Spreadsheet Modelling (Using Excel)

EMGN226

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Content

Unit 01: Introduction to Spreadsheets

Objectives

- gain insight to history of spreadsheet,

- analyse the importance of spreadsheet,

- understand how to navigate through a spreadsheet.

- learn about how to craft formulas,

- understand common errors in spreadsheets,

- know the differences between Sheets and Excel.

Introduction

Have you ever heard of the term "spreadsheet"?

- The use of spreadsheets is synonymous with digital software and large online databases.

- But the spreadsheet has been organizing various aspects of our lives for hundreds of years.

- Nowadays, the spreadsheet is such an integral part of any computer that you won't often find one that doesn't already have some sort of spreadsheet software pre-installed.

- In fact, the boom in computer usage over the years may not have been so prominent without online spreadsheets.

- Let's take a look at the history and evolution of spreadsheets and the vital role they play in our lives today.

Why is it Called the Spreadsheet?

- The term spreadsheet might seem strange to those who associate it with only its digital capability.

- However, the spreadsheet is quite a literal reference to its original form hundreds of years ago.
- Back then, a spreadsheet was a ledger book full of huge sheets of paper that would quite literally spread across the table.
- Rows and columns divided these sheets for manually entering data using a pen or pencil.

The Original Spreadsheet Looks Something Like This:

How are They Generally Used?

- Accountants would primarily use these ledger books for a variety of finance-related scenarios that handled a lot of data.
- A whole spreadsheet could cover aspects such as accounts receivable, investments, inventory and expenses.
- Everything accountants needed to know was right there in one place, so they could easily make important decisions.

1.1 The History of Spreadsheets

- From hundreds of years ago to now, the spreadsheet has evolved from its humble beginnings to something that's powerful enough to help organize the operations of multi-billion dollar enterprises.
- After the rise of the digital revolution, its digital counterpart replaced the physical spreadsheet.
- Let's explore the transformation of this new spreadsheet form in more detail.

Where it All Began?

- Even though in the early 70s the first computer had been created along with electronic spreadsheet software such as LANPAR, they didn't gain as much traction.
- Even though LANPAR could replace paper-based spreadsheets entirely, the computers were simply too costly, bulky, and scarce to the public.
- Instead, it wasn't until the late 70s and early 80s when the personal computer made its way into the market that the online spreadsheet really took off.
- VisCalc was the first spreadsheet program for personal computers. Dan Bricklin and Bob Frankston officially created VisCalc in 1979.

- VisCalc came pre-installed on the Apple II computer, which ended up creating a lot of excitement amongst home users.
- This led to many other companies following suit, including IBM, which came up with their own product – the IBM PC.
- It was the spreadsheet utility that contributed to the skyrocket of the PC market that continued to thrive over the upcoming decades.
- Spreadsheet software on personal computers was a monumental moment for many.
- However, during the early 80s, computers were still command-line operating machines.
- Spreadsheet programs such as SuperCalc, Multiplan and Lotus 1-2-3 were advanced enough; they just lacked the user-friendly nature like many operating systems at the time.
- Then came along the graphical user interface (GUI). This made handling programs such as spreadsheets much easier.
- Visual components replaced the text-dominated features across the entire software.
- This completely transformed the user-friendly nature of the spreadsheet and exponentially increased its use among home users.
- Excel 1.0 was the very first GUI-based spreadsheet program that Microsoft specifically built for Macintosh.
- Later on, they transitioned Excel to the Windows environment, and there was no looking back.
- Since then, Microsoft Excel has been the most dominant spreadsheet software over the last two decades.
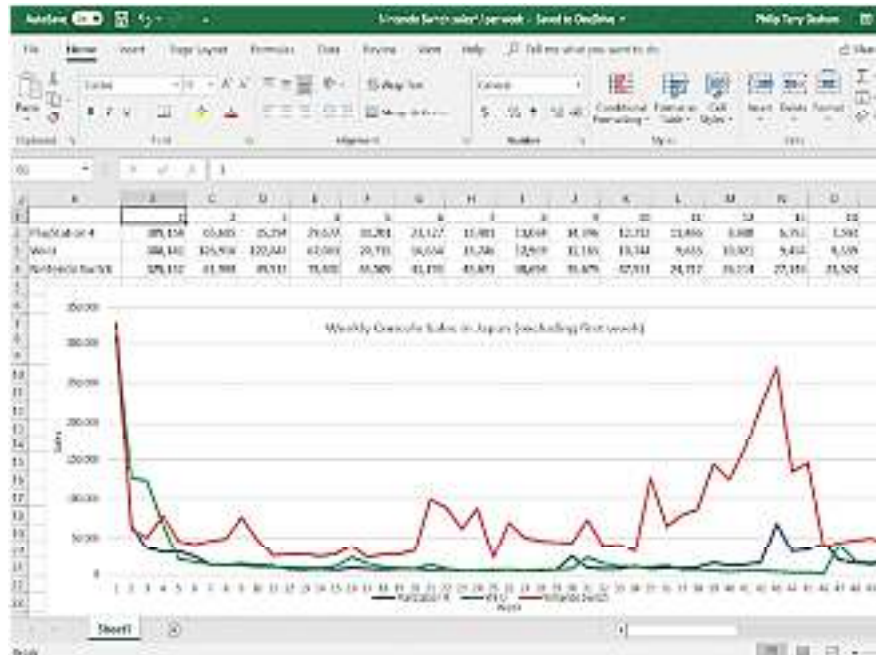
- Although Microsoft Excel has remained the ultimate spreadsheet software even today, there remain several notable competitor spreadsheet applications on the market.

- These include Apple's Numbers (part of the iWork productivity suite), Neo Office spreadsheet and WPS spreadsheet.

- There have also been a number of non-proprietary, free, open-source alternative applications such as Open Office.org, Libre Office Calc, Calligra Sheets and Pyspread.

1.2 What's Happening with Spreadsheets Now?

- Spreadsheets have come a long way over the past few decades, and they are continuing to become more intuitive, flexible and powerful than ever.

- In just the past few years, spreadsheet software now offers powerful analytical tools to turn data into useful insights.

- The most notable is their visual representation, that now helps businesses project future developments for their companies.

- Moreover, cloud-based spreadsheets are now a key part of many organizations.

- Google Sheets offers the most popular free cloud-based spreadsheet program that now ranks number 2 in the world, just behind Microsoft's Excel.

- This has revolutionized the way businesses can work, allowing offline collaboration anywhere, increasing productivity for many.

- The latest phenomenon in the spreadsheet world is the automation of spreadsheet processes.

- Now, there are various tools available in the market to automate the collection, input and analysis of your data into spreadsheets, so you don't have to worry about a thing.

- The potential of these automation tools is almost limitless, too.

- Now, businesses can build and scale a variety of complex systems through the simple connection of spreadsheets.

- Businesses now have fully functioning CRM or ERP platforms, thanks to spreadsheets.

- With automation tools specialized in spreadsheets such as Sheetgo, you can build workflows that will continue to automate themselves for any period of time.

- With intelligence like this, almost anything will be possible in the future.
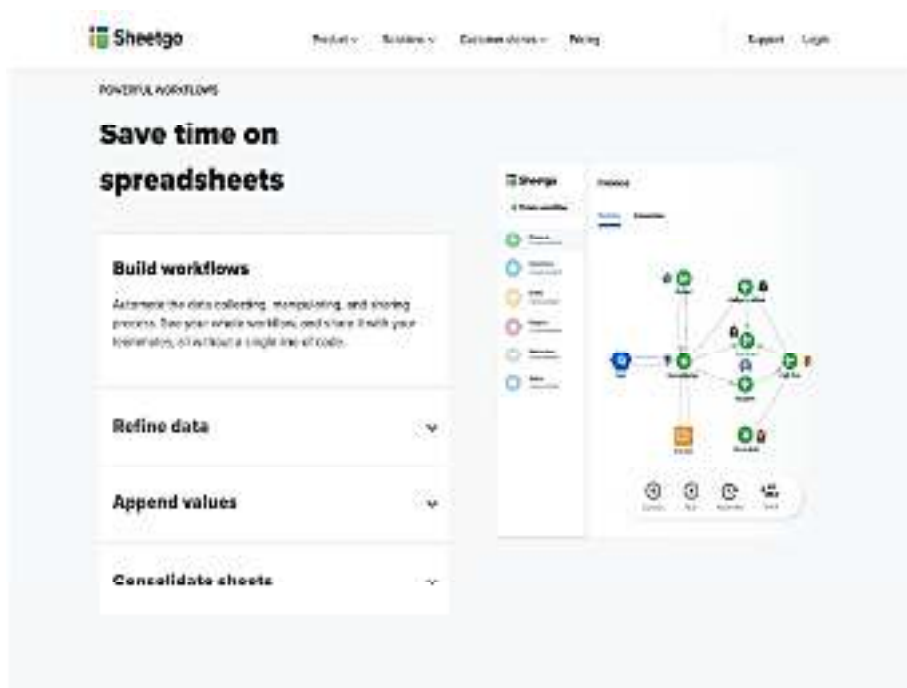
1.3   Importance of Spreadsheets

1.   Spreadsheets are free.

2.   Spreadsheets require minimal training.

3.   Spreadsheets are customizable.

4.   Spreadsheets can be more collaborative than other tools.

5.   It's easy to manipulate and analyze data.

6.   One can integrate spreadsheets with certain tools.

7.   Spreadsheets are quick and easy to add into a workflow.

8.   Spreadsheets are fantastic tools for financial documents.

9.   One have access to countless spreadsheet templates.

10.   One can visualize data.

11.   Budgeting and Spending Help

12.   Assisting with Data Exports

1.4   Navigating Worksheets in Excel: Overview

•   Navigating worksheets in Excel lets you view different worksheets in a workbook.

•   To move from one worksheet to another, click the worksheet name tab of the worksheet to view.

•   The worksheet name tabs appear in the lower-left corner of the workbook.

•   If you have many worksheets in a workbook or give worksheets very long names, you may not be able to see all the worksheet name tabs.

•   This is because they begin to slide underneath the horizontal scroll bar to the right.

•   Only when this occurs can you then click the "Previous Sheet" and "Next Sheet" buttons to the left of the worksheet name tabs.

- Doing this then moves the worksheet tab names out from underneath the horizontal scroll bar.

- Keep clicking until you see the one you want to view. At that point, then click its worksheet name tab to view it.
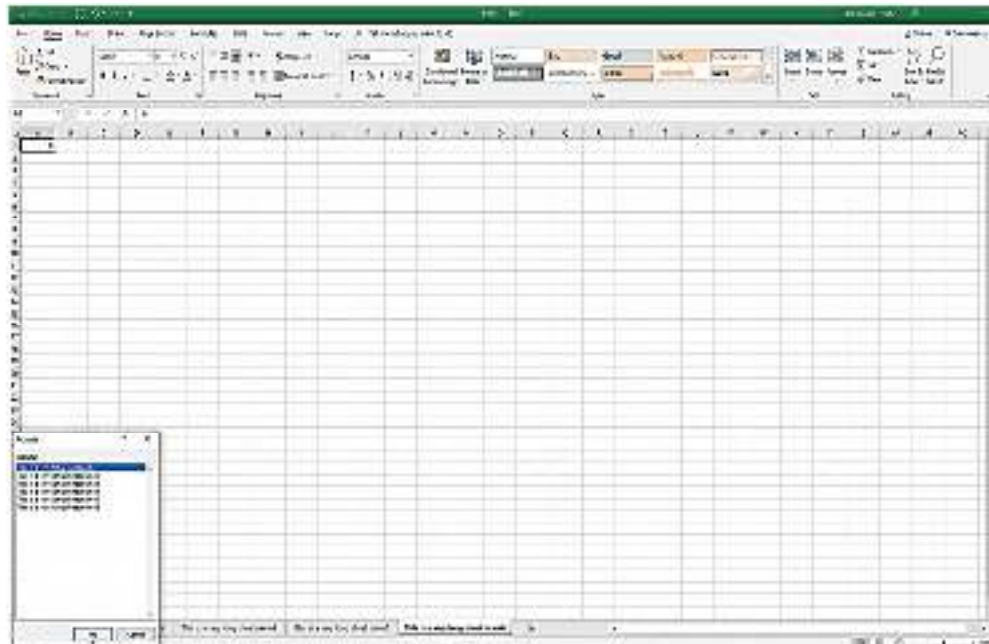
Navigating Worksheets in Excel: Instructions

1. To move from one worksheet to another in Excel, click the worksheet name tab of the worksheet to view from the set of worksheet name tabs in the lower-left corner of the workbook.

2. Alternatively, to move to the previous worksheet using a keyboard shortcut, press "Ctrl" + "PageUp" on your keyboard.

3. Alternatively, to move to the next worksheet using a keyboard shortcut, press "Ctrl" + "PageDown" on your keyboard.

4. Only after you have worksheet name tabs that have slid underneath the horizontal scroll bar can you then click the "Previous Sheet" and "Next Sheet" buttons to the left of the worksheet name tabs to move the names of the worksheet tabs out from underneath the horizontal scroll bar until you can see the one you want to view.

5. At that point, then click its worksheet name tab to view it.

6. Alternatively, right-click either the "Previous Sheet" or "Next Sheet" buttons to select the name of the worksheet to view from the "Activate" dialog box that appears.

7. After selecting the sheet name to view, then click the "OK" button to activate the selected worksheet.

1.5 Formulae in MS-Excel

- Spreadsheets are used in every organization to sort, classify and calculate data.

- Knowing how to manipulate and calculate data is a relevant skill for any student working in a lab, internship, summer position or early career position.

- Microsoft Excel's power is in its ability to calculate and display results from data entered into its cells.

- To calculate anything in Excel, you need to enter formulas into its cells.

- Formulas can be simple arithmetical formulas or complicated formulas involving conditional statements and nested functions.
- All Excel formulas use a basic syntax starting with "=".

Create a simple formula in Excel

- You can create a simple formula to add, subtract, multiply or divide values in your worksheet.
- Simple formulas always start with an equal sign (=), followed by constants that are numeric values and calculation operators such as plus (+), minus (-), asterisk(*), or forward slash (/) signs.

Let's Take an Example of a Simple Formula.

1. On the worksheet, click the cell in which you want to enter the formula.
2. Type the **=** (equal sign) followed by the constants and operators (up to 8192 characters) that you want to use in the calculation.

    For our example, type =1+1.

Notes:

- Instead of typing the constants into your formula, you can select the cells that contain the values that you want to use and enter the operators in between selecting cells.
- Following the standard order of mathematical operations, multiplication and division is performed before addition and subtraction.

3. Press Enter (Windows) or Return (Mac).

Let's take another variation of a simple formula. Type =5+2*3 in another cell and press Enter or Return. Excel multiplies the last two numbers and adds the first number to the result.

ERRORS

- MS Excel is popular for only its most useful automatic calculation feature, which we achieve by applying various functions and formulas.
- But while using formulas in Excel cell, we get multiple types of errors.

The error can be:

1. #DIV/0
2. #N/A
3. #NAME?
4. #NULL!
5. #NUM!
6. #REF!
7. #VALUE!
8. #####
9. Circular Reference

1 – #DIV/0 Error

- #DIV/0! Error is received when we work with a spreadsheet formula, which divides two values in a formula and the divisor (the number being divided by) is zero. It stands for divide by zero error.

2 – #N/A Error

- This error means "no value available" or "not available." It indicates that the formula cannot find the value that we suppose it may return.

3 – #NAME? Error

- This error is displayed when we usually misspell the function name.
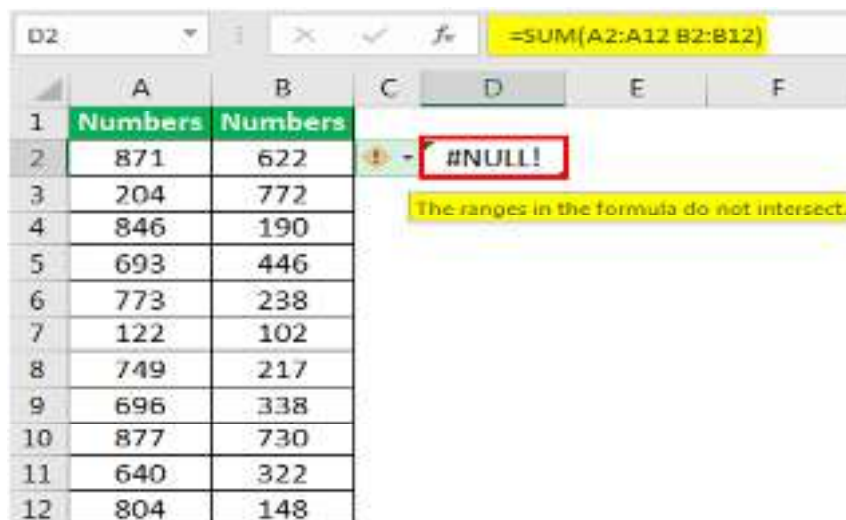
4 – #NULL! Error

- This error is usually displayed when cell references are not specified correctly.
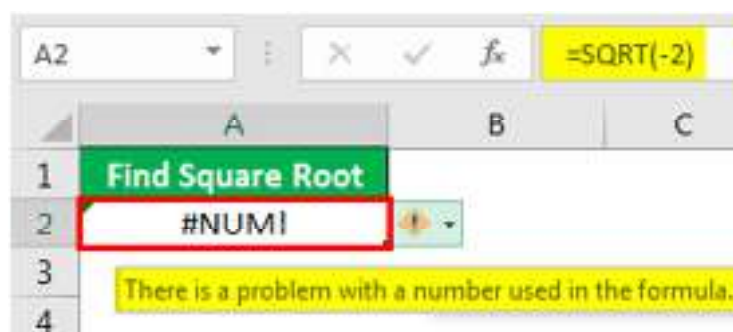
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- We get this error when we do not use the space character appropriately. The space character is called the "intersect operator," which specifies the range that intersects each other at any cell.

- In the below image, we have used the space character, but the ranges A2:A12 and B2:B12 are not intersecting; that is why this error is displayed.

5 – #NUM! Error

- This error is usually displayed when a number for any function argument is found invalid.

- For example: To find out the square root in excel of a negative number is not possible as the square of a number always has to be positive.

6 – #REF! Error

This error usually comes when

1. We accidentally deleted the cell which we referenced in the formula.

2. We cut and paste the referenced cell in different locations.

7 – #VALUE! Error

- This error comes when we use the wrong data type for a function or formula.

- For example, we can add only numbers. But if we use any other data type like text, this error will be displayed.

8 – ###### Error

- This error is displayed when the column width in excel is not enough to show the stored value in the cell.

9 – Circular Reference Error

- This type of error comes when we reference the same cell in which we are writing the function or formula.

1.6 What is the Difference Between Worksheet, Workbook, and Spreadsheet?

- To create or maintain our daily work report on the computer, some software's available there which allows users to keep daily work secure in the form of a workbook, spreadsheet as well as a worksheet.

- Microsoft Excel is well-known software to do such kinds of tasks, apart from that nowadays Google Sheets is also the best option to maintain and create daily work-related files.

- Sometimes there is confusion like situations go to create where users do not get the exact meaning of spreadsheet, worksheet, and Workbook. While some users think that all of these things are the same, though there is so much similarity between them some basic aspects differ from each other.

1. Workbook

The workbook is a set of one or more worksheets, where you can make and save your professional as well as personal documents securely.

The workbook is also a file/book, but it is a bunch of worksheet files, where one or more files you can add. The workbook can be used on different platforms like a school assignment, Professional content files, Business related files. But every time you will get to see multiple numbers of worksheets added to the workbook file.

2. Spreadsheet

As we told you earlier that some software allows users to create their work-related files, here a spreadsheet is one kind of software through that users can organize their data in a row and columns. With the help of a spreadsheet, users can do calculations in between that row and columns.

Users get options to edit, format and create worksheets within a spreadsheet, that's why any user can easily fill their data into columns and rows available in a spreadsheet. While organizing and keeping data secure is much easier with the help of spreadsheets.

3. Worksheet

Normally worksheet is a single page of the file where user can fill their data into rows and columns, the data into rows and columns is popularly known as a worksheet.

With the help of a worksheet, users can create their educational, school work-related, professional as well as business-related file. You can also handle tax forms and accounting-related work also with the help of a worksheet.

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Difference Between Worksheet, Spreadsheet and Workbook

WORKSHEET	SPREADSHEET	WORKBOOK
1. Worksheet is a single page file/spreadsheet, where rows and columns are available, You can easily fill your data into that row and column.	1. Spreadsheet is a program that allows users to create a work report.	1. Workbook is a bunch/bundle of spreadsheets, in the workbook, there may have one or more worksheets can be available.
2. The data which are filled into rows and columns is called a worksheet or worksheet report.	2. Spreadsheet is a large platform where users can create many worksheets as well as workbooks.	2. Workbook is a program that depends on worksheets as well spreadsheets.
3. To create a worksheet on the computer, you need to enter it into a spreadsheet. without that, it is an almost impossible task.	3. Spreadsheet is a program that's why to create workbooks and worksheets, the spreadsheet is so important and essential.	3. To create a workbook you need of a spreadsheet and worksheet, then only its creation is possible.
4. You can add a worksheet to the workbook by creating it with the help of a spreadsheet.	4. You can create a workbook as well as a worksheet in the spreadsheet program. That's why you don't need to add a spreadsheet anywhere among these two(Workbook and Workbook).	4. In Workbook you can add many Worksheets, but the creation of a workbook is possible only with a spreadsheet.
5. You can use worksheets to create school assignments, professional work reports, business reports as well as accounting-related work details.	5. Spreadsheet allows you to create any kind of work report as with the help of this you can create as many work report files that much you want.	5. Into the workbook you can add a bunch of worksheets, so if you need to add multiples of worksheets that are related to different topics that time you can add them in the workbook.
6. Worksheet contains matrix rectangular cells which arrange there in a tabular form of row and column.	6. Spreadsheet is a program of such matrix rectangular cells in the form of row and column.	6. In the workbook there is an association available of such kinds of features with work-related data.
7. It is an easy task to add a worksheet into the workbook, as well as create a worksheet into a spreadsheet.	7. You can create both worksheets as well as workbooks so easily within a spreadsheet.	7. It is not a simple task to add one workbook to another workbook.
8. Data analysis and manipulation are only possible with a worksheet, not with the workbook.	8. You need to create a data report first on to worksheet via spreadsheet then only you can analyze as well as manipulate that.	8. It is not possible to data analysis and manipulation with the help of a workbook.

9. Worksheet is always a single sheet.	9. No limit to creating a worksheet and workbook within a spreadsheet.	9. Workbook is a bundle of worksheets, while you can create many workbooks in a tp spreadsheet.
10. In each cell of the worksheet user can enter the date, time, number, Excel formula as well as a math formula.	10. With the help of a spreadsheet users can perform mathematical and arithmetic operations, also statistical well as and financial operations also can be performed there.	10. that task can be performed on any spreadsheet and worksheet, for that workbook is compatible.
11. Worksheet is a specific set of data.	11. In spreadsheet-specific worksheets as well as a general form of data can be available in the workbook.	11. In the workbook general form of data is available.
12. Interlinking between two worksheets is so easy task.	12. In a spreadsheet, You can link data between two worksheets into the same workbook.	12. Establishing a linkage between two workbooks is no easy task due to security issues.
13. The fundamental form of the worksheet is just like a single page of any book.	13. Spreadsheet fundamental form is like a whole program where you can create either a single page or a whole book.	13. The fundamental form of any workbook is like one kind of book whose can be any number of pages (worksheet)present into that.

Summary

- Microsoft Excel is a powerful spreadsheet program developed by Microsoft and is a part of the Microsoft Office suite of applications.
- Excel provides a grid-based interface with rows and columns, allowing users to organize and analyze data efficiently.
- It supports various mathematical, statistical, and financial functions, enabling users to perform calculations and manipulate data easily.
- Excel allows users to create and format spreadsheets, including tables, charts, and graphs, to present data visually.
- Users can input data into cells and use formulas to perform calculations, such as summing up values, finding averages, or calculating percentages.
- Excel offers a range of built-in functions and formulas, such as SUM, AVERAGE, IF, VLOOKUP, and COUNT, which can be used to perform complex calculations and data analysis.
- It provides features like sorting and filtering data, which allow users to organize and extract specific information from large datasets quickly.
- Excel supports data visualization through various chart types, including bar graphs, line charts, pie charts, and scatter plots, helping users understand data trends and patterns.
- Users can create macros in Excel to automate repetitive tasks, saving time and increasing efficiency.
- Excel files can be saved in various formats, including .xlsx, .xls, .csv, and .pdf, allowing users to share and collaborate on spreadsheets with others.

Keywords

- Spreadsheet: Microsoft Excel is primarily used as a spreadsheet program, allowing users to organize and manipulate data in a grid-based interface.
- Formulas: Excel provides a wide range of built-in functions and formulas that enable users to perform calculations and data analysis, such as summing values, finding averages, and performing complex mathematical operations.
- Data Analysis: Excel offers features and tools for data analysis, including sorting, filtering, pivot tables, and charts, allowing users to analyze and visualize data to gain insights and make informed decisions.

Self Assessment

1. The files that are created with Spreadsheet software are called

A. Package
B. Program
C. Worksheet
D. Spreadsheet

2. Which is used to calculate and analyze a set of numbers?

A. Improve
B. StarCalc
C. Spreadsheet
D. Database

3. A Spreadsheet, sometimes is called as

A. Cells
B. Worksheet
C. Menus
D. Notebook pages

4. Which bars have shortcut icons for frequently done tasks in the Spreadsheet?

A. Main Tool bar
B. Object bar
C. Formula bar
D. Menu bar

5. The Spreadsheet VisiCalc contains

A. 63 columns and 254 rows
B. 256 rows and 256 columns
C. 10000 rows and 256 columns
D. 36000 rows and 256 columns

6. Which is used to print the worksheet with grid lines?

A. Grid checkbox
B. Check box
C. Text box
D. Dialog box

7. Which shortcut icon is used to select and insert functions?

A. Functional Auto pilot
B. File series
C. Function wizard
D. Category

8. Star Office Calc has a variety of

A. Buttons
B. Functions
C. Formulae
D. Options

9. The cells are addressed in terms of

A. Row and column labels
B. Row labels
C. Rows
D. Columns

10. Which of the following data can be typed into a Spreadsheet cell?

A. Formulae
B. Text
C. Numbers
D. All of these

11. Which bar is used to display options?

A. Menu
B. Function
C. Formula
D. Status

12. The intersection of rows and columns creates

A. Cells
B. Worksheets
C. Spreadsheets
D. None of these

13. Worksheet data can be viewed in forms of

A. Charts
B. Graphs
C. Charts or graphs
D. Data

14. By pressing _____ key and type in the range you want, the suggested range will be accepted.

A. Backspace
B. Open
C. Close
D. Enter

15. Address of first cell in the worksheet is

A. A
B. A0
C. A1
D. 1A

Answers for Self Assessment

1.	C	2.	C	3.	B	4.	B	5.	A
6.	A	7.	C	8.	B	9.	A	10.	D
11.	A	12.	A	13.	C	14.	A	15.	C

Review Questions

1. What is Microsoft Excel and what is its primary purpose?
2. How does Excel organize data within its interface?
3. What are some common mathematical and statistical functions available in Excel?
4. How can you create formulas in Excel, and what are some examples of commonly used formulas?

Further Readings

https://blog.sheetgo.com/spreadsheets-tips/history-of-spreadsheets/

https://blog.hubspot.com/sales/dangers-of-using-spreadsheets-for-sales#:~:text=Spreadsheets%20make%20it%20easy%20to,a%20certain%20phrase%20or%20parameter.

https://www.teachucomp.com/navigating-worksheets-in-excel-instructions/

https://support.microsoft.com/en-us/office/create-a-simple-formula-in-excel-11a5f0e5-38a3-4115-85bc-f4a465f64a8a

https://www.wikihow.com/Type-Formulas-in-Microsoft-Excel

https://www.wallstreetmojo.com/errors-in-excel/

https://www.gyanipandit.com/en/difference-between-worksheet-workbook-and-spreadsheet/

Unit 02: Basic Functions and Utilities

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2.2   Fill Handle

2.3   Rows and Columns

2.4   Protecting Worksheets and Workbooks

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Answers for Self Assessment

Review Questions

Further Readings

Objectives

- understand about entering different types of data in MS Excel.
- understand how to use fill handles.
- understand how to manage rows and columns.
- understand the process and steps of protecting worksheets and workbooks.

Introduction

- The information entered to a cell is known as data and can adopt four basic forms--text, number, formula or function.
- A text entry is characterized by its first character being a letter, a space or a punctuation mark.
- Text entries (often known as labels) are used to enter descriptive comments to the worksheet.
- This could be your name at the top of the sheet, or a descriptor of the worksheet's purpose, or a list of names of clients about whom you have information.

2.1   Different types of data in MS Excel

Text. Entry

- The fundamental feature of a text entry is that arithmetic calculations cannot be performed on them.
- They are for descriptive purposes only.

Numerical Data Entry

- Numerical data entries, on the other hand, commence with a positive or negative numeric character and contain only numerical characters thereafter.

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- They are the raw data to which calculations can subsequently be applied and are entered directly to the sheet in the form:

  23 or -19 or 167.

- It is important to note that text characters, spaces or punctuation marks must not be included before or after numeric characters if the contents of the cell are to be used for calculations.

- For example, 23 is a valid numeric entry that could be subjected to an arithmetic process (squared, cubed, etc.), but 23rd (as in the 23rd of lune) is a text entry that cannot be manipulated mathematically.

- As long as Excel receives numbers, and only numbers, then the entry will be treated numerically, but once a non-numeric character such as a letter of the alphabet is introduced the whole entry usually becomes textual.

Formula Entry

- Formula entries are what distinguish a spreadsheet from a calculator.

- They are algebraic rather than arithmetic concepts and allow general rather than specific computations to be performed.

- For example, suppose your annual salary is 20000 and your partner's is INR 25000. Your combined income is clearly INR 45000.

- Enter your salary (as a number) into the Al cell of your worksheet and your partner's to the A2 cell.

- The task to be undertaken is to write an expression (in A3, say) that will compute the combined income.

- At first sight you might be tempted to write, in A3;

  A1+A2

- but if you do, then you will find that it appears as text rather than as the required numerical answer of 45000.

- Try it now.

- The reason for this is that, as we saw above, any entry that commences with a letter will be treated by Excel as text and will not produce a numerical result.

- Clearly the problem being faced is to distinguish, for example, the 'A' of the cell reference A1 from 'A' as in the first character of a text label such as Asset value.

- Excel allows this to be done quite simply by placing an equals sign (=) in front of any entries that require arithmetic computation on the basis of formulae using cell addresses.

- Thus,

  =A1+A2

Excel Function Entry

- The final form of entry to an active cell is an Excel function.

- Excel contains a large number of pre-programmed functions that can perform sophisticated tasks as required.

- In Excel, a function, like a formula, is always preceded by an equal's sign if it is the first entry to a cell.

- Then the name of the function must be supplied, followed by an opening bracket.

- There then follow the arguments of the function.

- Some functions only have one argument, but others have several, in which case each argument is separated by a comma.

- That was:

  =Al+A2

- The same result could have been obtained by using the SUM function. This contains only one argument -the range of cells to be summed; and so we could write:

$$=SUM(A1:A2)$$

- Now, while typing =SUM(A1:A2) is in fact slightly less efficient than typing =Al+A2, this would not be the case if we were required to sum, say, the first 100 rows of column A.
- Using a formula, we would have had to type:

=A1+A2+A3+ ..and so on until ..A99+A100

- Clearly, this is very tedious, especially in comparison with the functional alternative:

=SUM(A1:100)

- Appropriate Excel functions will be introduced throughout the text as and when they are required.
- Some are indispensable for serious quantitative analysis, but in other cases there may be no alternative to writing a formula of your own, in which case you have created what is known as a user-defined function.
- Finally, Excel functions and user-defined functions can be used together without difficulty.

2.2   Fill Handle

- Fill Handle is a feature in Excel that enables you to auto-complete a list in a row/column by simply dragging it using your mouse.
- A basic understanding of fill handle in Excel could save you some time and make you more productive.
- 'Fill Handle' is a tool that you can use to autocomplete lists in Excel.
- For example, if you have to enter numbers 1 to 20 in cell A1:A20, instead of manually entering each number, you can simply enter the first two numbers and use the fill handle to do the rest.
- Let's first understand where is the fill handle in Excel.
- Suppose you have the data as shown below:

	A	B
1	1	
2	2	
3		
4		
5		
6		
7		

Here are the steps to use the fill handle to quickly insert numbers up to 20.

- Select the data set.
- Hover the mouse over the bottom-right edge of the selection, you would see a plus icon appear –

Let's Have a Look

- Click the left button on the mouse and drag it down. Excel identifies a pattern of the first 2 numbers (an increment of 1) and uses that to fill that entire series.

- If you have data in the adjacent column, you can also hover the mouse over the right edge of the selection and double click.

- It will automatically fill the list to the last cell based on the data in the adjacent column.

How it actually works?

- For example, if I double-click on the fill handle (as shown below), it will fill the column till cell A11 (since there is data until cell B11 in the adjacent column).

Examples of Using Fill Handle in Excel

- Autofill Numbers that Increment/Decrement by 1

- Autofill Weekday Names

- Autofill Dates

Auto Fill Options
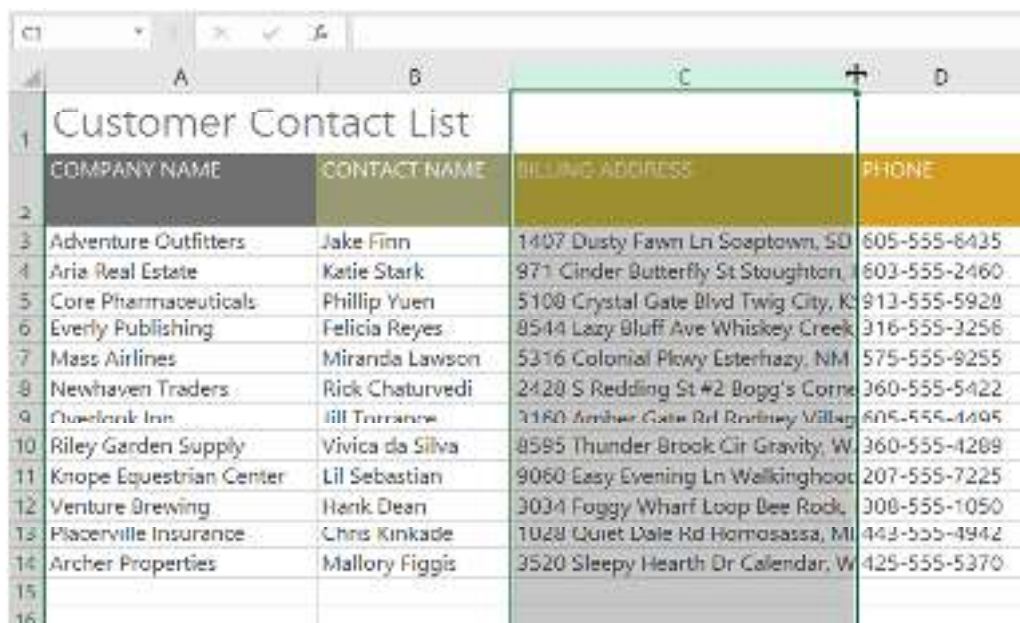
- While fill handle recognizes patterns and fills the list, it also gives some additional options you can use.

- As soon you drag the mouse (or double click) and autocomplete the list, you will see the Autofill option icon at the bottom right of the list.

- When you click on this icon, a list of options becomes available.

- These options are different for different types of data (numbers, dates, days).

2.3   Rows and Columns

- By default, every row and column of a new workbook is set to the same height and width.

- Excel allows you to modify column width and row height in different ways, including wrapping text and merging cells.
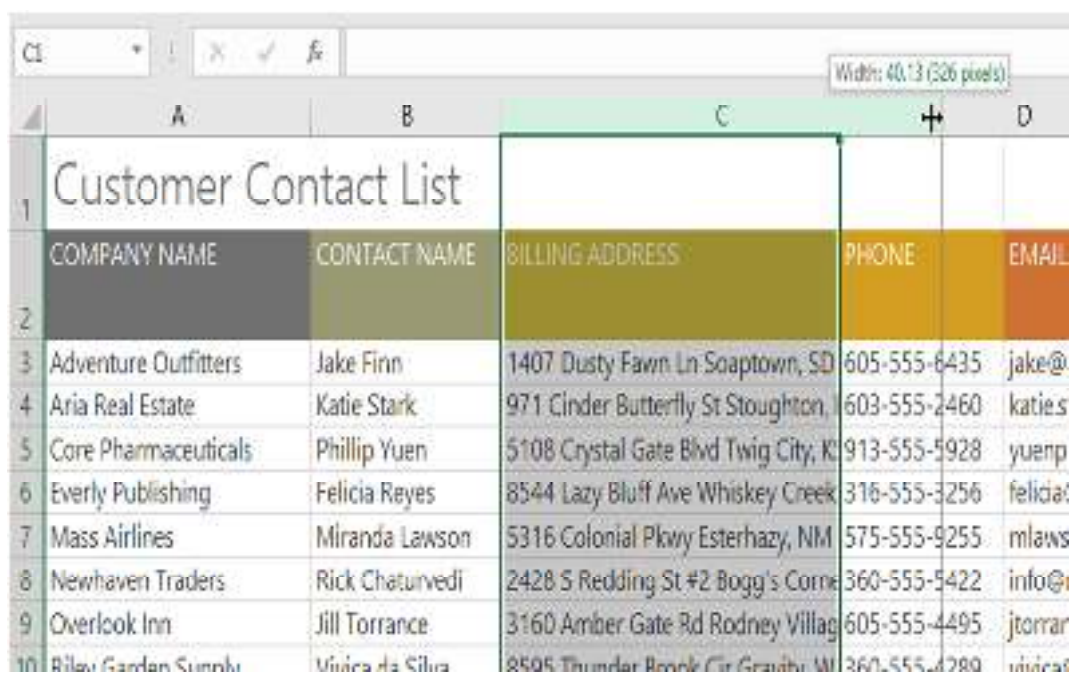
To modify column width:

- In our example below, column C is too narrow to display all of the content in these cells.

- We can make all of this content visible by changing the width of column C.

- Position the mouse over the column line in the column heading so the cursor becomes a double arrow.

- Click and drag the mouse to increase or decrease the column width.

- Release the mouse. The column width will be changed.

To AutoFit column width:

- The AutoFit feature will allow you to set a column's width to fit its content automatically.
- Position the mouse over the column line in the column heading so the cursor becomes a double arrow.

- Double-click the mouse. The column width will be changed automatically to fit the content.

To modify row height:

- Position the cursor over the row line so the cursor becomes a double arrow.

- Click and drag the mouse to increase or decrease the row height.

- Release the mouse. The height of the selected row will be changed.

To modify all rows or columns:

- Instead of resizing rows and columns individually, you can modify the height and width of every row and column at the same time.

- This method allows you to set a uniform size for every row and column in your worksheet. In our example, we will set a uniform row height.

- Locate and click the Select All button just below the name box to select every cell in the worksheet.

- Position the mouse over a **row line** so the cursor becomes a double arrow.

- Click and drag the mouse to increase or decrease the row height, then release the mouse when you are satisfied. The row height will be changed for the entire worksheet.

Spreadsheet Modelling (Using Excel)

Inserting, deleting, moving, and hiding

- After you've been working with a workbook for a while, you may find that you want to insert new columns or rows, delete certain rows or columns, move them to a different location in the worksheet, or even hide them.

To insert rows:

- Select the row heading below where you want the new row to appear. In this example, we want to insert a row between rows 4 and 5, so we'll select row 5.

- Click the Insert command on the Home tab.

- Click the **Insert** command on the **Home** tab.
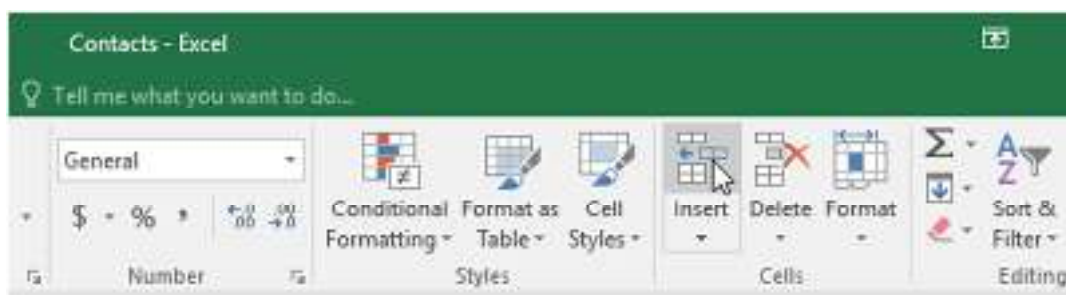
- The **new row** will appear **above** the selected row.

- When inserting new rows, columns, or cells, you will see a **paintbrush icon** next to the inserted cells. This button allows you to choose how Excel formats these cells. By default, Excel formats inserted rows with the same formatting as the cells in the row above. To access additional options, hover your mouse over the icon, then click the **drop-down arrow**.

To insert columns:

1. Select the **column heading** to the right of where you want the new column to appear. For example, if you want to insert a column between columns D and E, select **column E**.

2. Click the **Insert** command on the **Home** tab.

3. The **new column** will appear **to the left** of the selected column.
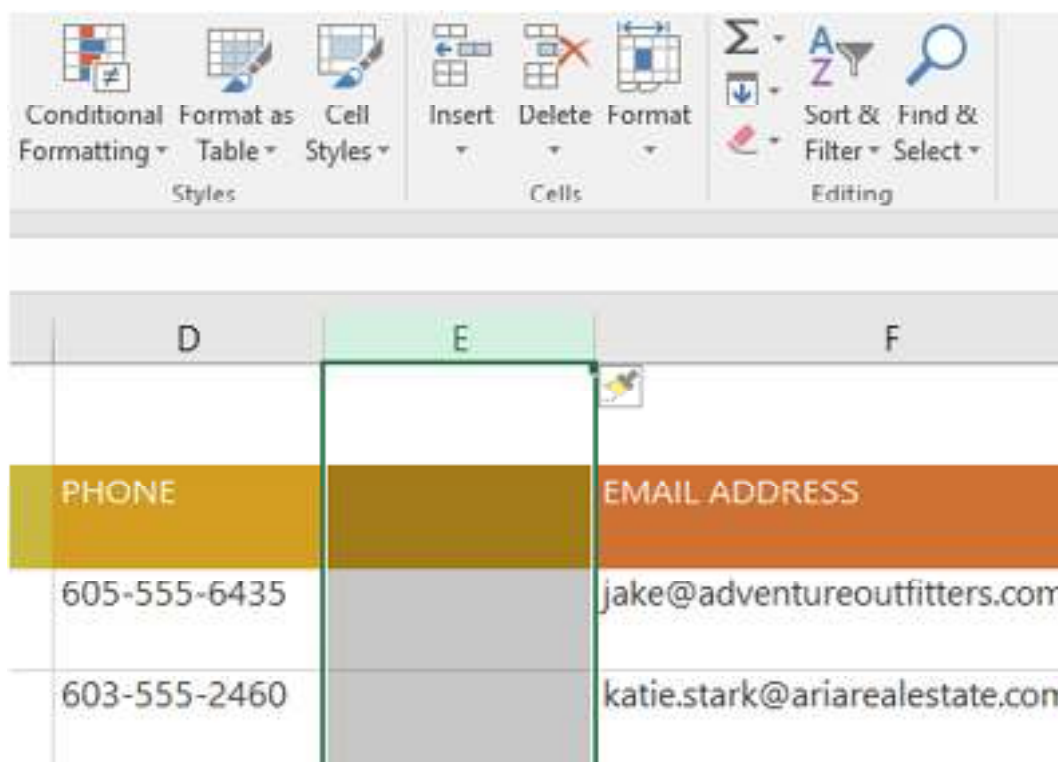
When inserting rows and columns, make sure to select the entire row or column by clicking the **heading**. If you select only a cell in the row or column, the **Insert** command will only insert a new cell.

To delete a row or column:

It's easy to delete a row or column that you no longer need. In our example we'll delete a row, but you can delete a column the same way.

1. Select the **row** you want to delete. In our example, we'll select **row 9**.
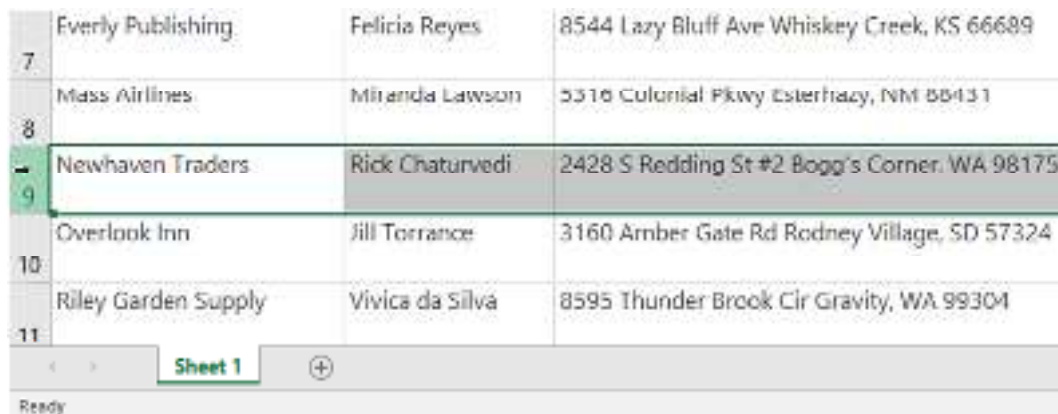
2. Click the **Delete** command on the **Home** tab.

3. The **selected row** will be deleted, and those around it will **shift**. In our example, **row 10** has moved up, so it's now **row 9**.

Spreadsheet Modelling (Using Excel)

It's important to understand the difference between **deleting** a row or column and simply **clearing its contents**. If you want to remove the **content** from a row or column without causing others to shift, **right-click a heading**, then select **Clear Contents** from the drop-down menu.
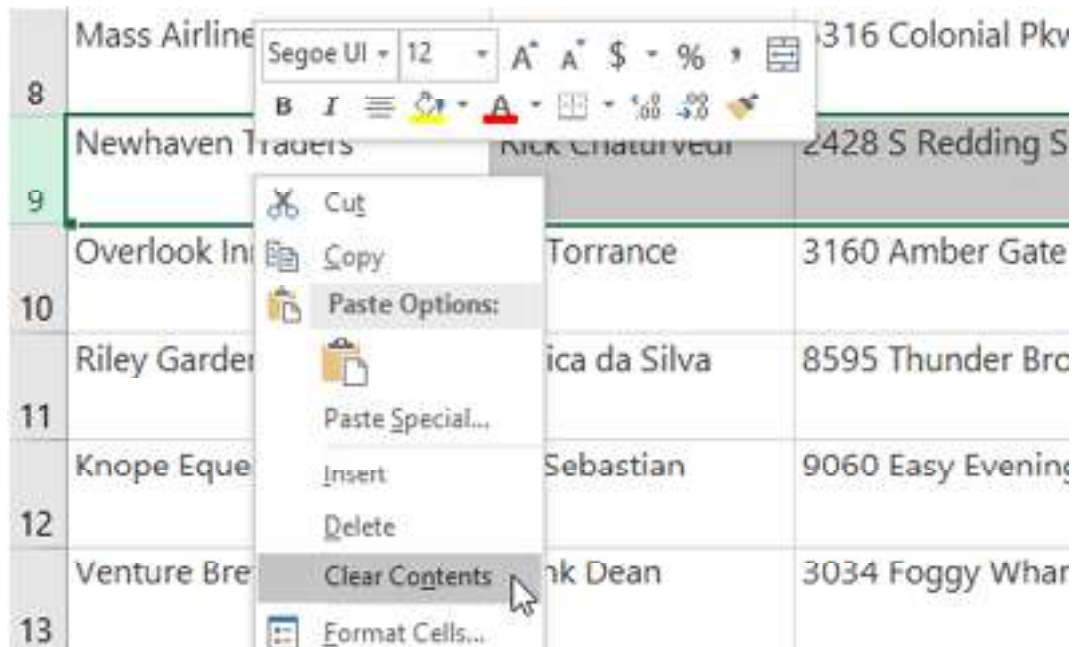
To move a row or column:

Sometimes you may want to **move** a column or row to rearrange the content of your worksheet. In our example we'll move a column, but you can move a row in the same way.

1. Select the desired **column heading** for the column you want to move.

2. Click the **Cut** command on the **Home** tab, or press **Ctrl+X** on your keyboard.

3. Select the **column heading** to the right of where you want to move the column. For example, if you want to move a column between columns E and F, select **column F**.

4. Click the **Insert** command on the **Home** tab, then select **Insert Cut Cells** from the drop-down menu.

Spreadsheet Modelling (Using Excel)

5. The column will be **moved** to the selected location, and the columns around it will shift.

You can also access the **Cut** and **Insert** commands by right-clicking the mouse and selecting the **desired commands** from the drop-down menu.
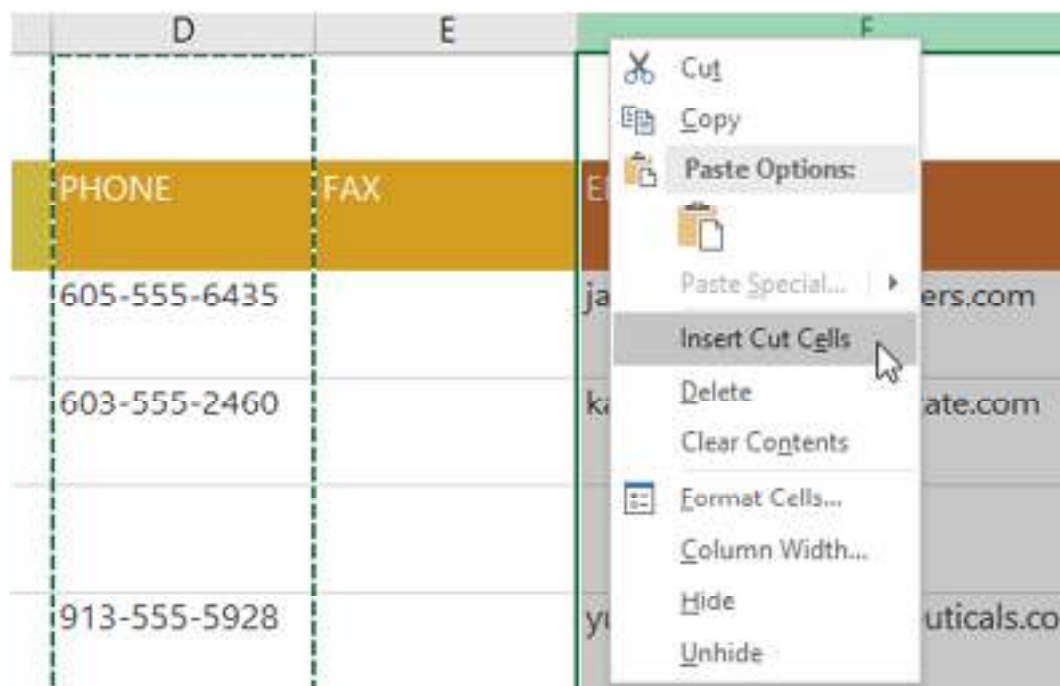
To hide and unhide a row or column:

At times, you may want to **compare** certain rows or columns without changing the organization of your worksheet. To do this, Excel allows you to **hide** rows and columns as needed. In our example we'll hide a few columns, but you can hide rows in the same way.

1. Select the **columns** you want to **hide**, right-click the mouse, then select **Hide** from the **formatting** menu. In our example, we'll hide columns C, D, and E.
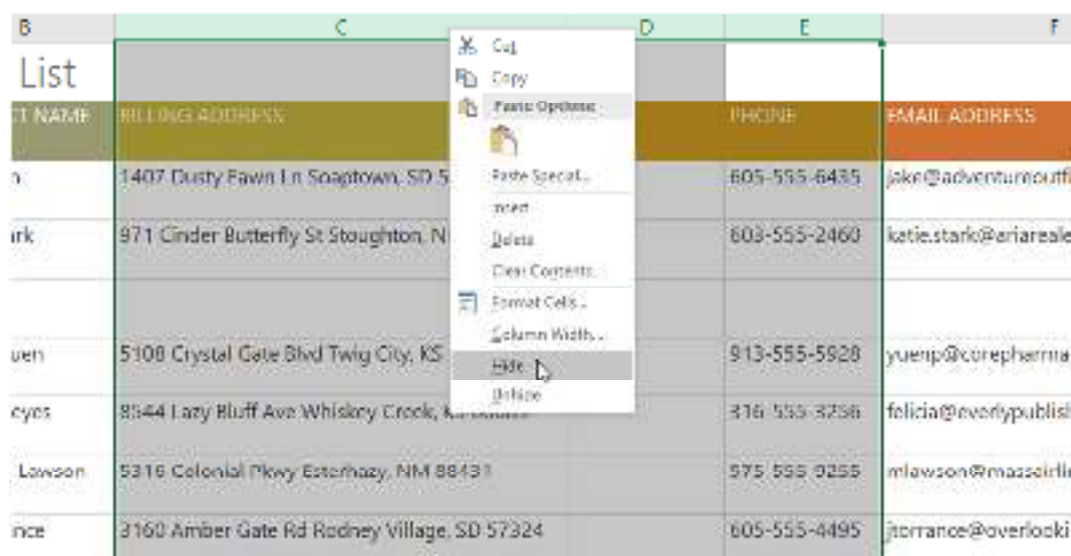
2. The columns will be **hidden**. The **green column line** indicates the location of the hidden columns.

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3. To **unhide** the columns, select the columns on **both sides** of the hidden columns. In our example, we'll select columns **B** and **F**. Then right-click the mouse and select **Unhide** from the **formatting** menu.

