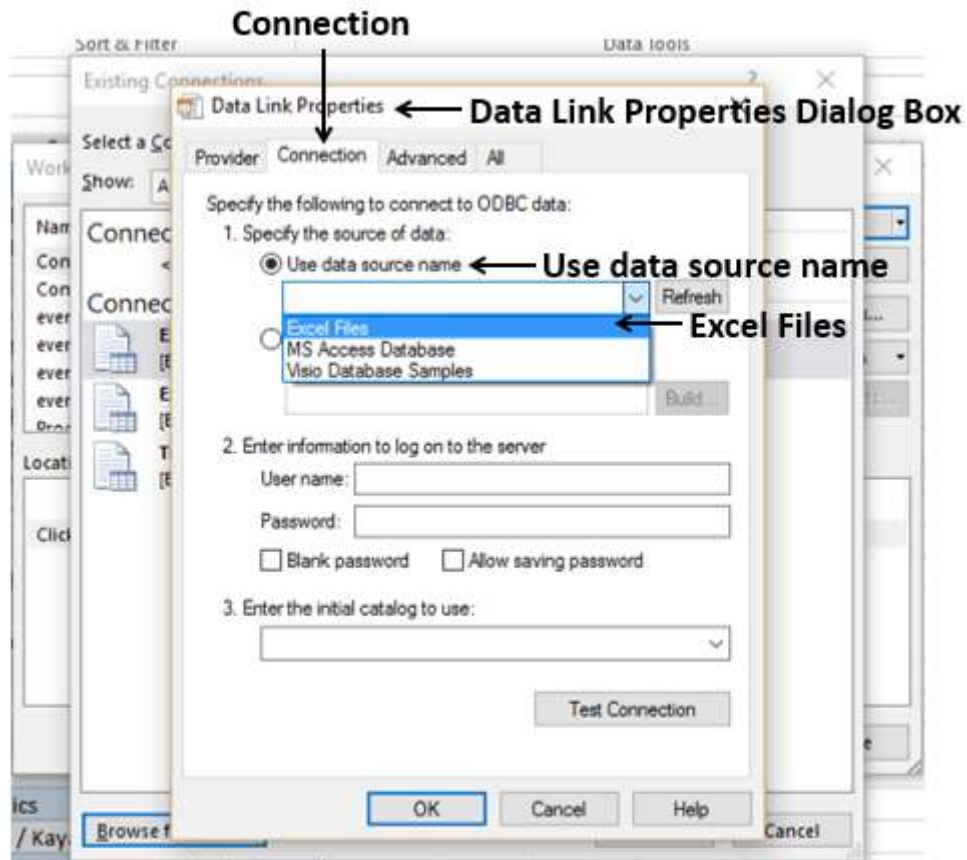
3. Click **Browse for More...** button. The **Select Data Source** dialog box appears.



4. Click the **New Source** button. The **Data Connection Wizard** dialog box appears.



5. Select **Other/Advanced** in the data source list and click Next. The Data Link Properties dialog box appears.

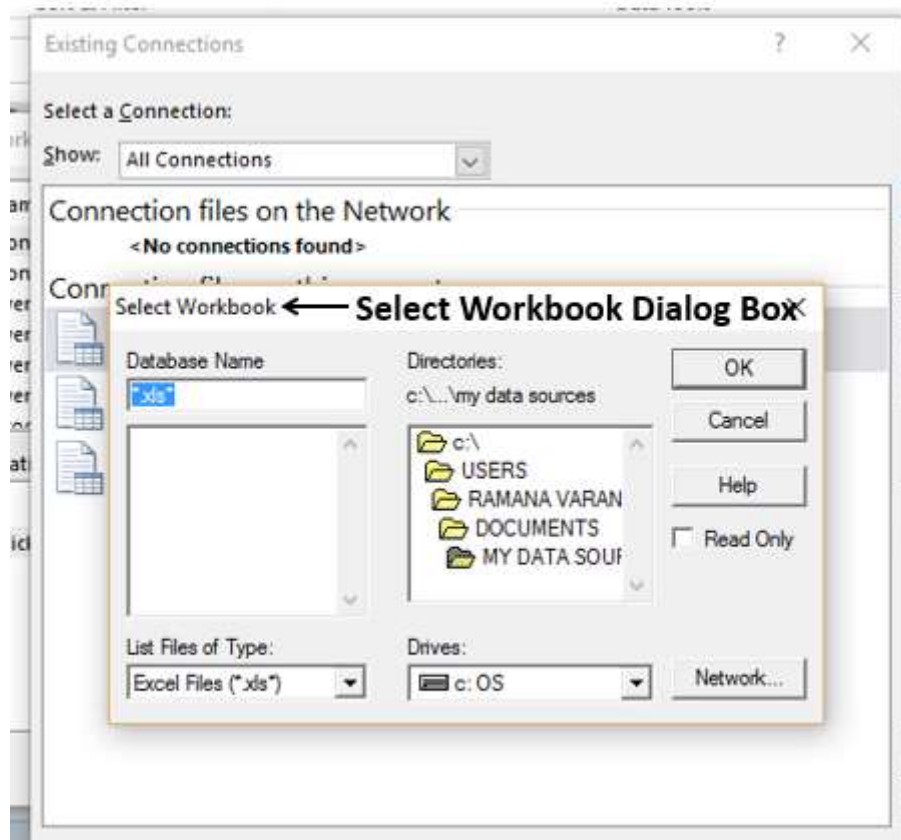


6. Set the data link properties as follows-

- Click the **Connection** tab.
- Click Use data source name.
- Click the down-arrow and select **Excel Files** from the drop-down list.
- Click OK.



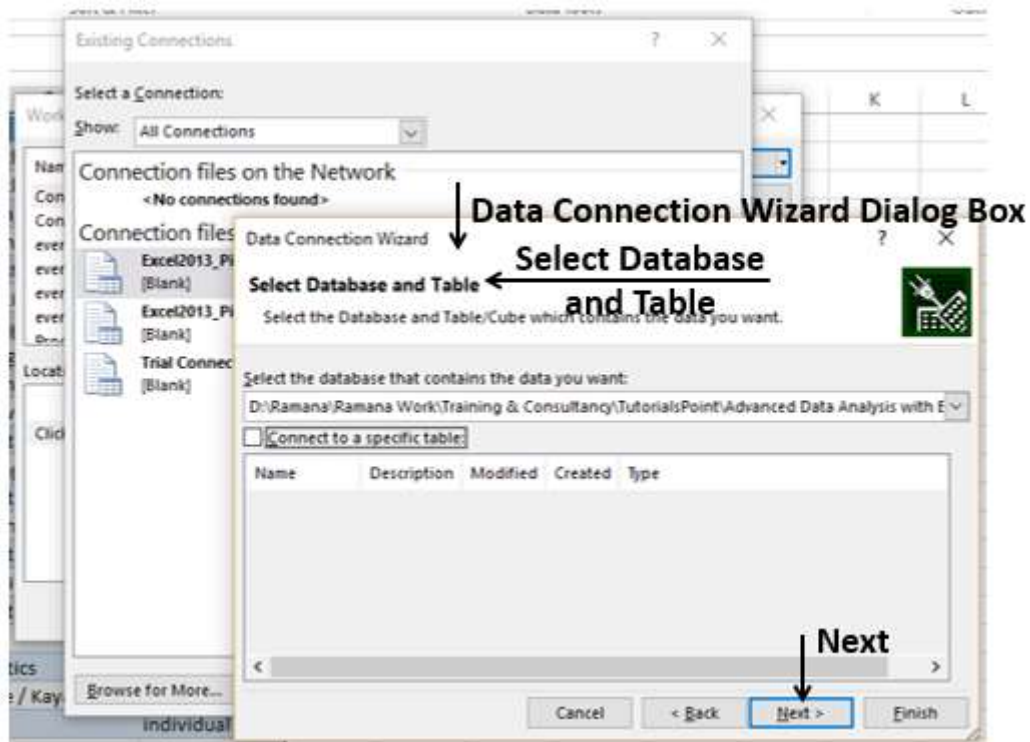
The **Select Workbook** dialog box appears.



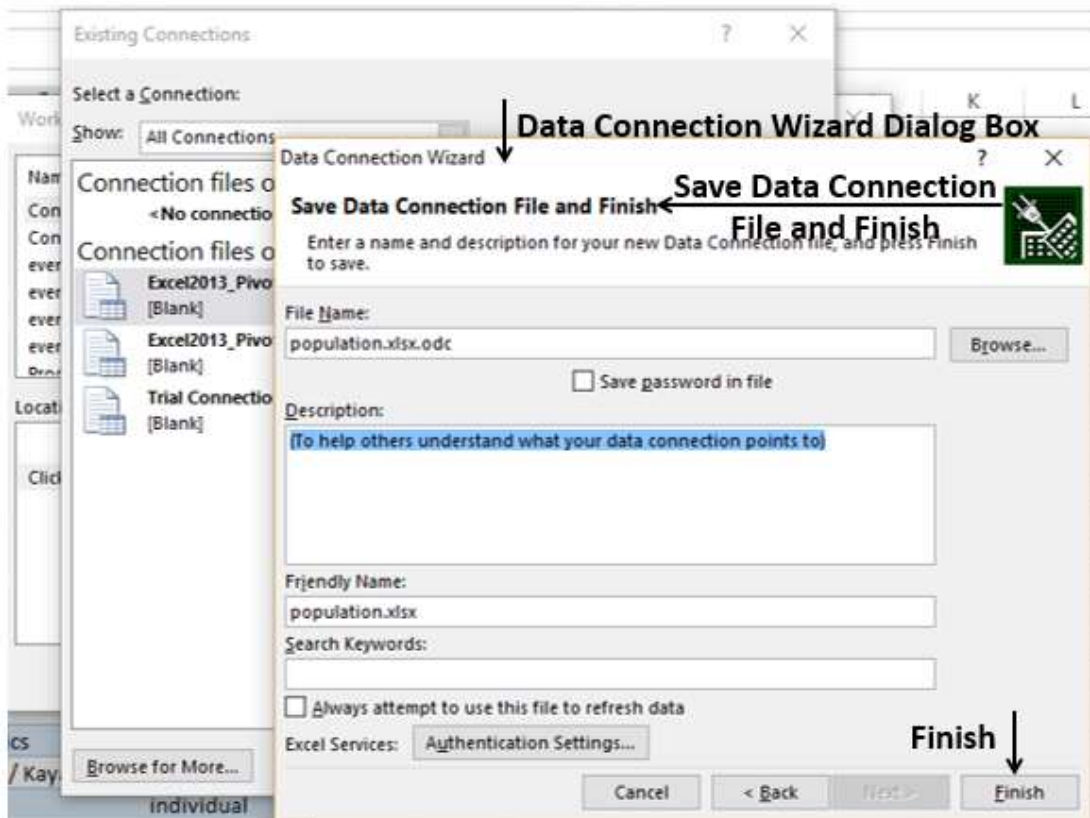
**7.** Browse to the location where you have the workbook to be imported is located. Click OK.

The **Data Connection Wizard** dialog box appears with Select Database and Table.

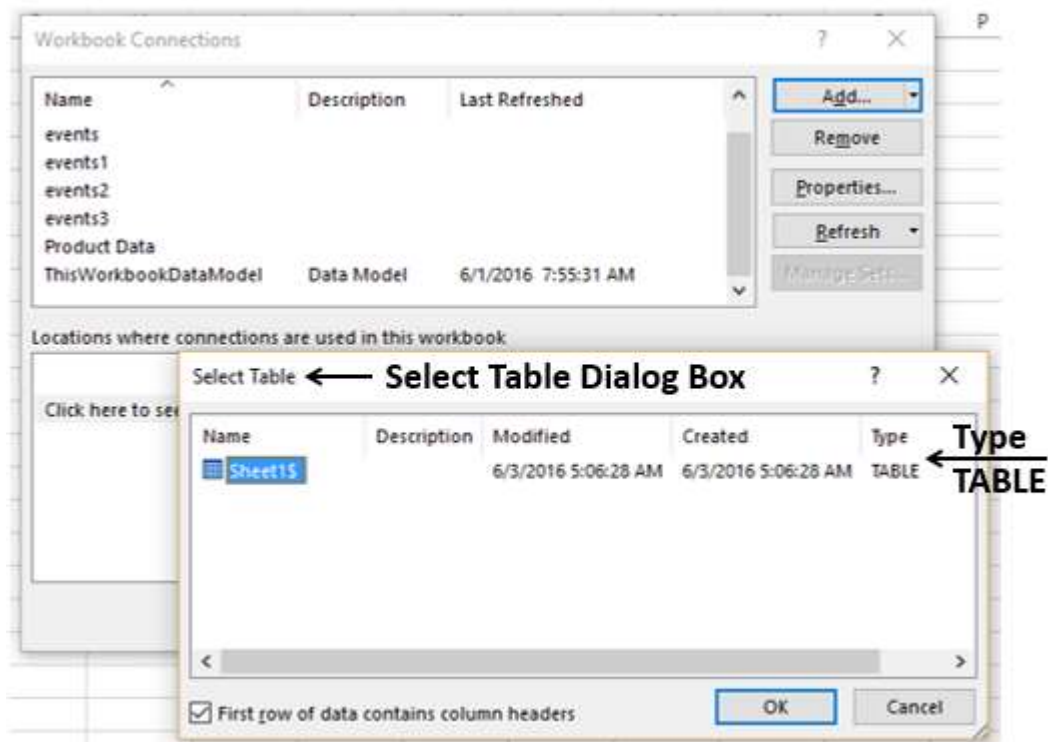
**Note:** In this case, Excel treats each worksheet that is getting imported as a table. The table name will be the worksheet name. So, to have meaningful table names, name / rename the worksheets as appropriate.



8. Click Next. The **Data Connection Wizard** dialog box appears with Save Data Connection File and Finish.



9. Click the Finish button. The **Select Table** dialog box appears.



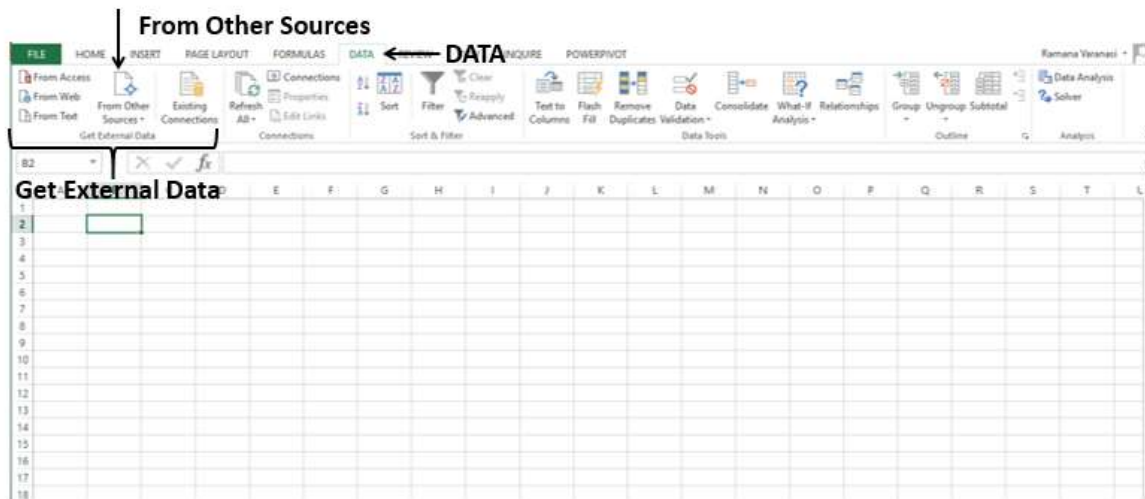
As you observe, Name is the worksheet name that is imported as type TABLE. Click OK.

The Data connection with the workbook you have chosen will be established.

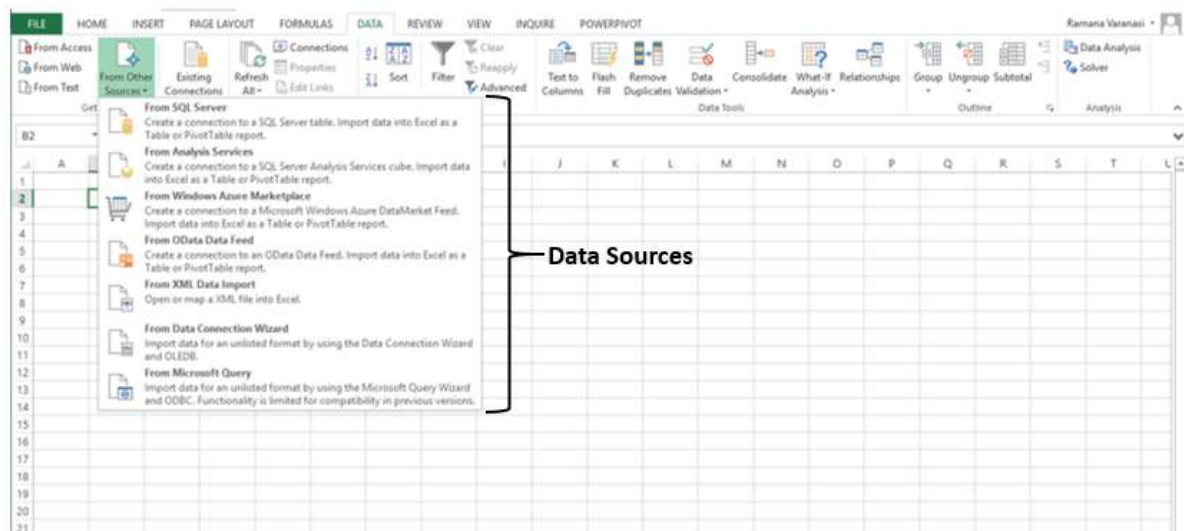
## Importing Data from Other Sources

Excel provides you options to choose various other data sources. You can import data from these in few steps.

1. Open a new blank workbook in Excel.
2. Click the DATA tab on the Ribbon.
3. Click **From Other Sources** in the Get External Data group.



Dropdown with various data sources appears.



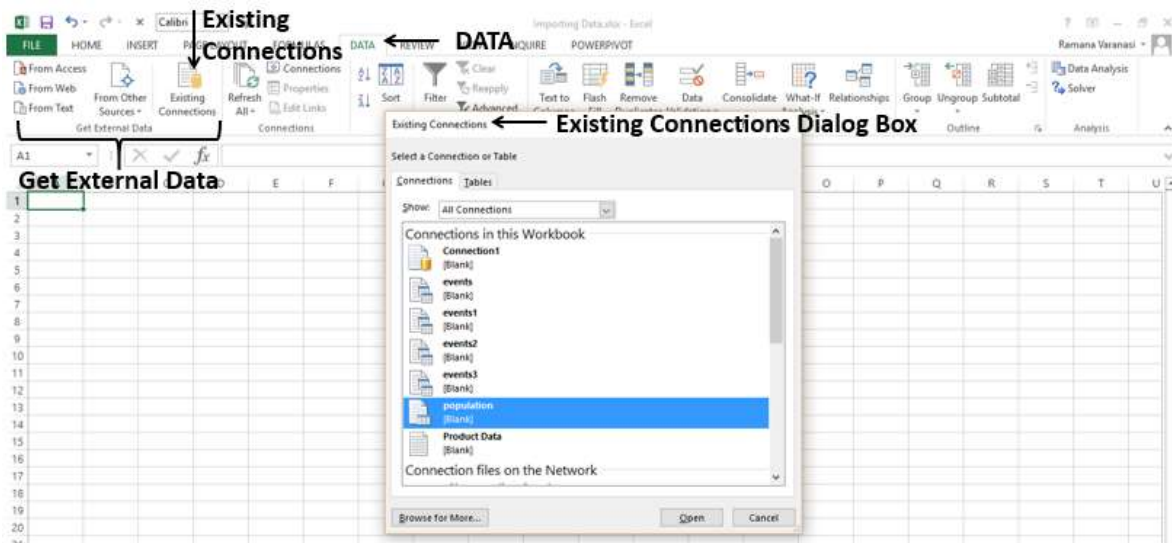
You can import data from any of these data sources into Excel.

## Importing Data using an Existing Connection

In an earlier section, you have established a data connection with a workbook.

Now, you can import data using that existing connection.

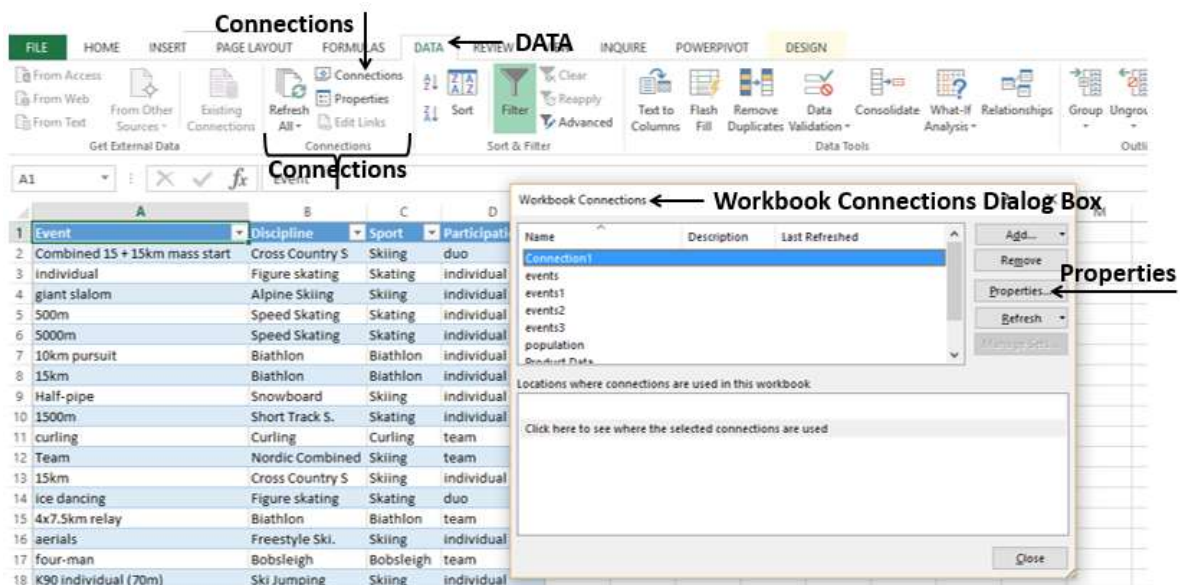
1. Click the DATA tab on the Ribbon.
2. Click **Existing Connections** in the Get External Data group. The Existing Connections dialog box appears.
3. Select the connection from where you want to import data and click Open.



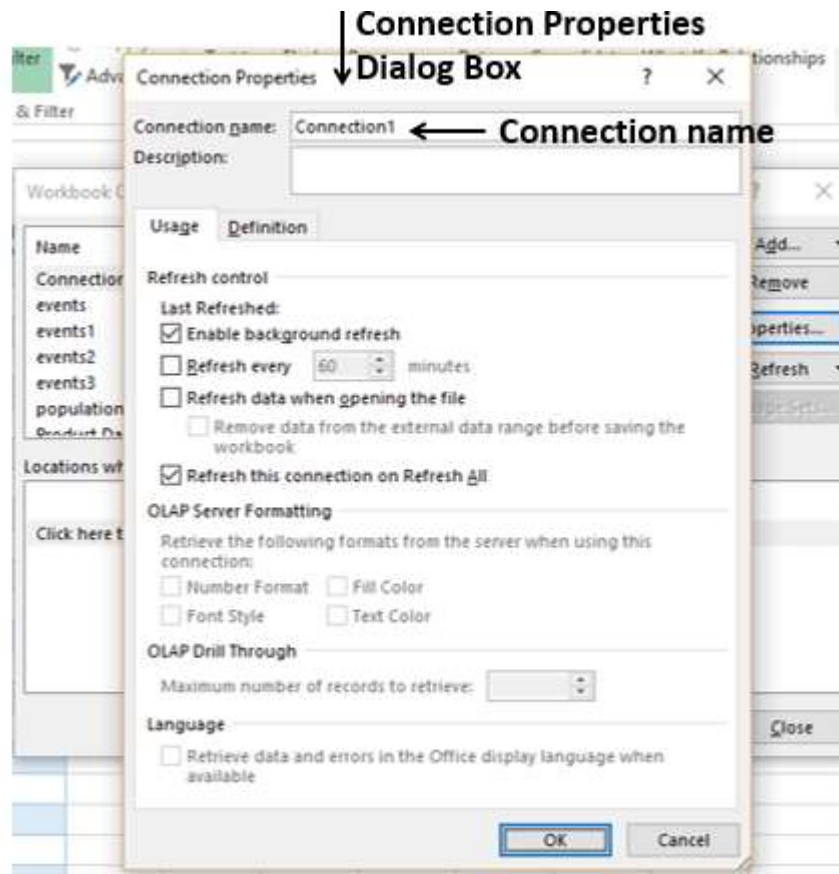
## Renaming the Data Connections

It will be useful if the data connections you have in your workbook have meaningful names for the ease of understanding and locating.

1. Go to **DATA > Connections** on the Ribbon. The **Workbook Connections** dialog box appears.
2. Select the connection that you want to rename and click Properties.



The **Connection Properties** dialog box appears. The present name appears in the Connection name box-



3. Edit the Connection name and click OK. The data connection will have the new name that you have given.

## Refreshing an External Data Connection

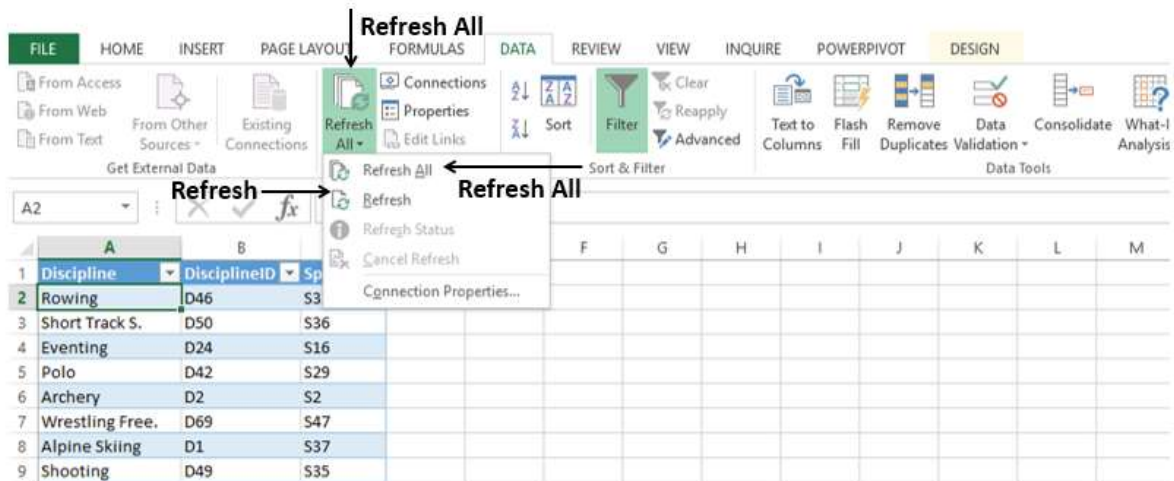
When you connect your Excel workbook to an external data source, as you have seen in the above sections, you would like to keep the data in your workbook up to date reflecting the changes made to the external data source time to time.

You can do this by refreshing the data connections you have made to those data sources. Whenever you refresh the data connection, you see the most recent data changes from that data source, including anything that is new or that is modified or that has been deleted.

You can either refresh only the selected data or all the data connections in the workbook at once.

1. Click the DATA tab on the Ribbon.
2. Click **Refresh All** in the Connections group.





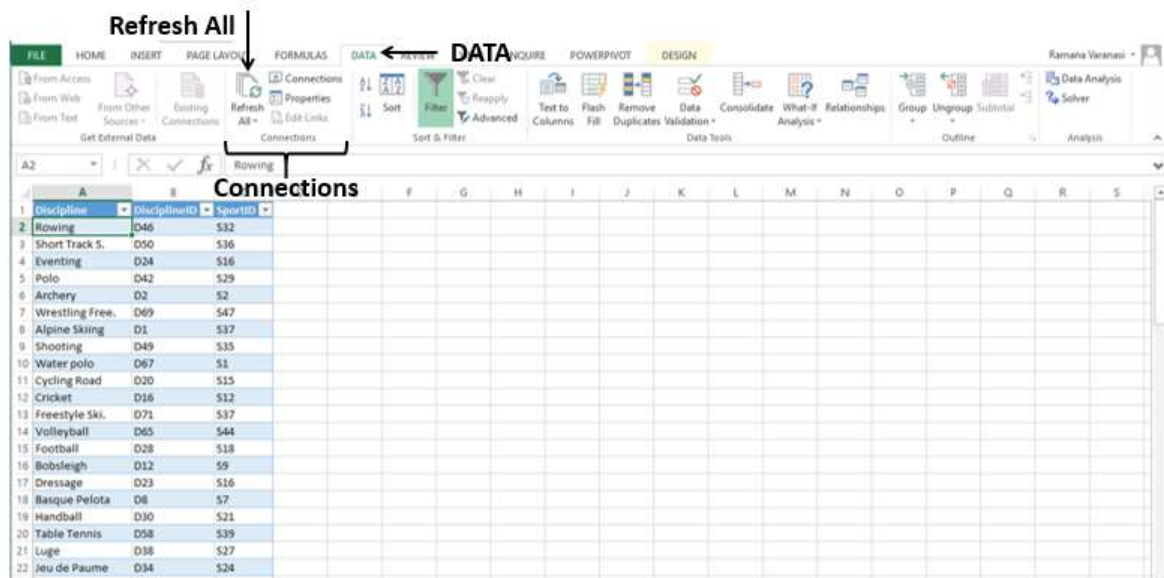
As you observe, there are two commands in the dropdown list – Refresh and Refresh All.

- If you click **Refresh**, the selected data in your workbook is updated.
- If you click **Refresh All**, all the data connections to your workbook are updated.

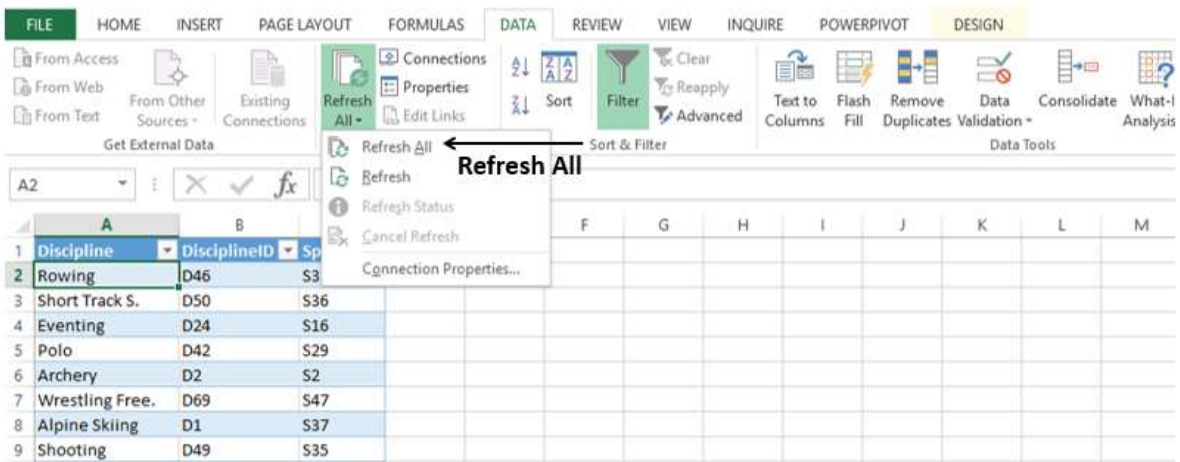
## Updating all the Data Connections in the Workbook

You might have several data connections to your workbook. You need to update them from time to time so that your workbook will have access to the most recent data.

1. Click any cell in the table that contains the link to the imported data file.
2. Click the Data tab on the Ribbon.
3. Click Refresh All in the Connections group.



4. Select Refresh All from the dropdown list. All the data connections in the workbook will be updated.

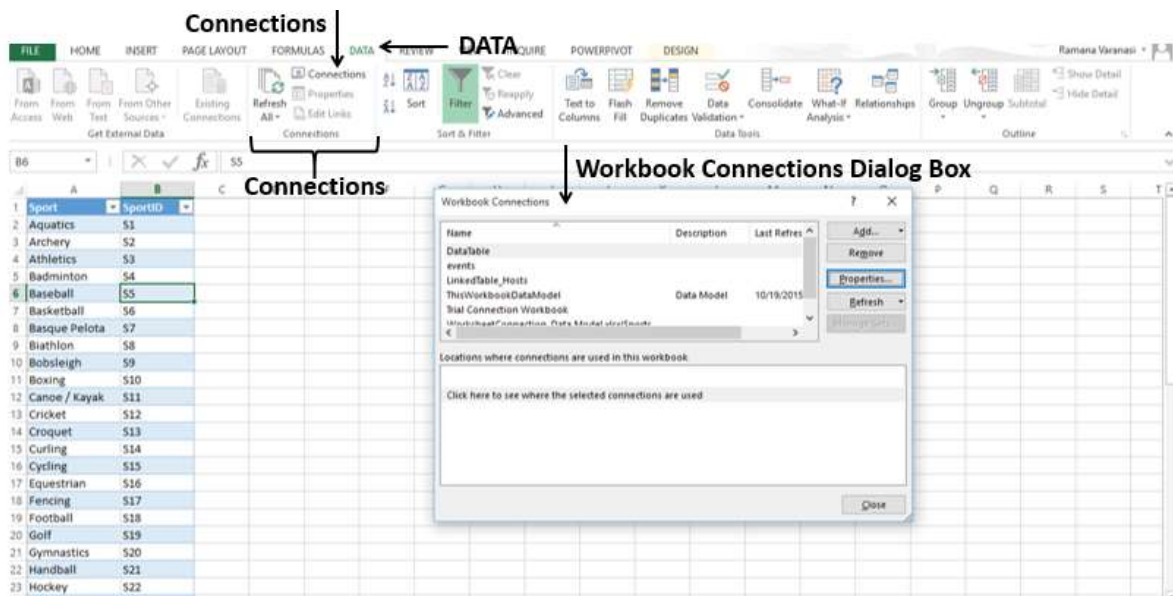


## Automatically Refresh Data when a Workbook is opened

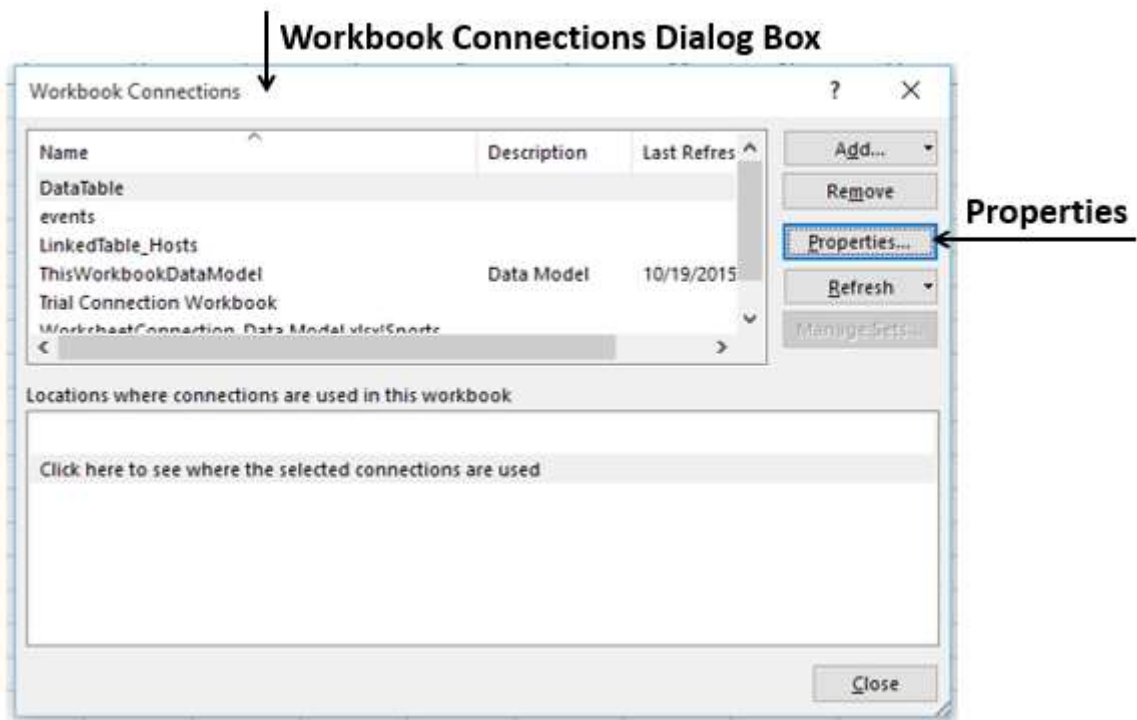
You might want to have access to the recent data from the data connections to your workbook whenever your workbook is opened.

1. Click any cell in the table that contains the link to the imported data file.
2. Click the Data tab.
3. Click Connections in the Connections group.

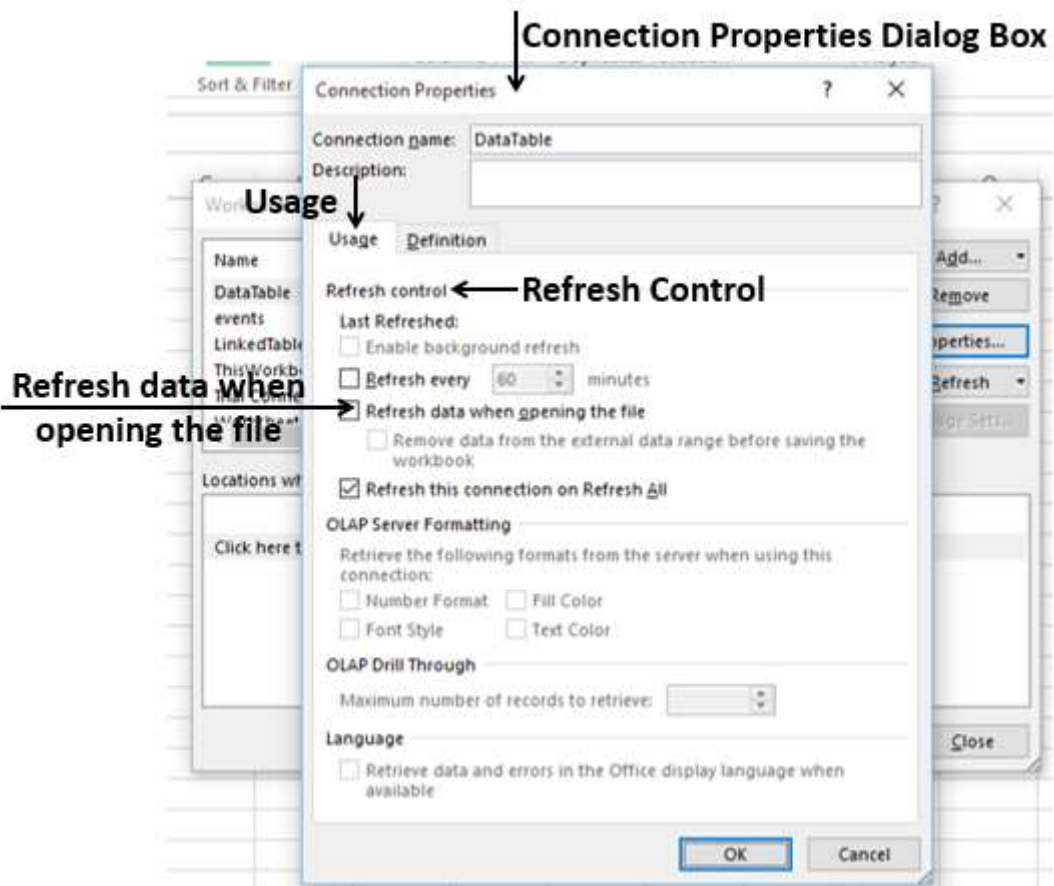
The Workbook Connections dialog box appears.



4. Click the Properties button. The Connection Properties dialog box appears.



5. Click the Usage tab.



6. Check the option - Refresh data when opening the file.

You have another option also- **Remove data from the external data range before saving the workbook.** You can use this option to save the workbook with the query definition but without the external data.

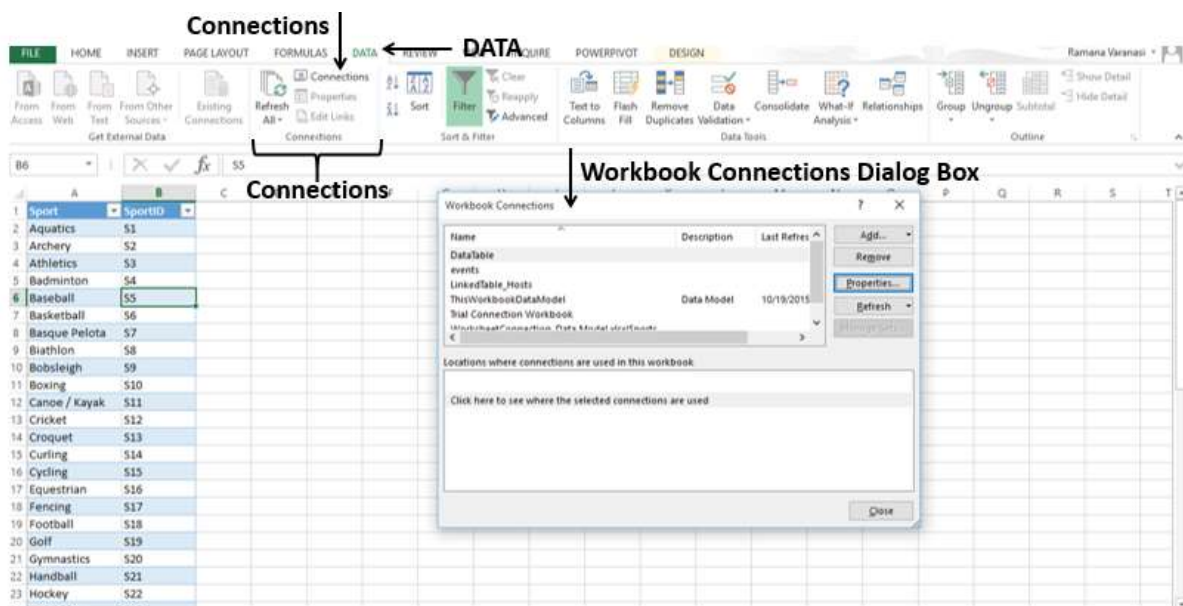
7. Click OK. Whenever you open your workbook, the up to date data will be loaded into your workbook.

## Automatically Refresh Data at regular Intervals

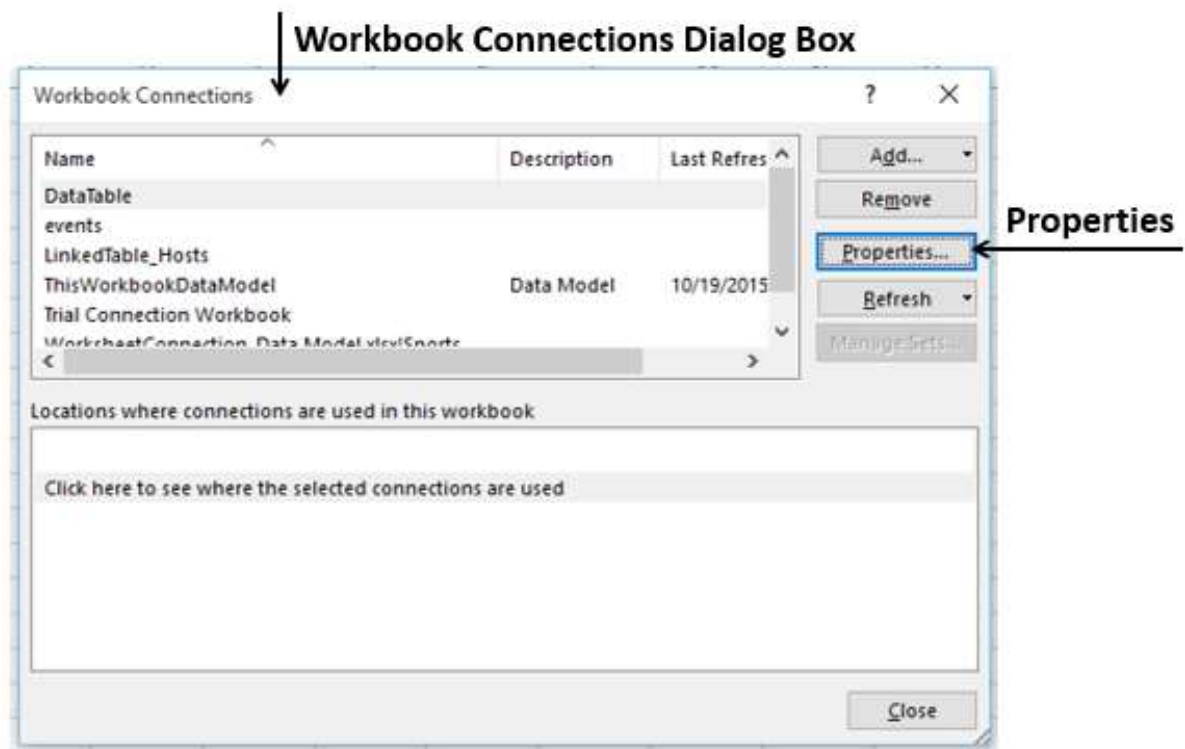
You might be using your workbook keeping it open for longer durations. In such a case, you might want to have the data refreshed periodically without any intervention from you.

1. Click any cell in the table that contains the link to the imported data file.
2. Click the Data tab on the Ribbon.
3. Click Connections in the Connections group.

The Workbook Connections dialog box appears.

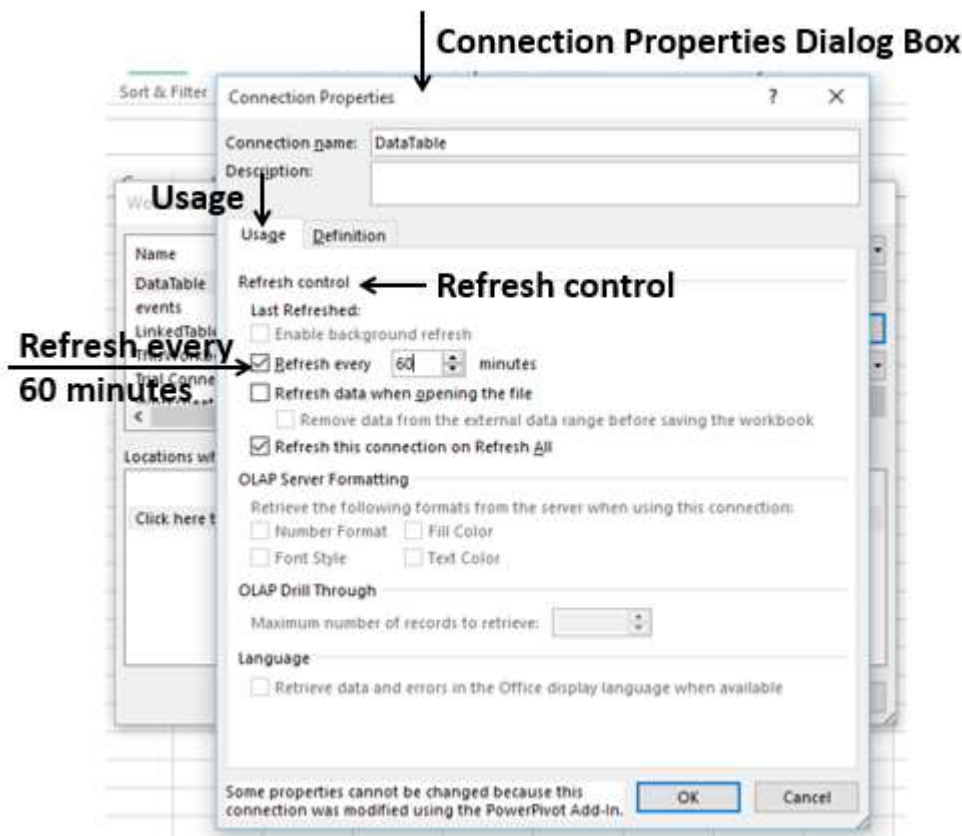


4. Click the Properties button.



The Connection Properties dialog box appears. Set the properties as follows-

- Click the **Usage** tab.
- Check the option **Refresh every**.
- Enter 60 as the number of minutes between each refresh operation and click Ok.



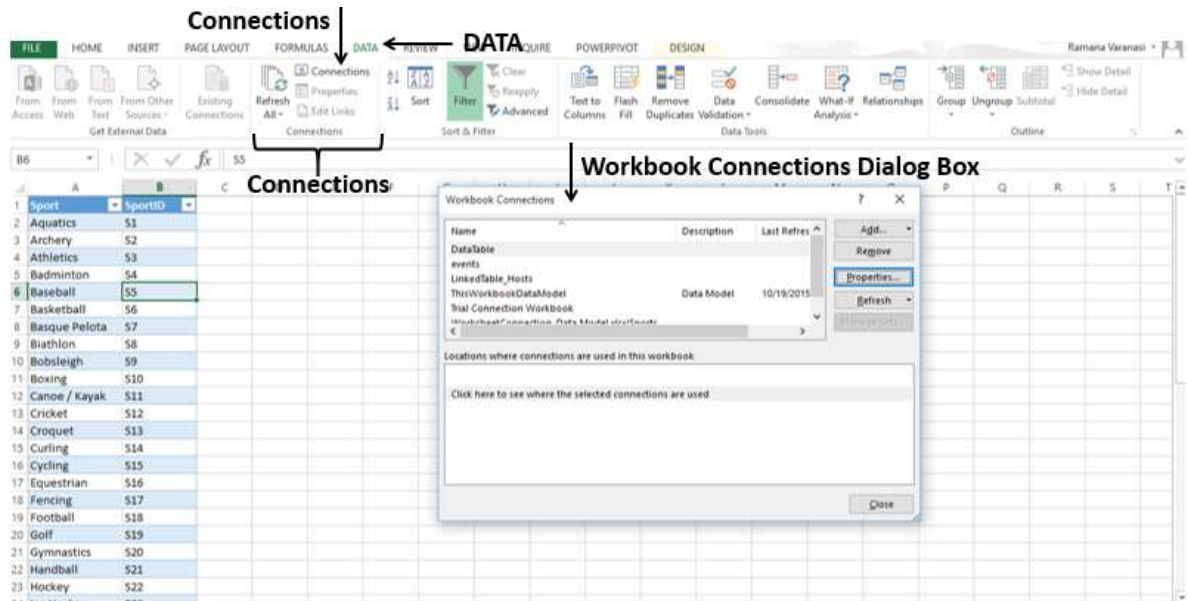
Your Data will be automatically refreshed every 60 min. (i.e. every one hour).

## Enabling Background Refresh

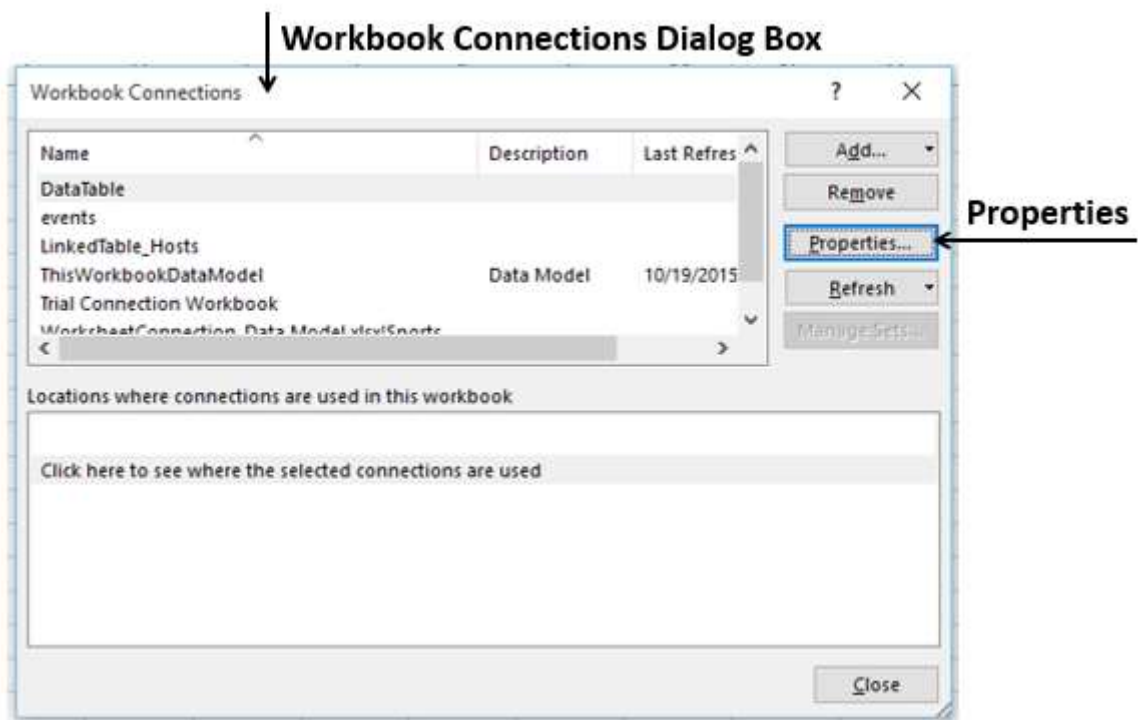
For very large data sets, consider running a background refresh. This returns control of Excel to you instead of making you wait several minutes or more for the refresh to finish. You can use this option when you are running a query in the background. However, during this time, you cannot run a query for any connection type that retrieves data for the Data Model.