4. The hidden columns will reappear.

Wrapping text and merging cells

Whenever you have too much cell content to be displayed in a single cell, you may decide to **wrap the text** or **merge** the cell rather than resize a column. Wrapping the text will automatically modify a cell's **row height**, allowing cell contents to be displayed **on multiple lines**. Merging allows you to combine a cell with adjacent empty cells to create **one large cell**.

To wrap text in cells:

1. Select the cells you want to wrap. In this example, we'll select the cells in **column C**.

2. Click the **Wrap Text** command on the **Home** tab.

3. The text in the selected cells will be **wrapped**.

Spreadsheet Modelling (Using Excel)

Click the **Wrap Text** command again to **unwrap** the text.

To merge cells using the Merge & Center command:
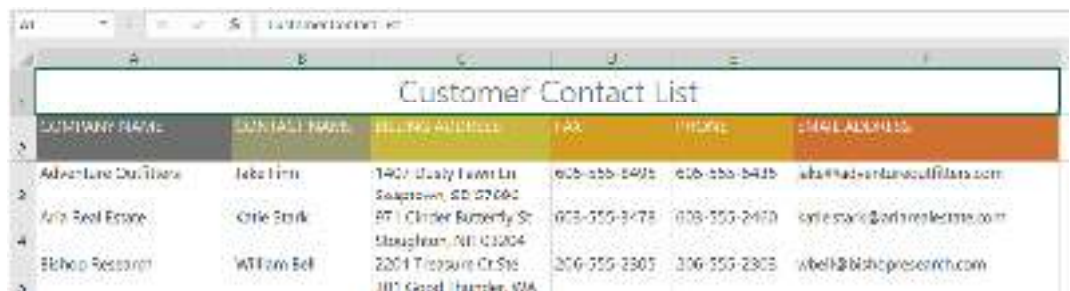
1. Select the **cell range** you want to merge. In our example, we'll select **A1:F1**.

2. Click the **Merge & Center** command on the **Home** tab. In our example, we'll select the cell range **A1:F1**.

3. The selected cells will be **merged**, and the text will be **centered**.

To access additional merge options:

If you click the drop-down arrow next to the **Merge & Center** command on the **Home** tab, the **Merge** drop-down menu will appear.
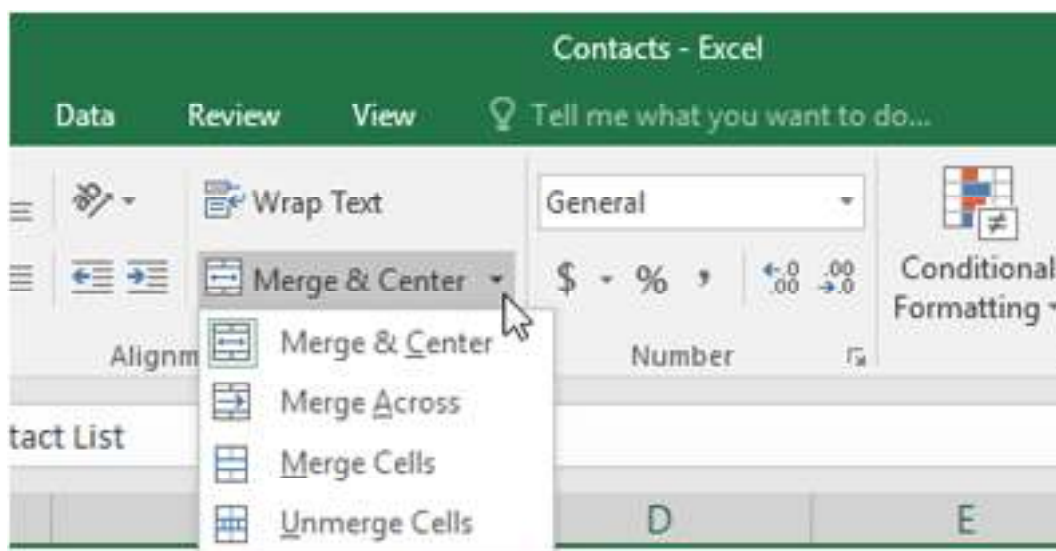
From here, you can choose to:

- **Merge & Center**: This merges the selected cells into **one cell** and **centers** the text.

- **Merge Across**: This merges the selected cells into **larger cells** while keeping each **row** separate.

- **Merge Cells**: This merges the selected cells into one cell but **does not cente**r the text.

- **Unmerge Cells**: This unmerges selected cells.

Be careful when using this feature. If you merge multiple cells that all contain data, Excel will keep only the contents of the upper-left cell and discard everything else.

Centering across selection

Merging can be useful for organizing your data, but it can also create problems later on. For example, it can be difficult to move, copy, and paste content from merged cells. A good alternative to merging is to **Center Across Selection**, which creates a similar effect without actually combining cells.

To use Center Across Selection:

1. Select the desired cell range. In our example, we'll select **A1:F1**. **Note**: If you already merged these cells, you should **unmerge them** before continuing to step 2.

2. Click the **small arrow** in the lower-right corner of the **Alignment** group on the **Home** tab.
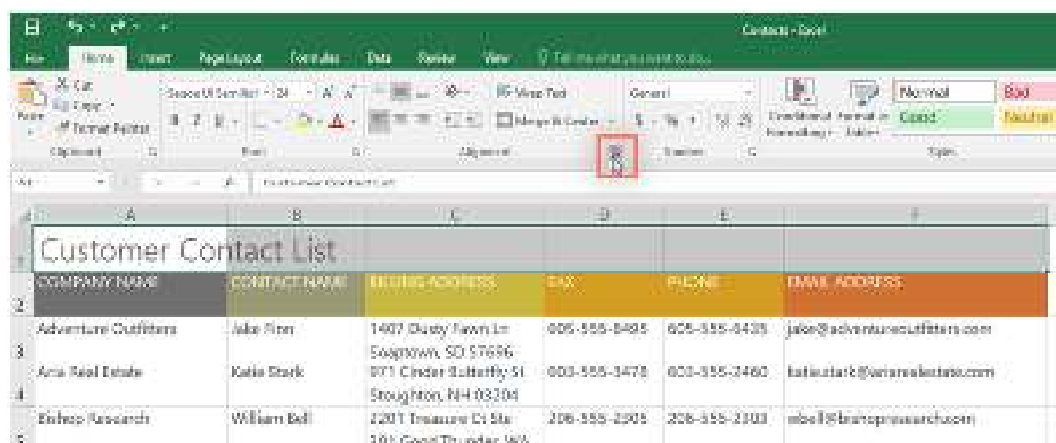
3. A dialog box will appear. Locate and select the **Horizontal** drop-down menu, select **Center Across Selection**, then click **OK**.
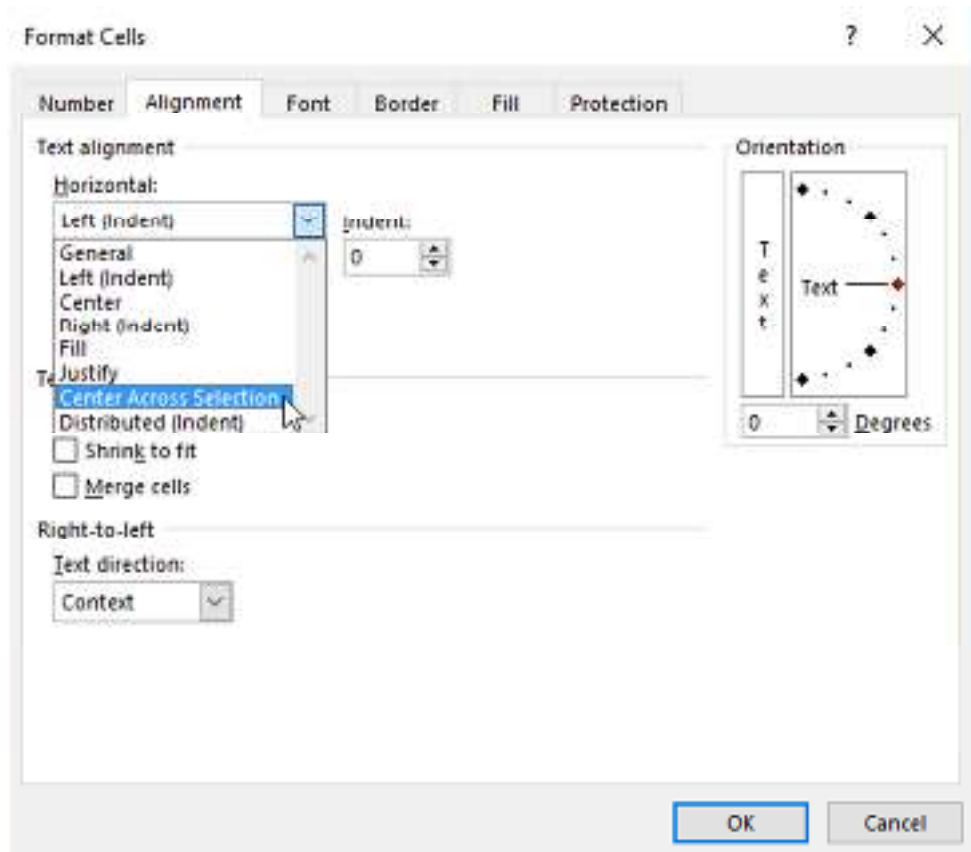
4. The content will be centered across the selected cell range. As you can see, this creates the same visual result as merging and centering, but it preserves each cell within A1:F1.

2.4 Protecting Worksheets and Workbooks

- Sometimes while sharing your spreadsheets you may not want the receiver to change the content of your worksheet or perhaps change only specific content and leave the rest untouched.
- To protect your worksheet from being edited by other people, Excel offers a protection feature.
- By following a couple of steps you can set protection to your work.

Protect an entire workbook from editing: A workbook can be protected by encrypting the workbook with a password, making the workbook read-only, or protecting the structure of a workbook.

Encrypt a workbook with a password:

To prevent other people from accessing your Excel files, protect them with a password. Head on to the file menu and do the following:

Step 1: Select **File > Info.**

Step 2: Select the **Protect Workbook** box and choose **Encrypt with Password**.
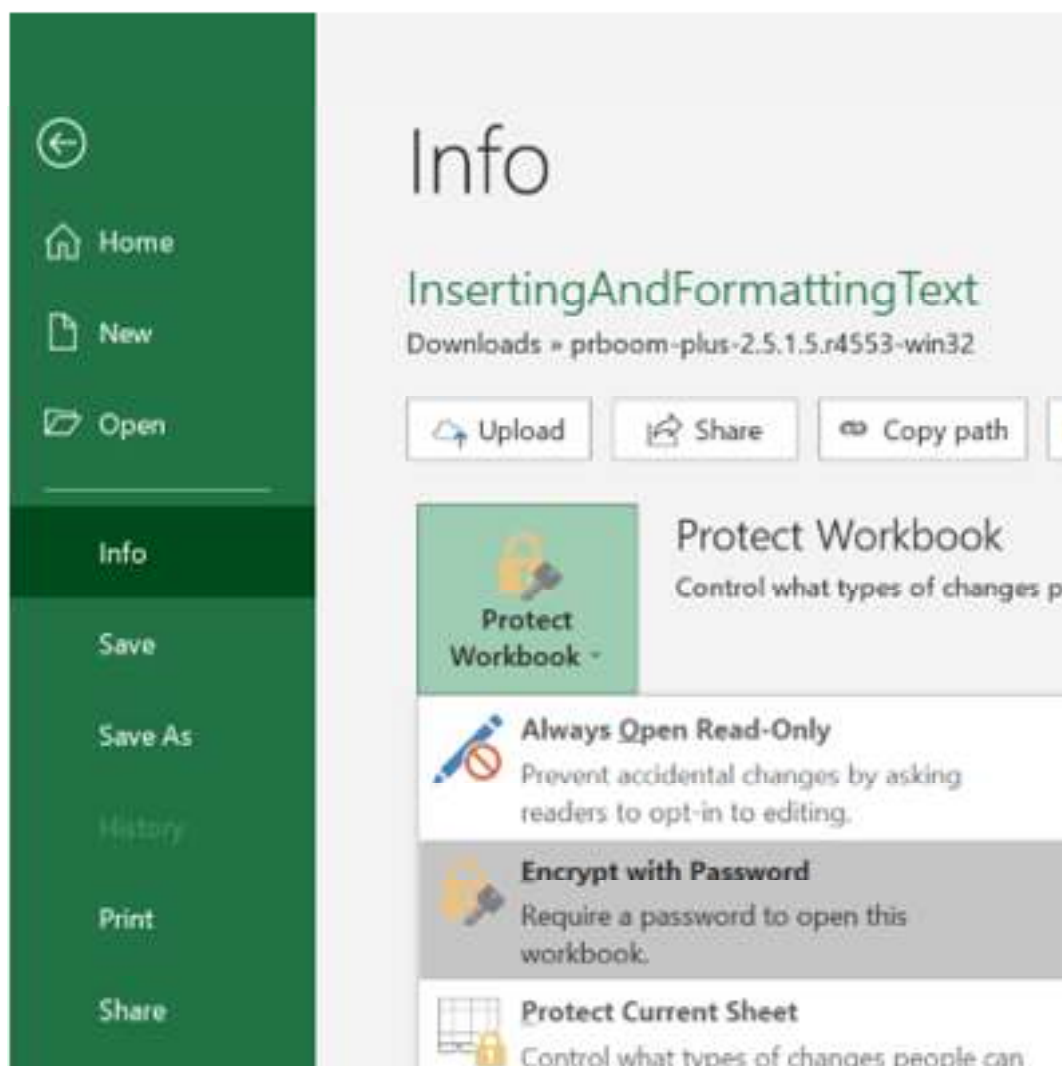
Step 3: Enter a password in the **Password box**, and then select **OK**.

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Encrypt Document ? ✕

Encrypt the contents of this file

Password:

| |

Caution: If you lose or forget the password, it cannot be recovered. It is advisable to keep a list of passwords and their corresponding document names in a safe place. (Remember that passwords are case-sensitive.)

OK   Cancel

Step 4: Confirm the password in the **Re-enter Password box** and then select **OK**.

Confirm Password ? ✕

Encrypt the contents of this file

Reenter password:

| |

Caution: If you lose or forget the password, it cannot be recovered. It is advisable to keep a list of passwords and their corresponding document names in a safe place. (Remember that passwords are case-sensitive.)

OK   Cancel

TIP: Excel can't retrieve your password once forgotten hence it's advised to keep it easy to remember.

Making a workbook Read-only :

By making a workbook read only the user can read the content of the file and then enable editing if the user wishes to make changes, it gives the user a hint to be cautious about editing the file.

To make a workbook read-only open the Excel file you want to protect and then :

Step 1: Head on to **File>info**

Step 2: Select the **Protect Workbook** box and choose **Always open Read-Only.**
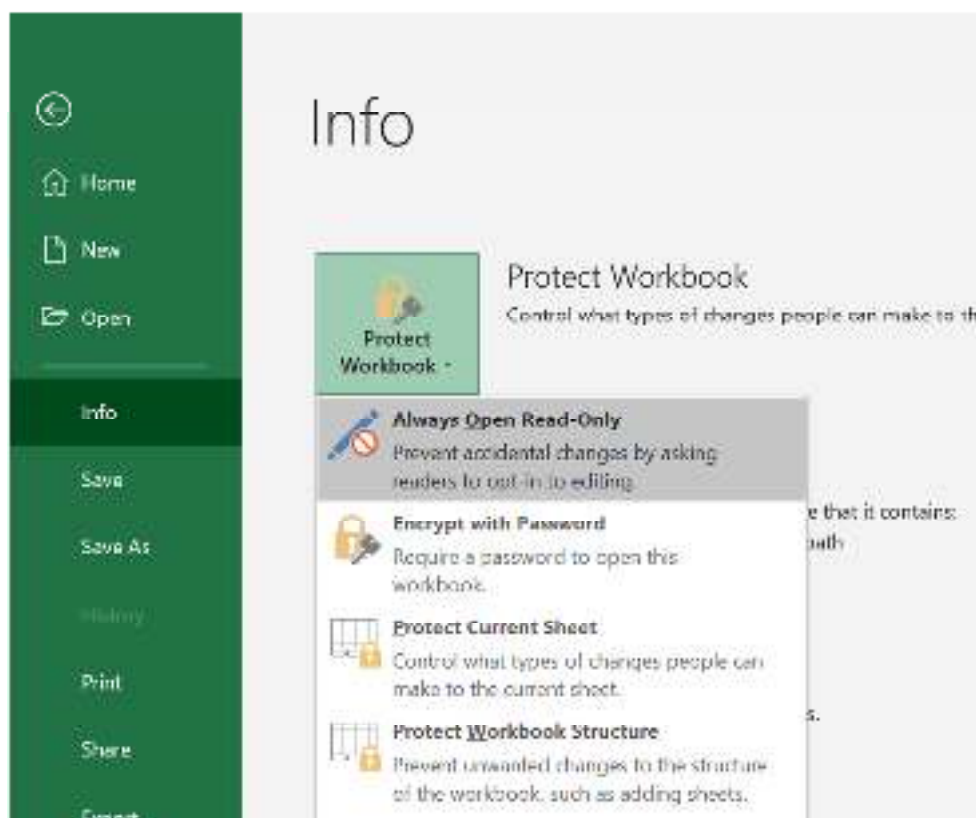
Step 3: Open the file and a warning will be displayed stating the author prefers the file to be opened in read-only mode. This makes the user aware of the author's concerns.

Protecting the structure of a workbook:

To prevent other users from viewing hidden worksheets, adding, moving, deleting, or hiding worksheets, and renaming worksheets, you can protect the structure of your Excel workbook with a password.

Step 1: Click on **Review tab>Protect workbook** (under Changes).

Step 2: Enter a **password** in the password box.
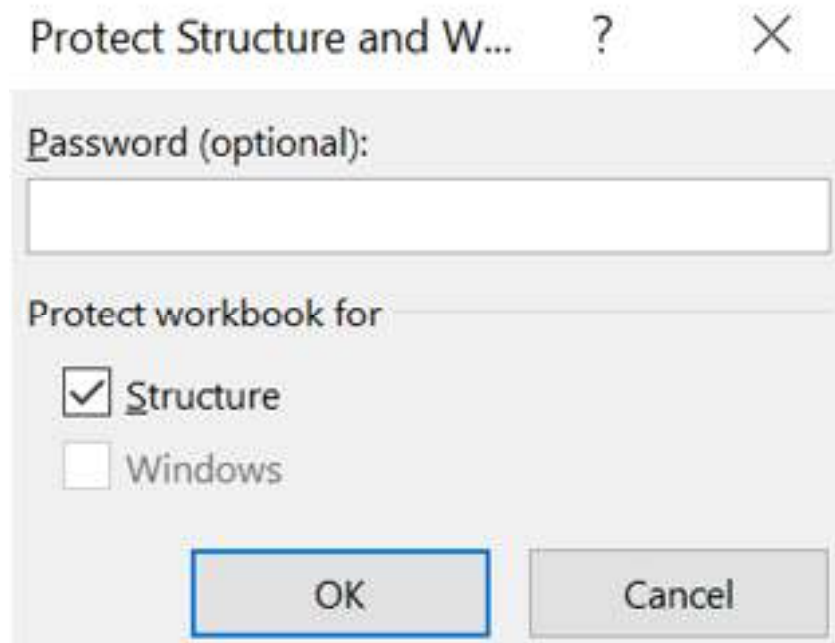
Step 3: Click **ok** and re-enter the password to confirm and hit **OK** again.

To **remove** the password from the workbook Head on to **Review > Protect Workbook > type in the password** and the workbook will be free from the password.

Protecting a worksheet from editing:

To protect the Workbook from editing follow the below steps:

Step 1: Open the worksheet you want to protect.

Step 2: Head on to **Review tab > Protect sheet.**
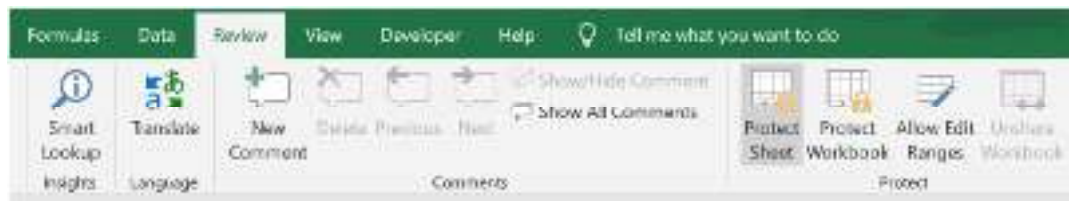
Step 3: This opens a **project sheet dialog** and prompts you to enter a **password** for the sheet. You can check the boxes you want the user to be able to edit after protection and uncheck the rest.
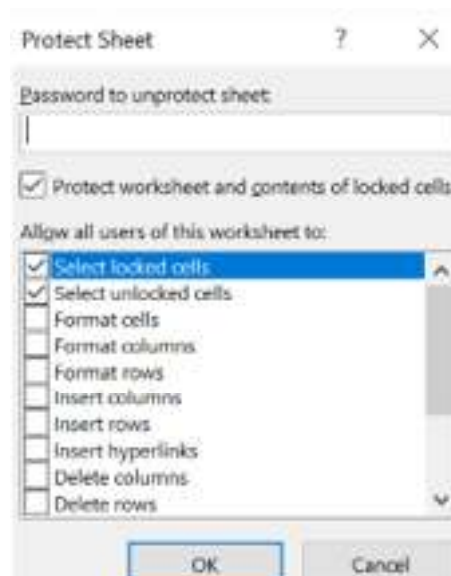
Step 4: Hit **OK** and confirm password (don't lose this password).

Your sheet is now protected, try typing into the sheet and see what excel prompts!
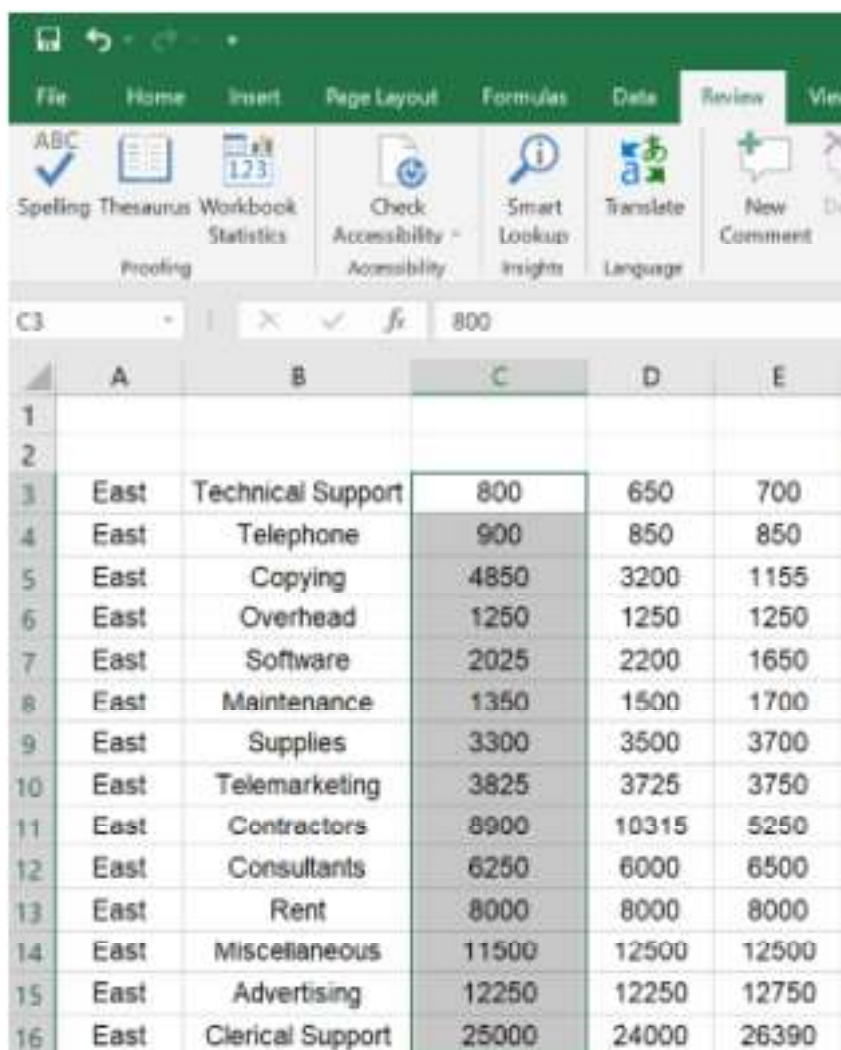
As a developer if you want to make changes to your sheet you can hit the **unprotect sheet** under the r**eview tab>enter the password> make the changes.**

Protect specific cells from editing:

By default, every single cell in an Excel worksheet is locked. So if you head on to the Review tab and hit protected every single cell in the worksheet gets protected and no one can make any changes. But if you want the user to be able to edit certain cells and leave the rest unedited then follow these steps :

Step 1: Open the file you want to protect.

Step 2: Select the cells from the file that you want the **users to be able to edit and make changes to**(cells you want to unlock).

Step 3: Then under the **font section** click on the arrow pointing downwards icon on the **bottom-right** (called font settings)

Step 4: As the **Format cells** dialog box opens up, head on to **Protection**, turn off the **locked property** for the selected cells, and hit ok.

Spreadsheet Modelling (Using Excel)
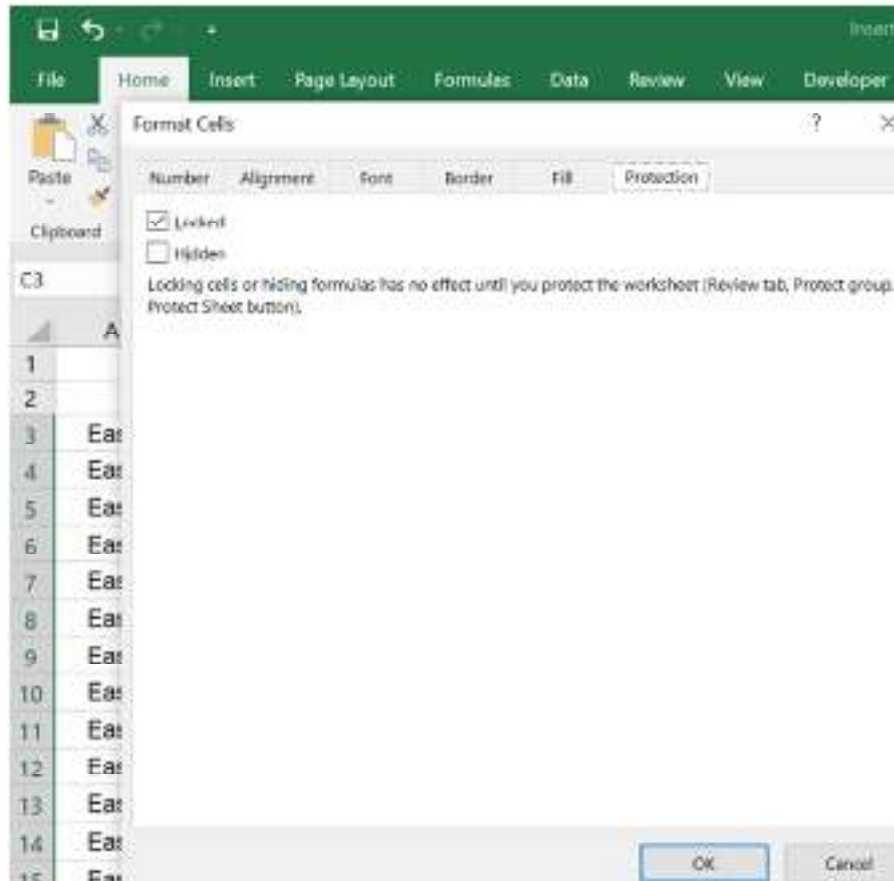
These cells are no longer locked and can be edited by the user. Deciding which cells should be locked and which shouldn't is important while protecting the sheets.

Step 5: Head on to the **Review tab > Protect sheet.** This opens a **protect sheet** dialog and prompts you to enter a **password** for the sheet. You can check the boxes you want the user to be able to edit after protection and uncheck the rest.

Step 6: Hit **OK** and confirm password (don't lose this password).

Step 7: Click ok and re-enter the password to confirm and hit **OK** again.

Summary

- Rows and columns in MS Excel can be managed by inserting, deleting, or adjusting their size. You can easily insert or delete rows and columns to accommodate data changes or to organize your spreadsheet effectively.
- You can adjust the width or height of rows and columns to fit the content or enhance readability. Excel provides options to auto-fit the width or height based on the content or manually specify the size.
- Excel also offers features to hide or unhide rows and columns, which can be useful for temporarily hiding data or focusing on specific sections of your spreadsheet. This helps in managing large data sets and improving the visibility of important information.
- Protecting worksheets in MS Excel helps secure the data and prevent unauthorized changes. It allows you to control who can edit, delete, or move data within the protected sheet, ensuring the integrity of your spreadsheet.
- Excel provides various protection options, such as password protection, which requires a password to unprotect the sheet and make modifications. This adds an extra layer of security to prevent unauthorized access.
- Additionally, you can specify specific cells or ranges to be locked or unlocked within a protected worksheet. This allows certain areas to remain editable while protecting the rest of the sheet, ensuring data accuracy and preventing accidental modifications.

Keywords

- Inserting/deleting rows and columns: Refers to the ability to add or remove rows and columns in an Excel worksheet. Inserting rows or columns allows for expanding the data set or inserting new information, while deleting rows or columns removes unwanted data or adjusts the structure of the worksheet.
- Adjusting row height and column width: Involves modifying the height of rows and the width of columns in Excel. This adjustment helps in accommodating the content within cells, ensuring readability and proper alignment of data.
- Hiding/unhiding rows and columns: Refers to the ability to temporarily conceal rows or columns in an Excel worksheet. Hiding rows or columns can be useful when you want to focus on specific data or temporarily remove information from view. Unhiding rows or columns allows for revealing the hidden data when needed.

Self Assessment

1. You can navigate around an Excel spreadsheet by:
A. Pressing the space bar on your computer keyboard.
B. Using your mouse to click the green File button in the top left hand corner of your screen.
C. Using the navigation bar with an up pointing arrow and down pointing arrow on the right hand side of your screen.
D. By using the screen maximizing block in the top right corner of your screen.

2. How do you know which cell in Excel is currently selected?
A. The selected cell will be highlighted.
B. It will have a black border around it and the contents of the cell will appear in the formula bar (above the grid).
C. There is no way of telling which cell is selected.

D. The number of the selected cell will appear on the status bar at the bottom of the screen.

3. How do you delete numbers from a cell?
A. You have to press the same numbers on your keyboard.
B. By pressing delete several times.
C. It is not possible to delete numbers from a sheet once they have been inserted.
D. By selecting the cell and pressing the delete button on your keyboard.

4. What is the horizontal navigation bar at the bottom right of a spreadsheet used for?
A. To move the view of the spreadsheet to cells on the right or left of the screen.
B. To expand the screen and make it fill your screen.
C. To add horizontal lines to the spreadsheet.
D. To navigate upwards and downwards through a spreadsheet.

5. How do you delete text or numbers from many cells at the same time?
A. It is not possible to do this. You have to select each cell individually.
B. Hold down the control key on your keyboard and press delete.
C. Enter the number of cells you wish to delete into a blank cell and press enter twice.
D. Hold your left mouse button down whilst dragging the mouse cursor across all the cells you wish to select, then press delete.

6. A user wanted to create a numbered list numbered: 1 -10. When they used the Autofill Handle it created a list of 10 number 1s (as pictured above). What is the solution?
A. Insert the formula =Sum(1) in the first cell before using the Autofill handle to increment each successive fill by 1 step.
B. On the Home tab, go to the Editing group and click the Fill button.
C. Select cells A2 to A11. On the Home tab select Merge and Centre to create a numbered list.
D. Click on the Autofill Options icon that appears just after completing an Autofill and select 'Fill Series' from the options.

7. For which of the following lists can you NOT use the Autofill function?
a) Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday.
b) Apples, Pears, Oranges, Passion Fruit, Bananas.
c) January, February, March, April, May, June.
d) You can use Autofill to create all of the above types of lists.

8. How would you create a list where you need a word followed by a number? For example Participant 1, Participant 2, Participant 3 all the way to Participant 200, for example?
A. First type the word 'Participant' in the first cell then use the Autofill handle to copy the word down to 200th cell. Then insert a number in the first cell and copy it down using the Autofill handle again.
B. Type the word and number 'Participant 1' in the first cell and then copy it down to the 200th cell.
C. You need to create a customized list to do this using Autofill options located in the Excel Options – General section.
D. None of the above options are correct.

9. Which of the options listed at a-d below will assist me in creating a workweek roster that contains only the days: Monday, Wednesday, Friday and Saturday?
A. Create a list containing Monday, Wednesday, Friday and Saturday. Select the entire list and use the Autofill handle to fill out the roster with this series.

B. Create a customized list containing Monday, Wednesday, Friday and Saturday using the Custom Lists option located in the Advanced Options – General section in the Backstage view.

C. Both options a and b are correct.

D. Neither option a nor b is correct.

10. How can you use Autofill to QUICKLY recreate the list pictured in the example above?

A. Type the first number in the series, '0', then drag the fill handle down and select 'Series' from the Autofill Options.

B. Launch the Fill Options dialogue box in the Editing group. Check the options for 'column' and 'linear'. For step value insert '50' and for stop value insert '450' and press OK.

C. It is not possible to use Autofill to copy down lists of non-sequential numbers.

D. Type '0' in the first cell and '50' in the second. Select both cells and then use the Fill handle to drag down to the '450' value.

11. The letters in Excel represent the...

A. Rows

B. Columns

C. Cells

D. Data

12. The numbers in Excel represent the….

A. Rows

B. Columns

C. Cells

D. Data

13. What is the cell in the worksheet in which you can type data?

A. Main cell

B. Open cell

C. Active cell

D. Absolute cell

14. The intersection of a row and column.

A. column

B. row

C. cell

D. active cell

15. What does the Protect Workbook function do?

A. It protects all the worksheets in a workbook from being reformatted or typed into

B. It adds a password to access the worksheet.

C. It prevents worksheets from being inserted, deleted or moved.

D. It saves a workbook in a way that will allow only a select group of people to access to it.

16. Casey is doing a very confidential company budget worksheet in Excel. How can she prevent anyone, including the IT department, from being able to open the file and view its contents?

A. By clicking on the Home tab, selecting Protect Sheet and entering a password to prevent access to the sheet.

B. By clicking on the Info tab in the Backstage View, selecting Protect Workbook – Encrypt with Password and entering a password.

C. By clicking on the Review tab and selecting Protect Workbook and entering a password for protecting the sheet.

D. All of the options listed above will block access to the workbook

Answers for Self Assessment

1.	C	2.	B	3.	D	4.	A	5.	D
6.	D	7.	D	8.	B	9.	C	10.	D
11.	B	12.	A	13.	C	14.	C	15.	C
16.	B								

Review Questions

1. How can you insert a new row in an Excel worksheet?
2. What is the purpose of adjusting the column width in Excel?
3. How do you hide a specific column in Excel?
4. What are the steps to delete multiple rows in Excel simultaneously?
5. Explain the importance of adjusting row heights in a worksheet.
6. What is the purpose of using the "Text" data type in Excel?
7. How does Excel handle dates and what data type is used for dates?
8. How can you format a cell or range of cells as currency in Excel?
9. What is the difference between the "Number" and "Percentage" data types in Excel?
10. How can you apply a custom data format to a cell in Excel?
11. What happens when you double-click the fill handle in Excel?
12. How can you use the fill handle to fill a series based on an existing pattern in Excel?
13. Is it possible to customize the default behavior of the fill handle in Excel? If so, how?
14. How can you use the fill handle to quickly populate a range with a formula that references adjacent cells in Excel?

Further Readings

- Business Data Analysis Using Excel, David Whigham
- https://trumpexcel.com/how-to-use-fill-handle-in-excel/
- https://edu.gcfglobal.org/en/excel/modifying-columns-rows-and-cells/1/#
- https://www.geeksforgeeks.org/protecting-excel-worksheets-and-workbooks/

Unit 03: Spreadsheet Calculations

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3.3   Formulae and Functions
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Objectives

In this unit, we will

- Get an Introduction to Range
- Study Naming a Range
- Understand the concept of functions and formulae in MS- Excel.
- Understand the concept of absolute and relative referencing in MS- Excel.
- Understand the concept of working across sheets in MS- Excel.

Introduction

- Whenever we see the word range in excel, we refer to it as a cell or a collection of cells in an excel spreadsheet.
- It can also be used to refer to the adjacent cells or non-adjacent cells in the dataset.
- In excel, each range has its defined set of coordinates or positions, unlike A4:A7, B5: F9C, etc.
- You can perform many operations with ranges in your Excel worksheet, unlike copying the dataset, moving data from one position to another, formatting cells, and even you can name your range.

3.1   Range

Select a Range

- While working with excel, you may want to select a multi cell range so you can easily make a command for all the cells at once.
- For example, let's suppose you can highlight the headers in the cell range A2:E2.
- You select the range and change the background colour of the cells.

A. Select contiguous range of cells

Select the cell from where you want to start selecting your range. In our case, we have selected the B2 cell.
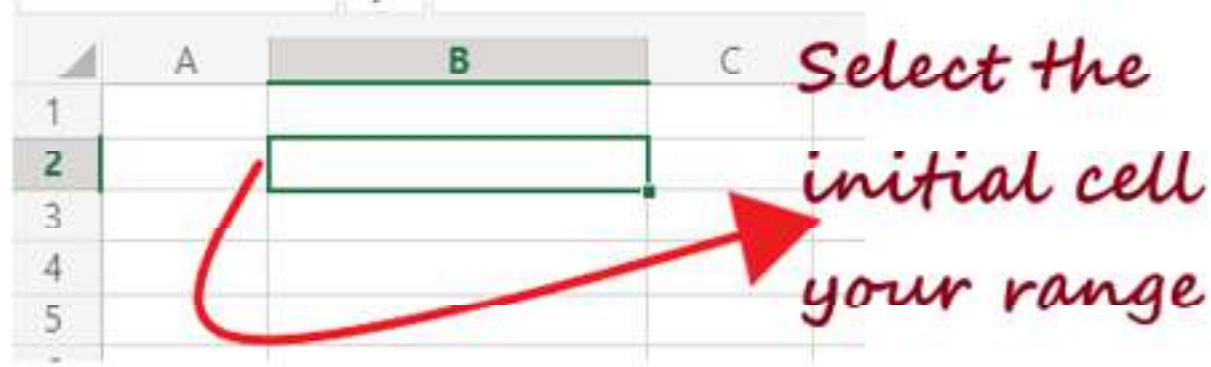
Drag your cursor to the last cell of your range. As you can see, we have dragged our pointer to the D5 cell.
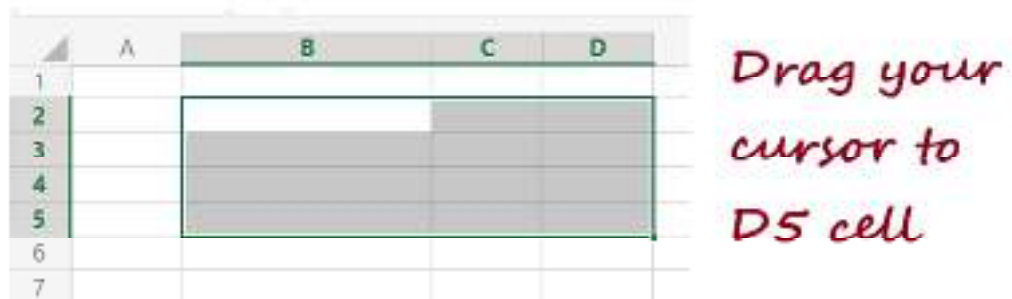
Hence *the range B2: D5 got selected.*
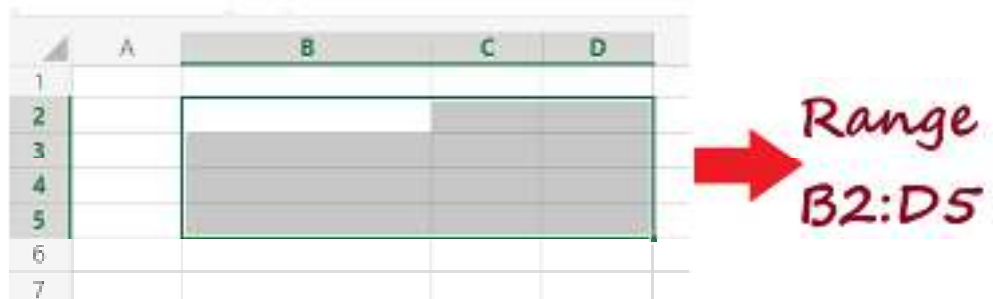
Similarly, you can select any range of cells in your Excel worksheet.

B. Select non-contiguous range of cells

Select the cell from where you want to start selecting your range. In our case, we have selected the B2 cell.
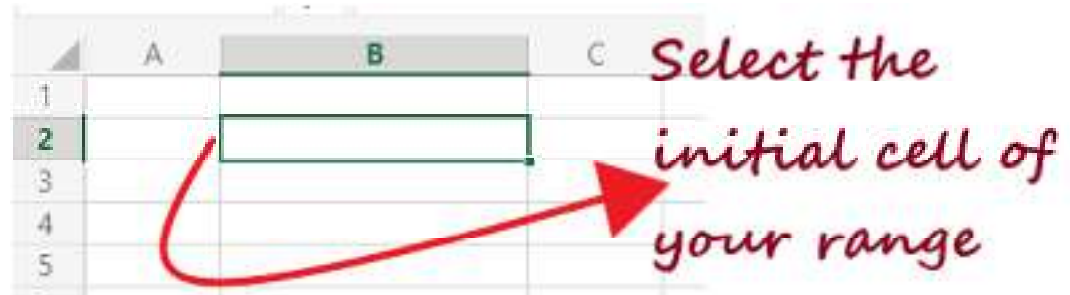
Hold the **'CTRL'** key on your *select and the various non-adjacent cells.* We have selected B2:B6, C3:C6, D4 range of cells.

Non-contiguous range of cells (B2:B6, C3:C6, D4)
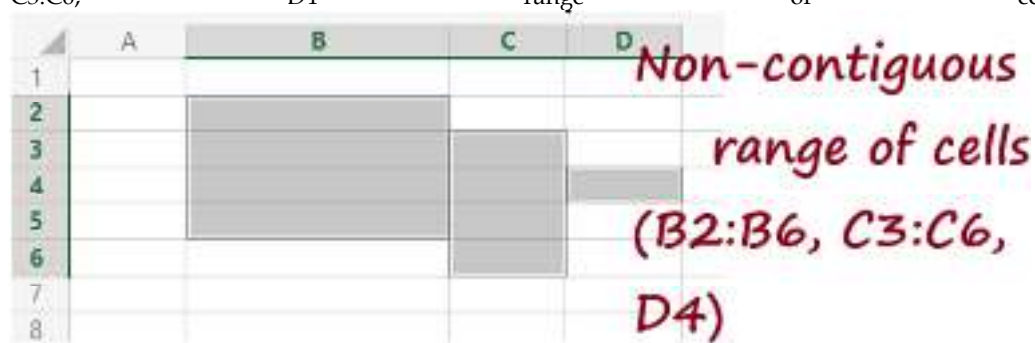
Types of Ranges

1. **Vertical Range**

    Vertical range refers to the selection of the cells within a column. For example, in the below image, the vertical range is A1:A5. However, if you select the entire column, the vertical range would be A: A.
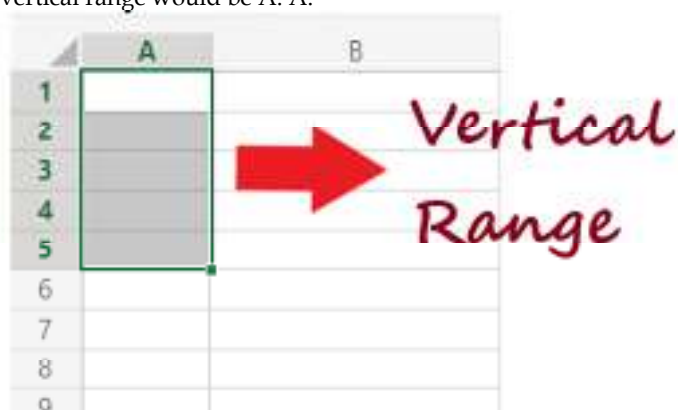
Vertical Range

2. **Horizontal Range**

    Horizontal Range refers to the selection of cells within a row. For example, in the below image, the horizontal range is A2:E2. However, if you select the entire row, the vertical range would be 2:2.

Horizontal Range
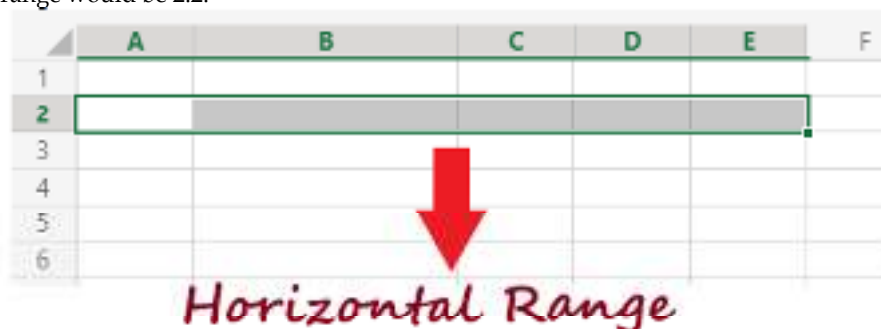
3. **Mixed Range**

   Mixed Range refers to the collection of cells formed by combining adjacent rows and columns. For instance, in the below example, the mixed Range is A2: F10.
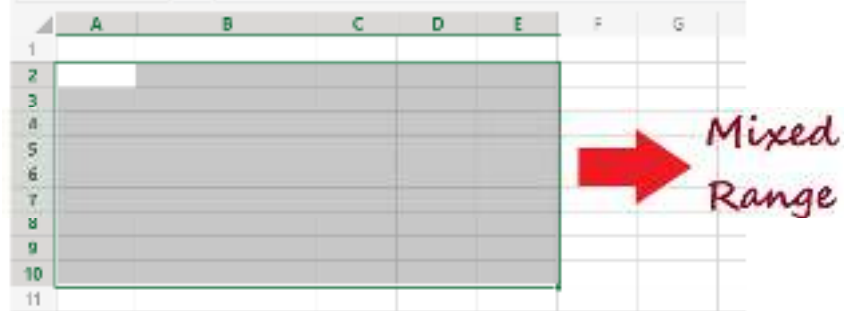
4. **Multiple Selection Range**

   To define a range, it's not necessary to select only the adjacent cells. Therefore with Multiple Selection Range, a collection of non-adjacent cells are selected. For instance, in the below example the Multiple Selection range is B4, B8, C7, D5, D8, E6.

Move a Range

By default, if you move a range of cells in excel, *it will move the data from one location to another along with its formatting* such as font, text or number format, cell borders, font colour, etc.

Follow the given below steps to move a range of cells in Excel:

1. *Select the range of cells* you want to move from one location to another in your excel spreadsheet.
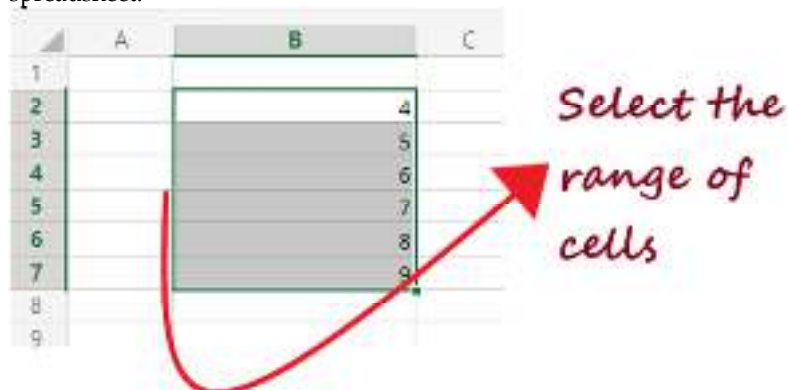
2. As soon as you select the cells, you will notice the entire range of selected *cells become active with a green box* around it.
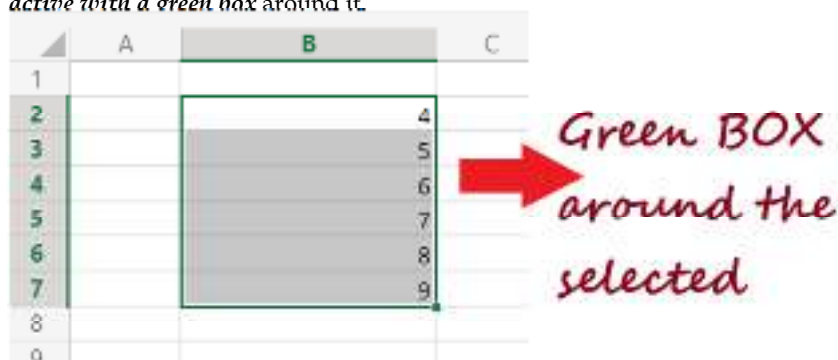
3. Move your cursor to the green border, and you will see that the **cursor changes to a four-headed arrow icon.**
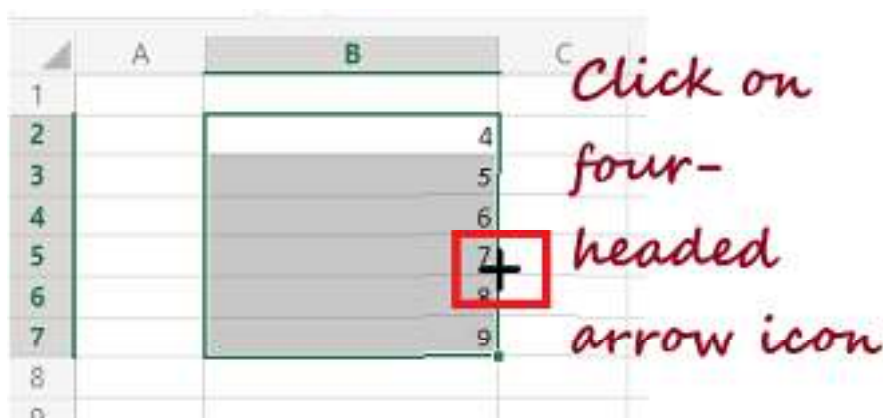
4. Using the arrow *moves the cell to another location within the same Excel worksheet.* Unlike here, we can move it to column E.
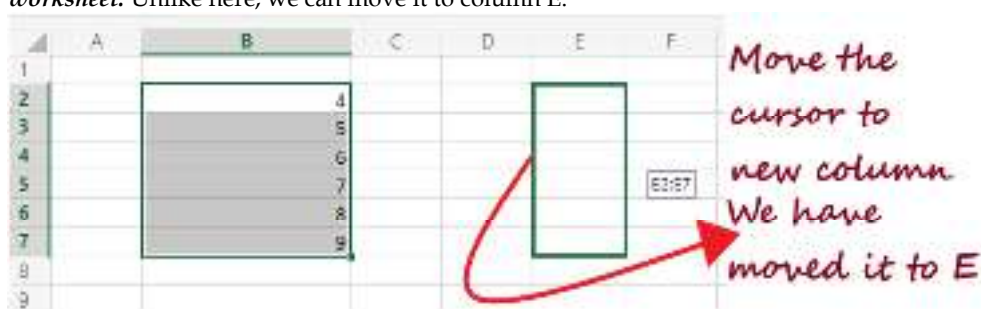
Copy/Paste a Range

By default, if you *copy a range of cells in excel, it will copy the data from one location along with its formatting* such as font, text or number format, cell borders, font colour, etc. and *paste it to its new location.*

Follow the given below steps to copy & paste a range of cells in Excel:

1. ***Select the range of cells*** that you wish to copy.
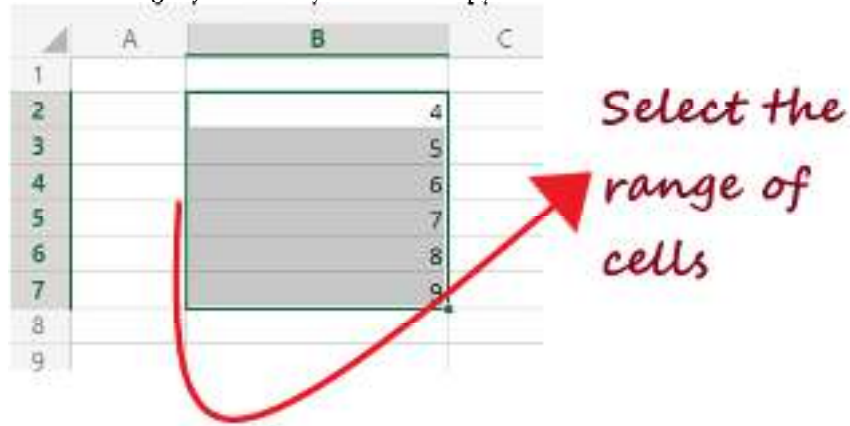
2. Put your cursor on top of your selected cell and right-click on it. The following window will be displayed. Click on the Copy option. Or you can directly press the shortcut key, i.e., ***CTRL + c.***

3. Select the cell from where you want to start pasting the copied cell. Either right-click on the cell and select the paste option or press the **'CTRL + V'** option directly.
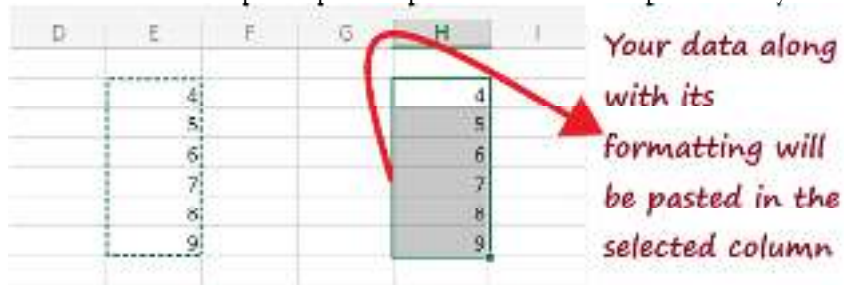
That's it, your data (along with its formatting) will be pasted to the new location of your excel spreadsheet.