- Click in any cell in the table that contains the link to the imported data file.
- Click the Data tab.
- Click Connections in the Connections group. The Workbook Connections dialog box appears.

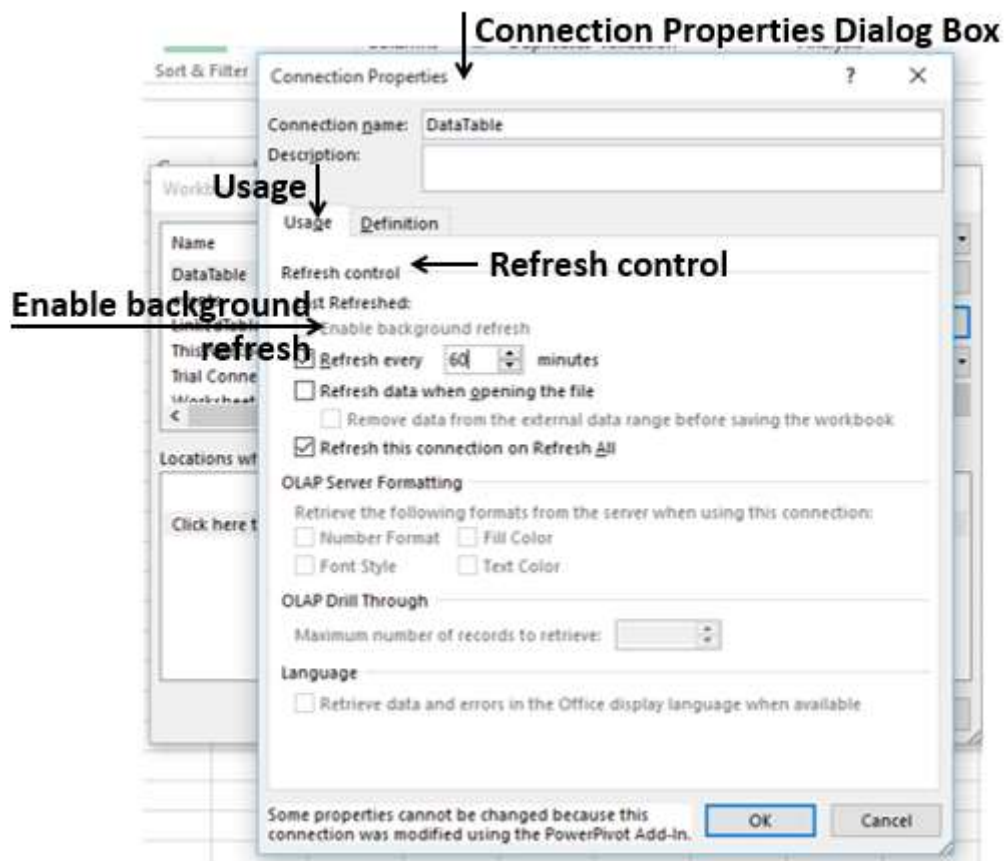




Click the Properties button.



The Connection Properties dialog box appears. Click the Usage tab. The Refresh Control options appear.



- Click Enable background refresh.
- Click OK. The Background refresh is enabled for your workbook.

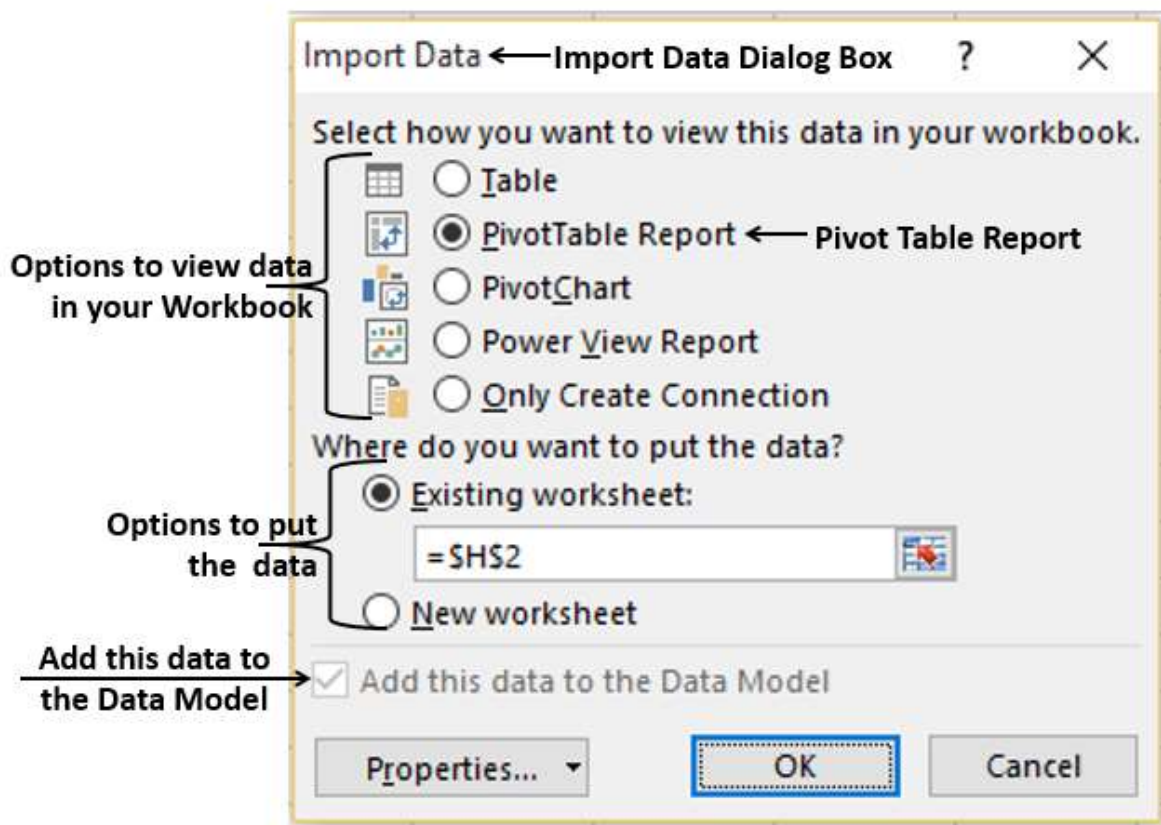
# 30. Data Model

Data Model is available in Excel 2013 and later versions. In Excel, you can use the Data Model to integrate data from multiple tables in the current workbook and / or from the imported data and / or from the data sources connected to the workbook through data connections.

With a Data Model, you can create relationships among the tables. Data model is used transparently in PivotTable, PivotChart, PowerPivot and Power View reports.

## Creating Data Model while Importing Data

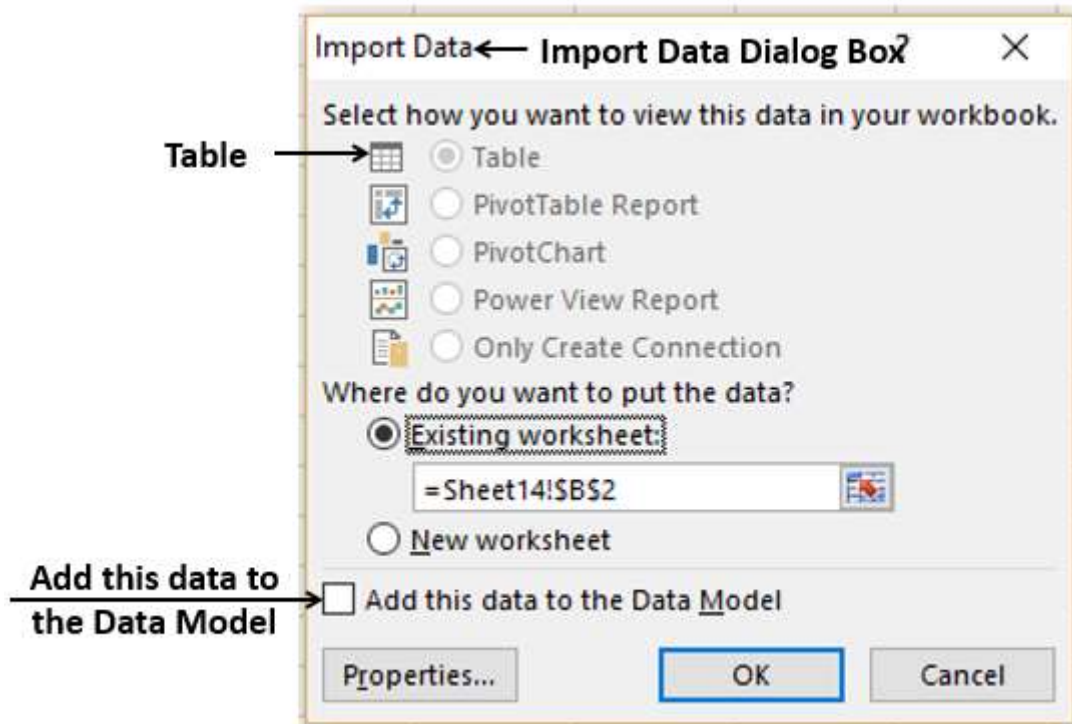
When you import data from relational databases like Microsoft Access database that contain multiple related tables, Data Model is automatically created if you import more than one table at once.



You can optionally add tables to the Data Model, when you import data from the following data sources -

- Relational databases, one table at a time
- Text Files
- Excel Workbooks

For example, while you are importing data from an Excel workbook, you can observe the option **Add this data to the Data Model**, with an enabled check box.



If you want to add the data you are importing to the Data Model, check the box.

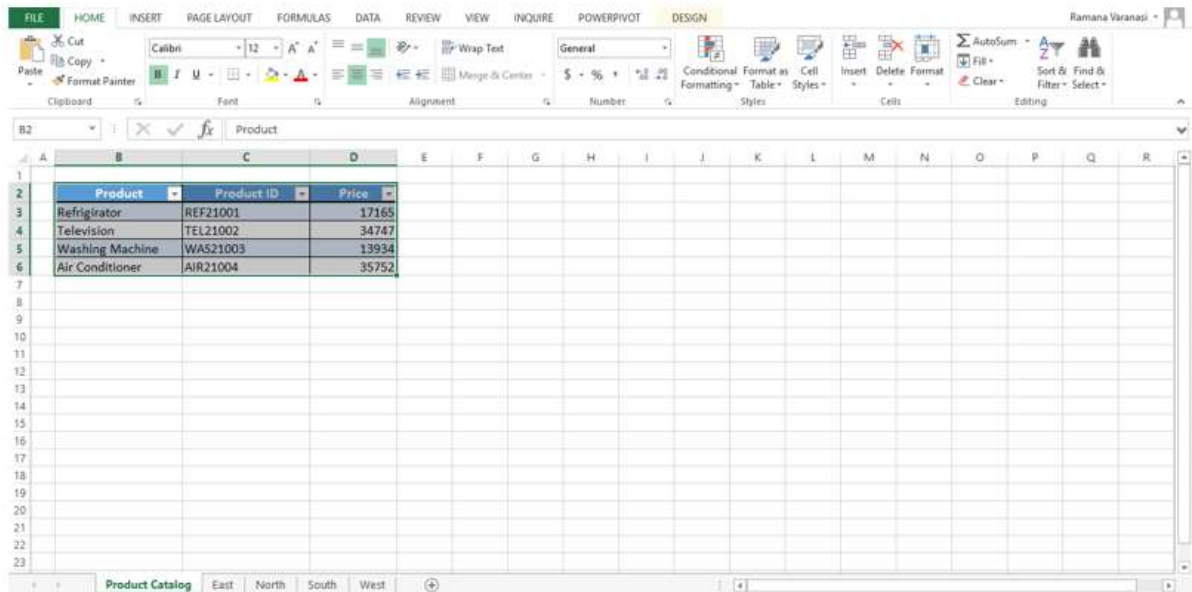
## Creating Data Model from Excel Tables

You can create the Data Model from Excel tables using PowerPivot commands. You will learn PowerPivot in detail in later chapters.

All the Data Model commands are available under the PowerPivot tab on the Ribbon. You can add Excel tables to the Data Model with these commands.

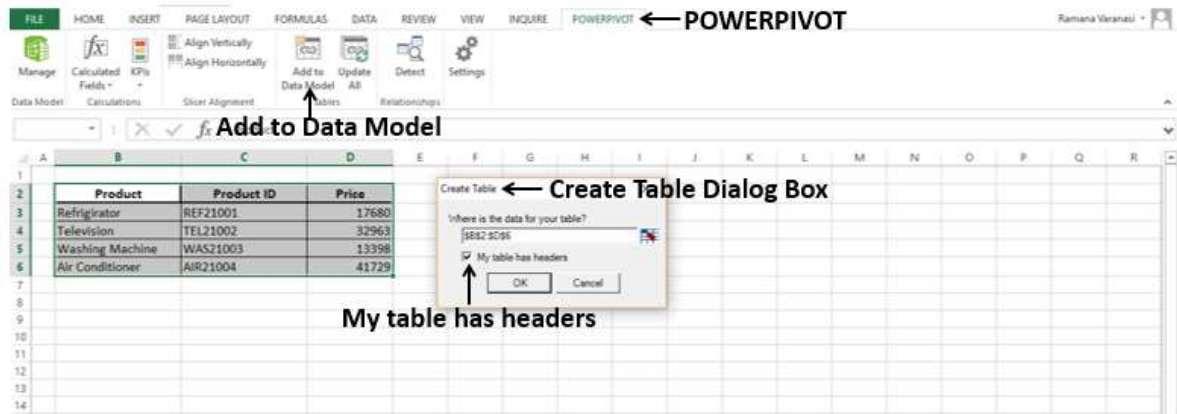
Consider the following sales data workbook, wherein you have Product Catalog worksheet that contains Product, Product ID and Price. You have four worksheets for the sales in 4 regions – East, North, South and West.

Each of these four worksheets contain No. of Units sold and Total Amount for each of the Products in each month. You need to calculate the total amount for each of the products in each region and total amount of sales in each region.



The following steps enable you to arrive at the desired results-

- Start with creating the Data Model.
- Click in the Product Catalog worksheet.
- Click the POWERPIVOT tab on the Ribbon.
- Click Add to Data Model. The Create Table dialog box appears.
- Select the table range.
- Check the box My table has headers. Click OK.

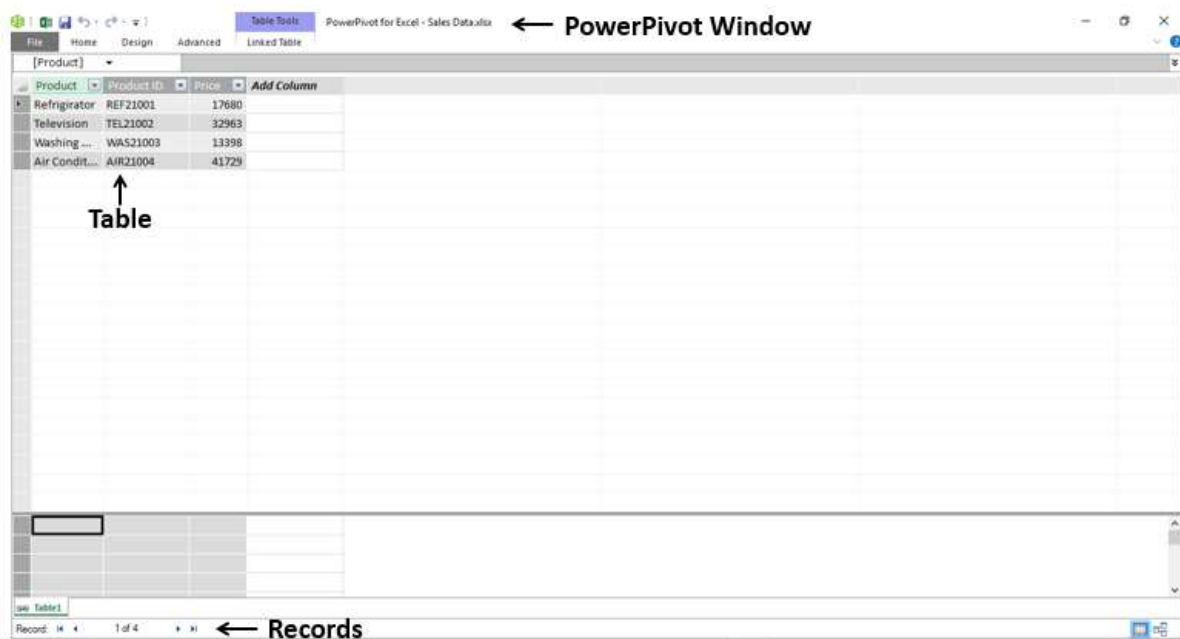


A new window – PowerPivot for Excel - <your Excel file name> appears.

The following message appears in the center of the blank window –



The table Product Backlog that you added to the Data Model appears as a sheet in PowerPivot window. Each row in the table is a record and you can go back and forth the records using the left and right arrow buttons at the bottom of the window.



- Click the Linked Table tab in the PowerPivot window.
- Click Go to Excel Table.





The Excel data window appears.

- Click the worksheet tab – East.
- Click the POWERPIVOT tab on the Ribbon.
- Click Add to Data Model.

Another sheet appears in the PowerPivot window displaying the East table.

Repeat for the worksheets – North, South and West. In all, you have added five tables to the Data Model. Your PowerPivot window looks as below –

S. No.	Month	Product	Product ID	Price	No. of Units	Total Amount	Add Column
1	April	Refrigerator	REF21001	16725	20	334500	
2	April	Television	TEL21002	36416	24	873984	
3	April	Washing ...	WAS21003	12337	17	209729	
4	April	Air Condit...	AIR21004	38009	20	760180	
5	May	Refrigerator	REF21001	16944	15	254160	
6	May	Television	TEL21002	35437	24	850488	
7	May	Washing ...	WAS21003	12047	28	337316	
8	May	Air Condit...	AIR21004	39959	33	1318647	
9	June	Refrigerator	REF21001	18648	21	391608	
10	June	Television	TEL21002	33915	19	644385	
11	June	Washing ...	WAS21003	12810	30	384300	
12	June	Air Condit...	AIR21004	41062	32	1313984	
13	July	Refrigerator	REF21001	17138	26	445588	
14	July	Television	TEL21002	34840	18	627120	
15	July	Washing ...	WAS21003	12876	17	218892	
16	July	Air Condit...	AIR21004	38856	23	893688	
17	August	Refrigerator	REF21001	16290	21	342090	
18	August	Television	TEL21002	35694	24	856656	

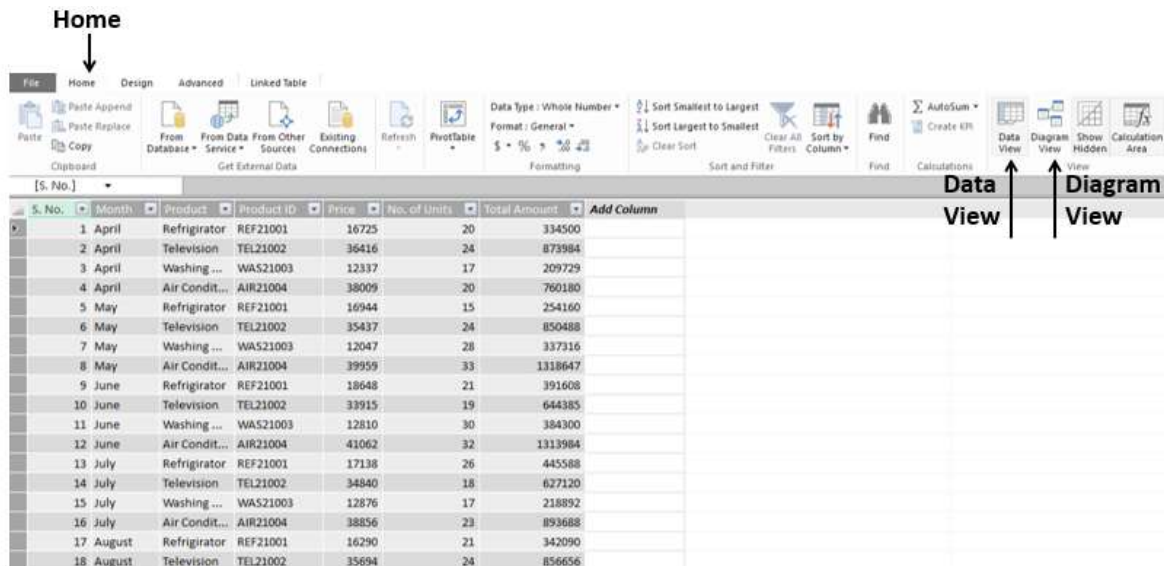
**Tables in the Data Model**

Product Catalog | East | North | South | West

## Creating Relationships between Tables

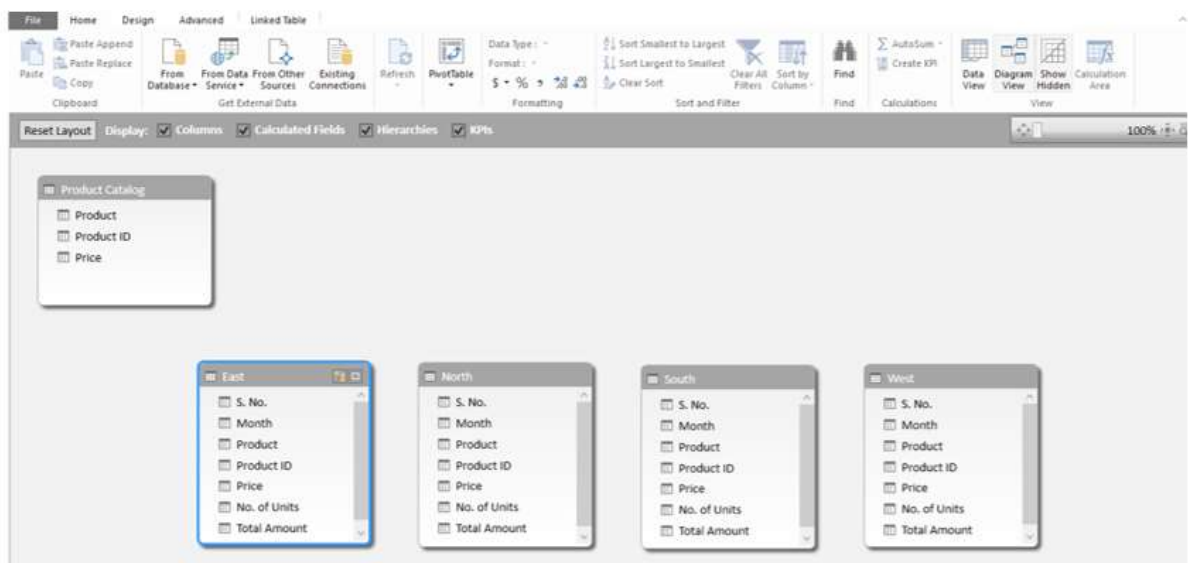
If you want to make calculations across the tables, you have to first define relationships among them.

- Click the Home tab on the Ribbon in the PowerPivot window. As you can observe, the tables are displayed in the Data View.
- Click Diagram View.

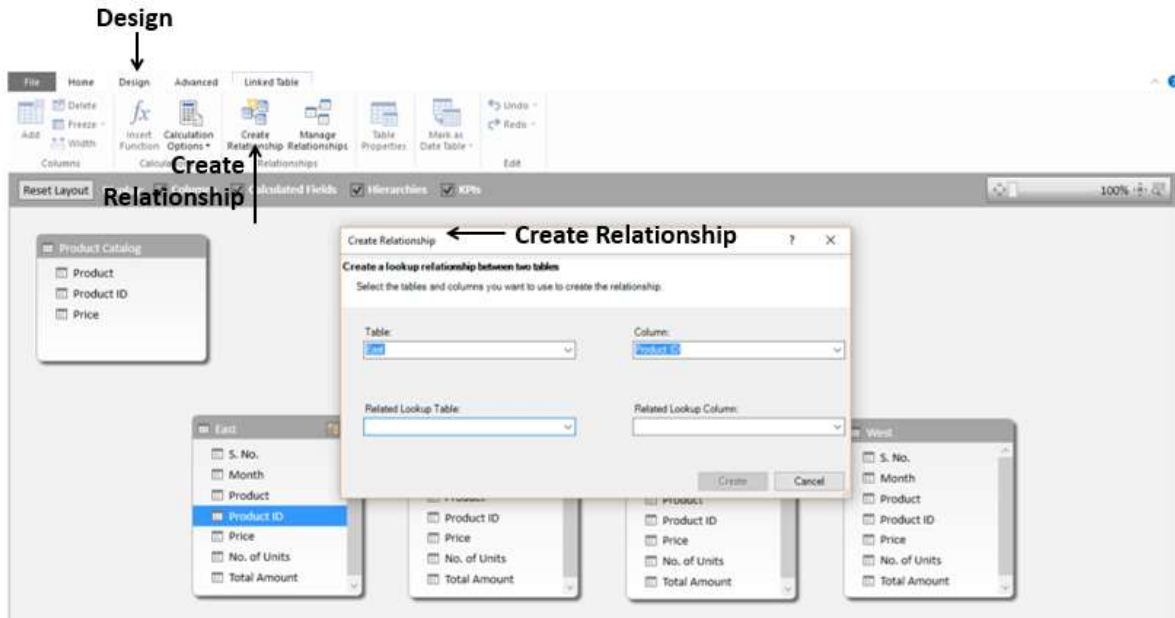


The tables appear in the Diagram View. As you observe, some of the tables may be out of display area and all the fields in the tables may not be visible.

- Resize each table to show all the fields in that table.
- Drag and arrange the tables so that all are displayed.

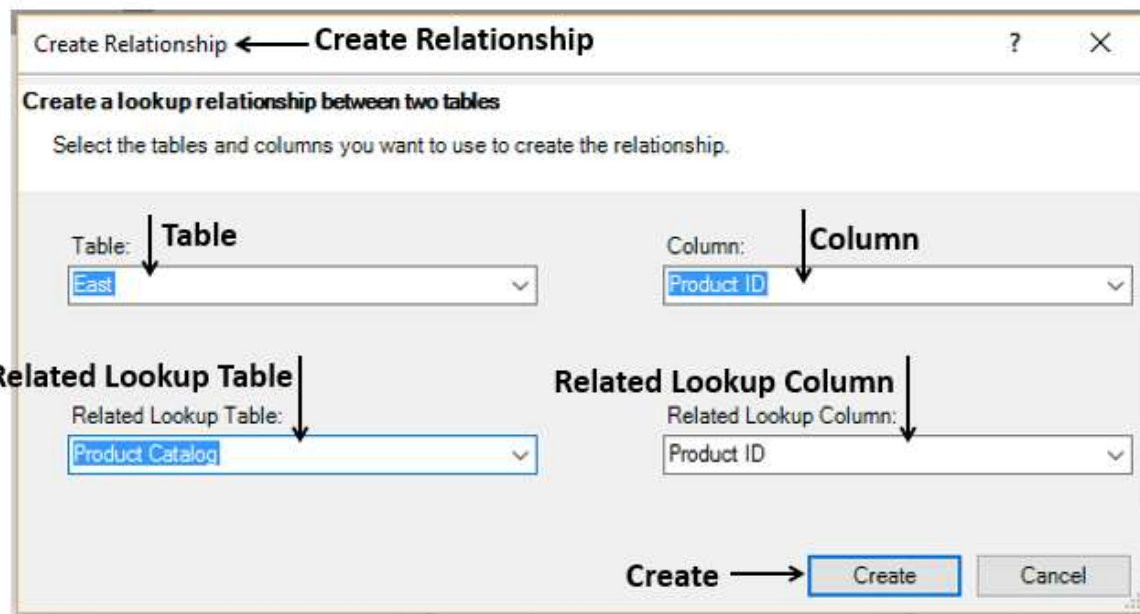


- In the East table, click on Product ID.
- Click the Design tab on the Ribbon.
- Click Create Relationship. The Create Relationship dialog box appears.

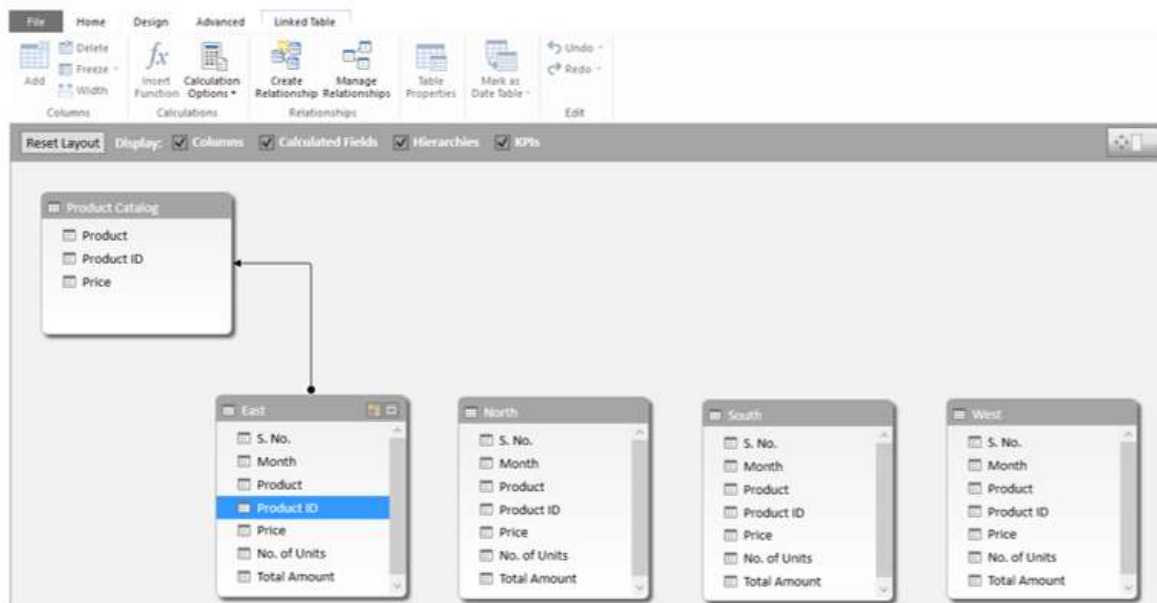


In the box under Table, East is displayed. In the box under Column, Product ID is displayed.

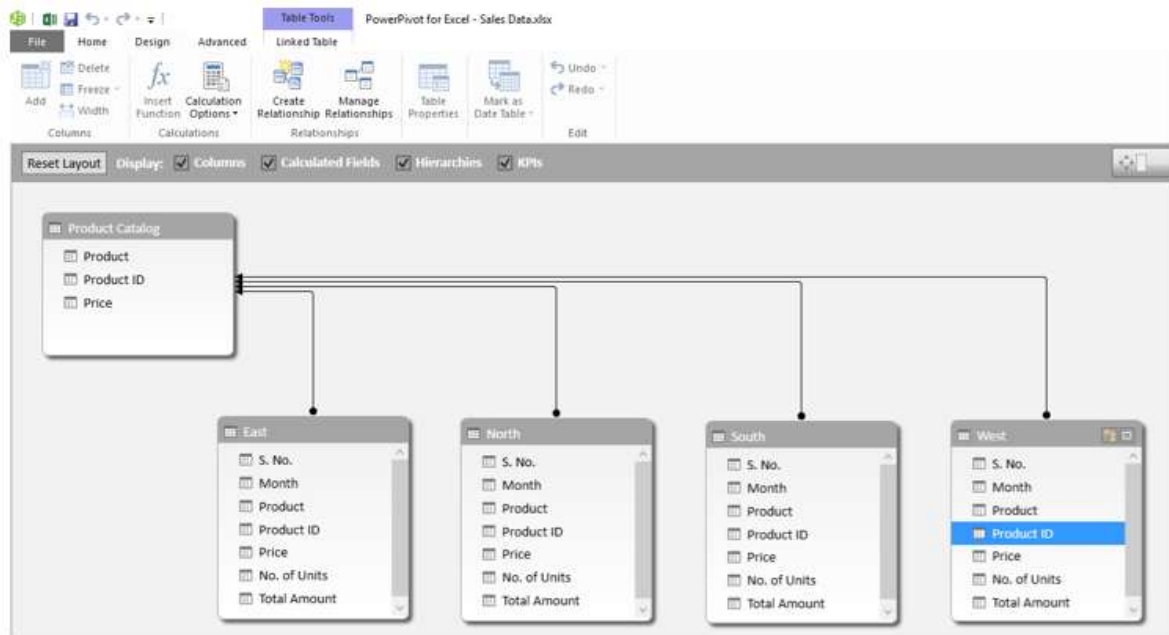
- In the box under Related Lookup Table, select Product Catalog.
- Product ID appears in the box under Related Lookup Column.
- Click the Create button.



Line representing Relationship between the tables East and Product Backlog appears.



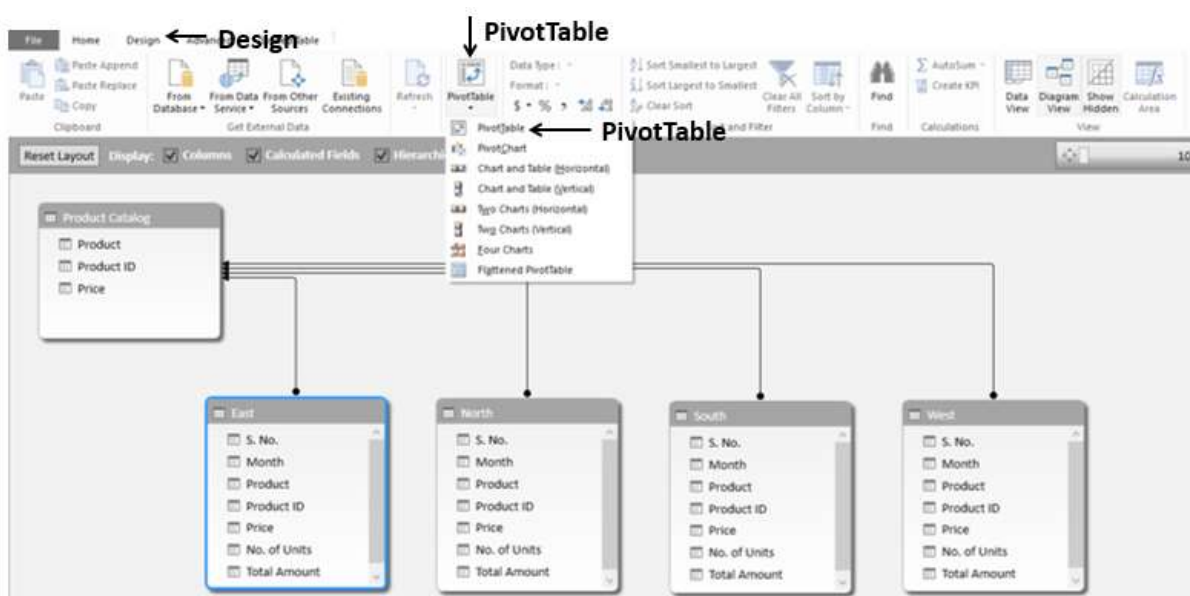
- Repeat the same steps for the tables – North, South and West. Relationship Lines appear.



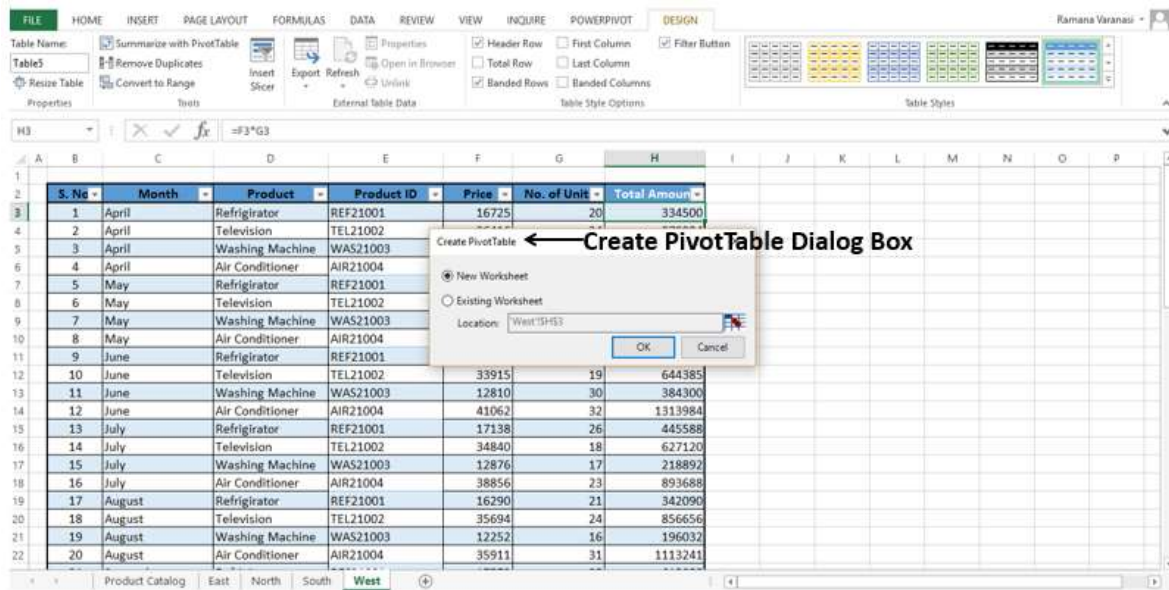
## Summarizing the Data in the Tables in the Data Model

Now, you are all set to summarize the sales data for each of the products in each region in just few steps.

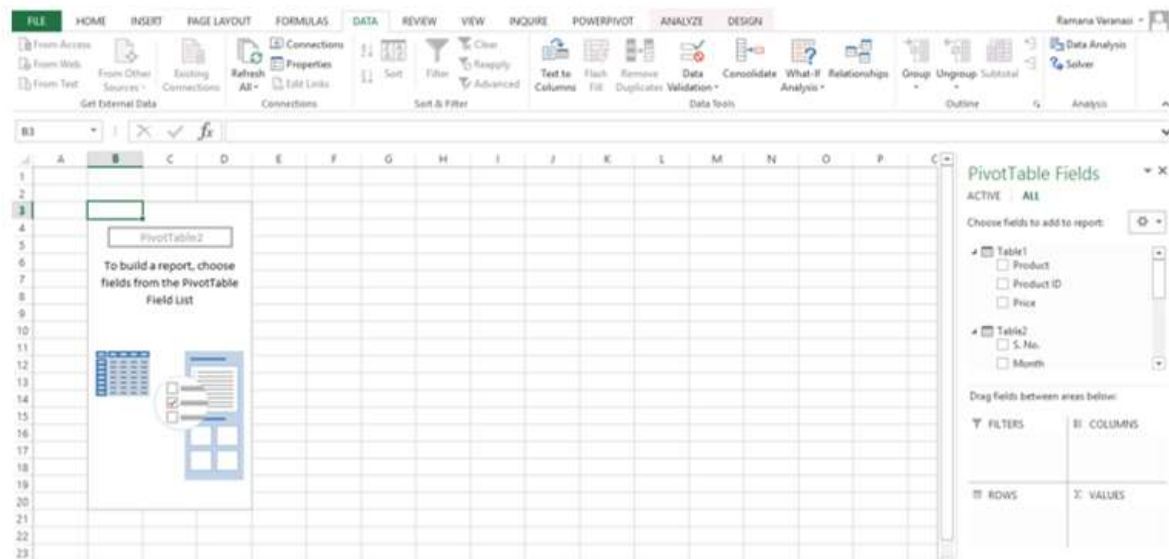
- Click the Home tab.
- Click PivotTable.
- Select PivotTable from the drop-down list.



Create PivotTable dialog box appears in the Excel tables window. Select New Worksheet.

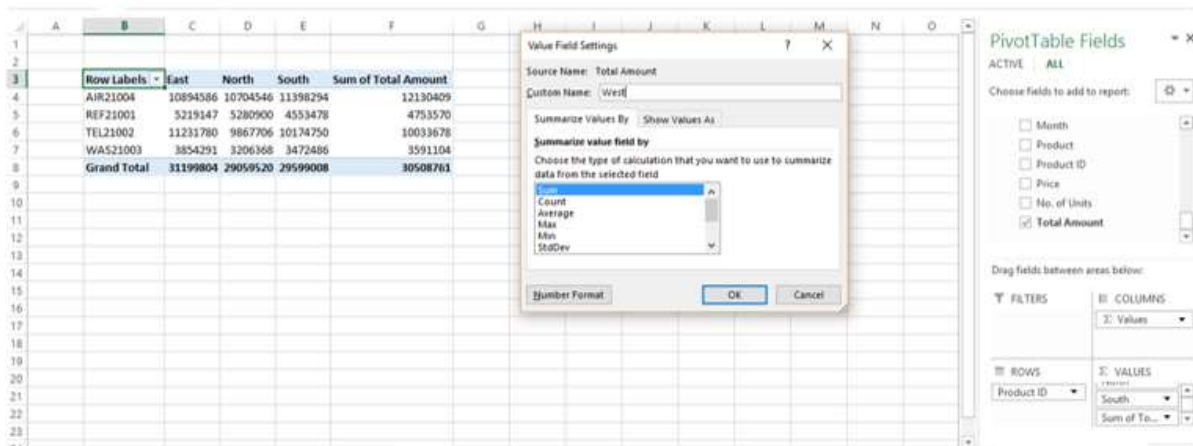


In a new worksheet, an empty PivotTable appears. As you can observe, the Fields List contains all the tables in the Data Model with all the fields displayed.



- Select Product ID from Table 1 (Product Catalog).
- Select Total Amount from the other four tables.
- For each of fields in  $\Sigma$  Values, change the Custom Name in Value Field Settings to display the region names as column labels.





The sum of Total Amount will be replaced by the label you give. PivotTable with summarized values from all the data tables shows you the required results.

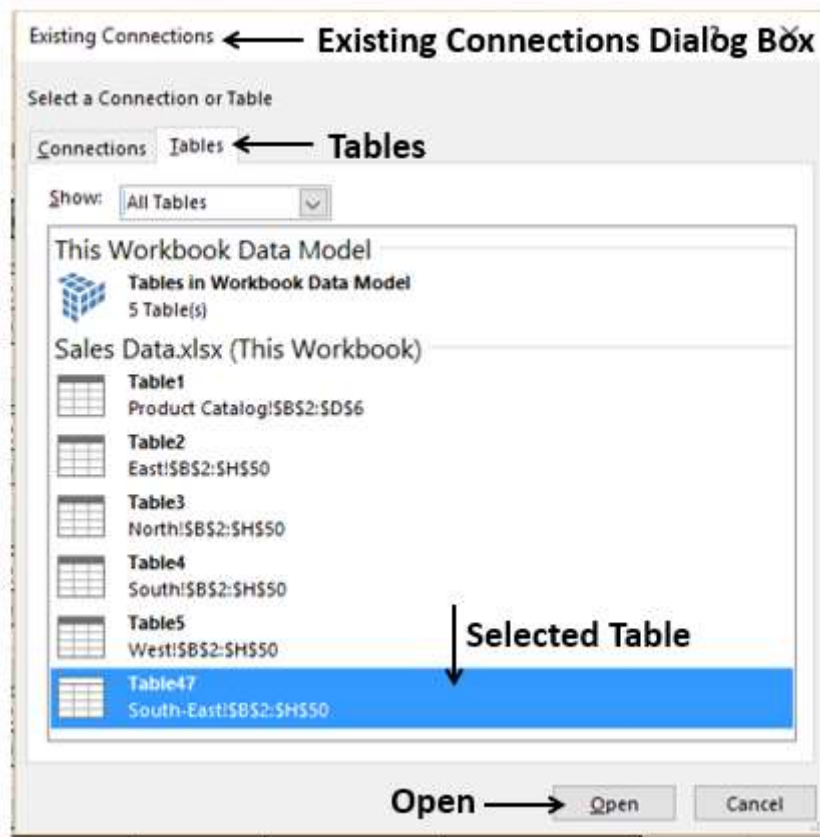
	A	B	C	D	E	F
1		Drop Report Filter Fields Here				
2						
3			<b>Values</b>			
4		<b>Product ID</b>	<b>East</b>	<b>North</b>	<b>South</b>	<b>West</b>
5		AIR21004	10894586	10704546	11398294	12130409
6		REF21001	5219147	5280900	4553478	4753570
7		TEL21002	11231780	9867706	10174750	10033678
8		WAS21003	3854291	3206368	3472486	3591104
9		<b>Grand Total</b>	<b>31199804</b>	<b>29059520</b>	<b>29599008</b>	<b>30508761</b>
10						

## Adding Data to Data Model

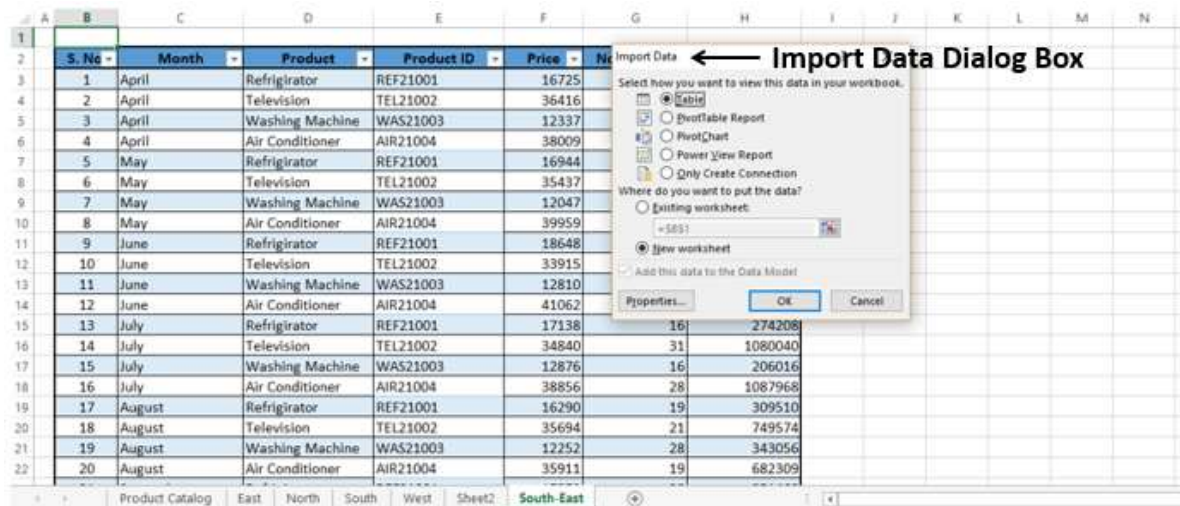
You can add a new data table to the Data Model or new rows of data to the existing tables in the Data Model.

Add a new data table to the Data Model with the following steps.

- Click the DATA tab on the Ribbon.
- Click Existing Connections in the Get External Data group. The Existing Connections dialog box appears.
- Click the Tables tab. The names of all the tables in the workbook will be displayed.
- Click the name of the table you want to add to the Data Model.



Click on the Open button. The Import Data dialog box appears.



As you are aware, while importing data table, it is automatically added to the Data Model. The newly added table appears in the PowerPivot window.

Add new rows of data to the existing tables in the Data Model.

Refresh the Data Connection. New rows of data from the data source get added to the Data Model.

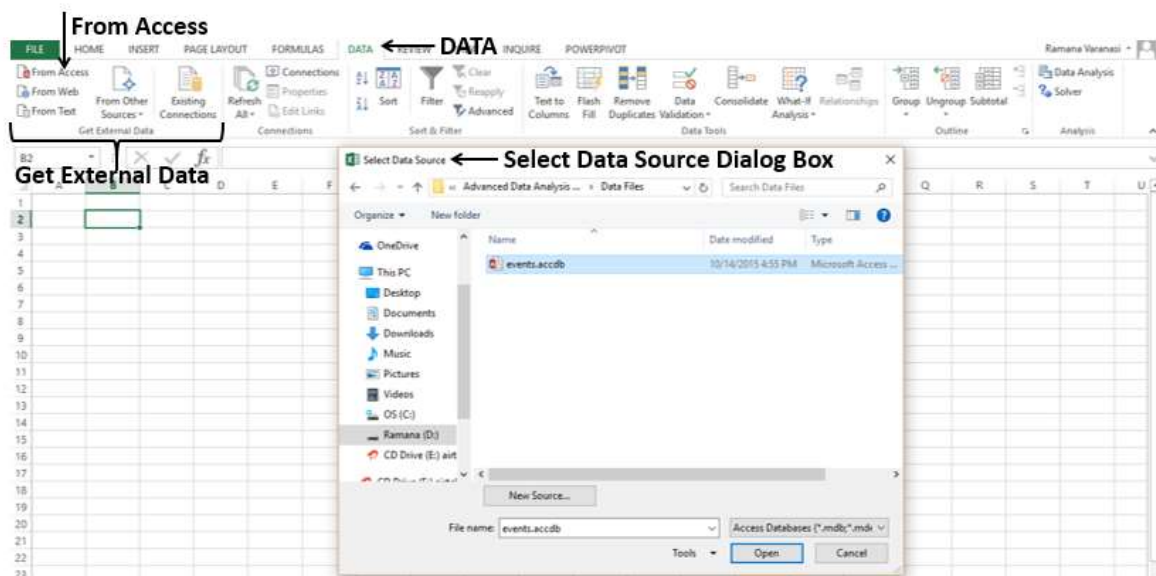
# 31. Exploring Data with PivotTables

You can do extensive data analysis using PivotTables and produce desired reports. The integration of Data Model with PivotTable enhances the way the data is collated, connected, summarized and reported. You can import tables from external data sources and create a PivotTable with the imported tables. This facilitates automatic updations of the values in the PivotTable whenever the data in the connected data sources is updated.

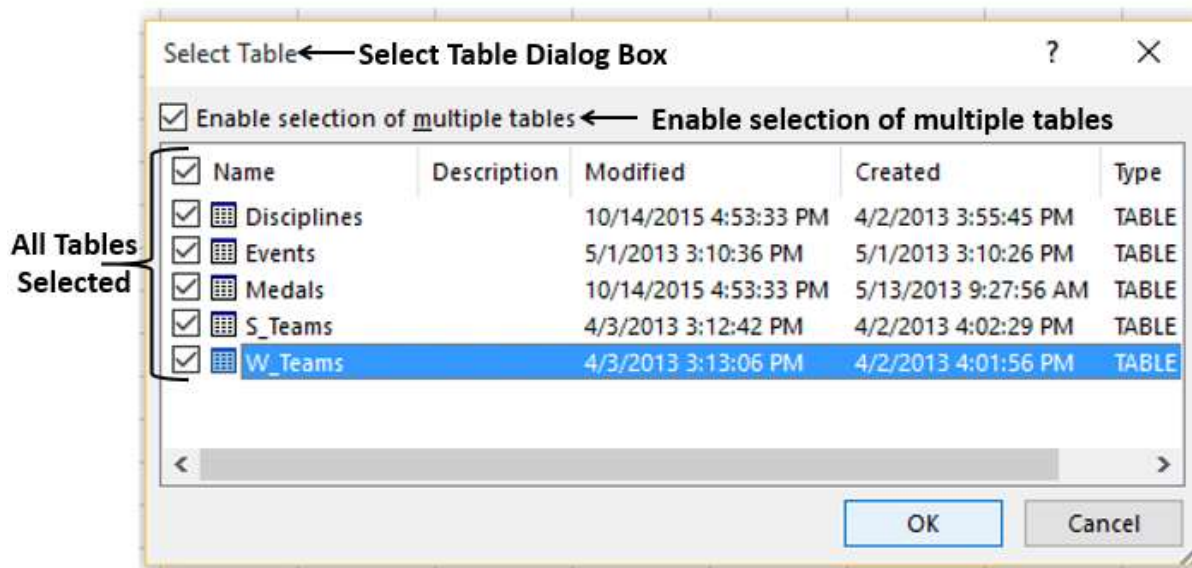
## Creating a PivotTable to analyze External Data

To create a PivotTable to analyze external data-

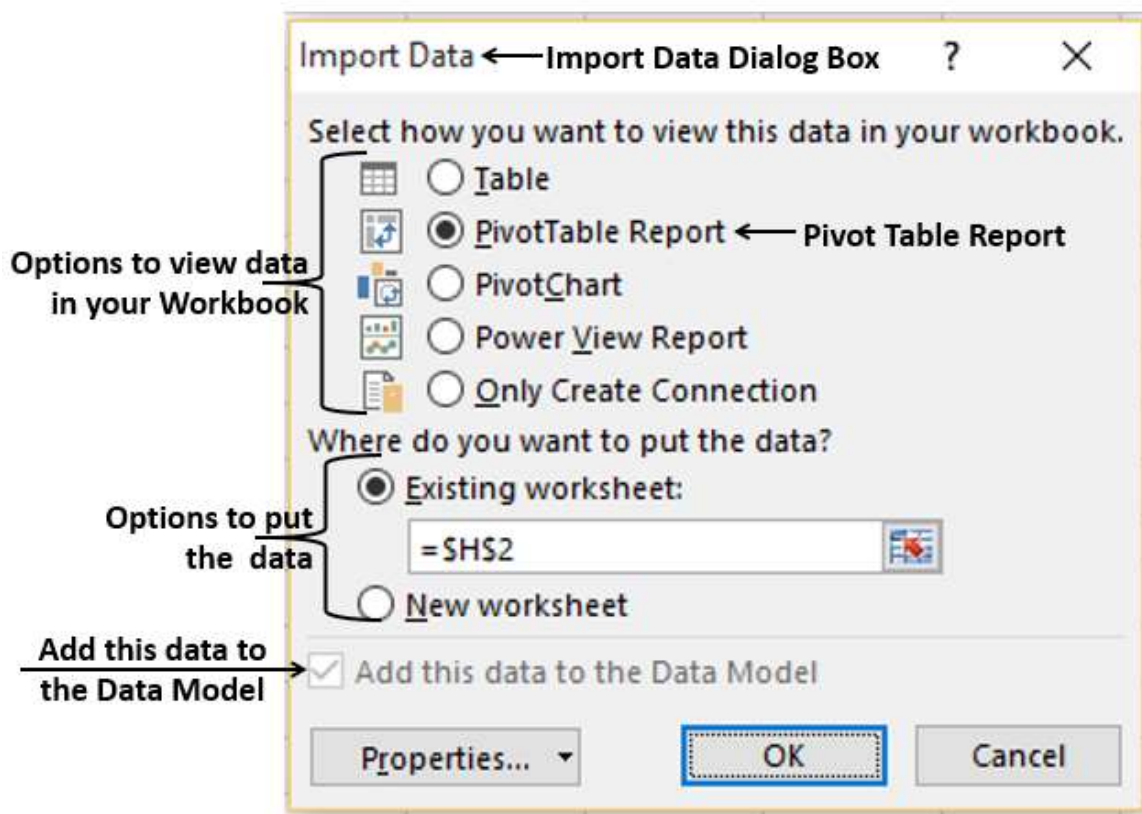
- Open a new blank workbook in Excel.
- Click the DATA tab on the Ribbon.
- Click From Access in the Get External Data group. The Select Data Source dialog box appears.
- Select the Access database file.



- Click the Open button. The Select Table dialog box appears, displaying the tables in the database. Access database is a relational database and the tables will be similar to Excel tables, with the exception that relationships exist among those tables.
- Check the box Enable selection of multiple tables.
- Select all the tables. Click OK.

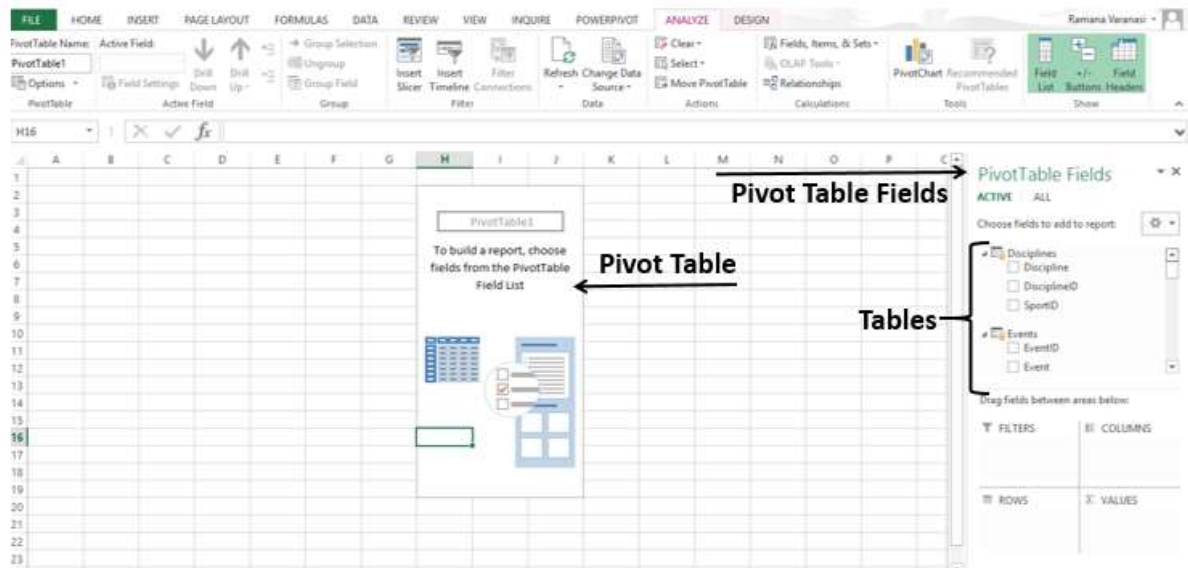


The **Import Data** dialog box appears. Select PivotTable Report. This option imports the tables into your Excel workbook and creates a PivotTable for analyzing the imported tables.



As you observe, the checkbox Add this data to the Data Model is selected and disabled, indicating that the tables will be added to the Data Model automatically.

The data will be imported and an empty PivotTable will be created. The imported tables appear in the PivotTable Fields list.



## Exploring Data in Multiple Tables

You can analyze the data from the imported multiple tables with PivotTable and arrive at the specific report you want in just few steps. This is possible because of the pre-existing relationships among the tables in the source database. As you imported all the tables from the database together at the same time, Excel recreates the relationships in its Data Model.

In the PivotTable Fields list, you will find all the tables that you imported and the fields in each of them. If the fields are not visible for any table,

- Click on the arrow next to that table in the PivotTable Fields list
- The fields in that table will be displayed.

## Exploring Data using PivotTable

You know how to add fields to PivotTable and drag fields across areas. Even if you are not sure of the final report that you want, you can play with the data and choose the appropriate report.

Suppose you want to have a report displaying the following –

- Data for five disciplines - Archery, Diving, Fencing, Figure Skating and Speed Skating.
- Regions that scored more than 80 medals in these 5 disciplines.
- The count of medals in each of the five disciplines in each of these regions.
- Total count of medals for the five disciplines in each of these regions.



You can see how easily you can create this report in few steps.

To start with, create a PivotTable displaying the count of medals in all the regions for the selected five disciplines as follows-

- Drag the NOC\_CountryRegion field from the Medals table to the COLUMNS area.
- Drag Discipline from the Disciplines table to the ROWS area.
- Filter Discipline to display only the five disciplines for which you wanted the report. This can be done either in the PivotTable Fields area, or from the Row Labels filter in the PivotTable itself.
- Drag Medal from the Medals table to the VALUES area.
- Drag Medal from the Medals table to the FILTERS area.

You will get the following PivotTable -

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POWERPIVOT

ANALYZE

DESIGN

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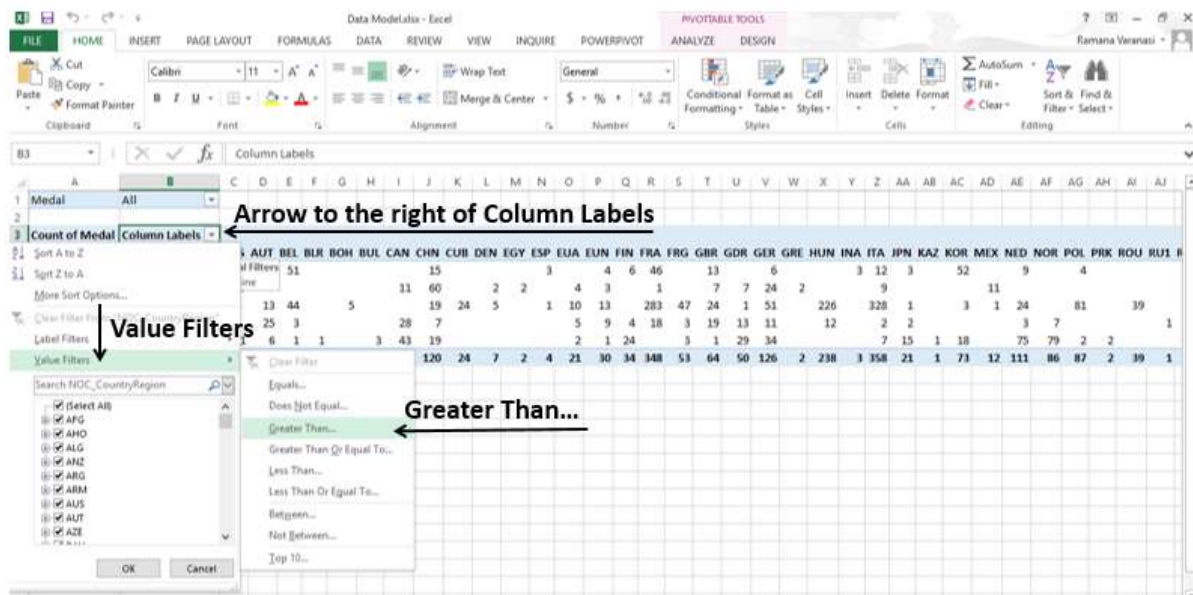
11

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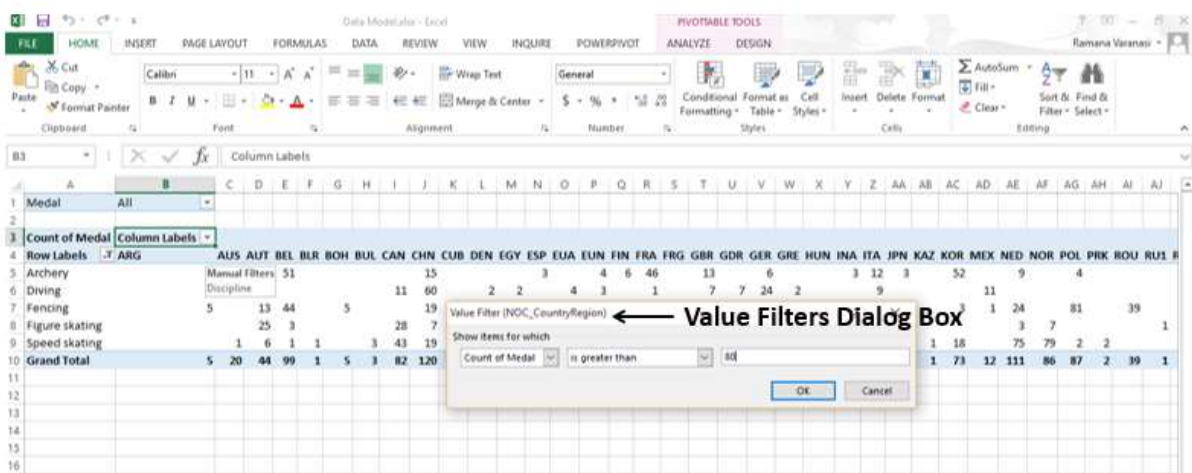
As you observe, Count of Medals is displayed for all the regions and for the five disciplines that you selected. Next, you have to fine-tune this report so that only those regions with total count of medals greater than 80 will be displayed.

- Click the arrow button to the right of Column Labels.
- Click Value Filters in the drop-down list that appears.
- Select **Greater Than...** from the drop-down list that appears.

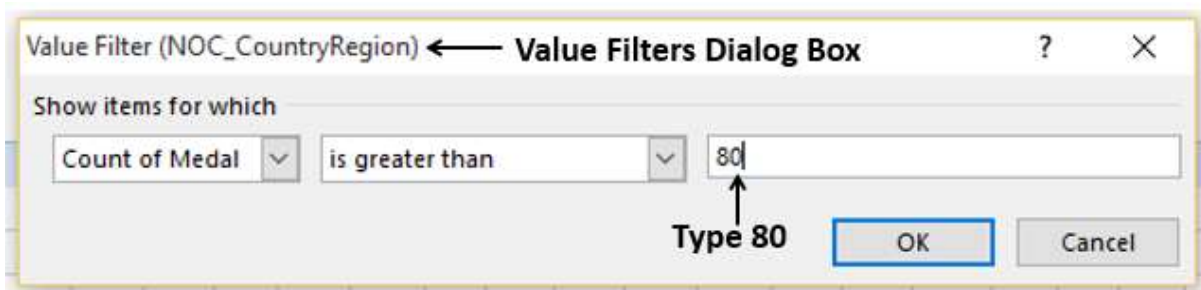




Value Filters dialog box appears.



As you observe, Count of Medals and is greater than are displayed in the boxes below **Show items for which**. Type 80 in the box next to the box containing is greater than and click OK.



Now, the PivotTable displays only those regions with total count of medals in the selected five disciplines greater than 80.

FILE

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PivotTable Name: PivotTable1

Active Field: Discipline

Options: Field Settings

Active Field: Discipline

Group Selection: Ungroup, Group Field, Group

Insert: Slicer, Timeline, Filter

Refresh: Refresh, Change Data Source

Actions: Clear, Select, Move PivotTable

Calculations: Fields, Items, & Sets, OLAP Tools, Relationships

Tools: PivotChart, Recommended PivotTables

Field List: Field Buttons, Headers

AS

Archery

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	
1	Medal	All																																		
2																																				
3	Count of Medal	Column Labels																																		
4	Row Labels	BEL	CAN	CHN	FRA	GER	HUN	ITA	NED	NOR	POL	RUS	URS	USA	Grand Total																					
5	Archery		51	15	46	6	12	9			4	1	7	52	203																					
6	Diving			11	60	1	24	9				24	14	131	274																					
7	Fencing		44		19	283	51	226	328	24		81	41	145	1290																					
8	Figure skating		3	28	7	18	11	12	2	3	7		29	42	51	213																				
9	Speed skating		1	43	19		34		7	75	79	2	8	60	73	401																				
10	Grand Total		99	82	120	348	126	238	358	111	86	87	103	268	355	2381																				
11																																				
12																																				
13																																				
14																																				
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←

PivotTable with desired Results

## Creating a Relationship between Tables with PivotTable Fields

If you do not import the tables at the same time, if the data is from different sources, or if you add new tables to your workbook, you have to create the relationships among the tables by yourself.

Add a new worksheet with a table that contains Sport and SportID fields to your workbook.

File Home Insert Page Layout Formulas Data Review View Inquire POWERPivot DESIGN

Clipboard Font Paragraph Alignment Number Styles Cells Editing

Sport	SportID
Aquatics	51
Archery	52
Athletics	53
Badminton	54
Baseball	55
Basketball	56
Basque Pelota	57
Biathlon	58
Bobsleigh	59
Boxing	510
Canoe / Kayak	511
Crickets	512
Croquet	513
Curling	514
Cycling	515
Equestrian	516
Fencing	517
Football	518
Golf	519
Gymnastics	520
Handball	521
Hockey	522

- Name the table- **Sports**.
- Click ALL in the PivotTable Fields list in the PivotTable worksheet.

The screenshot shows the Excel 2016 interface. A PivotTable is active, showing medal counts by country and discipline. A new table named 'Sports' has been added, containing data for various sports and countries. The PivotTable Fields task pane on the right shows the 'Sports' table added to the 'ROWS' area. A message box is visible, stating 'Relationships between tables may be needed. A CREATE button appears next to the message.'

Medal	All	CAN	CHN	FRA	GER	HUN	ITA	NED	NOR	POL	RUS	URS	USA	Grand Total
Archery	51	15	46	6	12	9	4	1	7	52	203			
Diving	11	60	1	24	9				24	14	131			274
Fencing	44	19	283	51	226	328	24		81	41	145	48		1290
Figure skating	3	28	7	18	11	12	2	3	7	29	42	51		213
Speed skating	1	43	19	34		7	75	79	2	8	60	73		401
Grand Total	99	82	120	348	126	238	358	111	86	87	103	268	355	2381

You can see that the newly added table- Sports is also visible in the PivotTable Fields list.

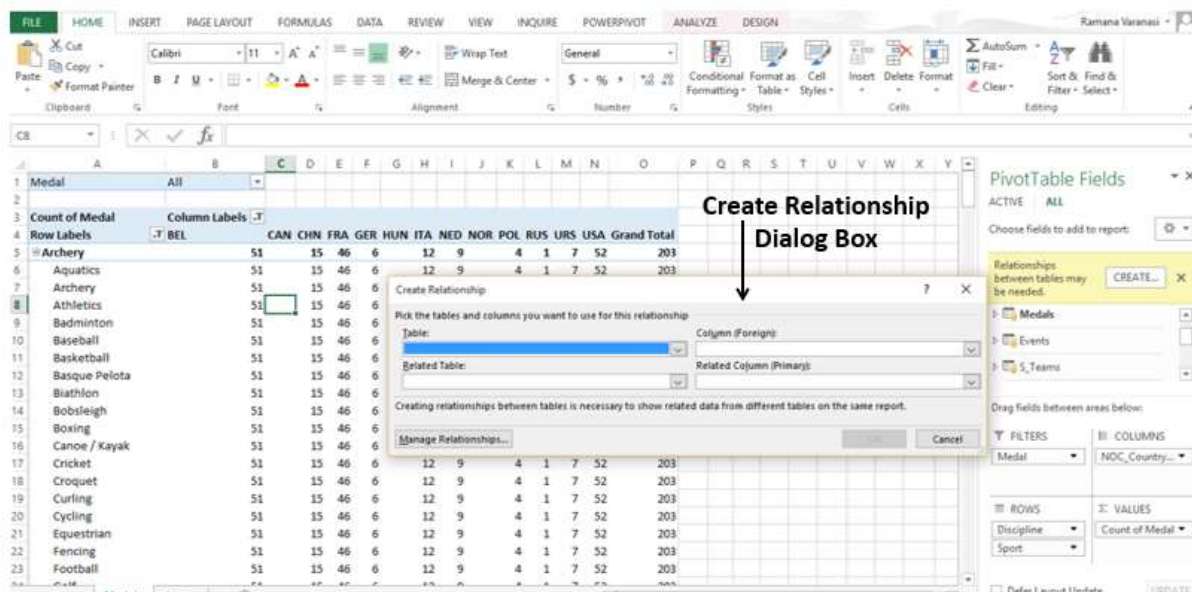
Next, add the field Sport also to the PivotTable as follows -

- Drag the field Sport from the table Sports to ROWS area. The Sport values appear as Row labels in the PivotTable.
- A message will appear in the PivotTable Fields list that Relationships between tables may be needed. A CREATE button appears next to the message.

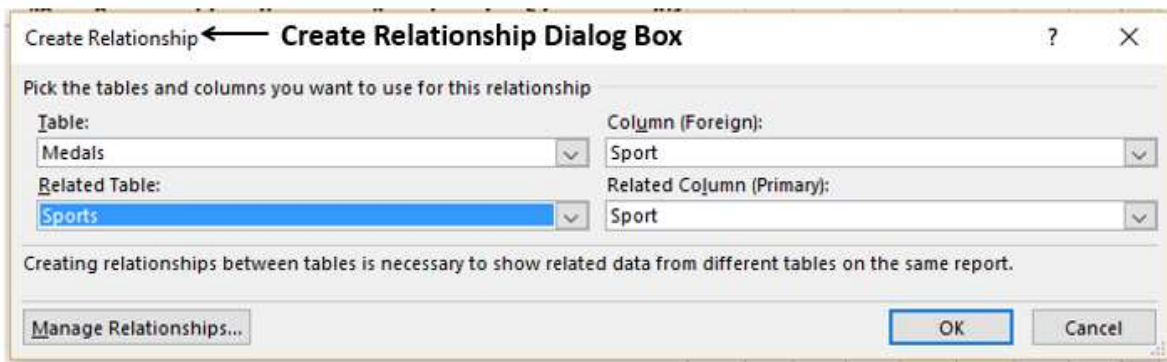
The screenshot shows the Excel 2016 interface. The PivotTable Fields task pane on the right shows the 'Sports' table added to the 'ROWS' area. A message box is visible, stating 'Relationships between tables may be needed. A CREATE button appears next to the message.'

Medal	All	CAN	CHN	FRA	GER	HUN	ITA	NED	NOR	POL	RUS	URS	USA	Grand Total
Archery	51	15	46	6	12	9	4	1	7	52	203			
Aquatics	51	15	46	6	12	9	4	1	7	52	203			
Archery	51	15	46	6	12	9	4	1	7	52	203			
Athletics	51	15	46	6	12	9	4	1	7	52	203			
Badminton	51	15	46	6	12	9	4	1	7	52	203			
Baseball	51	15	46	6	12	9	4	1	7	52	203			
Basketball	51	15	46	6	12	9	4	1	7	52	203			
Basque Pelota	51	15	46	6	12	9	4	1	7	52	203			
Biathlon	51	15	46	6	12	9	4	1	7	52	203			
Bobsleigh	51	15	46	6	12	9	4	1	7	52	203			
Boxing	51	15	46	6	12	9	4	1	7	52	203			
Canoe / Kayak	51	15	46	6	12	9	4	1	7	52	203			
Cricket	51	15	46	6	12	9	4	1	7	52	203			
Croquet	51	15	46	6	12	9	4	1	7	52	203			
Curling	51	15	46	6	12	9	4	1	7	52	203			
Cycling	51	15	46	6	12	9	4	1	7	52	203			
Equestrian	51	15	46	6	12	9	4	1	7	52	203			
Fencing	51	15	46	6	12	9	4	1	7	52	203			
Football	51	15	46	6	12	9	4	1	7	52	203			

Click the CREATE button. The Create Relationship dialog box appears.



- Select Medals under Table.
- Select Sport under Column.
- Select Sports under Related Table. Sport appears under related column.
- Click OK.



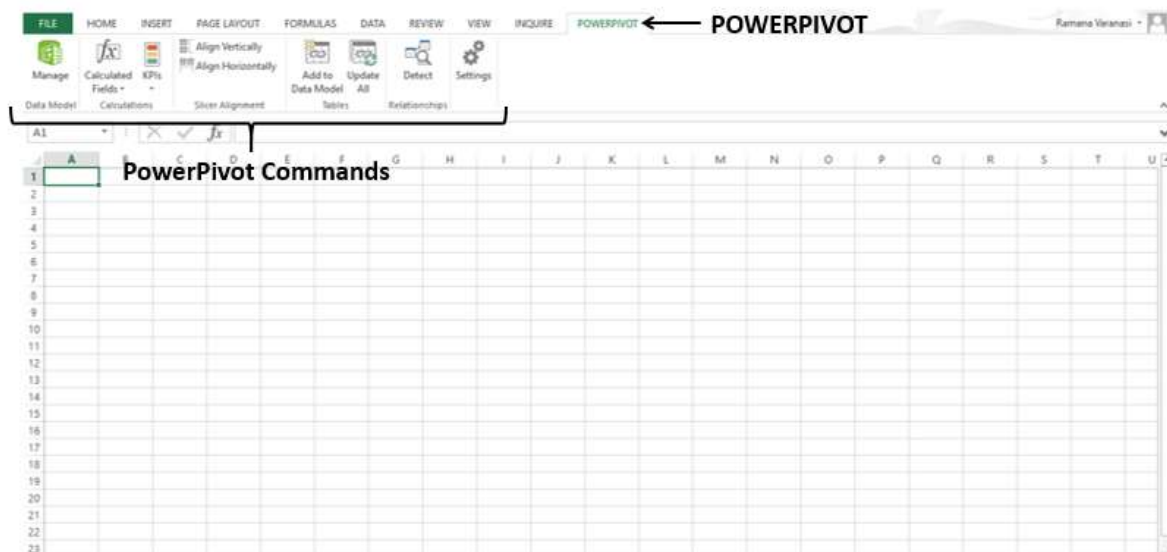




## 32. Exploring Data with PowerPivot

PowerPivot is an easy to use Data Analysis tool that can be used from within Excel. You can use PowerPivot to access and mashup data from virtually any data source. You can create your own fascinating reports with PowerPivot.

You can access the PowerPivot commands from PowerPivot tab on the Ribbon. Click the PowerPivot tab on the Ribbon. The PowerPivot commands will be displayed on the Ribbon. You can observe that the commands related to Data Model also appear here.



### Adding Tables to Data Model

If you have imported tables, they are added to the Data Model. You can manage the Data Model from PowerPivot Ribbon. You can add tables to Data Model with PowerPivot as follows -

- Insert a new worksheet in your workbook.
- Copy data from the web page and paste it on the worksheet.
- Create a table with the pasted data.
- Name the table as Hosts.
- Rename the worksheet as Hosts.

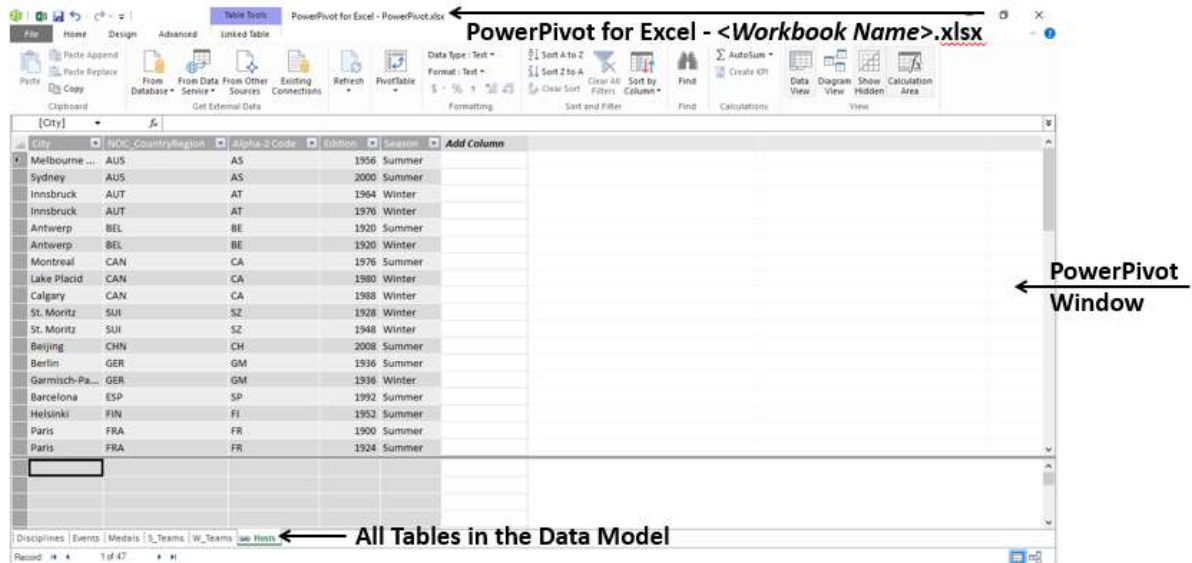


City	NOC	Country/Region	Alpha-2 Code	Edition	Season
Melbourne / Stockholm	AUS		AS	1956 Summer	
Sydney	AUS		AS	2000 Summer	
Innsbruck	AUT		AT	1964 Winter	
Innsbruck	AUT		AT	1976 Winter	
Antwerp	BEL		BE	1920 Summer	
Antwerp	BEL		BE	1920 Winter	
Montreal	CAN		CA	1976 Summer	
Lake Placid	CAN		CA	1980 Winter	
Calgary	CAN		CA	1988 Winter	
St. Moritz	SUI		SZ	1928 Winter	
St. Moritz	SUI		SZ	1948 Winter	
Beijing	CHN		CH	2008 Summer	
Berlin	GER		GM	1936 Summer	
Garmisch-Partenkirchen	GER		GM	1936 Winter	
Barcelona	ESP		SP	1992 Summer	
Helsinki	FIN		FI	1952 Summer	
Paris	FRA		FR	1900 Summer	
Paris	FRA		FR	1924 Summer	
Chamonix	FRA		FR	1924 Winter	

- Click the table Hosts.
- Click the POWERPIVOT tab on the Ribbon.
- Click Add to Data Model in the Tables group.

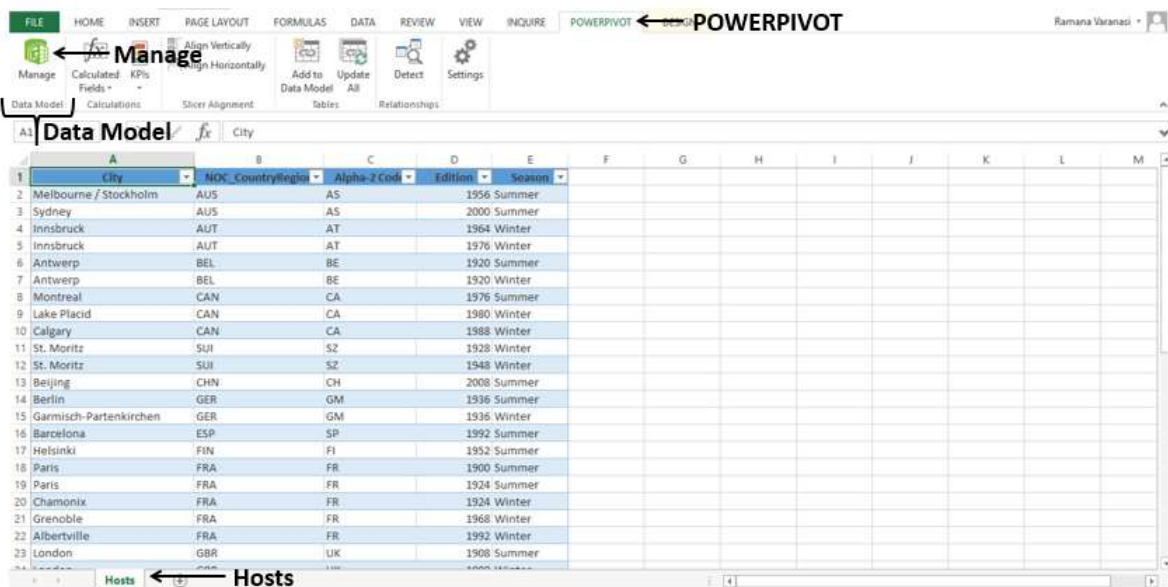
City	NOC	Country/Region	Alpha-2 Code	Edition	Season
Melbourne / Stockholm	AUS		AS	1956 Summer	
Sydney	AUS		AS	2000 Summer	
Innsbruck	AUT		AT	1964 Winter	
Innsbruck	AUT		AT	1976 Winter	
Antwerp	BEL		BE	1920 Summer	
Antwerp	BEL		BE	1920 Winter	
Montreal	CAN		CA	1976 Summer	
Lake Placid	CAN		CA	1980 Winter	
Calgary	CAN		CA	1988 Winter	
St. Moritz	SUI		SZ	1928 Winter	
St. Moritz	SUI		SZ	1948 Winter	
Beijing	CHN		CH	2008 Summer	
Berlin	GER		GM	1936 Summer	
Garmisch-Partenkirchen	GER		GM	1936 Winter	
Barcelona	ESP		SP	1992 Summer	
Helsinki	FIN		FI	1952 Summer	
Paris	FRA		FR	1900 Summer	
Paris	FRA		FR	1924 Summer	
Chamonix	FRA		FR	1924 Winter	
Grenoble	FRA		FR	1968 Winter	
Albertville	FRA		FR	1992 Winter	
London	GBR		UK	1908 Summer	

The table is added to the Data Model. The PowerPivot window appears. You will find the table Hosts in the Data Model tables.



## Viewing Tables in the Data Model

- Click on the POWERPIVOT tab on the Ribbon.
- Click on Manage in the Data Model group.



PowerPivot window appears, in Data View.

PowerPivot has two views –

- Data View:** It displays all the tables in the Data Model with fields displayed in columns and data as records in the rows, with a calculation area below each table. The table tabs look similar to the Excel worksheet tabs with names. You can move from table to table by clicking on the tabs.

- **Diagram View:** It displays all the tables as boxes with table name as caption and the fields listed in the box. You can drag the tables to align them, resize them to make all the fields visible, and create relationships by just clicking on the fields and connecting them with lines.

You will understand the Diagram View and the Relationships in detail in the later sections.

Here, observe that all the tables in the Data Model are visible in the PowerPivot window, irrespective of whether they are present as worksheets in the workbook or not.

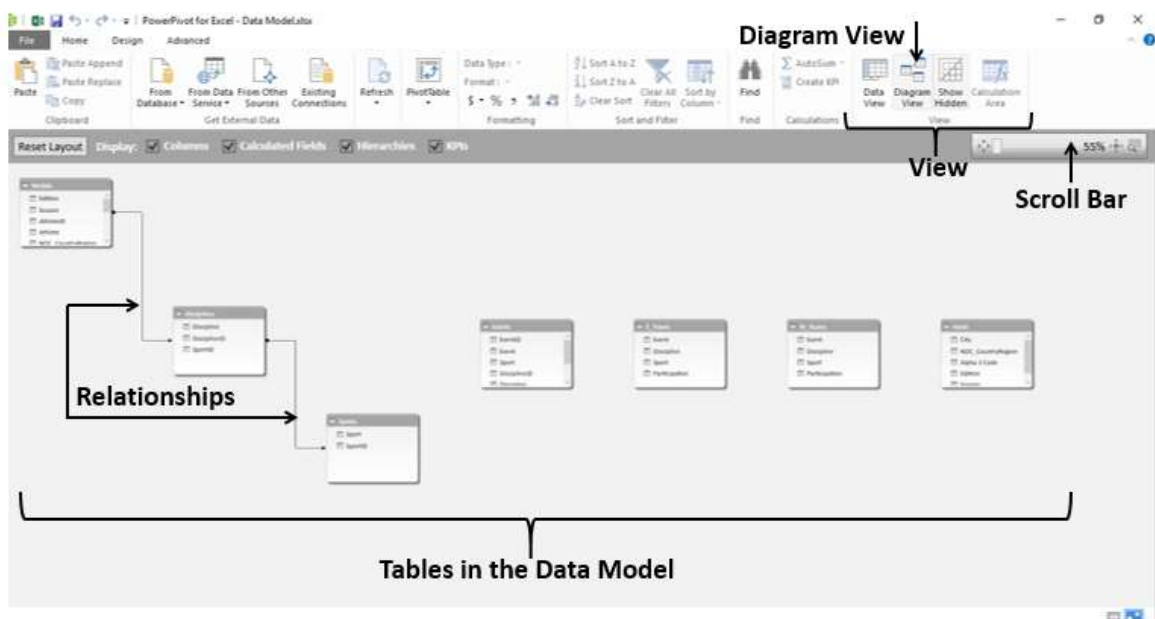
## Viewing Relationships between Tables

You can use the data from different tables for analysis and reporting only when relationships exist among them.

You can view the relationships between tables from the diagram view in the PowerPivot window.

- Click **Diagram View** in the **View** group.
- Resize the diagram using the scroll bar so that you can see all the tables in the Data Model in the diagram.

All the tables in the Data Model appear with their fields lists. The relationships among the tables are denoted by the lines connecting them.



## Creating Relationships between Tables

You might want to create a relationship between the tables – Medals and Events. In order to do this, there should be a field that is common in both the tables and contains unique values in one of the tables. First, you need to verify this.

- Click the Data View in the View group.
- Click the Events tab to view the Events table.

**Data View**

**View**

**DisciplineEvent**

**Events**

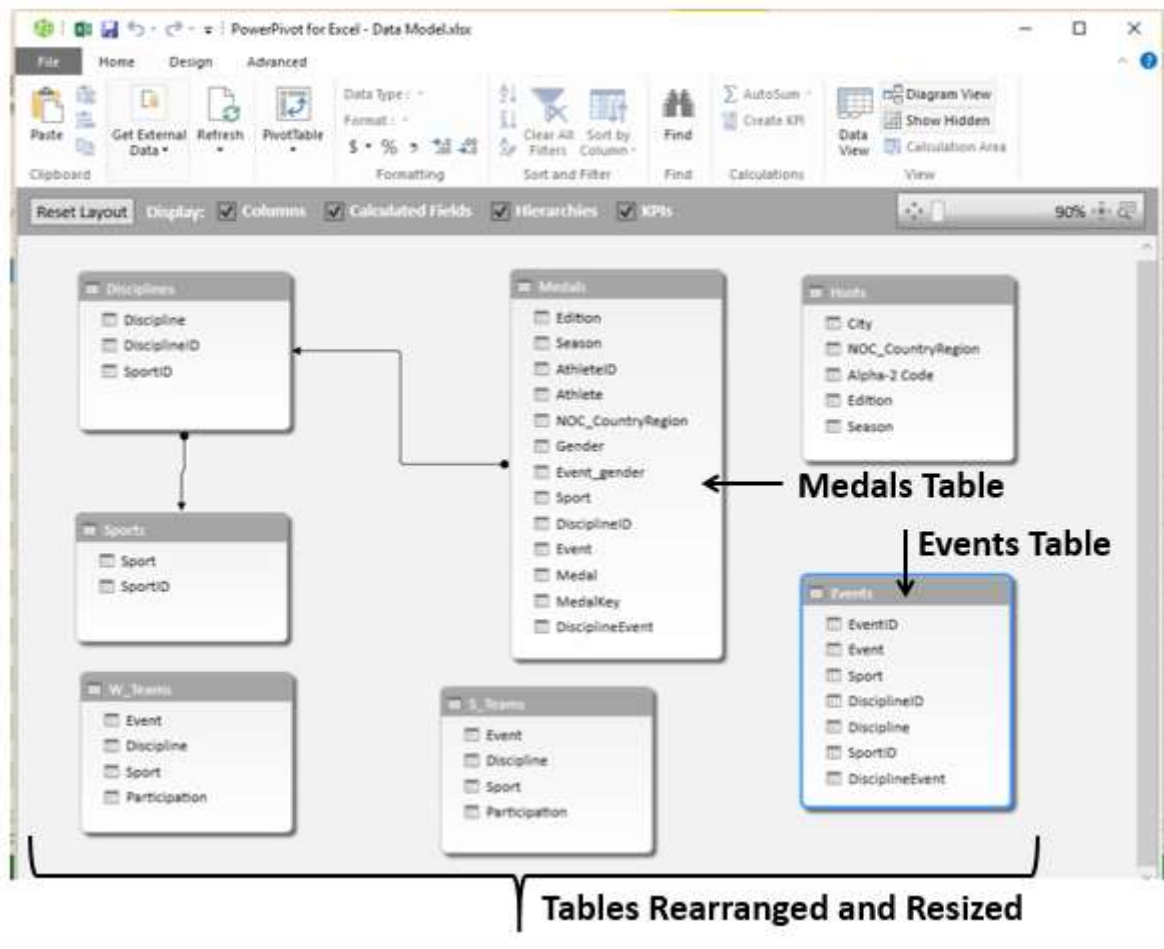
**Events Table**

EventID	Event	Sport	DisciplineID	Discipline	SportID	DisciplineEvent
E2	- 47.6kg ...	Wrestling	D69	Wrestling Fc...	S47	D69- 47.6kg (light...
E4	- 48kg ...	Wrestling	D69	Wrestling Fc...	S47	D69- 48kg
E7	- 48kg (l...	Wrestling	D69	Wrestling Fc...	S47	D69- 48kg (light-fl...
E13	- 52kg (f...	Wrestling	D69	Wrestling Fc...	S47	D69- 52kg (flywel...
E16	- 54kg (...)	Wrestling	D69	Wrestling Fc...	S47	D69- 54kg (banta...
E18	- 55kg ...	Wrestling	D69	Wrestling Fc...	S47	D69- 55kg
E20	- 56kg (...)	Wrestling	D69	Wrestling Fc...	S47	D69- 56kg (banta...
E26	- 60kg (f...	Wrestling	D69	Wrestling Fc...	S47	D69- 60kg (feathe...
E35	+ 100kg ...	Wrestling	D69	Wrestling Fc...	S47	D69+ 100kg (super...
E42	+ 71.67k...	Wrestling	D69	Wrestling Fc...	S47	D69+ 71.67kg (hea...
E44	+ 73kg (l...	Wrestling	D69	Wrestling Fc...	S47	D69+ 73kg (heavy...
E51	+ 80kg (...)	Wrestling	D69	Wrestling Fc...	S47	D69+ 80kg (heavy...
E53	+ 82.5kg...	Wrestling	D69	Wrestling Fc...	S47	D69+ 82.5kg (supe...
E58	+ 87kg (...)	Wrestling	D69	Wrestling Fc...	S47	D69+ 87kg (heavy...
E65	+ 97kg (...)	Wrestling	D69	Wrestling Fc...	S47	D69+ 97kg (heavy...
E73	100 - 13...	Wrestling	D69	Wrestling Fc...	S47	D69100 - 130kg (s...
E190	47.6 - 52...	Wrestling	D69	Wrestling Fc...	S47	D6947.6 - 52.16kg ...
E194	48 - 52k...	Wrestling	D69	Wrestling Fc...	S47	D6948 - 52kg (flyw...
E197	48 - 54kg	Wrestling	D69	Wrestling Fc...	S47	D6948 - 54kg

You can observe that the field **DisciplineEvent** in the Events table has unique values (no duplicate values).

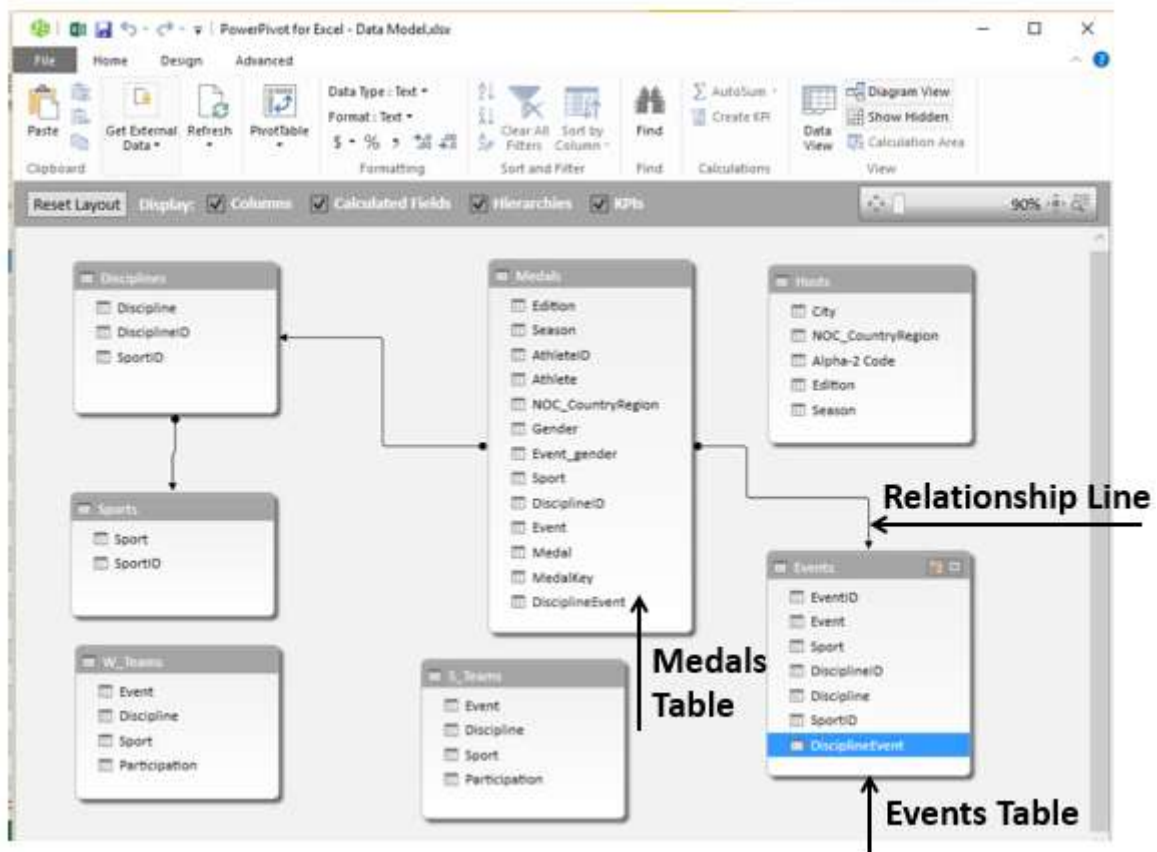
Click the Medals tab to view the Medals table. The field DisciplineEvent is available in the Medals table also. Hence, you can create a relationship using the field DisciplineEvent as follows -

- Click Diagram View in the View group.
- Rearrange the tables in the view by dragging them so that Events table and Medals table are close to each other.
- Resize the tables so that all the fields are visible.



Click the field DisciplineEvent in the Events table and Drag to the field DisciplineEvent in the Medals table.

A line appears between the Events table and the Medals table, indicating that a relationship has been established.

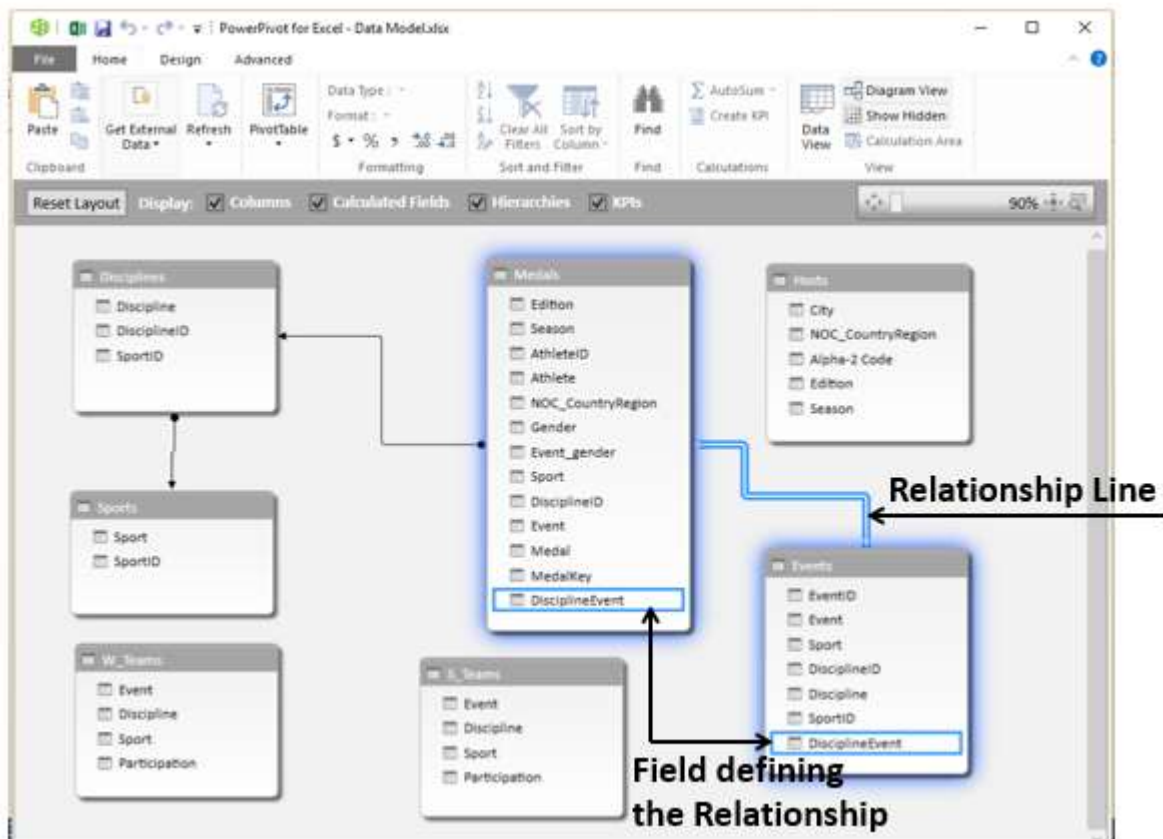


## Viewing the Field defining a Relationship

You can view the field that is used to create the relationship between two tables.

Click the relationship line connecting the two tables. The relationship line and the field defining the relationship between the two tables get highlighted.



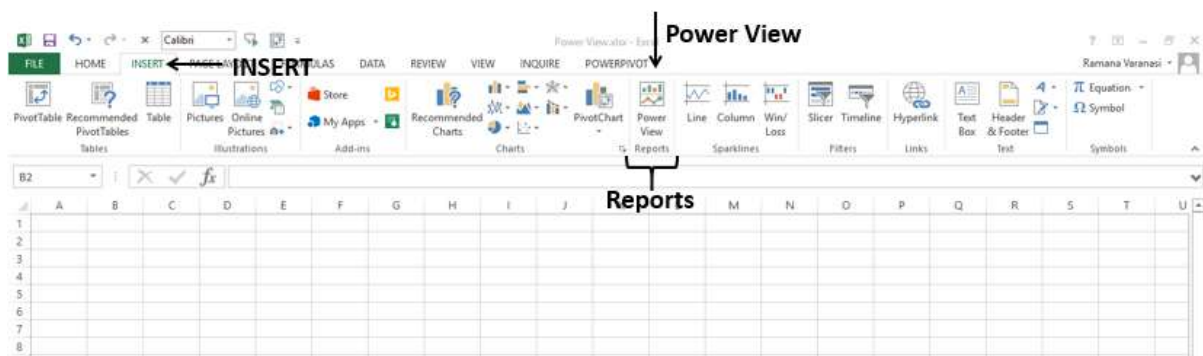


# 33. Exploring Data with Power View

Power View enables interactive data exploration, visualization and presentation that encourages intuitive ad-hoc reporting. Large data sets can be analyzed on the fly using the versatile visualizations. The data visualizations can also be made dynamic facilitating ease of presentation of the data with a single Power View report.

Power View is introduced in Microsoft Excel 2013. Before you start your data analysis with Power View, make sure that the Power View add-in enabled and available on the Ribbon.

Click the INSERT tab on the Ribbon. Power View should be visible in the Reports group.

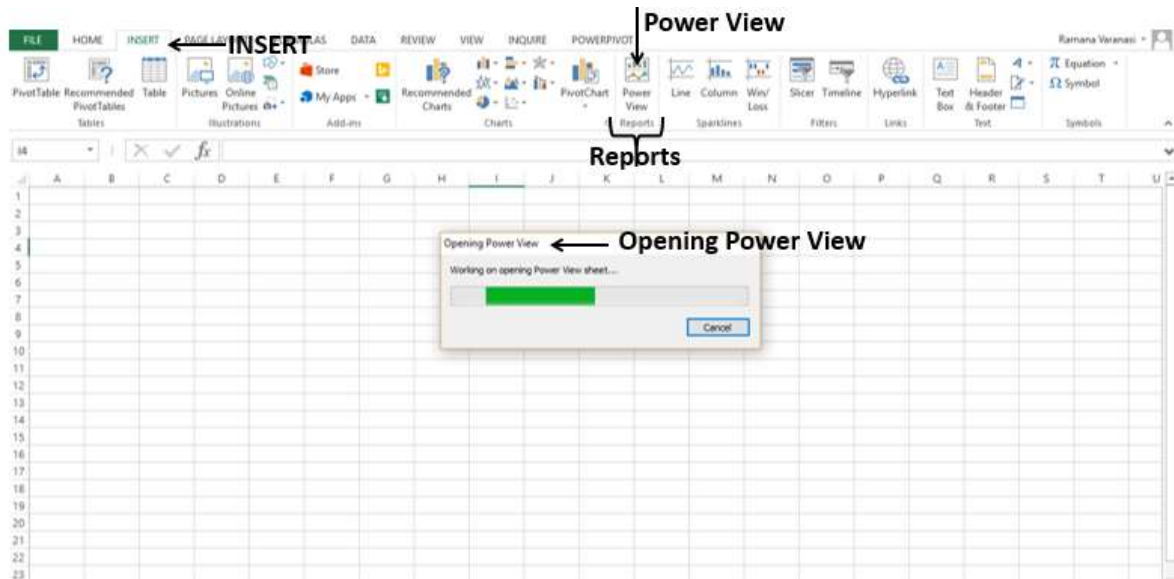


## Creating a Power View Report

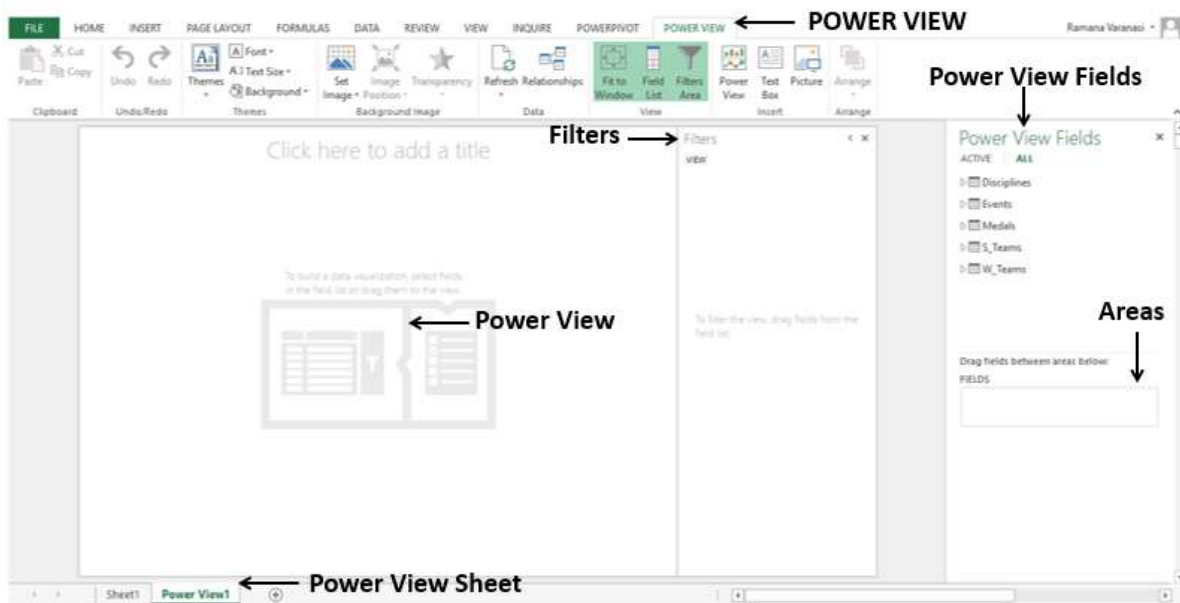
You can create a Power View report from the tables in the Data Model.

- Click the INSERT tab on the Ribbon.
- Click Power View in the Reports group.

**Opening Power View** message box appears with a horizontal scrolling green status bar. This might take a little while.



Power View sheet is created as a worksheet in your Excel workbook. It contains an empty Power View report, Filters space holder and the Power View Fields list displaying the tables in the Data Model. Power View appears as a tab on the Ribbon in the Power View sheet.