Named Range in Excel

A named range is an amazing excel feature used to define the name for a collection of cells or ranges in a worksheet. Named range works as an added advantage as it helps to calculate functions and formulas quickly.

To add a named range in your Excel worksheet, follow the below steps:

1. Select the range of cells for which you want to define the name.
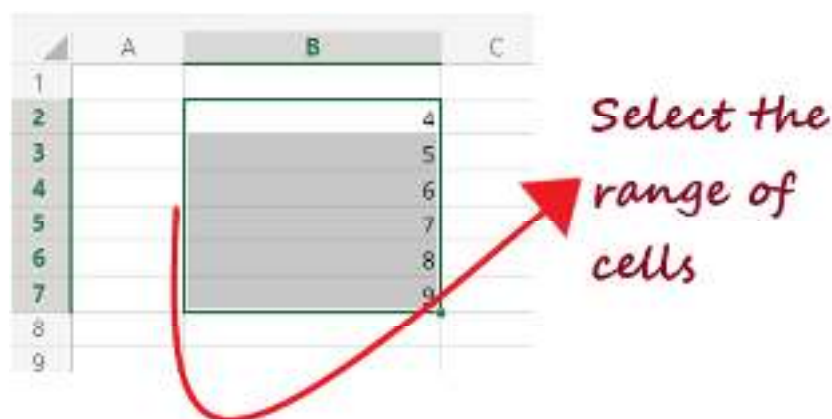
2. Go to the ribbon toolbar located at the top of your Excel window. Click on the Formulas tab -> Defined Names group -> Define Name option.

3. The New Name window will open (as shown below). In the descriptive name textbox, enter any suitable name for the range. In our case, we have entered Student_Marks as the name for the selected range.
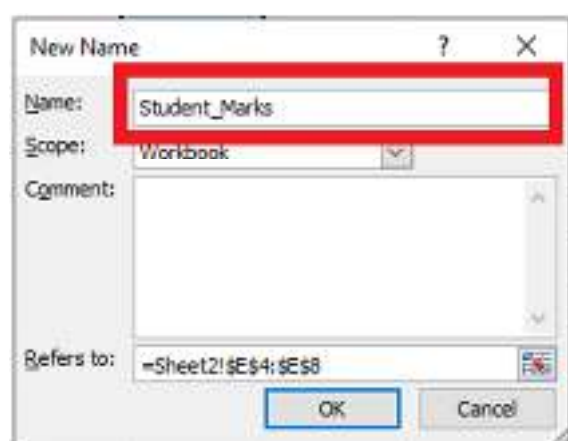
4. After specifying the name, it's time to specify the range of cells from which you want to apply the name; therefore, in the "Refers to" box, select the range from your Excel worksheet.
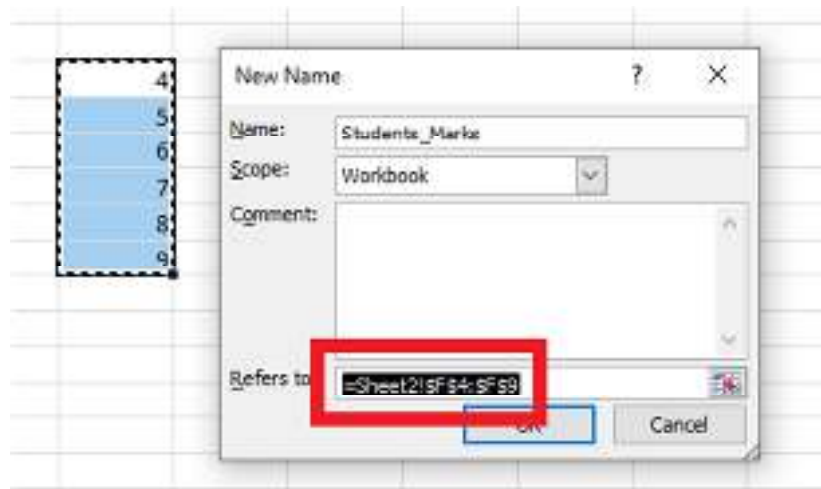
5. Once done, click on the OK button.
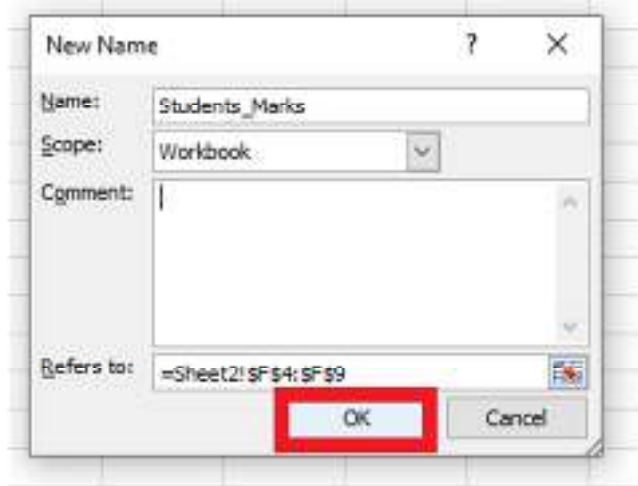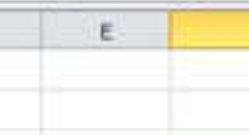
5. The window will be closed, and when you return to the spreadsheet, you will notice the name Students_Marks is highlighted in the Name box for the selected range of cells (as shown in the image below).

6. Now that we have defined the range's name, we can directly use the name Student_Marks in formulas to refer to the named range of cells. For example, type the below formula in your excel worksheet.

=SUM(Student_Marks)

8. The SUM formula will quickly *calculate the sum of all numbers* present in a defined range and will give you the following result.

=SUM(Student_Marks)

8. The SUM formula will quickly *calculate the sum of all numbers* present in a defined range and will give you the following result.

Result: 55

Spreadsheet Modelling (Using MS Excel)

Excel Named Range - Makes it Easy!!

- Excel Named Ranges makes it easy to refer to data sets in Excel.
- You can create a named range in Excel for each data category, and then use that name instead of the cell references. For example, dates can be named 'Date', Sales Rep data can be named 'SalesRep' and sales data can be named 'Sales'.

Benefits of Creating Named Ranges in Excel

- Use Names instead of Cell References
- No Need to Go Back to the Dataset to Select Cells

- Named Ranges Make Formulas Dynamic

3.2 Absolute, Relative, and Mixed Cell References in Excel

- A worksheet in Excel is made up of cells. These cells can be referenced by specifying the row value and the column value.
- For example, A1 would refer to the first row (specified as 1) and the first column (specified as A). Similarly, B3 would be the third row and second column.
- The power of Excel lies in the fact that you can use these cell references in other cells when creating formulas.

Now there are three kinds of cell references that you can use in Excel:

1. Relative Cell References
2. Absolute Cell References
3. Mixed Cell References

Understanding these different types of cell references will help you work with formulas and save time (especially when copy-pasting formulas).

What are Relative Cell References in Excel?

Suppose we have a data set shown below:

	A	B	C	D
1	Item	Price	Quantity	Total
2	Item A	15	15	
3	Item B	20	20	
4	Item C	12	18	
5	Item D	18	8	
6	Item E	8	10	
7	Item F	10	20	
8	Item G	20	10	

To calculate the total for each item, we need to multiply the price of each item with the quantity of that item.

For the first item, the formula in cell D2 would be B2* C2 (as shown below):

D2		× ✓ f_x	=B2*C2	
	A	B	C	D
1	Item	Price	Quantity	Total
2	Item A	15	15	225
3	Item B	20	20	
4	Item C	12	18	
5	Item D	18	8	
6	Item E	8	10	
7	Item F	10	20	
8	Item G	20	10	

Now, instead of entering the formula for all the cells one by one, you can simply copy cell D2 and paste it into all the other cells (D3:D8). When you do it, you will notice that the cell reference automatically adjusts to refer to the corresponding row. For example, the formula in cell D3 becomes B3*C3 and the formula in cell D4 becomes B4*C4.

	A	B	C	D
1	Item	Price	Quantity	Total
2	Item A	15	15	225
3	Item B	20	20	
4	Item C	12	18	
5	Item D	18	8	
6	Item E	8	10	
7	Item F	10	20	
8	Item G	20	10	

These cell references that adjust itself when the cell is copied are called **relative cell references in Excel**.

When to Use Relative Cell References in Excel?

Relative cell references are useful when you have to create a formula for a range of cells and the formula needs to refer to a relative cell reference.

In such cases, you can create the formula for one cell and copy-paste it into all cells.

What are Absolute Cell References in Excel?

Unlike relative cell references, absolute cell references don't change when you copy the formula to other cells.

For example, suppose you have the data set as shown below where you have to calculate the commission for each item's total sales.

The commission is 20% and is listed in cell G1.

	A	B	C	D	E	F	G
1	Item	Price	Quantity	Total	Commission		20%
2	Item A	15	15	225			
3	Item B	20	20	400			
4	Item C	12	18	216			
5	Item D	18	8	144			
6	Item E	8	10	80			
7	Item F	10	20	200			
8	Item G	20	10	200			

To get the commission amount for each item sale, use the following formula in cell E2 and copy for all cells:

Note that there are two dollar signs ($) in the cell reference that has the commission – $G$2.

What does the Dollar ($) sign do?

A dollar symbol, when added in front of the row and column number, makes it absolute (i.e., stops the row and column number from changing when copied to other cells).

For example, in the above case, when I copy the formula from cell E2 to E3, it changes from =D2*$G$1 to =D3*$G$1.

Note that while D2 changes to D3, $G$1 doesn't change.

Since we have added a dollar symbol in front of 'G' and '1' in G1, it wouldn't let the cell reference change when it's copied.

Hence this makes the cell reference absolute.

When to Use Absolute Cell References in Excel?

Absolute cell references are useful when you don't want the cell reference to change as you copy formulas. This could be the case when you have a fixed value that you need to use in the formula (such as tax rate, commission rate, number of months, etc.)

While you can also hard code this value in the formula (i.e., use 20% instead of $G$2), having it in a cell and then using the cell reference allows you to change it at a future date.

For example, if your commission structure changes and you're now paying out 25% instead of 20%, you can simply change the value in cell G2, and all the formulas would automatically update.

What are Mixed Cell References in Excel?

Mixed cell references are a bit more tricky than the absolute and relative cell references.

There can be two types of mixed cell references:

- The row is locked while the column changes when the formula is copied.
- The column is locked while the row changes when the formula is copied.

Let's see how it works using an example.

Below is a data set where you need to calculate the three tiers of commission based on the percentage value in cell E2, F2, and G2.

	A	B	C	D	E	F	G
1						Commission	
2					10%	15%	20%
3	Item	Price	Quantity	Total	Tier 1	Tier 2	Tier 3
4	Item A	15	15	225			
5	Item B	20	20	400			
6	Item C	12	18	216			
7	Item D	18	8	144			
8	Item E	8	10	80			
9	Item F	10	20	200			
10	Item G	20	10	200			

Now you can use the power of mixed reference to calculate all these commissions with just one formula.

Enter the below formula in cell E4 and copy for all cells.

=$B4*$C4*E$2

E4 f_x =$B4*$C4*E$2

	A	B	C	D	E	F	G
1						Commission	
2					10%	15%	20%
3	Item	Price	Quantity	Total	Tier 1	Tier 2	Tier 3
4	Item A	15	15	225	22.5	33.75	45
5	Item B	20	20	400	40	60	80
6	Item C	12	18	216	21.6	32.4	43.2
7	Item D	18	8	144	14.4	21.6	28.8
8	Item E	8	10	80	8	12	16
9	Item F	10	20	200	20	30	40
10	Item G	20	10	200	20	30	40

The above formula uses both kinds of mixed cell references (one where the row is locked and one where the column is locked).

Let's analyze each cell reference and understand how it works:

- **$B4 (and $C4)** – In this reference, the dollar sign is right before the Column notation but not before the Row number. This means that when you copy the formula to the cells on the right, the reference will remain the same as the column is fixed. For example, if you copy the formula from E4 to F4, this reference would not change. However, when you copy it down, the row number would change as it is not locked.
- **E$2** – In this reference, the dollar sign is right before the row number, and the Column notation has no dollar sign. This means that when you copy the formula down the cells, the reference will not change as the row number is locked. However, if you copy the formula to the right, the column alphabet would change as it's not locked.

How to Change the Reference from Relative to Absolute (or Mixed)?

To change the reference from relative to absolute, you need to add the dollar sign before the column notation and the row number.

For example, A1 is a relative cell reference, and it would become absolute when you make it $A$1.

If you only have a couple of references to change, you may find it easy to change these references manually. So you can go to the formula bar and edit the formula (or select the cell, press F2, and then change it).

However, a faster way to do this is by using the keyboard shortcut – F4.

When you select a cell reference (in the formula bar or in the cell in edit mode) and press F4, it changes the reference.

Suppose you have the reference =A1 in a cell.

Here is what happens when you select the reference and press the F4 key.

- **Press F4 key once:** The cell reference changes from A1 to $A$1 (becomes 'absolute' from 'relative').

- **Press F4 key two times:** The cell reference changes from A1 to A$1 (changes to mixed reference where the row is locked).

- **Press F4 key three times:** The cell reference changes from A1 to $A1 (changes to mixed reference where the column is locked).

- **Press F4 key four times:** The cell reference becomes A1 again.

3.3   Formulae and Functions

Formulas and functions are the building blocks of working with numeric data in Excel. This article introduces you to formulas and functions.

What is Formulas in Excel?

FORMULAS IN EXCEL is an expression that operates on values in a range of cell addresses and operators. For example, =A1+A2+A3, which finds the sum of the range of values from cell A1 to cell A3. An example of a formula made up of discrete values like =6*3.

```
=A2 * D2 / 2
```

- "=" tells Excel that this is a formula, and it should evaluate it.
- "A2" * D2" makes reference to cell addresses A2 and D2 then multiplies the values found in these cell addresses.
- "/" is the division arithmetic operator
- "2" is a discrete value

Formulas practical exercise

We will work with the sample data for the home budget to calculate the subtotal.

- Create a new workbook in Excel
- Enter the data shown in the home supplies budget above.
- Your worksheet should look as follows.

Spreadsheet Modelling (Using MS Excel)

We will now write the formula that calculates the subtotal

Set the focus to cell E4

Enter the following formula.

=C4*D4

HERE,

- "C4*D4" uses the arithmetic operator multiplication (*) to multiply the value of the cell address C4 and D4.

Press enter key

You will get the following result

The following animated image shows you how to auto select cell address and apply the same formula to other rows.
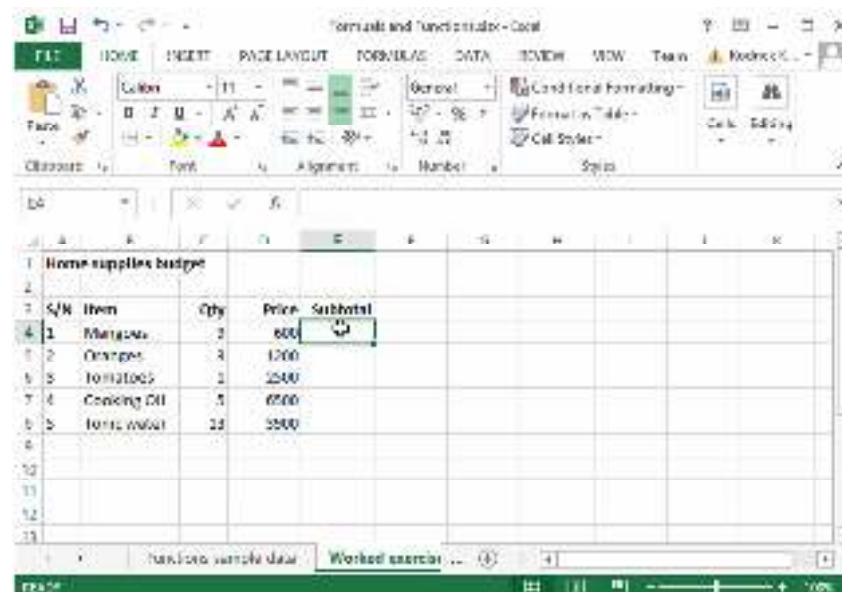
Mistakes to avoid when working with formulas in Excel

Lovely Professional University

1. Remember the rules of Brackets of Division, Multiplication, Addition, & Subtraction **(BODMAS).** This means expressions are brackets are evaluated first. For arithmetic operators, the division is evaluated first followed by multiplication then addition and subtraction is the last one to be evaluated. Using this rule, we can rewrite the above formula as =(A2 * D2) / 2. This will ensure that A2 and D2 are first evaluated then divided by two.

2. Excel spreadsheet formulas usually work with numeric data; you can take advantage of data validation to specify the type of data that should be accepted by a cell i.e. numbers only.

3. To ensure that you are working with the correct cell addresses referenced in the formulas, you can press F2 on the keyboard. This will highlight the cell addresses used in the formula, and you can cross check to ensure they are the desired cell addresses.

4. When you are working with many rows, you can use serial numbers for all the rows and have a record count at the bottom of the sheet. You should compare the serial number count with the record total to ensure that your formulas included all the rows.

What is Function in Excel?

FUNCTION IN EXCEL is a predefined formula that is used for specific values in a particular order. Function is used for quick tasks like finding the sum, count, average, maximum value, and minimum values for a range of cells. For example, cell A3 below contains the SUM function which calculates the sum of the range A1:A2.

- **SUM** for summation of a range of numbers

- **AVERAGE** for calculating the average of a given range of numbers

- **COUNT** for counting the number of items in a given range

The importance of functions

Functions increase user productivity when working with excel. Let's say you would like to get the grand total for the above home supplies budget. To make it simpler, you can use a formula to get the grand total. Using a formula, you would have to reference the cells E4 through to E8 one by one. You would have to use the following formula.

= E4 + E5 + E6 + E7 + E8

With a function, you would write the above formula as

=SUM (E4:E8)

As you can see from the above function used to get the sum of a range of cells, it is much more efficient to use a function to get the sum than using the formula which will have to reference a lot of cells.

Common functions

Let's look at some of the most commonly used functions in ms excel formulas. We will start with statistical functions.

S/N	FUNCTION	CATEGORY	DESCRIPTION	USAGE
01	SUM	Math & Trig	Adds all the values in a range of cells	=SUM(E4:E8)
02	MIN	Statistical	Finds the minimum value in a range of cells	=MIN(E4:E8)
03	MAX	Statistical	Finds the maximum value in a range of cells	=MAX(E4:E8)
04	AVERAGE	Statistical	Calculates the average value in a range of cells	=AVERAGE(E4:E8)

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S/N	FUNCTION	CATEGORY	DESCRIPTION	USAGE
05	COUNT	Statistical	Counts the number of cells in a range of cells	=COUNT(E4:E8)
06	LEN	Text	Returns the number of characters in a string text	=LEN(B7)
07	SUMIF	Math & Trig	Adds all the values in a range of cells that meet a specified criteria. =SUMIF(range,criteria,[sum_range])	=SUMIF(D4:D8,">=1000",C4:C8)
08	AVERAGEIF	Statistical	Calculates the average value in a range of cells that meet the specified criteria. =AVERAGEIF(range,criteria,[average_range])	=AVERAGEIF(F4:F8,"Yes",E4:E8)
09	DAYS	Date & Time	Returns the number of days between two dates	=DAYS(D4,C4)
10	NOW	Date & Time	Returns the current system date and time	=NOW()

Numeric Functions

As the name suggests, these functions operate on numeric data. The following table shows some of the common numeric functions.

S/N	FUNCTION	CATEGORY	DESCRIPTION
1	ISNUMBER	Information	Returns True if the supplied value is numeric and False if it is not numeric
2	RAND	Math & Trig	Generates a random number between 0 and 1
3	ROUND	Math & Trig	Rounds off a decimal value to the specified number of decimal points
4	MEDIAN	Statistical	Returns the number in the middle of the set of given numbers
5	PI	Math & Trig	Returns the value of Math Function PI(π)
6	POWER	Math & Trig	Returns the result of a number raised to **POWER(number, power)**
7	MOD	Math & Trig	Returns the Remainder when you divide two numbers
8	ROMAN	Math & Trig	Converts a number to roman numerals

String functions

These basic excel functions are used to manipulate text data. The following table shows some of the common string functions.

S/N	FUNCTION	CATEGORY	DESCRIPTION	USAGE
1	LEFT	Text	Returns a number of specified characters from the start (left-hand side) of a string	=LEFT("GUR
2	RIGHT	Text	Returns a number of specified characters from the end (right-hand side) of a string	=RIGHT("GU
3	MID	Text	Retrieves a number of characters from the middle of a string from a specified start position and length. **=MID (text, start_num, num_chars)**	=MID("GURU
4	ISTEXT	Information	Returns True if the supplied parameter is Text	=ISTEXT(valu
5	FIND	Text	Returns the starting position of a text string within another text string. This function is case-sensitive. **=FIND(find_text, within_text, [start_num])**	=FIND("oo",
6	REPLACE	Text	Replaces part of a string with another specified string. **=REPLACE (old_text, start_num, num_chars, new_text)**	=REPLACE("

Date Time Functions

These functions are used to manipulate date values. The following table shows some of the common date functions

S/N	FUNCTION	CATEGORY	DESCRIPTION	USAGE
1	DATE	Date & Time	Returns the number that represents the date in excel code	=DATE(2015,2,4)
2	DAYS	Date & Time	Find the number of days between two dates	=DAYS(D6,C6)
3	MONTH	Date & Time	Returns the month from a date value	=MONTH("4/2/2015")
4	MINUTE	Date & Time	Returns the minutes from a time value	=MINUTE("12:31")
5	YEAR	Date & Time	Returns the year from a date value	=YEAR("04/02/2015")

Formula vs Function

Formula in Excel	Function in Excel
The user writes a formula.	A function is pre-existing in the excel spreadsheet.
You can use any operation within a formula to calculate whatever values you need.	Functions cannot be customised. A user can choose from numerous functions available to perform the calculations.
Formulas can be used to calculate values within a range of cells or a single cell.	Functions can be used to find maximum or minimum values throughout the spreadsheet. Few other functions include – finding the lowest or highest digit or arranging values in ascending or descending order and for many other functions.
A Formula cannot be modified according to your requirements.	But a function can be modified based on the developer's requirements.
A formula cannot be used as a function.	A function can be used as a formula.
Simple calculations can be performed manually using a formula.	While complex calculations using a function are more difficult to do.
Formulas do not have a particular syntax in excel.	Whereas, Functions follow a particular syntax in excel. Syntax has to be followed in order.
Predefined parameters are not relevant to a formula.	Functions have their own set of pre-designed parameters on which to operate to get outcomes.

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3.4 Working Across Sheets

Most of the time, we create or insert formulas for a single worksheet in Excel. But sometimes, we need to create formulas for multiple Excel worksheets. By doing so, we can save a lot of time. In this tutorial, we will learn how to calculate data across worksheets with formulas in Excel easily.

4 Easy Ways to Calculate Data Across Worksheets with Formulas in Excel

This article will guide you with **four** easy ways to calculate data **across worksheets** with **formulas** in Excel. To demonstrate the methods, we will use a dataset (**B4:E9**) that contains the **Names** and **marks** of **Math**, **History** and **Economics** of some **students**. We will use some excellent examples with explanations so that anyone can easily understand them. So without further delay, let's get started.

1. Calculate Data Across Worksheets Using Excel Formula with Shift Key

In the first method, we will use the **Shift** key for inserting **formulas** in Excel to **calculate** data **across worksheets**. Here, we will use **the SUM function** in Excel for calculating the total marks in **Math** for all the tests (**Test 1**, **Test 2**, **Test 3**, **Test 4** & **Test 5**). For this, we will use the dataset (**B4:E9**) below. The steps are below.

Steps:

- Firstly, click on the **Shift Key** tab located at the **bottom** of the **worksheet**.

- Secondly, select cell **C5**.

- Thirdly, enter the **SUM** function in cell **C5**.

- Now, click on the **Test1** sheet tab.

- Consequently, you can see **Test1** in the **Formula Bar**.

- After that, click on the **Test5** tab holding down the **Shift** key.

- Then, select cell **C5** of the **Test1** worksheet.

- Thereupon, go to the **Formula Bar** and close the **parentheses** (see screenshot).
- The final **formula** is given below:

=SUM('Test1:Test5'!C5)

- Finally, press the **Enter** key to get the result in cell **C5**.

- To **copy** the formula in the rest of the cells, drag the **fill handle** to the **right** (up to cell **E5**).

- After dragging to the **right**, select them and **double-click** on the plus sign to autofill the next cells.

- In this way, we can **calculate** the **total marks** for all subjects (see the picture below).

2. Manually Insert Formulas to Calculate Data for Several Excel Worksheets

Here, we will insert a **formula** manually for several **worksheets** to calculate the **total marks** of the **History** of the dataset (**B4:E9**) below. We will insert the **formula** in cell **D5** of the dataset. Follow the steps below to insert the formula.

Steps:

- First of all, go to cell **D5**.

- Next, to get the **total marks** of **History**, enter the following formula in cell **D5**:

=Test1!D5+Test2!D5+Test3!D5+Test4!D5+Test5!D5

- After that, press the **Enter** key.

- Therefore, you will get the **total marks** of **History** for all the tests in cell **D5**.

Finally, drag the **fill handle** to **copy** the **formula** up to cell **D9** (see screenshot).

- Similarly, we can also calculate the total marks of **Math** by inserting the following **formula** in cell **C5** and then use the **fill handle** tool up to cell **C9**:

=Test1!C5+Test2!C5+Test3!C5+Test4!C5+Test5!C5

- Moreover, calculate the total marks of **Economics** by typing the formula below in cell **E5** and then autofill the next cells by **double-clicking** on the **plus** sign:

=Test1!E5+Test2!E5+Test3!E5+Test4!E5+Test5!E5

- The final result is in the picture below.

Summary

- Remember the rules of Brackets of Division, Multiplication, Addition, & Subtraction **(BODMAS).** This means expressions are brackets are evaluated first. For arithmetic operators, the division is evaluated first followed by multiplication then addition and subtraction is the last one to be evaluated. Using this rule, we can rewrite the above formula as =(A2 * D2) / 2. This will ensure that A2 and D2 are first evaluated then divided by two.

- Excel spreadsheet formulas usually work with numeric data; you can take advantage of data validation to specify the type of data that should be accepted by a cell i.e. numbers only.

- To ensure that you are working with the correct cell addresses referenced in the formulas, you can press F2 on the keyboard. This will highlight the cell addresses used in the formula, and you can cross check to ensure they are the desired cell addresses.
- When you are working with many rows, you can use serial numbers for all the rows and have a record count at the bottom of the sheet. You should compare the serial number count with the record total to ensure that your formulas included all the rows.

Keywords

- Range: A group or selection of cells in Excel.
- Cell: A single unit within a range that holds data.
- Selection: The act of choosing a range or multiple cells in Excel.
- Reference: A cell or range address used in formulas or functions.
- Range Name: A defined name given to a specific range of cells.
- Merge Cells: Combining multiple adjacent cells into a single larger cell.
- Copy Range: Duplicating a range of cells and placing it elsewhere in the worksheet.
- Paste Range: Placing copied or cut cells into a new location in the worksheet.
- Fill Range: Automatically filling a range of cells with a series, such as numbers or dates.
- Sort Range: Reordering the cells within a range based on certain criteria.
- Filter Range: Displaying only the cells within a range that meet specific conditions.
- Conditional Formatting: Applying formatting rules to a range based on specified criteria.
- Sum Range: Calculating the sum of a range of cells.
- Average Range: Calculating the average value of a range of cells.
- Max Range: Finding the maximum value within a range of cells.
- Min Range: Finding the minimum value within a range of cells.
- Count Range: Counting the number of cells that contain data within a range.

- Relative Reference: A reference that changes based on the location of the formula when copied or filled to other cells. It adjusts automatically to its new position relative to the original cell.
- Absolute Reference: A reference that remains constant when copied or filled to other cells. It always refers to the same cell, regardless of its new location.
- Mixed Reference: A reference that contains both relative and absolute components. You can lock either the row or column reference while allowing the other to change.
- $ Symbol: The dollar sign ($) is used to indicate an absolute reference in Excel. Placing a $ before the column letter or row number locks that component of the reference.
- F4 Key: Pressing the F4 key on your keyboard can toggle between different reference types (relative, absolute, mixed) when editing a formula in Excel. It helps quickly switch between reference modes.

Self Assessment

1. Microsoft Excel is used for?

A. Analysis
B. Data Entry
C. Data Management
D. All of the above

2. What is the collection of worksheets called?

A. Ledger
B. Book
C. Testbook
D. Workbook

3. How do you display current date only in MS Excel?
A. Date ()
B. Today ()
C. Now ()
D. Time ()

4. What does COUNTA () function do?
A. Counts cells having alphabets
B. Counts empty cells
C. Counts cells having number
D. Counts non-empty cells

5. You can check the conditions against _____ when applying conditional formatting
A. Cell value
B. Formula
C. Both of above
D. None of above

6. It is much important to give a ………………………… sign at the beginning of the formula.
A. plus sign
B. minus sign
C. Hyphen
D. is equal to sign

7. It shows the types of operations
A. Operators
B. symbols
C. Operands
D. None of these

8. This type of operators are used for performing mathematical calculations.
A. Comparison
B. Logical
C. Arithmetic
D. All of the above

9. This type of operators are used for making comparison between two values.
A. Comparison
B. Logical
C. Arithmetic
D. All of the above

10. When you copy a formula?
A. Excel erases the original copy of the formula
B. Excel edits cell references in the newly copied formula
C. Excel adjusts absolute cell references
D. Excel doesn't adjust relative cell references

11. Which of the following is an absolute cell reference?
A. A.!A!1
B. B.$A$1
C. C.#a#1
D. D.A1

12. When a range is selected, how can you activate the previous cell?
A. Press the Alt key
B. Press Tab
C. Press Enter
D. None of above

13. Where can you set the shading color for a range of cells in Excel?
A. Choose required color form Patterns tab of Format Cells dialog box

B. Choose required color on Fill Color tool in Formatting toolbar

C. Choose required color on Fill Color tool in Drawing toolbar

D. All of above

14. The Name box on to the left of formula bar

A. Shows the name of workbook currently working on

B. Shows the name of worksheet currently working on

C. Shows the name of cell or range currently working on

D. None of above

15. If you need to remove only the formatting done in a range (numbers and formula typed there should not be removed), you must
A. From Edit menu choose Clear and then Formats
B. From Edit menu choose Delete
C. Click on Remove Formatting tool on Standard Toolbar
D. Double click the Format Painter and then press Esc key in keyboard

16. You cannot use a named range in a formula that references another worksheet.
A. True
B. False

Answers for Self Assessment

1.	D	2.	D	3.	B	4.	D	5.	C
6.	D	7.	A	8.	C	9.	A	10.	B
11.	B	12.	D	13.	D	14.	C	15.	A
16.	B								

Review Questions

1. What is the difference between a formula and a function in Excel? Provide examples of each.
2. How can you use the SUM function to add up a range of cells in Excel? Provide an example.
3. What is the purpose of using absolute references ($) in formulas? Give an example where absolute references are useful.
4. How can you nest functions within a formula in Excel? Provide an example of a nested function.
5. What is the IF function in Excel, and how is it used? Provide an example of an IF function formula.
6. How can you reference a cell from a different sheet in a formula? Provide an example.
7. What is the purpose of using the sheet name in a cell reference? How can you include the sheet name in a reference?
8. How can you perform calculations across multiple sheets using the SUM function in Excel? Provide an example.
9. How do you create a 3D reference to calculate across multiple sheets? Explain the syntax and provide an example.
10. What are the potential challenges or considerations when performing calculations across sheets in Excel? How can you overcome these challenges?

Further Readings

- https://www.javatpoint.com/range-in-excel
- https://www.excel-easy.com/introduction/range.html
- https://trumpexcel.com/find-range-in-excel/
- https://trumpexcel.com/named-ranges-in-excel/
- https://www.w3schools.com/excel/excel_formulas.php
- https://www.guru99.com/introduction-to-formulas-and-functions-in-excel.html
- https://www.excel-easy.com/introduction/formulas-functions.html
- https://www.wallstreetmojo.com/basic-excel-formulas/
- https://edu.gcfglobal.org/en/excelformulas/functions/1/#
- https://trumpexcel.com/excel-functions/
- https://www.exceldemy.com/how-to-calculate-formulas-across-worksheets-in-excel/

Unit 04: Formatting Spreadsheets

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Objectives

After this unit, you will be able to

- understand the process of formatting excel sheets.
- understand borders and their use in MS - Excel.
- Change horizontal cell alignment.
- Change vertical cell alignment.
- Change text control
- Change text orientation
- Understand different number formats in Excel.

Introduction

- All cell content uses the same formatting by default, which can make it difficult to read a workbook with a lot of information.
- Basic formatting can customize the look and feel of your workbook, allowing you to draw attention to specific sections and making your content easier to view and understand.
- One can also apply number formatting to tell Excel exactly what type of data you're using in the workbook, such as percentages (%), currency ($), and so on.

4.1   Formatting Excel Sheets

To change Font

- By default, the font of each new workbook is set to Calibri.
- However, Excel provides many other fonts you can use to customize your cell text.

- • In the example below, we'll format our title cell to help distinguish it from the rest of the worksheet.

- • Select the cell(s) you want to modify.

	A	B
1	Webinar Training Log	
2	Email Address	Last Name
3	heidi.lee@vestainsurance.com	Lee
4	josie.gates@vestainsurance.com	Gates

- • Click the drop-down arrow next to the Font command on the Home tab. The Font drop-down menu will appear.

- • Select the desired font. A live preview of the new font will appear as you hover the mouse over different options. In our example, we'll choose Georgia.

- • The text will change to the selected font.

	A	B
1	Webinar Training Log	
2	Email Address	Last Name
3	heidi.lee@vestainsurance.com	Lee
4	josie.gates@vestainsurance.com	Gates

Note:

- • When creating a workbook in the workplace, you'll want to select a font that is easy to read.

- Along with Calibri, standard reading fonts include Cambria, Times New Roman, and Arial.

To change the font size:

- Select the cell(s) you want to modify.

- Click the drop-down arrow next to the Font Size command on the Home tab. The Font Size drop-down menu will appear.

- Select the desired font size. A live preview of the new font size will appear as you hover the mouse over different options. In our example, we will choose 16 to make the text larger.

- The text will change to the selected font size.

Spreadsheet Modelling (Using Excel)

Note:

- You can also use the Increase Font Size and Decrease Font Size commands or enter a custom font size using your keyboard.
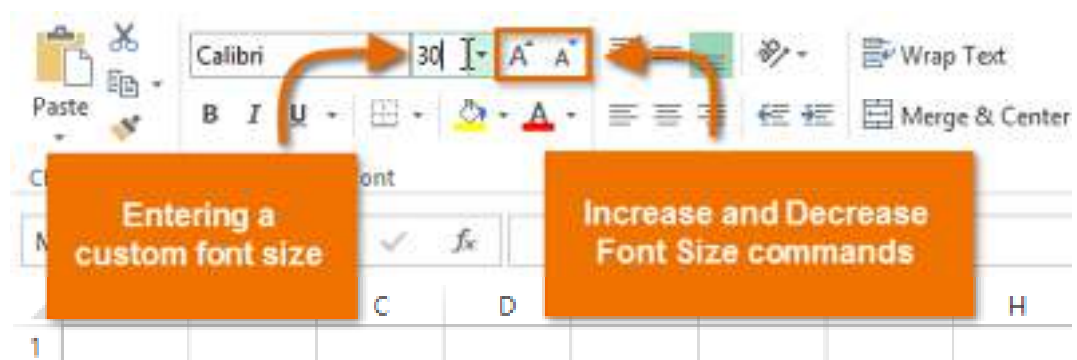
To change the font colour:

- Select the cell(s) you want to modify.

- Click the drop-down arrow next to the Font Color command on the Home tab. The Color menu will appear.

- Select the desired font color. A live preview of the new font color will appear as you hover the mouse over different options. In our example, we'll choose Green.

- The text will change to the selected font color.

To use the Bold, Italic, and Underline commands:

- Select the cell(s) you want to modify.

- Click the Bold (B), Italic (*I*), or Underline (U) command on the Home tab. In our example, we'll make the selected cells bold.
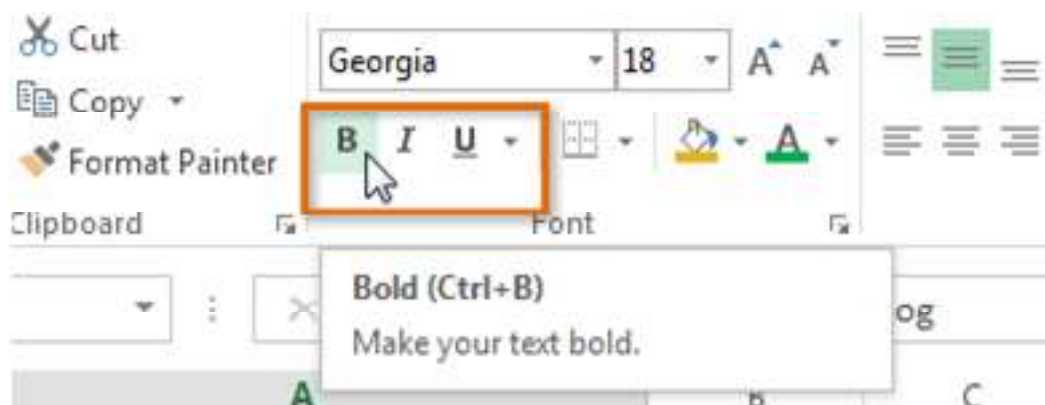
- The **selected style** will be applied to the text.

Note: You can also press **Ctrl+B** on your keyboard to make selected text **bold**, **Ctrl+I** to apply **italics**, and **Ctrl+U** to apply an **underline**.

Text alignment

By default, any text entered into your worksheet will be aligned to the bottom-left of a cell, while any numbers will be aligned to the bottom-right. Changing the **alignment** of your cell content allows you to choose how the content is displayed in any cell, which can make your cell content easier to read.

To change horizontal text alignment:

In our example below, we'll modify the alignment of our **title** cell to create a more polished look and further distinguish it from the rest of the worksheet.

1. Select the **cell(s)** you want to modify.

2. Select one of the three **horizontal alignment** commands on the **Home** tab. In our example, we'll choose **Center Align**.

3. The text will **realign**.

3	**Webinar Training Log**	
4	Email Address	Last Name
5	heidi.lee@vestainsurance.com	Lee
6	josie.gates@vestainsurance.com	Gates

To change vertical text alignment:

1. Select the **cell(s)** you want to modify.

3	**Webinar Training Log** ✛	
4	Email Address	Last Name
5	heidi.lee@vestainsurance.com	Lee
6	josie.gates@vestainsurance.com	Gates

2. Select one of the three **vertical alignment** commands on the **Home** tab. In our example, we'll choose **Middle Align**.

Middle Align

Align text so that it is centered between the top and bottom of the cell.

3. The text will **realign**.

3	**Webinar Training Log**	
4	Email Address	Last Name
5	heidi.lee@vestainsurance.com	Lee
6	josie.gates@vestainsurance.com	Gates

You can apply **both** vertical and horizontal alignment settings to any cell.

Cell borders and fill colors

Cell borders and **fill colors** allow you to create clear and defined boundaries for different sections of your worksheet. Below, we'll add cell borders and fill color to our **header cells** to help distinguish them from the rest of the worksheet.

To add a border:

1. Select the **cell(s)** you want to modify.

2. Click the **drop-down arrow** next to the **Borders** command on the **Home** tab. The **Borders** drop-down menu will appear.

3. Select the **border style** you want to use. In our example, we will choose to display **All Borders**.
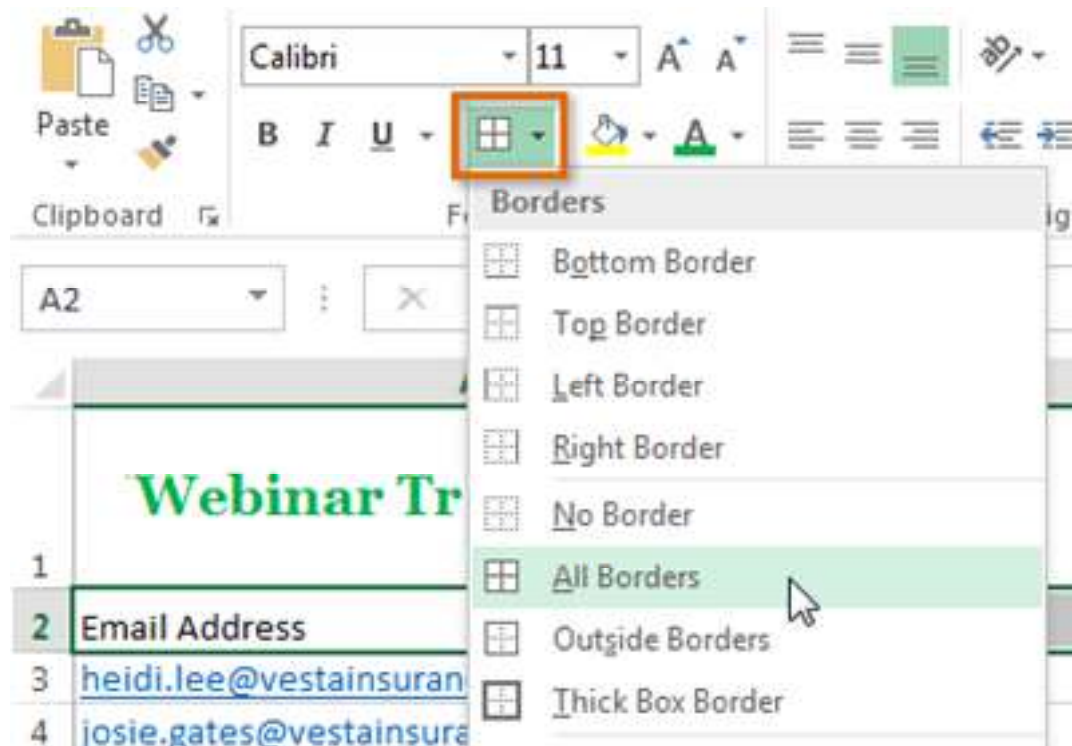
4. The **selected border style** will appear.

You can draw borders and change the **line style** and **color** of borders with the **Draw Borders** tools at the bottom of the Borders drop-down menu.

To add a fill color:

1. Select the **cell(s)** you want to modify.

2. Click the **drop-down arrow** next to the **Fill Color** command on the **Home** tab. The **Fill Color** menu will appear.

3. Select the **fill color** you want to use. A **live preview** of the new fill color will appear as you hover the mouse over different options. In our example, we'll choose **Light Green**.

4. The **selected fill color** will appear in the selected cells.

Format Painter

If you want to copy formatting from one cell to another, you can use the **Format Painter** command on the **Home** tab. When you click the Format Painter, it will copy all of the formatting from the selected cell. You can then **click and drag** over any cells you want to paste the formatting to.
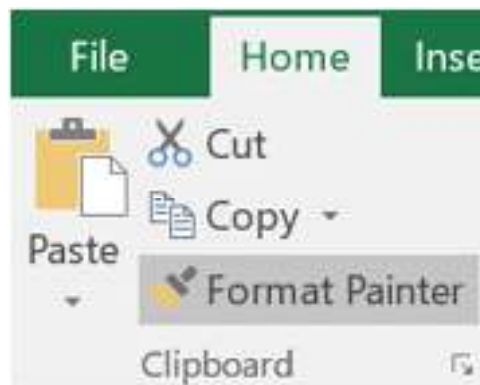
Cell styles

Instead of formatting cells manually, you can use Excel's **predesigned cell styles**. Cell styles are a quick way to include professional formatting for different parts of your workbook, such as **titles** and **headers**.

To apply a cell style:

In our example, we'll apply a new cell style to our existing **title** and **header cells**.

1. Select the **cell(s)** you want to modify.

2. Click the **Cell Styles** command on the **Home** tab, then choose the **desired style** from the drop-down menu. In our example, we'll choose **Accent 1**.

3. The **selected cell style** will appear.

Applying a cell style will **replace** any existing cell formatting except for text alignment. You may not want to use cell styles if you've already added a lot of formatting to your workbook.

Formatting text and numbers

One of the most powerful tools in Excel is the ability to apply **specific formatting** for text and numbers. Instead of displaying all cell content in exactly the same way, you can use formatting to change the appearance of **dates**, **times**, **decimals**, **percentages (%)**, **currency ($),** and much more.

To apply number formatting:

In our example, we'll change the **number format** for several cells to modify the way **dates** are displayed.

1. Select the **cells(s)** you want to modify.

2. Click the **drop-down arrow** next to the **Number Format** command on the **Home** tab. The **Number Formatting** drop-down menu will appear.

3. Select the **desired formatting option**. In our example, we will change the formatting to **Long Date**.

4. The selected cells will change to the **new formatting** style. For some number formats, you can then use the **Increase Decimal** and **Decrease Decimal** commands (below the Number Format command) to change the number of decimal places that are displayed.

Click the buttons in the interactive below to learn about different text and number formatting options.
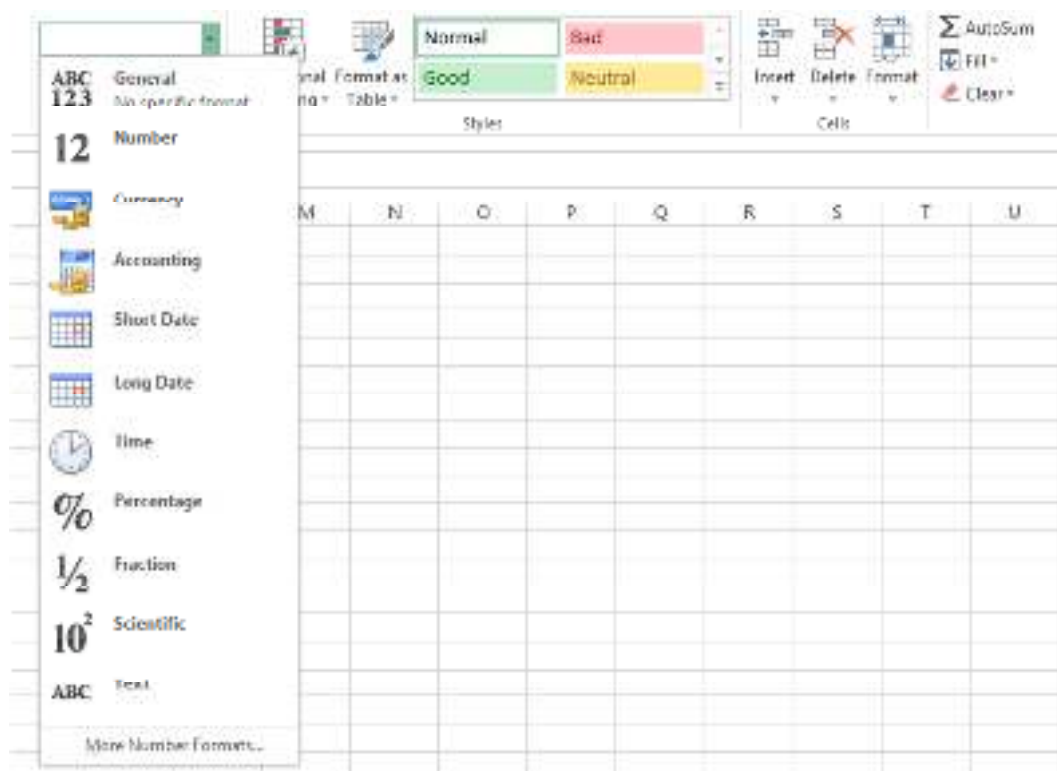
4.2 Borders and Shades in Excel

- MS Excel is powerful spreadsheet software that helps users store data across multiple worksheets. Each worksheet contains several cells formed by the intersection of rows and columns. By default, the Excel cells have no borders and use white shades. However, borders or shades can help make data easy to read or highlight when we have a large data set.
- Apart from this, it becomes too complex to read when we take prints of worksheet data without borders. Excel allows us to add a border and color shades to one or more desired cells within the worksheet.
- Borders in Excel are outlined in data tables or a specific range of cells.
- In Excel, borders are used to separate the data in borders from the rest of the text.
- It is a good way of representing data.
- In addition, it helps the user to look for specific data easily.
- These borders are available in the "Home" tab in the fonts section.
- We can add the border to a single cell or multiple cells.
- Borders are of different styles and can be used as per the requirement.
- Borders help present the data set in a more presentable format in Excel.
- We can use borders for tabular format data or headlines to emphasize a specific set of data or can be used to distinguish different sections.
- We can use it to define or divide the sections of a worksheet.
- We can use it to emphasize specific data.
- We can also make the data more understandable and presentable.

Borders and Shades (Shading)

In Excel, borders refer to a line drawn across any or all of four sides of a cell in a worksheet. When adding a border to one or more cells, we can choose specific sides to include or exclude. Moreover, we can also manually draw borders for custom or desired sides of cells. For example, we can add (or draw) borders to the top and bottom of the cell and leave the other sides open.

1	Anuj
2	Bhanu
3	Bhuvneshwar
4	Chitra
5	Shambhu

⇧

Cells Without Borders

1	Anuj
2	Bhanu
3	Bhuvneshwar
4	Chitra
5	Shambhu

⇧

Cells with Borders

Furthermore, shading refers to an artistic design or color used as the background of a cell in a worksheet. When adding shading (background color) to one or more cells, we can choose one of the pre-defined colors set for a specific cell. Additionally, we can also choose a custom color for the desired cell.

1	Anuj
2	Bhanu
3	Bhuvneshwar
4	Chitra
5	Shambhu

⇧

Cells Without Shades

1	Anuj
2	Bhanu
3	Bhuvneshwar
4	Chitra
5	Shambhu

⇧

Cells with Shades

Applying Borders in Excel

Creating a border is one of the easiest things to do in Excel. Although there are several methods, this is usually done using the following two methods:

Applying Borders from Ribbon

Excel Ribbon is the primary area for accessing most existing commands or tools. While creating a border in Excel, we can take advantage of the Excel ribbon and apply a border to the desired cell using the following steps:

o   First, we need to **select the effective Excel cells** where we wish to insert borders. We can hold down the mouse's left button and drag the selected shading from one cell to the others. Besides, while selecting non-adjacent (or non-contiguous) cells in Excel, we must click on individual cells while holding down the **Ctrl** key.

- o After selecting the effective cell, we need to go to the **Home** tab on the ribbon and click on the **drop-down** icon   next   to **Border,** as   shown   in   the   following   image:

- o In the next window, Excel will display various pre-defined border styles. We must **click on the desired border style** to apply it.

- o After clicking on the desired border (for example, All Border) from the list, the same will be instantly inserted into the selected Excel cells.

Although there are many existing border options, sometimes, we may need to insert a border on specific sides of the cell manually. For example, suppose we need to add or insert a border on any cell's left and right sides. We can manually draw borders using the Draw Border option from the drop-down list in such a case.

After selecting the Draw Border option, our mouse cursor will convert into a pencil icon. We can click or drag on the desired grids to draw corresponding borders.
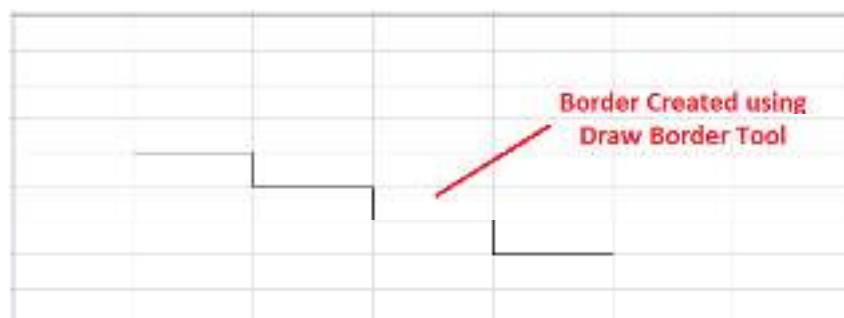
Similarly, we can choose **Line Color** or **Line Style** options to color the desired borders or choose border-style like a single line, multi-line, etc.

Applying Borders from Format Cells dialogue box

Since adding a border is part of the Excel formatting tool, we can also apply a border using the Format Cells dialog box. We can perform the following steps to access the Format Cells dialog box and insert a border in the desired Excel cell:

First, we need to **select/ highlight the effective cells** in the worksheet.

Once the desired cells are selected, we need to launch the **Format Cells** dialogue box. The easiest option to access/open it is to use the keyboard shortcut **'Ctrl + 1'.** However, we must only press the key '1' from the keyboard area, not the number keypad.

In the Format Cells dialogue box, we need to click on the **Border** tab, as shown below:
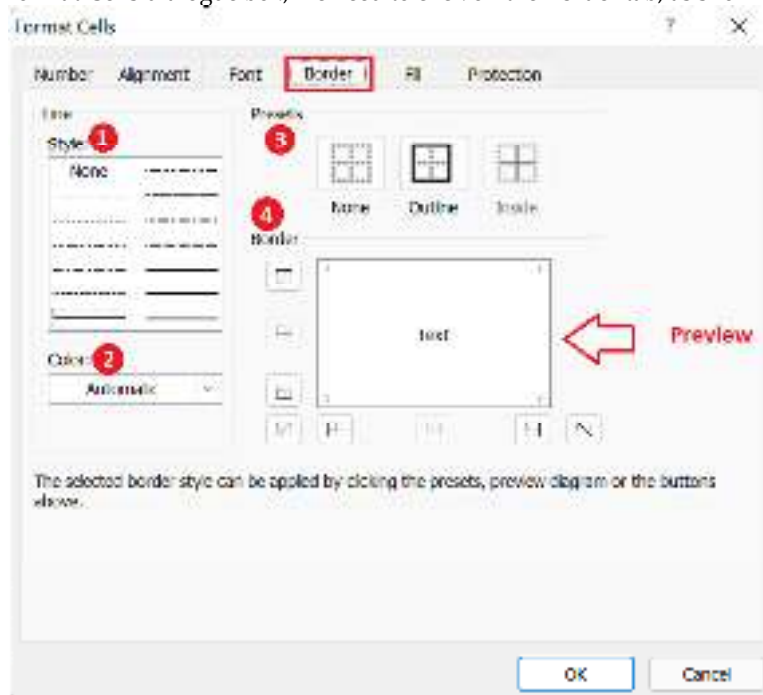
We can adjust the cell's borders in multiple ways using different sections displayed in the above dialogue box:

1. The **Line Style** section helps us select the desired design for the borders, such as single line border, dotted line border, double-line border, etc.