## Power View with Calculated Fields

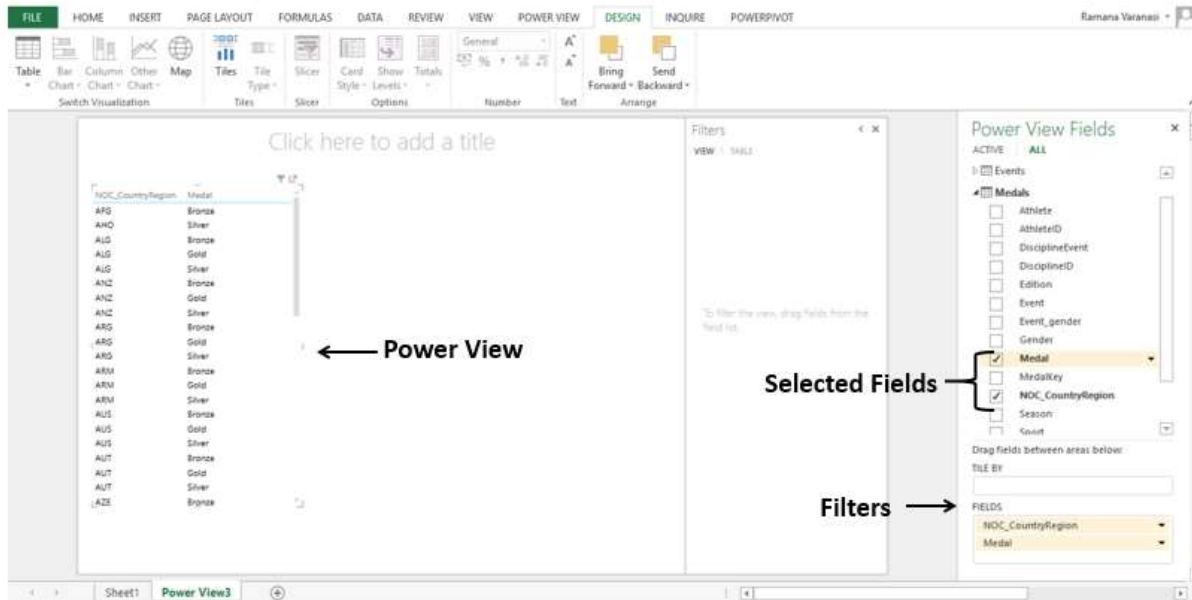
In the Data Model of your workbook, you have the following data tables –

- Disciplines
- Events
- Medals

Suppose you want to display the number of medals that each country has won.

- Select the fields NOC\_CountryRegion and Medal in the table Medals.

These two fields appear under FIELDS in the Areas. Power View will be displayed as a table with the two selected fields as columns.



The Power View is displaying what medals each country has won. To display the number of medals won by each country, the medals need to be counted. To get the medal count field, you need to do a calculation in the Data Model.

- Click PowerPivot tab on the Ribbon.
- Click Manage in the Data Model group. The tables in the Data Model will be displayed.
- Click the Medals tab.
- In the Medals table, in the calculation area, in the cell below the Medal column, type the following DAX formula -

**Medal Count:=COUNTA([Medal])**

The screenshot shows the PowerPivot for Excel - Power View ribbon. The formula bar displays the DAX formula: `Medal Count:=COUNTA([Medal])`. The table below shows the Medals table with columns: Edition, Season, AthleteID, Athlete, NOC, CountryRegion, Gender, Event\_gender, Sport, Discipli..., Event, Medal, MedalKey, and DisciplinedEvent. The table contains 20 rows of data.

Edition	Season	AthleteID	Athlete	NOC	CountryRegion	Gender	Event_gender	Sport	Discipli...	Event	Medal	MedalKey	DisciplinedEvent
1/1/1956 ...	Winter	A29666		URS		Men	M	Skiing	D18	4x10km ...	Gold	M10187	D184x10km relay
1/1/1956 ...	Winter	A29667		SWE		Men	M	Skiing	D18	4x10km ...	Bronze	M10188	D184x10km relay
1/1/1956 ...	Winter	A29668		FIN		Men	M	Skiing	D18	4x10km ...	Silver	M10189	D184x10km relay
1/1/1960 ...	Winter	A29729		URS		Men	M	Skiing	D18	4x10km ...	Bronze	M10319	D184x10km relay
1/1/1960 ...	Winter	A29730		NOR		Men	M	Skiing	D18	4x10km ...	Silver	M10320	D184x10km relay
1/1/1960 ...	Winter	A29731		FIN		Men	M	Skiing	D18	4x10km ...	Gold	M10321	D184x10km relay
1/1/1960 ...	Winter	A29732		URS		Men	M	Skiing	D18	4x10km ...	Bronze	M10322	D184x10km relay
1/1/1960 ...	Winter	A29733		NOR		Men	M	Skiing	D18	4x10km ...	Silver	M10323	D184x10km relay
1/1/1960 ...	Winter	A29734		FIN		Men	M	Skiing	D18	4x10km ...	Gold	M10324	D184x10km relay
1/1/1960 ...	Winter	A29736		URS		Men	M	Skiing	D18	4x10km ...	Bronze	M10326	D184x10km relay
1/1/1960 ...	Winter	A29737		NOR		Men	M	Skiing	D18	4x10km ...	Silver	M10327	D184x10km relay
1/1/1960 ...	Winter	A29738		FIN		Men	M	Skiing	D18	4x10km ...	Gold	M10328	D184x10km relay
1/1/1960 ...	Winter	A29790		URS		Men	M	Skiing	D18	4x10km ...	Bronze	M11192	D184x10km relay
1/1/1960 ...	Winter	A29791		NOR		Men	M	Skiing	D18	4x10km ...	Silver	M11193	D184x10km relay
1/1/1960 ...	Winter	A29792		FIN		Men	M	Skiing	D18	4x10km ...	Gold	M11194	D184x10km relay
1/1/1964 ...	Winter	A29855		URS		Men	M	Skiing	D18	4x10km ...	Bronze	M11326	D184x10km relay
1/1/1964 ...	Winter	A29856		SWE		Men	M	Skiing	D18	4x10km ...	Gold	M11327	D184x10km relay
1/1/1964 ...	Winter	A29857		FIN		Men	M	Skiing	D18	4x10km ...	Silver	M11328	D184x10km relay

You can observe that the medal count formula appears in the formula bar and to the left of the formula bar, the column name Medal is displayed.

You will get a Power View message that the Data Model is changed and if you click OK, the changes will be reflected in your Power View. Click OK.



In the Power View Sheet, in the Power View Fields list, you can observe the following -

- A new field Medal Count is added in the Medals table.
- A calculator icon appears adjacent to the field Medal Count, indicating that it is a calculated field.
- Deselect the Medal field and select the Medal Count field.

Your Power View table displays the medal count country wise.

The screenshot shows the Power View interface with a table titled 'Medals'. The table has two columns: 'NOC\_CountryRegion' and 'Medal Count'. The 'Medal Count' column contains values for various countries/regions. The 'Power View Fields' pane on the right shows a list of fields under the 'Medals' table. The 'Medal Count' field is highlighted, and an arrow points from it to the 'Medal Count' column in the table, labeled 'Newly added Calculated Field'. Another arrow points to the table itself, labeled 'Power View'.

NOC_CountryRegion	Medal Count
ARG	1
AHO	1
AUG	14
ANZ	29
ARG	239
ARM	9
AUS	1079
AUT	344
AZE	16
BAH	23
BAH	1
BOL	1
BEL	420
BER	1
BLR	98
BCH	7
BRA	372
BUL	330
BWI	5
CAN	827
CHI	33

## Filtering Power View

You can filter the values displayed in Power View by defining the filter criteria.

- Click the TABLE tab in the Filters.
- Click Medal Count.
- Click the icon Range file mode that is to the right of Medal Count.
- Select **is greater than** or **equal to** from the drop-down list in the box below Show items for which the value.
- Type 1000 in the box below that.
- Click apply filter.

Below the field name – Medal Count, is greater than or equal to 1000 appears. Power View will display only those records with Medal Count  $\geq 1000$ .



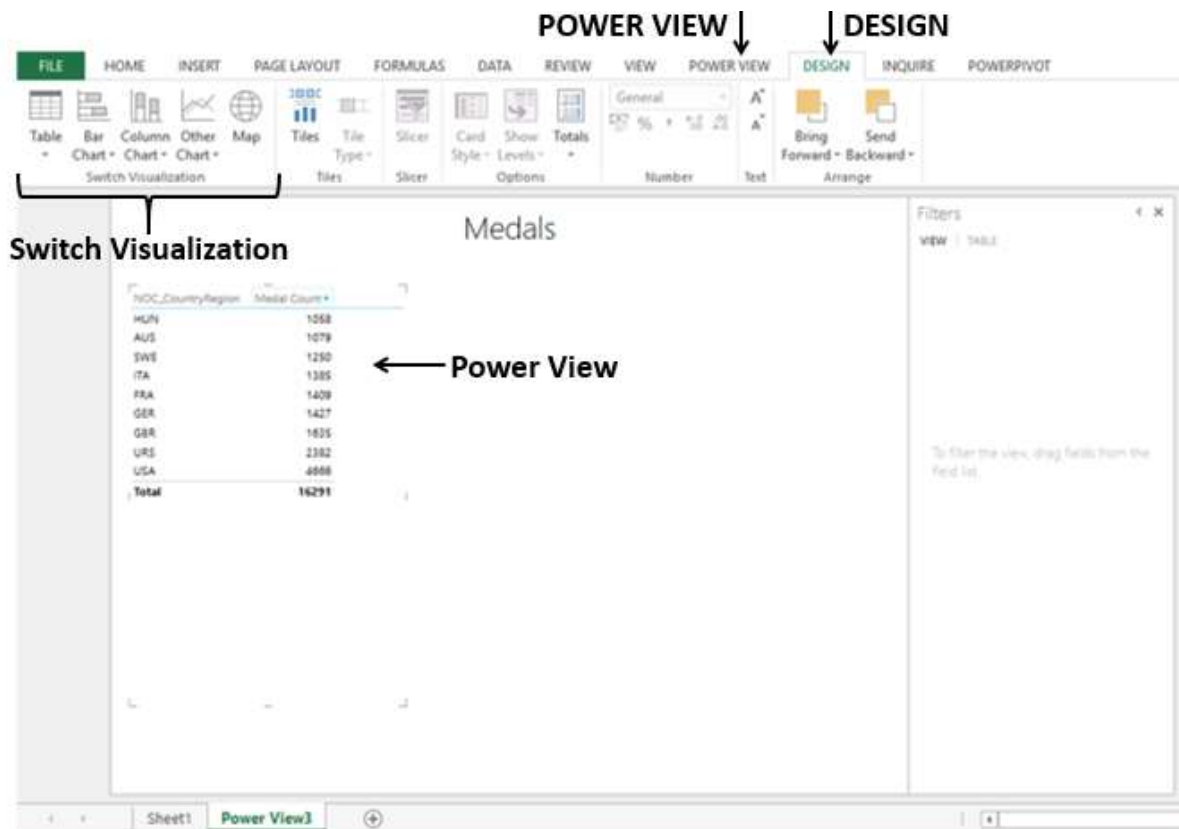
The screenshot shows a Power View interface for a table named 'Medals'. The table has two columns: 'NOC\_CountryRegion' and 'Medal Count'. The data is filtered to show only countries with a medal count greater than or equal to 1000. The 'Filters' pane on the right shows the filter 'Medal Count is greater than or equal to 1000' applied. The 'TABLE' tab is selected in the 'Filters' pane. The 'Medal Count' column is highlighted in the table. The 'Filtered Power View' label points to the table. The 'Apply Filter' button is visible in the 'Filters' pane.

NOC_CountryRegion	Medal Count
AUS	1079
FRA	1409
GBR	1635
GER	1427
HUN	1058
ITA	1385
SWE	1250
URS	2382
USA	4666
<b>Total</b>	<b>16291</b>

## Power View Visualizations

In the Power View sheet, two tabs – POWER VIEW and DESIGN appear on the Ribbon.

Click the **DESIGN** tab. You will find several visualization commands in the Switch Visualization group on the Ribbon.



You can quickly create a number of different data visualizations that suit your data using Power View. The visualizations possible are Table, Matrix, Card, Map, Chart types such as Bar, Column, Scatter, Line, Pie and Bubble Charts, and sets of multiple charts (charts with same axis).

To explore the data using these visualizations, you can start on the Power View sheet by creating a table, which is the default visualization and then easily convert it to other visualizations, to find the one that best illustrates your Data. You can convert one Power View visualization to another, by selecting a visualization from the Switch Visualization group on the Ribbon.

It is also possible to have multiple visualizations on the same Power View sheet, so that you can highlight the significant fields.

In the sections below, you will understand how you can explore data in two visualizations – Matrix and Card. You will get to know about exploring data with other Power View visualizations in later chapters.

## Exploring Data with Matrix Visualization

Matrix Visualization is similar to a Table Visualization in that it also contains rows and columns of data. However, a matrix has additional features –

- It can be collapsed and expanded by rows and/or columns.
- If it contains a hierarchy, you can drill down/drill up.
- It can display totals and subtotals by columns and/or rows.

- It can display the data without repeating values.

You can see these the differences in the views by having a Table Visualization and a Matrix Visualization of the same data side by side in the Power View.

- Choose the fields – Sport, Discipline and Event. A Table representing these fields appears in Power View.

Sport	Discipline	Event
Aquatics	Diving	plain high diving
Aquatics	Diving	plunge for distance
Aquatics	Diving	synchronized diving 10m platform
Aquatics	Diving	synchronized diving 3m springboard
Aquatics	Swimming	100m backstroke
Aquatics	Swimming	100m breaststroke
Aquatics	Swimming	100m butterfly
Aquatics	Swimming	100m freestyle
Aquatics	Swimming	100m freestyle for sailors
Aquatics	Swimming	10m platform
Aquatics	Swimming	1200m freestyle
Aquatics	Swimming	1500m freestyle
Aquatics	Swimming	200m backstroke
Aquatics	Swimming	200m breaststroke
Aquatics	Swimming	200m butterfly
Aquatics	Swimming	200m freestyle
Aquatics	Swimming	200m individual medley
Aquatics	Swimming	200m obstacle event
Aquatics	Swimming	200m team swimming
Aquatics	Swimming	3m springboard
Aquatics	Swimming	4000m freestyle
Aquatics	Swimming	400m breaststroke
Aquatics	Swimming	400m freestyle
Aquatics	Swimming	400m individual medley
Aquatics	Swimming	4x100m freestyle relay

**Power View –  
Table Visualization**

As you observe, there are multiple disciplines for every sport and multiple events for every discipline. Now, create another Power View visualization on the right side of this Table visualization as follows -

- Click the Power View sheet in the space to the right of the Table.
- Choose the fields – Sport, Discipline and Event.

Another Table representing these fields appears in Power View, to the right of the earlier Table.

Sport	Discipline	Event	Sport	Discipline	Event
Aquatics	Diving	plain high diving	Aquatics	Diving	plain high diving
Aquatics	Diving	plunge for distance	Aquatics	Diving	plunge for distance
Aquatics	Diving	synchronized diving 10m platform	Aquatics	Diving	synchronized diving 10m platform
Aquatics	Diving	synchronized diving 3m springboard	Aquatics	Diving	synchronized diving 3m springboard
Aquatics	Swimming	100m backstroke	Aquatics	Swimming	100m backstroke
Aquatics	Swimming	100m breaststroke	Aquatics	Swimming	100m breaststroke
Aquatics	Swimming	100m butterfly	Aquatics	Swimming	100m butterfly
Aquatics	Swimming	100m freestyle	Aquatics	Swimming	100m freestyle
Aquatics	Swimming	100m freestyle for sailors	Aquatics	Swimming	100m freestyle for sailors
Aquatics	Swimming	10m platform	Aquatics	Swimming	10m platform
Aquatics	Swimming	1200m freestyle	Aquatics	Swimming	1200m freestyle
Aquatics	Swimming	1500m freestyle	Aquatics	Swimming	1500m freestyle
Aquatics	Swimming	200m backstroke	Aquatics	Swimming	200m backstroke
Aquatics	Swimming	200m breaststroke	Aquatics	Swimming	200m breaststroke
Aquatics	Swimming	200m butterfly	Aquatics	Swimming	200m butterfly
Aquatics	Swimming	200m freestyle	Aquatics	Swimming	200m freestyle
Aquatics	Swimming	200m individual medley	Aquatics	Swimming	200m individual medley
Aquatics	Swimming	200m obstacle event	Aquatics	Swimming	200m obstacle event
Aquatics	Swimming	200m team swimming	Aquatics	Swimming	200m team swimming
Aquatics	Swimming	3m springboard	Aquatics	Swimming	3m springboard
Aquatics	Swimming	4000m freestyle	Aquatics	Swimming	4000m freestyle
Aquatics	Swimming	400m breaststroke	Aquatics	Swimming	400m breaststroke
Aquatics	Swimming	400m freestyle	Aquatics	Swimming	400m freestyle
Aquatics	Swimming	400m individual medley	Aquatics	Swimming	400m individual medley
Aquatics	Swimming	4x100m freestyle relay	Aquatics	Swimming	4x100m freestyle relay
Aquatics	Swimming	4x100m medley relay	Aquatics	Swimming	4x100m medley relay

- Click the right Table.
- Click the DESIGN tab on the Ribbon.
- Click Table in the Switch Visualization group.
- Select Matrix from the drop-down list.

**DESIGN**

**Table**

**Matrix**

**Sports, Disciplines and Events**

Sport	Discipline	Event
Aquatics	Diving	plain high diving
Aquatics	Diving	plunge for distance
Aquatics	Diving	synchronized diving 10m platform
Aquatics	Diving	synchronized diving 3m springboard
Aquatics	Swimming	100m backstroke
Aquatics	Swimming	100m breaststroke
Aquatics	Swimming	100m butterfly
Aquatics	Swimming	100m freestyle
Aquatics	Swimming	100m freestyle for sailors
Aquatics	Swimming	10m platform
Aquatics	Swimming	1200m freestyle
Aquatics	Swimming	1500m freestyle
Aquatics	Swimming	200m backstroke
Aquatics	Swimming	200m breaststroke
Aquatics	Swimming	200m butterfly
Aquatics	Swimming	200m freestyle
Aquatics	Swimming	200m individual medley
Aquatics	Swimming	200m obstacle event
Aquatics	Swimming	200m team swimming
Aquatics	Swimming	3m springboard
Aquatics	Swimming	4000m freestyle
Aquatics	Swimming	400m breaststroke
Aquatics	Swimming	400m freestyle
Aquatics	Swimming	400m individual medley
Aquatics	Swimming	4x100m freestyle relay
Aquatics	Swimming	4x100m medley relay

The Table on the right in Power View gets converted to Matrix.

**Power View - Table Visualization**

**Power View - Matrix Visualization**

**Sports, Disciplines and Events**

Sport	Discipline	Event
Aquatics	Diving	plain high diving
Aquatics	Diving	plunge for distance
Aquatics	Diving	synchronized diving 10m platform
Aquatics	Diving	synchronized diving 3m springboard
Aquatics	Swimming	100m backstroke
Aquatics	Swimming	100m breaststroke
Aquatics	Swimming	100m butterfly
Aquatics	Swimming	100m freestyle
Aquatics	Swimming	100m freestyle for sailors
Aquatics	Swimming	10m platform
Aquatics	Swimming	1200m freestyle
Aquatics	Swimming	1500m freestyle
Aquatics	Swimming	200m backstroke
Aquatics	Swimming	200m breaststroke
Aquatics	Swimming	200m butterfly
Aquatics	Swimming	200m freestyle
Aquatics	Swimming	200m individual medley
Aquatics	Swimming	200m obstacle event
Aquatics	Swimming	200m team swimming
Aquatics	Swimming	3m springboard
Aquatics	Swimming	4000m freestyle
Aquatics	Swimming	400m breaststroke
Aquatics	Swimming	400m freestyle
Aquatics	Swimming	400m individual medley
Aquatics	Swimming	4x100m freestyle relay
Aquatics	Swimming	4x100m medley relay

The table on the left lists the sport and discipline for each and every event, whereas the matrix on the right lists each sport and discipline only once. So, in this case, Matrix visualization gives you a comprehensive, compact and readable format for your data.

Now, you can explore the data to find the countries that scored more than 300 medals. You can also find the corresponding sports and have subtotals.

- Select the fields NOC\_CountryRegion, Sport and Medal Count in both the Table and Matrix Visualizations.
- In the Filters, select the filter for the Table and set the filtering criteria as is greater than or equal to 300.
- Click apply filter.
- Set the same filter to Matrix also. Click apply filter.

**Medals**

NOC_CountryRegion	Sport	Medal Count
AUS	Aquatics	354
ITA	Fencing	328
USA	Aquatics	1096
USA	Athletics	935
USA	Rowing	347
<b>Total</b>		<b>3060</b>

NOC_CountryRegion	Sport	Medal Count
AUS	Aquatics	354
	<b>Total</b>	<b>354</b>
ITA	Fencing	328
	<b>Total</b>	<b>328</b>
USA	Aquatics	1096
	Athletics	935
	Rowing	347
	<b>Total</b>	<b>2378</b>
<b>Total</b>		<b>3060</b>

**Filters**

VIEW: MATRIX

3 Medal Count is greater than or equal to 300

Show items for which the value is greater than or equal to 300

And Or

apply filter

3 NOC\_CountryRegion (AT)

3 Sport (AT)

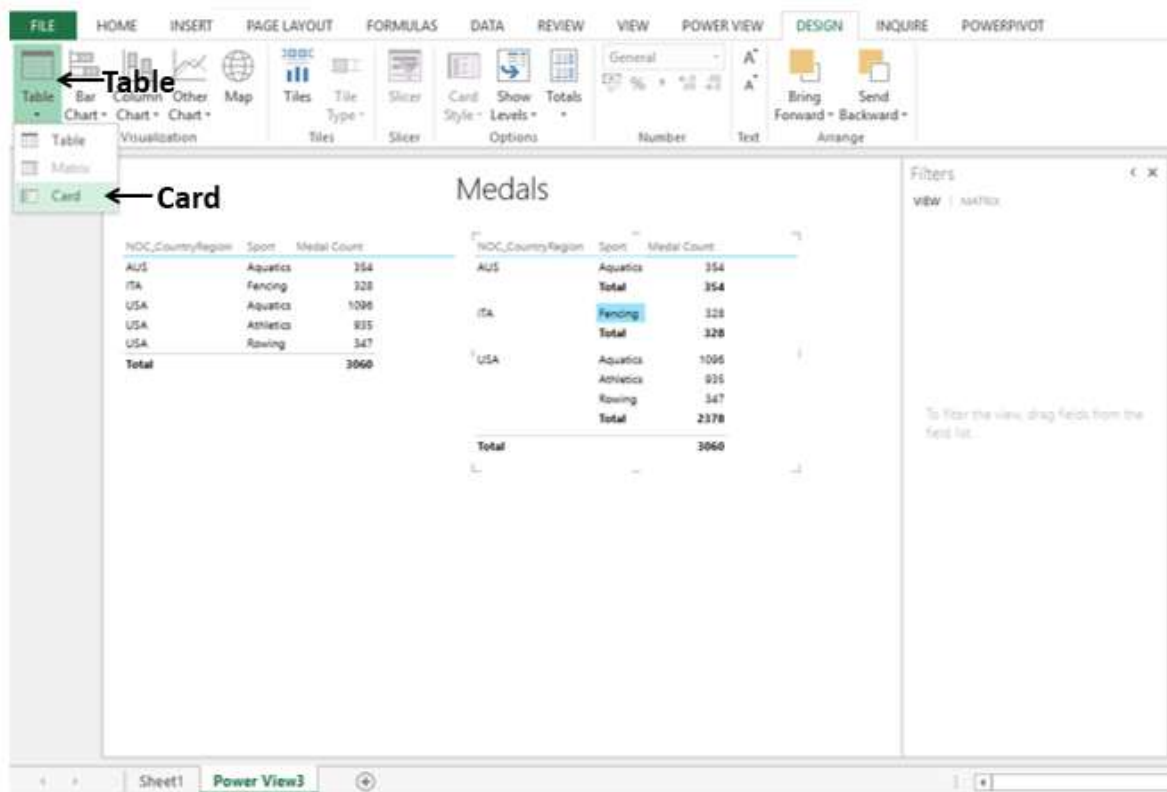
Once again, you can observe that in the Matrix view, the results are legible.

## Exploring Data with Card Visualization

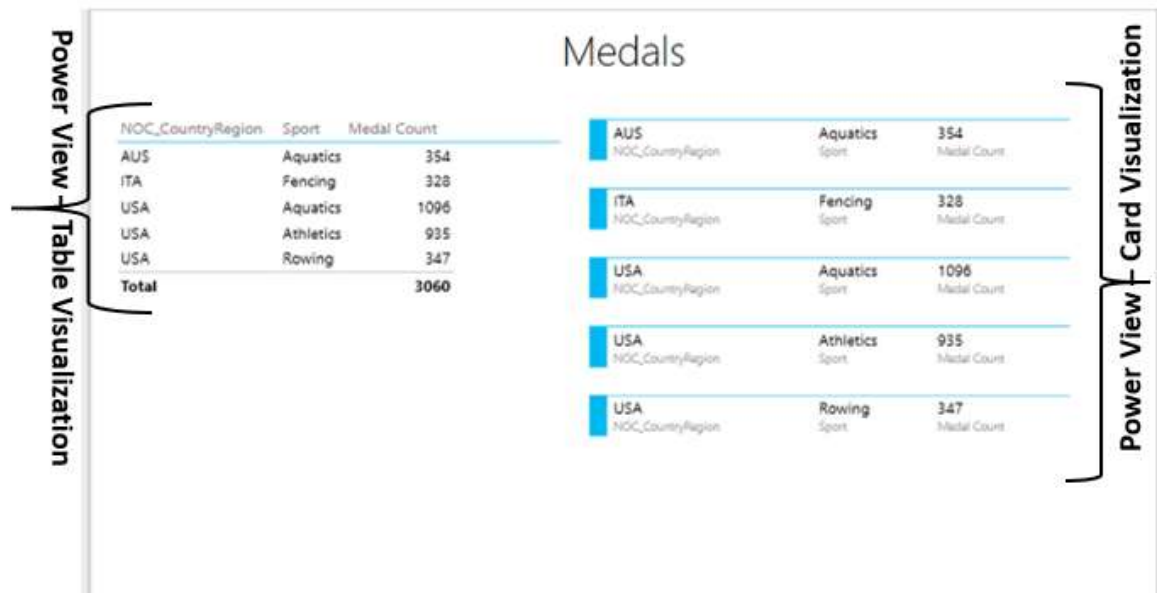
In a card visualization, you will have a series of snapshots that display the data from each row in the table, laid out like an index card.

- Click the Matrix Visualization that is on the right side in the Power view.
- Click Table in the Switch Visualization group.
- Select Card from the drop-down list.





The Matrix Visualization gets converted to Card Visualization.



You can use the Card view for presenting the highlighted data in a comprehensive way.

## Data Model and Power View

A workbook can contain the following combinations of Data Model and Power View.

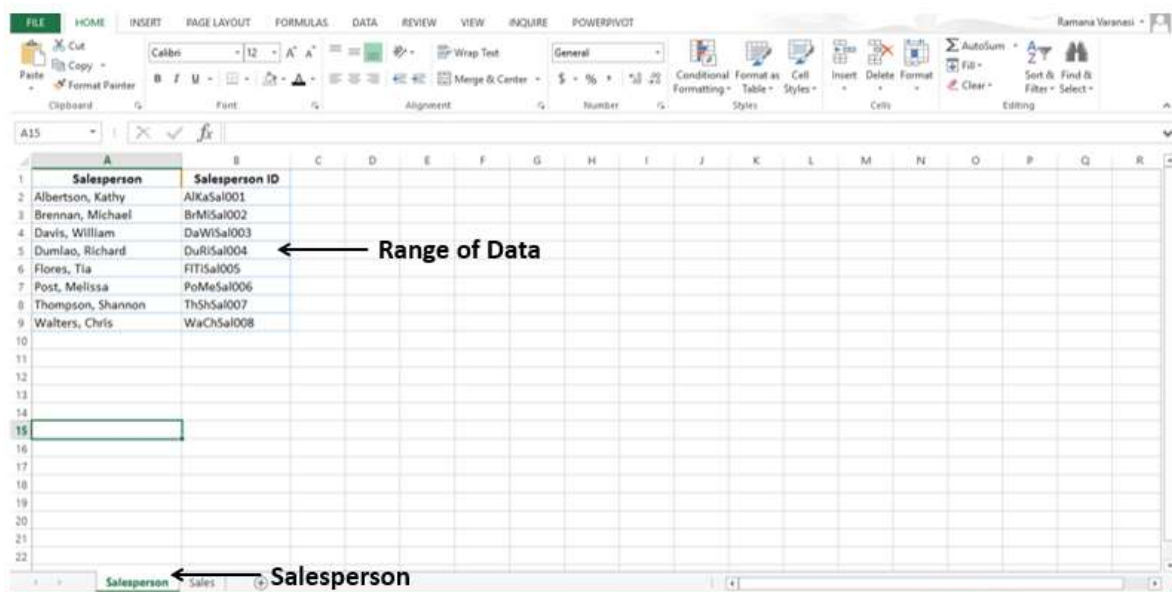
- An internal Data Model in your workbook that you can modify in Excel, in PowerPivot, and even in a Power View sheet.
- Only one internal Data Model in your workbook, on which you can base a Power View sheet.
- Multiple Power View sheets in your workbook, with each sheet based on a different Data Model.

If you have multiple Power View sheets in your workbook, you can copy visualizations from one to another only if both the sheets are based on the same Data Model.

## Creating Data Model from Power View Sheet

You can create and/or modify the Data Model in your workbook from the Power View sheet as follows -

Start with a new workbook that contains Salesperson data and Sales data in two worksheets.

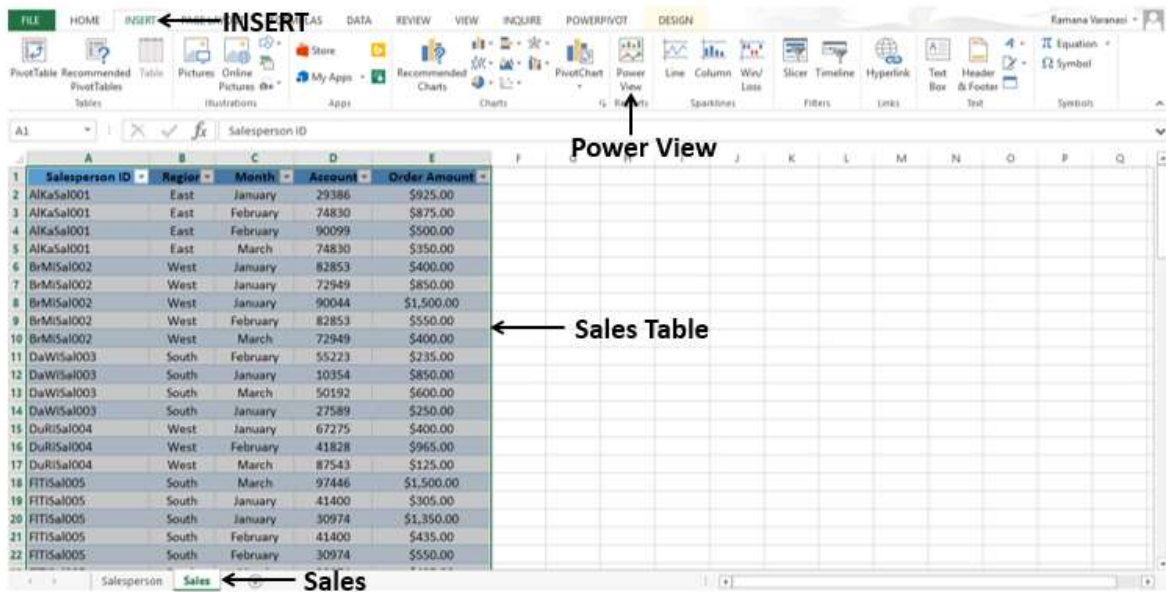


- Create a table from the range of data in the Salesperson worksheet and name it Salesperson.
- Create a table from the range of data in the Sales worksheet and name it Sales.

You have two tables – Salesperson and Sales in your workbook.

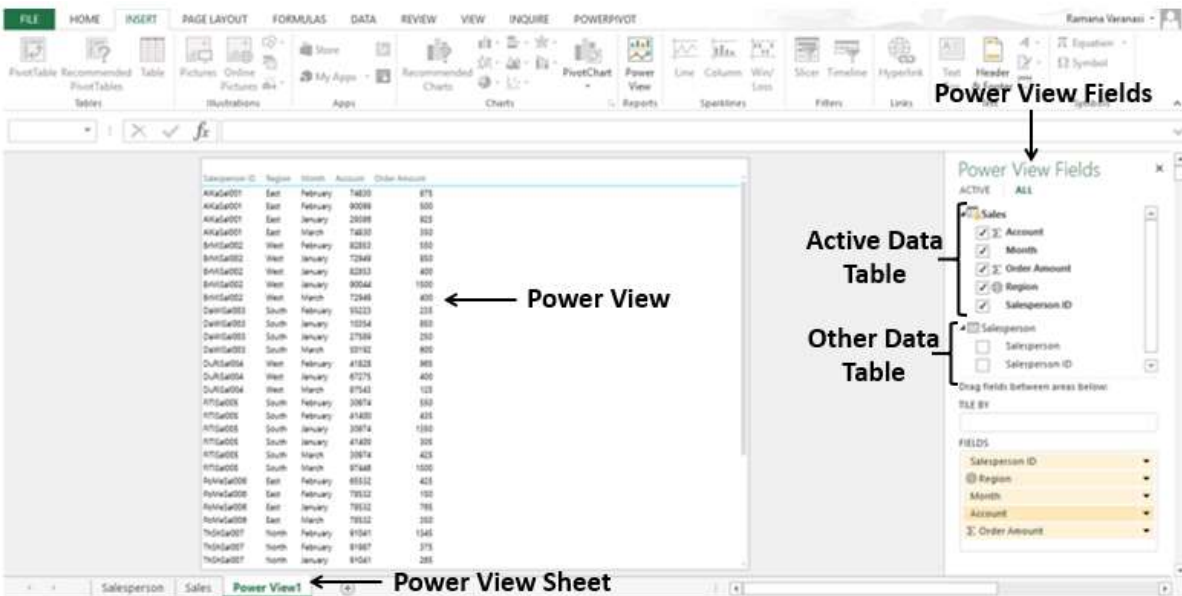
- Click the Sales table in the Sales worksheet.
- Click the INSERT tab on the Ribbon.

- Click Power View in the Reports group.



Power View Sheet will be created in your workbook.

You can observe that in the Power View Fields list, both the tables that are in the workbook are displayed. However, in the Power View, only the active table (Sales) fields are displayed since only the active data table fields are selected in the Fields list.

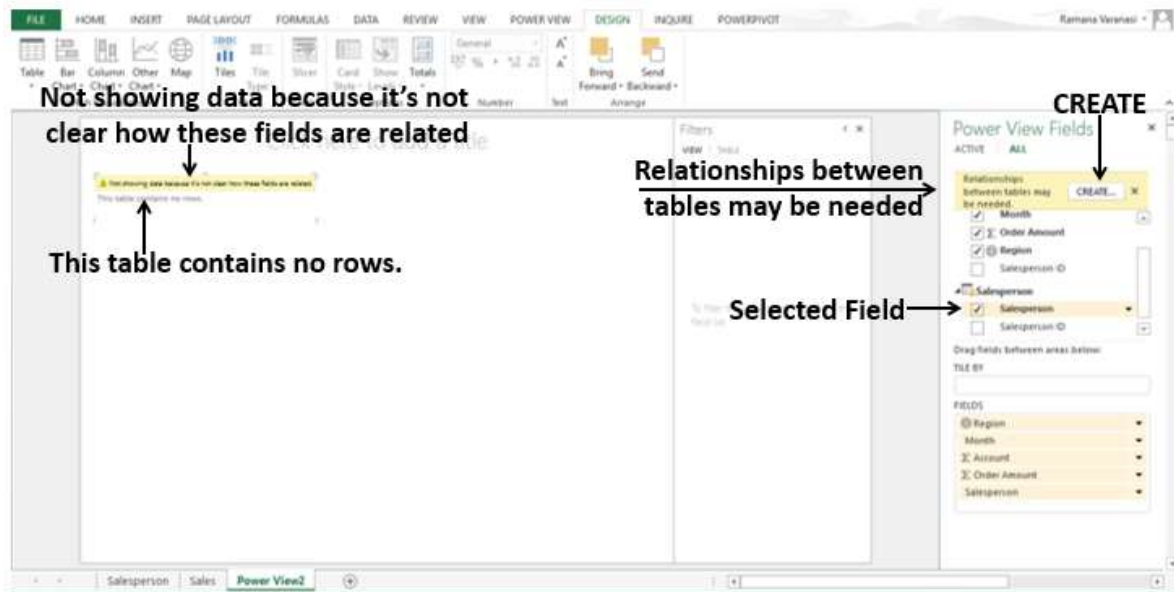


You can observe that in the Power View, Salesperson ID is displayed. Suppose you want to display the Salesperson name instead.

In the Power View Fields list, make the following changes.

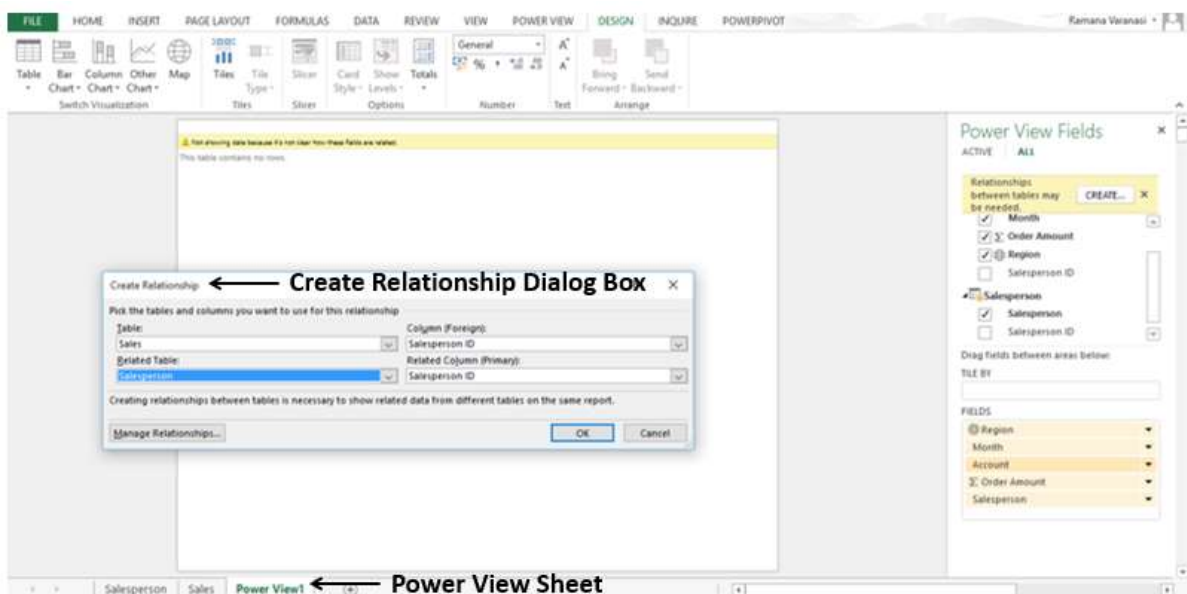
- Deselect the field Salesperson ID in the Salesperson table.
- Select the field Salesperson in the Salesperson table.

As you do not have a Data Model in the workbook, no relationship exists between the two tables. No data is displayed in Power View. Excel displays messages directing you what to do.



A CREATE button also will be displayed. Click the CREATE button.

The **Create Relationship** dialog box opens in the Power View Sheet itself.

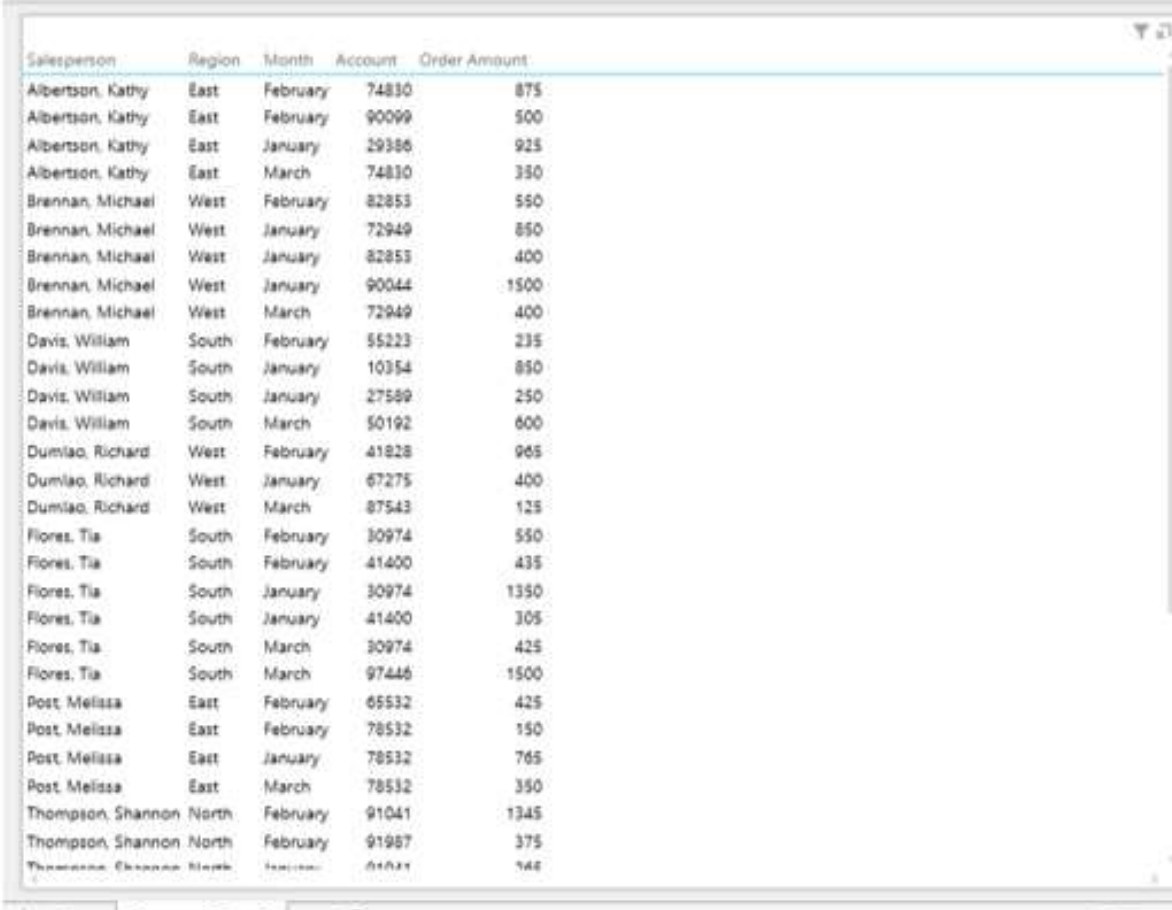


- Create a relationship between the two tables using the Salesperson ID field.

Without leaving the Power View sheet, you have successfully created the following -

- The internal Data Model with the two tables, and
- The relationship between the two tables.

The field Salesperson appears in Power View along with the Sales data.



Salesperson	Region	Month	Account	Order Amount
Albertson, Kathy	East	February	74830	875
Albertson, Kathy	East	February	90099	500
Albertson, Kathy	East	January	29386	925
Albertson, Kathy	East	March	74830	350
Brennan, Michael	West	February	82853	550
Brennan, Michael	West	January	72949	850
Brennan, Michael	West	January	82853	400
Brennan, Michael	West	January	90044	1500
Brennan, Michael	West	March	72949	400
Davis, William	South	February	55223	235
Davis, William	South	January	10354	850
Davis, William	South	January	27589	250
Davis, William	South	March	50192	600
Dumlao, Richard	West	February	41828	965
Dumlao, Richard	West	January	67275	400
Dumlao, Richard	West	March	87543	125
Flores, Tia	South	February	30974	550
Flores, Tia	South	February	41400	435
Flores, Tia	South	January	30974	1350
Flores, Tia	South	January	41400	305
Flores, Tia	South	March	30974	425
Flores, Tia	South	March	97446	1500
Post, Melissa	East	February	65532	425
Post, Melissa	East	February	78532	150
Post, Melissa	East	January	78532	765
Post, Melissa	East	March	78532	350
Thompson, Shannon	North	February	91041	1345
Thompson, Shannon	North	February	91987	375
Thompson, Shannon	North	January	91041	145

- Retain the fields Region, Salesperson and  $\Sigma$  Order Amount in that order in the area FIELDS.
- Convert the Power View to Matrix Visualization.
- Drag the field Month to the area TILE BY. Matrix Visualization appears as follows –

**Sales Summary**

February January March ← **Tile**

Region	Salesperson	Order Amount
West	Brennan, Michael	550
	Dumilac, Richard	965
	<b>Total</b>	1515
South	Davis, William	235
	Flores, Tia	985
	<b>Total</b>	3975
North	Thompson, Shannon	1720
	<b>Total</b>	1720
East	Albertson, Kathy	1375
	Rort, Melissa	875
	<b>Total</b>	1950
<b>Total</b>		9160

← **Matrix**

**Power View Fields**

ACTIVE | All

**Sales**

- ☐ Account
- ☐ Month
- ☒ Order Amount
- ☒ Region
- ☐ Salesperson ID

**Salesperson**

- ☒ Salesperson
- ☐ Salesperson ID

Drag fields between areas below:

**TILE BY** → Month

**Σ VALUES** → Order Amount

**ROWS** → Region, Salesperson

**COLUMNS**

As you observe, for each of the regions, the Salespersons of that region and sum of Order Amount are displayed. Subtotals are displayed for each region. The display is month wise as selected in the tile above the view. As you select the month in the tile, the data of that month will be displayed.



## 34. Exploring Data with Power View Charts

In Power View, you have a number of Chart options: Pie, Column, Bar, Line, Scatter, and Bubble. The Charts in Power View are interactive. If you click on a value in one chart-

- That value in that chart is highlighted.
- That value in all the other charts in Power View is also highlighted.
- All the tables, matrices and tiles in Power View are filtered to that value.

Thus, Power View Charts serve as interactive, pictorial data analysis tools. Further, the charts are interactive in a presentation setting also, which would enable you to highlight the analysis results.

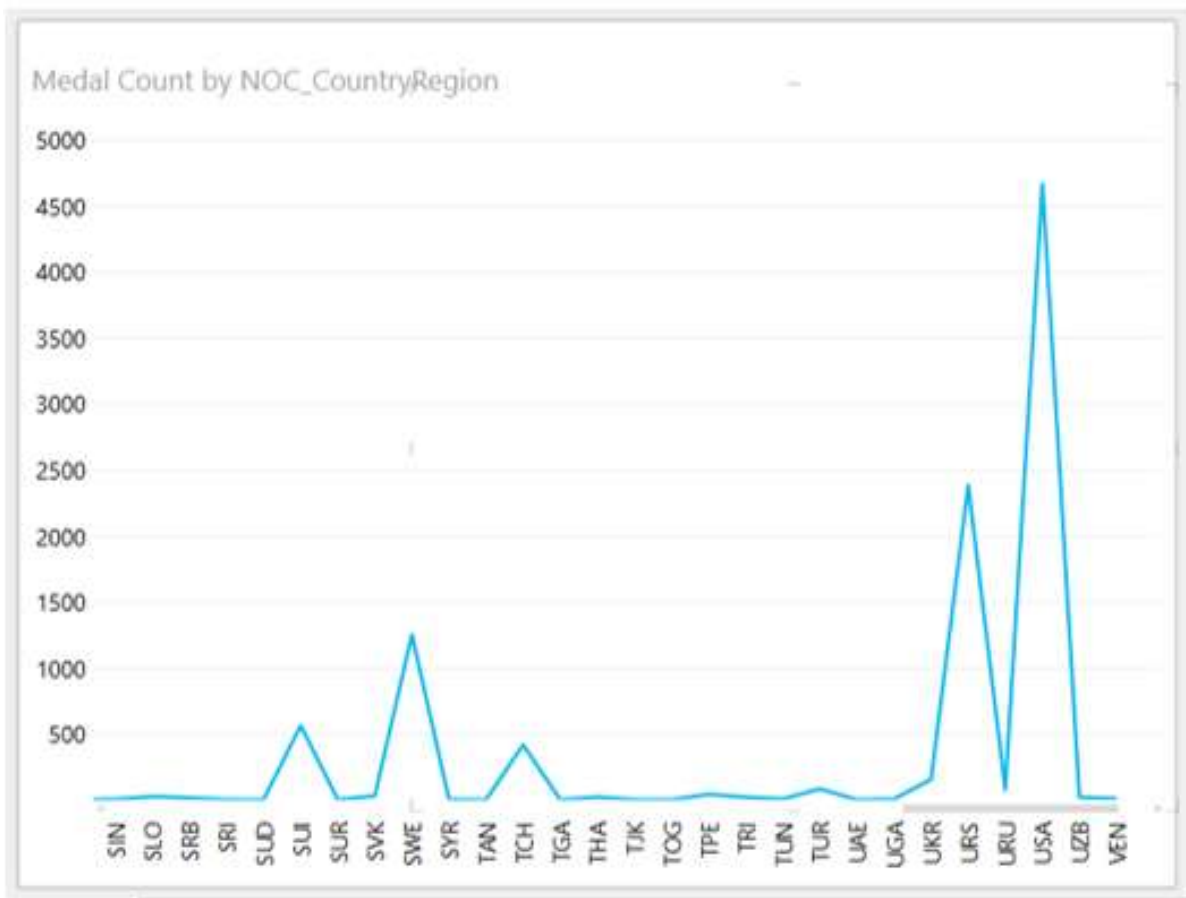
### Exploring with Line Charts

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You can use Line charts for comparing data points in one or more data series. Line charts distribute category data evenly along a horizontal (category) axis, and all numerical value data along a vertical (value) axis.

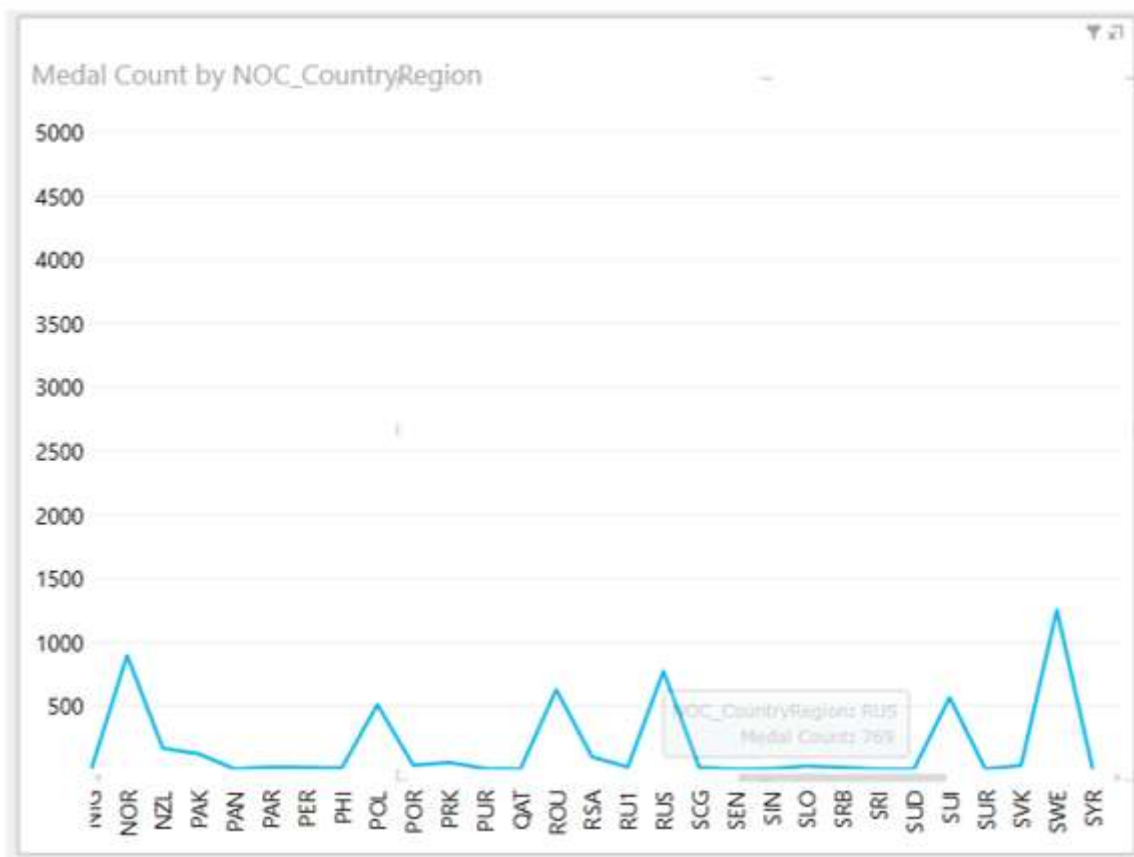
Suppose you want to display the Medal Count for each country.

- Create a Power View with the fields NOC\_CountryRegion and Medal Count selected. By default, Table will be displayed.
- Click the Table.
- Click Other Chart in the Switch Visualization group.
- Select Line from the drop-down list. Line Chart will be displayed in the Power View.



- Click on the Line or the Category (x-axis) axis.
- Drag to left or right. The Categories to the left or right will be displayed and Line chart will be displayed accordingly.
- Place the cursor on any of the data points on the line.

The values corresponding to that data point will be displayed at that point.



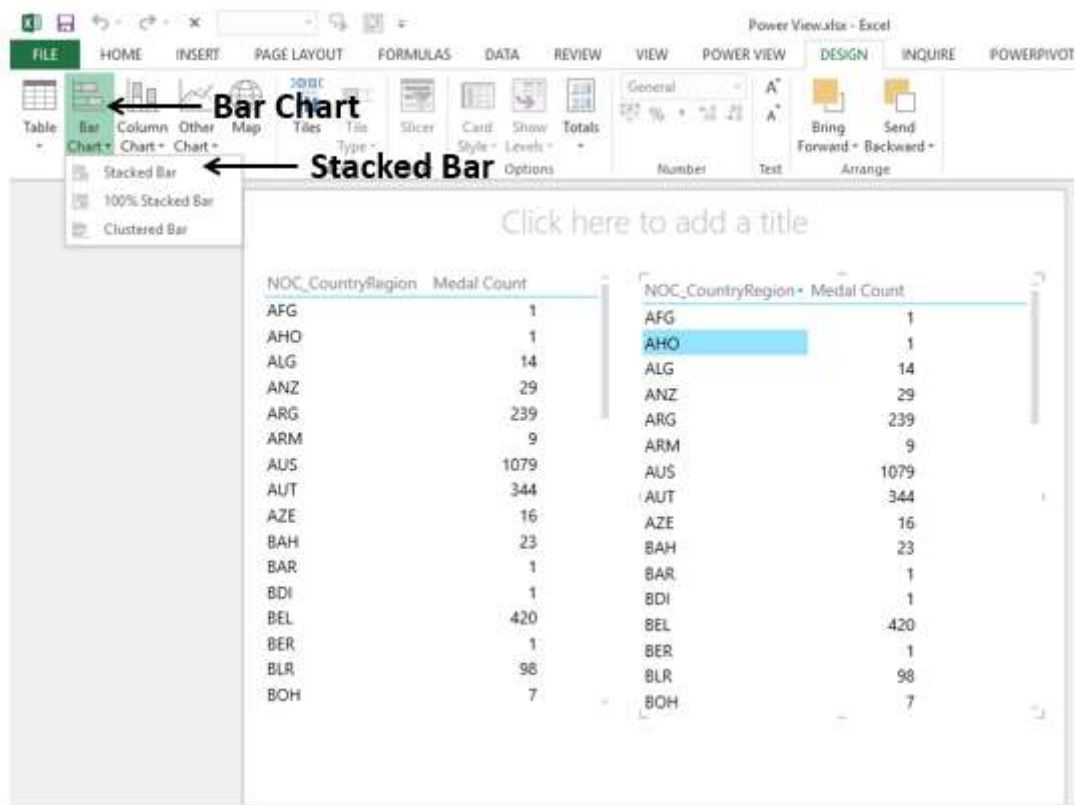
## Exploring with Bar Charts

You can use Bar charts for comparing data points in one or more data series. In a Bar chart, categories are organized along the vertical axis and values along the horizontal axis. In Power View, there are three Bar chart subtypes –

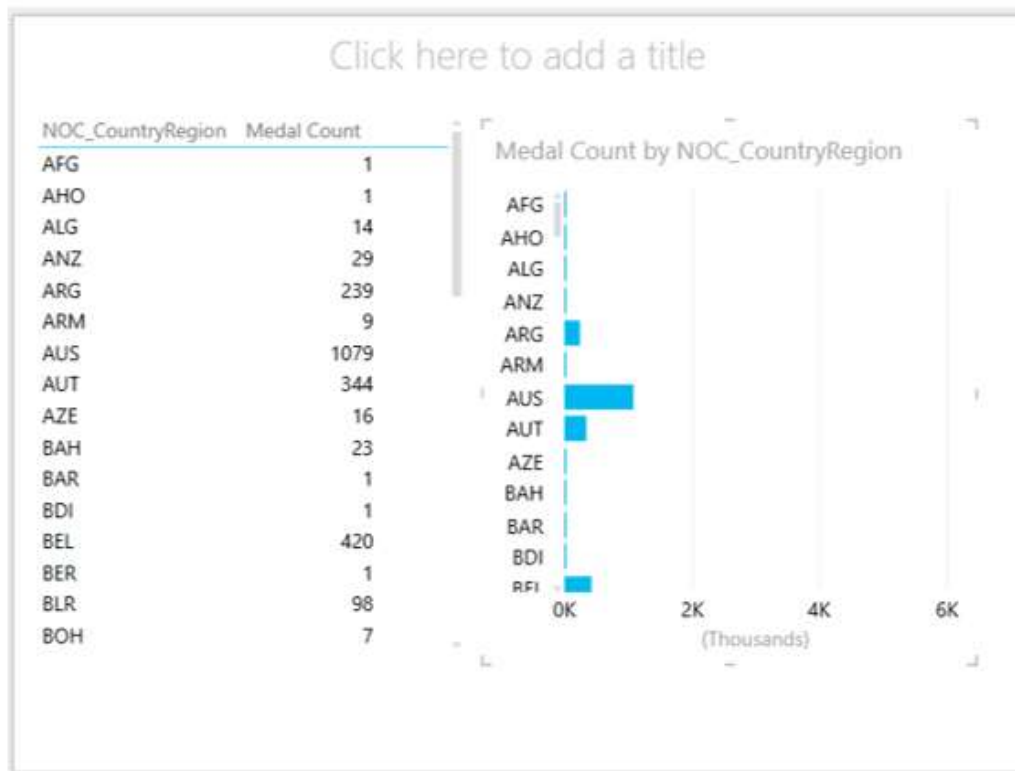
- Stacked Bar.
- 100% Stacked Bar.
- Clustered Bar.

You can convert a Table Visualization to Bar Chart Visualization as follows –

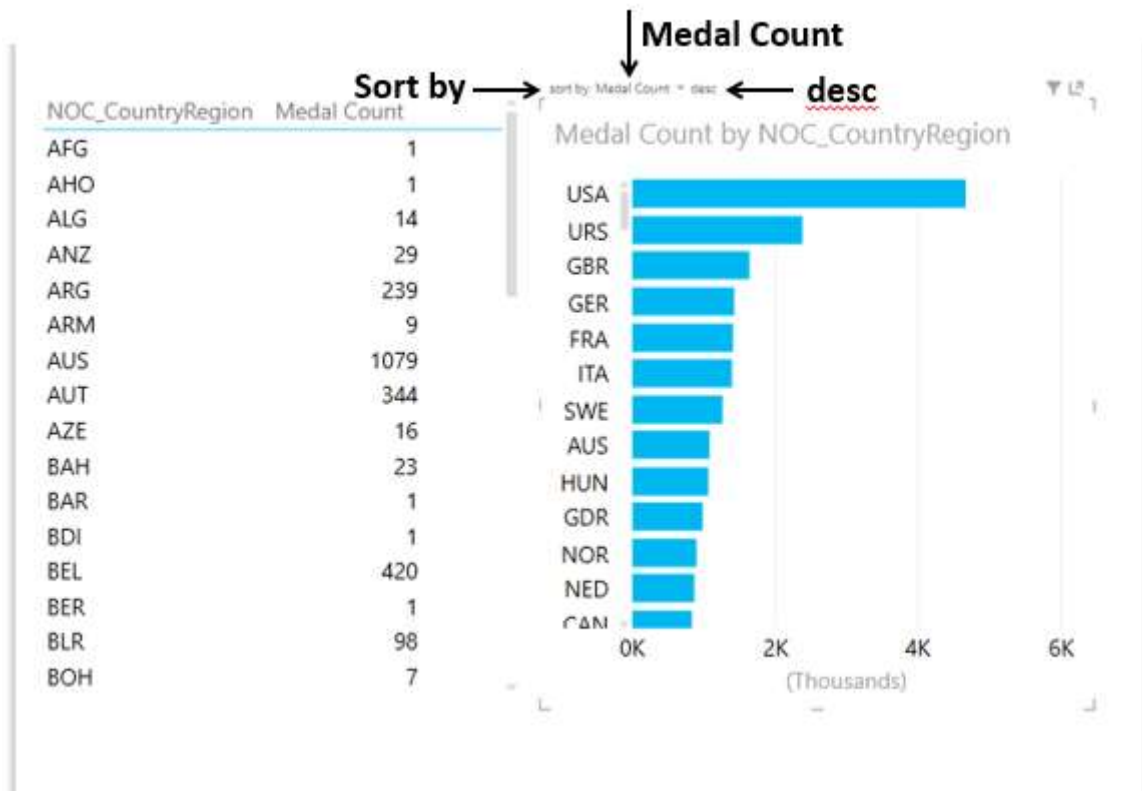
- Create two Table visualizations side-by-side.
- Click the right Table.
- Click Bar Chart in the Switch Visualization group.
- Click Stacked Bar.



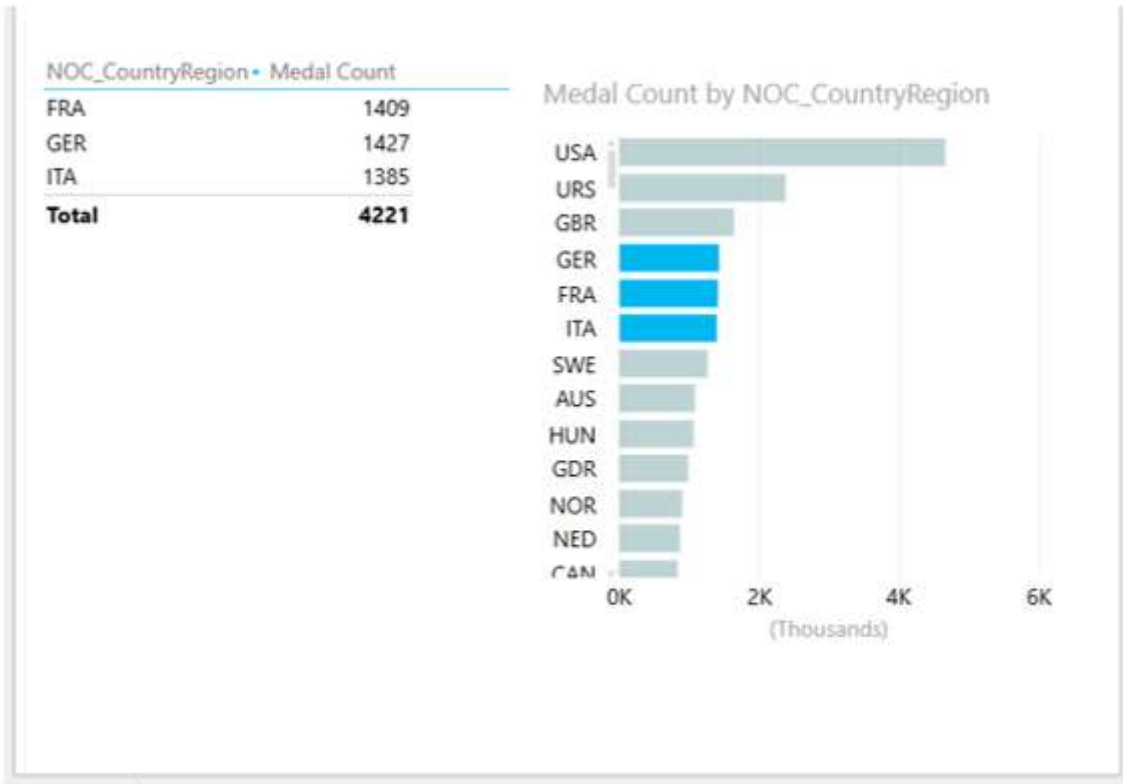
The Table Visualization on the right gets converted to Bar Chart Visualization. As you observe, the y-axis values are sorted by the category values in ascending order.



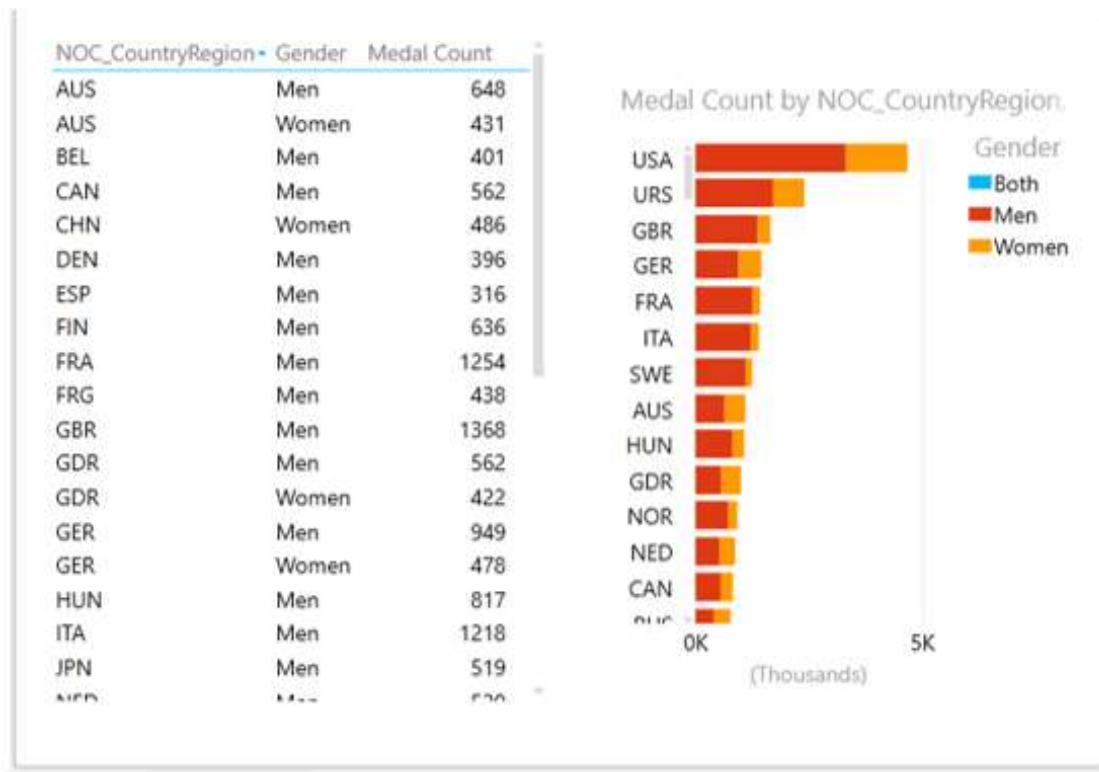
- Take the cursor above the Bar chart. You will find – sort by NOC\_CountryRegion asc.
- Click NOC\_CountryRegion. It is changed to Medal Count.
- Click asc. It is changed to desc. You will find that the Bar Chart is sorted by descending Medal Count.



- Click the Bar with Category GER. Only that Bar will be highlighted.
- With Ctrl key pressed, click the Bars with Categories FRA and ITA. The Bars for GER, FRA and ITA will be highlighted.
- The Table on the left also shows values for these three Categories only.



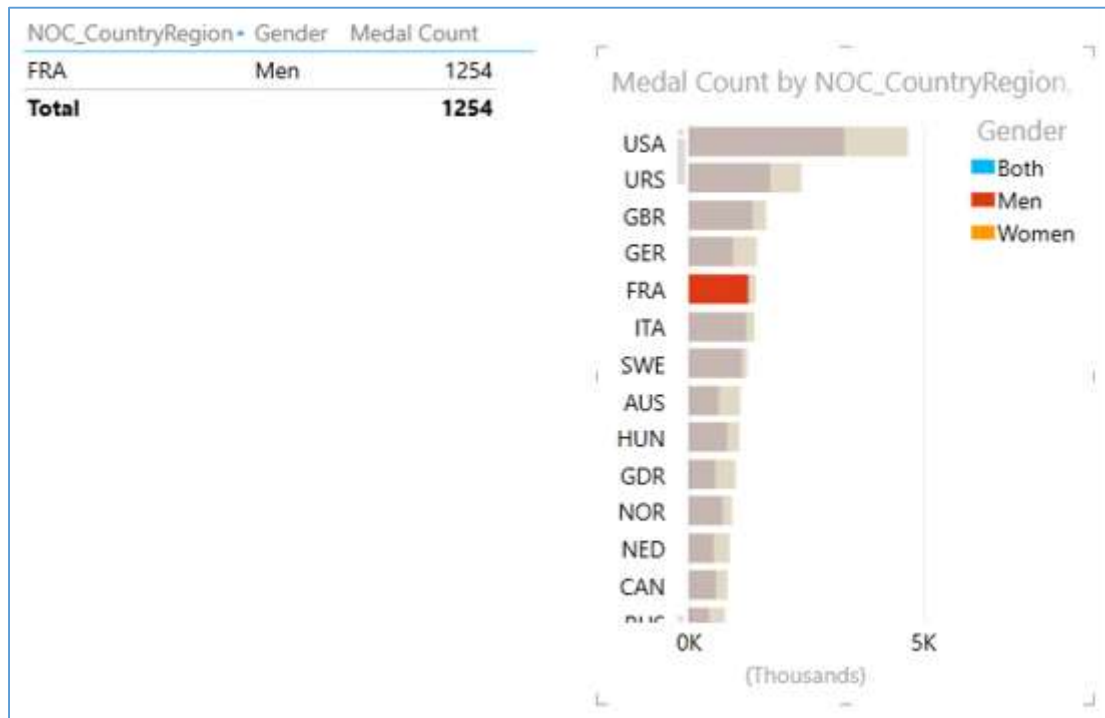
In both the visualizations, click the Gender field also in the Power View Fields list.





Click the left portion of the Bar – GER. It is highlighted. In the Table, only the information for GER and Men will be displayed.

**Note:** You cannot make multiple selections in this case.



## Exploring with Column Charts

You can use Column charts for showing data changes over a period of time or for illustrating comparison among items. In Column charts, categories are along the horizontal axis and values along the vertical axis.

In Power View, there are three Column chart subtypes –

- Stacked Column.
- 100% Stacked Column.
- Clustered Column.

You can convert a Table Visualization to Column Chart Visualization as follows –

- Create two Table visualizations side-by-side.
- Click the right Table.
- Click Column Chart in the Switch Visualization group.
- Click Stacked Column.

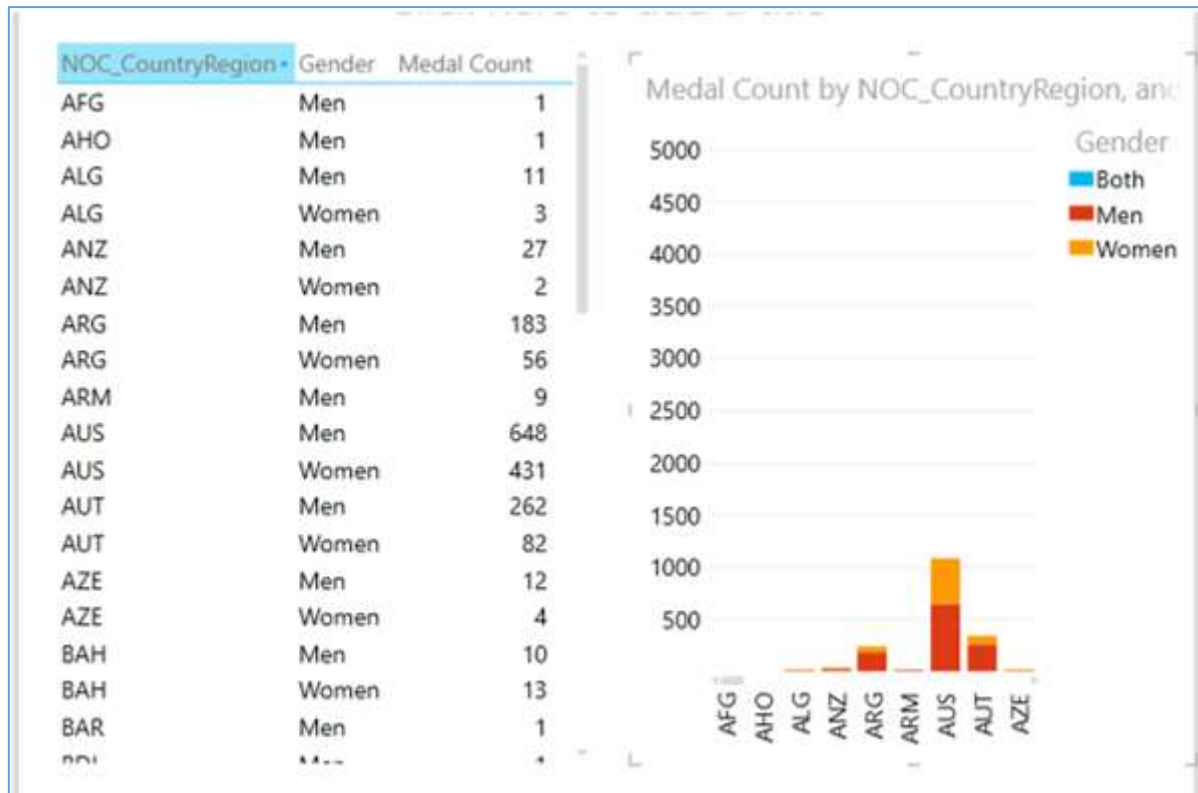
**Column Chart**

**Stacked Column**

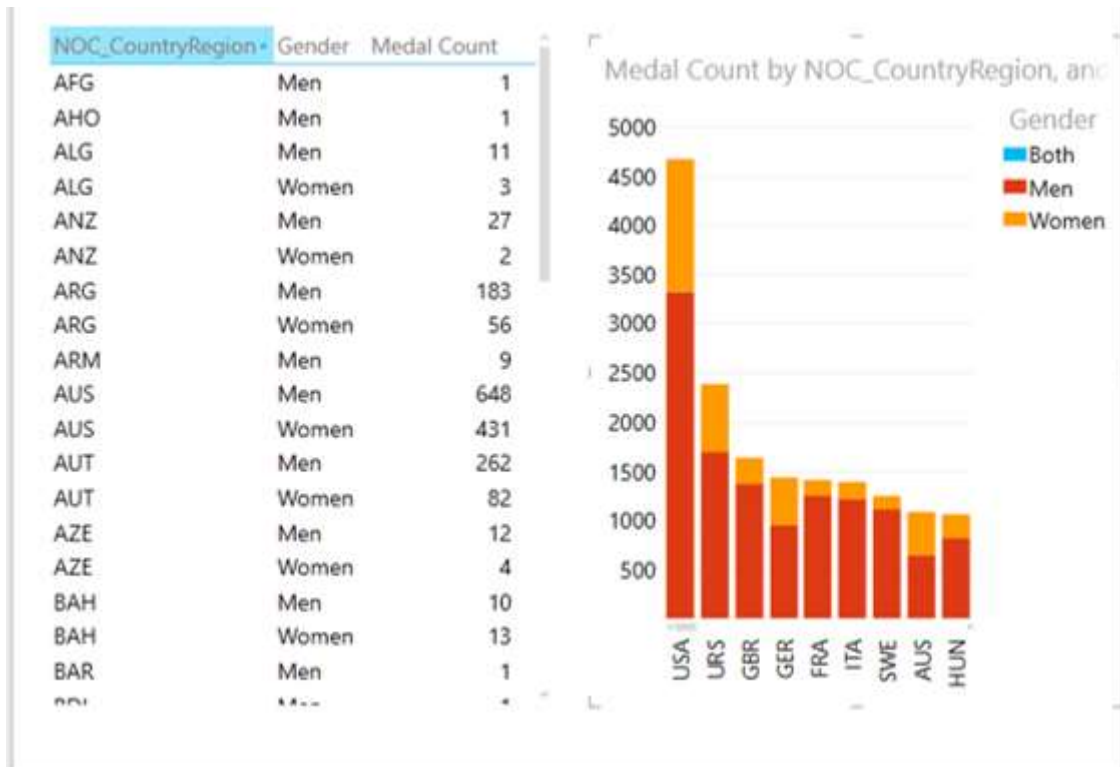
Click here to add a title

NOC_CountryRegion	Gender	Medal Count
AFG	Men	1
AHO	Men	1
ALG	Men	11
ALG	Women	3
ANZ	Men	27
ANZ	Women	2
ARG	Men	183
ARG	Women	56
ARM	Men	9
AUS	Men	648
AUS	Women	431
AUT	Men	262
AUT	Women	82
AZE	Men	12
AZE	Women	4
BAH	Men	10
BAH	Women	13
BAR	Men	1

The Table Visualization on the right is converted to Bar Chart Visualization. As you observe, the x-axis values are sorted by the category values in ascending order.

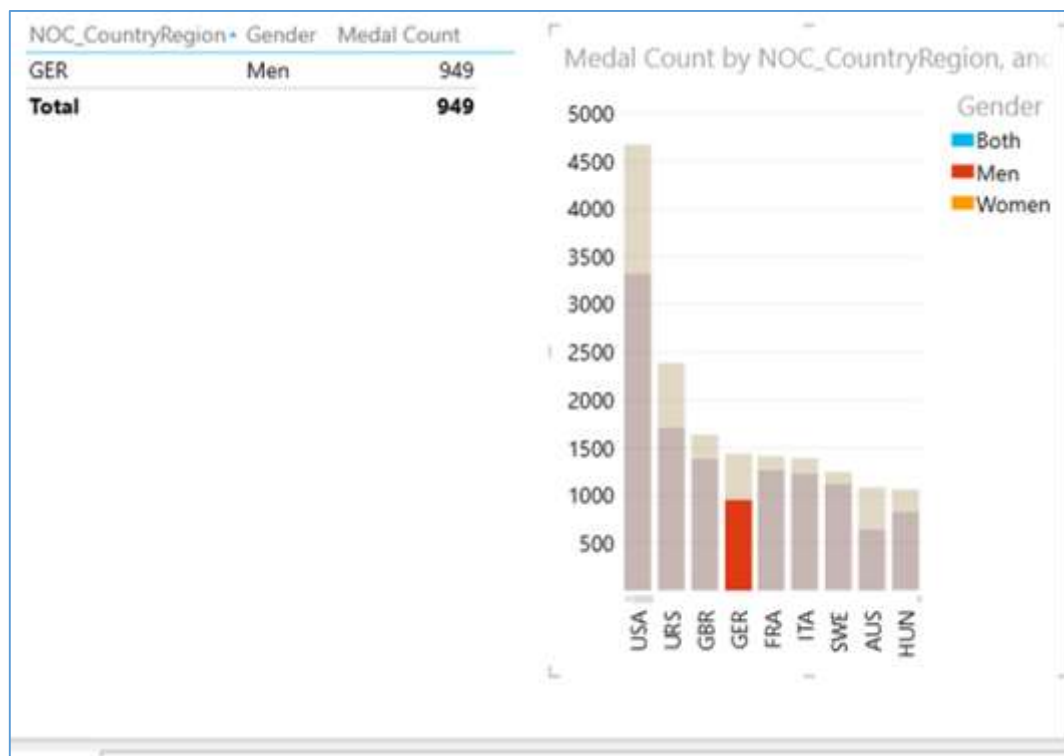


- Take the cursor to above the Column chart. You will find – sort by NOC\_CountryRegion asc.
- Click on NOC\_CountryRegion. It gets changed to Medal Count.
- Click on asc. It gets changed to desc. You will find that the Column Chart is sorted by descending Medal Count.



Click on the lower portion of the Bar with Category GER. It gets highlighted.

In the Table, only the information for GER and Men will be displayed.

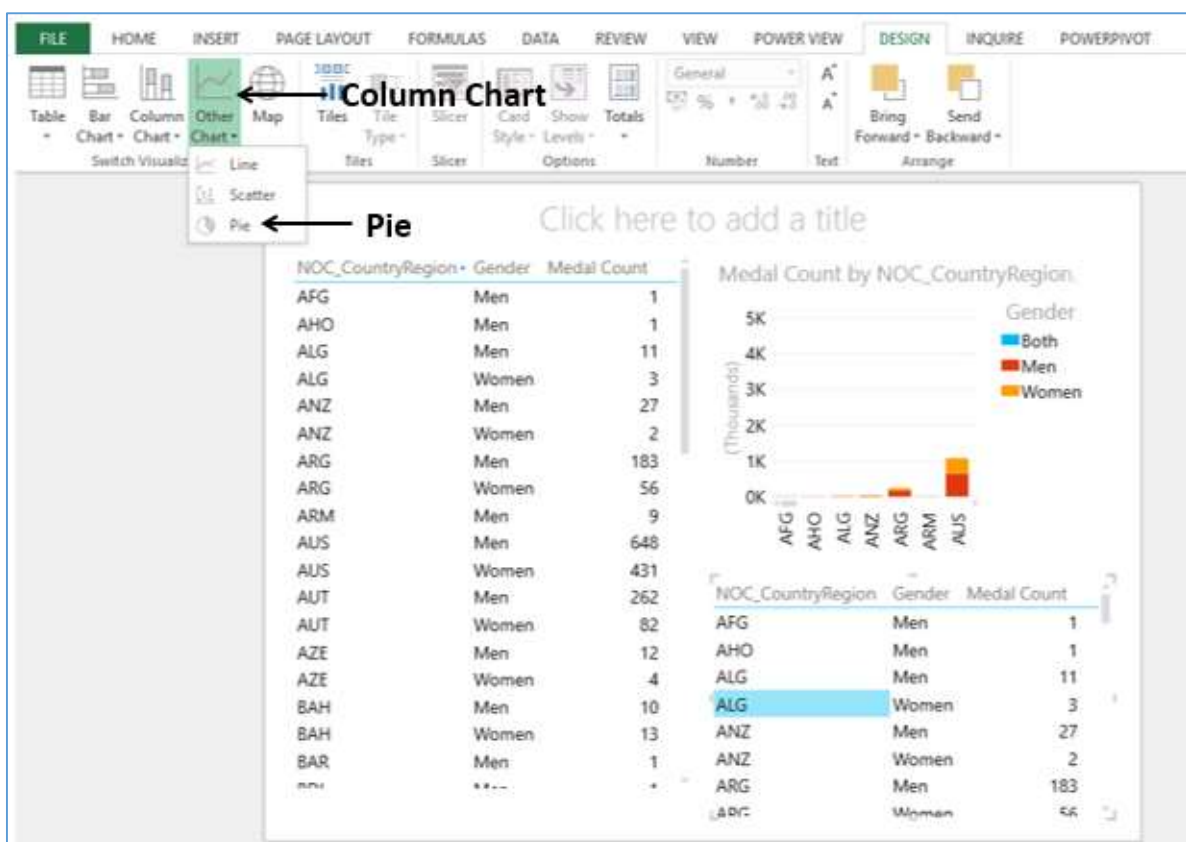


## Exploring with Simple Pie Charts

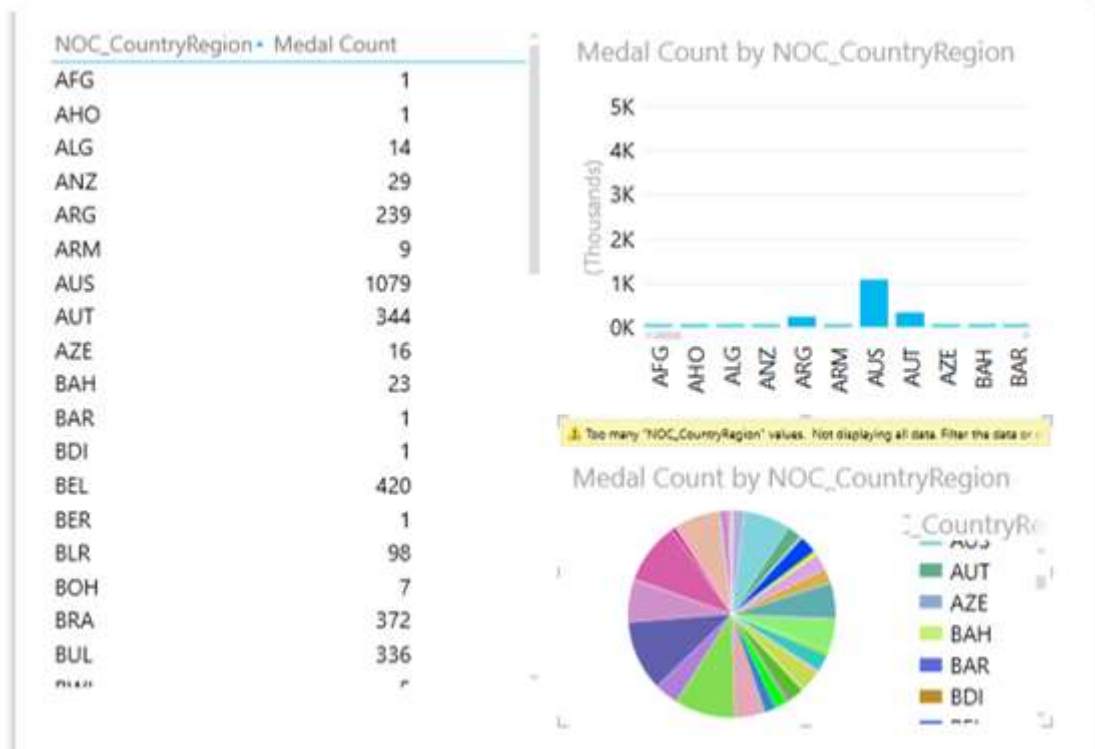
Pie charts in Power View are simple or sophisticated. You will learn simple Pie charts in this section. You will learn sophisticated Pie charts in the next section.

Start with creating a Pie chart as follows –

- Resize the Stacked Column chart and move it upwards.
- Create another Table visualization below the Stacked Column chart.
- Click the new Table.
- Click Other Chart in the Switch Visualization group.
- Select Pie.



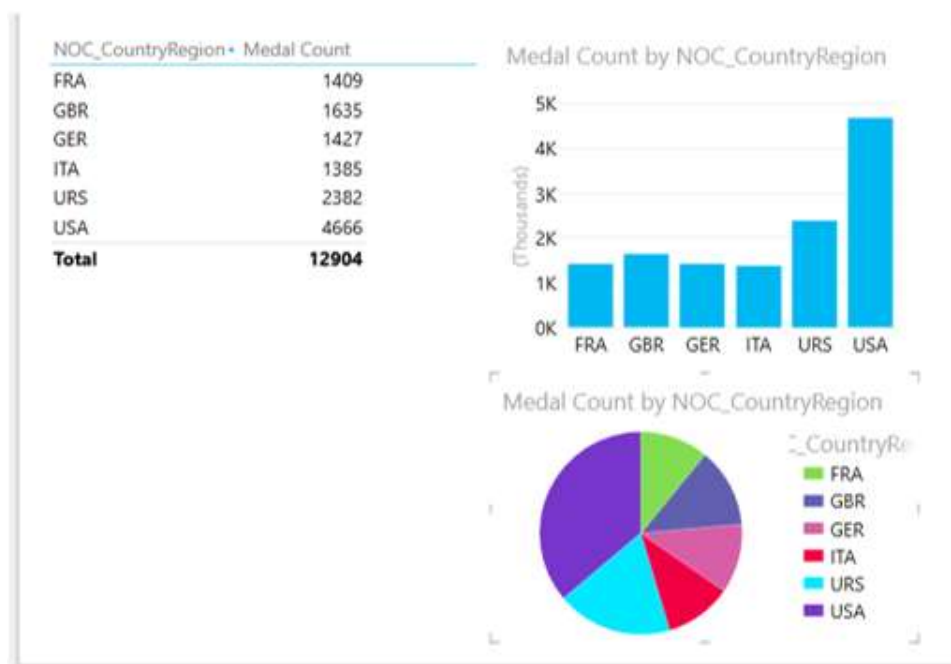
The Table Visualization below the Stacked Column chart is converted to Pie Chart Visualization. As you observe, there are too many slices in the Pie chart as there are many categories (countries). Note that Pie charts work well only when the number of categories is 8 or less.



You can reduce the number of categories by filtering the values as follows –

- Set the filtering as Medal Count is greater than or equal to 1300 in –
  - Table Visualization
  - Column Chart Visualization
  - Pie Chart Visualization

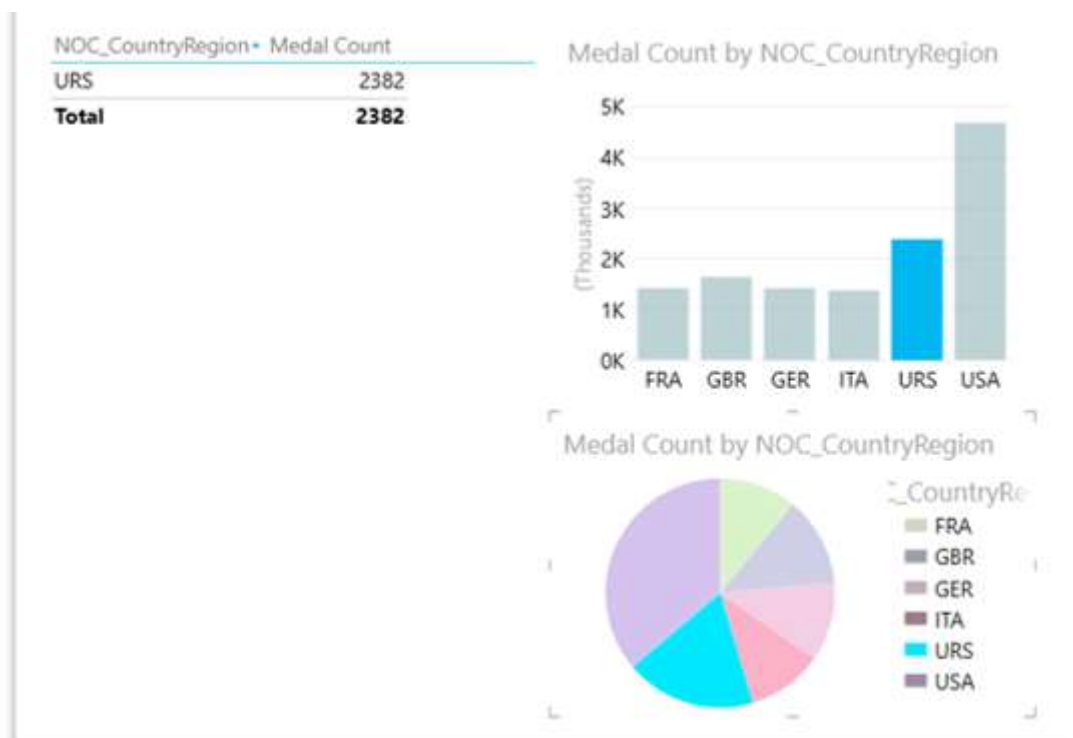
**Note:** You have to define and apply filtering to each of the visualizations separately.





Now, you have a Simple Pie Chart Visualization, wherein the count of Medals are shown by the Pie size, and countries by colors.

Click on a Pie slice. That slice is highlighted and others get grayed. The corresponding column in the Column chart also is highlighted. In the table, only the values corresponding to the highlighted Pie slice will be displayed.



## Exploring with Sophisticated Pie Charts

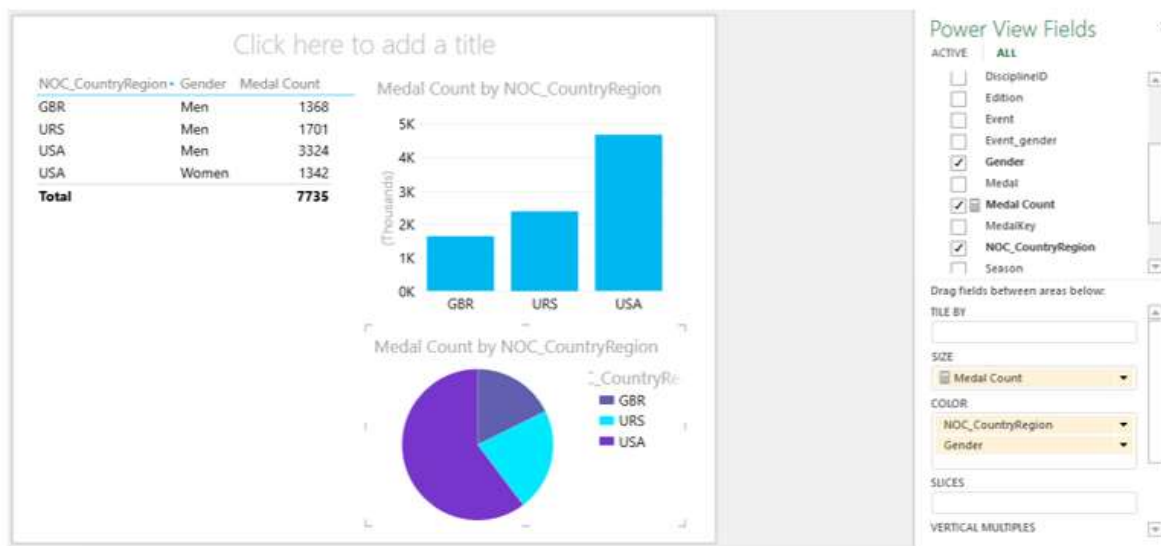
You can make your Pie Chart Visualization sophisticated, by adding more features. You can make a pie chart that -

1. Drills down when you double-click a slice, or
2. Shows sub-slices within the larger color slices.

### A Pie chart that drills down when you double-click a slice

- In the Pie chart, in the Power View Fields list, drag the field Gender to COLOR area, to below the field NOC\_CountryRegion. This means you have two categories.
- In the Table, include Gender also in the Fields list.

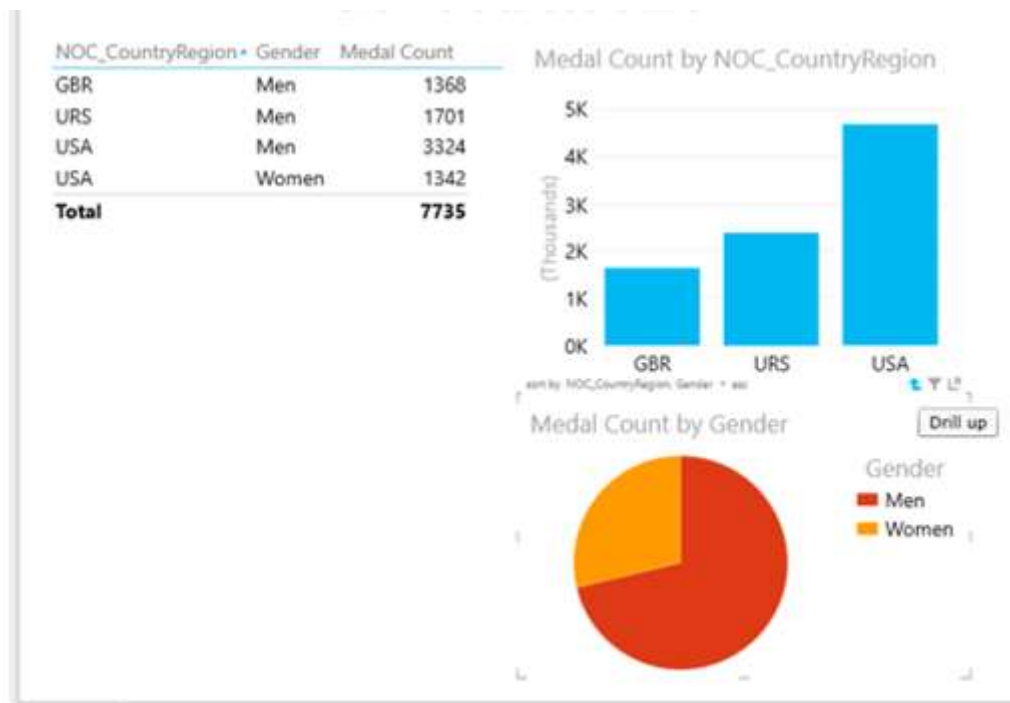
Your Power View looks as follows-



As you observe, there is a single slice with one color for each category - country.

On the Pie chart, double-click on the USA slice.

The Pie chart in your Power View will be changed to show values by Gender, which is the second category, for the selected category (USA). The colors of the pie chart now show the percentages of the second field, i.e., Gender, filtered for the pie color you double-clicked. In other words, the Pie chart was drilled down. As you observe, a small arrow appears on the top right corner of the Pie chart. If you place the mouse over it, the arrow is highlighted and Drill up will be displayed.

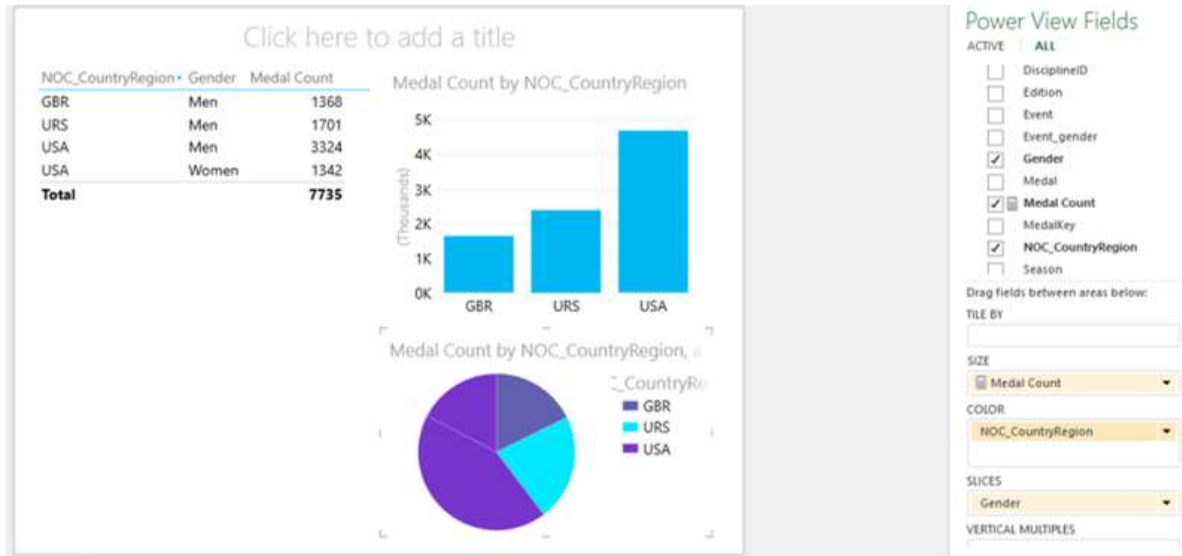


Click the drill up arrow. The Pie Chart returns to its previous state.

## A Pie chart that shows sub-slices within the larger color slices

In the Pie chart, in the Power View Fields list, drag the field Gender from COLOR area to SLICES area.

Your Power View looks as follows –

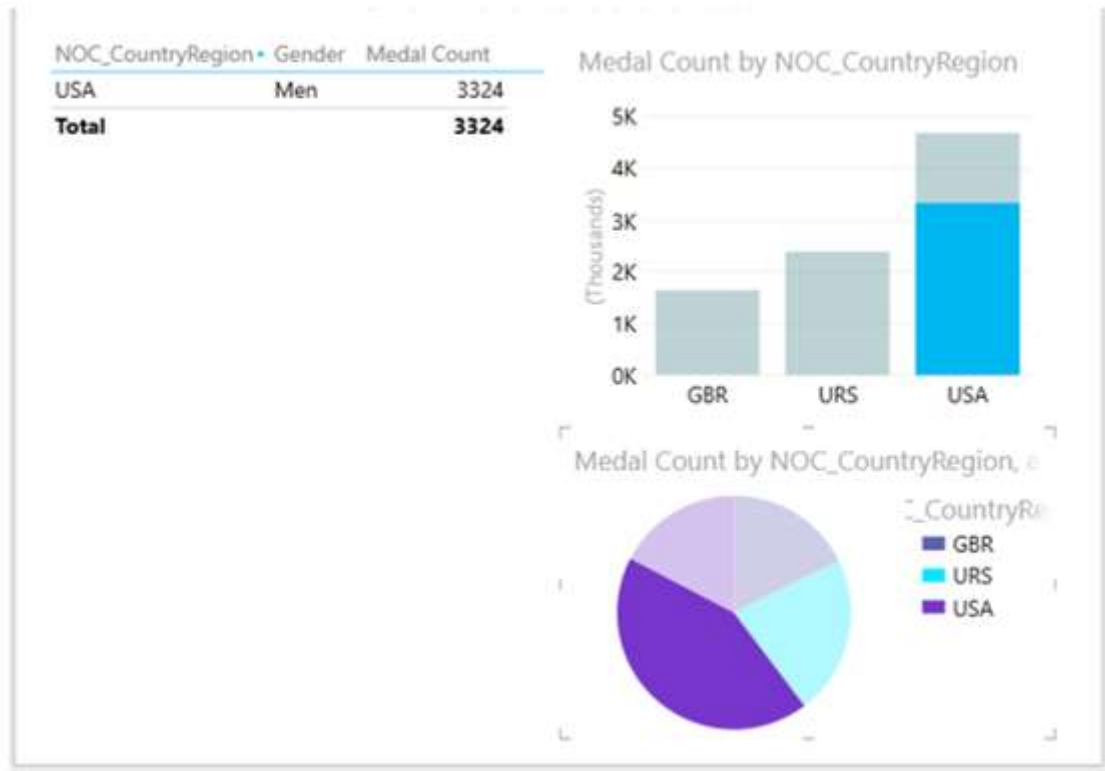


As you can see, in the Pie chart, there are two slices of same color for the category USA.

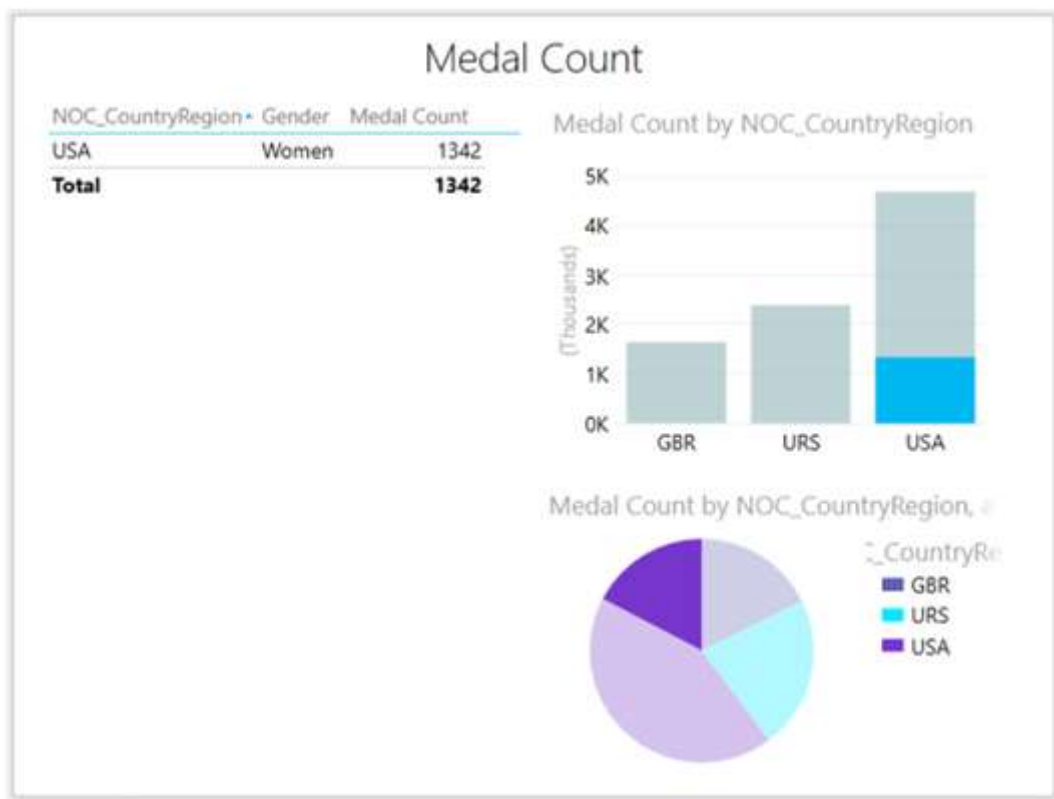
Click on one of these slices.

You will be able to see the following changes in Power View –

- The selected slice is highlighted and other slices are grayed or deactivated.
- The bar for the category USA displays the medal count for the selected slice.
- The Table shows the values for the selected slice.



- Click the other slice. You can observe the changes as given above for this selected slice.