2. The **Color** section or drop-down list under the Line category allows us to choose any desired color for the border. We can either choose the pre-defined colors or choose our custom color using the More Colors option.

3. The **Presets** section helps us apply quick borders to the selected cells in the worksheet. Using Presets, we can select between **None** (no border), **Outline** (all sides borders), or **Inside** (borders in the connected sides of cells).

4. The **Border** section helps us to choose different border styles. We can click on the displayed block to choose the top border, bottom border, left border, right border, diagonal border, etc. The preview section displays the border style as per the selected preference or settings in the dialogue box.

After adjusting the settings for the borders, we must click the OK button to close the dialogue box and apply the changes in the worksheet.

Deleting Borders in Excel

To remove/delete border in the Excel worksheet, we can use any of the following methods:

o   First, we need to select the cells from which we wish to remove borders. Next, we must go to **Home > Border > No Border.** This will remove the borders from selected cells. For

ЗЗ

o   We can click on any desired color, and the same will be immediately applied to the selected cell as a background color.

o   If we don't find the color we want, we can click on the **'More Colors'** button from the window and choose any custom color accordingly.
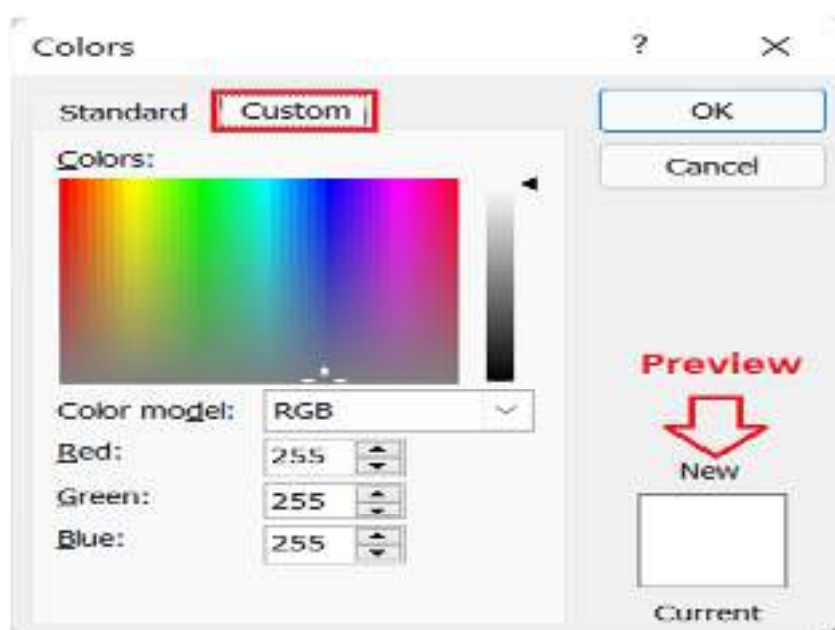
o **Applying Shades from Format Cells dialogue box**

We can use the Format Cells dialogue box to apply any desired color shades in Excel cells, like applying the border. We must select the cells, open **the Format Cells** dialogue box (Ctrl + 1), click the **'Fill'** tab, and adjust the preference accordingly. The Fill tab contains the following sections or preference options:
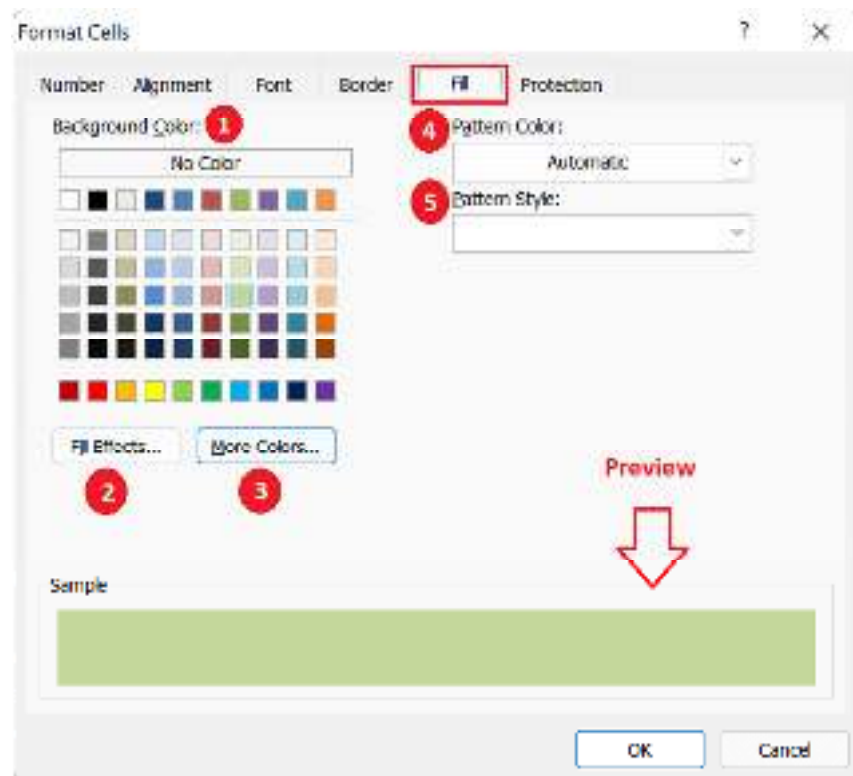
In the above dialogue box, we can apply or modify the color shades in various ways using different sections, such as:

1. This section displays a set of pre-defined colors. We can select the desired color by clicking on the respective block.

2. This section allows us to choose gradient-style shades. We can choose between one color or multi-color shades and gradient direction.

3. This section enables us to choose the color that is not available within the displayed blocks. Using this section (button), we can create any custom color we want.

4. This section allows us to choose the color for the pattern style we want to add along with the shades.

5. This section contains various pattern styles that can be applied along with the selected color shades. This includes dotted gray patterns, horizontal and vertical lines, diagonals, diagonal crosshatches, etc.

After adjusting the settings for the shades, we need to click on the OK button to close the dialogue box and apply the selected color shades to the desired cells within the worksheet.

Deleting Shades in Excel

When deleting or removing shades or background color of Excel cell(s), we can use any of the following methods:

- First, we need to select the cells from which we wish to remove shades. Next, we must go to **Home > Fill > No Fill.** This will immediately remove the color shades from the selected

cells. To remove colors from the entire sheet, we can use the keyboard shortcut **'Ctrl + A'** to select all cells in the sheet, then choose 'No Fill'. To select specific cells, we can hold down the **Ctrl** key while clicking the corresponding cells.

- If we have just applied the shades in the cell, we can click Undo (Ctrl + Z) to remove them.
- We can select the cells and go to **Home > Clear > Clear Formatting.** Although this method helps remove color shading, it also removes other formattings like font color, border, etc. Thus, this method may not be suitable in all conditions.

Border Colors

- Colored borders are added by selecting a color before adding the border.
- The color can be changed in the Border Color menu:
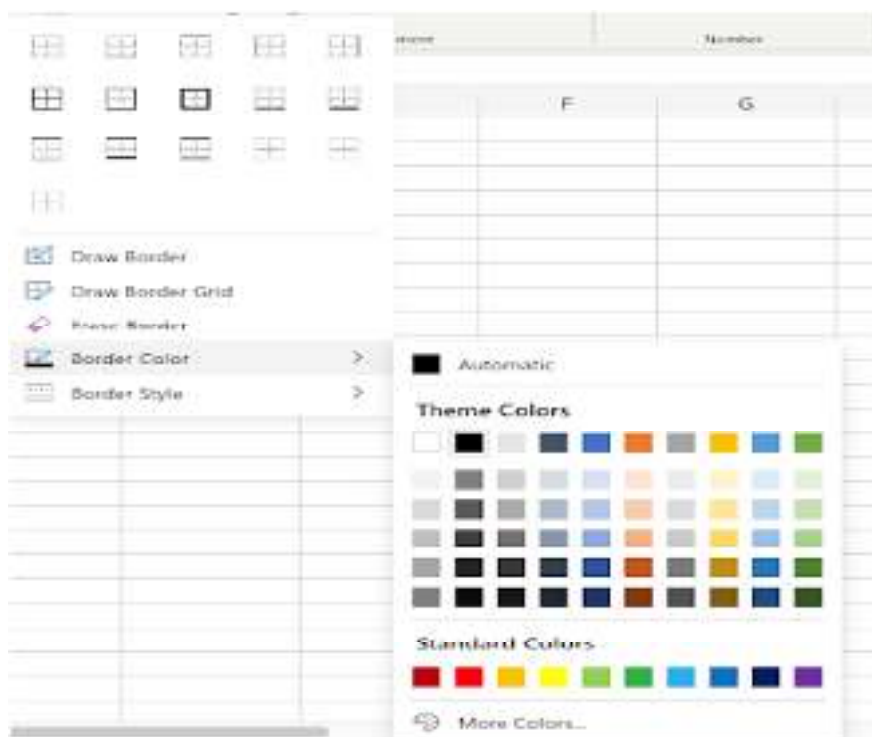
Border Style

- Borders styles can be changed.

- The menu is accessed in the Border Style menu.
- Excel offers 6 different border styles:
    - ✓ Solid line
    - ✓ Dashed line
    - ✓ Dotted line
    - ✓ Medium line
    - ✓ Thick line
    - ✓ Double line

4.3 Alignment Tools

- By default, Microsoft Excel aligns numbers to the bottom-right of cells and text to the bottom-left.
- However, you can easily change the default alignment by using the ribbon, keyboard shortcuts, Format Cells dialog or by setting your own custom number format.
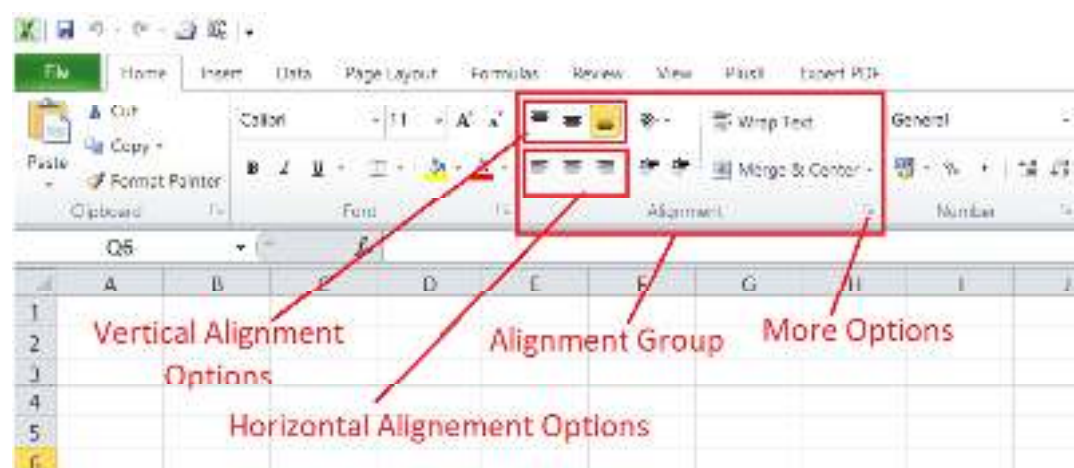
How to change alignment in Excel using the ribbon?

- To change text alignment in Excel, select the cell(s) you want to realign, go to the Home tab > Alignment group, and choose the desired option:
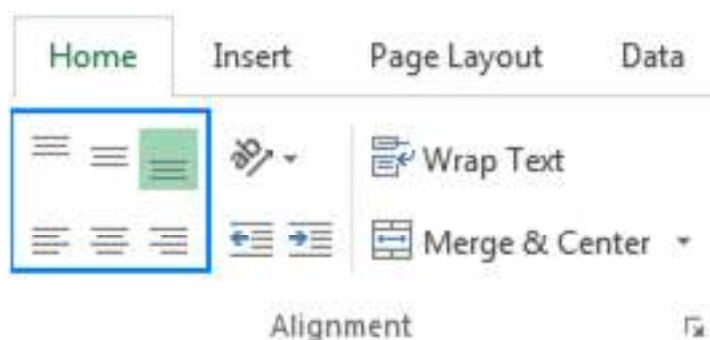
Example of the Horizontal Alignments
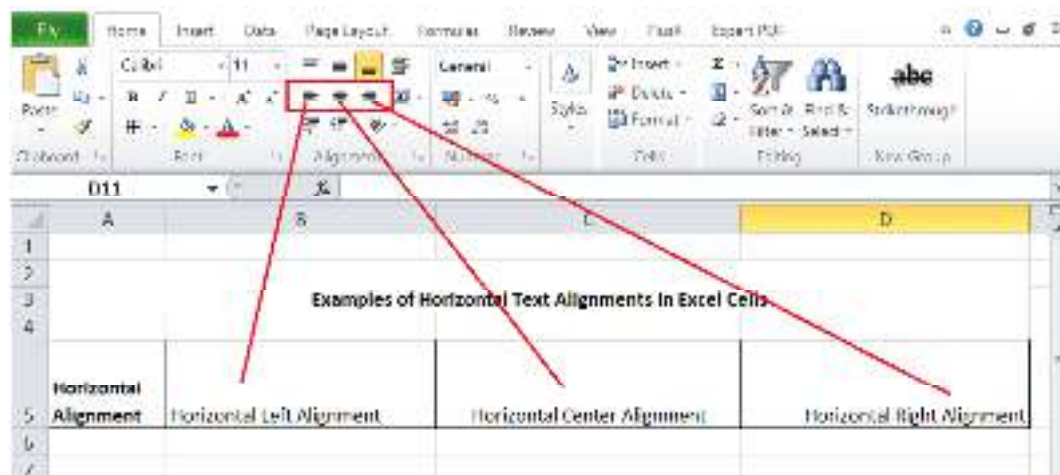
Example of the Vertical Alignments
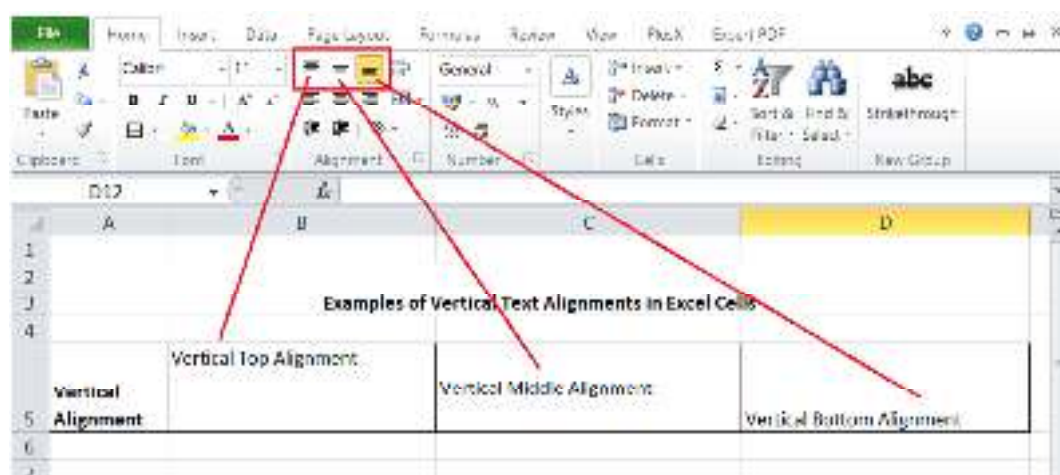
Vertical alignment

If you'd like to align data vertically, click one of the following icons:

- Top Align - aligns the contents to the top of the cell.
- Center Align - centers the contents between the top and bottom of the cell.
- Bottom Align - aligns the contents to the bottom of the cell (the default one).

Please note that changing vertical alignment does not have any visual effect unless you increase the row height.

Horizontal alignment

- To align your data horizontally, Microsoft Excel provides these options:
- Align Left - aligns the contents along the left edge of the cell.

- • Center - puts the contents in the middle of the cell.
- • Align Right - aligns the contents along the right edge of the cell.

Combining Vertical and Horizontal Alignment

- • By combining different vertical and horizontal alignments, you can arrange the cell contents in different ways, for example:
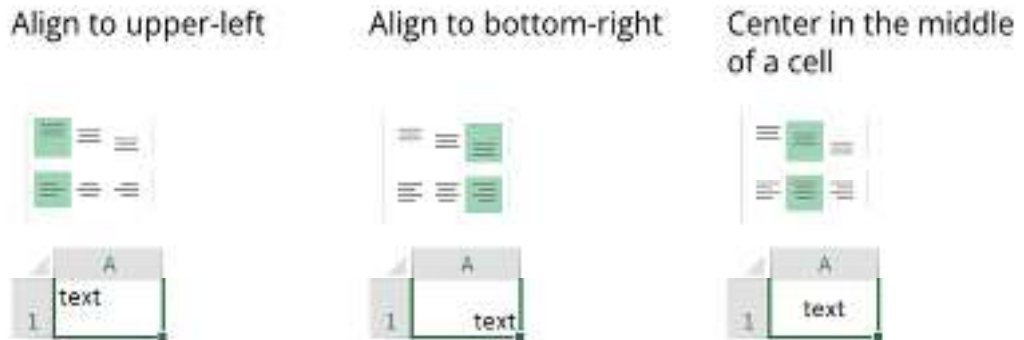
Change Text Orientation (Rotate Text)

- • Click the Orientation button on the Home tab, in the Alignment group, to rotate text up or down and write vertically or sideways.
- • These options come in especially handy for labelling narrow columns:
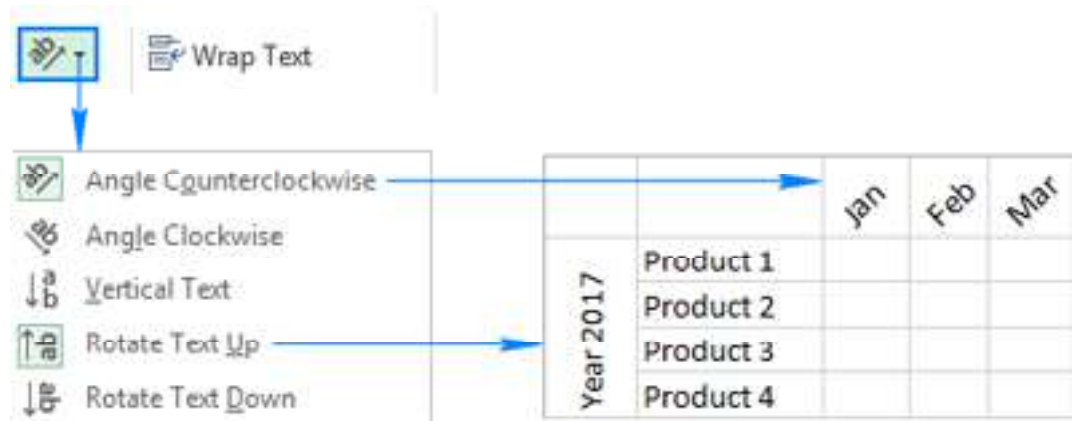
Indent text in a cell

- • In Microsoft Excel, the Tab key does not indent text in a cell like it does, say, in Microsoft Word; it just moves the pointer to the next cell. To change the indentation of the cell contents, use the Indent icons that reside right underneath the Orientation button.
- • To move text further to the right, click the Increase Indent icon. If you have gone too far right, click the Decrease Indent icon to move the text back to the left.
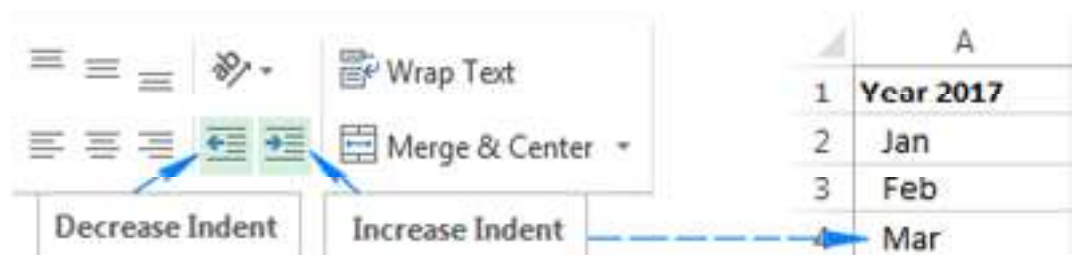
How to align text in Excel using the Format Cells dialog?

- Another way to re-align cells in Excel is using the Alignment tab of the Format Cells dialog box. To get to this dialog, select the cells you want to align, and then either:

- Press Ctrl + 1 and switch to the Alignment tab, or

- Click the Dialog Box Launcher arrow at the bottom right corner of the Alignment.

- In addition to the most used alignment options available on the ribbon, the Format Cells dialog box provides several less used (but not less useful) features:
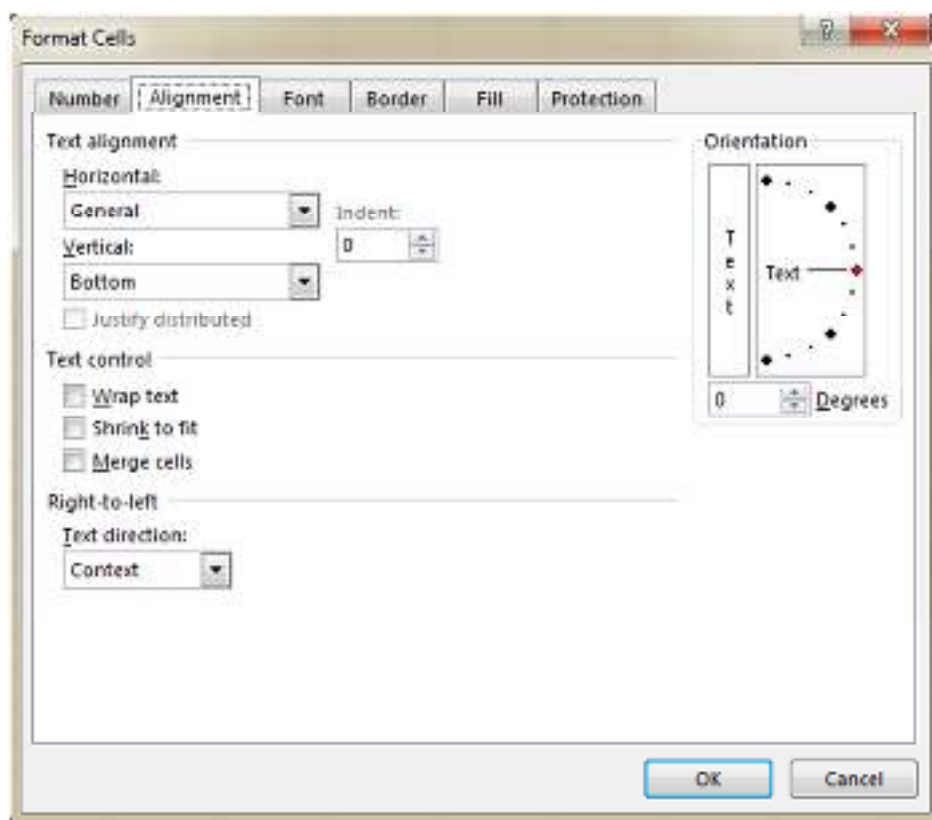
Text alignment options

- Apart from aligning text horizontally and vertically in cells, these options allow you to justify and distribute the cell contents as well as fill an entire cell with the current data.

How to fill cell with the current contents?

- Use the Fill option to repeat the current cell content for the width of the cell.

- For example, you can quickly create a border element by typing a period in one cell, choosing Fill under Horizontal alignment, and then copying the cell across several adjacent columns:

How to justify text in Excel?

- To justify text horizontally, go to the Alignment tab of the Format Cells dialog box, and select the Justify option from the Horizontal drop-down list.

- This will wrap text and adjust spacing in each line (except for the last line) so that the first word aligns with the left edge and last word with the right edge of the cell:
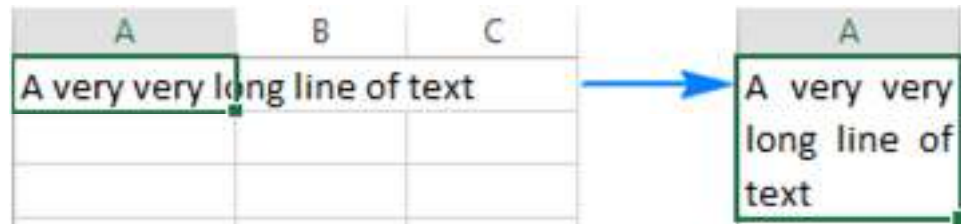
Text control options

- These options control how your Excel data is presented in a cell.

- Wrap text - if the text in a cell is larger than the column width, enable this feature to display the contents in several lines. For more information, please see How to wrap text in Excel.

- Shrink to fit - reduces the font size so that the text fits into a cell without wrapping. The more text there is in a cell, the smaller it will appear.

- Merge cells - combines selected cells into one cell. For more information, please see How to merge cells in Excel without losing data.
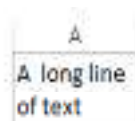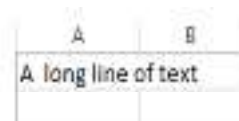
Changing Text Direction

- The bottom-most section of the Alignment tab, named Right-to-left, controls the text reading order.

- The default setting is Context, but you can change it to Right-to-Left or Left-to-Right.

- In this context, "right-to-left" refers to any language that is written from right to left, for example Arabic.

- If you don't have a right-to-left Office language version installed, then you will need to install an appropriate language pack.

4.4 Number Formats

What are number formats?

- Whenever you're working with a spreadsheet, it's a good idea to use appropriate number formats for your data.

- Number formats tell your spreadsheet exactly what type of data you're using, such as percentages (%), currency ($), times, dates, and so on.

Why use number formats?

Number formats don't just make your spreadsheet easier to read—they also make it easier to use. When you apply a number format, you're telling your spreadsheet exactly **what kinds of values** are stored in a cell. For example, the **date** format tells the spreadsheet that you're entering **specific**

calendar dates. This allows the spreadsheet to better understand your data, which can help ensure that your data remains consistent and that your formulas are calculated correctly.

If you don't need to use a specific number format, the spreadsheet will usually apply the **general** number format by default. However, the general format may apply some small formatting changes to your data.

Applying number formats

Just like other types of formatting, such as changing the font color, you'll apply number formats by selecting cells and then choosing the desired formatting option. Every spreadsheet program allows you to add number formatting, but the process will vary depending on which application you're using:

- For **Microsoft Excel 2007-2019**, go to the **Home** tab, click the **Number Format** drop-down menu in the **Number** group, and select the desired format. You can also click one of the quick number-formatting commands below the drop-down menu.
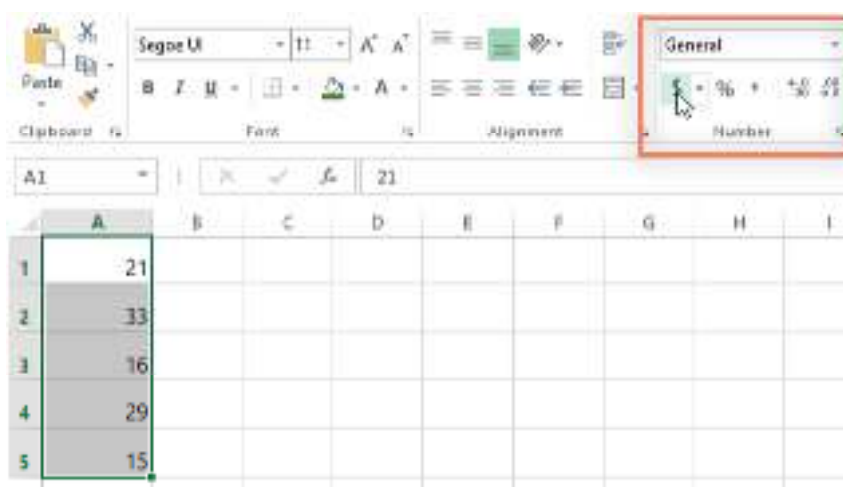
- For **Excel 2003** and earlier, go to **Format > Cells**.

- For **Google Sheets**, click the **More Formats** button near the left side of the toolbar—this button will look like the numbers **123**. To the left of the command, you can also click the **Currency** or **Percent** commands to quickly apply those formats.

For most versions of Microsoft Excel, you can also select the desired cells and press **Ctrl+1** on your keyboard to access more number-formatting options.

In this example, we've applied the **Currency** number format, which adds currency symbols ($) and displays two decimal places for any numerical values.
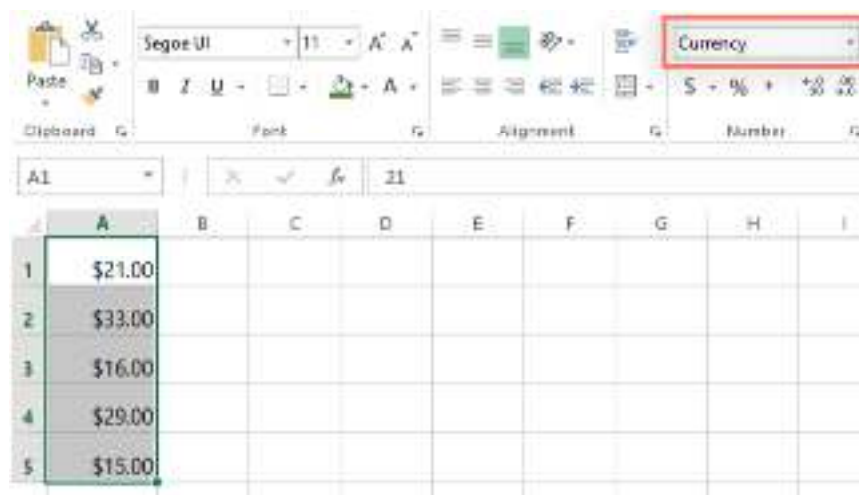
If you select any cells with number formatting, you can see the **actual value** of the cell in the formula bar. The spreadsheet will use this value for formulas and other calculations.
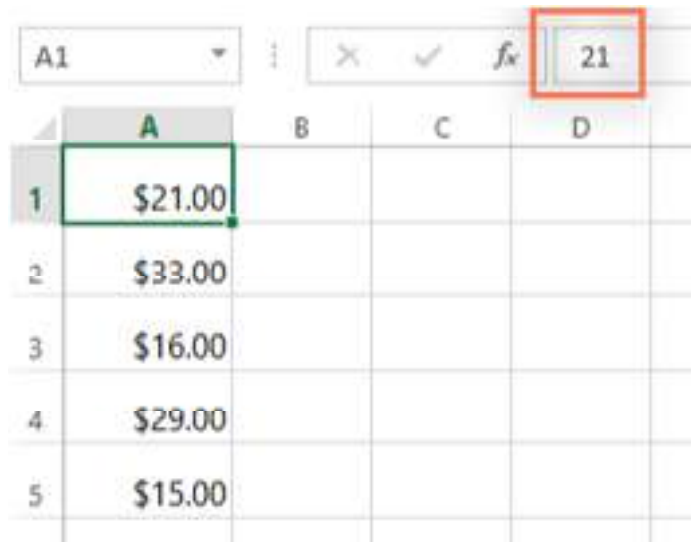
Using number formats correctly

There's more to number formatting than selecting cells and applying a format. Spreadsheets can actually apply a lot of number formatting **automatically** based on the way you enter data. This means you'll need to enter data in a way the program can understand, and then ensure that those cells are using the proper number format. For example, the image below shows how to use number formats correctly for dates, percentages, and times:

Now that you know more about how number formats work, we'll look at a few different number formats in action.

Percentage formats

One of the most helpful number formats is the **percentage** (%) format. It displays values as percentages, such as **20%** or **55%**. This is especially helpful when calculating things like the cost of sales tax or a tip. When you type a percent sign (%) after a number, the percentage number format will be be applied to that cell **automatically**.
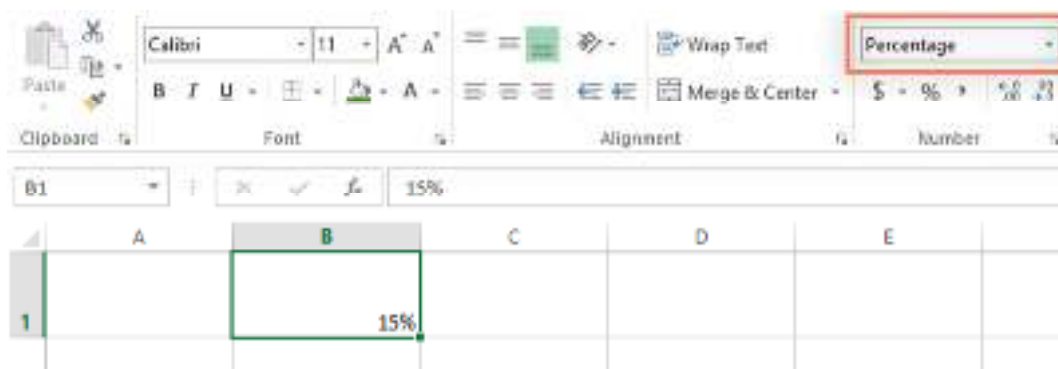
As you may remember from math class, a percentage can also be written as a **decimal**. So 15% is the same thing as 0.15, 7.5% is 0.075, 20% is 0.20, 55% is 0.55, and so on. You can review **this lesson** from our **Math** tutorial to learn more about converting percentages to decimals.

There are many times when percentage formatting will be useful. For example, in the images below, notice how the **sales tax rate** is formatted differently for each spreadsheet (5, 5%, and 0.05):

No percentage formatting   Percentage formatting   Written as decimal

As you can see, the calculation in the spreadsheet on the left didn't work correctly. Without the percentage number format, our spreadsheet thinks we want to multiply $22.50 by 5, not 5%. And while the spreadsheet on the right still works without percentage formatting, the spreadsheet in the middle is easier to read.

Date formats

Whenever you're working with **dates**, you'll want to use a date format to tell the spreadsheet that you're referring to **specific calendar dates**, such as July 15, 2014. Date formats also allow you to work with a powerful set of date functions that use time and date information to calculate an answer.

Spreadsheets don't understand information the same way a person would. For instance, if you type **October** into a cell, the spreadsheet won't know you're entering a date so it will treat it like any other text. Instead, when you enter a date, you'll need to use a **specific format** your spreadsheet understands, such as **month/day/year** (or **day/month/year** depending on which country you're in). In the example below, we'll type **10/12/2014** for October 12, 2014. Our spreadsheet will then automatically apply the date number format for the cell.
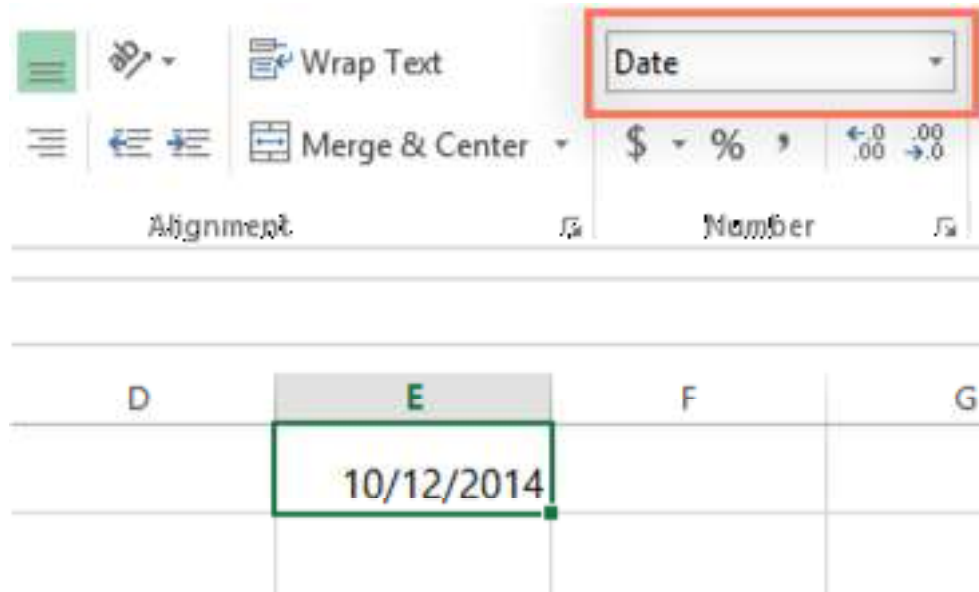
Now that we have our date correctly formatted, we can do lots of different things with this data. For example, we could use the fill handle to continue the dates through the column, so a different day appears in each cell:
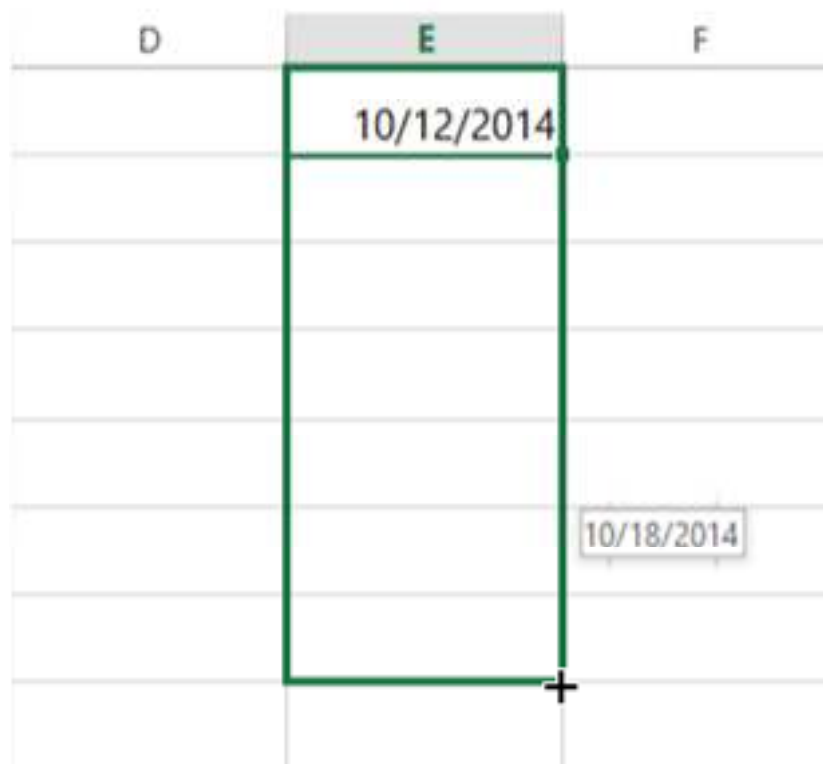
If the date formatting isn't applied automatically, it means the spreadsheet did not understand the data you entered. In the example below, we've typed **March 15th**. The spreadsheet did not understand that we were referring to a date, so this cell is still using the **general** number format.
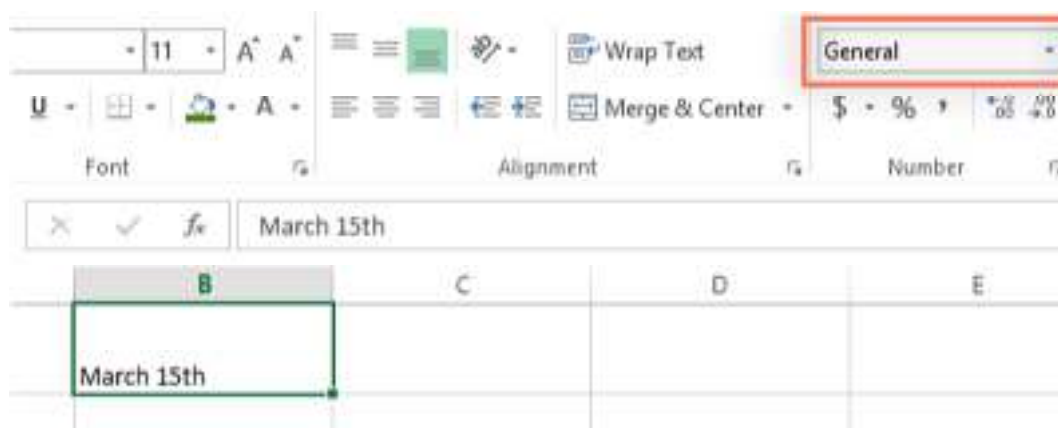
On the other hand, if we type **March 15** (without the "th"), the spreadsheet **will** recognize it as a date. Since it doesn't include a year, the spreadsheet will automatically add the current year so the date will have all of the necessary information. We could also type the date several other ways, such as **3/15**, **3/15/2014**, or **March 15 2014**, and the spreadsheet would still recognize it as a date.

Other Date Formatting Options

Some programs have more date formatting options, which can change the way dates appear in your spreadsheet. Again, this process this may vary slightly based on the spreadsheet program you're using. To access these options in Excel 2007-2019, select the **Number Format** drop-down menu and choose **More Number Formats**.
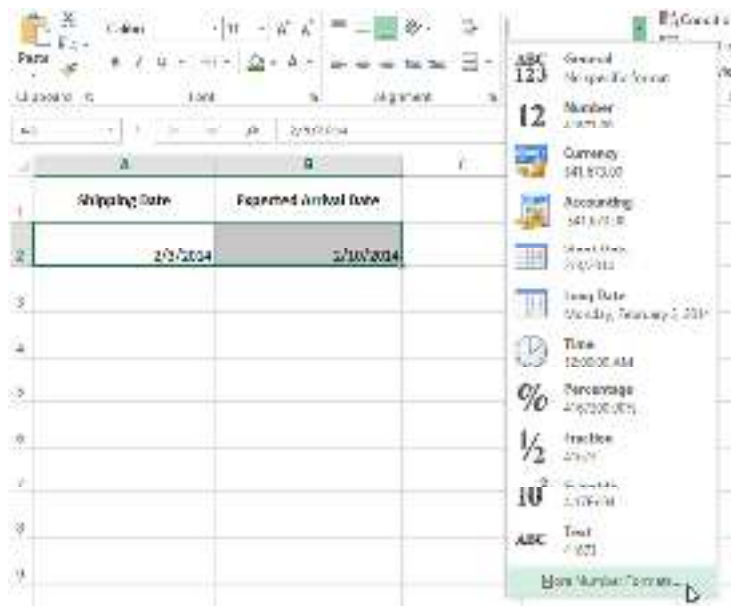
A dialog box will appear. From here, you can choose the desired date formatting option.
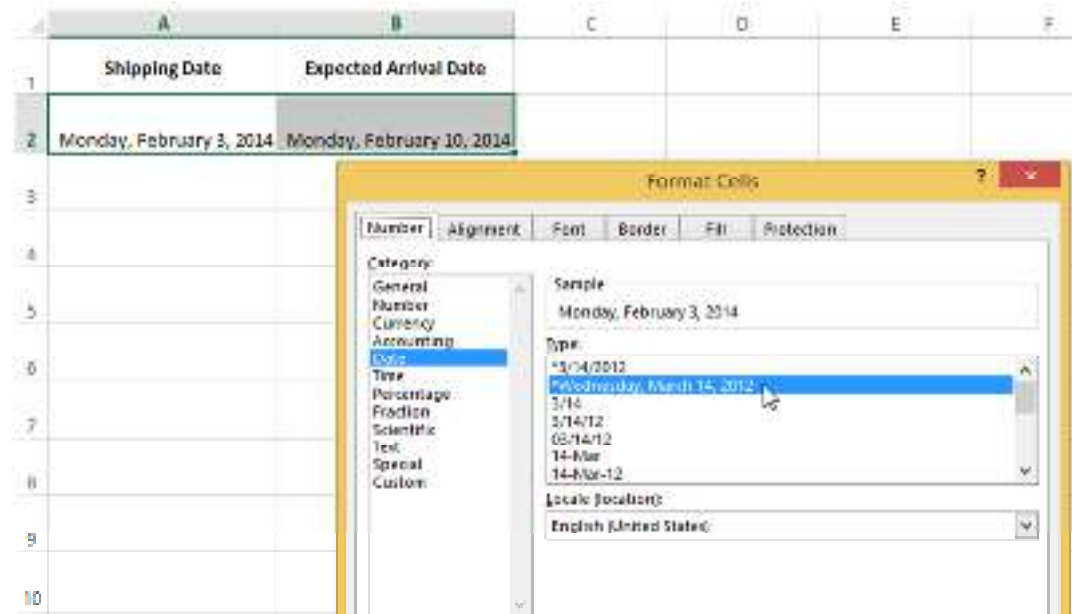
As you can see in the formula bar, a custom date format doesn't change the actual date in our cell—it just changes the way it's displayed.
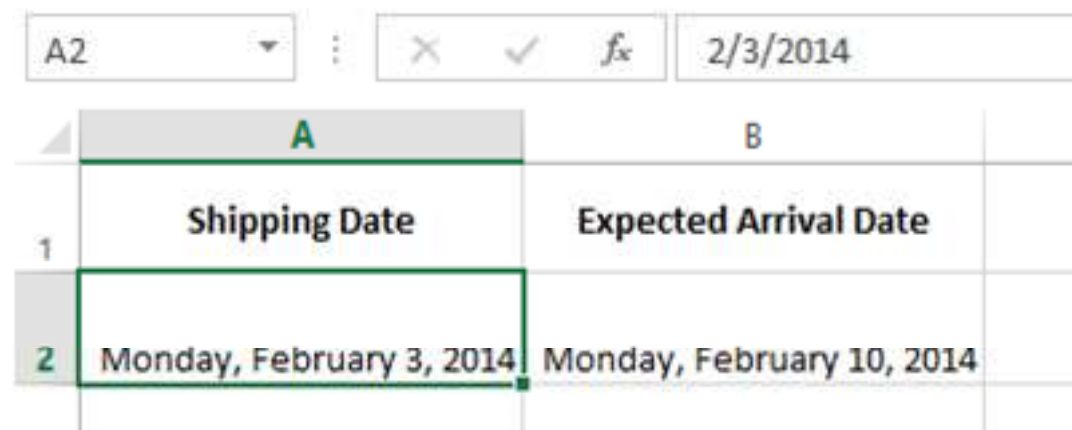
Number Formatting Tips

Here are a few tips for getting the best results with number formatting:

- **Apply number formatting to an entire column**: If you're planning to use one column for a certain type of data, like dates or percentages, you may find it easiest to select the entire column by clicking the column letter and then applying the desired number formatting. This way, any data you add to this column in the future will already have the correct number format. Note that the header row usually won't be affected by number formatting.
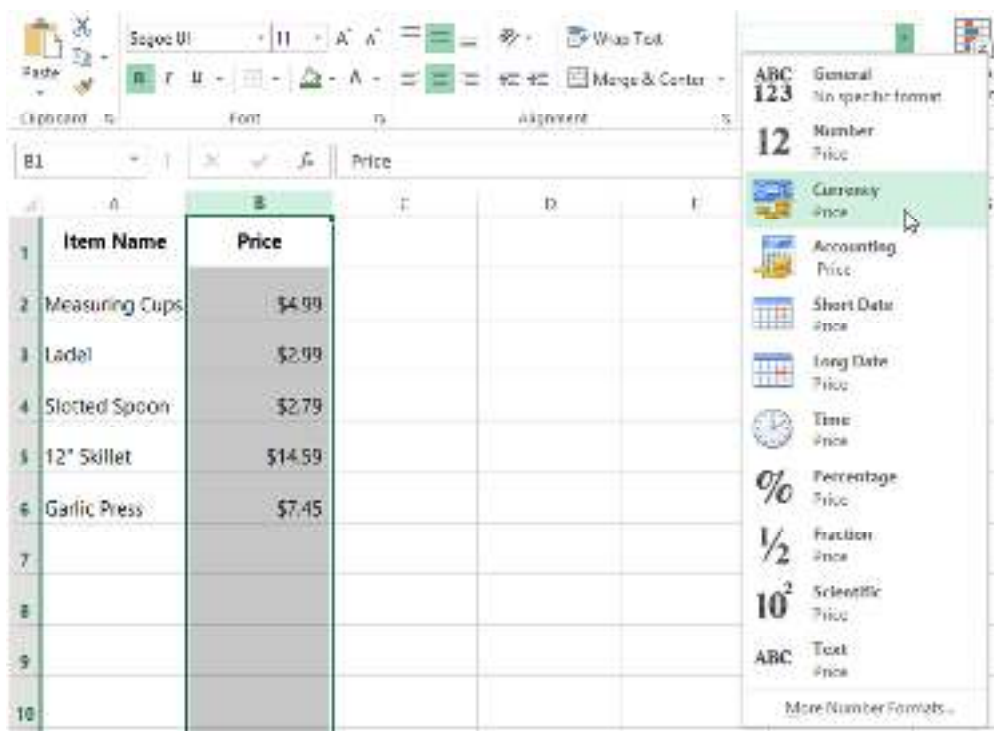
- **Double-check your values after applying number formatting**: If you apply number formatting to existing data, you may have unexpected results. For example, applying **percentage** (%) formatting to a cell with a value of 5 will give you 500%, not 5%. In this case, you'd need to retype the values correctly in each cell.

	A	B
1	**Percentage of Total**	
2	500%	
3	7300%	
4	1200%	
5	550%	
6	1200%	

- If you reference a cell with number formatting in a formula, the spreadsheet may automatically apply the same number formatting to the new cell. For example, if you use a value with currency formatting in a formula, the calculated value will also use the currency number format.

B1		f_x	=A1/2

	A	B	C
1	$184.50	$92.25	

- If you want your data to appear **exactly as entered,** you'll need to use the **text** number format. This format is especially good for numbers you don't want to perform calculations with, such as phone numbers, zip codes, or numbers that begin with 0: for example, "02415". For best results, you may want to apply the text number format before entering data in those cells.

Benefits of using Excel number formats

Here are some benefits that users may experience when using Excel number format:

- **Makes information easy to understand:** You can use Excel number formats to make the information within a spreadsheet easier to understand since you may view data in different layouts.

- **Keeps information the same:** When rearranging the data using number formats, you can change the format of a spreadsheet while keeping the information the same.

- **Offers quicker organization:** You may organize the data within your spreadsheet quicker by using the number format. The process provides automated formatting procedures, which allow you to select a number format you may use to sort your data automatically, rather than organizing it manually, which may take longer.

- **Provides a more professional look:** Most number formats allow you to decide on the number of decimals that each cell value displays, which may give your spreadsheet a more professional, consistent and formatted look.

Summary

- Formatting Excel sheets involves modifying the appearance and layout of the data in a spreadsheet.
- Borders in MS Excel are used to create visual divisions between cells or ranges of cells.
- Horizontal cell alignment refers to the positioning of text within a cell from left to right.
- Vertical cell alignment determines the positioning of text within a cell from top to bottom.
- Text control allows you to manipulate the display of text, such as making it bold, italic, or underlined.
- Text orientation in Excel enables you to rotate or tilt the text within a cell to different angles.
- Excel provides various number formats, such as currency, percentage, and date, to represent numeric values in different ways.
- Number formats allow you to control decimal places, thousand separators, and other display options for numerical data.
- Understanding number formats is important for presenting data accurately and in a visually appealing manner.
- By mastering these Excel formatting techniques, you can enhance the readability and professionalism of your spreadsheets.

Keywords

- Formatting: Modifying the appearance and layout of data in a specific manner.
- Excel sheets: Spreadsheets created and managed using Microsoft Excel software.
- Borders: Lines or outlines that can be applied to cells or ranges in Excel to visually separate or highlight them.
- Use: The purpose or function of something, in this case, the purpose and application of borders in MS Excel.
- Horizontal: Referring to the left-to-right positioning of elements, such as text, within cells.
- Cell alignment: The positioning of text or data within a cell, either horizontally or vertically.
- Change: Modifying or adjusting the existing settings or attributes.
- Text control: Manipulating the display of text within cells, such as applying formatting options like bold, italic, or underlined.
- Text orientation: The angle or direction at which text is displayed within cells, allowing rotation or tilting of the text.
- Number formats: The different ways in which numeric values can be displayed, such as currency, percentage, or date formats, in Excel.

Self Assessment

1. Which tool you will use to join some cells and place the content at the middle of joined cell?
A. From Format Cells dialog box click on Merge Cells check box
B. From Format Cells dialog box select the Centered alignment
C. From Format Cells dialog box choose Merge and Center check box
D. Click on Merge and Center tool on formatting toolbar

2. If you need a text to show vertically in a cell. How will you achieve this?
A. Choose Vertical on Text alignment in Format Cells dialog box
B. Choose 90 Degrees in Orientation of Format Cells dialog box
C. Choose Distributed from the Vertical drop down list of Format Cells dialog box
D. Choose Center Across Selection from Horizontal combo box in Format Cells dialog box

3. Merge cells option can be applied from
A. Format Cells dialog box Alignment Tab
B. Formattingtoolbar
C. Both of above
D. None of above

4. You can set page border in excel from: _____?
A. From Border tab in Format Cells dialog box
B. From Border tool in Formatting toolbar
C. From Line Style tool in Drawing toolbar
D. You can not set page border in Excel

5. Which of the following format you can decide to apply or not in Auto format dialog box?
A. Number format
B. Border format
C. Font format
D. All of above

6. How can you remove borders applied in cells?
A. Choose None on Border tab of Format cells
B. Open the list on Border tool in Format Cell toolbar then choose first tool (none)
C. Both of above
D. None of above

7. You can set page border in excel from -
A. From Border tab in Format Cells dialog box
B. From Border tool in Formatting toolbar
C. From Line Style tool in Drawing toolbar
D. You can not set page border in Excel

8. Tab scroll buttons are place on excel screen
A. Towards the bottom right corner
B. Towards the bottom left corner
C. Towards the top right corner
D. Towards the top left corner

9. Formatting a cell in Number format you can't set

A. Decimal Places
B. Use 1000 separator
C. Negative numbers
D. Currency Symbol

10. Which of the following format you can decide to apply or not in AutoFormat dialog box?

A. Number format

B. Border format

C. Font format

D. All of above

11. It is used to display the worksheets attractive and legible manner.

A. Editing
B. Formatting
C. Polishing
D. None of these

12. It refers to the position in which data is placed within the cell.
A. Alignment
B. Location
C. Destination
D. All of these

13. It is the process of converting the selected cells into the one cell.
A. Combining
B. Mixing
C. Conversion
D. Merging

14. In Excel, by default the sheets tabs colour is
A. Black
B. white
C. yellow
D. Red

15. This feature In Excel means formatting to the selected data gets applied only if the values of
    the cell meets the specified condition.
A. Argument formatting
B. Exceptional Formatting
C. Conditional formatting
D. All of the above

Answers for Self Assessment

1. D	2. B	3. A	4. D	5. D
6. C	7. D	8. B	9. D	10. D
11. B	12. A	13. D	14. B	15. C

Review Questions

1. What is the process of formatting Excel sheets?
2. How can borders be used in MS Excel, and what is their purpose?
3. How can you change the horizontal cell alignment in Excel?
4. How can you change the vertical cell alignment in Excel?
5. What does text control refer to in Excel, and how can it be changed?
6. How can you change the text orientation within cells in Excel?
7. What is the significance of understanding different number formats in Excel?

Further Readings

- https://edu.gcfglobal.org/en/excel2013/formatting-cells/1/#
- https://www.javatpoint.com/borders-and-shades-in-excel
- https://www.educba.com/borders-in-excel/
- https://edu.gcfglobal.org/en/excelformulas/understanding-number-formats/1/#
- https://www.indeed.com/career-advice/career-development/excel-number-formats

Unit 05: Data Analysis

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Objectives

- understand the use of Find and Replace Functions.

- understand the use of text functions.

- understand the use of filtering data.

- understand the use of sorting data.

- understand the use of conditional formatting.

Introduction

- The Find and Replace feature of Excel looks for a data value and replaces it with another data value.

- This data value can be a text string, number, date or special character.

- The Find and Replace feature can search within a worksheet or workbook, by rows or columns, and within formulas, values or comments.

- For example, in a financial report of Excel, the text string "asset" may need to be replaced with "assets."

- The purpose of using the Find and Replace feature in Excel is to locate certain information in a database.

- It also allows modifying the existing data values with a few clicks.

- By default, the Find and Replace excel feature looks for a partial match. But, it can also look for an exact match if the option "match entire cell contents" is selected.

5.1   How to Access the Find and Replace Feature of Excel?

The shortcuts to the Find and Replace excel feature are stated as follows:

- "Ctrl+F" opens the Find tab of the Find and Replace feature.

- "Ctrl+H" opens the Replace tab of the Find and Replace feature.

Alternatively, the "find" and "replace" options can be clicked from the "find & select" drop-down ("editing" group) of the Home tab. These options open the Find and Replace tabs of the Find and Replace feature of Excel.

Let us consider some examples to understand the working of the Find and Replace feature of Excel.

Example #1–Find a Partial Match in a Worksheet

The following image shows two worksheets titled "Jan" and "Feb." These worksheets contain datasets that report the sales made (column C) to different customers (column B) in January and February.

The names of the products, cost of goods sold (COGS), profits, and regions are also displayed in columns A, D, E, and F respectively. A similar dataset (with different numbers) is in columns H to M as well.

Find the name "Mitchel" in the worksheet "Jan." Use the Find and Replace feature of Excel.

The steps to use find and replace function in excel is follows:

1. **Go to the worksheet "Jan." Next, press the keys "Ctrl+F" together. The Find tab of the "find and replace" dialog box opens. This is shown in the following image.**

   Note: By default, Excel searches in the currently active worksheet.

2. **Type the word to be searched in the "find what" box. We type "Mitchel."**

Note that this search is not case-sensitive. So, even if the worksheet contains "MITCHEL," it will show up in the search results.

3. Press either the "Enter" key or the "find next" option. The first occurrence of the name "Daniel Mitchel" is selected. So, cell B7 is selected, as shown in the following image. Clicking "find next" again and again selects the subsequent occurrences of "Mitchel."

Notice that though we entered "Mitchel" in the "find what" box, Excel has selected the name "Daniel Mitchel." This is called a partial match. It implies that if there are any additional words preceding or succeeding the search value, the entire string containing the search value is returned in the result.

Click "find all" to see all the strings containing "Mitchel." The results are shown in the following image. These results display the following information:
The column "book" displays the name of the workbook containing the search value.
The column "sheet" displays the name of the worksheet containing the search value.
The column "cell" displays the reference of the cells containing the search value.
The column "value" displays the entire string containing the search value.

Notice that at the bottom of the dialog box, Excel displays the number of cells containing the search value. In this case, there are 8 cells in the worksheet "Jan," which contain either "Mitchel" or "Daniel Mitchel."
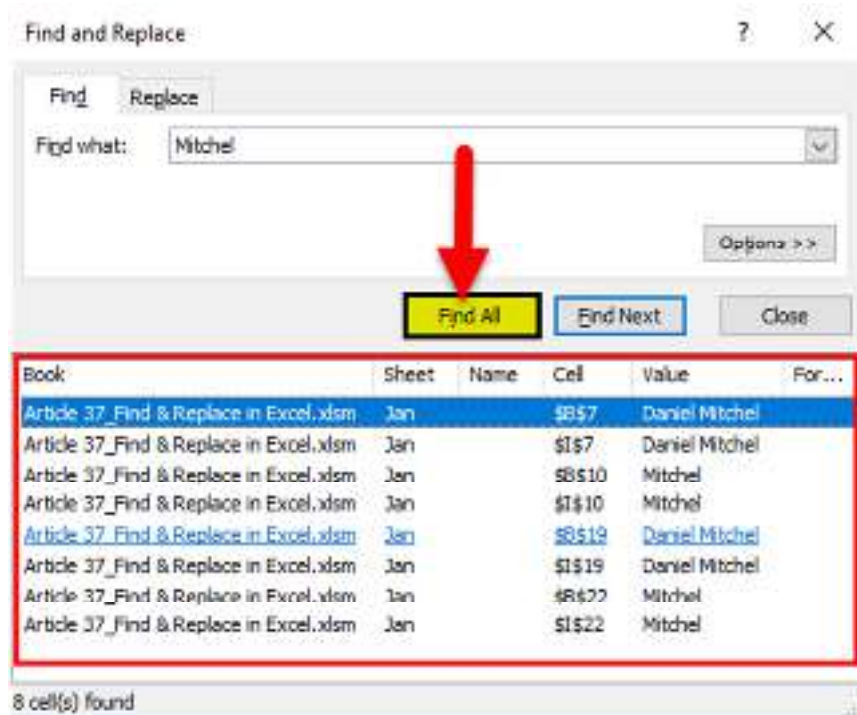
Difference between "find all" and "find next": The "find all" option shows all the occurrences of the search value. Further, clicking any of the entries shown by this option takes the user to the corresponding cell.

The "find next" option helps scan through the different cells containing the search value. Clicking "find next" for the first time selects the first occurrence of the search value. Likewise, clicking "find next" the second time selects the second occurrence of the search value, and so on.

Example #2–Find a Partial Match in a Workbook

Working on the dataset of example #1, find the name "Mitchel" in the entire workbook. Use the Find and Replace feature of Excel.

The steps to search the stated string in the entire workbook are listed as follows:

Step 1: Press the keys "Ctrl+F" together. The Find tab of the "find and replace" window opens. Type the name "Mitchel" in the "find what" box.

Next, click "options," shown within a black box in the following image.
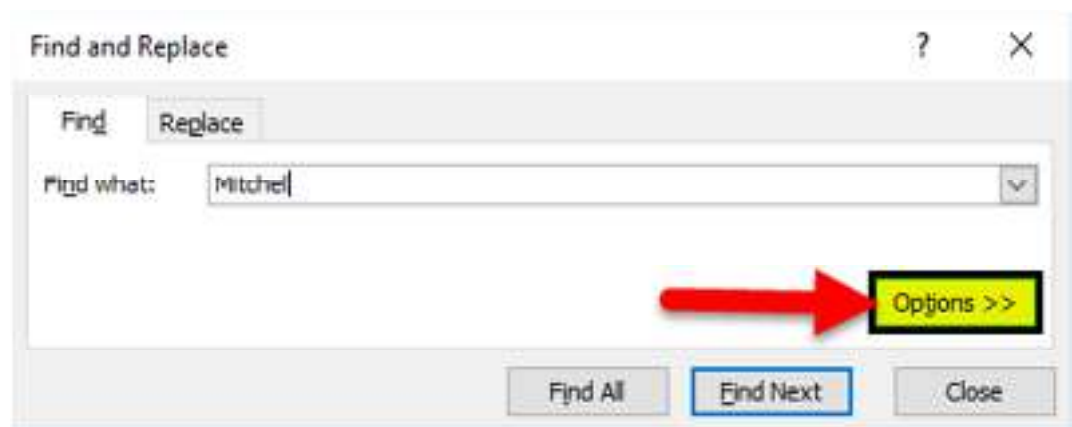
Step 2: Clicking "options" expands the "find and replace" dialog box. Click the drop-down next to the option "within" and select "workbook."

The selection is shown in the following image.
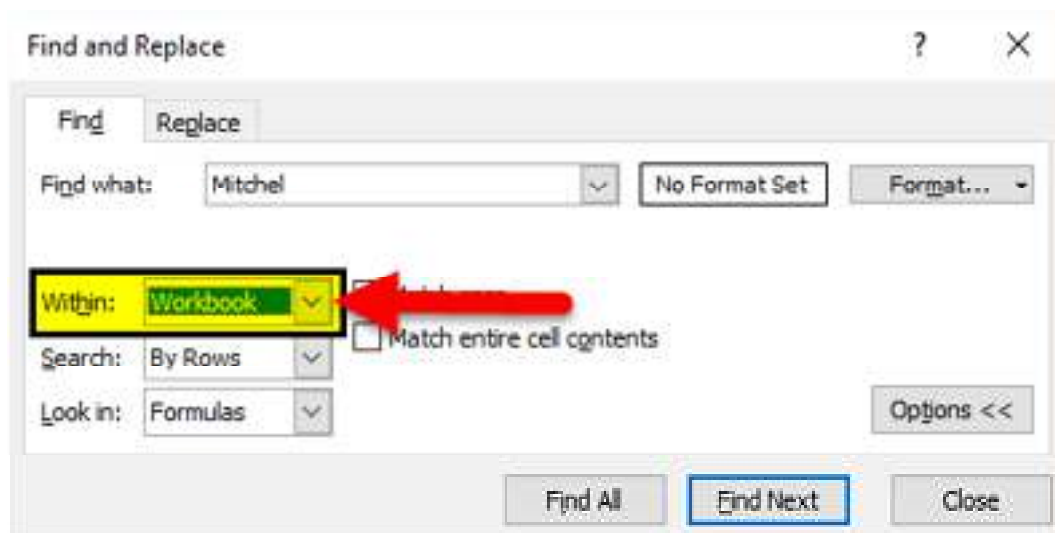
Step 3: Click "find all" to see all the results. The results are shown in the following image. This time the string "Mitchel" has been found in 16 cells of the workbook.

Clicking any of the entries will select the respective cell.

Example #3–Find an Exact Match in a Workbook

Working on the dataset of example #1, find an exact match of "Mitchel" in the entire workbook. Use the Find and Replace feature of Excel.

The steps to search the exact name in the entire workbook are listed as follows:

Step 1: Press the keys "Ctrl+F." In the Find tab of the "find and replace" window, perform the following tasks:

- Click "options" to expand the "find and replace" window.

- Enter the name "Mitchel" in the "find what" box.

- Select "workbook" in the box adjacent to "within."

- Select the checkbox of "match entire cell contents."

- Leave the "search" and "look in" parameters to default values which are "by rows" and "formulas" respectively.

The name of the "find what" box and the selections are shown in the following image.

Note: When the option "match entire cell contents" is selected, the Find and Replace excel feature looks for exactly those data values that have been entered in the "find what" box.
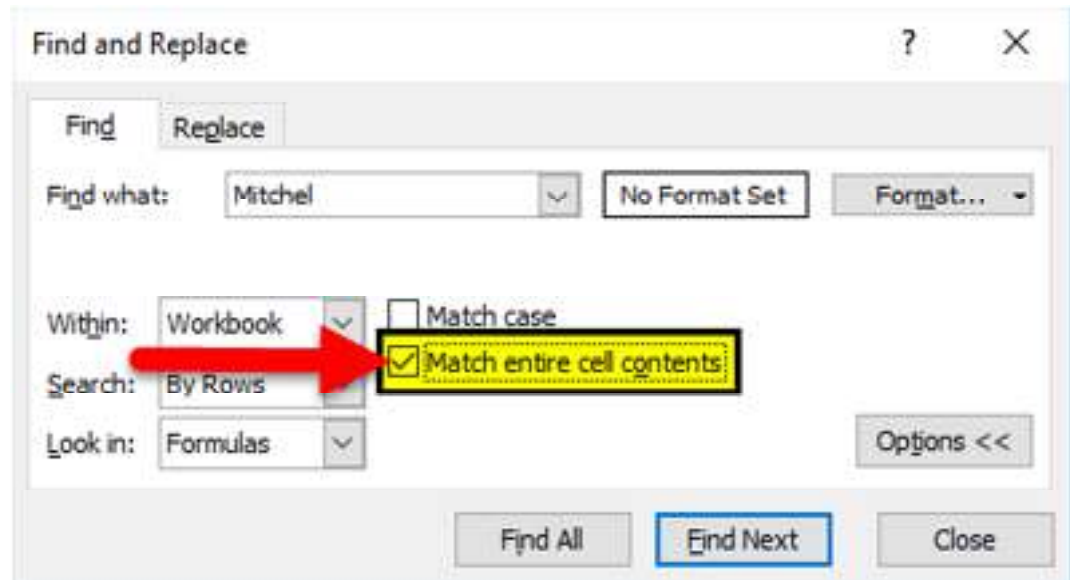
Step 2: Click "find all" to view all the exact matches of the name "Mitchel." In the current workbook, 8 cells contain the exact name.

The results (shown in the following image) display the cell references, exact value, and the names of the worksheet and the workbook.
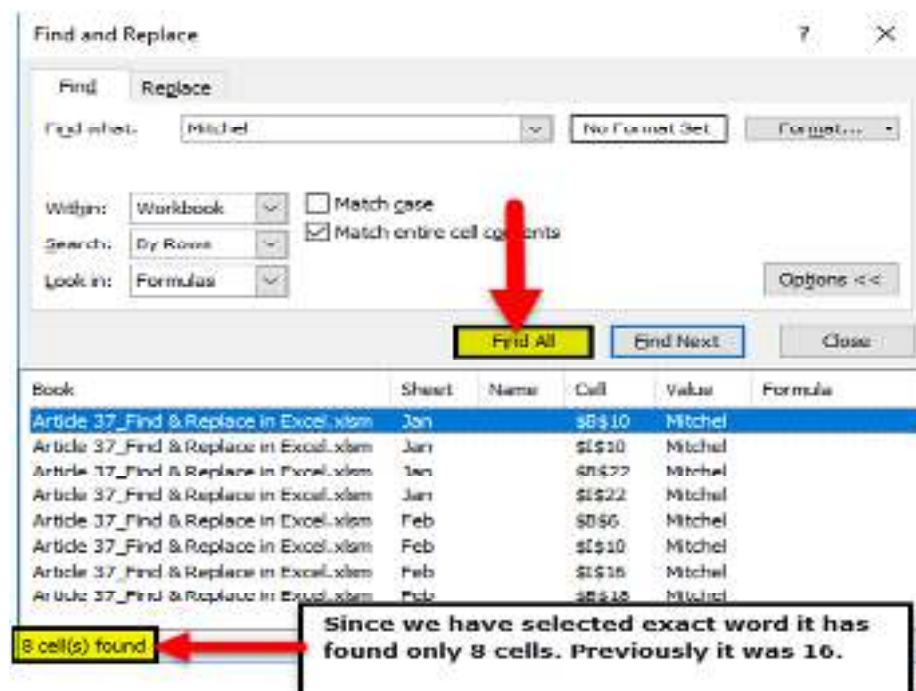
Example #4–Replace the Range Reference of a Formula

The following image shows the names (column A), salaries per annum (in $ in column B), salaries per month (in $ in column C), and departments (column D) of some employees of an organization.

The total salary per annum is shown in cell G3. This sum incorrectly considers the range B2:B10 in place of the range B2:B22. Rectify the range of the formulas in cells G3 and H3 so that the total salary per annum is calculated accurately. Use the Find and Replace feature of Excel.

The steps to edit a formula by using the Find and Replace feature of Excel are listed as follows:

Step 1: Copy the **SUM** formula of cell G3. For this, perform the given tasks:

- Select cell G3. The formula [=SUM(B2:B10)] appears in the formula bar.

- Copy this formula by pressing the keys "Ctrl+C" together.

- Press the Escape (Esc) key once the formula has been copied. This will help exit the formula bar.

Alternatively, copy the formula of cell H3 by pressing the keys "Ctrl+C." Next, press "Ctrl+H."

Step 2: The Replace tab of the "find and replace" window opens. Paste the copied formula in the "find what" box, as shown in the following image. For pasting the formula, press the keys "Ctrl+V" together.

Note: Instead of copying and pasting, one can type the formula directly in the "find what" box.
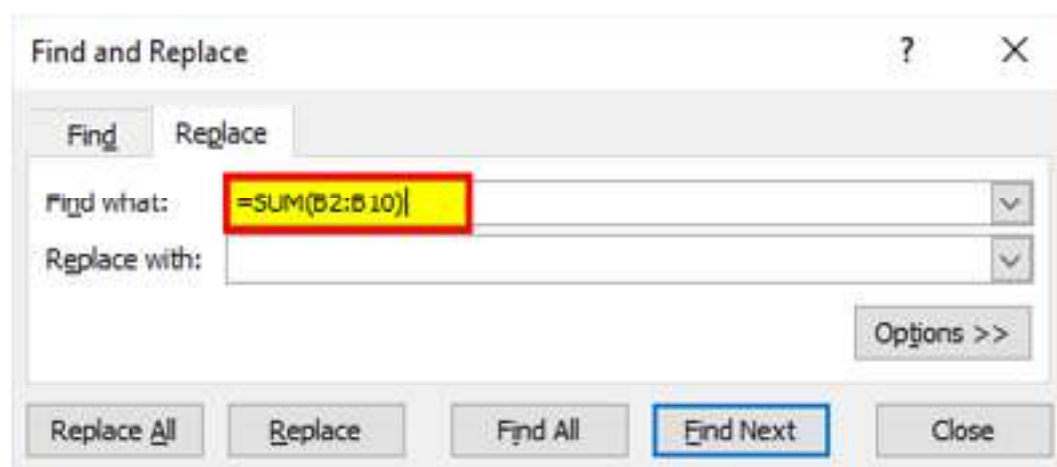
Step 3: Enter the correct formula in the "replace with" box. So, type the formula "=SUM(B2:B22)" without the beginning and ending double quotation marks. This is shown in the following image.

Spreadsheet Modelling (Using Excel)

Next, click "replace all."
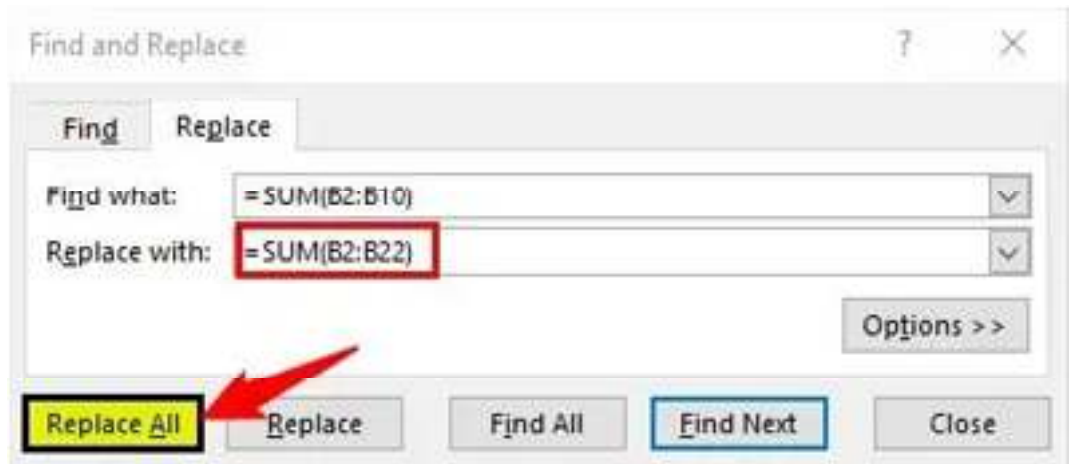
Step 4: Click "Ok" in the message stating the number of replacements made. The formulas of cells G3 and H3 change from "=SUM(B2:B10)" to "=SUM(B2:B22)." As a result, the total salary per annum changes.

The new output is shown within a red box in the following image. Hence, the total salary paid to the given 21 employees is $11,179,954 per annum.

Example #5–Replace the Existing Text to Make Two Strings Identical

There are two images titled "image 1" and "image 2." Both images are in different worksheets. Further, the following information is given:

- Image 1 shows the product code (column A) and prices (in $ in column B) of 21 products of a multinational organization.

- Image 2 shows the product code (column A) and a blank column (column B) for the prices of the 21 products.

Notice that the product codes of both images consist of some letters prefixed to a number. The letters are different in both images, but the subsequent numbers are the same.

Make the product code identical in both images by using the Find and Replace feature of Excel. This will help fetch the prices of "image 1" in "image 2" (column B) with the **VLOOKUP function**.

	A	B
1	**Product Code**	**Price**
2	Prdct-1	20
3	Prdct-2	17
4	Prdct-3	18
5	Prdct-4	24
6	Prdct-5	20
7	Prdct-6	10
8	Prdct-7	20
9	Prdct-8	22
10	Prdct-9	14
11	Prdct-10	15
12	Prdct-11	10
13	Prdct-12	17
14	Prdct-13	12
15	Prdct-14	13
16	Prdct-15	24
17	Prdct-16	10
18	Prdct-17	17
19	Prdct-18	17
20	Prdct-19	10
21	Prdct-20	25
22	Prdct-21	20
23		

	A	B
1	**Product Code**	**Price**
2	Pdc-1	
3	Pdc-2	
4	Pdc-3	
5	Pdc-4	
6	Pdc-5	
7	Pdc-6	
8	Pdc-7	
9	Pdc-8	
10	Pdc-9	
11	Pdc-10	
12	Pdc-11	
13	Pdc-12	
14	Pdc-13	
15	Pdc-14	
16	Pdc-15	
17	Pdc-16	
18	Pdc-17	
19	Pdc-18	
20	Pdc-19	
21	Pdc-20	
22	Pdc-21	
23		

The steps to make the product code identical by using the Find and Replace feature of Excel are listed as follows:

Step 1: Press the keys "Ctrl+H" to open the Replace tab of the "find and replace" window.

Step 2: Enter "pdc" in the "find what" box. Enter "prdct" in the "replace with" box. Next, click "replace all." A message stating the number of replacements made is displayed. Click "Ok" to proceed.

The entries and the outputs are shown in the following image. Now, one can easily apply the VLOOKUP function to fetch the prices in this image. Had the replacements not been made, the VLOOKUP function could not have been applied.
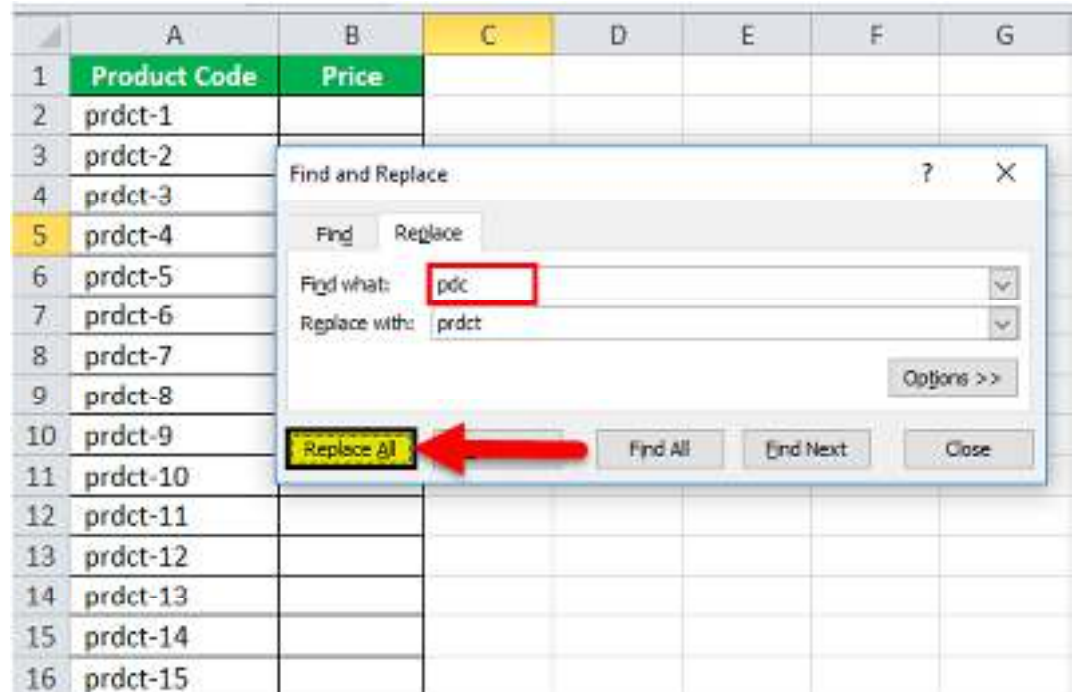
Difference between "replace all" and "replace": The "replace all" option replaces all the occurrences of the search value in one go. In contrast, the "replace" option replaces one occurrence at a time.

Therefore, use "replace" when not sure which occurrence needs to be replaced. Use "replace all" when all occurrences of the search value need to be replaced.

Example #6–Replace the Old Formatting of a Cell

The following image shows some departments of an organization. Cell A4 is in grey and cells B5, C2, and D5 are in blue. We want all the cells containing "marketing" to be in one color.

Therefore, replace the grey color of cell A4 with blue color. Use the Find and Replace feature of Excel.

The steps to change the formatting with the Find and Replace feature of Excel are listed as follows:

Step 1: Select the dataset whose formatting needs to be changed. We have selected the range A2:D6.

Next, press the keys "Ctrl+H" to open the Replace tab of the "find and replace" window. In this tab, click "options" shown on the right side.

This entire step is shown in the following image.

Step 2: Once "options" is clicked, the "find and replace" window expands. Click the drop-down arrow of the first "format" option (to the right of the "find what" box). Next, select "choose format from cell."

The selection is shown within a black box in the following image.
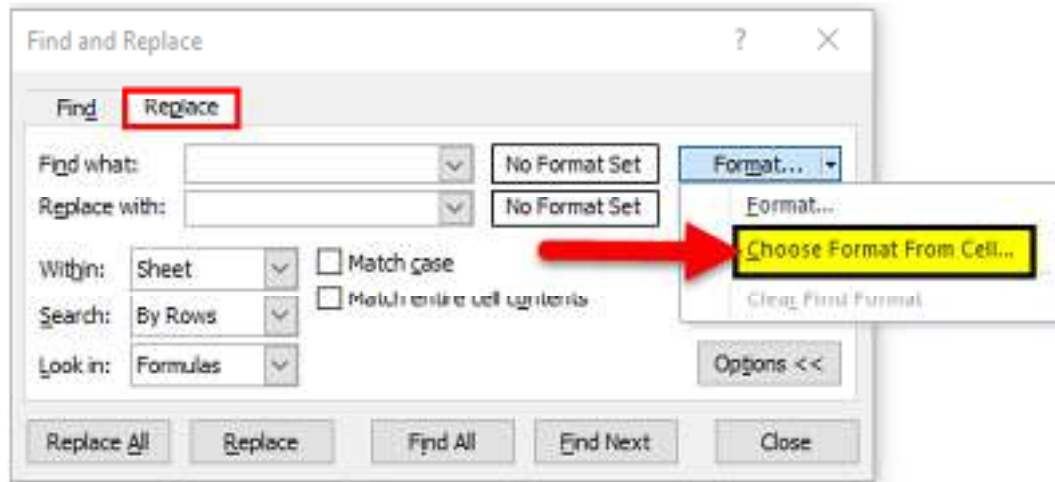
Step 3: Select the cell whose formatting needs to be changed. We select cell A4. As a result, the "no format set" on the left of "format" changes to "preview." This "preview" option reflects the color of cell A4, as shown in the following image.

Note: The "preview" option of the following image and cell A4 of the first image (at the beginning of this example) show a slight variation in color. Please ignore this variation, which may be due to different Excel versions being used to create images.
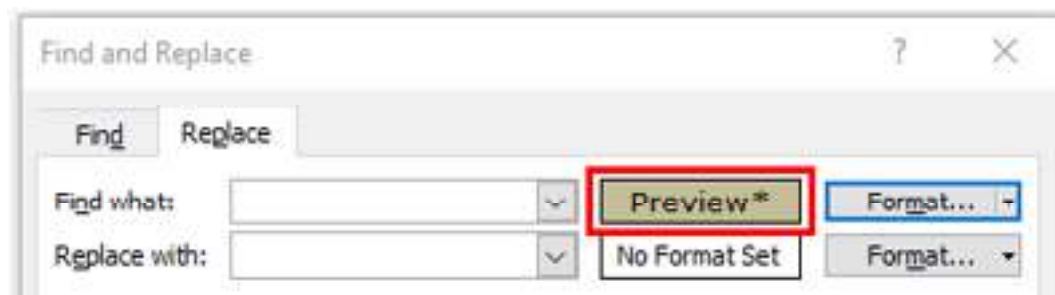
Step 4: Click the drop-down arrow of the second "format" option (to the right of the "replace with" box). Select "choose format from cell" and click any of the blue cells (B5, C2 or D5). Consequently, the "preview" option appears in blue, as shown in the following image.

Next, click "replace all."

Spreadsheet Modelling (Using Excel)
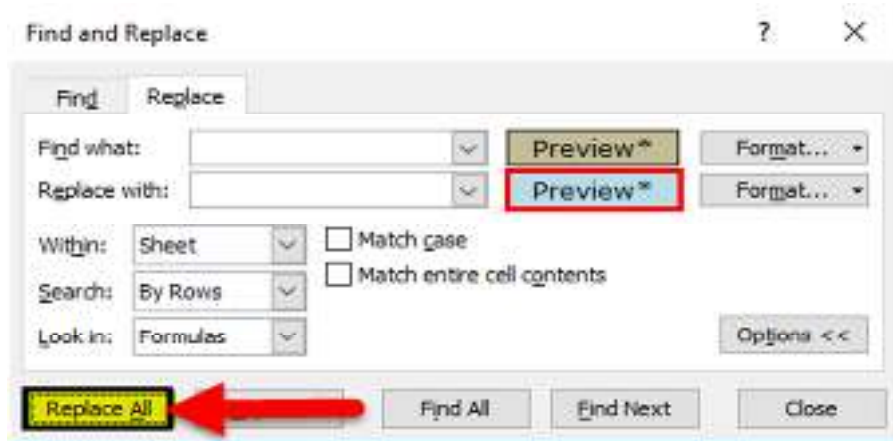
Step 5: Excel shows the number of replacements made. Click "Ok" to proceed. The output is shown in the following image.

Hence, cell A4 has also been colored blue. In this way, the formatting of a cell can be searched and replaced. So, we have searched for the grey color and replaced it with the blue color. Now, all cells containing "marketing" are in a single color.

Note: Alternatively, one can select the "format" option from both the "format" drop-downs. Thereafter, from the respective "fill" tabs, select the color to be searched and the color to be replaced with.

Example #7–Find a Comment in a Worksheet

The following image contains two datasets (range A1:D11 and range A13:D23) that show the gross sales (column B), cost of goods sold (COGS in column C), and profits (column D) of ten products of an organization. Further, the following information is given:

- Both datasets pertain to different time periods. The figures in brackets in column D are the losses suffered by the organization.

- In both datasets, each cell of column D contains **comments**. This is indicated by the small, red triangles at the top-right side of each cell.

- There are three kinds of comments, namely, "no commission," "commission @ 5%," and "commission @ 10%."

Find the comment "no commission" in the current worksheet, which has been renamed "comment." Use the Find and Replace feature of Excel.

	A	B	C	D
1	**Product**	**Gross Sales**	**COGS**	**Profit**
2	PDC-6	263,550	326,596	(63,046)
3	PDC-7	167,966	261,214	(93,248)
4	PDC-5	199,337	347,758	(148,421)
5	PDC-10	276,693	284,057	(7,364)
6	PDC-9	333,030	253,225	79,805
7	PDC-3	229,782	297,917	(68,135)
8	PDC-8	229,063	291,616	(62,553)
9	PDC-4	214,985	315,105	(100,120)
10	PDC-1	183,039	167,327	15,712
11	PDC-2	325,282	308,418	16,864
12				
13	**Product**	**Gross Sales**	**COGS**	**Profit**
14	PDC-6	211,125	223,182	(12,057)
15	PDC-7	150,098	289,850	(139,752)
16	PDC-5	244,332	195,732	48,600
17	PDC-10	310,148	336,528	(26,380)
18	PDC-9	167,304	195,025	(27,721)
19	PDC-3	190,517	234,735	(44,218)
20	PDC-8	293,401	324,610	(31,209)
21	PDC-4	246,915	156,680	90,235
22	PDC-1	272,864	153,892	118,972
23	PDC-2	186,396	182,411	3,985
24				

The steps to search a specific comment by using the Find and Replace feature of Excel are listed as follows:

Step 1: Open the Find tab of the "find and replace" dialog box. For this, press the keys "Ctrl+F" together. Next, click "options." Make the following selections in this window:

- Select "sheet" and "by rows" in the "within" and "search" parameters. These are the default selections of Excel.

- Select the option "comments" from the drop-down of "look in."

The selection of the second pointer is shown within a black box in the following image.
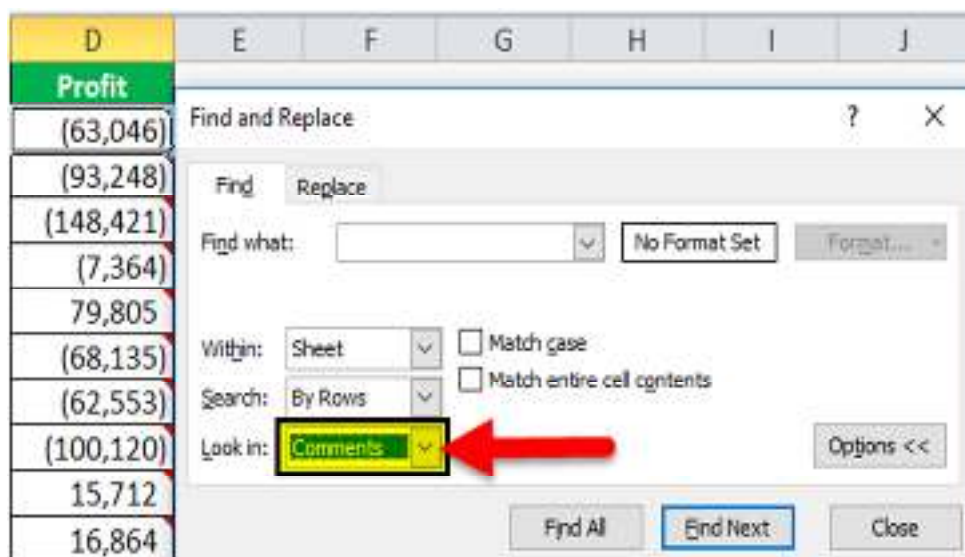
Spreadsheet Modelling (Using Excel)

Step 2: In the "find what" box, enter the string of the comment that needs to be searched. We have entered "no commission," as shown in the following image.

Next, click "find all."
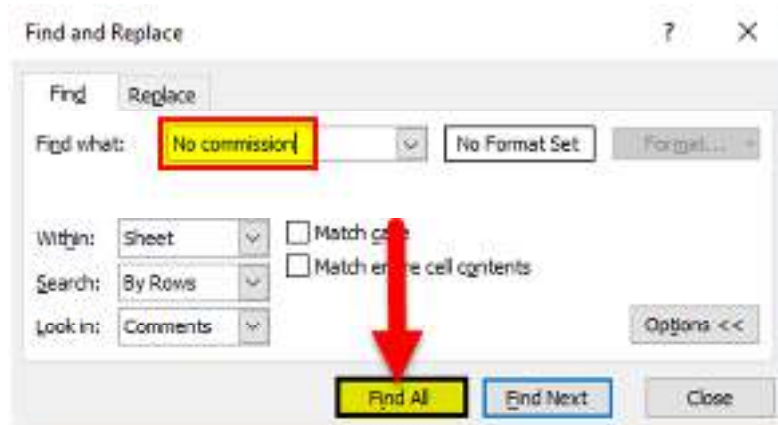
Step 3: The search results are shown in the following image. Notice that 13 cells (refer to the bottom of the image) contain the comment "no commission."

The references to cells containing the specific comment (no commission) are displayed in the column "cell." The formulas (of column D) and the names of the workbook and worksheet are displayed in columns "formula," "book," and "sheet" respectively.

Clicking any of the entries of these results will select the cell containing the comment.
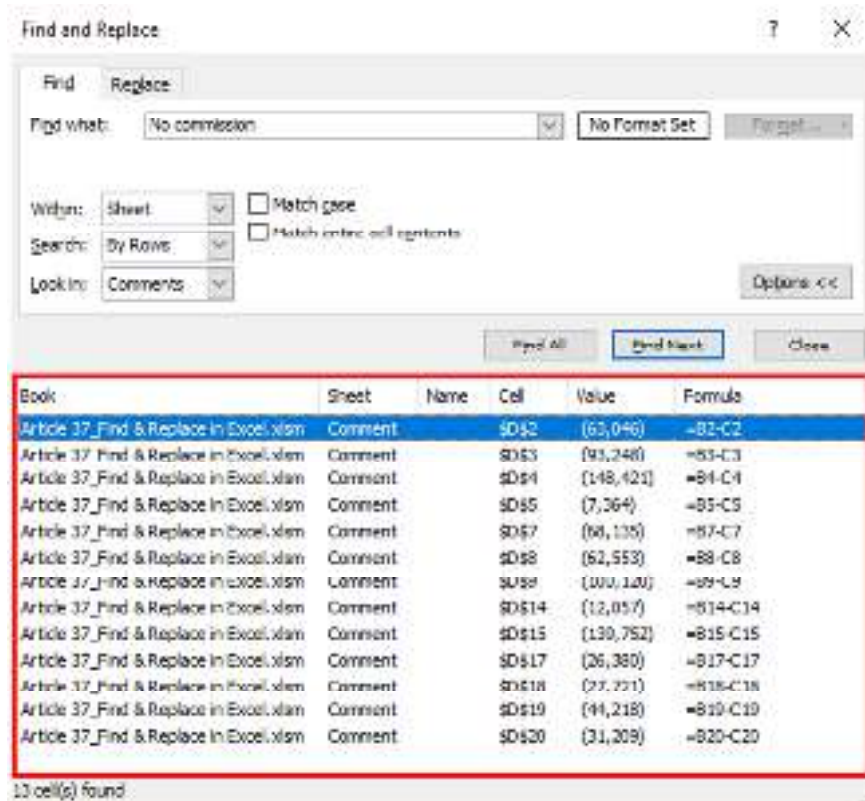
The Key Points Related to the Find and Replace Feature of Excel

The important points related to the Find and Replace feature of Excel are listed as follows:

- The search can be limited to a specific range of the worksheet. For such restriction, select the range prior to opening the Find tab of the "find and replace" window. If no range is selected, Excel searches in the currently active sheet. If the search value cannot be found in the selected range or the active worksheet, a message stating the same is displayed.

- The replacements can also be restricted to a specific region of the worksheet. For this, select the area (or range) prior to opening the Replace tab of the "find and replace" window. If no range is selected, Excel makes the replacements in the entire active sheet.

- The Find and Replace excel feature can replace the existing formatting of cells with the new formatting. For this, make use of the two "format" drop-downs of the Replace tab.

- The search value can be looked up in a protected worksheet, but a replacement cannot be made. For replacing, unprotect the sheet first.

5.2 Text Functions

Excel is mostly about the numerical data, but at times you can come across the data which has too much text and that is the time when Text Functions in Excel will help you to simplify the things easily.

Left() & Right()

- You can use the Left function when you want to extract the leftmost characters from a string.
- Syntax =left(text, num_char) or right(text, num_char)
- Similarly, you can also use the Right function to extract the rightmost characters from a string.

Len()

- Len function in Excel helps you to know the length of a string that is number of characters in a string.
- Syntax = LEN(text)
- Note: Spaces are included while calculating length.

B1			fx	=LEN(A1)	

	A	B	C	D
1	Learn Excel Easily	18		
2				
3				
4				
5				

Mid ()

- Mid function in Excel is used to extract the characters from the middle of a string.
- Syntax = MID(text, start_char, num_chars)

B1			fx	=MID(A1,7,5)	

	A	B	C	D
1	Learn Excel Easily	Excel		
2				
3				
4				
5				

Find ()

- Find function in Excel is used when you want to know the position of certain characters in a particular string.
- Syntax =FIND(find_text, within_text,[start_num])

B1			fx	=FIND("Easi",A1)	

	A	B	C	D
1	Learn Excel Easily	13		
2				
3				
4				
5				

Proper ()

- Proper function in Excel capitalizes each word in the string that is, it converts the case into proper case.
- Syntax =PROPER(Text)

Rept ()

- Rept function in Excel is used when you want a certain text to be repeated certain number of times.
- Syntax =REPT(Text, number_times)

Trim()

- Trim function in Excel removes the unnecessary spaces from a particular string.
- Syntax =TRIM(Text)

Upper()

- Upper function in Excel converts the text into Upper case from lower case.
- Syntax =UPPER(Text)

Spreadsheet Modelling (Using Excel)

Substitute ()

- Substitute function in Excel helps to replace existing text with a new text in a particular string.
- Syntax =SUBSTITUTE(text, old_text, new_text, instance number)

Concatenate ()

- Concatenate function in Excel helps to join the text of two or more cells.
- Syntax =CONCATENATE(text1, text2,….)

5.3   Filtering

If your worksheet contains a lot of content, it can be difficult to find information quickly. **Filters** can be used to **narrow down** the data in your worksheet, allowing you to view only the information you need.

- The filter in excel helps display relevant data by eliminating the irrelevant entries temporarily from the view.
- The data is filtered as per the given criteria. The purpose of filtering is to focus on the crucial areas of a dataset.
- For example, the city-wise sales data of an organization can be filtered by the location. Hence, the user can view the sales of selected cities at a given time.

- A filter is necessarily required when working with a huge database.

- Being a widely used tool, the filter converts a comprehensive view into an easy-to-understand one.

- To apply filters, the dataset must contain a header row which specifies the name of every column.

How to Filter in Excel?
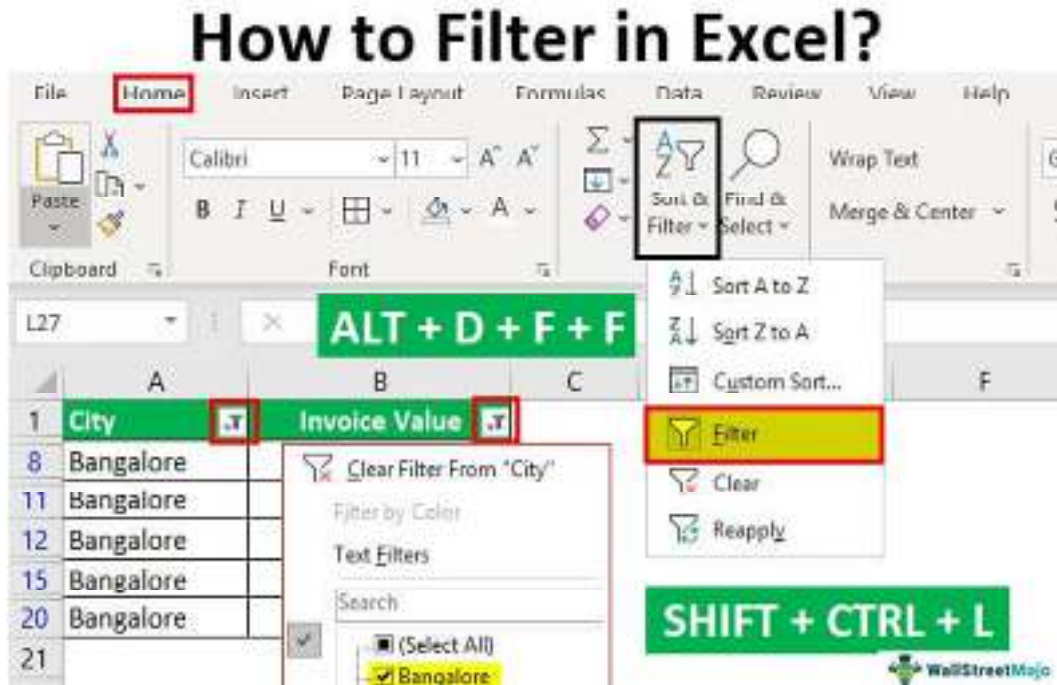
To filter data:

In our example, we'll apply a filter to an equipment log worksheet to display only the laptops and projectors that are available for checkout.

1. In order for filtering to work correctly, your worksheet should include a **header row**, which is used to identify the name of each column. In our example, our worksheet is organized into different columns identified by the header cells in row 1: **ID#**, **Type**, **Equipment Detail**, and so on.

ID #	Type	Equipment Detail	Checked Out	Checked In	Checked Out By
3000	Camera	Saris Lumina Digital Camera	12-May-15	15-May-15	Shannon Nguyen
3005	Camera	Saris Zoom 7-60 Digital Camera	27-Jul-15	06-Aug-15	Sela Shepard
1021	Laptop	15" EDI SmartPad L200-3 Laptop	15 Sep 15	01-Oct 15	Sofie Ragnar
1022	Laptop	15" EDI SmartPad L200-3 Laptop	14 Aug 15	16-Aug 15	Hank Sorenson
1023	Laptop	15" EDI SmartPad L200-3 Laptop	08-Aug-15	15-Aug-15	Jennifer Weiss
3070	Camera	Omega Pixl Digital Camcorder	06-Oct-15		Min Seung
1025	Laptop	15" EDI SmartPad L200-4X	26-Sep-15	04-Oct-15	Min Seung
1031	Laptop	17" Saris X-10 Laptop	04-Oct-15		Nick Ortiz
1032	Laptop	17" Saris X-10 Laptop	19 Sep 15		Stanley Geyer
1033	Laptop	17" Saris X-10 Laptop	24-Sep-15	26-Sep-15	George D'Agosta

2. Select the **Data** tab, then click the **Filter** command.

Spreadsheet Modelling (Using Excel)

3. A **drop-down arrow** will appear in the header cell for each column.

4. Click the **drop-down arrow** for the column you want to filter. In our example, we will filter column **B** to view only certain types of equipment.

5. The **Filter menu** will appear.

6. **Uncheck** the box next to **Select All** to quickly deselect all data.
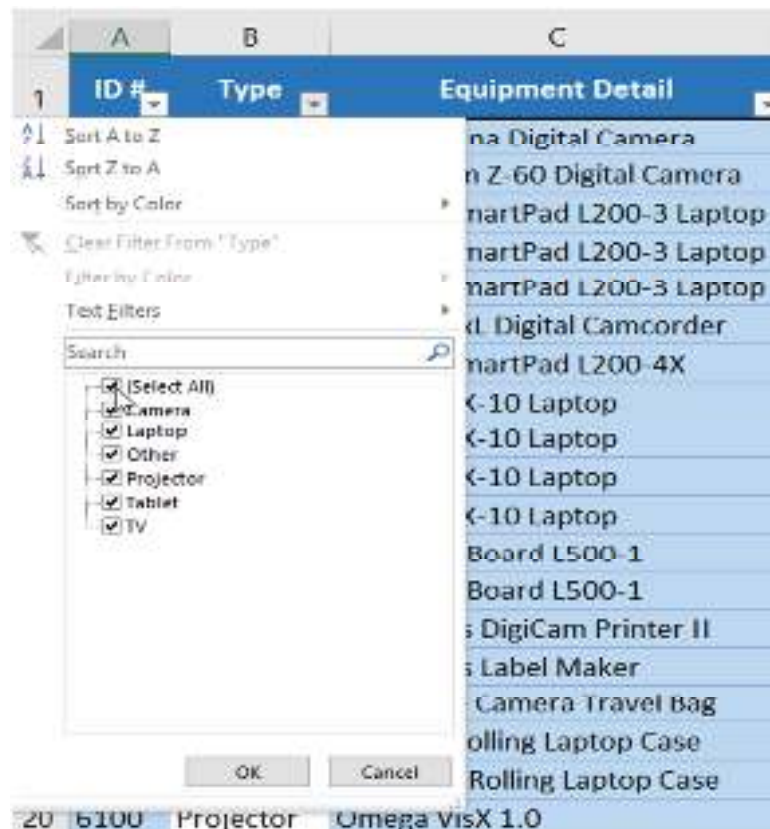
7. **Check** the boxes next to the data you want to filter, then click **OK**. In this example, we will check **Laptop** and **Projector** to view only these types of equipment.
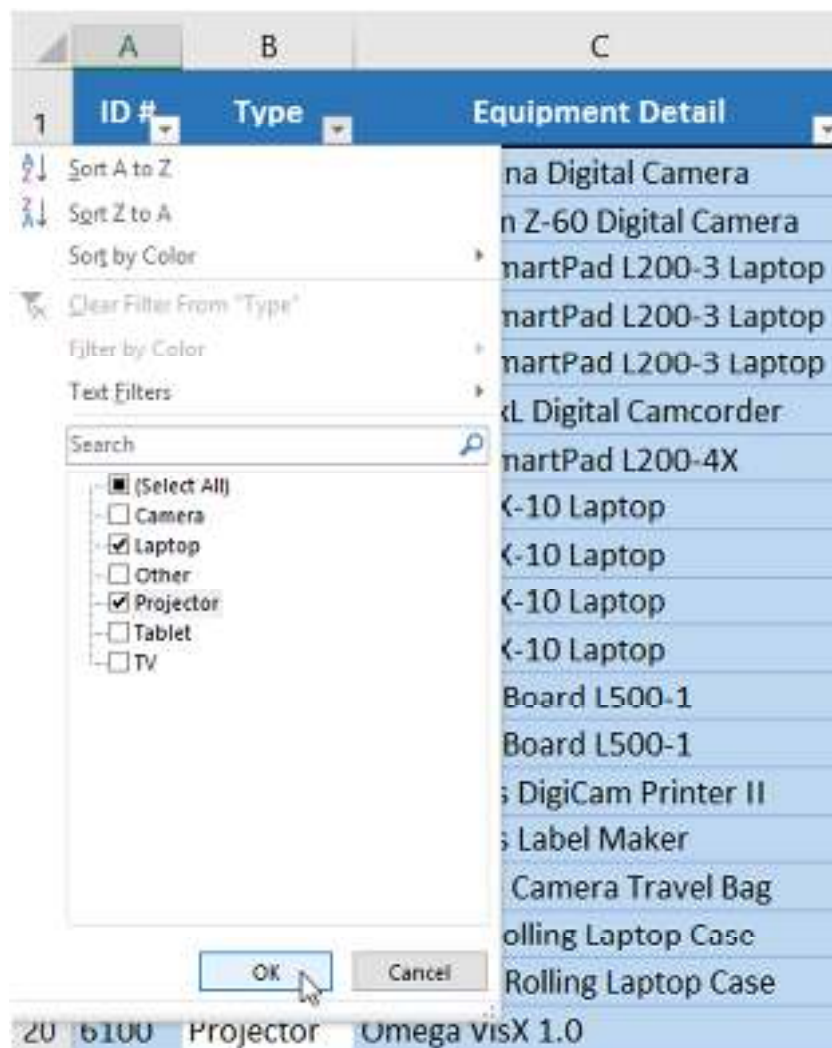
8. The data will be **filtered**, temporarily hiding any content that doesn't match the criteria. In our example, only laptops and projectors are visible.

Filtering options can also be accessed from the **Sort & Filter** command on the **Home** tab.

Spreadsheet Modelling (Using Excel)
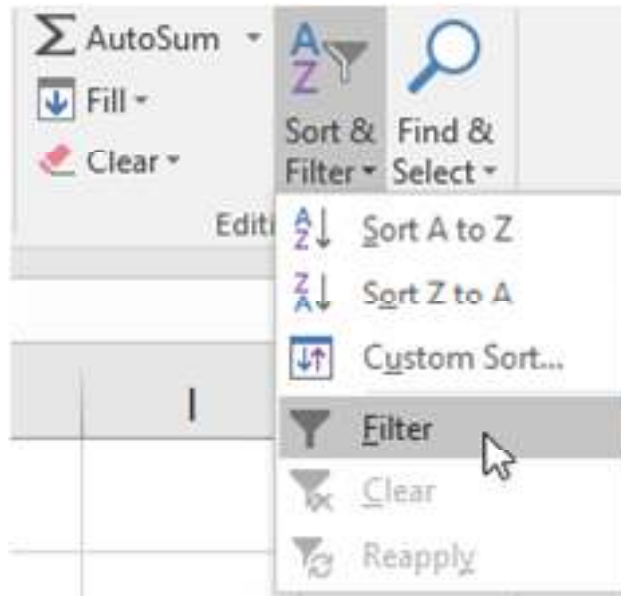
To apply multiple filters:

Filters are **cumulative**, which means you can apply **multiple filters** to help narrow down your results. In this example, we've already filtered our worksheet to show laptops and projectors, and we'd like to narrow it down further to only show laptops and projectors that were checked out in August.