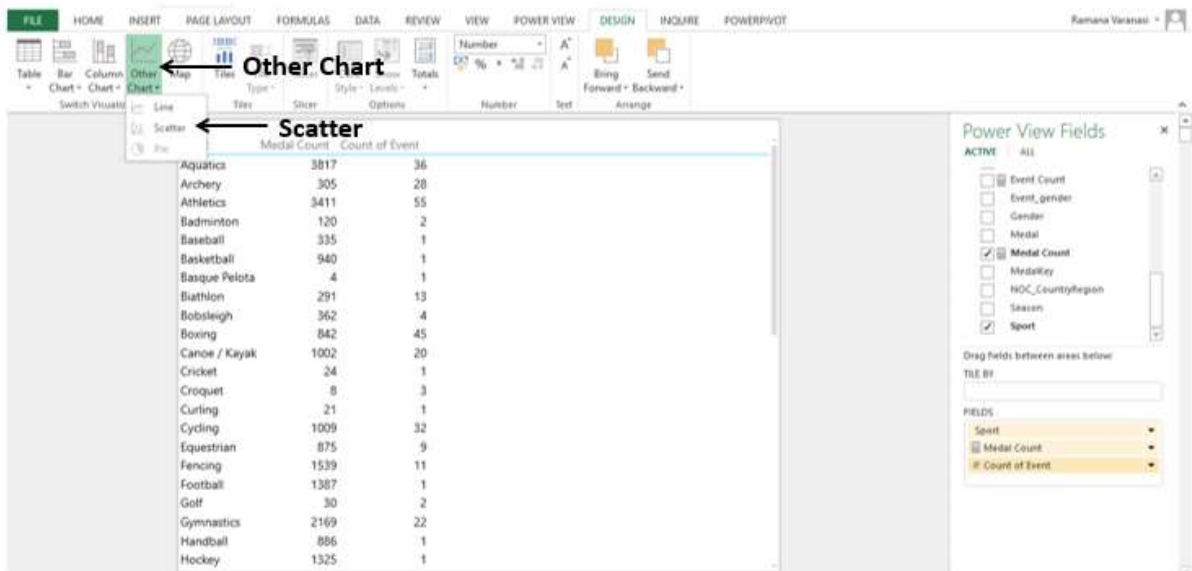


## Exploring with Scatter Charts

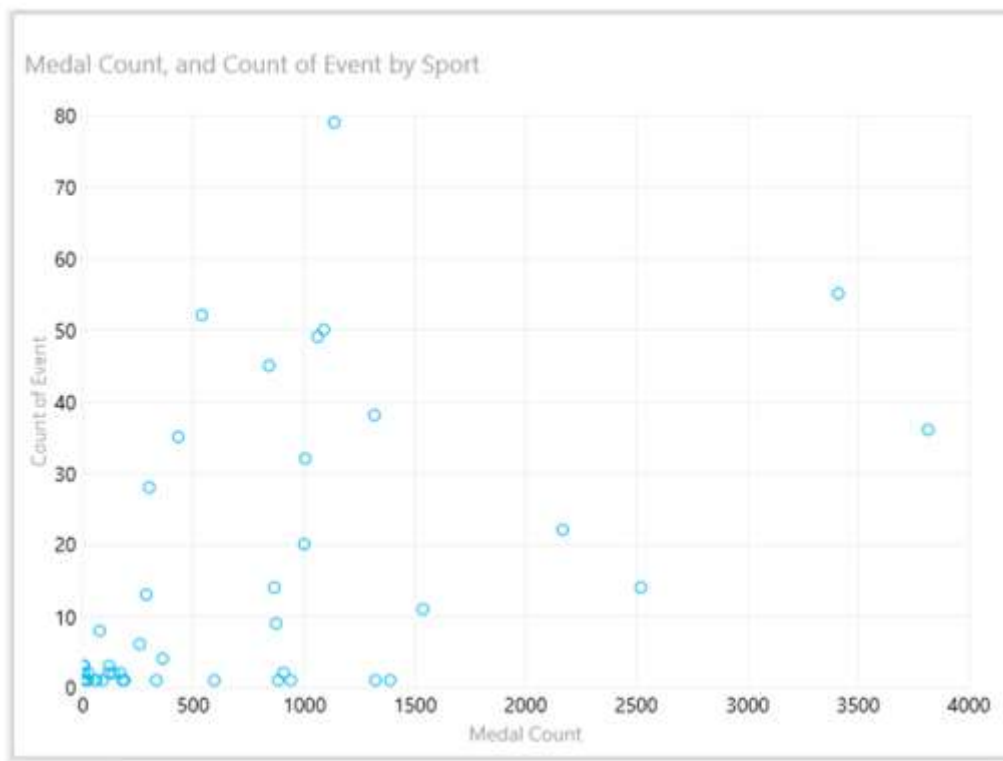
You can use Scatter charts to display many related data in one chart. In Scatter charts, the x-axis displays one numeric field and the y-axis displays another, making it easy to see the relationship between the two values for all the items in the chart.

To create a Scatter Chart Visualization, proceed as follows-

- Add the fields Sport, Medal Count and Event to Table.
- Click the arrow next to Event in the Power View Fields list. Click Count (Distinct). The field Event changes to the numeric field Count of Event. Therefore, you have one category field – Sport and two numeric fields – Medal Count and Count of Event.
- Click **Other Chart** in the Switch Visualization group.
- Click **Scatter**.

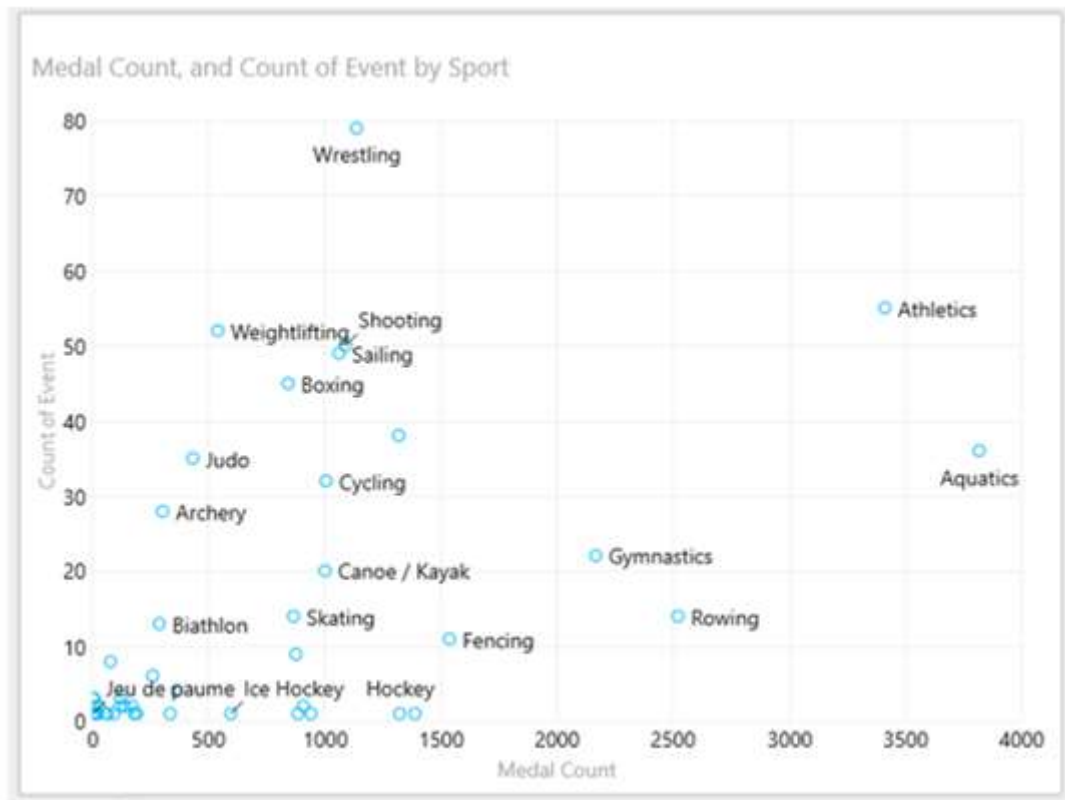


You will get the Scatter Chart Visualization, with the data points displayed as circles of same size, showing how the Count of Event and Medal Count values are related for each sport.



- Click the LAYOUT tab on the Ribbon.
- Click Data Labels in the Labels group.
- Select Right from the drop-down list. The Data labels appear for the data points.





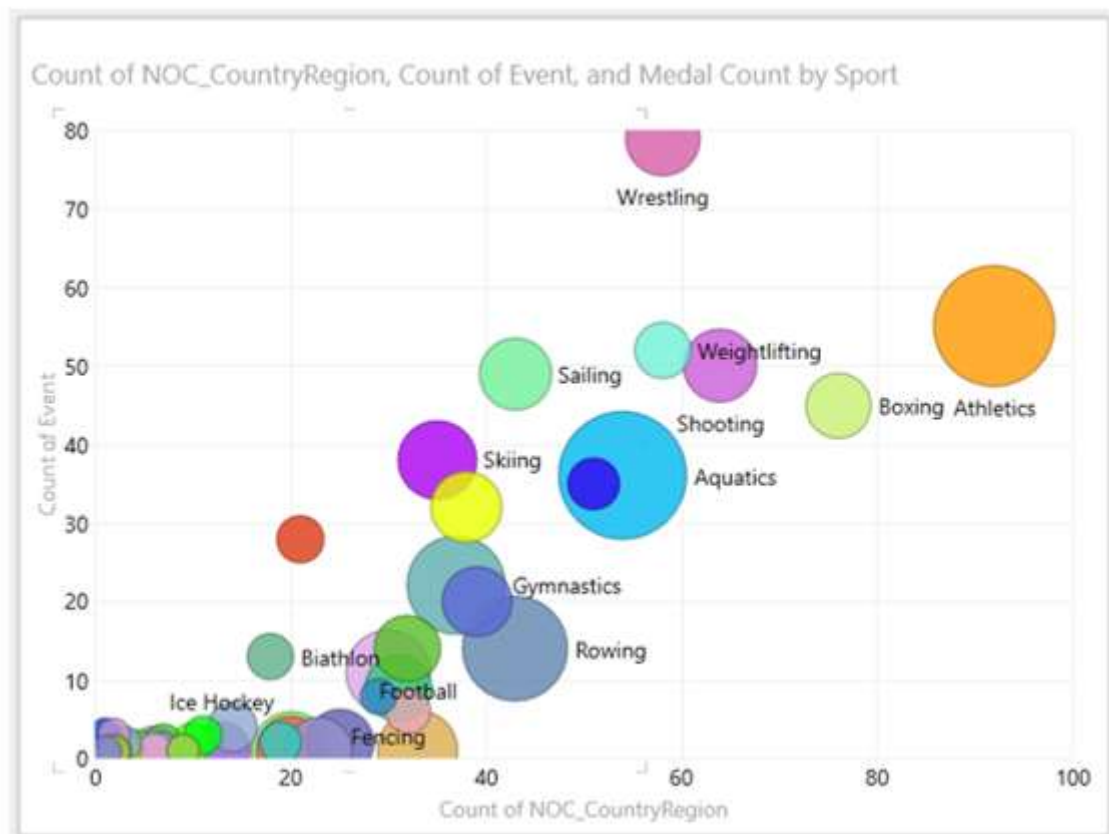
The sport Wrestling has less number of medals in more number of events as compared to the sport Aquatics that has more number of medals in less number of events.

## Exploring with Bubble Charts

You can use Bubble charts to display many related data in one chart. In Bubble Charts, the x-axis displays one numeric field and the y-axis displays another, making it easy to see the relationship between the two values for all the items in the chart. A third numeric field controls the size of the data points.

To create a Bubble Chart Visualization, proceed as follows-

- Drag Medal Count to Size.
- Drag NOC\_CountryRegion to  $\Sigma$  X-VALUE. The Scatter chart is converted to Bubble chart.

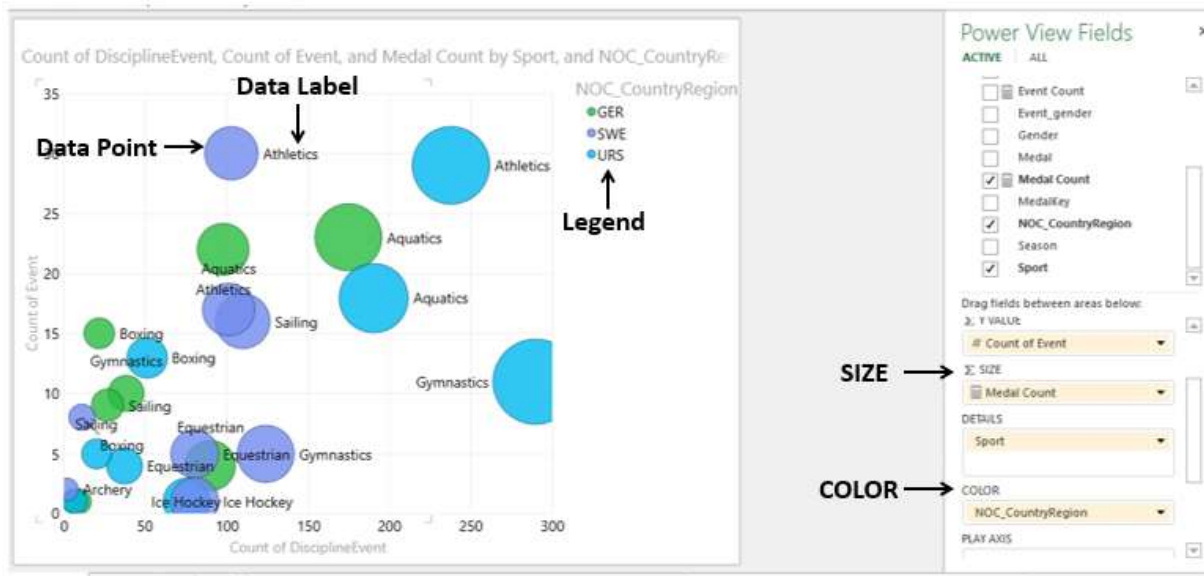


As you observe, the size of each bubble shows the medal count. The data labels show the Sport.

## Exploring with Colors

You can also color the bubbles by a category as follows –

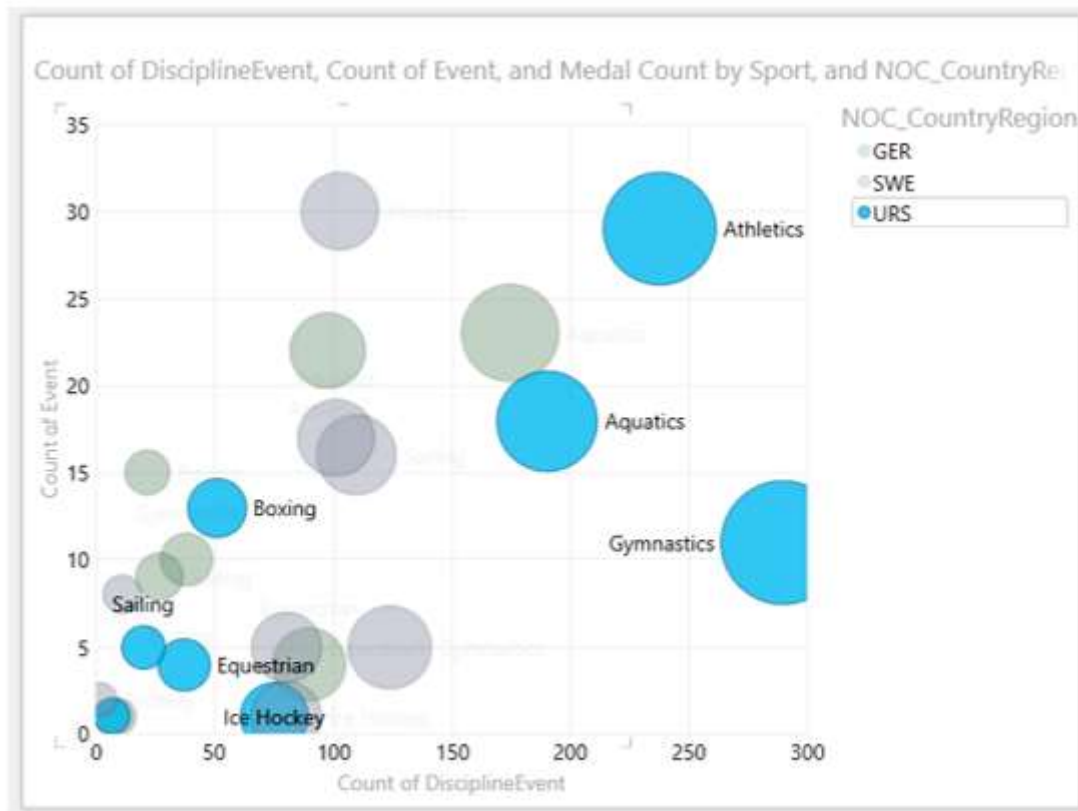
- Drag the field NOC\_CountryRegion to COLOR area in the Power View Fields list.
- Drag the field DiscipleEvent to  $\Sigma$  X-VALUES.



As you observe, Legend shows the values of the category that is in COLOR area and the respective colors. The data labels correspond to the category in DETAILS area. The size of the data points is by the area  $\Sigma$  SIZE.

Next, you can see how selecting a category in Legend changes the visualization –

Click on a value in the Legend. Only the data points of that color (i.e., corresponding to that value) will be highlighted. All the other data points will be deactivated.

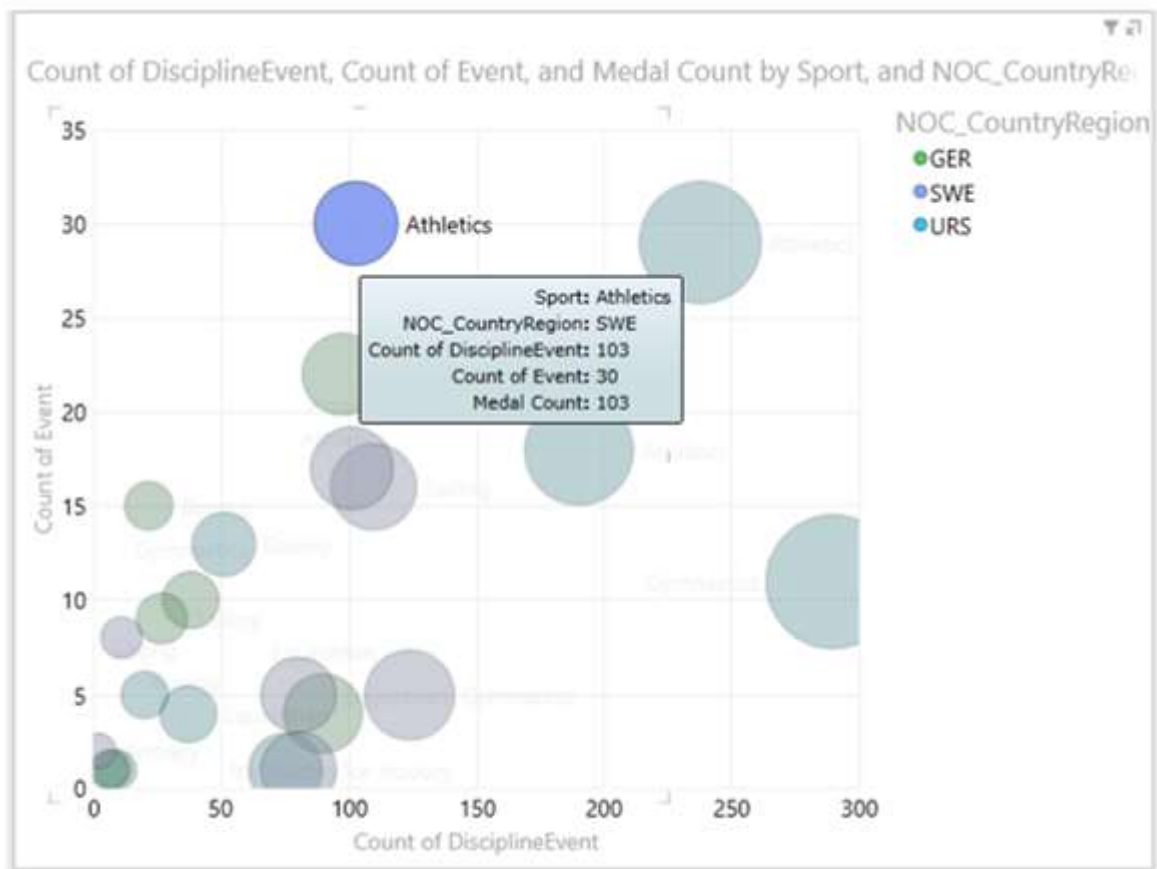


As you observe, all the sports corresponding to the selected country are displayed and the size of each bubble represents the medal count.

If you want to know the details of a single data point-

- Highlight the data point by just clicking on that bubble.
- Place the cursor on that data point.

Only that bubble is highlighted and the rest of the bubbles get grayed. All the information about that data point will be displayed in a box next to the data point.



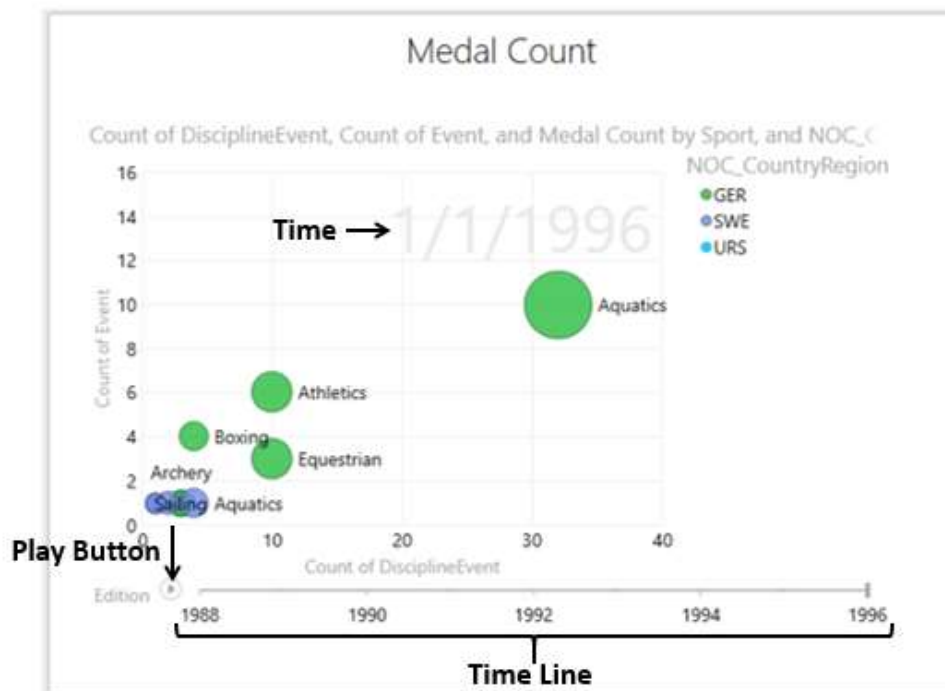
## Exploring with Play Axis

You can visualize the data changes over a period of time using Play Axis as follows –

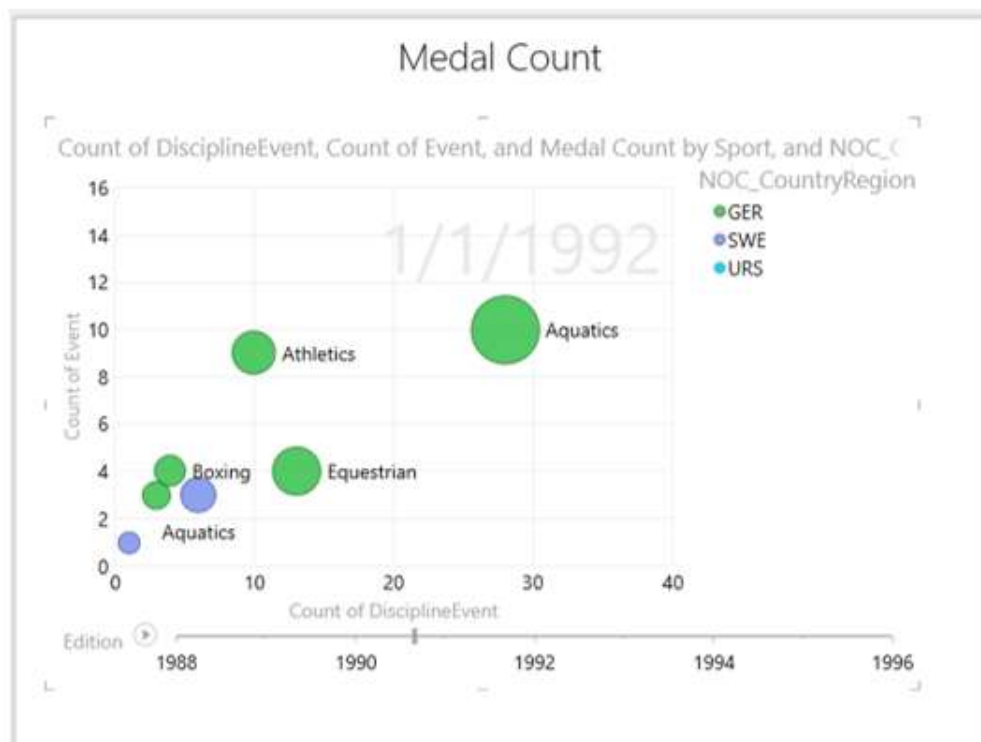
- Drag the field Edition in the Power View Fields list to PLAY AXIS area.

A timeline with a Play button is inserted in your Bubble chart visualization. You can adjust the timeline by filtering the Edition field values in the Filters. This would be useful if you want to focus on a particular time range or if the timeline is too wide.

- Adjust the timeline by filtering Edition field in Filters and choosing a span of time values.



- Click the Play button. The bubbles travel, grows and shrink to show how the values change based on the play axis. A small vertical line appears on the timeline that moves across the timeline. The time at that point also is displayed.



You can pause at any point to study the data in more detail.

## 35. Exploring Data with Power View Maps

You can use maps to display your data in the context of geography. Maps in Power View use Bing map tiles, so you can zoom and pan as you would with any other Bing map. To make maps work, Power View has to send the data to Bing through a secured web connection for geocoding. So, it asks you to enable content. Adding locations and values places dots on the map. The larger the value, the bigger the dot. When you add a multi-value series, you get pie charts on the map, with the size of the pie chart showing the size of the total.

### Exploring Data with Geographic Fields

You can create a Power View Map Visualization if your data has a geographic field such as Country/Region, State/Province, or City.

To create a map visualization for the medal count, country wise proceed as follows -

- Create a new Power View sheet from INSERT tab on the Ribbon.
- Drag the fields NOC\_CountryRegion and Medal Count in the Power View Fields list to the Power View. A Table with these two fields are created.

**Geographic Field**

**NOC\_CountryRegion**

**Medal Count** ← **Numeric Field**

ARG	1
ARM	1
AUS	14
ANZ	29
ARG	239
ARM	9
AUS	1079
AUT	344
AZE	16
BAH	23
BAR	1
BOI	1
BEL	420
BER	1
BUR	98
BOH	7
BRA	372
BUL	336
BWI	5
CAN	827
CHI	33
CHN	714
QV	1
CUR	22
COL	11
CRC	4
CRO	86
CUB	395
CZE	87

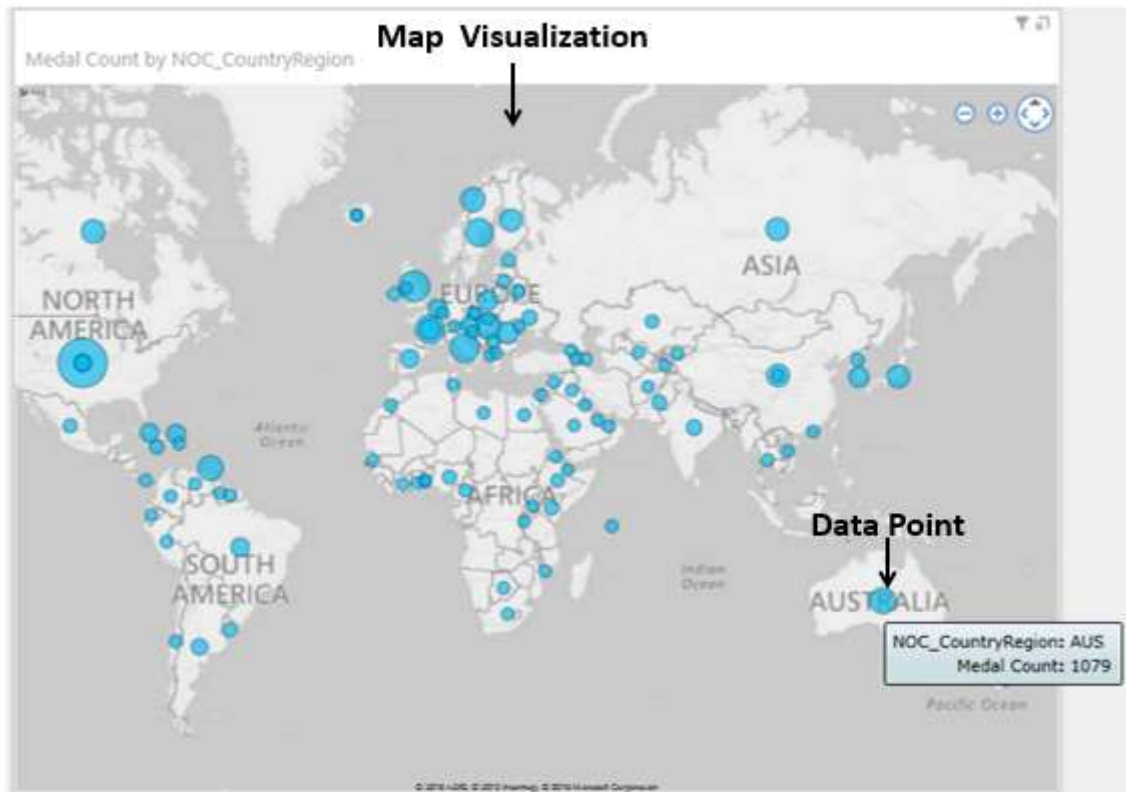
So, you have a geographic field and a numeric field.

- Click the DESIGN tab on the Ribbon.



- Click Map in the Switch Visualization group.

The Table Visualization converts into Map Visualization.



As you observe, Power View creates a map with a dot representing each geographic location. The size of the dot is the value of the corresponding numeric field, which is the medal count in this case. Further, in the Power View Fields list, the Geographic field will be in the Locations area and the Numeric field will be in the  $\Sigma$  SIZE area.

To display more information about a data point, you can do one of the following -

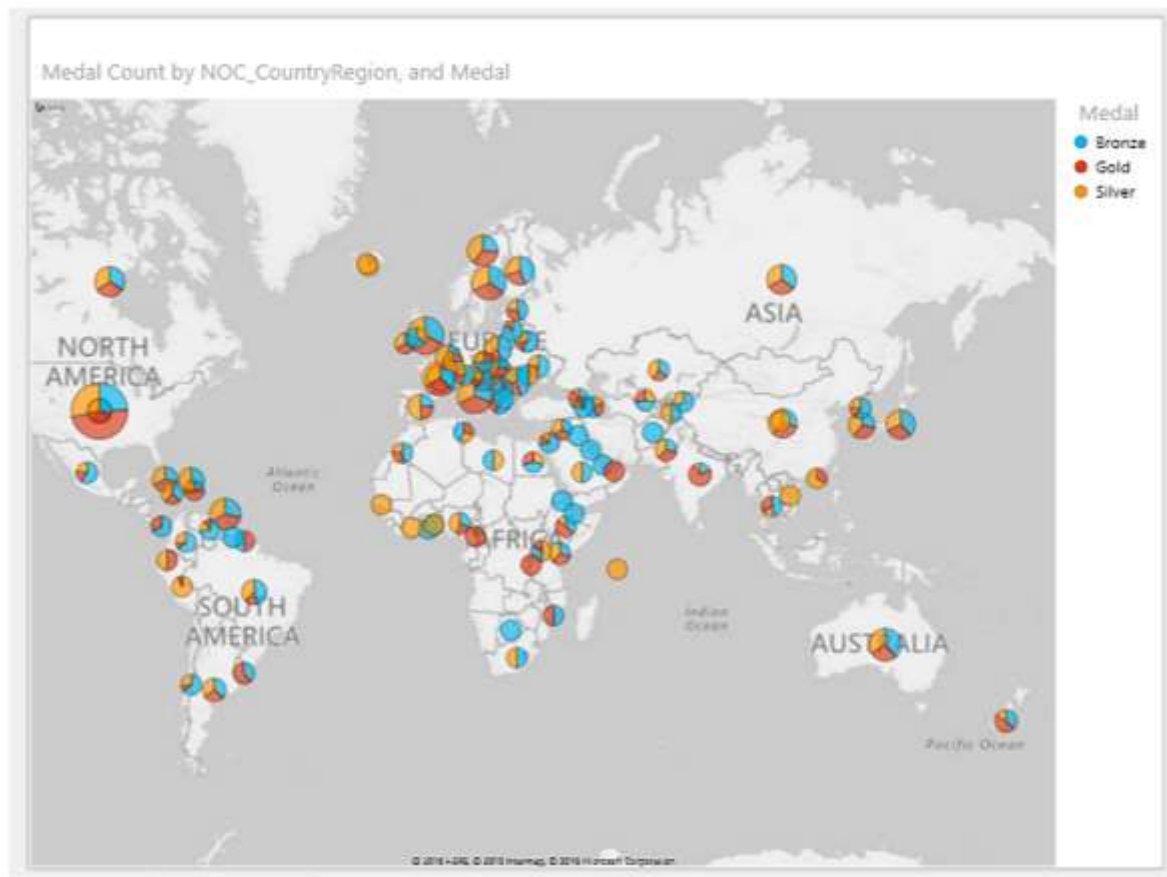
- If you place the cursor on a dot on the map, a box appears displaying the geographic location name and the corresponding numeric value.
- If you click on a dot on the map, that particular dot gets highlighted.

## Pie Charts as Data Points

Suppose you want to add another field also to the map visualization. For example, you might want to display the details about the medals, viz. the medal types – Gold, Silver and Bronze. You can do it as follows -

- Drag the field Medal from the Power View Fields list to the COLOR area.

The dots are converted to Pie charts. A Legend for Medal appears displaying the types of medals and respective colors. i.e., each color in the Pie chart represents the type of the medal.

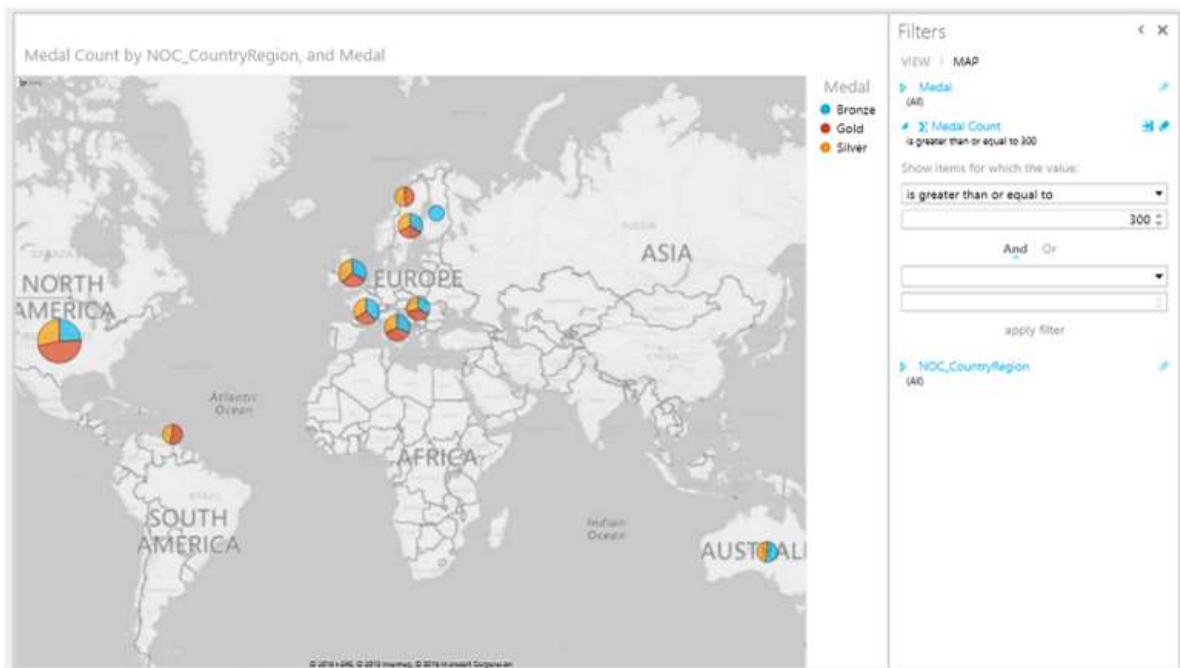


You can observe that the size of a Pie chart corresponds to the medal count and the size of each slice in the Pie chart corresponds to the count of that medal type.

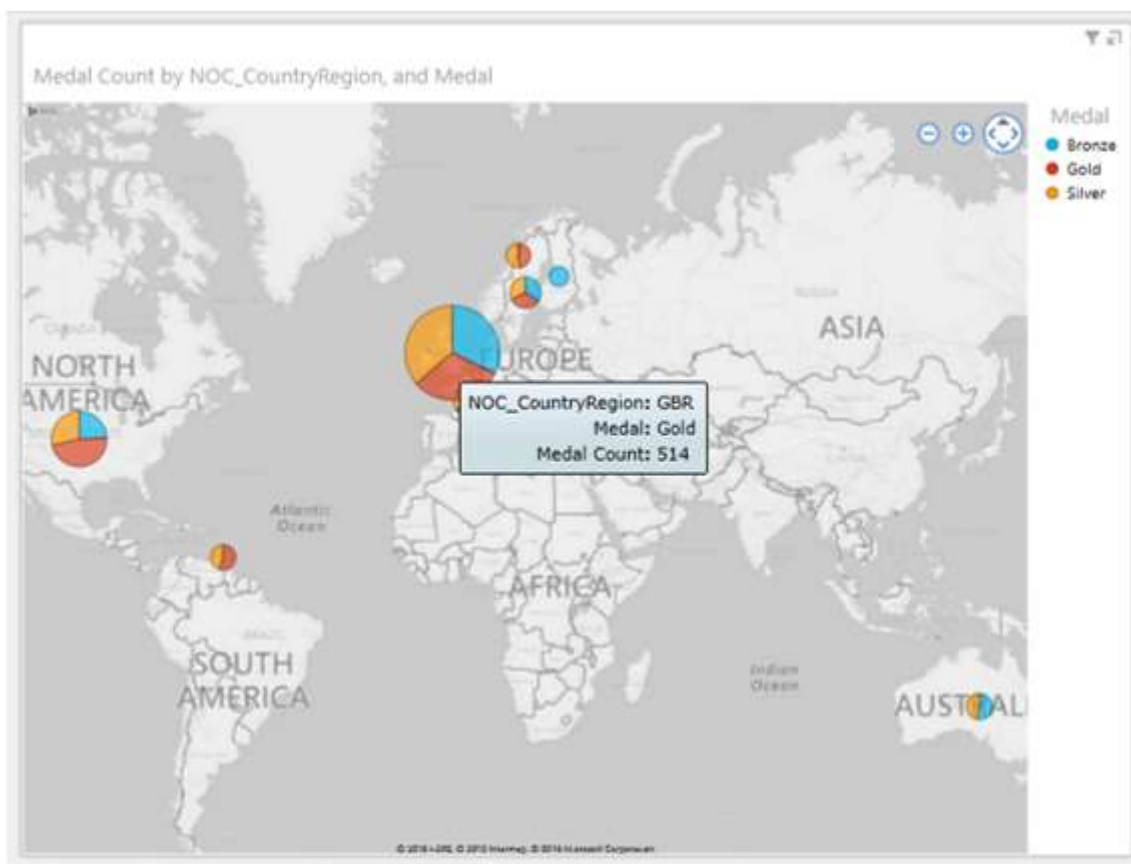
## Highlighting a Data Point

Now, you can filter your data and highlight a significant data point as follows -

- In the Filters area, set the Medal Count to display only the values greater than or equal to 300.
- Apply the filter. The map zooms and displays only the filtered values.



Place the cursor on the dot representing Great Britain. The dot gets highlighted and zoomed. The details of the Pie chart will be displayed.



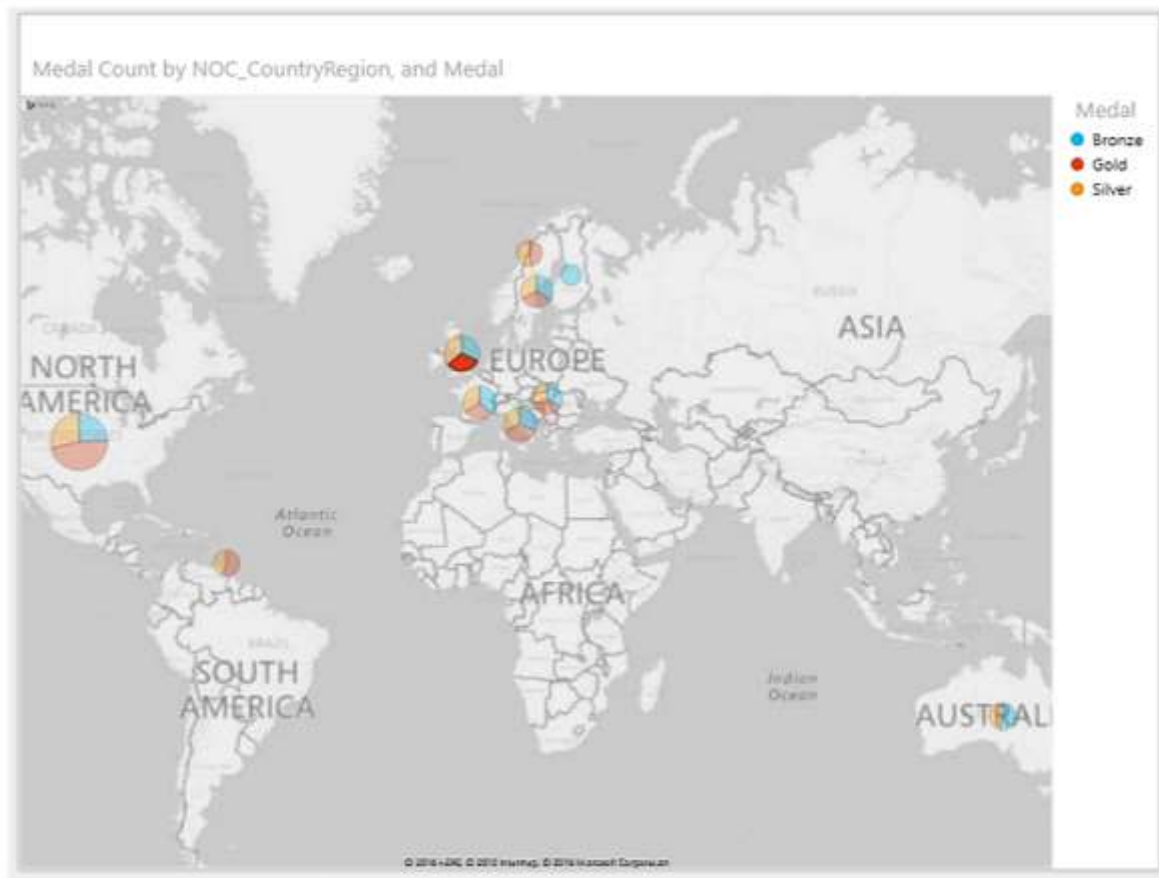
As you can see, the medal count for gold for Great Britain is 514. You can find the medal counts for silver and bronze by placing the cursor on those slices.

## Highlighting a Pie Slice in a Data Point

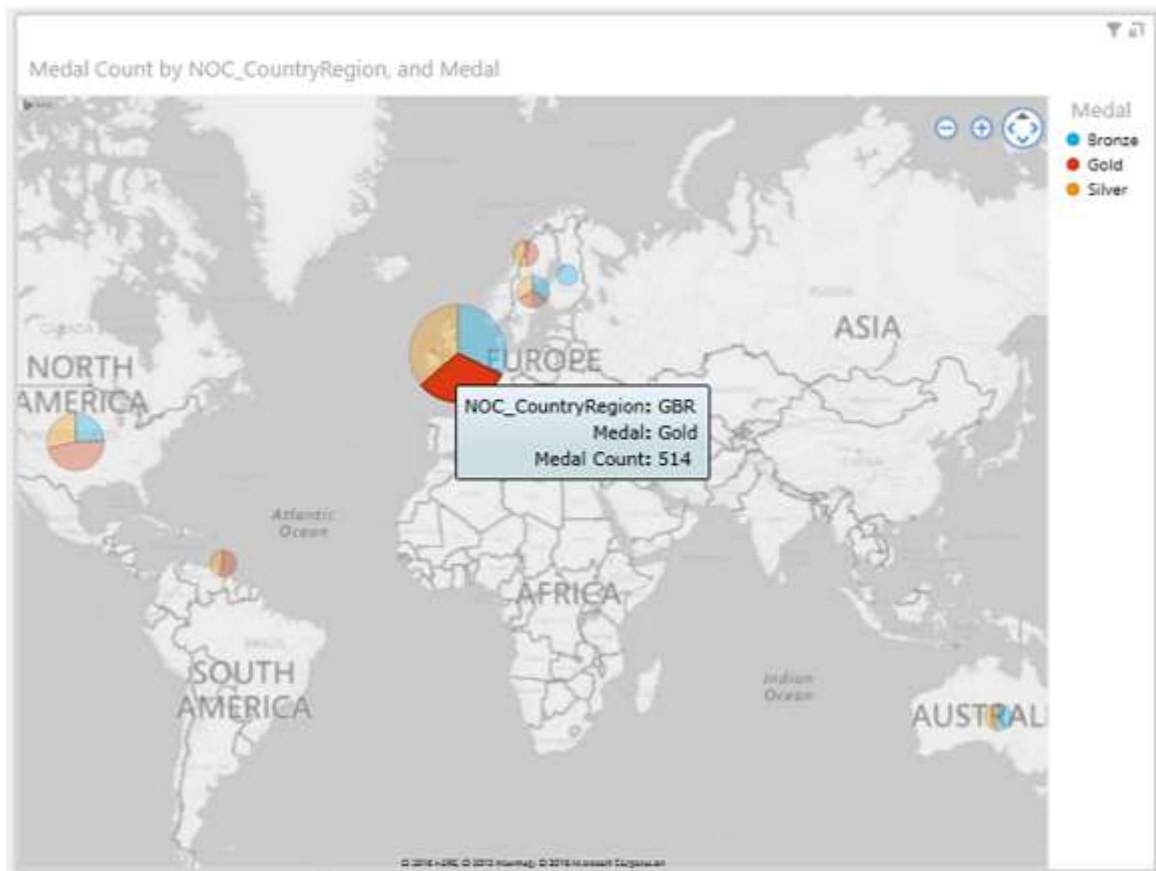
Next, you might want to highlight the gold medal count of Great Britain.

- Place the cursor on the slice with red color (as you can make out that red represents gold in the Legend). Click it.

That Pie Slice will be highlighted. The other slices in that Pie chart and all the other Pie charts will be deactivated.



Place the cursor on the dot again. The dot is zoomed. The slice representing gold will be highlighted. The details of the slice will be displayed.



## 36. Exploring Data with Power View Multiples

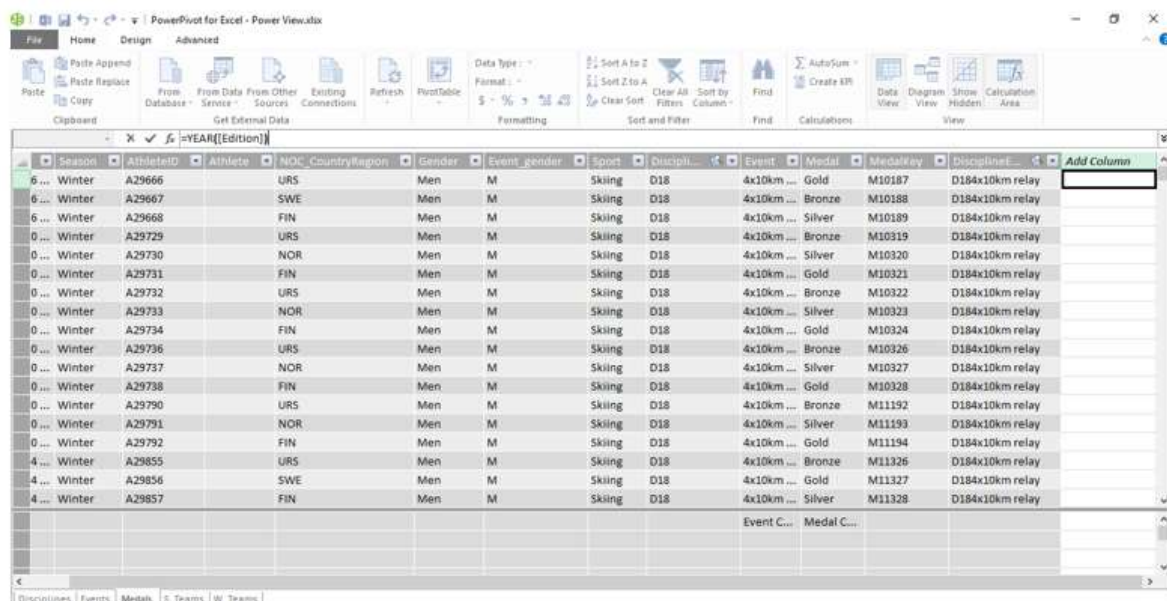
Multiples, also called Trellis Charts are a series of charts with identical X and Y axes. You can arrange Multiples side by side, to compare many different values easily at the same time.

- You can have Line charts, Pie charts, Bar charts and Column charts as Multiples.
- You can arrange the Multiples horizontally or vertically.

### Line Charts as Multiples

You might want to display the medal count by year for each Region. Firstly, you need to have the field Year. To get this field, you need to have a calculated column as follows-

- Click the Medals tab in the Data View of the Data Model (in the PowerPivot window).
- Click in the first cell in the right most column with the header Add Column.
- Type **=YEAR([Edition])** in the formula bar and press Enter.



Season	AthleteID	Athlete	NOC	CountryRegion	Gender	Event_gender	Sport	Discipline	Event	Medal	MedalWay	Discipline...	Add Column
6 ...	Winter	A29666		URS	Men	M	Skiing	D18	4x10km ...	Gold	M10187	D184x10km relay	
6 ...	Winter	A29667		SWE	Men	M	Skiing	D18	4x10km ...	Bronze	M10188	D184x10km relay	
6 ...	Winter	A29668		FIN	Men	M	Skiing	D18	4x10km ...	Silver	M10189	D184x10km relay	
0 ...	Winter	A29729		URS	Men	M	Skiing	D18	4x10km ...	Bronze	M10319	D184x10km relay	
0 ...	Winter	A29730		NOR	Men	M	Skiing	D18	4x10km ...	Silver	M10320	D184x10km relay	
0 ...	Winter	A29731		FIN	Men	M	Skiing	D18	4x10km ...	Gold	M10321	D184x10km relay	
0 ...	Winter	A29732		URS	Men	M	Skiing	D18	4x10km ...	Bronze	M10322	D184x10km relay	
0 ...	Winter	A29733		NOR	Men	M	Skiing	D18	4x10km ...	Silver	M10323	D184x10km relay	
0 ...	Winter	A29734		FIN	Men	M	Skiing	D18	4x10km ...	Gold	M10324	D184x10km relay	
0 ...	Winter	A29736		URS	Men	M	Skiing	D18	4x10km ...	Bronze	M10326	D184x10km relay	
0 ...	Winter	A29737		NOR	Men	M	Skiing	D18	4x10km ...	Silver	M10327	D184x10km relay	
0 ...	Winter	A29738		FIN	Men	M	Skiing	D18	4x10km ...	Gold	M10328	D184x10km relay	
0 ...	Winter	A29790		URS	Men	M	Skiing	D18	4x10km ...	Bronze	M11192	D184x10km relay	
0 ...	Winter	A29791		NOR	Men	M	Skiing	D18	4x10km ...	Silver	M11193	D184x10km relay	
0 ...	Winter	A29792		FIN	Men	M	Skiing	D18	4x10km ...	Gold	M11194	D184x10km relay	
4 ...	Winter	A29855		URS	Men	M	Skiing	D18	4x10km ...	Bronze	M11326	D184x10km relay	
4 ...	Winter	A29856		SWE	Men	M	Skiing	D18	4x10km ...	Gold	M11327	D184x10km relay	
4 ...	Winter	A29857		FIN	Men	M	Skiing	D18	4x10km ...	Silver	M11328	D184x10km relay	

A new column with header CalculatedColumn1 is created with values corresponding to the Year values in Edition column.



ID	Athlete	NOC_CountryRegion	Gender	Event_gender	Sport	Discipli...	Event	Medal	MedalKey	Disciplin...	CalculatedColumn1	Add Column
		URS	Men	M	Skiing	D18	4x10km ...	Gold	M10187	D184x10km relay	1956	
		SWE	Men	M	Skiing	D18	4x10km ...	Bronze	M10188	D184x10km relay	1956	
		FIN	Men	M	Skiing	D18	4x10km ...	Silver	M10189	D184x10km relay	1956	
		URS	Men	M	Skiing	D18	4x10km ...	Bronze	M10319	D184x10km relay	1960	
		NOR	Men	M	Skiing	D18	4x10km ...	Silver	M10320	D184x10km relay	1960	
		FIN	Men	M	Skiing	D18	4x10km ...	Gold	M10321	D184x10km relay	1960	
		URS	Men	M	Skiing	D18	4x10km ...	Bronze	M10322	D184x10km relay	1960	
		NOR	Men	M	Skiing	D18	4x10km ...	Silver	M10323	D184x10km relay	1960	
		FIN	Men	M	Skiing	D18	4x10km ...	Gold	M10324	D184x10km relay	1960	
		URS	Men	M	Skiing	D18	4x10km ...	Bronze	M10326	D184x10km relay	1960	
		NOR	Men	M	Skiing	D18	4x10km ...	Silver	M10327	D184x10km relay	1960	
		FIN	Men	M	Skiing	D18	4x10km ...	Gold	M10328	D184x10km relay	1960	
		URS	Men	M	Skiing	D18	4x10km ...	Bronze	M11192	D184x10km relay	1960	
		NOR	Men	M	Skiing	D18	4x10km ...	Silver	M11193	D184x10km relay	1960	
		FIN	Men	M	Skiing	D18	4x10km ...	Gold	M11194	D184x10km relay	1960	
		URS	Men	M	Skiing	D18	4x10km ...	Bronze	M11326	D184x10km relay	1964	
		SWE	Men	M	Skiing	D18	4x10km ...	Gold	M11327	D184x10km relay	1964	
		FIN	Men	M	Skiing	D18	4x10km ...	Silver	M11328	D184x10km relay	1964	

Click on the header and rename it as Year.