1. Click the **drop-down arrow** for the column you want to filter. In this example, we will add a filter to column **D** to view information by date.

2. The **Filter menu** will appear.

3. **Check** or **uncheck** the boxes depending on the data you want to filter, then click **OK**. In our example, we'll uncheck everything except for **August**.
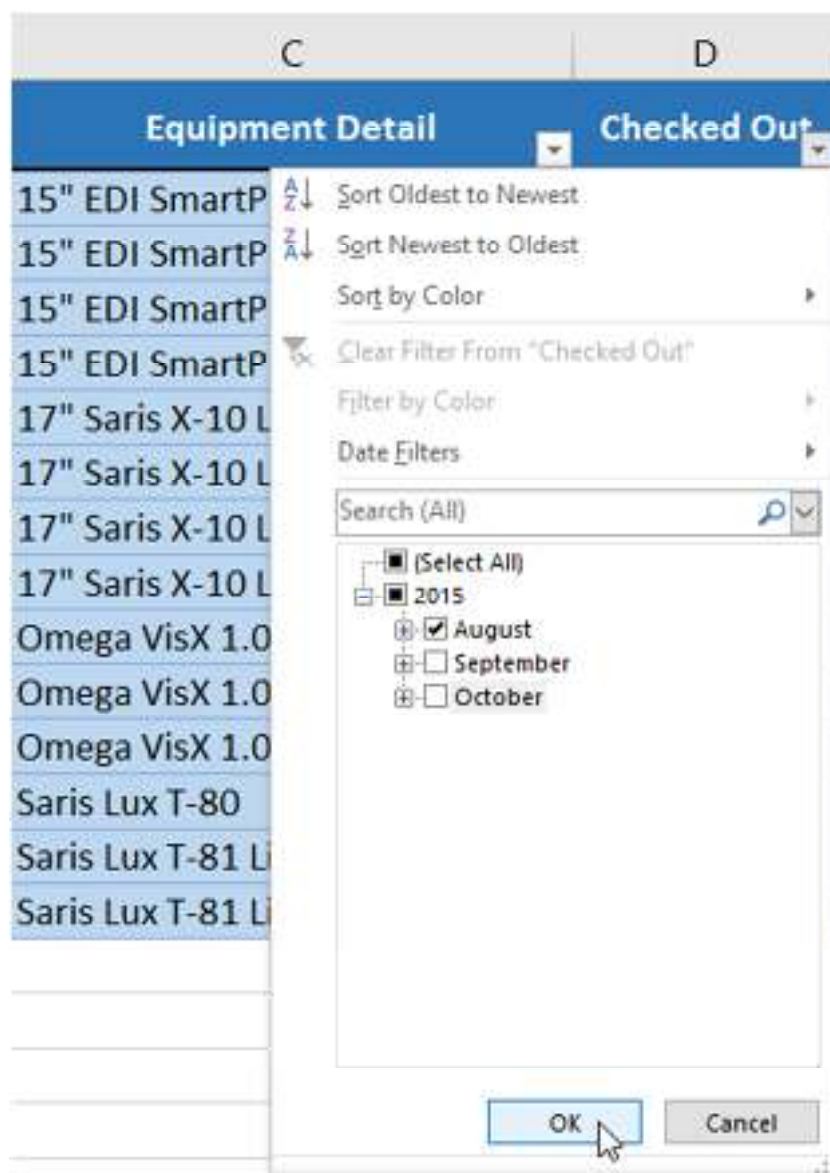
4. The new filter will be applied. In our example, the worksheet is now filtered to show only laptops and projectors that were checked out in August.

	A	B	C	D	E	F
1	ID #	Type	Equipment Detail	Checked Out	Checked In	Checked Out By
5	1022	Laptop	15" EDI SmartPad L200 3 Laptop	14 Aug 15	16 Aug 15	Hank Sorenson
6	1023	Laptop	15" EDI SmartPad L200 3 Laptop	08-Aug-15	15-Aug-15	Jennifer Weiss
12	1034	Laptop	17" Saris X-10 Laptop	25-Aug-15	27-Aug-15	Jay Peralta
22	G102	Projector	Omega VisX 1.0	22 Aug 15	23 Aug 15	Jamila Kyle
31						
32						

To clear a filter:

After applying a filter, you may want to remove—or **clear**—it from your worksheet so you'll be able to filter content in different ways.

1. Click the **drop-down arrow** for the filter you want to clear. In our example, we'll clear the filter in column **D**.

Spreadsheet Modelling (Using Excel)

2. The **Filter menu** will appear.

3. Choose **Clear Filter From [COLUMN NAME]** from the Filter menu. In our example, we'll select **Clear Filter From "Checked Out"**.
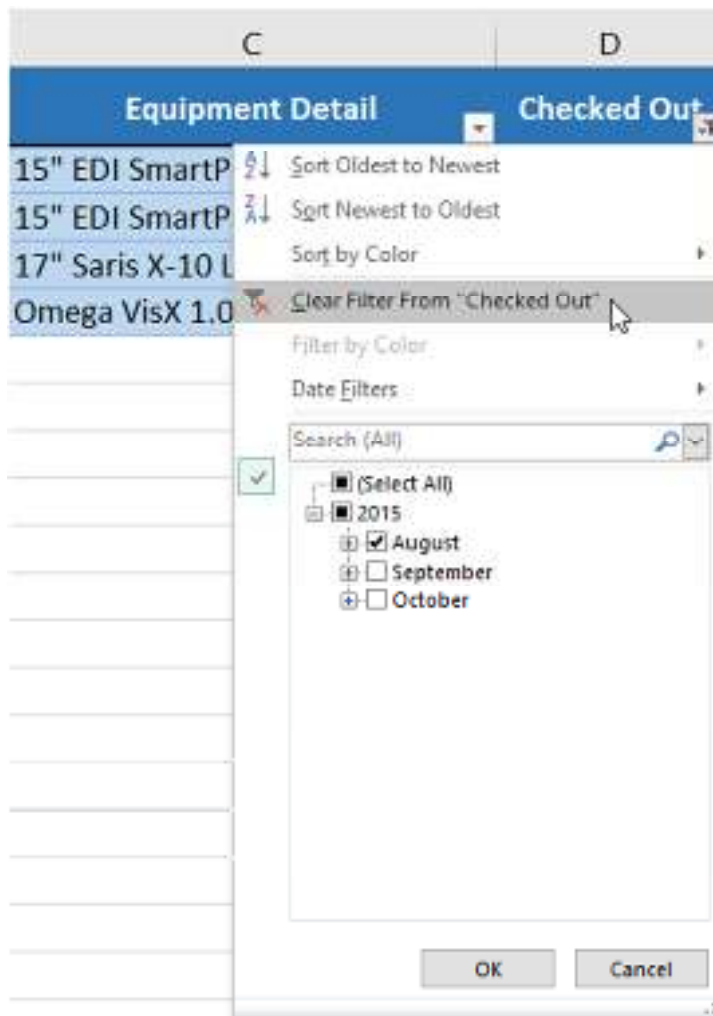
4. The filter will be cleared from the column. The previously hidden data will be displayed.

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	A	B	C	D	E	F
1	ID #	Type	Equipment Detail	Checked Out	Checked In	Checked Out By
4	1021	Laptop	15" EDI SmartPad L200-3 Laptop	15-Sep-15	01-Oct-15	Sofie Ragnar
5	1022	Laptop	15" EDI SmartPad L200-3 Laptop	14-Aug-15	15	Hank Sorenson
6	1023	Laptop	15" EDI SmartPad L200-3 Laptop	08-Aug-15	15-Aug-15	Jennifer Weiss
8	1025	Laptop	15" EDI SmartPad L200 4X	26-Sep-15	04-Oct-15	Min Seung
9	1031	Laptop	17" Saris X-10 Laptop	04-Oct-15		Nick Ortiz
10	1032	Laptop	17" Saris X-10 Laptop	19-Sep-15		Stanley Geyer
11	1033	Laptop	17" Saris X-10 Laptop	24-Sep-15	26-Sep-15	George D'Agosta
12	1034	Laptop	17" Saris X-10 Laptop	25-Aug-15	27-Aug-15	Jay Peralta
20	6100	Projector	Omega VisX 1.0	28-Sep-15	01-Oct-15	Win Armitage
21	6101	Projector	Omega VisX 1.0	26-Sep-15	27-Sep-15	Michael Farley
22	6102	Projector	Omega VisX 1.0	22-Aug-15	23-Aug-15	Jamila Kyle
23	6200	Projector	Saris Lux T-80	01-Sep-15	04-Sep-15	Jolie Chaturvedi
24	6301	Projector	Saris Lux T-81 Lite	10-Sep-15		Marques Herndon
25	6302	Projector	Saris Lux T-81 Lite	08-Sep-15	15-Sep-15	Dean Sorenson
31						
32						

To remove all filters from your worksheet, click the **Filter** command on the **Data** tab.

Advanced filtering

If you need a filter for something specific, basic filtering may not give you enough options. Fortunately, Excel includes several **advanced filtering tools**, including **search**, **text**, **date**, and **number filtering**, which can narrow your results to help find exactly what you need.

To filter with search:

Excel allows you to **search** for data that contains an exact phrase, number, date, and more. In our example, we'll use this feature to show only **Saris** brand products in our equipment log.

1. Select the **Data** tab, then click the **Filter** command. A **drop-down arrow** will appear in the header cell for each column. **Note**: If you've already added filters to your worksheet, you can skip this step.

2. Click the **drop-down arrow** for the column you want to filter. In our example, we'll filter column **C**.

Spreadsheet Modelling (Using Excel)

3. The **Filter menu** will appear. Enter a **search term** into the **search box**. Search results will appear automatically below the **Text Filters** field as you type. In our example, we'll type **saris** to find all Saris brand equipment. When you're done, click **OK**.
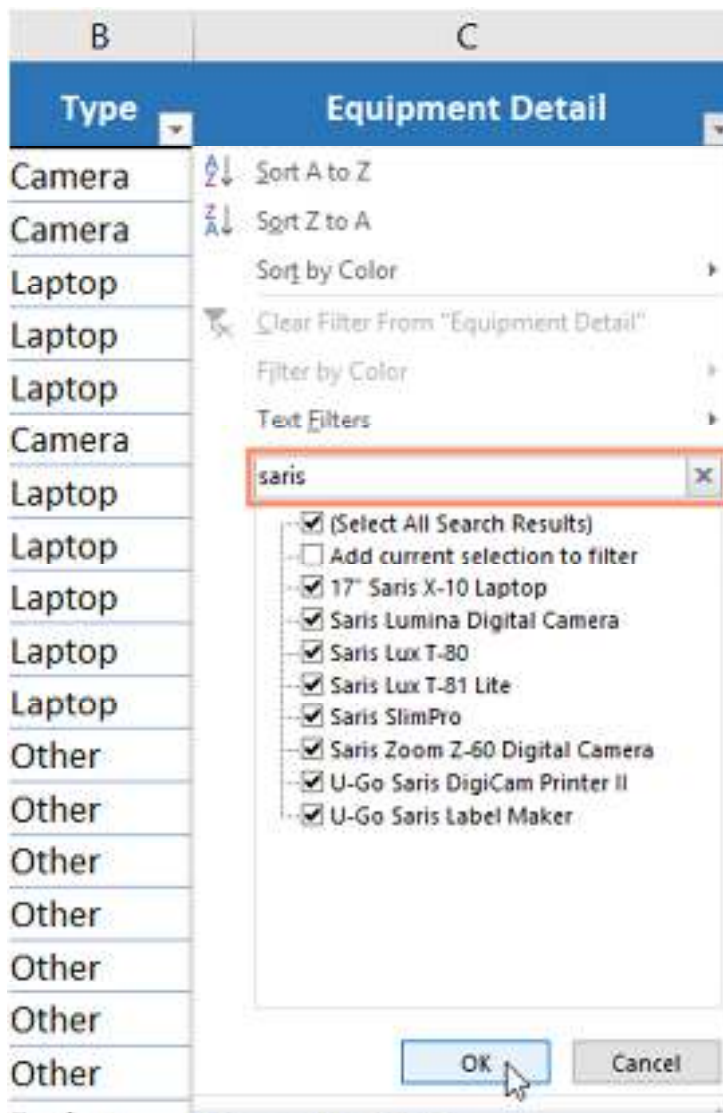
4. The worksheet will be **filtered** according to your search term. In our example, the worksheet is now filtered to show only Saris brand equipment.

	A	B	C	D	E	F
1	ID #	Type	Equipment Detail	Checked Out	Checked In	Checked Out By
2	3000	Camera	Saris Lumina Digital Camera	12-May-15	15-May-15	Shannon Nguyen
4	3005	Camera	Saris Zoom Z-60 Digital Camera	27-Jul-15	06-Aug-15	Sela Shepard
9	1031	Laptop	17" Saris X-10 Laptop	04-Oct-15		Nick Ortiz
10	1032	Laptop	17" Saris X-10 Laptop	19-Sep-15		Stanley Geyer
11	1033	Laptop	17" Saris X-10 Laptop	24-Sep-15	26-Sep-15	George D'Agosta
12	1034	Laptop	17" Saris X-10 Laptop	25-Aug-15	27-Aug-15	Jay Peralta
15	3800	Other	U-Go Saris DigiCam Printer II	04-Aug-15	05-Aug-15	Hank Sorenson
16	3900	Other	U-Go Saris Label Maker	13-Jun-15	20-Jun-15	Clint Gosse
23	6200	Projector	Saris Lux T-80	01-Sep-15	04-Sep-15	Jolie Chaturvedi
24	6301	Projector	Saris Lux T-81 Lite	10-Sep-15		Marques Herndon
25	6302	Projector	Saris Lux T-81 Lite	08-Sep-15	15-Sep-15	Dean Sorenson
26	1011	Tablet	Saris SlimPro	04-Oct-15		Jay Peralta
27	1012	Tablet	Saris SlimPro	29-Sep-15		August Zorn
31						
32						

To use advanced text filters:

Advanced text filters can be used to display more specific information, like cells that contain a certain number of characters or data that excludes a specific word or number. In our example, we'd like to exclude any item containing the word **laptop**.

1. Select the **Data** tab, then click the **Filter** command. A **drop-down arrow** will appear in the header cell for each column. **Note**: If you've already added filters to your worksheet, you can skip this step.

2. Click the **drop-down arrow** for the column you want to filter. In our example, we'll filter column **C**.

	A	B	C	D	E	F
1	ID #	Type	Equipment Detail	Checked Out	Checked In	Checked Out By
2	3000	Camera	Saris Lumina Digital Camera	12-May-15 (Equipment Detail) (Showing All)	15-May-15	Shannon Nguyen
3	3005	Camera	Saris Zoom Z-60 Digital Camera		06-Aug-15	Sela Shepard
4	1021	Laptop	15" EDI SmartPad L200-3 Laptop	15-Sep-15	01-Oct-15	Sofie Ragnar
5	1022	Laptop	15" EDI SmartPad L200-3 Laptop	14-Aug-15	16-Aug-15	Hank Sorenson
6	1023	Laptop	15" EDI SmartPad L200-3 Laptop	08-Aug-15	15-Aug-15	Jennifer Weiss
7	3070	Camera	Omega Pixl Digital Camcorder	06-Oct-15		Min Seung
8	1025	Laptop	15" EDI SmartPad L200-4X	26-Sep-15	04-Oct-15	Min Seung
9	1031	Laptop	17" Saris X-10 Laptop	04-Oct-15		Nick Ortiz
10	1032	Laptop	17" Saris X-10 Laptop	19-Sep-15		Stanley Geyer

3. The **Filter menu** will appear. Hover the mouse over **Text Filters**, then select the desired text filter from the drop-down menu. In our example, we'll choose **Does Not Contain...** to view data that does not contain specific text.
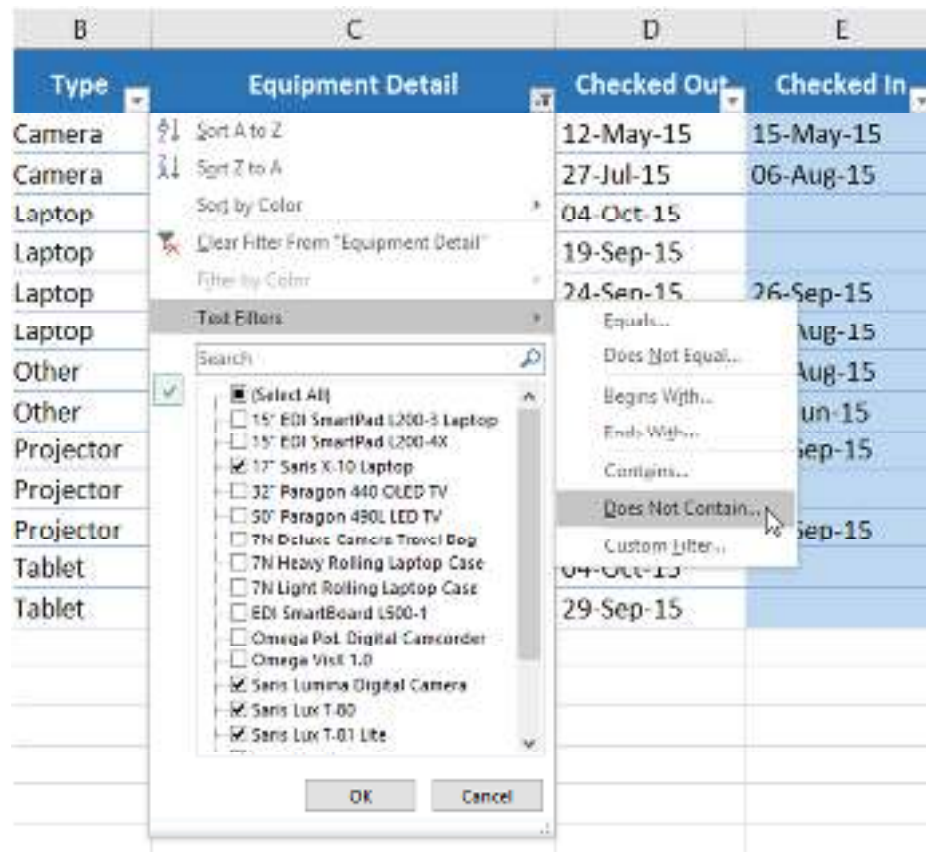
4. The **Custom AutoFilter** dialog box will appear. Enter the **desired text** to the right of the filter, then click **OK**. In our example, we'll type **laptop** to exclude any items containing this word.

5. The data will be filtered by the selected text filter. In our example, our worksheet now displays items that do not contain the word **laptop**.

To use advanced number filters:

Advanced number filters allow you to manipulate numbered data in different ways. In this example, we'll display only certain types of equipment based on the range of ID numbers.

1. Select the **Data** tab on the Ribbon, then click the **Filter** command. A **drop-down arrow** will appear in the header cell for each column. **Note**: If you've already added filters to your worksheet, you can skip this step.

2. Click the **drop-down arrow** for the column you want to filter. In our example, we'll filter column **A** to view only a certain range of ID numbers.

3. The **Filter menu** will appear. Hover the mouse over **Number Filters**, then select the desired number filter from the drop-down menu. In our example, we'll choose **Between** to view ID numbers between a specific number range.
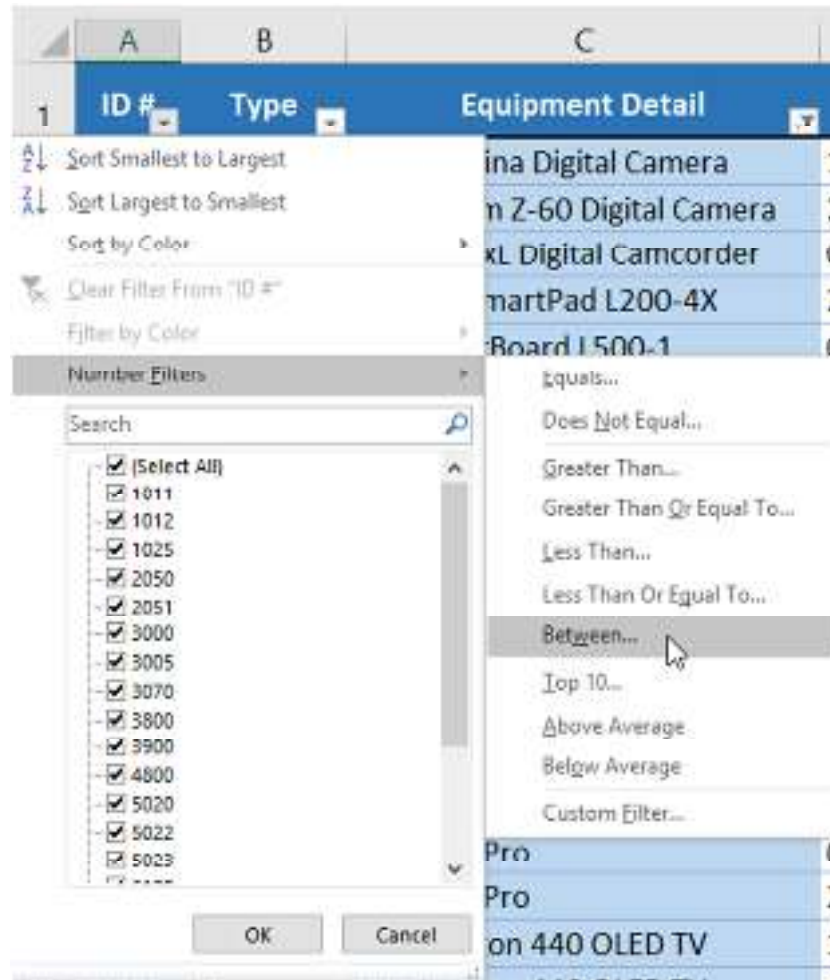
4. The **Custom AutoFilter** dialog box will appear. Enter the desired **number(s)** to the right of each filter, then click **OK**. In our example, we want to filter for ID numbers greater than or equal to **3000** but less than or equal to **6000**, which will display ID numbers in the 3000-6000 range.
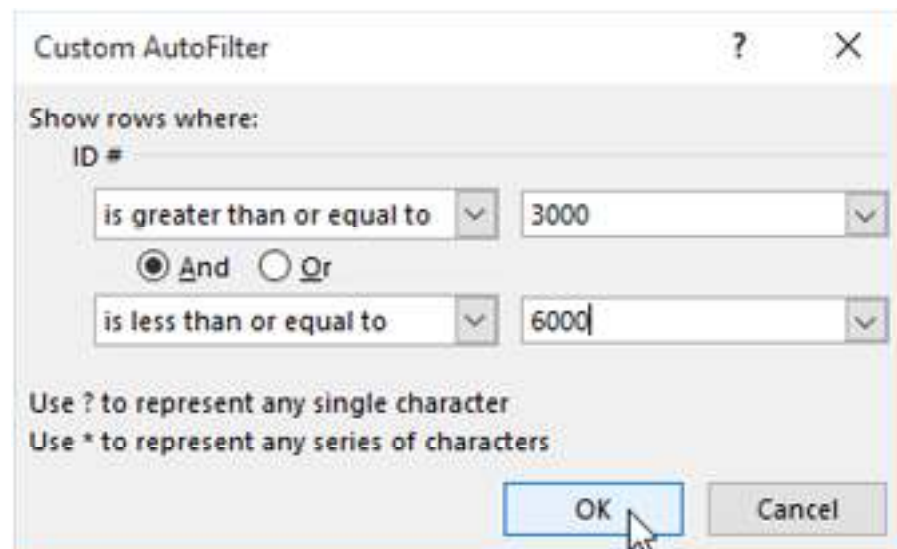
5. The data will be filtered by the selected number filter. In our example, only items with an ID number between **3000** and **6000** are visible.

To use advanced date filters:

Advanced date filters can be used to view information from a certain time period, such as last year, next quarter, or between two dates. In this example, we'll use advanced date filters to view only equipment that has been checked out between July 15 and August 15.

1. Select the **Data** tab, then click the **Filter** command. A **drop-down arrow** will appear in the header cell for each column. **Note**: If you've already added filters to your worksheet, you can skip this step.

2. Click the **drop-down arrow** for the column you want to filter. In our example, we'll filter column **D** to view only a certain range of dates.

3. The **Filter menu** will appear. Hover the mouse over **Date Filters**, then select the desired date filter from the drop-down menu. In our example, we'll select **Between...** to view equipment that has been checked out between July 15 and August 15.

Spreadsheet Modelling (Using Excel)
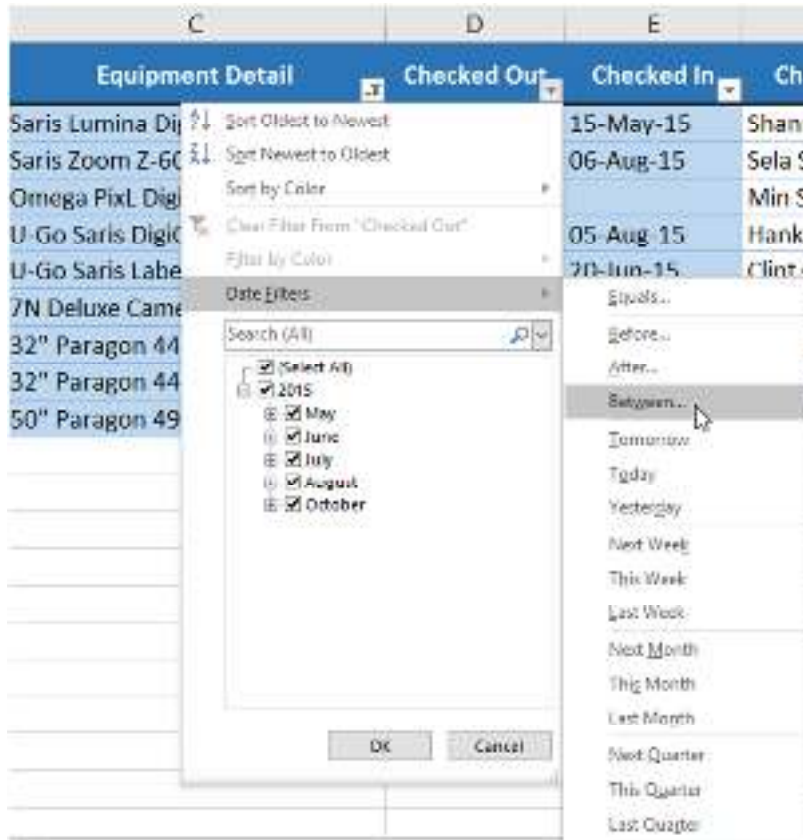
4. The **Custom AutoFilter** dialog box will appear. Enter the desired **date(s)** to the right of each filter, then click **OK**. In our example, we want to filter for dates after or equal to **July 15, 2015**, and before or equal to **August 15, 2015**, which will display a range between these dates.
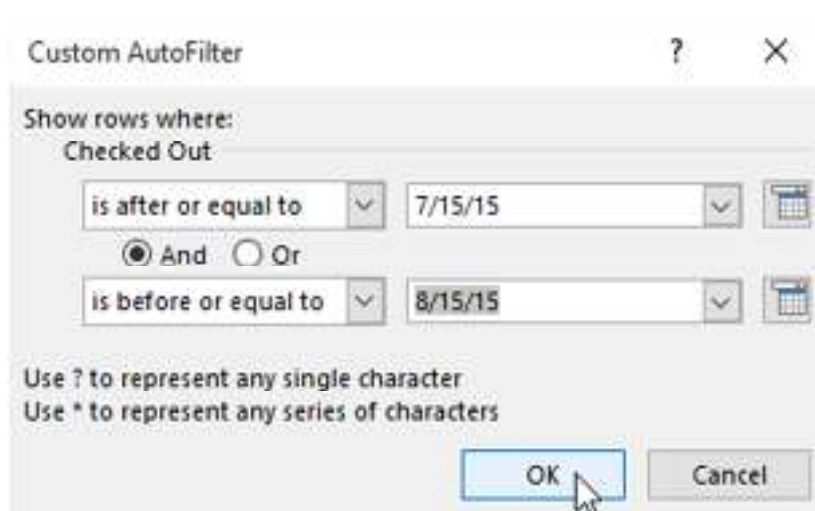
5. The worksheet will be filtered by the selected date filter. In our example, we can now see which items have been checked out **between July 15 and August 15**.

ID #	Type	Equipment Detail	Checked Out	Checked In	Checked Out By
3005	Camera	Saris Zoom Z-50 Digital Camera	27-Jul-15	06-Aug-15	Sela Shepard
3800	Other	U-Go Saris DigiCam Printer II	04-Aug-15	05-Aug-15	Hank Sorenson
4800	Other	7N Deluxe Camera Travel Bag	27-Jul-15	06-Aug-15	Sela Shepard
5020	TV	32" Paragon 440 OLED TV	11-Aug-15	13-Aug-15	Marta Lao
5022	TV	32" Paragon 440 OLED TV	17-Jul-15	17-Jul-15	Carl Langer

5.4 Sorting

As you add more content to a worksheet, organizing this information becomes especially important. You can quickly **reorganize** a worksheet by **sorting** your data. For example, you could organize a list of contact information by last name. Content can be sorted alphabetically, numerically, and in many other ways.

Sorting data in MS Excel rearranges the rows based on the contents of a particular column. You may want to sort a table to put names in alphabetical order. Or, maybe you want to sort data by Amount from smallest to largest or largest to smallest.

Types of sorting

When sorting data, it's important to first decide if you want the sort to apply to the **entire worksheet** or just a **cell range**.

Sort sheet organizes all of the data in your worksheet by one column. Related information across each row is kept together when the sort is applied. In the example below, the **Contact Name** column (column **A**) has been sorted to display the names in alphabetical order.

Customer Contact List

CONTACT NAME	BILLING ADDRESS	PHONE	EMAIL ADDRESS
Chaturvedi, Rick	2428 S Redding St #2 B	360-555-5422	info@newhaventraders.com
Dean, Hank	3034 Foggy Wharf Loo|	308-555-1050	hdean@venturebrewing.com
Figgis, Mallory	3520 Sleepy Hearth Dr	425-555-5370	malloryf@archerproperties.com
Finn, Jake	1407 Dusty Fawn Ln So	605-555-6435	jake@adventureoutfitters.com
Kinkade, Chris	1028 Quiet Dale Rd Ho|	443-555-4942	chris.kinkade@placervilleins.com
Lawson, Miranda	5316 Colonial Pkwy Est	575-555-9255	mlawson@massairlines.com
Reyes, Felicia	8544 Lazy Bluff Ave Wl	316-555-3256	felicia@everlypublishing.com
Sebastian, Lil	9060 Easy Evening Ln V	207-555-7225	lil@knopeequestrian.com
Silva, Vivica	8595 Thunder Brook Ci	360-555-4289	vivica@rileygardensupply.com
Stark, Katie	971 Cinder Butterfly St	603-555-2460	katie.stark@ariarealestate.com
Torrance, Jill	3160 Amber Gate Rd R|	605-555-4495	jtorrance@overlookinn.com
Yuen, Phillip	5108 Crystal Gate Blvd	913-555-5928	yuenp@corepharmaceuticals.com

Sort range sorts the data in a range of cells, which can be helpful when working with a sheet that contains several tables. Sorting a range will not affect other content on the worksheet.

To sort a sheet:

In our example, we'll sort a T-shirt order form alphabetically by **Last Name** (column **C**).

Select a **cell** in the column you want to sort by. In our example, we'll select cell **C2**.

Select the **Data** tab on the **Ribbon**, then click the **A-Z command** to sort A to Z, or the **Z-A command** to sort Z to A. In our example, we'll sort A to Z.
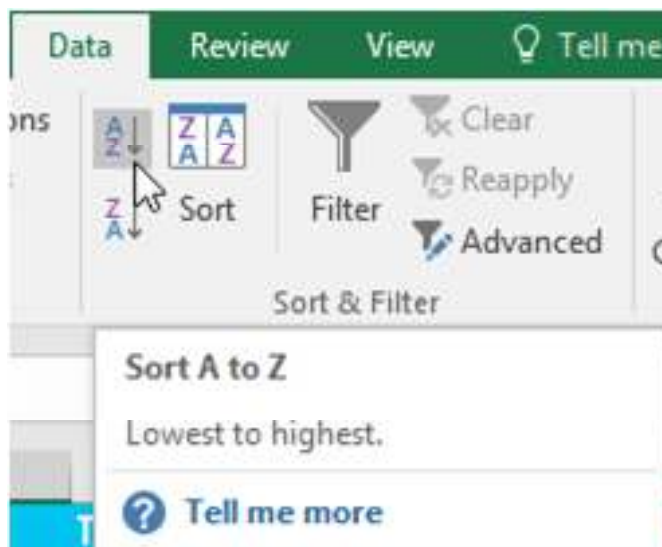
The worksheet will be **sorted** by the selected column. In our example, the worksheet is now sorted by **last name**.

	A	B	C	D	E
1	Homeroom #	First Name	Last Name	T-Shirt Size	Payment Method
2	110	Kris	Ackerman	Large	Money Order
3	105	Nathan	Albee	Medium	Check
4	220-B	Samantha	Bell	Medium	Check
5	110	Matt	Benson	Medium	Money Order
6	105	Christiana	Chen	Medium	Check Bounced
7	110	Gabriel	Del Toro	Medium	Cash
8	220-A	Brigid	Ellison	Small	Cash
9	220-A	Juan	Flores	X-Large	Pending

To sort a range:

In our example, we'll select a **separate table** in our T-shirt order form to sort the number of shirts that were ordered in each grade.

Select the **cell range** you want to sort. In our example, we'll select cell range **G2:H6**.

F	G	H	I
	Total Orders (by Grade)		
	Class	Orders	
	Freshmen	5	
	Sophomore	7	
	Junior	10	
	Senior	5	

Select the **Data** tab on the **Ribbon**, then click the **Sort** command.
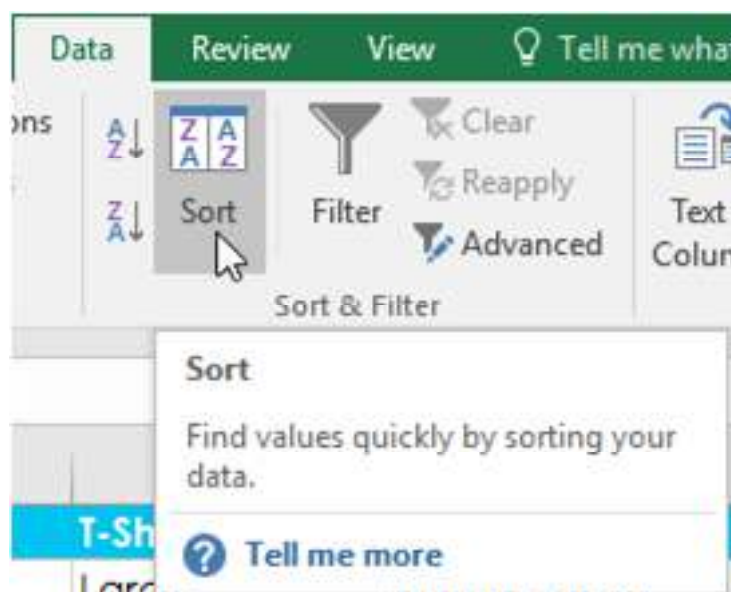
The **Sort** dialog box will appear. Choose the **column** you want to sort by. In our example, we want to sort the data by the number of T-shirt orders, so we'll select **Orders**.
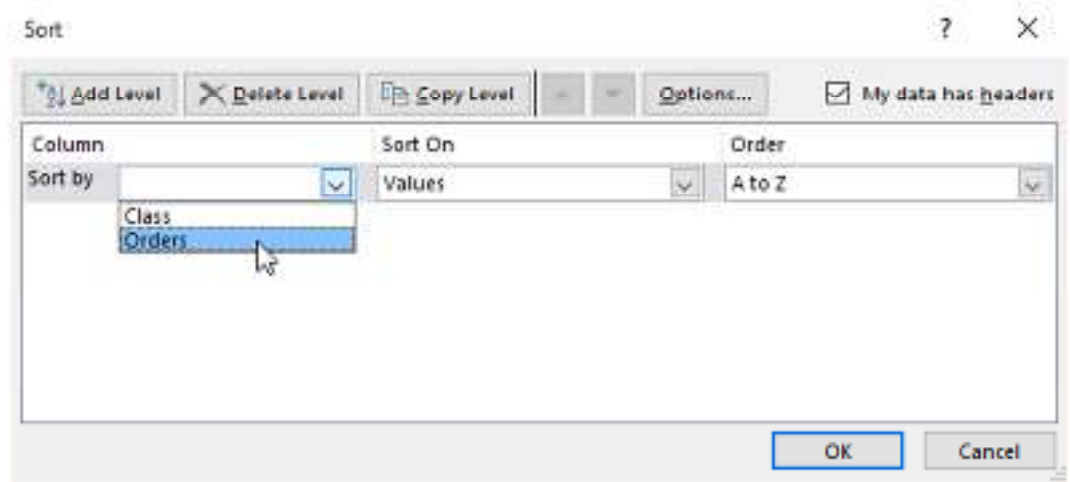
Decide the **sorting order** (either ascending or descending). In our example, we'll use **Largest to Smallest**.

Once you're satisfied with your selection, click **OK**.
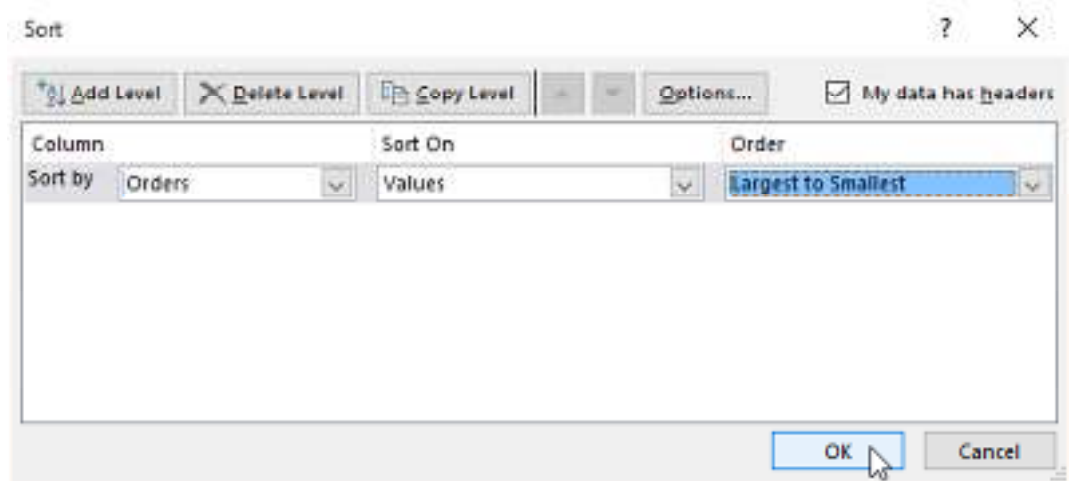
The cell range will be **sorted** by the selected column. In our example, the Orders column will be sorted from **highest to lowest**. Notice that the other content in the worksheet was not affected by the sort.

If your data isn't sorting properly, double-check your cell values to make sure they are entered into the worksheet correctly. Even a small typo could cause problems when sorting a large worksheet. In the example below, we forgot to include a hyphen in cell A18, causing our sort to be slightly inaccurate.

	A	B	C	D
1	Homeroom #	First Name	Last Name	T-Shirt Size
16	135	Jordan	Weller	Large
17	135	Alex	Yuen	Large
18	220A	Christopher	Peyton-Gomez	Small
19	220-A	Brigid	Ellison	Small
20	220-A	Juan	Flores	X-Large
21	220-A	Chevonne	Means	Medium

Custom sorting

Sometimes you may find that the default sorting options can't sort data in the order you need. Fortunately, Excel allows you to create a **custom list** to define your own sorting order.

To create a custom sort:

In our example below, we want to sort the worksheet by **T-Shirt Size** (column **D**). A regular sort would organize the sizes alphabetically, which would be incorrect. Instead, we'll create a custom list to sort from smallest to largest.

Select a **cell** in the column you want to sort by. In our example, we'll select cell **D2**.

	A	B	C	D	E
1	Homeroom #	First Name	Last Name	T-Shirt Size	Payment Method
2	110	Kris	Ackerman	Large	Money Order
3	105	Nathan	Albee	Medium	Check
4	220-B	Samantha	Bell	Medium	Check
5	110	Matt	Benson	Medium	Money Order
6	105	Christiana	Chen	Medium	Check Bounced
7	110	Gabriel	Del Toro	Medium	Cash
8	220-A	Brigid	Ellison	Small	Cash
9	220-A	Juan	Flores	X-Large	Pending
10	220-B	Tyrese	Hanlon	X-Large	Debit Card

1. Select the **Data** tab, then click the **Sort** command.

Spreadsheet Modelling (Using Excel)
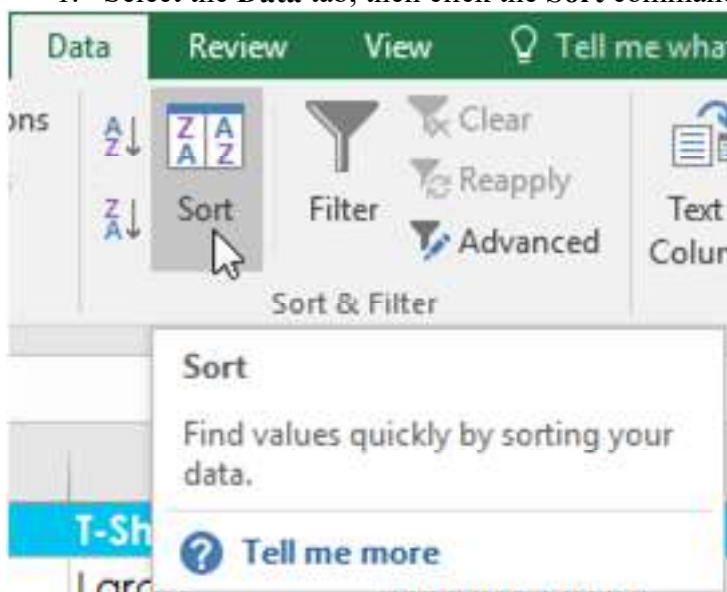
The **Sort** dialog box will appear. Select the **column** you want to sort by, then choose **Custom List...** from the **Order** field. In our example, we will choose to sort by **T-Shirt Size**.
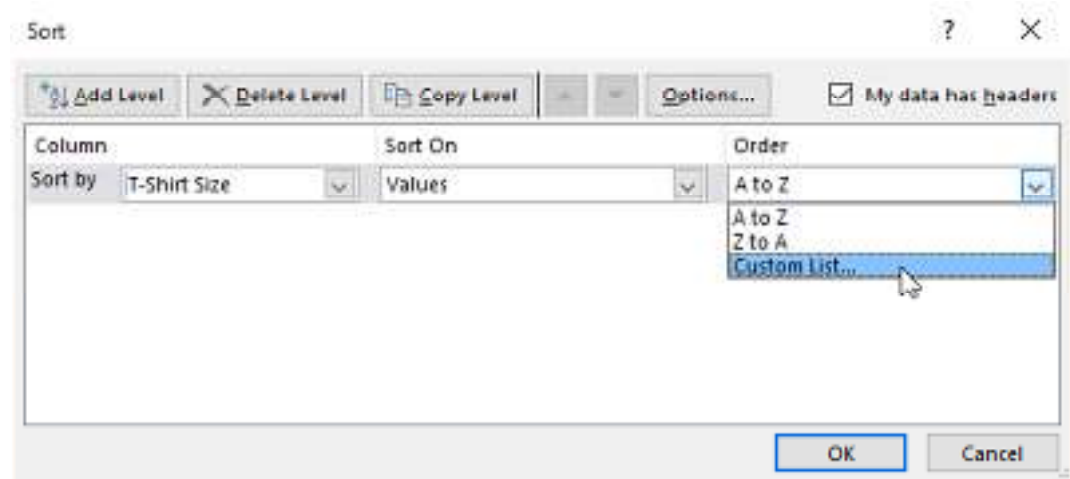
The **Custom Lists** dialog box will appear. Select **NEW LIST** from the **Custom Lists:** box.

Type the items in the desired custom order in the **List entries:** box. In our example, we want to sort our data by T-shirt size from **smallest** to **largest**, so we'll type **Small**, **Medium**, **Large**, and **X-Large**, pressing **Enter** on the keyboard after each item.
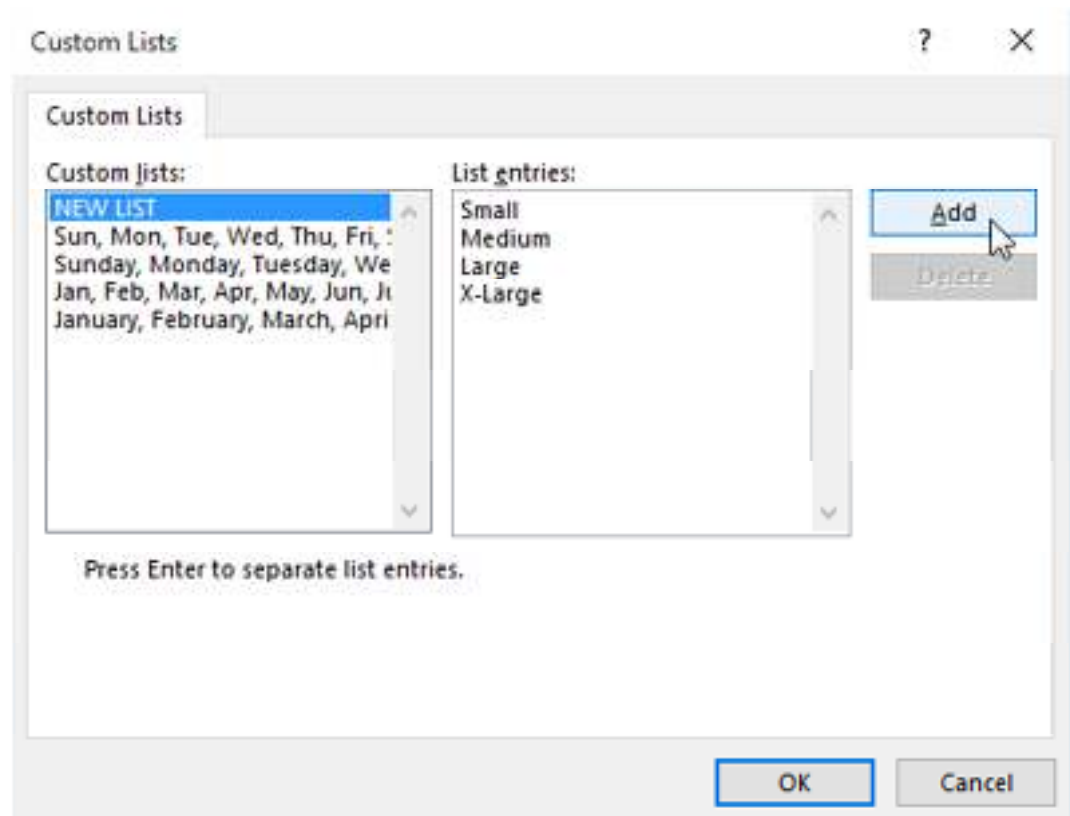
Click **Add** to save the new sort order. The new list will be added to the **Custom lists:** box. Make sure the new list is **selected**, then click **OK**.
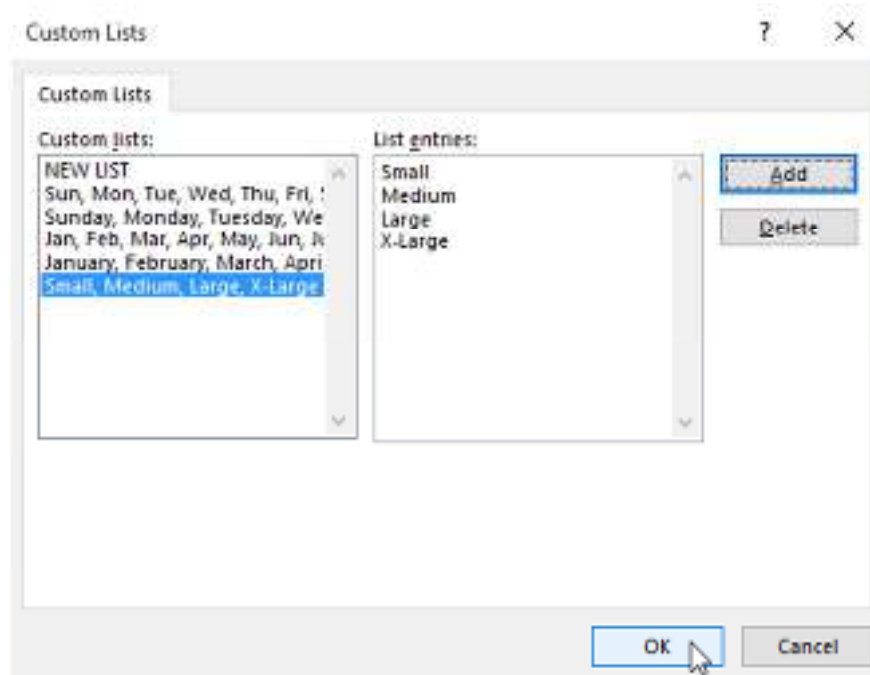
The Custom Lists dialog box will close. Click OK in the Sort dialog box to perform the custom sort.
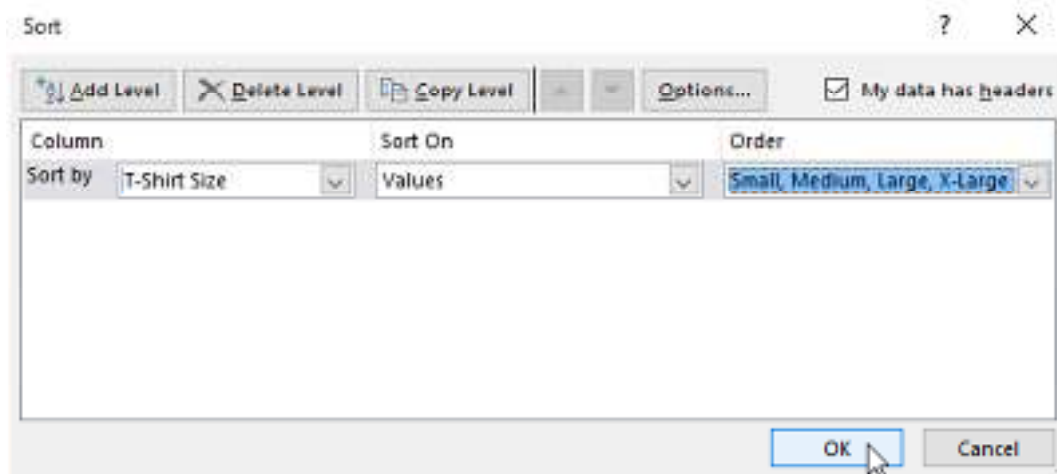
The worksheet will be **sorted** by the custom order. In our example, the worksheet is now organized by T-shirt size from smallest to largest.

Sorting levels

If you need more control over how your data is sorted, you can add multiple **levels** to any sort. This allows you to sort your data by **more than one column**.

To add a level:

In our example below, we'll sort the worksheet by **T-Shirt Size** (Column **D**), and then by **Homeroom Number** (column **A**).

Select a **cell** in the column you want to sort by. In our example, we'll select cell **A2**.

Click the **Data** tab, then select the **Sort** command.
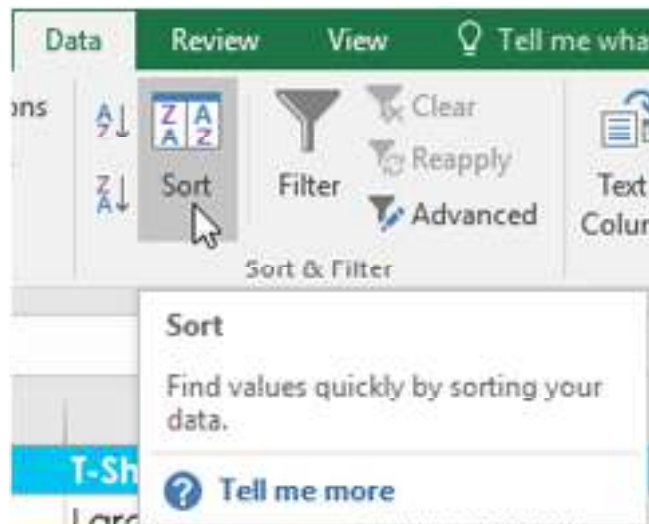
The **Sort** dialog box will appear. Select the first column you want to sort by. In this example, we will sort by **T-Shirt Size** (column **D**) with the custom list we previously created for the Order field.