ID	Athlete	NOC_CountryRegion	Gender	Event_gender	Sport	Discipli...	Event	Medal	MedalKey	Disciplin...	Year	Add Column
		URS	Men	M	Skiing	D18	4x10km ...	Gold	M10187	D184x10km relay	1956	
		SWE	Men	M	Skiing	D18	4x10km ...	Bronze	M10188	D184x10km relay	1956	
		FIN	Men	M	Skiing	D18	4x10km ...	Silver	M10189	D184x10km relay	1956	
		URS	Men	M	Skiing	D18	4x10km ...	Bronze	M10319	D184x10km relay	1960	
		NOR	Men	M	Skiing	D18	4x10km ...	Silver	M10320	D184x10km relay	1960	
		FIN	Men	M	Skiing	D18	4x10km ...	Gold	M10321	D184x10km relay	1960	
		URS	Men	M	Skiing	D18	4x10km ...	Bronze	M10322	D184x10km relay	1960	
		NOR	Men	M	Skiing	D18	4x10km ...	Silver	M10323	D184x10km relay	1960	
		FIN	Men	M	Skiing	D18	4x10km ...	Gold	M10324	D184x10km relay	1960	
		URS	Men	M	Skiing	D18	4x10km ...	Bronze	M10326	D184x10km relay	1960	
		NOR	Men	M	Skiing	D18	4x10km ...	Silver	M10327	D184x10km relay	1960	
		FIN	Men	M	Skiing	D18	4x10km ...	Gold	M10328	D184x10km relay	1960	
		URS	Men	M	Skiing	D18	4x10km ...	Bronze	M11192	D184x10km relay	1960	
		NOR	Men	M	Skiing	D18	4x10km ...	Silver	M11193	D184x10km relay	1960	
		FIN	Men	M	Skiing	D18	4x10km ...	Gold	M11194	D184x10km relay	1960	
		URS	Men	M	Skiing	D18	4x10km ...	Bronze	M11326	D184x10km relay	1964	
		SWE	Men	M	Skiing	D18	4x10km ...	Gold	M11327	D184x10km relay	1964	
		FIN	Men	M	Skiing	D18	4x10km ...	Silver	M11328	D184x10km relay	1964	

- Close the PowerPivot window. The Data Model gets updated. The new field -  $\Sigma$  Year appears in the Power View Fields list.
- Create a Table in Power View with fields NOC\_CountryRegion, Count of Year and Medal Count, by dragging the fields.

NOC_CountryRegion	Count of Year	Medal Count
ARG	1	1
AND	1	1
AUS	5	14
ANZ	2	29
ARG	17	239
ARM	3	9
AUS	26	1079
AUT	28	344
AZE	4	16
BAH	7	23
BAR	1	1
BDI	1	1
BEL	24	420
BER	1	1
BUR	8	98
BOH	2	7
BRA	17	372
BUL	17	336
BWA	1	5
CAN	29	827
CHI	7	33
CHN	11	714
CIV	1	1
CMR	5	22
COL	7	11
CRC	3	4
CRO	7	86
CUB	13	395
CZE	7	87

**Power View Fields**

ACTIVE ALL

☐ NOC\_CountryRegion  
☐ Edition  
☐ Event  
☐ Event Count  
☐ Event\_gender  
☐ Gender  
☐ Medal  
☒ Medal Count  
☐ MedalKey  
☒ NOC\_CountryRegion  
☐ Season  
☐ Sport  
☒  $\Sigma$  Year

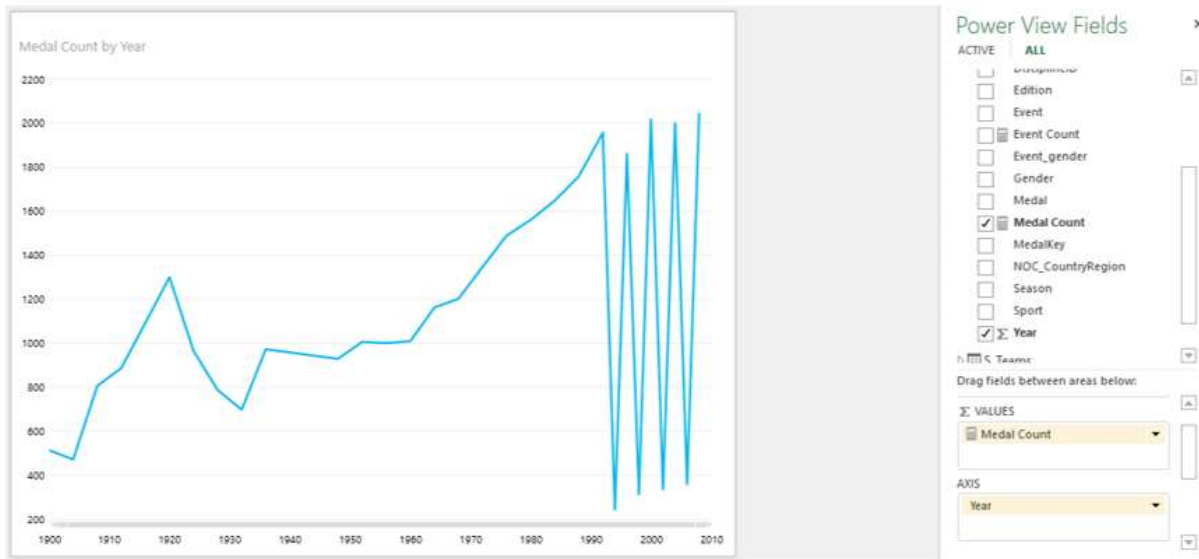
☐ S\_Teams  
☐ W\_Teams

Drag fields between areas below:

**FIELDS**  
☐ NOC\_CountryRegion  
☐ # Count of Year  
☐ Medal Count

- Convert Table into a Line chart in Power View.

- Remove the field NOC\_CountryRegion. A Line chart appears with Medal Count by Year.



As you can observe, Year is in AXIS area and Medal Count is in  $\Sigma$  VALUES area in Power View Fields list. In the Line chart, Year values are on X-axis and Medal count on Y-axis.

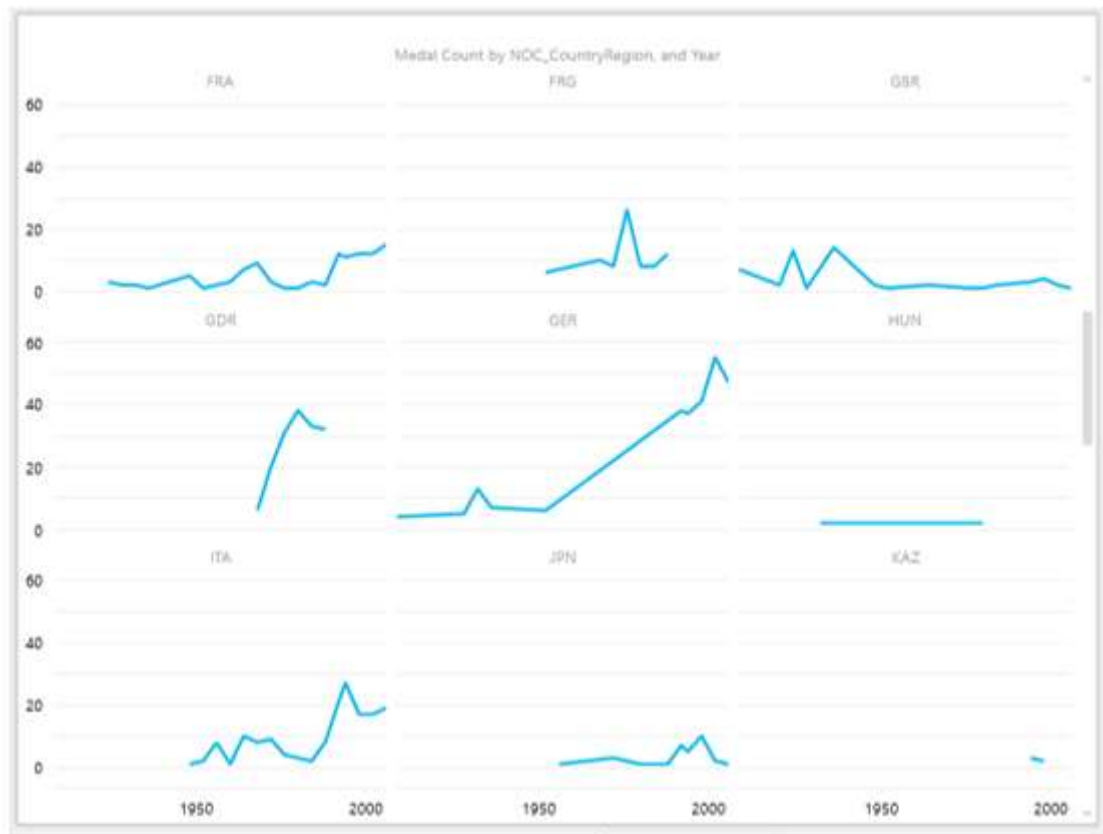
Now, you can create Multiples visualization with Line charts, as follows –

- Drag the field NOC\_CountryRegion to VERTICAL MULTIPLES area in the Power View Fields list.
- Click the tab LAYOUT on the Ribbon.
- Click Grid Height in the Multiples group.
- Click a value in the dropdown list.



- Click Grid Width in the Multiples group.
- Click on a value from the dropdown list.

You will get the Multiples Visualization with Line charts arranged as a grid, with each Line chart representing a country (NOC\_CountryRegion).



## Vertical Multiples

As you are aware, you have placed the NOC\_CountryRegion field in the VERTICAL MULTIPLES area. Hence, the visualization that you have got is the Vertical Multiples visualization. You can observe the following in the chart given above.

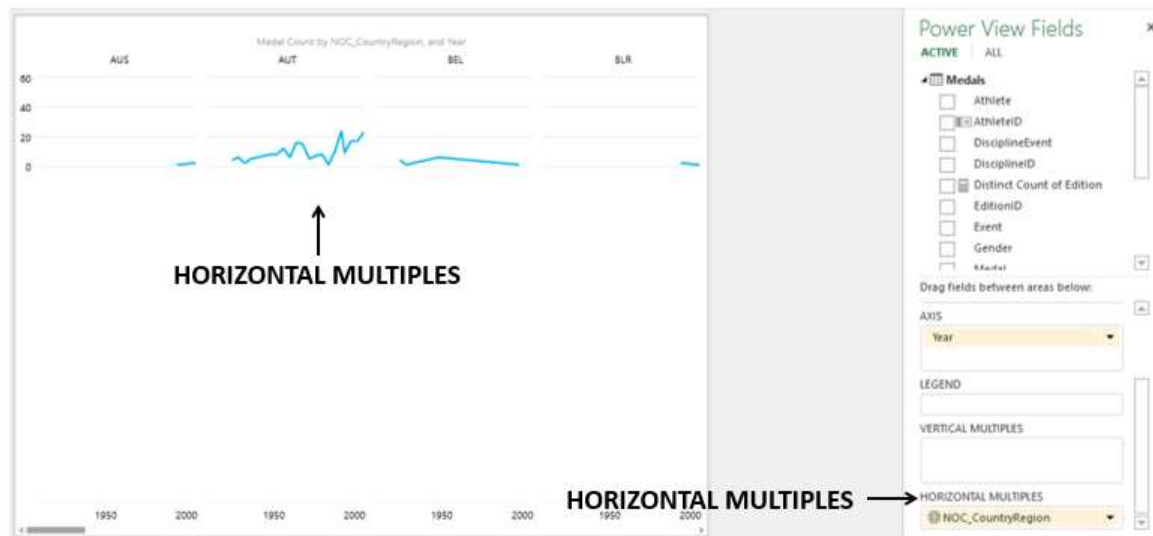
- One Line chart per category that is placed in VERTICAL MULTIPLES area, in this case – the country.
- The grid height and grid width that you have chosen determine the number of rows and number of columns for the Multiples.
- A common x-axis for all the multiples.
- A similar y-axis for each row of the multiples.
- A vertical scroll bar on the right side that can be used to drag the rows of Line charts up and down, so as to make the other Line charts visible.

## Horizontal Multiples

You can have the Multiples Visualization with Horizontal Multiples also as follows-

- Drag the field NOC\_CountryRegion to VERTICAL MULTIPLES area.
- Click the Layout tab on the Ribbon.
- Select the values for Grid Height and Grid Width in the Multiples group.

You will get the Horizontal Multiples visualization as follows –



You can observe the following in the above chart –

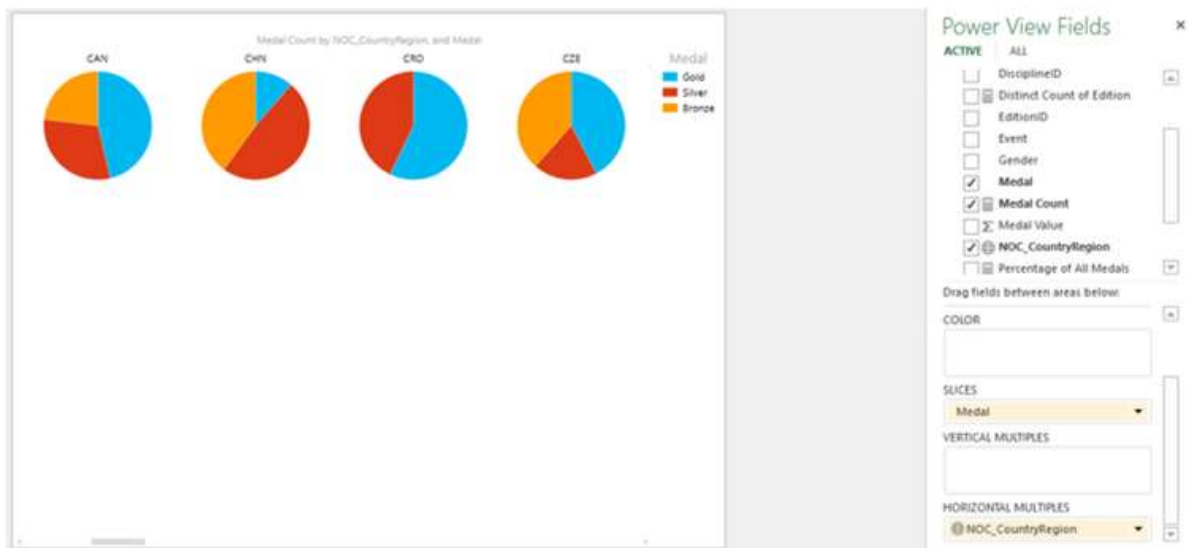
- One Line chart per category that is placed in HORIZONTAL MULTIPLES area, in this case – the country.
- The grid height that you have chosen determines the height of the Line charts, unlike the number of rows of Line charts as is the case in the VERTICAL MULTIPLES. In other words, there is a single row of Line charts with the height determined by the Grid Height that is chosen.
- The grid width that you have chosen determines the number of columns of Line charts in the row.
- A common x-axis for all the multiples.
- A common y-axis for all the multiples.
- A horizontal scroll bar at the bottom, below the x-axis, that can be used to drag the row of Line charts to the left and the right, so as to make the other Line charts visible.

## Pie Charts as Multiples

If you want to explore / visualize more than one category in Multiples, Pie charts is an option. Suppose you want to explore the medal count by medal type for each of the countries. Proceed as follows –

- Click the Design tab.
- Select Pie from the dropdown under Other Chart.
- Drag Medal to the area SLICES.

You will get the Horizontal Multiples visualization with Pie charts, as you have the field NOC\_CountryRegion in the area HORIZONTAL MULTIPLES.

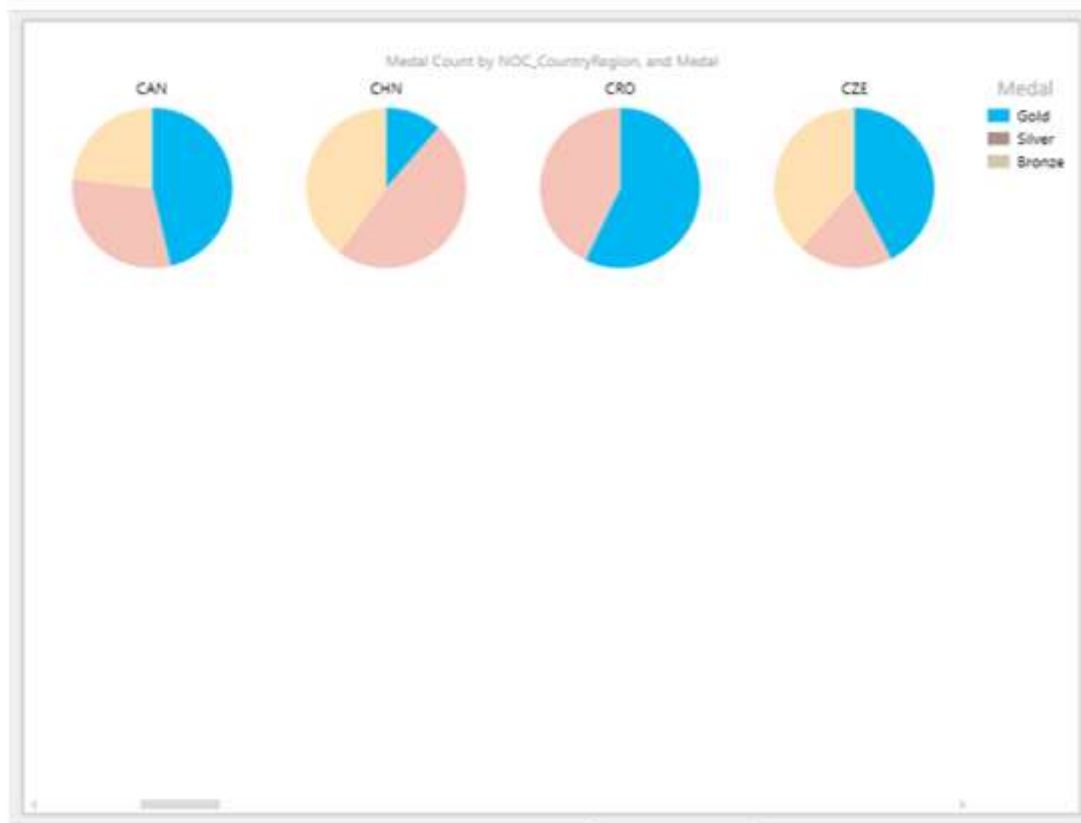


As you can observe the medal-count for each country is displayed as a Pie chart with the slices representing the medal types with the color as given in the Legend.

Suppose you want to highlight the count of gold medals for all the countries. You can do it in a single step as follows –

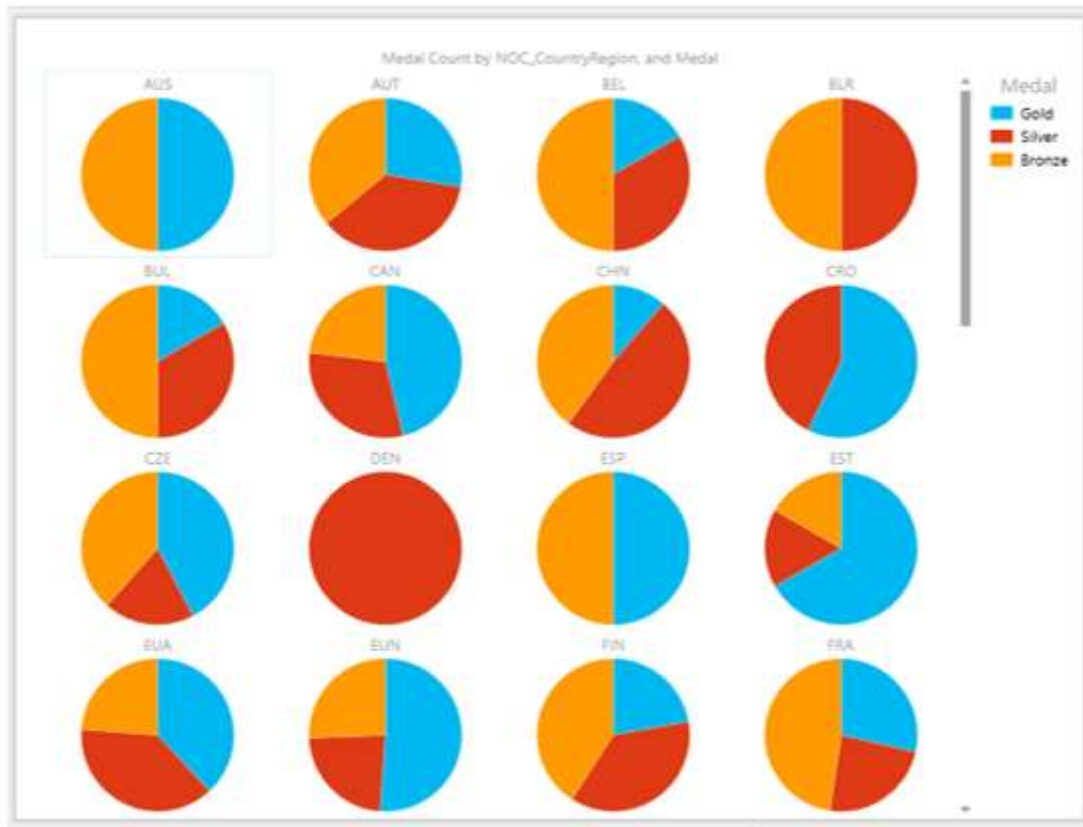
Click on the blue color slice one of the Pie charts (as blue is color for Gold as per the Legend). In all the Pie charts, only the blue slices are highlighted and other slices are grayed.





As you can observe, this gives a fast way of exploring and comparing the count of gold medals across the countries.

You might want to display more number of Pie charts in a visualization. You can do it by simply switching over to Vertical Multiples Visualization and choosing the right values for Grid Height and Grid Width for a proper display.



Click on the blue slice on one of the Pie charts. The blue slices in all the Pie charts are highlighted so that you can compare the gold medal counts across the countries.

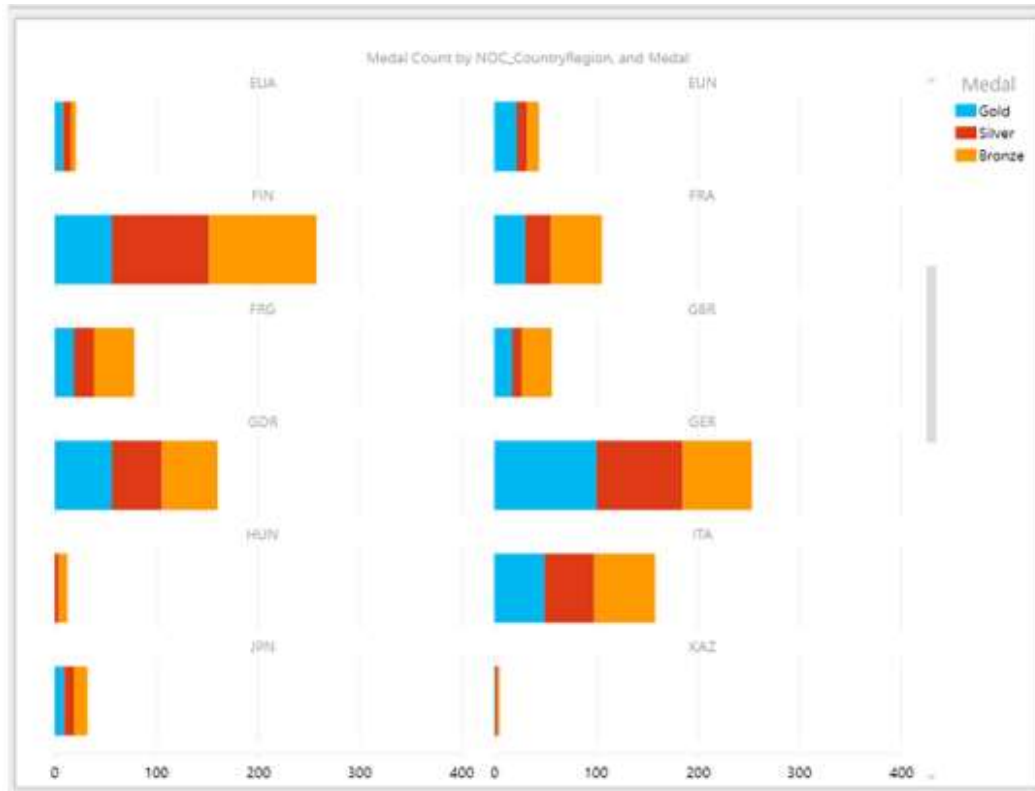


## Bar Charts as Multiples

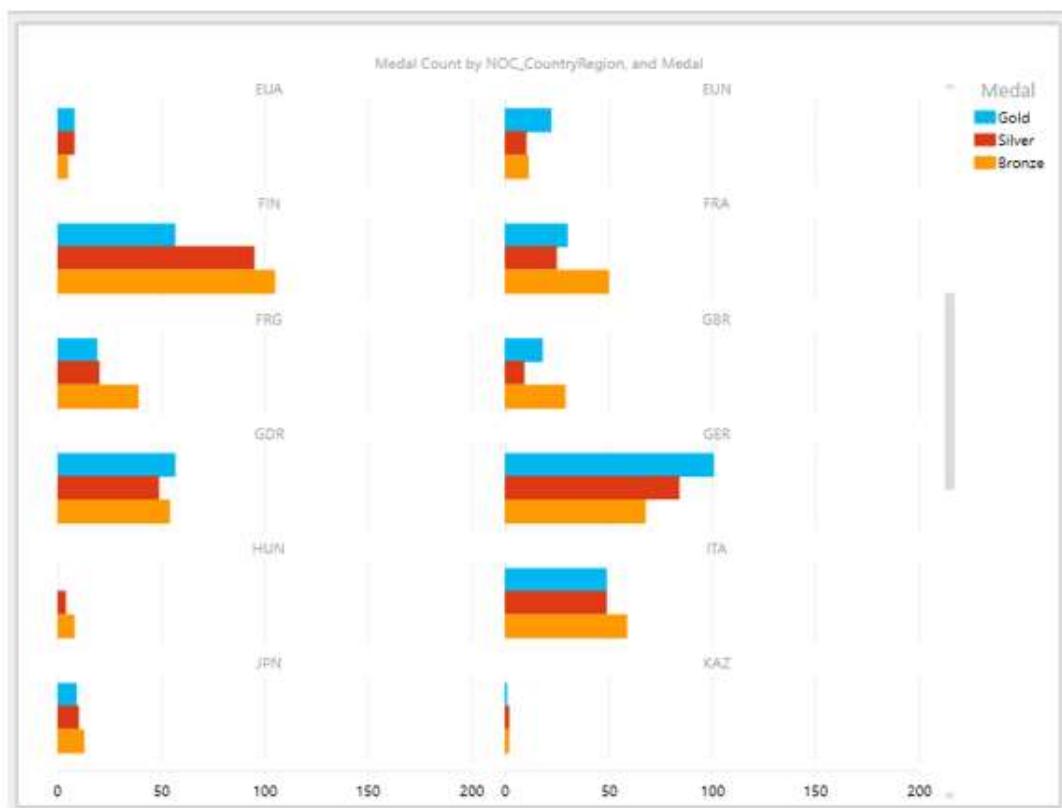
You can choose Bar charts also for Multiples visualization.

- Switch over to Stacked Bar visualization.
- Adjust the Grid Height and Grid Width to get a proper display of the Bar charts.

With Grid Height of 6 and Grid Width of 2, you will get the following –



You can have Clustered Bar charts also for this visualization.

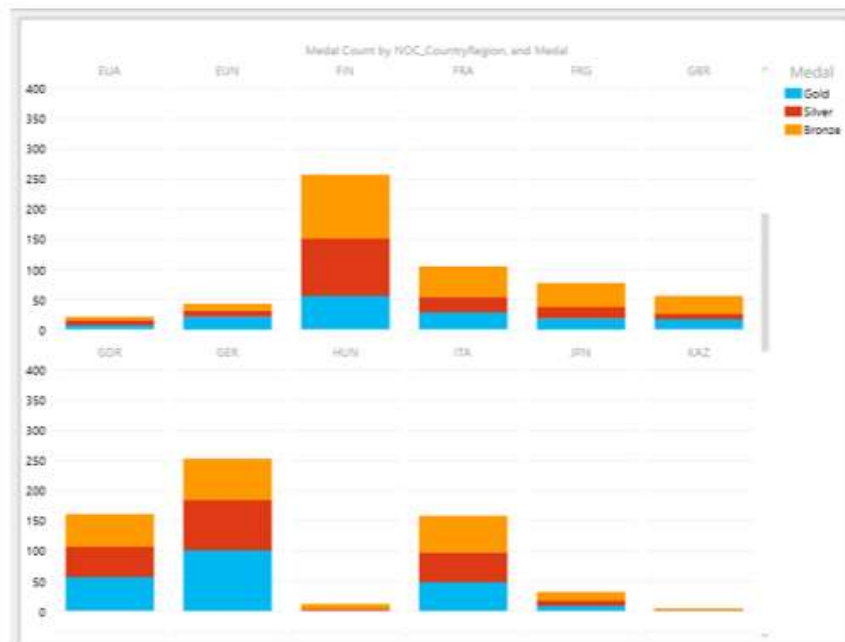


## Column Charts as Multiples

You can choose Column charts also for Multiples visualization.

- Switch over to Stacked Column visualization.
- Adjust the Grid Height and Grid Width to get a proper display of the Column charts.

With Grid Height of 2 and Grid Width of 6, you will get the following –



You can have Clustered Column charts also for this visualization.



## Wrap-up

The fields you choose depend on what you want to explore, analyze and present. For example, in all the visualizations above, we have chosen Medal for Slices that helped to analyze medal count by medal type. You might want to explore, analyze and present the data gender-wise. In such a case, choose the field Gender for Slices.

Once again, the visualization that is suitable also depends on the data you are displaying. If you are not sure about the suitability, you can just play around to choose the right one as switching across the visualizations is quick and simple in Power View. Moreover, you can also do it in the presentation view, in order to answer any queries that can arise during a presentation.



# 37. Exploring Data with Power View Tiles

Suppose you have lot of data to display with significant data points at varied places. In such a case, you might have to scroll very often in your Power View visualizations to find the data you are looking for. This would be tedious and also might not be smooth when you are presenting the results.

You can overcome this drudgery, using the tile feature in Power View. With tiles, you can gain insights from your data much more quickly. Tiles act as navigation strips, with a single tile for each possible field value. When you click on a tile, only data related to that field value is displayed. As it is easy to scroll the values in the navigation strip that dynamically changes the corresponding values in the visualization, tiles become an easy to use tool for you.

You can have Tiles in a Table, Matrix, Card or Chart visualization. You can have a combination of these in Power View and get them filtered with Tiles. A Tile can be simple text or an image.

## Table with Tiles

Start with a Table Visualization as follows –

- Drag the fields NOC\_CountryRegion, Sport and Medal Count to Power View. As you observe, as the number of rows is large, it is difficult to scroll up and down to highlight values.
- Drag the field Sport from FIELDS area to TILE BY area in the Power View Fields list.

Navigation Strip appears at the top of the Table.

The screenshot displays a Power View interface with a table titled "Medal Count by Country and Sport". The table shows medal counts for various countries under the "Aquatics" category. A navigation strip at the top of the table allows switching between "Aquatics", "Archery", and "Athletics". The "Power View Fields" pane on the right shows the "Sport" field in the "TILE BY" section and "NOC\_CountryRegion" and "Medal Count" in the "FIELDS" section.

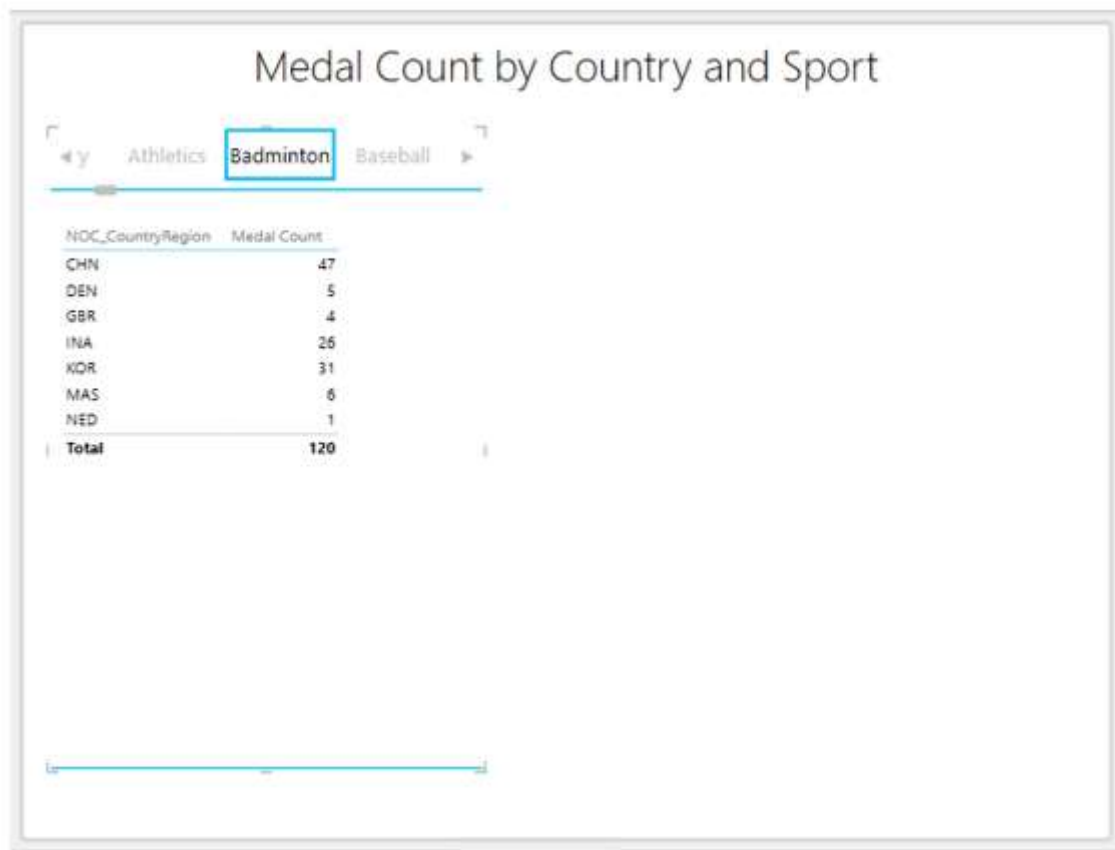
NOC_CountryRegion	Medal Count
ANZ	11
ARG	3
AUS	364
AUT	13
BEL	53
BRA	17
BUL	3
CAN	112
CHN	118
CRC	4
CRO	14
CUB	2
DEN	17
EGY	2
ESP	41
EUA	31
EUN	45
FIN	4
FRA	80

You can observe the following –

- By default, the first Tile in the Navigation Strip is selected.
- In the Table, the values are filtered to that of the Tile selected. In this case, the Sport that is selected.
- There are arrow buttons at the left and right edges of the Navigation strip to enable scrolling.

You can select a different Tile as follows –

- Scroll the Navigation Strip to display the Tile representing the Sport you are looking for, for e.g. Badminton.
- Click the Tile – Badminton. The values in the Table are filtered to those of Badminton.



Medal Count by Country and Sport

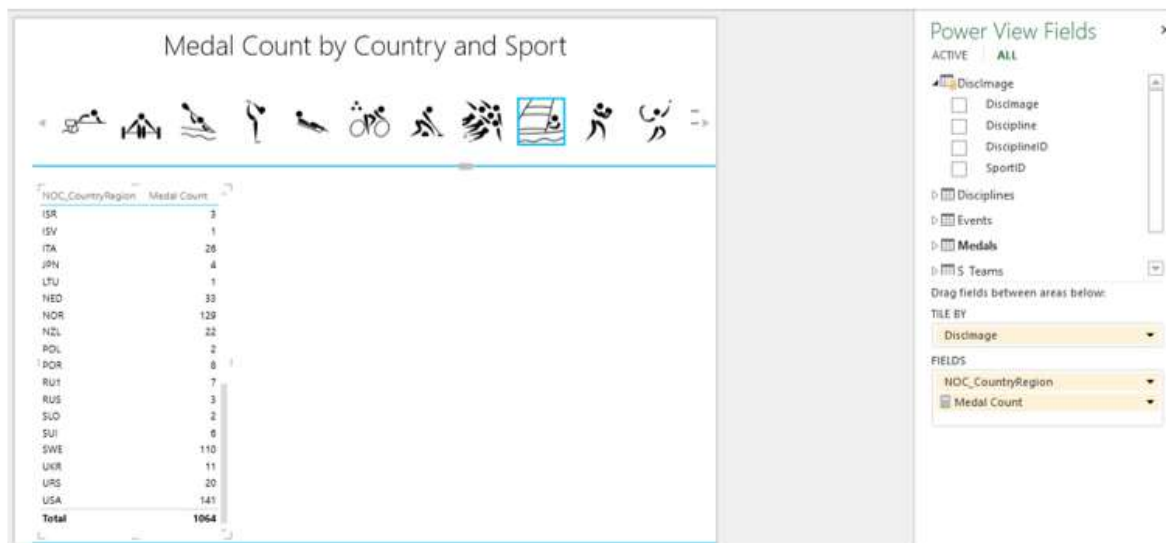
Navigation Strip: Athletics, **Badminton**, Baseball

NOC_CountryRegion	Medal Count
CHN	47
DEN	5
GBR	4
INA	26
KOR	31
MAS	6
NED	1
<b>Total</b>	<b>120</b>

You can observe the medal count Total is also displayed. You have an option to turn Totals on or off from the Ribbon. You also can make the Tiles more appealing and meaningful by having images in place of Text.

- Include a column that has hyperlinks to the image files corresponding to each of the Sports.

- Include that field, for e.g. Discimage in TILE BY. You will get the Tiles as images, portraying each sport.



## Tile Navigation Strip - Tab Strip

There are two types of navigation strips in Excel - Tile Flow and Tab Strip.

In a Tab strip, you can observe the following –

- Tab strip displays the navigation strip across the top of the Visualization.
- By default, the first Tile in the navigation strip that is the leftmost is selected.
- There are arrow buttons at the left and right edges of the navigation strip to enable scrolling.
- You can scroll to the left or right to display the Tiles.
- The highlighted Tile moves to the left or right as you scroll the tab strip. It can also go out of view, while scrolling.
- You can click on a Tile to select it. The Tile gets highlighted at the same position as it was before.
- In the Table, the values are filtered to that of the Tile selected. In this case, the Sport that is selected.

## Tile Navigation Strip - Tile Flow

You can convert the navigation strip from tab strip to tile flow as follows-

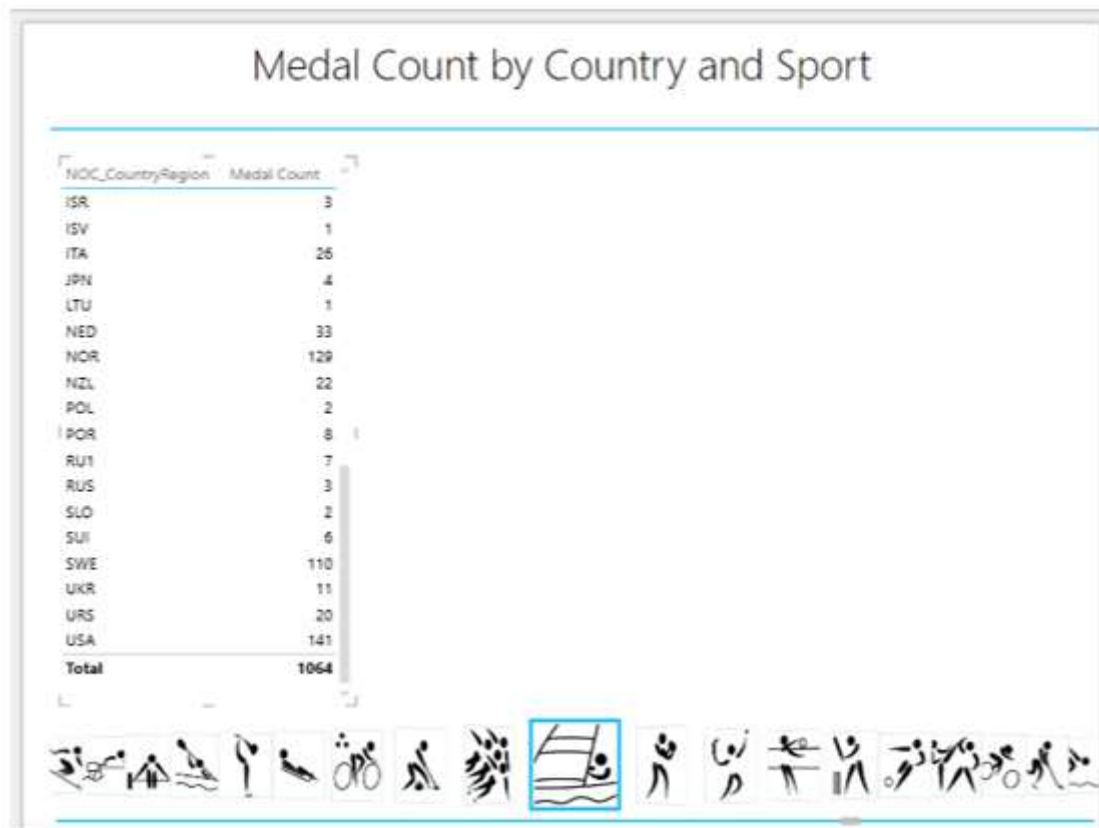
- Click a Tile on the navigation strip.
- Click the DESIGN tab on the Ribbon.

- Click Tile Type in the Tiles group.
- Click Tile Flow in the dropdown list.

The screenshot shows the Excel 2016 interface with the 'DESIGN' tab selected in the Power Pivot task pane. The 'Tile Type' dropdown is open, and 'Tile Flow' is selected. The main area displays a table titled 'medal Count by Country and Sport' with a navigation strip at the bottom.

NOC_CountryRegion	Medal Count
ISR	3
ISV	1
ITA	28
JPN	4
LTU	1
NED	33
NOR	129
NZL	22
POL	2
POR	8
RUS	7
RUS	3
SLO	2
SUI	6
SWE	110
UKR	11
URS	20
USA	141
<b>Total</b>	<b>1064</b>

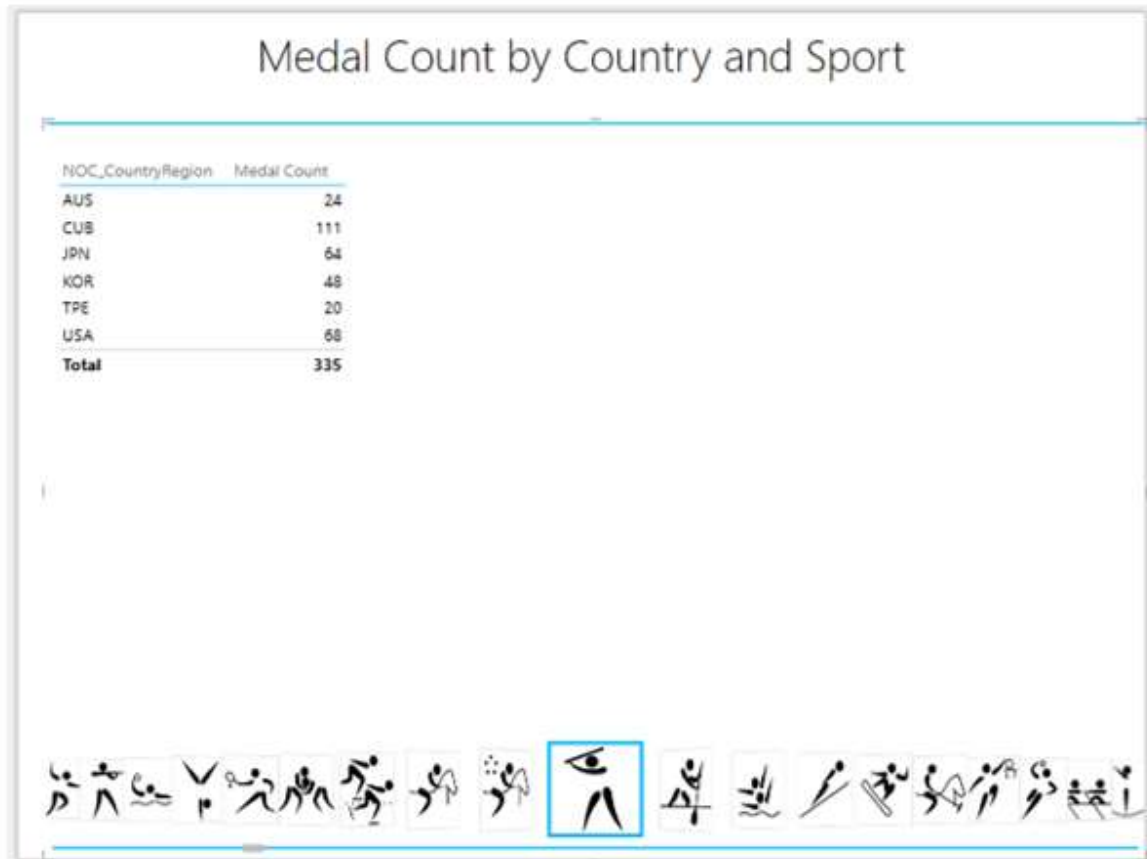
The navigation strip shifts to the bottom of the Table.



In a Tile Flow, you can observe the following –

- Tile flow displays the navigation strip across the bottom of the Visualization.
- By default, the first Tile in the navigation strip is selected. It will be displayed at the center of the tile flow.
- There are no arrow buttons for scrolling.
- You can scroll to the left or right by clicking on any of the Tiles to the left or right of the center Tile.
- The Tiles flow to the left or right and the center Tile will always get highlighted.
- You can click on a Tile to select it. The Tile gets highlighted and moves to the center of the Tile flow.
- As the selected Tile is always the center Tile, the following happens –
  - Selected Tile does not go out of view.
  - When you scroll to the left or right, the Tile that comes to the center position gets automatically selected and highlighted.
  - The original selection disappears.

- The Visualization, Table in this case, automatically is updated to the Tile in the center of the Tile flow.
- In the Table, the values are filtered to that of the Tile selected. In this case, the Sport that is selected.



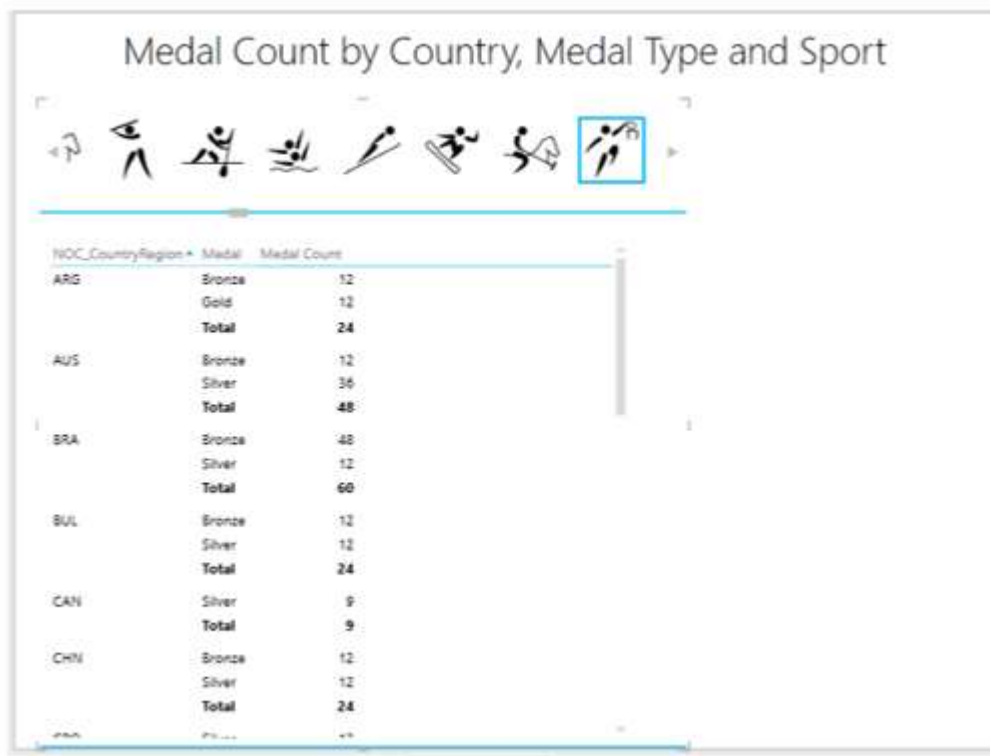
## Matrix with Tiles

Suppose you want the medal count by medal type – Gold, Silver and Bronze and also the total medal count, by country for a selected sport, you can display the results in a Matrix Tile visualization.

- Switch Visualization to Matrix.
- Add the field Medal to Matrix.

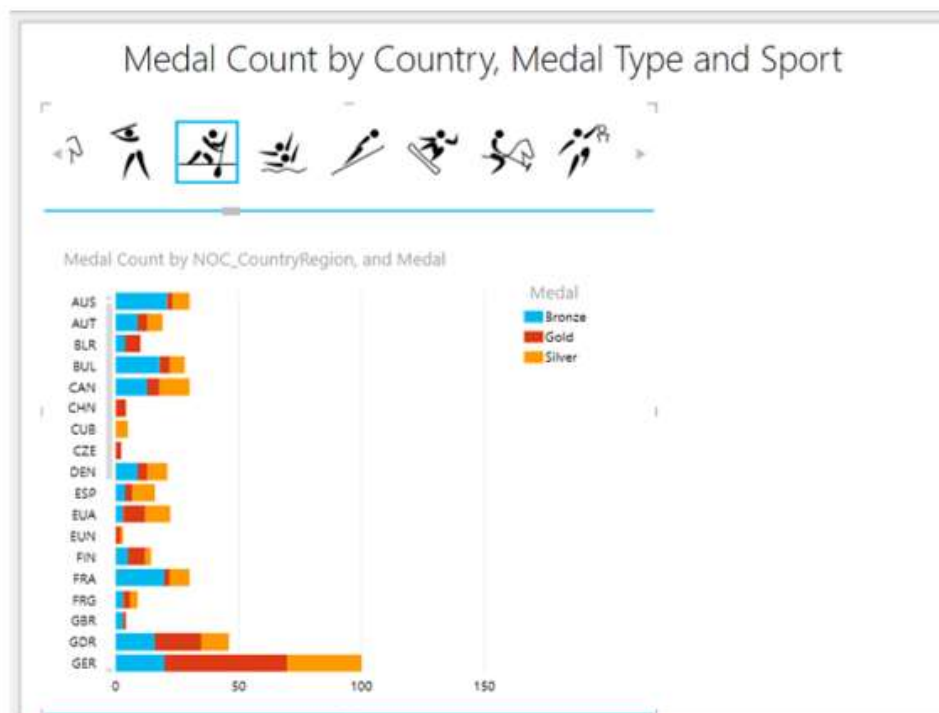
You will get the desired results as follows –





## Stacked Bar Chart with Tiles

You can make your explored results more conspicuous by switching your visualization to Stacked Bar Chart Tile Visualization –



## Maps with Tiles

As your data contains geographic locations, you can also switch over to Map Tile Visualization-



## 38. Exploring Data with Hierarchies

If your data more number of levels, it would be easy for you to explore and present it with Hierarchies. For any data value in your Hierarchy, you can drill down to display more details or drill up to have a holistic view.

If your data model has a hierarchy, you can use it in Power View. Otherwise, you can create a hierarchy in the Power View itself with few easy steps.

### **Creating a Hierarchy in Power View**

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In Power View a Hierarchy is best depicted in Matrix visualization. Create a Hierarchy in Matrix visualization as follows –

- Drag the fields NOC\_CountryRegion, Sport, Discipline, Year and Medal – in that order to ROWS area.
- Drag the field Medal Count to  $\Sigma$  VALUES. The order of the fields in the ROWS area defines the Hierarchy in Power View.
- If you are not sure about the order of fields, start with any order and then rearrange them in the ROWS area by dragging them up and down, while looking at the display in the Power View.

You will get the following Matrix visualization showing the five Hierarchy levels –

	NOC_CountryRegion	Sport	Discipline	Year	Medal	Medal Count
Level 1	AUS	Aquatics	Swimming	Level 5	1984 Gold	1
					Silver	8
					1988 Bronze	1
					Gold	1
					Silver	1
Level 2	AUS	Aquatics	Swimming	Level 4	1992 Bronze	5
					Gold	1
					Silver	3
					1996 Bronze	14
					Gold	2
Level 3	AUS	Aquatics	Swimming	Level 3	Silver	9
					2000 Bronze	4
					Gold	15
					Silver	27
					2004 Bronze	3
Level 4	AUS	Aquatics	Swimming	Level 4	Gold	17
					Silver	11
					2008 Bronze	22
					Gold	19
					Silver	13
Level 5	AUS	Aquatics	Swimming	Level 5	2000 Gold	13
					2008 Bronze	13
					2000 Gold	1
					2004 Bronze	1
					1900 Bronze	3
Level 6	AUS	Aquatics	Swimming	Level 6	1920 Silver	1
					1924 Gold	1
					1936 Bronze	1
					1948 Bronze	2
Level 7	AUS	Archery	Archery	Level 7		
Level 8	AUS	Athletics	Athletics	Level 8		

As you observe, the levels are nested.

## Drilling Up and Drilling Down the Hierarchy

You can drill up and drill down the hierarchy such that you can show just one level at a time. You can drill down for details and drill up for summary.

To enable drill up and drill down, first set up show levels option as follows –

- Click the DESIGN tab on the Ribbon.
- Click Show Levels in the Options group.
- Select Rows – Enable Drill Down One Level at a Time from the drop-down list.

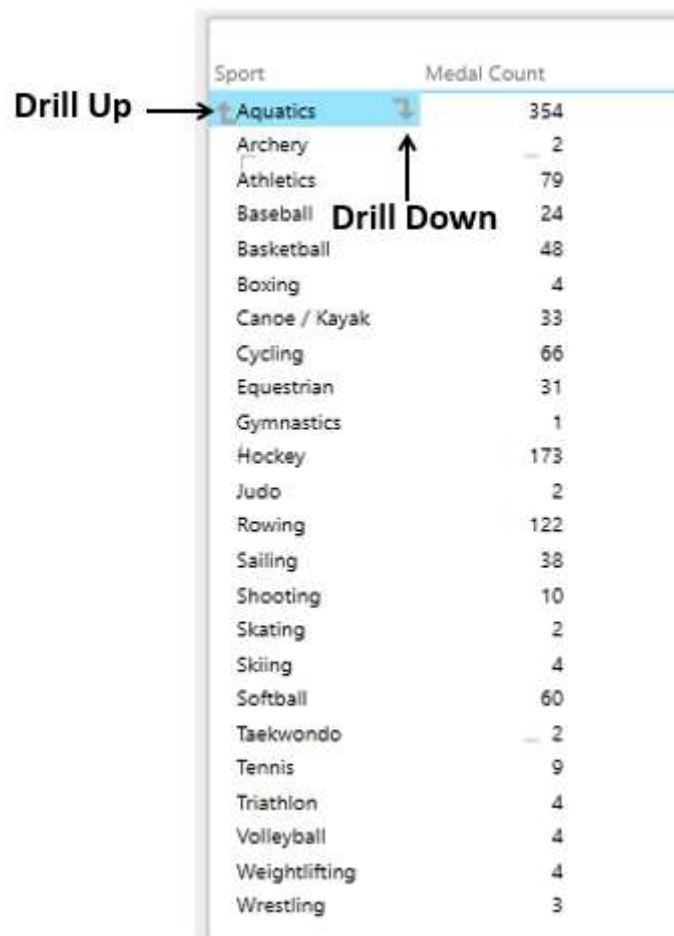
The Matrix collapses to display only Level 1 data.

NOC_CountryRegion	Medal Count
AFG	1
AHO	1
ALG	14
ANZ	29
ARG	239
ARM	9
AUS	1079
AUT	344
AZE	16
BAH	23
BAR	1
BDI	1
BEL	420
BER	1
BLR	98
BOH	7
BRA	372
BUL	336
BWL	5
CAN	827
CHI	33
CHN	714

As you observe, when you click on each of the data items, a downward arrow appears on the right side for that item indicating drill down.

Now, you can drill down the data one level at a time as follows -

- Click Level 1 data item for which you want further details. For example, click AUS. As you observe, Medal Count for AUS is 1079.
- Click on the arrow to the right side of it. Alternatively, you can double click on the data item.
- Level 2 data pertaining to AUS will be displayed.



Sport	Medal Count
Aquatics	354
Archery	2
Athletics	79
Baseball	24
Basketball	48
Boxing	4
Canoe / Kayak	33
Cycling	66
Equestrian	31
Gymnastics	1
Hockey	173
Judo	2
Rowing	122
Sailing	38
Shooting	10
Skating	2
Skiing	4
Softball	60
Taekwondo	2
Tennis	9
Triathlon	4
Volleyball	4
Weightlifting	4
Wrestling	3

As you observe, an upward arrow appears on the left side of the first item, indicating drill up and when you click on each of the data items, a downward arrow appears on the right side for that item indicating drill down.

Now, you can drill down the data one more level as follows -

- Click Level 2 data item for which you want further details. For example, click Aquatics. As you observe, the medal count for Aquatics is 354.
- Click on the arrow to the right side of it.
- Level 3 data pertaining to Aquatics will be displayed.



Discipline	Medal Count
Diving	17
Swimming	311
Water polo	26

As you observe, an upward arrow appears on the left side of the first item, indicating drill up and when you click on each of the data items, a downward arrow appears on the right side for that item indicating drill down.

Now, you can drill down the data one more level as follows -

- Click Level 3 data item for which you want further details. For e.g. click on Diving. As you observe, the medal count for Diving is 17.
- Click on the arrow to the right side of it.
- Level 4 data pertaining to Diving will be displayed.

Year	Medal Count
1924	1
2000	4
2004	9
2008	3

As you observe, an upward arrow appears on the left side of the first item, indicating drill up and when you click on each of the data items, a downward arrow appears on the right side for that item indicating drill down.

Now, you can drill down the data one more level as follows -

- Click on the Level 4 data item for which you want further details. For example, click on 2008. As you observe, the medal count for 2008 is 3.
- Click on the arrow to the right side of it.
- Level 5 data pertaining to 2008 will be displayed.



Medal	Medal Count
Gold	1
Silver	2

As you observe, for the first Level 5 data item an upward arrow appears on the left side indicating drill up. Drill down arrows do not appear on the right side for the data items as there are further levels to drill down.

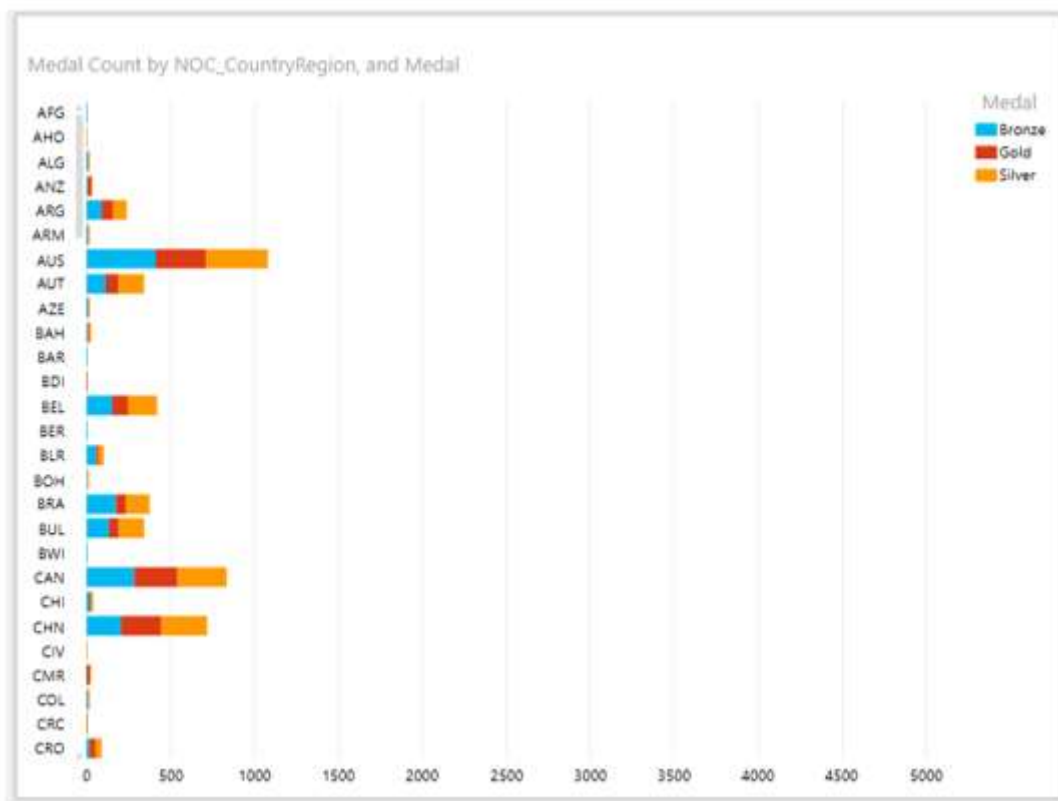
Now, you can drill up the data one level at a time by clicking on the upward arrow to the left side of the first item at each Level.

## Exploring a Hierarchy in Stacked Bar Chart

You might want to highlight certain values in a hierarchy in a significant way. In such a case, you can use a chart visualization, such as Stacked Bar chart as follows –

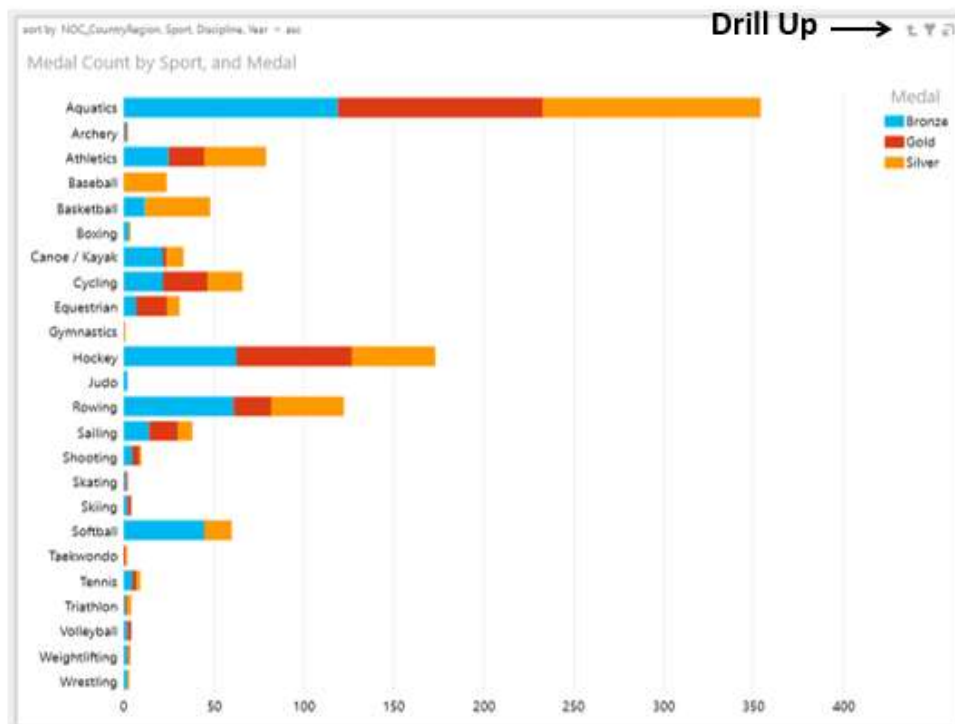
- Click the Matrix visualization and switch to Stacked Bar Chart.
- Drag the field Medal to LEGEND area.

You will get the Stacked Bar chart visualization as follows –



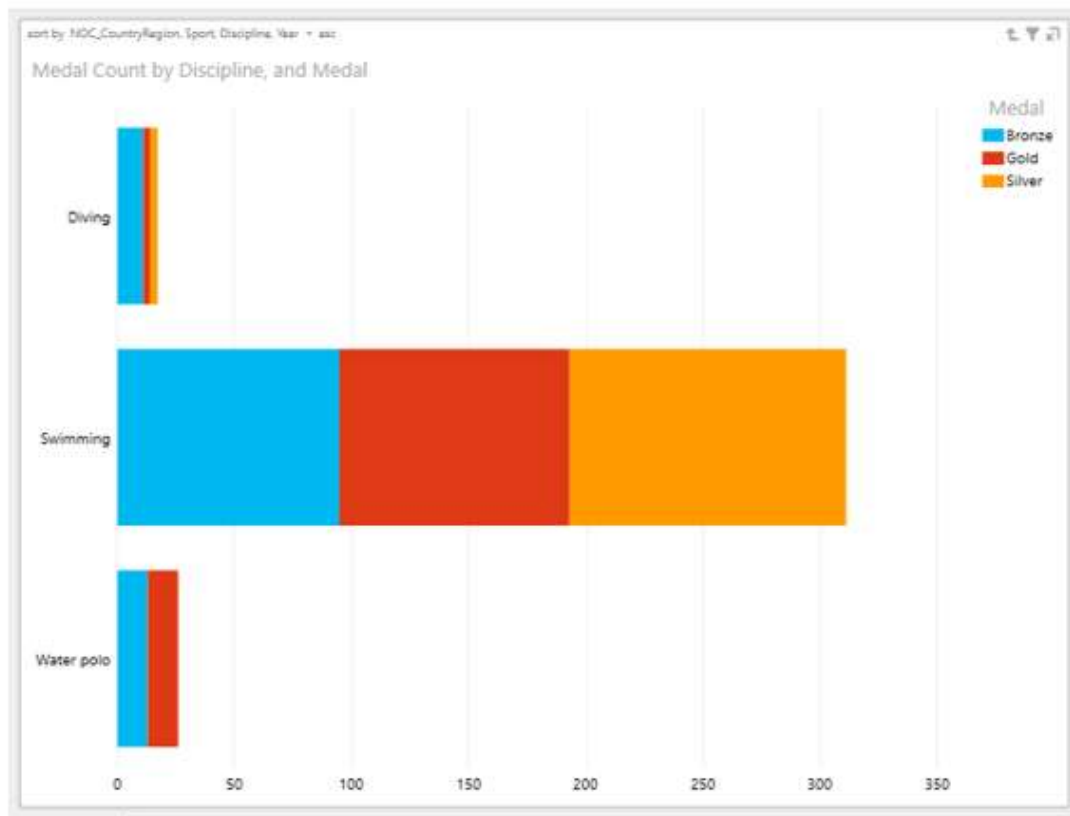
In this case, you need to double-click on a Bar to drill down.

Double-click on Bar representing AUS. The chart is drilled down to display the next level of data in the hierarchy.



As you can observe, an upward arrow indicating drill up appears at the top-right corner of the chart.

Drill down one more level by double-clicking on Aquatics Bar. The chart is drilled down to display the next level of data in the hierarchy.



You can drill down by double-clicking on a Bar or drill up by clicking on the drill up arrow on the top-right corner of the chart.

This gives you an interactive exploration of data during presentation also.

## 39. Aesthetic Power View Reports

You have learnt how to explore data interactively using Power View in the earlier chapters of this tutorial. Each Power View sheet can in turn be used as an interactive report. To make the Power View report more appealing, you can choose any of the themes, chart palettes, fonts and background colors that Power View provides you.

When you change the theme, the new theme applies to all the Power View visualizations in the report. Further, you can add background images, choose background formatting, format numbers, and change the Font or the text size.

### Report Layout Finalization

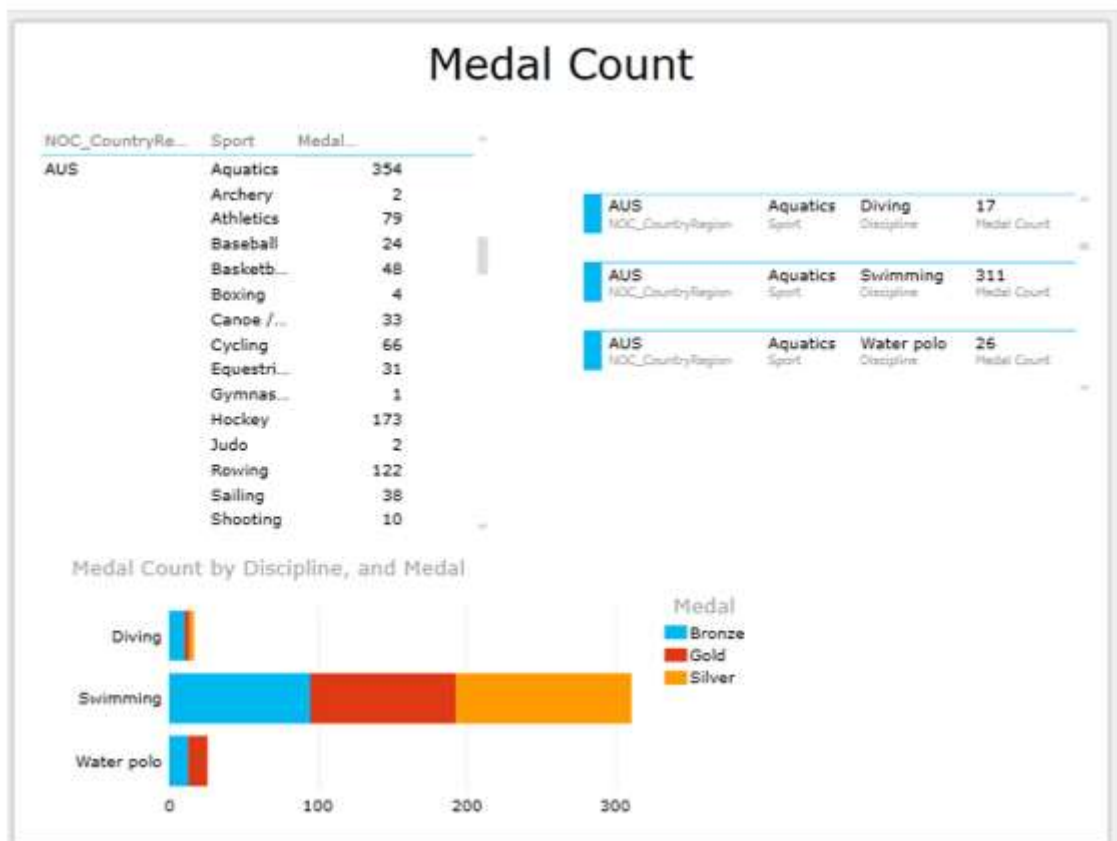
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As with any other report, you need to first decide on what you are going to report and the best layout so that you can highlight the significant data points.

Suppose you need to report the details of the medals won by Australia in aquatics. As you are aware, the details include the disciplines in aquatics, medal count, and the medal types (Gold, Silver and Bronze).

You can have three views in the report for the best portrayal of the data points in this case-

- Matrix that contains the data - country, sport, and medal count.
- Card that contains the data – country, sport, discipline and medal Count.
- Stacked Bar chart that contains the data that is drilled down to discipline, medal and medal count.



As you can observe, the data in the Matrix and Card is scrolled so that –

- Matrix displays the details of Australia for all sports and aquatics got 354 medals.
- Card displays Australia – sport aquatics, disciplines Diving, Swimming and Water polo and medal count in each of them.
- Stacked Bar chart displays the medal count by medal type in these three disciplines.

Now that the report layout is ready, you can start making it appealing. However, you need to keep two points in mind during this task –

- The look of the report should be based on the audience (Managers / Top Management / Clients).
- Do not get over bored with the different formatting options. Just keep it simple and highlight the data points that require attention.

In the following sections, you will understand how to arrive at a sample report with the following options –

- Selecting the Background.
- Selecting the Theme.
- Changing the Font.
- Changing the Text Size.

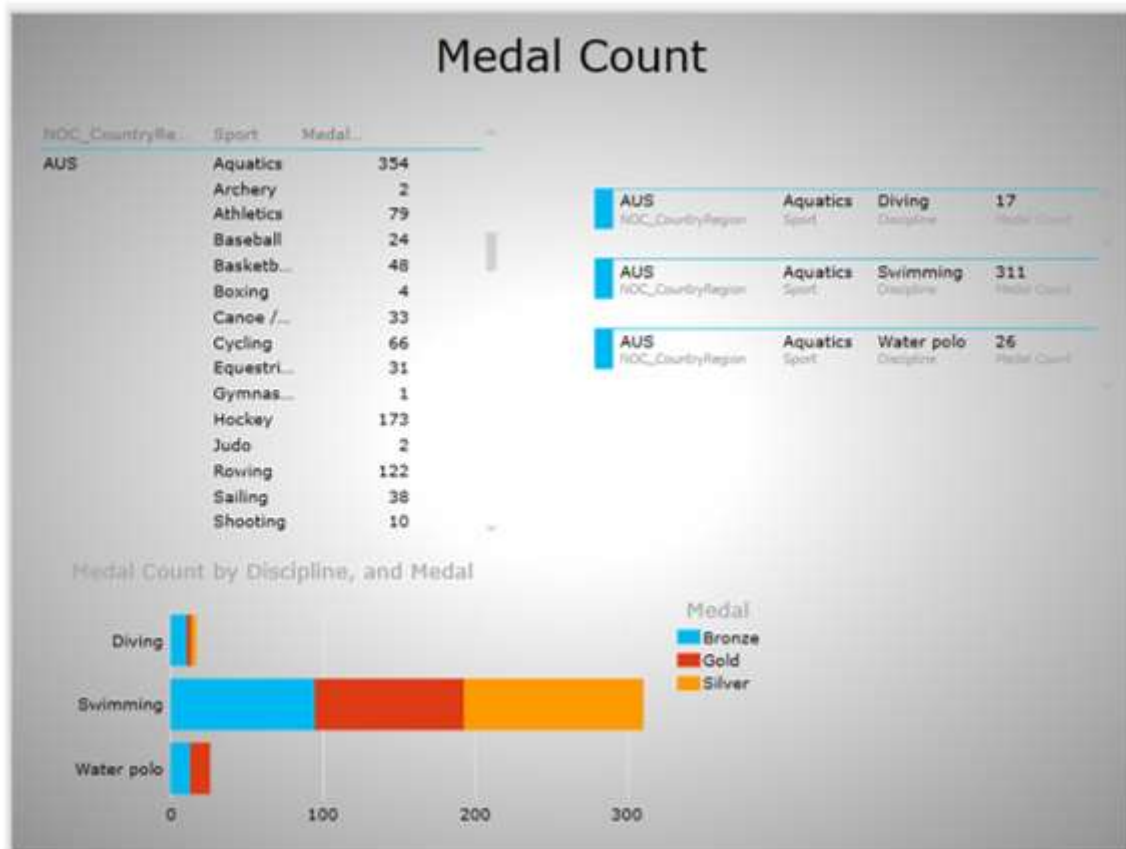


## Selecting the Background

You can have a background color for your Power View Report. By default, it is white. You can change it with the Background command.

- Click the POWER VIEW tab on the Ribbon.
- Click Background in the Themes group.
- Click Light1 Center Gradient. (You can choose the one that best suits your report).

The background color changes to the selected one.



You can even set a background image. For e.g. you can put your company logo or a view of your company facility.

## Selecting the Theme

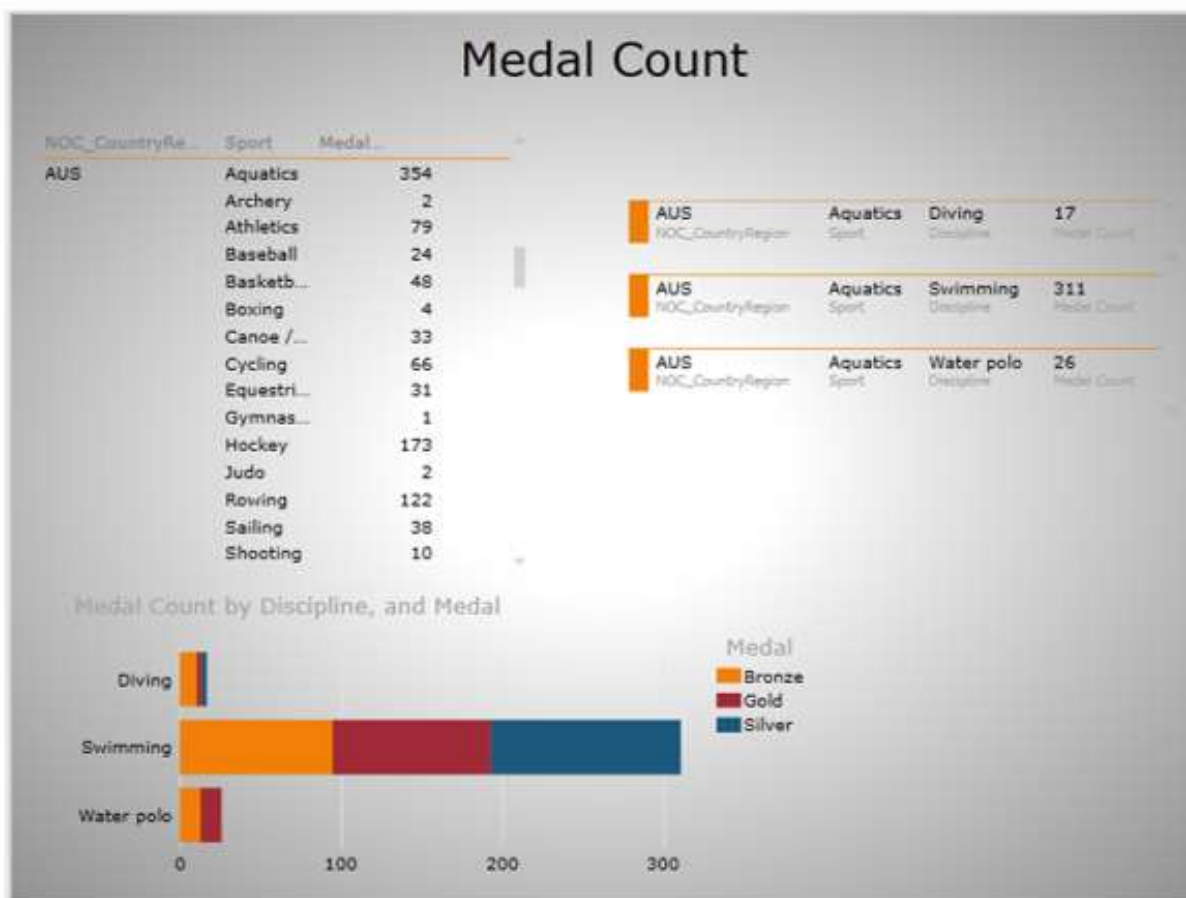
Power View supports several themes. Choose the one that suits your report as follows –

- Click on the POWER VIEW tab on the Ribbon.
- Click on Themes in the Themes group.

You will get many options to choose from. If you are not sure about the appropriate one, just play around with some to find how the display looks.

- Click on the theme Aspect.

Your report will be displayed in the selected theme.



## Changing the Font

As you can observe, the text in the report is not conspicuous. You can change the font as follows –

- Click on the POWER VIEW tab on the Ribbon.
- Click on Font in the Themes group.
- Click on Verdana in the dropdown list of fonts. (You can choose the one that best suits your report).

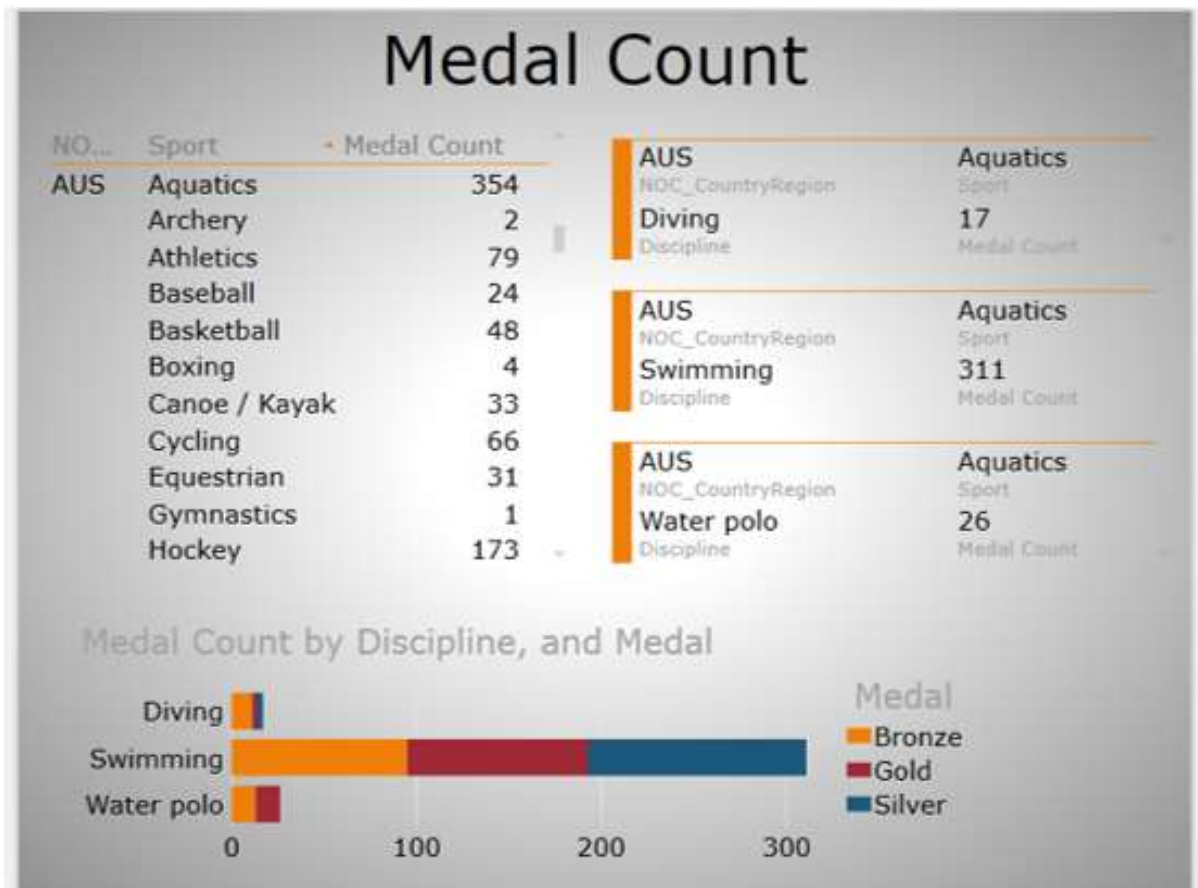
Next, you have to make the text display a bit larger.

## Changing the Text Size

Change the text size as follows –

- Click on the POWER VIEW tab on the Ribbon.
- Click on Text Size in the Themes group.

- Click on 150% in the dropdown list. (You can choose the one that best suits your report).
- Adjust the widths of the columns in Matrix.
- Adjust the size of each view in the report.



Your sample report is ready.

# 40. Key Performance Indicators

Key Performance Indicators (KPI) are a set of quantifiable measures that an organization uses to measure its performance over time. KPIs are normally used to evaluate the success of an organization as a whole or department-wise (e.g. sales, finance, etc.). You need to define the KPIs based on the organization objectives and monitor them from time to time to track the progress.

There are a number of KPI types to choose from based on your requirements. Examples include:

- Income and Expenses
- Rate of Return
- Average Purchase Value
- Customer Lifetime Value
- Working Capital

Note that KPIs are a form of communication involving the following activities –

- Identifying the KPIs based on the organization's objectives.
- Monitoring and reporting the KPIs.
- Altering the KPIs as the organization progresses and / or the organization's goals change.

## Identifying the KPIs

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The first and the most crucial step in KPI analysis is to identify the KPIs that effectively monitor the required trends in the organization. This requires complete understanding of the objectives and requires proper communication channels between the analysts and those who are responsible for fulfilling the objectives.

There are a number of KPIs to choose from, but the success in monitoring relies on the right choice of those that are relevant to the objectives. The KPIs differ from organization to organization and from department to department and will be effective only when they lead to improvement in the performance.

You can evaluate the relevance of a KPI using the SMART criteria – i.e. the KPI should be **S**pecific, **M**easurable, **A**ttainable, **R**elevant and **T**ime-bound. In other words, the KPI chosen should meet the following criteria -

- The KPI reflects your **S**pecific objective.
- The KPI enables you to **M**easure progress towards that goal.
- The goal for which the KPI is being defined is realistically **A**ttainable.
- The goal that the KPI is targeting is **R**elevant to the organization.

- You can set a time-frame for achieving the goal so that the KPI reveals how near the goal is as compared to the time that is left.

The defined KPIs are to be evaluated from time to time to find their relevance as the time progresses. If required, different KPIs need to be defined and monitored. Only then, your KPI monitoring will be relating to the current organization needs.

Based on the analysis needs, you have to choose the relevant KPIs, and examples include the following –

- Sales department might use a KPI to measure monthly gross profit against projected gross profit.
- Accounting department might measure monthly expenditures against revenue to evaluate costs.
- Human resources department might measure quarterly employee turnover.
- Business professionals frequently use KPIs that are grouped together in a business scorecard to obtain a quick and accurate historical summary of business success or to identify trends or to identify performance improvement opportunities.

The examples used in this chapter are indicative so as to help you in understanding how you can define and monitor KPIs in Excel. The sole discretion of identifying the KPIs lies with you based on the objectives so as to reflect the current scenario as compared to the targets.

## KPIs in Excel

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- You can analyze performance against the set target with PowerPivot. For e.g., a PowerPivot KPI could be used to determine for each year and salesperson how his actual sales compared to his sales target.
- You can explore and visualize the same KPI with Power View.
- You can also define new KPIs and /or edit them in Power View.
- You can produce aesthetic reports with KPIs in Power View.

## Defining a KPI in Excel

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The first step in KPI analysis is to define the identified KPI. This requires defining the three parameters for the KPI as follows –

### Base Value

A Base Value is defined by a calculated field that resolves to a value. The calculated field represents the current value for the item in that row of the table. E.g., aggregate of sales, profit for a given period, etc.

## Target Value/ Goal

A Target Value (or Goal) is defined by a calculated field that resolves to a value, or by an absolute value. It is the value against which the current value is evaluated. This could be a fixed number, for example, average number of sick-leave days that is applicable to all the employees, or a calculated field, which results in a different goal for each row, for example, budget of each department in the organization.

## Status

Status is the indicator of the value. It would be striking if you set it as visual indicator. In Power View in Excel, you can edit the KPI, choosing which indicators to use and what values to trigger each indicator.

For example, suppose you want to monitor the Sales targets of the Salespersons in an organization who are selling a product. The objective of the analysis is to identify the best performers who are meeting the target Sales Amount. You can proceed to define the KPI as follows –

- **Base Value** – Current Value of the Sales Amount for each salesperson.
- **Target Value / Goal** – This is fixed for all the salespersons so as to enable comparison between the salespersons. Assume that the Target Sales Amount is 3500. Note that for a different analysis you could vary the target values for the salespersons.
- **Status** – The Status is to be displayed with a graphic to easily determine the status of the Base Value compared to the Target Value.

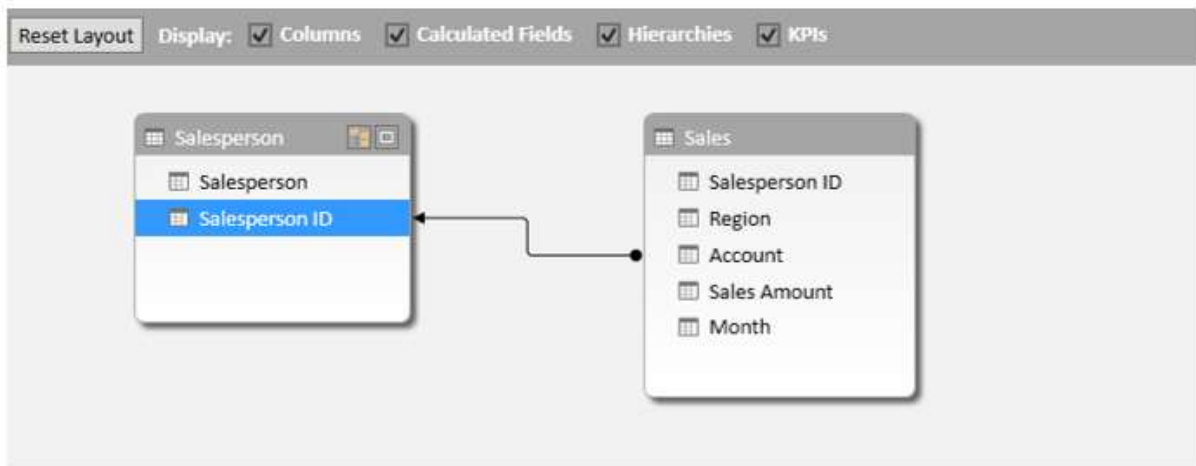
## KPIs in PowerPivot

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You can define KPIs in PowerPivot as follows -

- Start with two tables SalesPerson and Sales.
  - SalesPerson table contains SalesPerson ID and SalesPerson Name.
  - Sales table contains the sales information salesperson-wise and month-wise.
- Add the two tables to Data Model.
- Create a relationship between the two tables using the field SalesPerson ID.





To set the Base Value, you need a calculated field for Sales Amount.

- Add the calculated field in the Sales table for Sales Amount column in the Data Model as follows –

**Total Sales:= sum([Sales Amount])**

The screenshot shows the PowerPivot for Excel - KPI Analysis.xlsx window. The ribbon is set to 'Table Tools' with the 'PivotTable' tab selected. The ribbon includes options like 'From Database', 'From Data Service', 'From Other Sources', 'Existing Connections', 'Refresh', and 'PivotTable'. The data table below has columns: Salesperson ID, Region, Account, Sales Amount, and Month. The 'Sales Amount' column is highlighted, and the formula bar shows the calculated field: `Total Sales:=sum([Sales Amount])`. The table data is as follows:

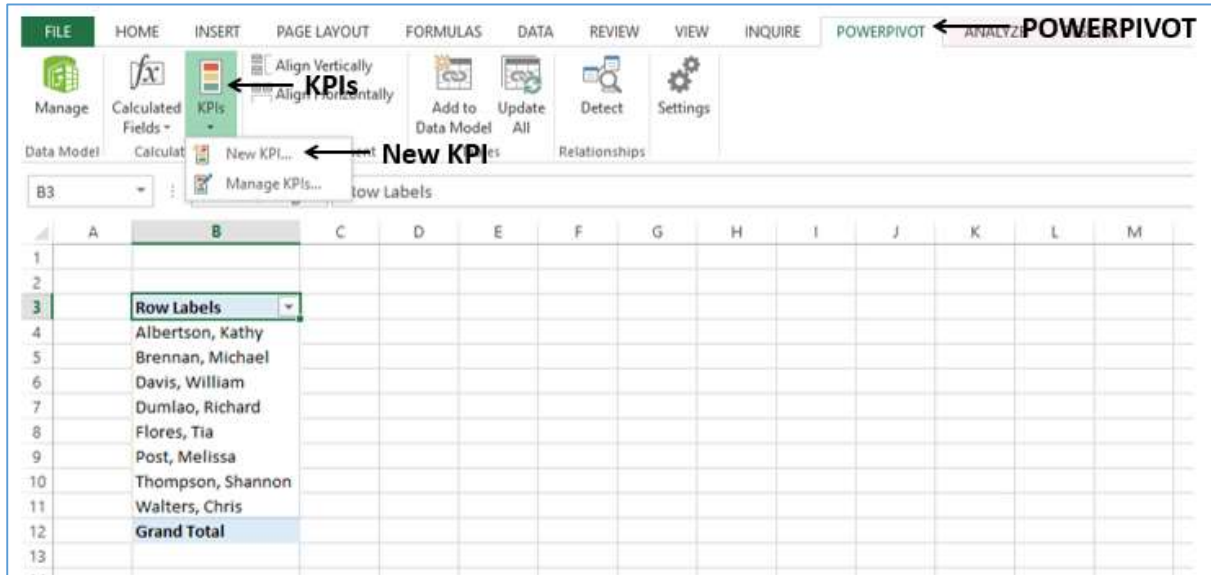
Salesperson ID	Region	Account	Sales Amount	Month
AlKa001	East	29386	925	January
AlKa001	East	74830	875	February
AlKa001	East	90099	500	February
AlKa001	East	74830	350	March
BrMi002	West	82853	400	January
BrMi002	West	72949	850	January
BrMi002	West	90044	1500	January
BrMi002	West	82853	550	February
BrMi002	West	72949	400	March
DaWi003	South	55223	235	February
DaWi003	South	10354	850	January
DaWi003	South	50192	600	March
DaWi003	South	27589	250	January
DuRi004	West	67275	400	January
DuRi004	West	41828	965	February
DuRi004	West	87543	125	March
FiTi005	South	97446	1500	March
FiTi005	South	41400	305	January
Total Sales:			23565	

The calculated field 'Total Sales: 23565' is highlighted with a red box and labeled 'Calculated Field'.

- Click on PivotTable on the Ribbon in the PowerPivot window.
- Select New Worksheet in the Create PivotTable dialog box.

The screenshot shows the Excel ribbon with the 'POWERPIVOT' tab selected. The ribbon includes options like 'Manage', 'Calculated Fields', 'KPIs', 'Align Vertically', 'Align Horizontally', 'Add to Data Model', 'Update All', 'Detect', and 'Settings'. The 'Create PivotTable' dialog box is open, showing the 'New Worksheet' option selected. The location is set to 'Sales!\$D\$8'.

- Add the field Salesperson to ROWS area in the PivotTable.
- Click on the POWERPIVOT tab on the Ribbon.
- Click on KPIs in the Calculations group.
- Click on New KPI in the dropdown list.



Key Performance Indicator (KPI) dialog box appears.

- Select Total Sales in the KPI base field (value) box.
- Under KPI Status, have the following options –
  - Under Define target value, select Absolute value and type 3500 in the box.
  - Under Define status thresholds, adjust the vertical bars representing the percentages to 40 and 80.
  - Under Select icon style, select the first option.

**KPI base field (value)**

**Key Performance Indicator (KPI) Dialog Box**

KPI base field (value): Total Sales

**KPI Status**

Define target value: **Define target value**

☐ Calculated Field: No target fields have been defined

☒ Absolute value: 3500

Define status thresholds: **Define status thresholds**

**Absolute value**


40 80 Target

Select icon style: **Select icon style**

Descriptions

OK Cancel

Click on the OK button. You can observe the following in the Sales table in PivotTable Fields list –

- Total Sales field is a KPI and is depicted by the icon .
- The three KPI parameters – Value, Goal and Status appear as fields under Total Sales KPI.

**PivotTable Fields**

**PivotTable Fields**

ACTIVE ALL

Choose fields to add to report:

VALUES

☐ Sales Amount

☐ Months

☒ Total Sales

☒ Value (Total Sales)

☒ Goal

☒ Status

Drag Fields between areas below:

FILTERS

COLUMNS

VALUES

VALUES

Rows: Salesperson

Values: Total Sales, Total Sales...

Refresh | Refresh All | Show Data

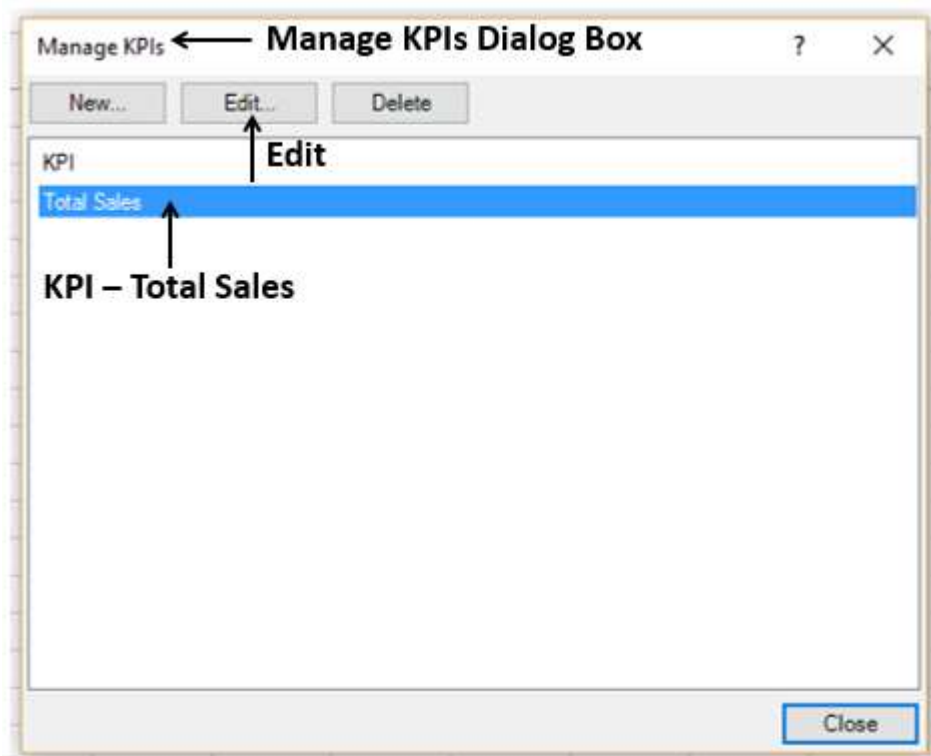
- Select the three KPI parameters – Value, Goal and Status under Total Sales.
- The three columns appear in the PowerPivot, with the Status column displaying the icons as per the corresponding value.

You can also define the KPI thresholds by values instead of percentages. To modify a defined KPI, proceed as follows -

- Click on KPIs in the Calculations group on the Ribbon.
- Click on Manage KPIs in the dropdown list.

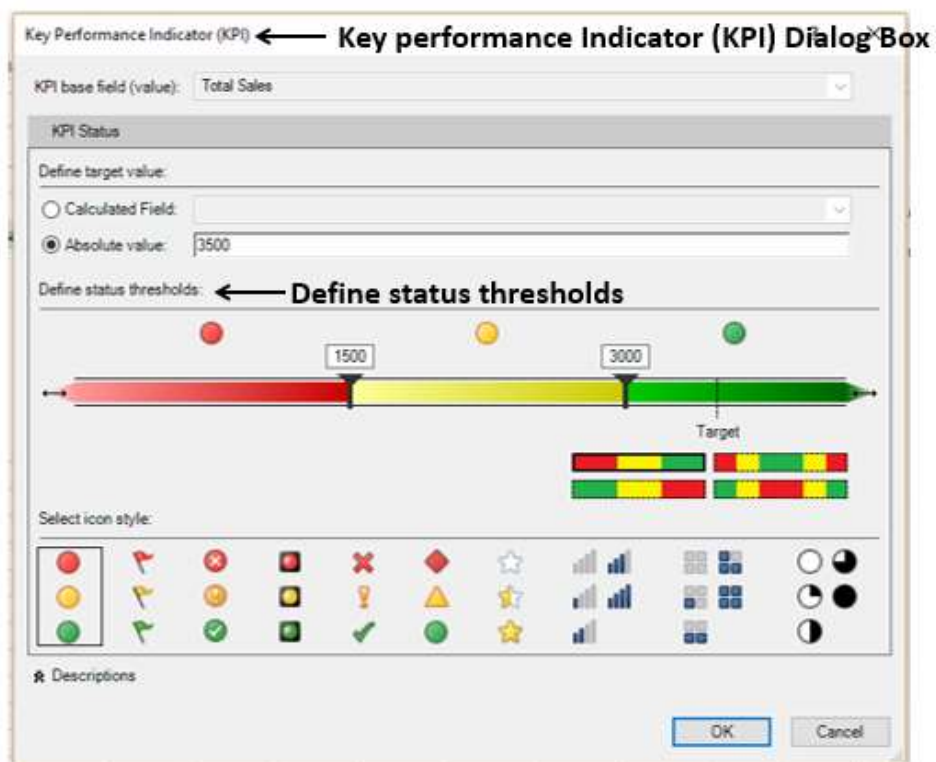
The screenshot displays the Microsoft Excel interface with the 'Manage KPIs' task pane open. The task pane includes options such as 'Align Vertically', 'Add to Data Model', 'Update All', 'Detect', and 'Settings'. The PivotTable in the background shows 'Row Labels' and columns for 'Total Sales', 'Total Sales Goal', and 'Total Sales Status'. The 'PivotTable Fields' task pane on the right shows 'Total Sales' as the value field and 'Salesperson' as the row field.

Manage KPIs dialog box appears.



- Click on the KPI – Total Sales.
- Click on the Edit button.

Key Performance Indicator (KPI) dialog box appears.





- Under Define status thresholds, adjust the vertical bars to 1500 and 3000.
- Retain the rest of the earlier options.
- Click on OK.

	A	B	C	D	E
1					
2					
3		Row Labels	Total Sales	Total Sales Goal	Total Sales Status
4		Albertson, Kathy	2650	3500	●
5		Brennan, Michael	3700	3500	●
6		Davis, William	1935	3500	●
7		Dumlao, Richard	1490	3500	●
8		Flores, Tia	4565	3500	●
9		Post, Melissa	1690	3500	●
10		Thompson, Shannon	3160	3500	●
11		Walters, Chris	4375	3500	●
12					
13					

As you can observe, the status icons reflect the changed thresholds.

## KPIs in Power View

You can create aesthetic reports with KPIs in Power View. You can either use the prior defined KPIs in Data Model or you can add KPIs in Power View.

To add or edit a KPI in Power View, proceed as follows –

- In the Power View Sheet, click on the PowerPivot tab.



The PowerPivot Ribbon appears, which you had used in the previous section.

- Click on KPIs in the Calculation group.
- Click on New KPI to add a KPI.
- Click on Manage KPIs to edit a KPI.

The steps are the same as in the previous section.

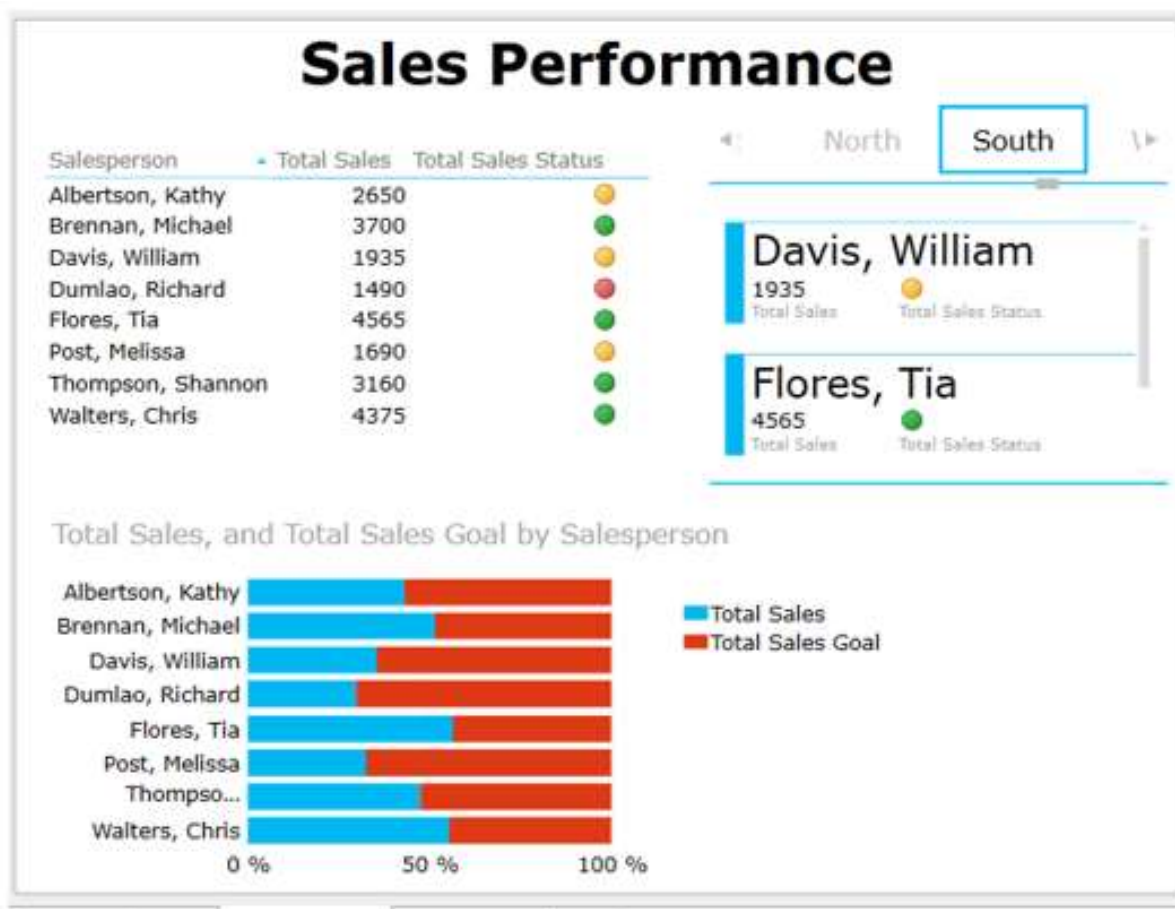
You can create an aesthetic report of Sales Performance with KPIs in Power View as follows:

- Click on DATA tab on the ribbon.
- Click on Power View in the Reports group.

Power View sheet appears.

- Add a Table with the fields – Salesperson, Total Sales and Total Sales Status.
- Add a second Table with the fields – Salesperson, Total Sales and Total Sales Goal.
- Convert the second Table to 100% Stacked Bar.
- Add a third Table with the fields – Salesperson, Region, Total Sales and Total Sales Status.
- Convert the third Table to Card. Drag the field Region to Tile By.
- Add the Title – Sales Performance.
- Change the font.
- Increase the Text Size.
- Resize Table, 100% Stacked Bar and Card appropriately.

Your Sales Performance report is ready –



As you can observe, in the Power View you could portray the results as follows –

- Table with icons for KPI status is similar to the PowerPivot report.
- 100% Stacked Bar depicts the percentage achieved with respect to the Goal. You can also notice that it gives a clear comparison of the performance of all.
- Card depicts the KPI status of the Salespersons along with the Region they belong to. You can interactively scroll through the Tiles to display results for different Regions that would give scope to assess performance region-wise also.