Click **Add Level** to add another column to sort by.
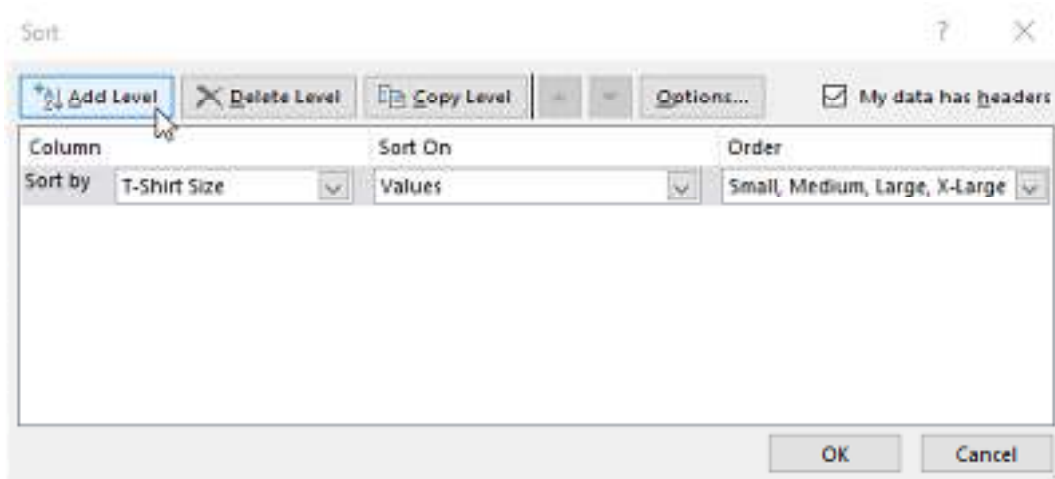
Select the next column you want to sort by, then click **OK**. In our example, we'll sort by **Homeroom # (column A)**.
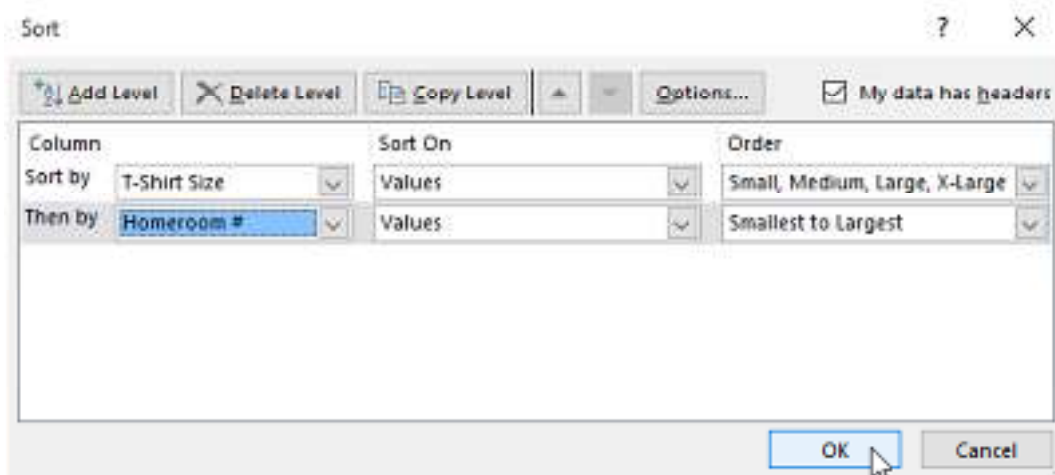
The worksheet will be **sorted** according to the selected order. In our example, the orders are sorted by T-shirt size. Within each group of T-shirt sizes, students are sorted by homeroom number.

	A	B	C	D	E
1	Homeroom #	First Name	Last Name	T-Shirt Size	Payment Method
2	105	Melissa	White	Small	Debit Card
3	105	Esther	Yaron	Small	Pending
4	135	Anisa	Naser	Small	Check Bounced
5	220-A	Brigid	Ellison	Small	Cash
6	220-A	Christopher	Peyton-Gomez	Small	Check
7	220-B	Michael	Lazar	Small	Cash
8	220-B	Malik	Reynolds	Small	Cash
9	220-B	Wendy	Shaw	Small	Cash
10	105	Nathan	Albee	Medium	Check
11	105	Christiana	Chen	Medium	Check Bounced
12	105	Sidney	Kelly	Medium	Check
13	110	Matt	Benson	Medium	Money Order
14	110	Gabriel	Del Toro	Medium	Cash
15	135	James	Panarello	Medium	Check
16	135	Chantal	Weller	Medium	Debit Card
17	220-A	Chevonne	Means	Medium	Money Order
18	220-B	Samantha	Bell	Medium	Check
19	220-B	Avery	Kelly	Medium	Debit Card
20	105	Derek	MacDonald	Large	Cash
21	110	Kris	Ackerman	Large	Money Order

If you need to change the order of a multilevel sort, it's easy to control which column is sorted first. Simply select the desired **column**, then click the **Move Up** or **Move Down** arrow to adjust its priority.
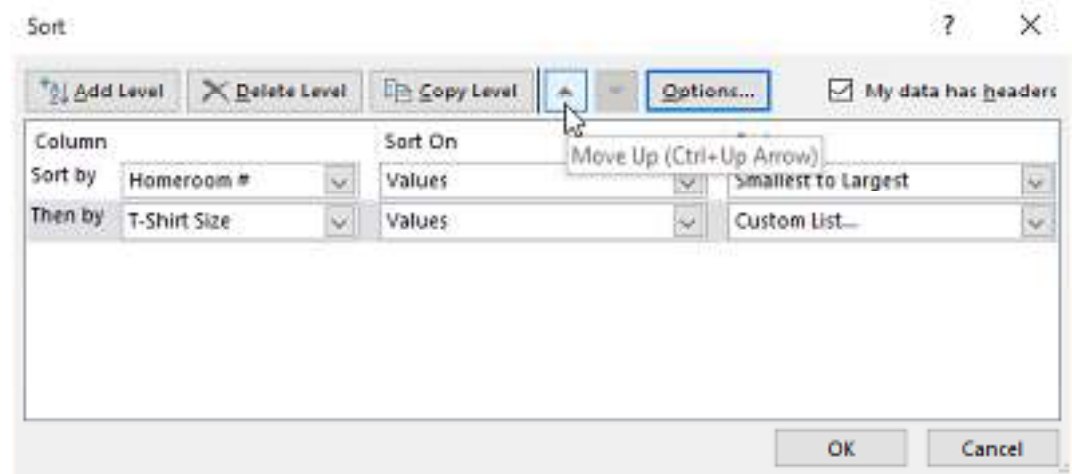
5.5 Conditional Formatting

Let's say you have a worksheet with thousands of rows of data. It would be extremely difficult to see patterns and trends just from examining the raw information. Similar to charts and sparklines, **conditional formatting** provides another way to visualize data and make worksheets easier to understand.

- Conditional Formatting in Excel enables you to the cells with certain color depending on the condition.

- It is an excellent way to visualize data in a spreadsheet.

- You can also create rules with your own custom formulas.

- This guide will provide you with step-by-step examples of the most popular conditional formatting functions.

Understanding conditional formatting

Conditional formatting allows you to automatically apply formatting—such as **colors**, **icons**, and **data bars**—to one or more cells based on the **cell value**. To do this, you'll need to create a **conditional formatting rule**. For example, a conditional formatting rule might be: **If the value is less than $2000, color the cell red**. By applying this rule, you'd be able to quickly see which cells contain values less than $2000.

	A	B	C	D	E
2	Salesperson	May	June	July	August
3	Albertson, Kathy	$3,799.00	$557.00	$3,863.00	$1,117.00
4	Allenson, Carol	$18,930.00	$1,042.00	$9,355.00	$1,100.00
5	Altman, Zoey	$5,725.00	$3,072.00	$6,702.00	$2,116.00
6	Bittiman, William	$1,344.00	$3,755.00	$4,415.00	$1,089.00
7	Brennan, Michael	$8,296.00	$3,152.00	$11,001.00	$1,122.00
8	Carlson, David	$3,945.00	$4,056.00	$3,726.00	$1,135.00
9	Collman, Harry	$8,337.00	$4,906.00	$9,007.00	$2,113.00
10	Counts, Elizabeth	$3,742.00	$521.00	$4,505.00	$1,024.00
11	David, Chloe	$7,605.00	$3,428.00	$3,973.00	$1,716.00

To create a conditional formatting rule:

In our example, we have a worksheet containing sales data, and we'd like to see which salespeople are meeting their monthly sales goals. The sales goal is $4000 per month, so we'll create a conditional formatting rule for any cells containing a value higher than 4000.

1. Select the **desired cells** for the conditional formatting rule.

2. From the **Home** tab, click the **Conditional Formatting** command. A drop-down menu will appear.

Spreadsheet Modelling (Using Excel)

3. Hover the mouse over the desired **conditional formatting type**, then select the **desired rule** from the menu that appears. In our example, we want to **highlight cells** that are **greater than** $4000.
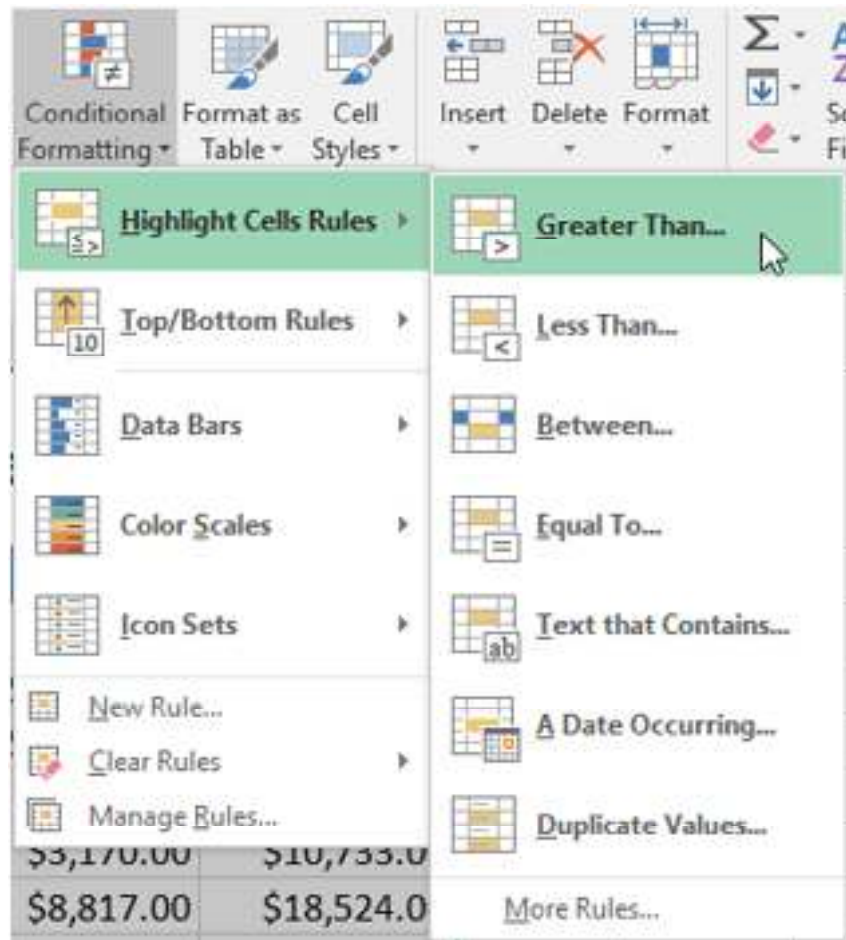
4. A dialog box will appear. Enter the **desired value(s)** into the blank field. In our example, we'll enter 4000 as our value.

5. Select a **formatting style** from the drop-down menu. In our example, we'll choose **Green Fill with Dark Green Text**, then click **OK**.

6. The conditional formatting will be applied to the selected cells. In our example, it's easy to see which salespeople reached the $4000 sales goal for each month.

You can apply multiple conditional formatting rules to a cell range or worksheet, allowing you to visualize different trends and patterns in your data.

Conditional formatting presets

Excel has several predefined styles—or **presets**—you can use to quickly apply conditional formatting to your data. They are grouped into three categories:

- **Data Bars** are horizontal bars added to each cell, much like a **bar graph**.

Spreadsheet Modelling (Using Excel)

$3,863.00	$1,117.00	$8,237.00	$8,690.00
$9,355.00	$1,100.00	$10,185.00	$18,749.00
$6,702.00	$2,116.00	$13,452.00	$8,046.00
$4,415.00	$1,089.00	$4,404.00	$20,114.00

- **Color Scales** change the color of each cell based on its value. Each color scale uses a **two- or three-color gradient**. For example, in the **Green-Yellow-Red** color scale, the **highest** values are green, the **average** values are yellow, and the **lowest** values are red.

$3,863.00	$1,117.00	$8,237.00	$8,690.00
$9,355.00	$1,100.00	$10,185.00	$18,749.00
$6,702.00	$2,116.00	$13,452.00	$8,046.00
$4,415.00	$1,089.00	$4,404.00	$20,114.00

- **Icon Sets** add a specific icon to each cell based on its value.

▼ $3,863.00	▼ $1,117.00	▬ $8,237.00	▬ $8,690.00
▬ $9,355.00	▼ $1,100.00	▬ $10,185.00	▲ $18,749.00
▼ $6,702.00	▼ $2,116.00	▬ $13,452.00	▬ $8,046.00
▼ $4,415.00	▼ $1,089.00	▼ $4,404.00	▲ $20,114.00

To use preset conditional formatting:

1. Select the **desired cells** for the conditional formatting rule.

2. Click the **Conditional Formatting** command. A drop-down menu will appear.

3. Hover the mouse over the **desired preset**, then choose a **preset style** from the menu that appears.

4. The conditional formatting will be applied to the selected cells.

Removing conditional formatting

To remove conditional formatting:

1. Click the **Conditional Formatting** command. A drop-down menu will appear.

2. Hover the mouse over **Clear Rules,** and choose which rules you want to clear. In our example, we'll select **Clear Rules from Entire Sheet** to remove all conditional formatting from the worksheet.
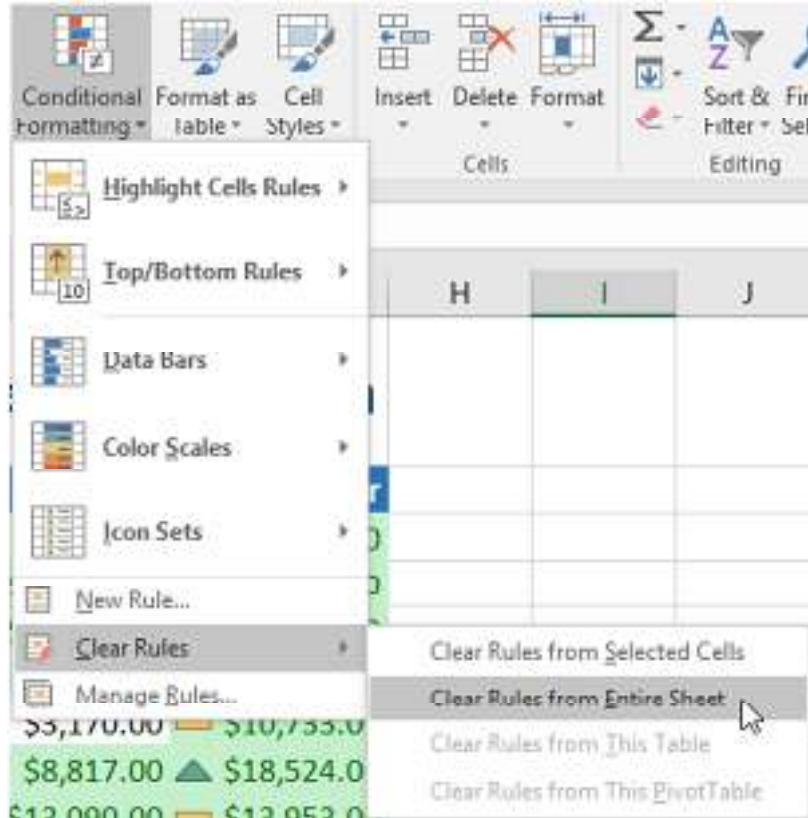
3. The conditional formatting will be removed.

Click **Manage Rules** to edit or delete **individual** rules. This is especially useful if you've applied **multiple rules** to a worksheet.
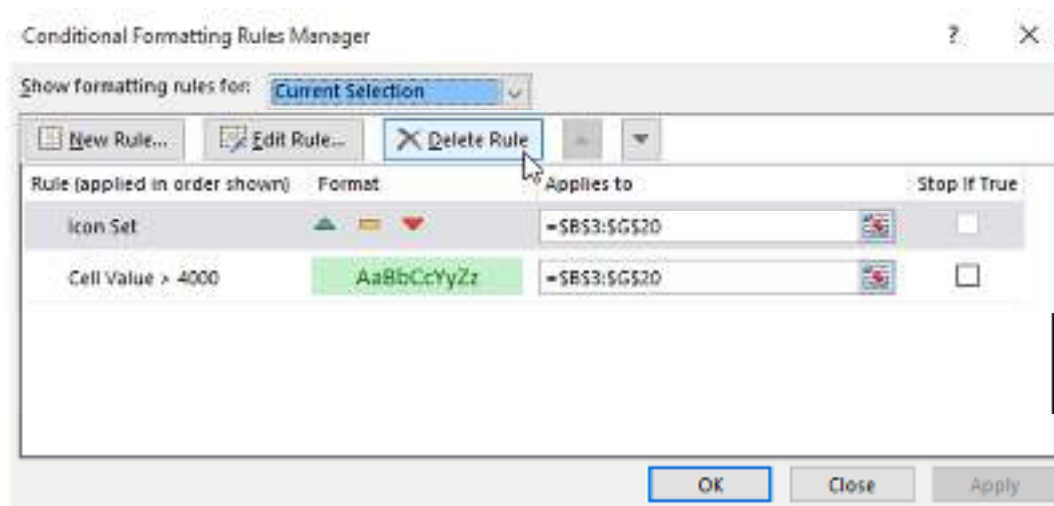
Summary

- Find and Replace Functions: These tools allow users to locate specific data within a worksheet or workbook and replace it with new values. Options like "Match case" help ensure precise replacements.

- Text Functions: Excel offers various text functions to manipulate and analyze text strings. Examples include UPPER() to convert text to uppercase and CONCATENATE() for joining text.

- Filtering Data: Data filtering helps users narrow down large datasets by displaying only the rows that meet specified criteria. Multiple criteria can be applied simultaneously for more precise results.

- Sorting Data: Sorting arranges data in ascending or descending order based on one or more selected columns. It helps organize information and identify patterns easily.

- Conditional Formatting: This feature allows users to apply formatting (e.g., colors, font styles) to cells based on predefined rules or formulas. It visually highlights data based on specific conditions.

- Find and Replace Tip: To search for cells with a specific format, use the "Find All" button in the Find dialog box, and then click "Find Next" to cycle through the results.

- Text Functions Tip: The LEFT(), RIGHT(), and MID() functions are valuable for extracting specific parts of a text string, such as the first characters, last characters, or a segment in the middle.

- Filtering Data Tip: Advanced filtering allows users to extract unique records from a dataset, which is helpful when creating reports or summaries.

- Sorting Data Tip: To sort data based on more than one column, use the "Sort" option and specify the column priority to arrange data accordingly.

- Conditional Formatting Tip: To ensure that conditional formatting rules apply correctly, set the rule precedence by arranging rules in the desired order of execution.

Keywords

- Find and Replace Functions: Features in software applications (like Excel) that allow users to locate specific pieces of data and replace them with new values throughout a document or dataset. It helps streamline data modification and cleanup tasks.

- Text Functions: Specialized formulas or functions within software (such as Excel) that enable users to manipulate and analyze text strings. These functions can perform

operations like extracting specific characters, joining strings, or converting text to different cases.

- Filtering Data: The process of narrowing down a dataset based on specific criteria to display only the rows that meet those conditions. Filtering helps users focus on relevant information and simplifies data analysis.

- Sorting Data: The process of arranging data in a specific order, typically based on the values in one or more columns. Sorting allows users to organize data systematically, making it easier to identify patterns and trends.

- Conditional Formatting: A feature that allows users to apply formatting styles (e.g., colors, fonts) to cells based on predefined conditions or rules. It visually highlights data based on specific criteria, enhancing data visualization and analysis.

Self Assessment

1. While Finding and Replacing some data in Excel, which of the following statement is valid?

A. You can Find and Replace within the sheet or workbook

B. Excel does not have option to match case for find

C. Both are valid

D. None are valid

2. Which of the following is not true about Find and Replace in Excel

A. You can search for bold and replace with italics

B. You can decide whether to look for the whole word or not

C. You can search in formula too

D. You can search by rows or columns or sheets

3. How can you find specific information in a list?

A. Select Tools > Finder from the menu

B. Click the Find button on the standard toolbar

C. Select Insert > Find from the menu

D. Select Data > Form from the menu to open the Data Form dialog box and click the Criteria button

4. What is the shortcut key to replace a data with another in sheet?

A. Ctrl + R

B. Ctrl + Shift + R

C. Ctrl + H

D. Ctrl + F

5. Text formulas:

A. Replace cell references

B. Return ASCII values of characters

C. Concatenate and manipulate text

D. Show formula error value

6.   How do you insert a row?

A. Right-click the row heading where you want to insert the new row and select Insert from the shortcut menu

B. Select the row heading where you want to insert the new row and select Edit >Row from the menu

C. Select the row heading where you want to insert the new row and click the Insert Row button on the standard toolbar

D. All of the above

7   If you need a text to show vertically in a cell. How will you achieve this?

A) Choose Vertical on Text alignment in Format Cells dialog box

B) Choose 90 Degrees in Orientation of Format Cells dialog box

C) Choose Distributed from the Vertical drop down list of Format Cells dialog box

D) Choose Center Across Selection from Horizontal combo box in Format Cells dialog box

8.   You can automatically adjust the size of text in a cell if they do not fit in width by

A) Double clicking on the right border of column header

B) From Format choose Columns and then Autofit Selection

C) From Format Cells dialog box mark Shrink to fit check box

D) All of above

9.   What is entered by the function =today()

A) The date value for the day according to system clock

B) The time value according to system clock

C) Today's date as Text format

D) All of above

10. Long text can be broken down into many lines within a cell. You can do this through

A) Wrap Text in Format >> Cells

B) Justify in Edit >> Cells

C) Text Wrapping in Format >> Cells, Layout tab

D) All of above

11. Borders can be applied to

A) Cells

B) Paragraph

C) Text

D) All of above

12. How do you rearrange the data in ascending or descending order?

A. Data Sort

B. Data Form

C. Data Table

D. Data Subtotals

13. You can check the conditions against _____ when applying conditional formatting

A. Cell value

B. Formula

C. Both of above

D. None of above

14. Which of the following is not true regarding Conditional Formatting?

A. You can add more than one condition to check

B. You can set condition to look for Bold and apply Italics on them

C. You can apply Font border and pattern formats that meets the specified conditions

D. You can delete any condition from Conditional Formatting dialog box if it is not required

15. Thick Borders cannot be applied in MS Excel

A. True

B. False

Answers for Self Assessment

1.	A	2.	A	3.	D	4.	C	5.	C
6.	A	7.	B	8.	C	9.	A	10.	D
11.	D	12.	A	13.	C	14.	B	15.	B

Review Questions

1. How can you access the Find and Replace dialog box in Microsoft Excel?
2. What is the purpose of using the "Match case" option in the Find and Replace function?
3. Explain the difference between finding and replacing values in a specific range versus the entire worksheet.
4. How can you convert a text string to uppercase in Excel using a text function?
5. What is the function of the CONCATENATE function, and how is it different from the "&" operator for combining text strings?
6. How do you extract a specific portion of a text string using the MID function in Excel?
7. What is data filtering, and how does it help in data analysis?
8. How can you apply multiple criteria simultaneously to filter data in Excel?
9. Explain the difference between filtering data and sorting data in terms of their purposes and outcomes.

10. How can you sort data in Excel based on multiple columns, and what is the significance of the sort order (ascending vs. descending)?

11. What is conditional formatting, and how can it be used to highlight specific cells in Excel?

12. How do you create a custom conditional formatting rule based on a formula?

13. Is it possible to apply more than one conditional formatting rule to a single cell, and if so, how is the precedence determined?

Further Readings

- https://www.wallstreetmojo.com/excel-find-and-replace/#popmake-95356
- https://www.edupristine.com/blog/text-functions-excel
- https://www.excelfunctions.net/excel-text-functions.html

- https://edu.gcfglobal.org/en/excel/filtering-data/1/#
- https://www.wallstreetmojo.com/add-filter-in-excel/
- https://edu.gcfglobal.org/en/excel2016/sorting-data/1/#
- https://www.tutorialspoint.com/excel/excel_data_sorting.htm

Unit 06: Spreadsheet Printing

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Objectives

After this unit you will be able to -

- Understand the concept and use of printing in MS-Excel.
- Understand the concept and use of print preview, orientation, margins, scaling, headers and footers in MS-Excel.

Introduction

Living in a digital world, we still need a printed copy every now and then. At first sight, printing Excel spreadsheets is super easy. Just click the *Print* button, right? In reality, a well-organized and beautifully formatted sheet that looks great on a monitor is often a mess on a printed page. This is because Excel worksheets are designed for comfortable viewing and editing on screen, not to fit on a sheet of paper.

How to print Excel spreadsheet

For starters, we will provide high-level instructions on how to print in Excel. And then, we will have a closer look at the most important and useful features.

To print an Excel worksheet, this is what you need to do:

1. In your worksheet, click *File* > *Print* or press Ctrl + P. This will get you to the <u>Print Preview</u> window.
2. In the *Copies* box, enter the number of copies you want to get.
3. Under *Printer*, choose which printer to use.
4. Under *Settings*, specify exactly what to print and configure the page margins, orientation, paper size, etc.
5. Click the **Print** button.

Choose what to print: selection, sheet or entire workbook

To tell Excel which data and objects should be included in the printout, under *Settings*, click the arrow next to *Print Active Sheets*, and choose one of these options:

Below you will find a brief explanation of each setting shown in the screenshot above and how to correctly use them.

Print selection / range

To print only a specific range of cells, highlight it on the sheet, and then choose *Print Selection*. To select non-adjacent cells or ranges, hold the Ctrl key while selecting.

Print entire sheet(s)

To print the **entire sheet** that you currently have open, pick *Print Active Sheets*.

To print multiple sheets, click on the sheet tabs while holding the Ctrl key, and then choose *Print Active Sheets*.

Print entire workbook

To print all sheets in the current workbook, select *Print Entire Workbook*.

Print Excel table

To print out an Excel table, click any cell within your table, and then choose *Print Selected Table*. This option appears only when the table or its part is selected.

How to print the same range in multiple sheets

When working with identically structured worksheets, such as invoices or sales reports, you will obvious want to print the same rage in all the sheets. Here's the fastest way to do this:

1. Open the first sheet and select the range to print.

2. While holding the Ctrl key, click on other sheet tabs to be printed. To select adjacent sheets, click the first sheet tab, hold the Shift key and click the last sheet tab.
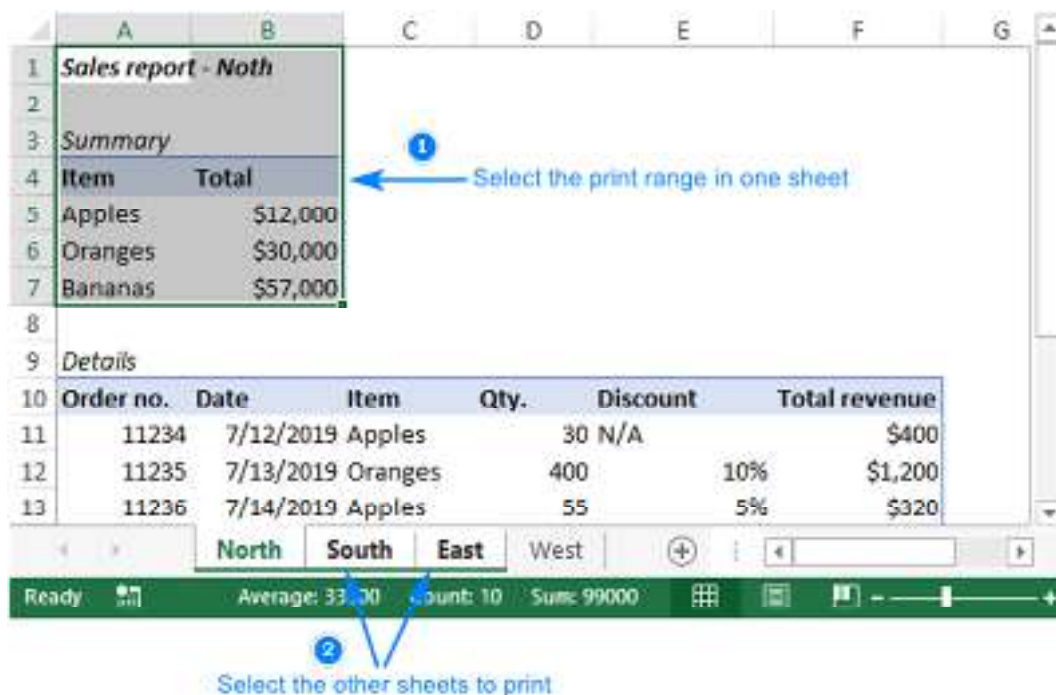
3. Click Ctrl + P and choose Print Selection in the drop-down list right under *Settings*.

4. Click the Print button.

Tip. To make sure Excel is going to print the data you want, check the number of pages at the bottom the *Preview* section. If you selected just one range per sheet, the number of pages should match the number of selected sheets. If two or more ranges are selected, each will be printed on a separate page, so you multiply the number of sheets by the number of ranges. For full control, use the right and left arrows to go through each printable page preview.
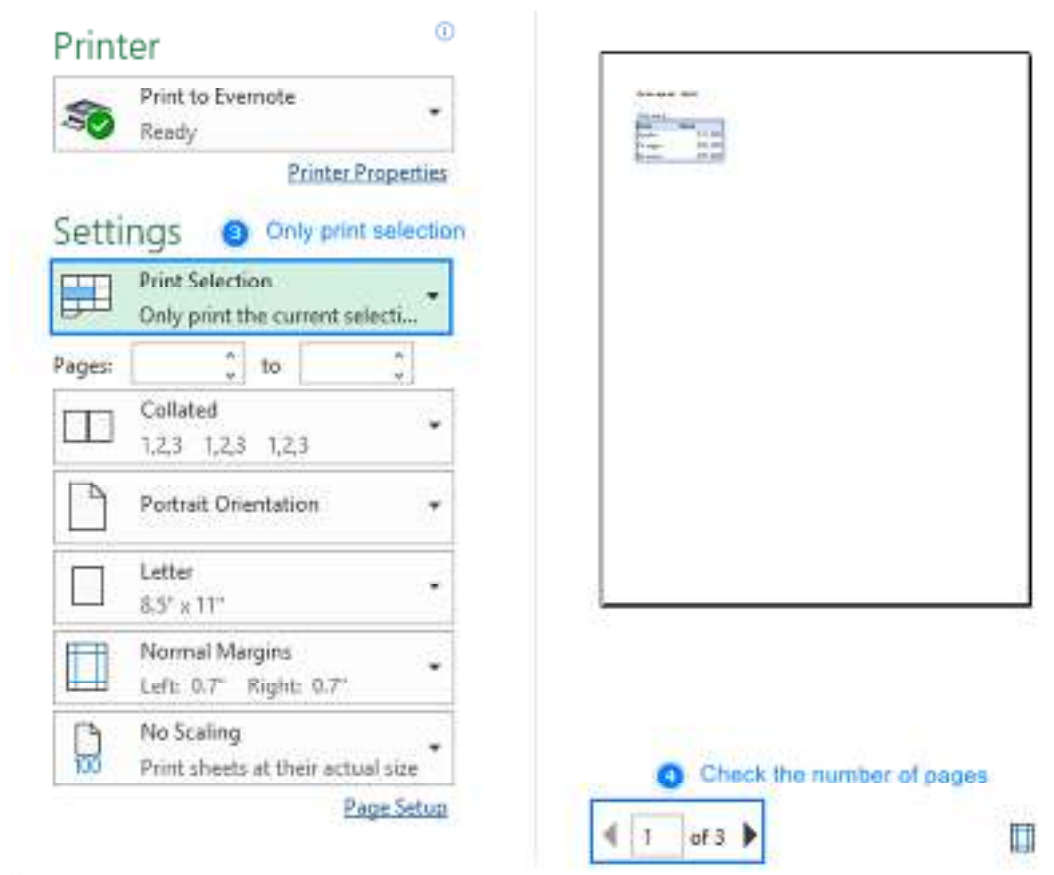
Tip. To set the print area in multiple sheets, you can use these Print Area macros.

How to print Excel spreadsheet on one page

By default, Excel prints sheets at their actual size. So, the bigger your worksheet, the more pages it will take. To print an Excel sheet on one page, choose one of the following Scaling options that reside at the end of the *Settings* section in the *Print Preview* window:

- Fit Sheet on One Page – this will shrink the sheet so that it fits on one page.

- Fit All Columns on One Page – this will print all the columns on one page while the rows may be split across several pages.

- Fit All Rows on One Page – this will print all the rows on one page, but the columns may extend to multiple pages.

To remove scaling, choose *No Scaling* in the list of options.

Please be very careful when printing on one page – in a huge sheet, your printout may become unreadable. To check how much scaling will actually be used, click *Custom Scaling Options… .* This will open the *Page Setup* dialog box, where you look at the number in the Adjust to box:

Spreadsheet Modelling (Using Excel)

If the *Adjust To* number is low, a printed copy will be difficult to read. In this case, the following adjustments might be useful:

- Change page orientation. The default *Portrait* orientation works well for worksheets that have more rows than columns. If your sheet has more columns than rows, change the page orientation to *Landscape*.

- Adjust margins. The smaller the margins, the more room there will be for your data.

- Specify the number of pages. To print an Excel spreadsheet on a predefined number of pages, on the *Page* tab of the *Page Setup* dialog, under *Scaling*, enter the number of pages in both Fit to boxes (wide and tall). Please note that using this option will ignore any manual page breaks.

Print to file – save the output for later use

Print to File is one of the most rarely used Excel print features underestimated by many. In short, this option saves output to a file instead of sending it to a printer.

Why would you want to print to file? To save time when additional printed copies of the same document are needed. The idea is that you configure the print settings (margins, orientation, page breaks, etc.) only once and save the output to a .pdf document. Next time you need a hard copy, simply open that .pdf file and hit *Print*.

Let's have a look at how that works:

1. On the *Page Layout* tab, configure the required print settings and press Ctrl + P.

2. In the *Print Preview* window, open the *Printer* drop-down list, and select Print to File.

3. Click the Print button.

4. Choose where to save a .png file containing the output.
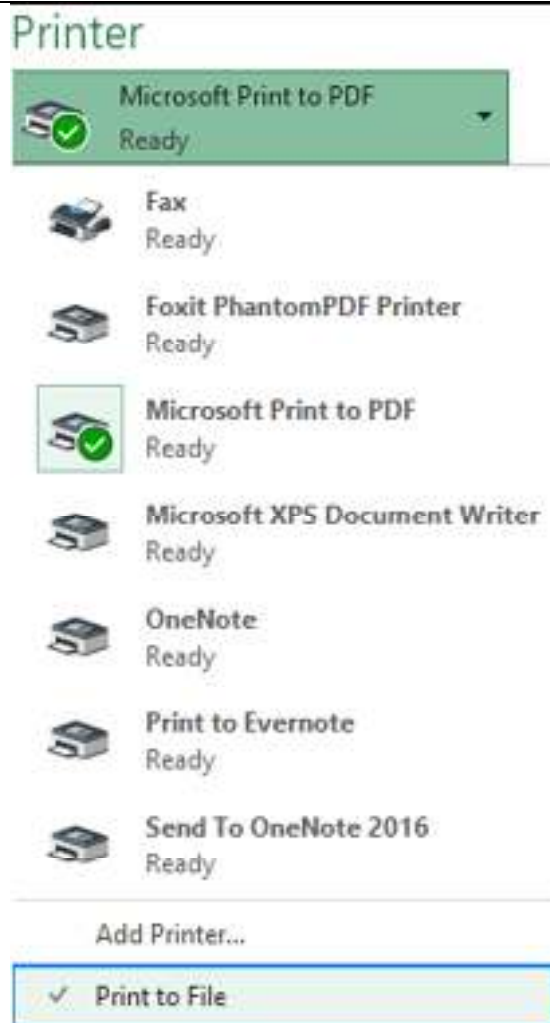
Print preview in Excel

It's always a good idea to preview outputs before printing to avoid unexpected results. There are a couple of ways to access print preview in Excel:

- Click *File* > *Print*.

- Press the print preview shortcut Ctrl + P or Ctrl + F2.

Excel Print Preview is an extremely helpful tool in terms of saving your paper, ink and nerves. It not only shows exactly how your worksheets will look on paper, but also allows making certain changes directly in the preview window:

- To preview the next and previous pages, use the right and left arrows at the bottom of the window or type the page number in the box and hit Enter. The arrows only appear when a selected sheet or range contains more than one printed page of data.

- To display page margins, click the Show Margins button in the bottom-right corner. To make the margins wider or narrower, simply drag them using the mouse. You can also adjust the column width by dragging the handles at the top or bottom of the print preview window.

- Though Excel Print Preview does not have a zoom slider, you can use a common shortcut Ctrl + scroll wheel to do a little zooming. To get back to the original size, click the *Zoom to Page* button in the lower-right corner.

Spreadsheet Modelling (Using Excel)
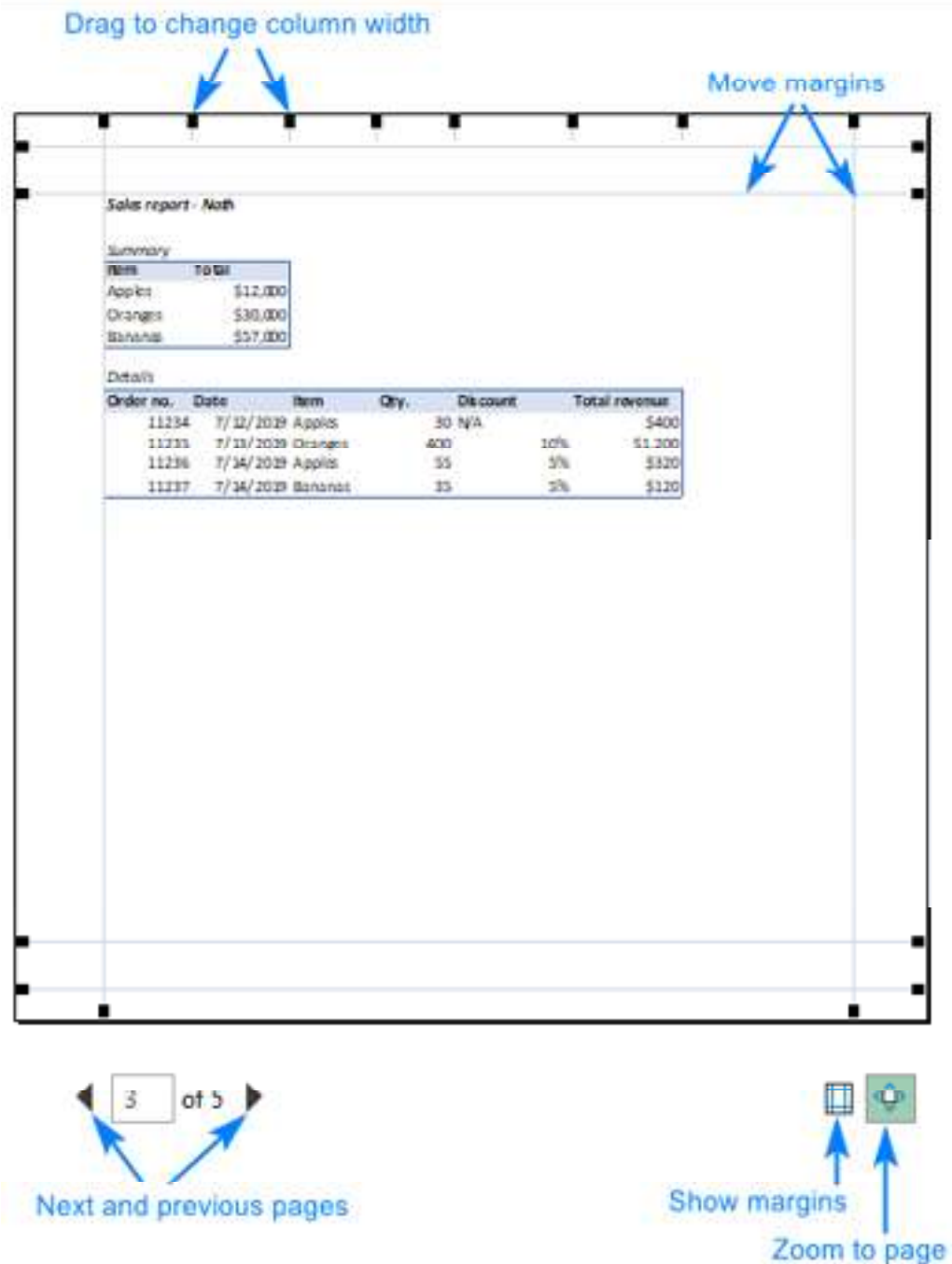
To exit *Print Preview* and return to your worksheet, click the arrow in the top-left corner of the Print Preview window.

Excel print options and features

The most frequently used print settings are available in the Print Preview window discussed above. Even more options are provided on the Page Layout tab of the Excel ribbon:
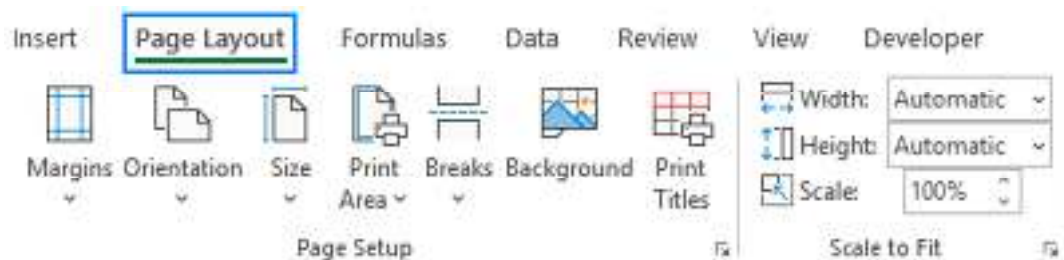
Apart from configuring page margins and paper size, here you can insert and remove page breaks, set print area, hide and show gridlines, specify the rows and columns to repeat on each printed page, and more.

Advanced options for which there is no space on the ribbon are available in the Page Setup dialog box. To open it, click the dialog launcher ◨ in the Page Setup group on the *Page Layout* tab.
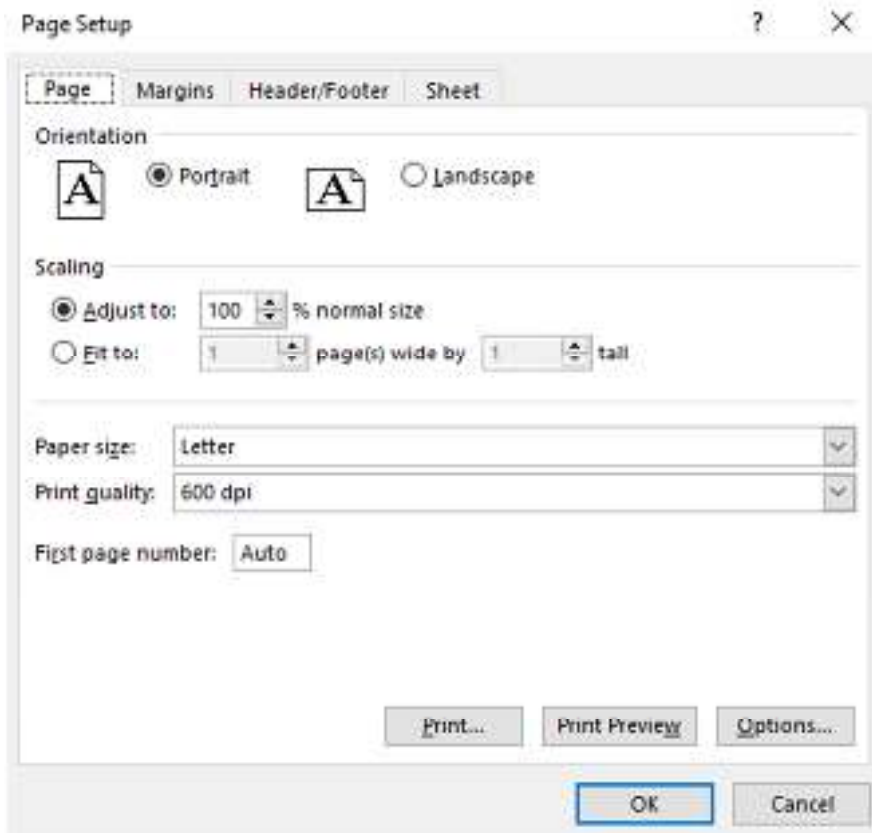
Note. The Page Setup dialog box can also be opened from the Print Preview window. In this case, some of the options, for example *Print area* or *Rows to repeat at top*, may be disabled. To enable these features, open the Page Setup dialog from the *Page Layout* tab.

Excel print area

To ensure that Excel prints a specific part of your spreadsheet and not all the data, set the print area. Here's how:

1. Select one or more ranges that you want to print.

2. On the *Page Layout* tab, in the *Page Setup* group, click Print Area > Set Print Area.
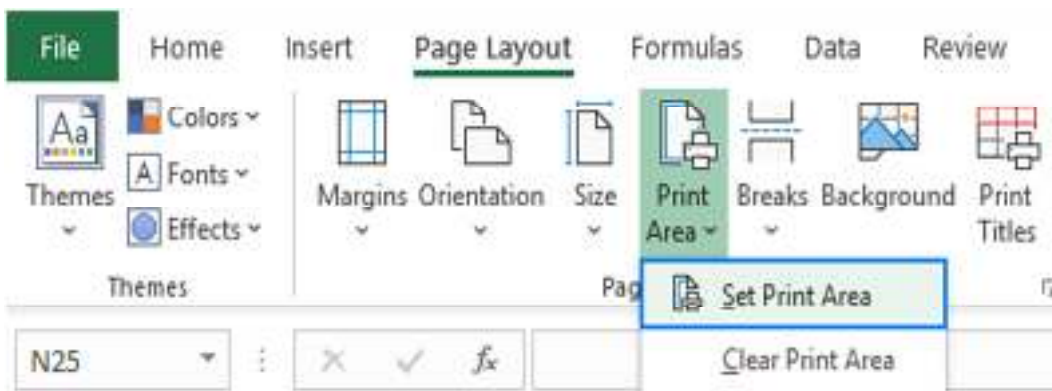
The Print Area setting is saved when you save the workbook. So, whenever you print this particular sheet, a hard copy will only include the print area.

For more information, please see How to set print area in Excel.

Spreadsheet Modelling (Using Excel)

How to add a print button to Excel Quick Access Toolbar

If you frequently print in Excel, it may be convenient to have the Print command on the <u>Quick Access Toolbar</u>. For this, just do the following:

1. Click the *Customize Quick Access Toolbar* button (the down arrow at the far-right of the Quick Access toolbar).

2. In the list of the displayed commands, select Print Preview and Print. Done!
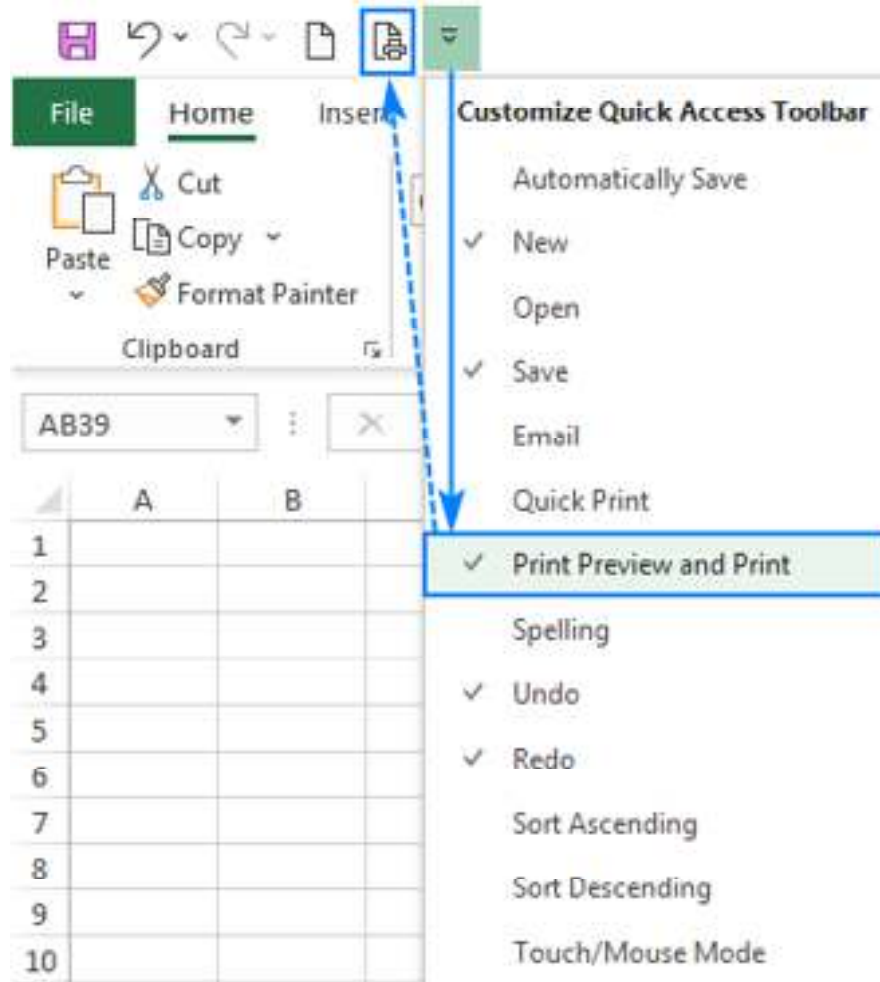
6.1 How to Insert Page Breaks in Excel

When printing a huge spreadsheet, you can control how the data is split over multiple pages by inserting page breaks. Here's how it works:

1. Click on the row or column that you want to move to a new page.

2. On the *Page Layout* tab, in the *Page Setup* group, click Breaks > Insert Page Break.

A page break is inserted. To visually see what data falls on different pages, switch to the *View* tab and enable Page Break Preview.
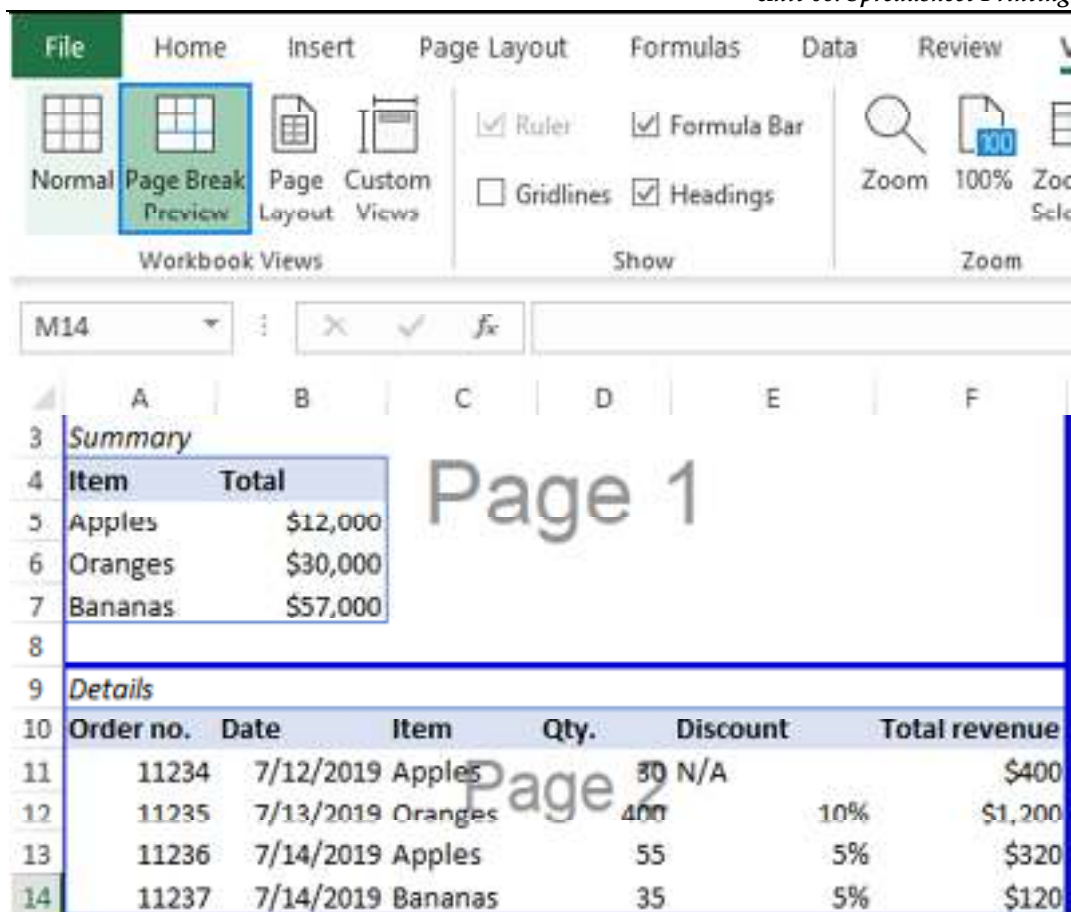
If you'd like to change the position of a certain page break, **move** it wherever you want by dragging the break line.

For more information, please see How to insert and remove page breaks in Excel.

How to print formulas in Excel

To get Excel to print formulas instead of their calculated results, you just need to show formula in a worksheet, and then print it as usual.

To have it done, switch to the *Formulas* tab, and click the Show Formulas button in the *Formula Auditing* group.
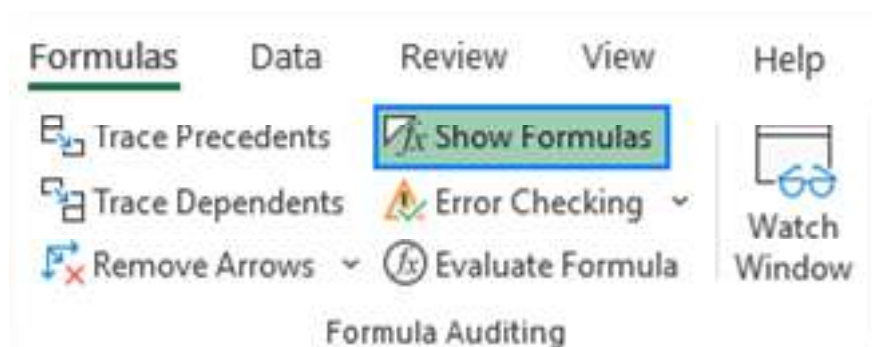
How to print a chart in Excel

To print only a chart without worksheet data, select the chart of interest and press Ctrl + P. In the *Print Preview* window, you will see a chart preview on the right and the Print Selected Chart option selected under *Settings*. If the preview looks as desired, click *Print*; otherwise adjust the settings:
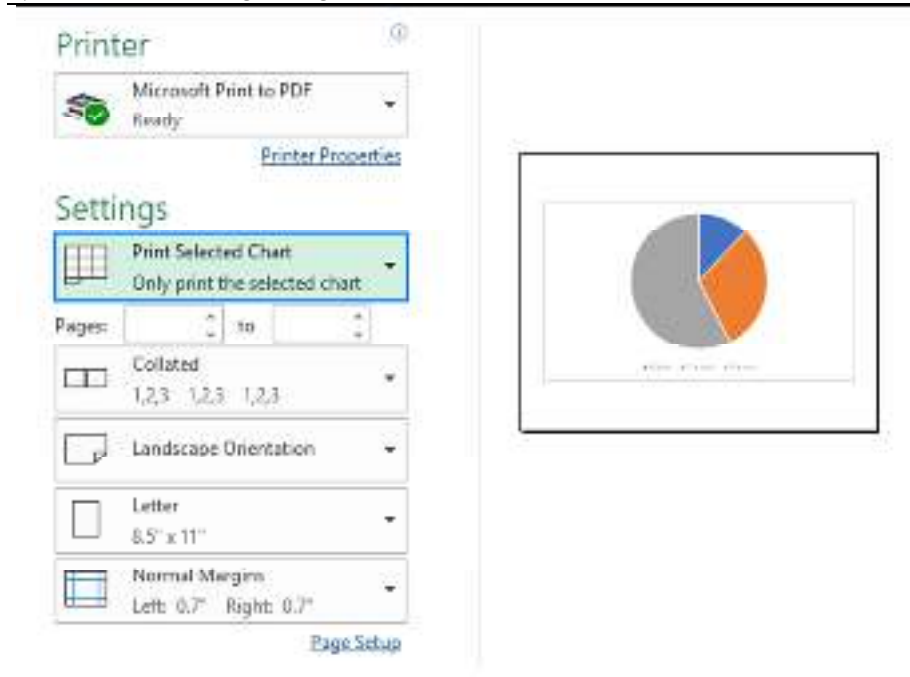
Tips and notes:

- To print all the contents of a sheet including the chart, press Ctrl + P without selecting anything on the sheet, and make sure the *Print Active Sheets* option is chosen under *Settings*.

- It's not possible to adjust the scaling of a chart in the *Print Preview* window. If you wish the printed chart to fit the full page, resize your graph to make it bigger.

How to print gridlines in Excel

By default, all worksheets are printed without gridlines. If you want to print Excel spreadsheet with lines between your cells, here's what you need to do:

1. Switch to the *Page Layout* tab.

2. in the *Sheet Options* group, under *Gridlines*, check the Print box.
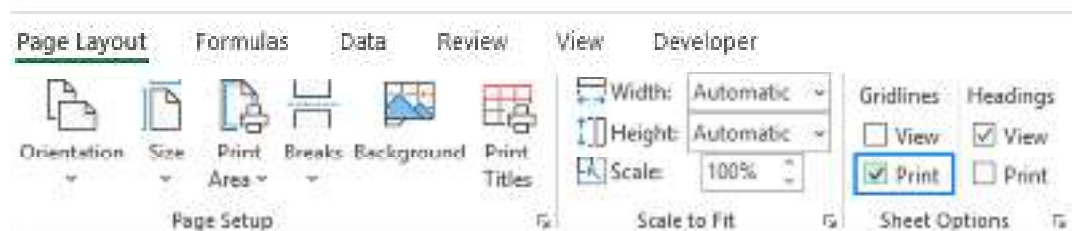
What to change the printed gridlines color? The detailed instructions can be found in How to make Excel print gridlines.

How to print titles in Excel

In a multi-page Excel sheet, understanding what this or that data means can be tricky. The *Print Titles* feature lets you show the column and row headers on every printed page, which will make reading a printed copy a lot easier.

To repeat header row or header column on every printed page, carry out these steps:

1. On the *Page Layout* tab, in the *Page Setup* group, click Print Titles.

2. On the *Sheet* tab of the *Page Setup* dialog box, under *Print titles*, specify which rows to repeat at top and/or which columns to repeat at left.

3. When done, click *OK*.
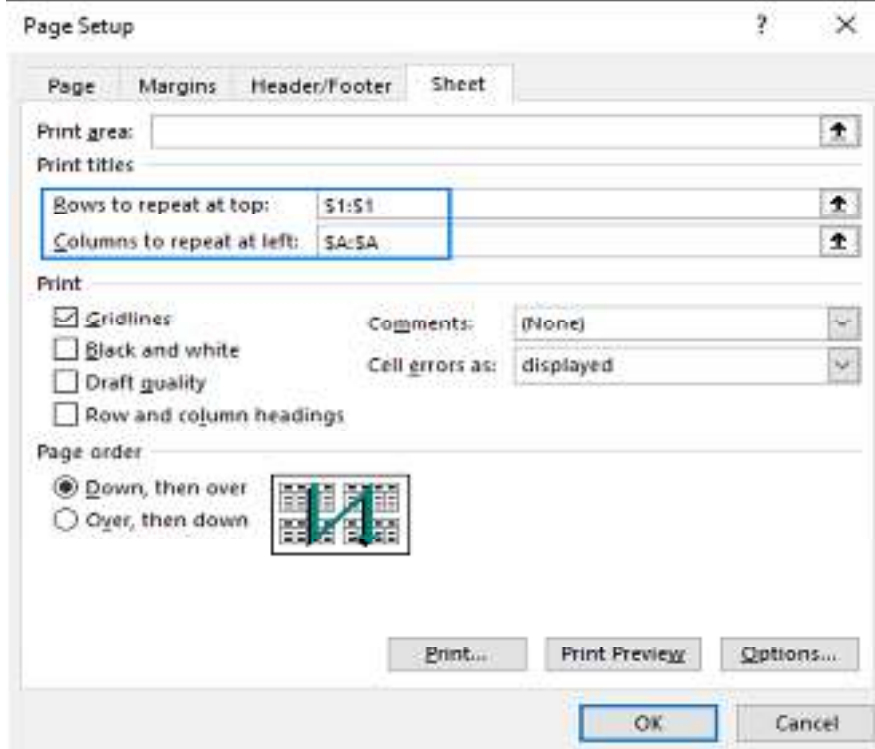
For more information, please see How to print row and column headers on every page.

How to print comments in Excel

In case your notes are no less important than the spreadsheet data, you may want to get comments on paper too. For this, do the following:

1. On the *Page Layout* tab, in the *Page Setup* group, click the dialog launcher (a small arrow in the lower-right corner of a group).

2. In the *Page Setup* window, switch to the *Sheet* tab, click the arrow next to Comments and choose how you want them printed:
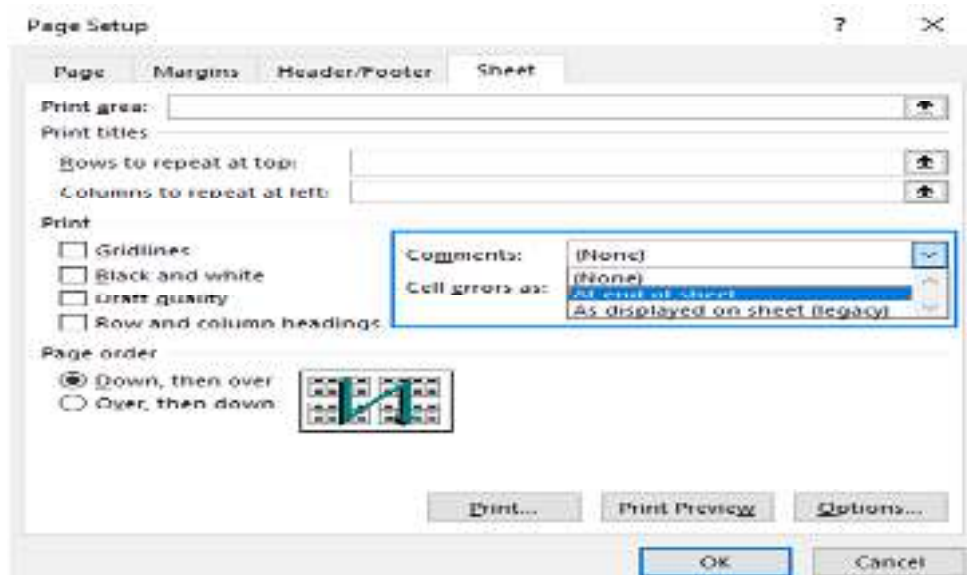
6.2 Print Preview and Adjustments, Orientation, Margins and Scale, Headers and Footers

When the report or data is ready, we usually send the data online to the user. However, there is a situation where we need to share offline with the users by printing them. In such cases, you need to know how to print a large amount of data.

1. Assume you have a large amount of data like the below.

2. To print this, first select the entire data.

3. Then, press the excel shortcut key "Ctrl + P."
4. It will take us to the window below.

5. We can see two slabs in the above image. The left side is "Print Setting Options," and the right is the "Print Preview" window.

We can see one more slab at the bottom, showing how many sheets it will print. The above says 1 of 36, i.e., out of 36 sheets, a print preview is visible for the 1st sheet.

Now, look at the data headers and compare them with "Print Preview."

6. We have a 11 headers in our data. Below are the headers in order.

"First_name," "Last_name," "Company_name," "Address," "City," "County," "State," "Zip," "Phone1," "Phone2," and "Email."

When we print this data, we usually expect the data to come in a single sheet only. But look at the "Print Preview" now.

Out of 11 headers, we could see only 4 headers. After printing these columns first, then it will print the remaining columns. After we get all the print copies, we need to arrange them in order.

Setup the Page to Preview Print

To set the page first, select the data first, then go to Page Layout **>> Print Area >> Set Print Area.**
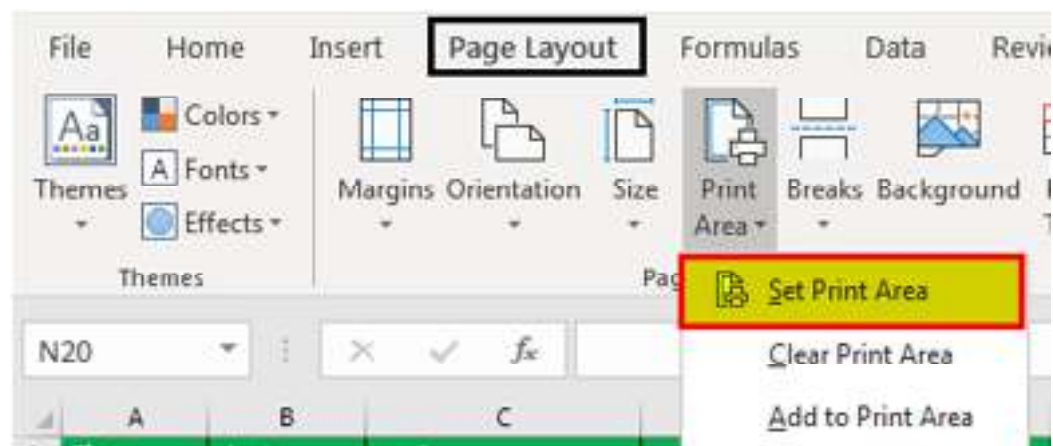
It will set what the area we are going to print is. Now, press "Ctrl + P" once again to see the "Print Preview."

First_name	Last_name	Company_name	Address
James	Butt	Benton, John B Jr	6649 N Blue Gum St
Josephine	Darakjy	Chanay, Jeffrey A Esq	4 B Blue Ridge Blvd
Art	Venere	Chemel, James L Cpa	8 W Cerritos Ave #54
Lenna	Paprocki	Feltz Printing Service	639 Main St
Donette	Foller	Printing Dimensions	34 Center St
Simona	Morasca	Chapman, Ross E Esq	3 Mcauley Dr
Mitsue	Tollner	Morlong Associates	7 Eads St
Leota	Dilliard	Commercial Press	7 W Jackson Blvd
Sage	Wieser	Truhlar And Truhlar Attys	5 Boston Ave #88
Kris	Marrier	King, Christopher A Esq	228 Runamuck Pl #2808
Minna	Amigon	Dorl, James J Esq	2371 Jerrold Ave
Abel	Maclead	Rangoni Of Florence	37275 St Rt 17m M
Kiley	Caldarera	Feiner Bros	25 E 75th St #69
Graciela	Ruta	Buckley Miller & Wright	98 Connecticut Ave Nw
Cammy	Albares	Rousseaux, Michael Esq	56 E Morehead St
Mattie	Poquette	Century Communications	73 State Road 434 E
Meaghan	Garufi	Bolton, Wilbur Esq	69734 E Carrillo St
Gladys	Rim	T M Byxbee Company Pc	322 New Horizon Blvd
Yuki	Whobrey	Farmers Insurance Group	1 State Route 27
Fletcher	Flosi	Post Box Services Plus	394 Manchester Blvd
Bette	Nicka	Sport En Art	6 S 33rd St
Veronika	Inouye	C 4 Network Inc	6 Greenleaf Ave
Willard	Kolmetz	Ingalls, Donald R Esq	618 W Yakima Ave
Maryann	Royster	Franklin, Peter L Esq	74 S Westgate St

◄ 1 of 36 ►

We can still see the same view. The problem here is we could be able to see only 4 columns out of 11 columns. So, we need to set the setting as "Fit All Column on One Page" under page scaling.

Click on the "No Scaling" dropdown list to view all the options.
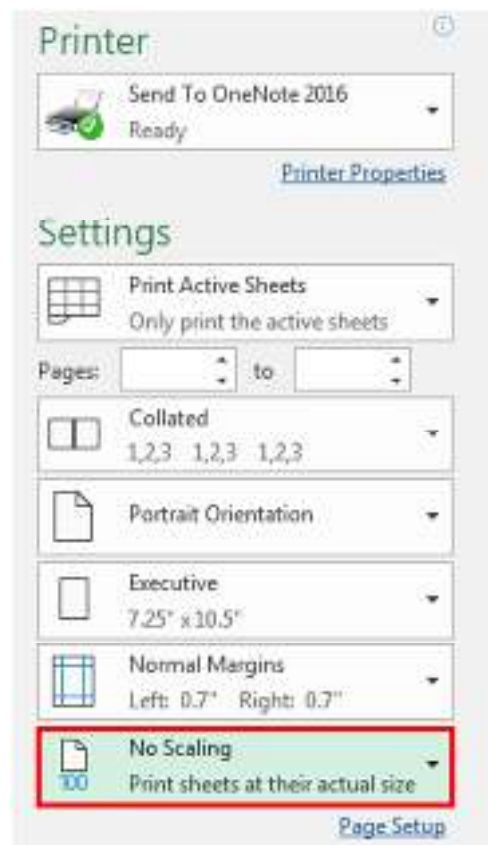
Select "Fit All Columns on One Page" to fit all the columns on one page.
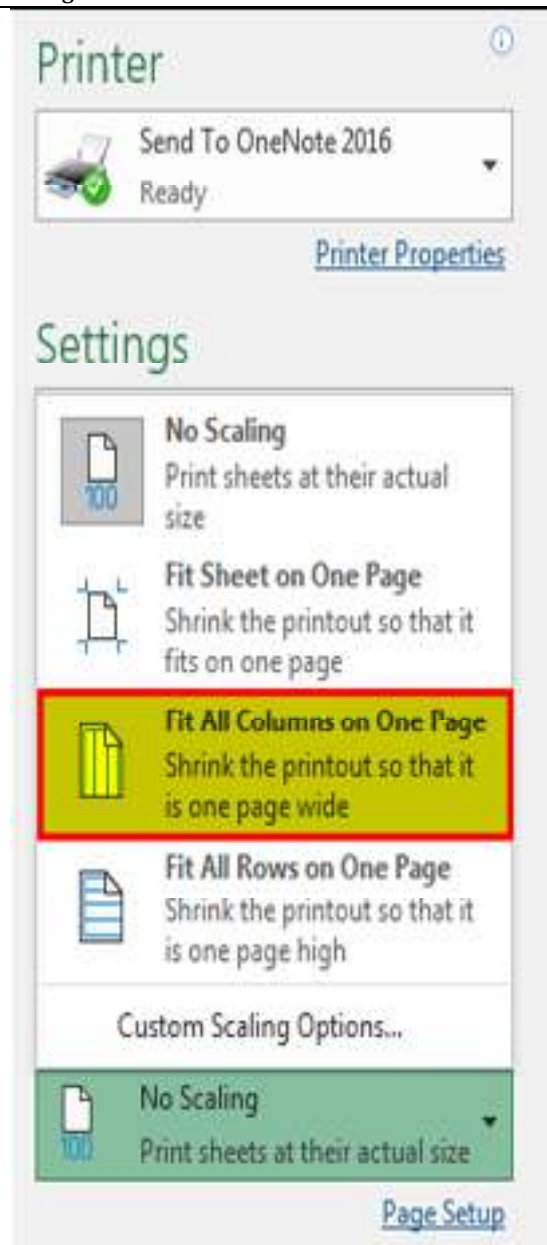
Now, it has fitted all the columns under one page. Since the data is large, it has trimmed the size of the fonts to very small.

Even though we printed this, we could not be able to read the contents, so how do we overcome this issue now?

To adjust the scaling, we need to change the page's orientation from "Portrait" to "Landscape."

Spreadsheet Modelling (Using Excel)

Now, we can read the contents a little better than the previous one.

Now, the total pages have been reduced from 36 to 13.

Like this option, we can set up the print area, adjust columns, decide on the page's orientation, and do many other settings with the help of the Excel "Print Preview" option.

Summary

- Page Setup: Before printing in Microsoft Excel, users should set up the page according to their needs. This includes configuring page orientation (portrait or landscape), margins, and paper size through the Page Layout tab.

- Print Preview: Excel provides a Print Preview feature, allowing users to see how the spreadsheet will look when printed. It helps identify and rectify potential layout issues.

- Page Scaling: Page scaling allows users to adjust the size of the spreadsheet content to fit the available paper size. This is helpful when dealing with larger or smaller data sets.

- Headers and Footers: Excel allows for customization of headers and footers, where you can include information like page numbers, titles, and dates. These elements provide context and professionalism to printed documents.

- Gridlines and Formulas: Users can choose whether to include gridlines and formulas in their printed spreadsheets. Gridlines help with data alignment, while printing formulas can be useful for reference.

- Repeat Rows/Columns: To improve readability, Excel enables users to repeat specific rows or columns on each printed page, such as column or row headers.

- Print Options: Excel offers various print options, like selecting a specific print area, setting the number of copies, and choosing the printer. Users should review these settings in the Print dialog box before confirming the print job.

Keywords

- Print Preview: Spreadsheet software offers a Print Preview feature, allowing users to preview and fine-tune the layout of their printouts before sending them to the printer. This feature helps ensure that the printed document will appear as expected.

- Page Orientation: Page orientation determines whether the printed page is in portrait (vertical) or landscape (horizontal) format. Selecting the appropriate orientation can optimize the presentation of your data.

- Page Margins: Page margins specify the space between the content and the edges of the printed page. Adjusting margins can impact the aesthetics and readability of the document.

- Page Scale: Page scaling enables users to adjust the size of the printed content, making it larger or smaller to fit within the available space. This feature is useful when trying to fit a large spreadsheet onto a single page or when printing at a specific scale.

- Headers and Footers: Headers and footers are areas at the top and bottom of printed pages where you can include information such as page numbers, titles, dates, and custom text. They help provide context and professionalism to printed documents.

Self Assessment

1. What is the primary purpose of the Print Preview feature in spreadsheet software?
A. To print the spreadsheet
B. To adjust the page orientation
C. To view and customize the print layout before printing
D. To set page margins

2. Which option allows you to change the size of the printed spreadsheet to fit on a specific number of pages?
A. Page orientation
B. Margins

C.   Page scale

D.   Headers and footers

3.   Which of the following is not a common page orientation in spreadsheet printing?

A.   Landscape

B.   Portrait

C.   Square

D.   Legal

4.   What do page margins determine in spreadsheet printing?

A.   The font size of the content

B.   The space between the header and footer

C.   The space around the edges of the printed page

D.   The alignment of text

5.   Which feature in spreadsheet software allows you to add information, such as page numbers and titles, at the top and bottom of printed pages?

A.   Headers and footers

B.   Page orientation

C.   Page margins

D.   Page scale

6.   What does adjusting the page scale in the print settings do?

A.   Changes the paper size

B.   Increases or decreases the size of the printed content

C.   Sets the print area

D.   Adjusts the page orientation

7.   In spreadsheet printing, what does the term "landscape" refer to?

A.   The printout of a beautiful landscape picture

B.   The orientation of the page where the width is greater than the height

C.   The use of green ink for printing

D.   The inclusion of footer information

8.   If you want to print a spreadsheet with more columns on a single page, which setting should you adjust?

A.   Page orientation

B.   Page margins

C.   Page scale

D.   Headers and footers

9.   Which of the following is not typically found in the headers and footers of a printed spreadsheet?

A.   Page numbers

B.   Date and time

C.   Cell formulas

D.   Title of the document

10. What is the default page orientation for most spreadsheet applications?
A. Portrait
B. Landscape
C. Square
D. Legal

11. What does increasing the top and bottom margins in a spreadsheet do?
A. Widens the page
B. Increases the content size
C. Adds more space between the header and footer
D. Adjusts the page orientation

12. In spreadsheet printing, what is the purpose of setting the paper size?
A. To determine the color of the paper
B. To specify the dimensions of the paper being used for printing
C. To change the font size
D. To adjust the page scale

13. Which option allows you to include a company logo and contact information in the header of a printed spreadsheet?
A. Page orientation
B. Page margins
C. Page scale
D. Headers and footers

14. What does the "Fit to Page" option typically do in spreadsheet printing?
A. Adjusts the content to fit the page size
B. Changes the paper color
C. Sets the page orientation
D. Changes the font style

15. In the context of headers and footers in spreadsheet printing, what does the term "center alignment" refer to?
A. Placing the header and footer content in the middle of the page
B. Adjusting the page orientation
C. Changing the font style
D. Including company information

Answers for Self Assessment

1.	C	2.	C	3.	C	4.	C	5.	A
6.	B	7.	B	8.	C	9.	C	10.	A
11.	C	12.	B	13.	D	14.	A	15.	A

Review Questions

1. What is the primary purpose of the Print Preview feature in spreadsheet software?

2. How does page orientation affect the layout of a printed spreadsheet?

3. Why are page margins important in spreadsheet printing, and how can you adjust them?

4. What does adjusting the page scale in spreadsheet printing allow you to do?

5. How do headers and footers enhance the quality of printed spreadsheets?

6. What is the default page orientation for most spreadsheet applications?

7. When might you want to increase the top and bottom margins when printing a spreadsheet?

8. Explain how you can customize the content in headers and footers for a printed spreadsheet.

9. How does the "Fit to Page" option typically work in spreadsheet printing?

10. Why is it essential to use the Print Preview function before printing a spreadsheet?

Further Readings

- https://www.ablebits.com/office-addins-blog/print-excel-spreadsheet/
- https://edu.gcfglobal.org/en/excel-tips/5-tips-for-printing-excel-spreadsheets/1/
- https://www.educba.com/print-in-excel/
- https://www.wallstreetmojo.com/print-in-excel/
- https://www.wallstreetmojo.com/print-preview-in-excel/
- https://www.ablebits.com/office-addins-blog/excel-header-footer-add-change-remove/

Unit 07: Charts and Graphs

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Objectives

- To understand charts offered by MS-Excel
- To gain insight to moving and resizing charts
- To know how to change chart styles and types
- To learn modification in chart elements

Introduction

It is sometimes difficult to interpret the Excel data due to complexity and size of data. So, charts are a way to represent the data graphically and interpret the data easily. Charts are the visual representation of data.

Excel provides charts to take advantage of graphical representation. The data represented through charts is more understandable than the data stored in an Excel table. This makes the process of analyzing data fast. Excel users can fast analyze the data.

Graphical representation of data using charts makes complex data analysis easier to understand. Excel has a variety of charts, each with its own different functionality and representation style.

7.1 Basic Chart Types

Excel offers many charts to represent the data in different manners, such as - Pie charts, Bar charts, Line charts, Stock charts, Surface charts, Radar charts, and many more. You can use them according to your data and analysis.

There is a list of basic and advanced level of charts used for different purposes to interpret the data.

Column Chart

Line Chart

Bar Chart

Area chart

Pie chart or Doughnut chart

Surface chart

These are the most used charts of Excel that an Excel user usually requires.

Microsoft Excel introduce one newer chart called Tree map chart for 2016 and newer version. It has come with some advanced features and representation styles.

We will illustrate each chart and its functionality with an example in this chapter. Learn carefully and use them accordingly.

Column Charts

A column chart is basically a vertical chart that is used to represent the data in vertical bars. It works efficiently with different types of data, but it is usually used for comparing the information.

For example, a company wants to see each month sell graphically and also wants to compare them. Column charts are best for it that help to analyze and compare each month's data with each other.
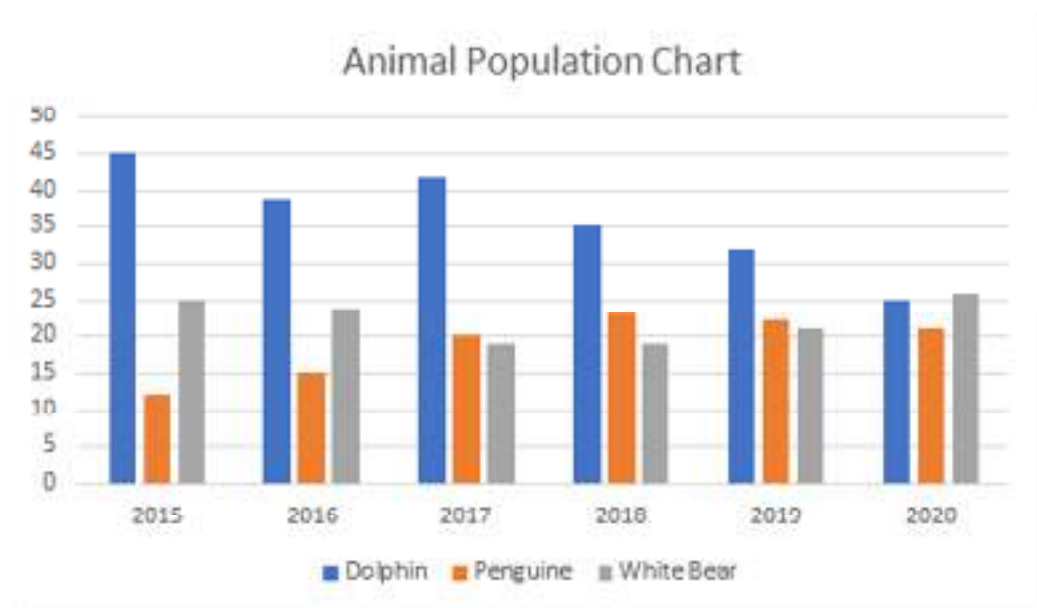
Line Chart

Line charts are most useful for showing trends. Using this chart, you can easily analyze the ups and downs in your data over time. In this chart, data points are connected with lines.
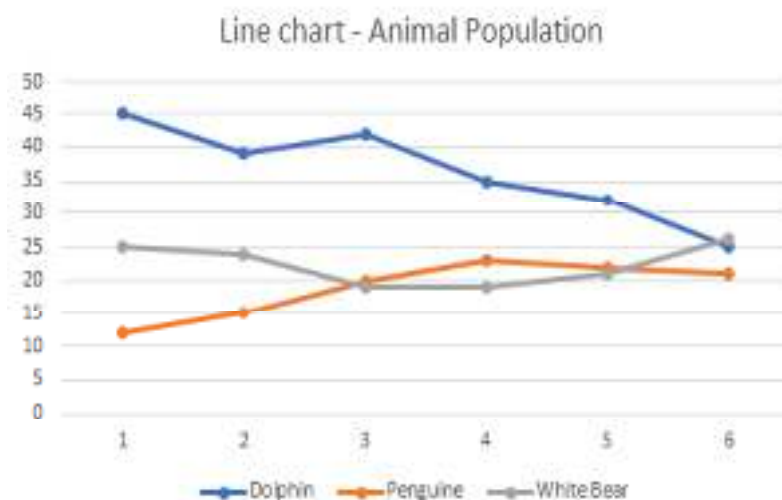
For example, a company wants to analyze the sell of products for the last five years graphically. Additionally, it also wants to analyze the ups and downs of each year product sell.

Bar chart

Bar charts are horizontal bars that work like column charts. Unlike column charts, Bar charts are horizontally plotted. Or you can say that bar charts and column charts are just opposite to each other.

For example, a company uses the bar chart to analyze the data through vertical bars to represent the data graphically. You can see as well as compare the values to each other, respective to data.
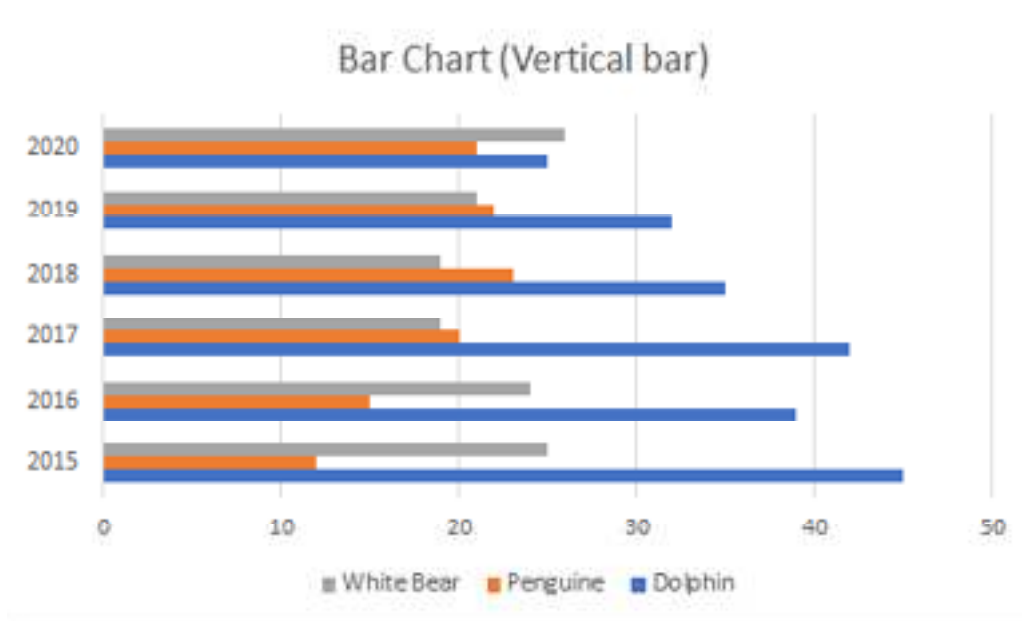
Area chart

Area charts are just like line charts. Unlike the line charts, gaps are filled with color in area charts. Area charts are easy to analyze the growth in business as its shows ups and downs through line.
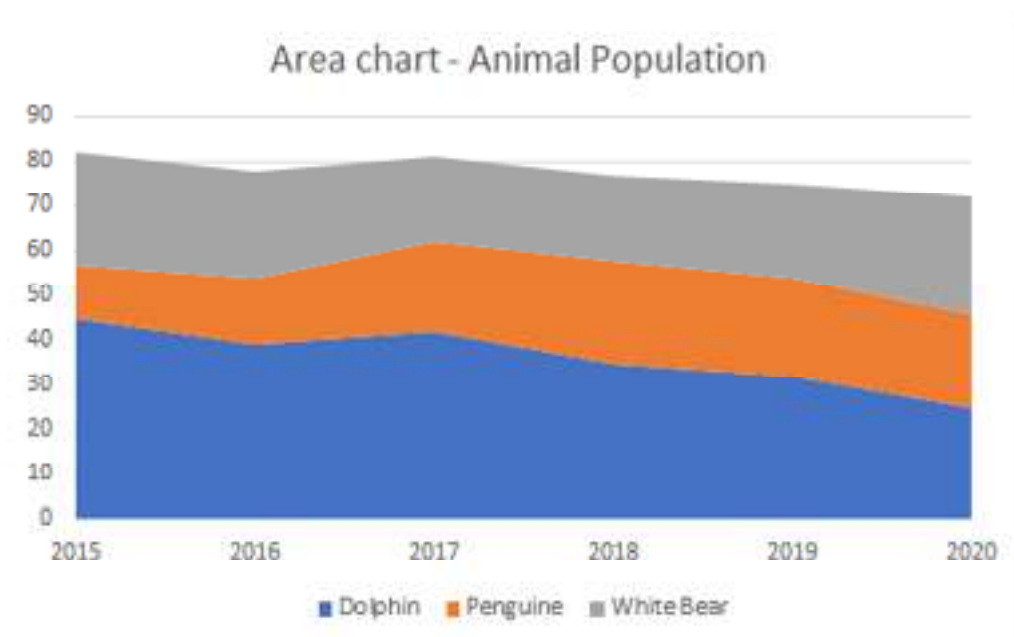
Similar to the line charts, data points in area charts are connected with lines.

Pie chart

Spreadsheet Modelling (Using Excel)

A pie chart is a rounded shape graph that is divided into slices of pie. Using this chart, you can easily analyze data that is divided into slices. It makes the data easy to compare the proportion.
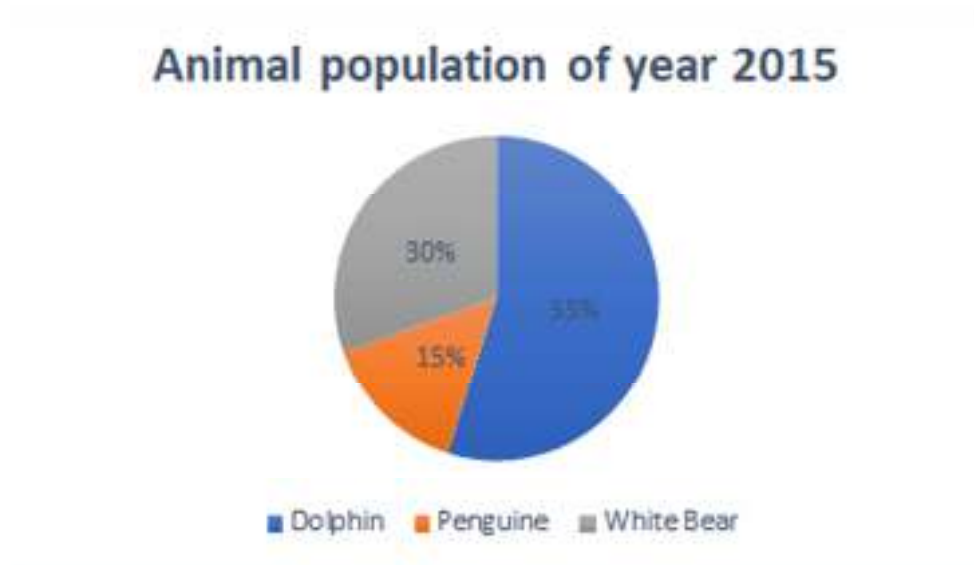
Pie charts make it easy to analyze which values make up the percentage of whole. Pie chart is also known as Doughnut chart. Excel offers 2D and 3D pie charts.

Surface chart

Surface chart is actually a 3D chart that helps to represent the data into a 3D landscape. These charts are best to use with a large dataset. This chart allows to displaying a variety of data at the same time.
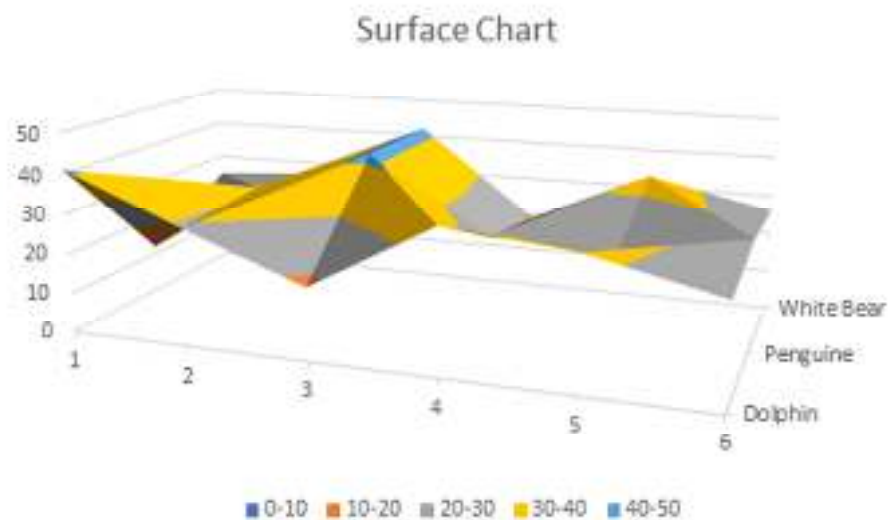
A large dataset is not easy to represent using other charts. Surface chart solve this problem that allows displaying large datasets using this 3D chart.

Choose your charts wisely

Excel offers too many charts as well as their 2D and 3D type. You can use any of them but choose them wisely according to your data. Different scenario requires different charts. Though, it can display all and correct information.

We have a list of some points for each type of chart that helps you to choose the chart wisely. Read them carefully -

	Chart Type	When to choose this chart
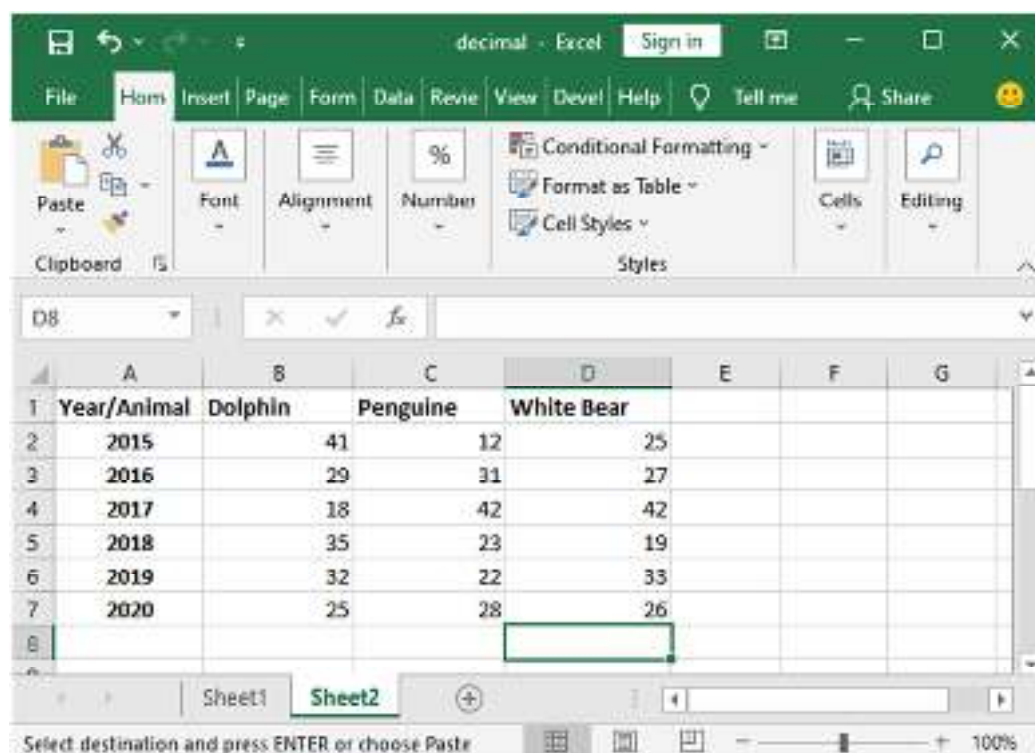
1.	Column Chart	Use the column chart when you want to compare the multiple values across a few categories. The values are shown through vertical bars.
2.	Line Chart	Choose this chart when you want to show the treads (ups and downs) over a period of time, like for months or years.
3.	Bar Chart	Like the column chart, use this chart to compare the values across a few categories. In this chart, values are displayed in the horizontal bar.
4.	Area chart	Area chart has the same pattern as the line chart. This chart is best to use for indicating a change among different sets.
5.	Pie or Doughnut chart	Pie chart is best to use when you want to quantify the values and show them as percentage.
6.	Surface chart	Surface chart is different than other charts. Use it when you need to analyze the optimum combination between two sets of data.

How to insert a chart?

Excel enables easy to use user interface using which you can easily insert a required chart for your data. You need to follow few simple steps, Excel > Insert tab > Chart section > choose a chart.

We will illustrate these steps from start to end for creating the chart for Excel data. Following are the steps to insert a chart in Excel.

Step 1: We have the following dataset (Animal population rate for six years from 2015-2020) for which you want to create a chart in Excel.

Step 2: Select the data, including column header and row label for which you want to create a chart. This data will be the source data for your chart.

Spreadsheet Modelling (Using Excel)
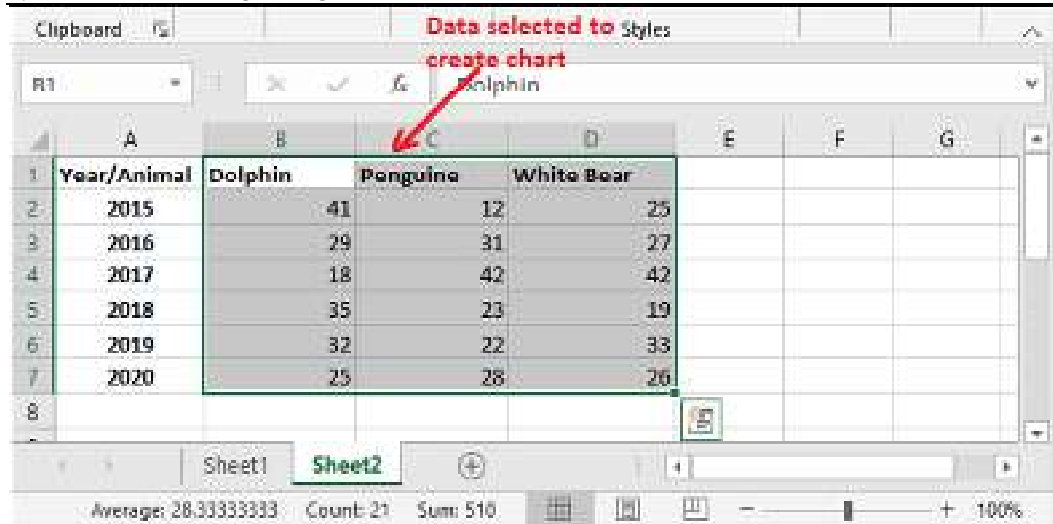
Step 3: Navigate to the Insert tab in the Excel header, where you will see a charts section that contains a list of all these charts.
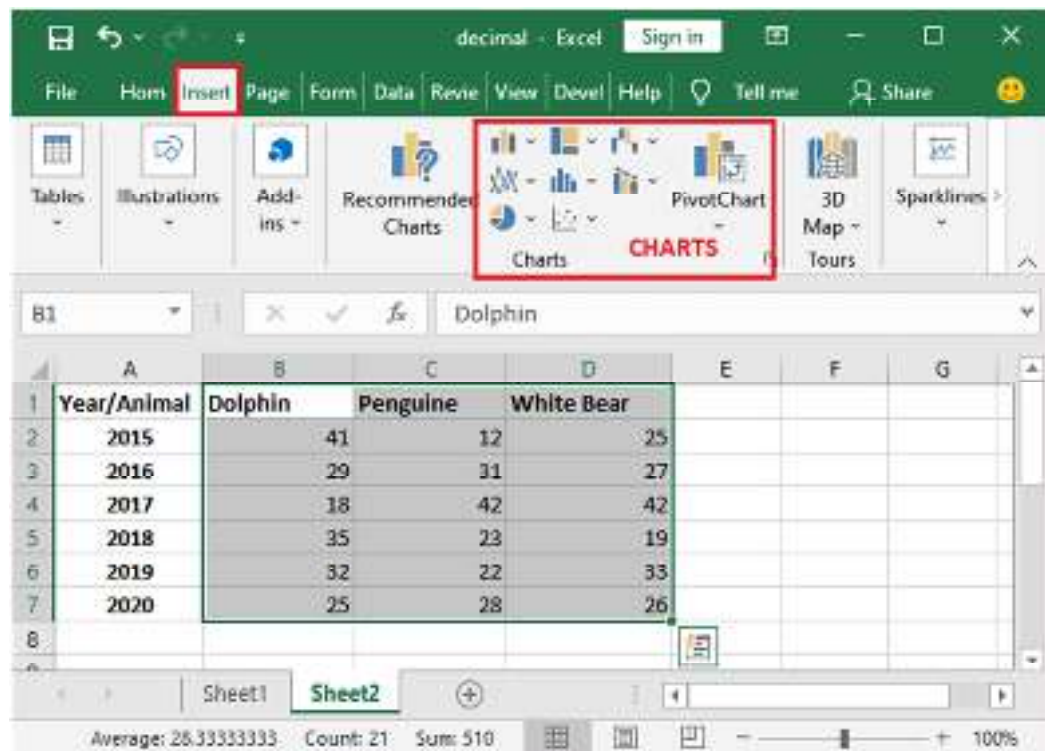
Step 4: Choose a chart from here according to your data. We have chosen a 3D Column

Step 5: The selected chart is inserted into your Excel worksheet. Initially, the chart looks like this for the data selected in step 2.
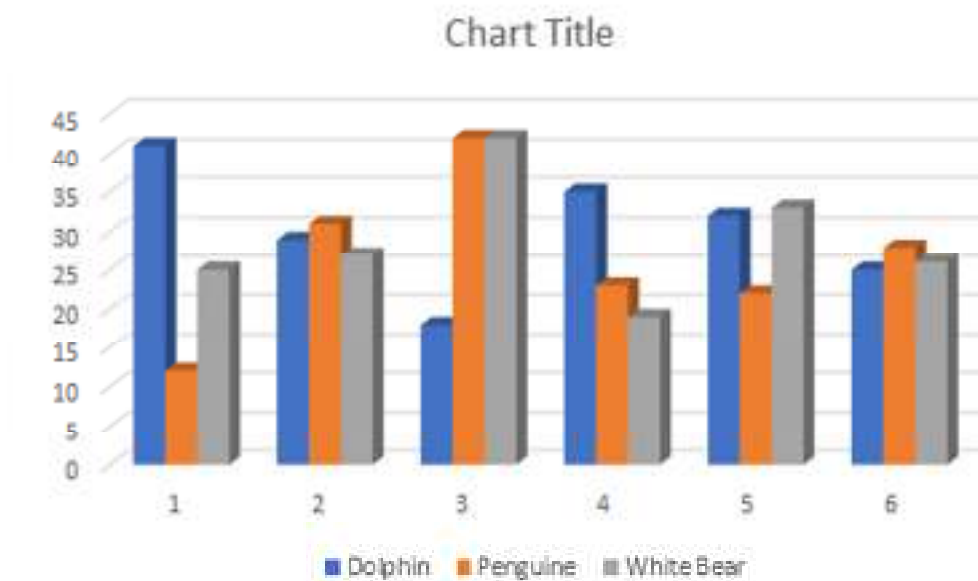
Currently, this chart does not have a valid title, clear values for analysis, and more. You can set up all these things in your chart by modifying it.

Step 6: Double-tap on the Chart Title to make it editable and then provide a new valid title that suites to it.
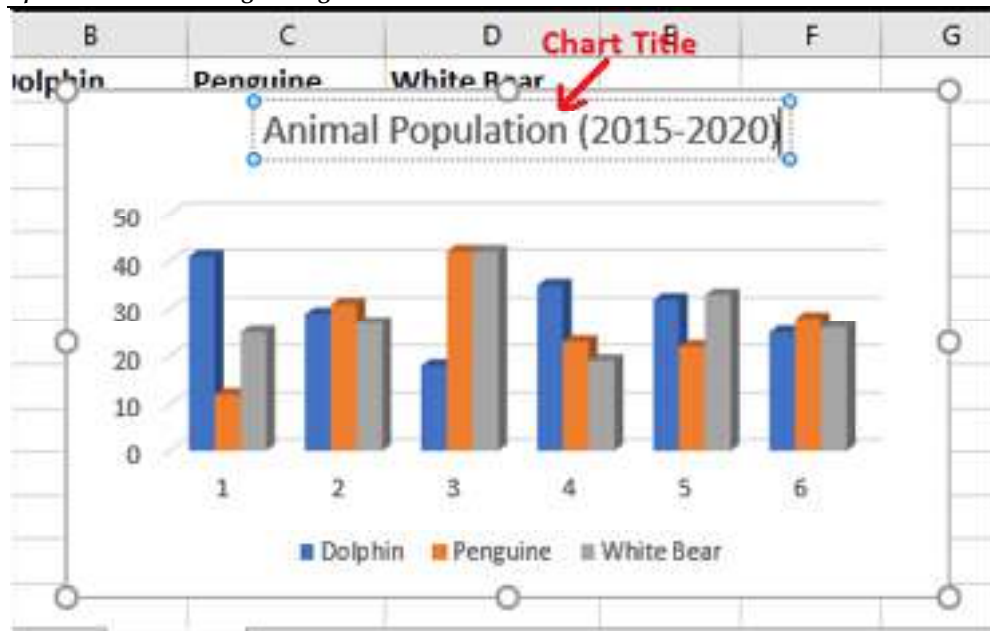
Here, Blue color vertical bar is representing to Dolphin, Orange vertical bar to Penguin, and Grey vertical bar to White Bear population count.

Step 7: You can also define each vertical bar for its year so that the user can easily analyze the values. Click on the Chart Filters icon here.

Step 8: Click on the Select data present at the bottom of the list to replace the years 2015 for each vertical bar.
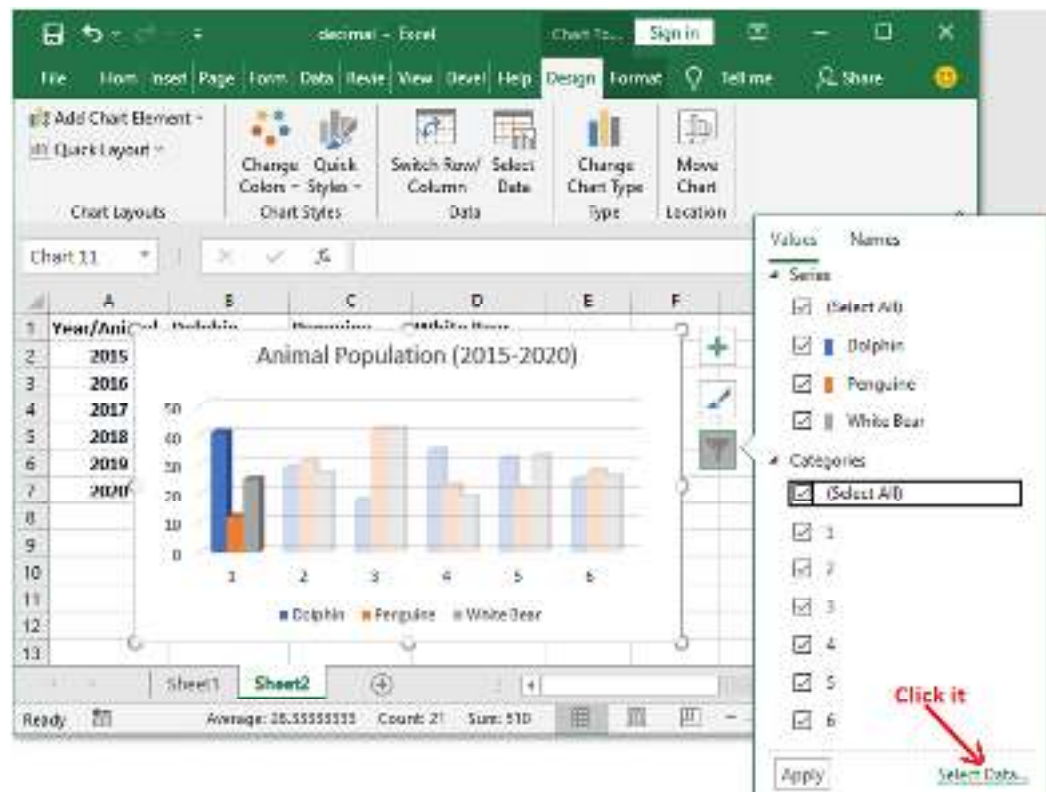
Step 9: Here, select the number **1** to replace it with year 2015 and click the Edit button.

Step 10: Enter the year and click OK.
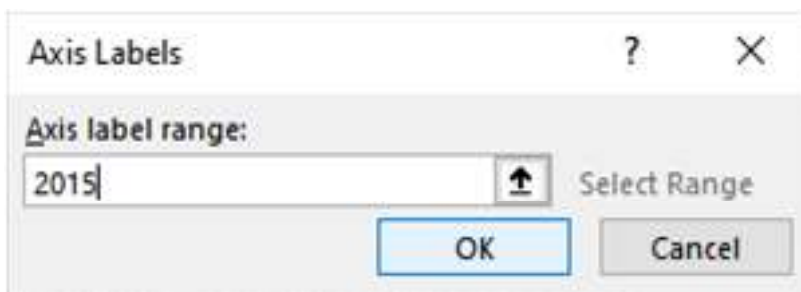
Step 11: The year 2015 will immediately reflect on the chart, and all other become blank. Now, to put all other years for each vertical bar, click one more time here.
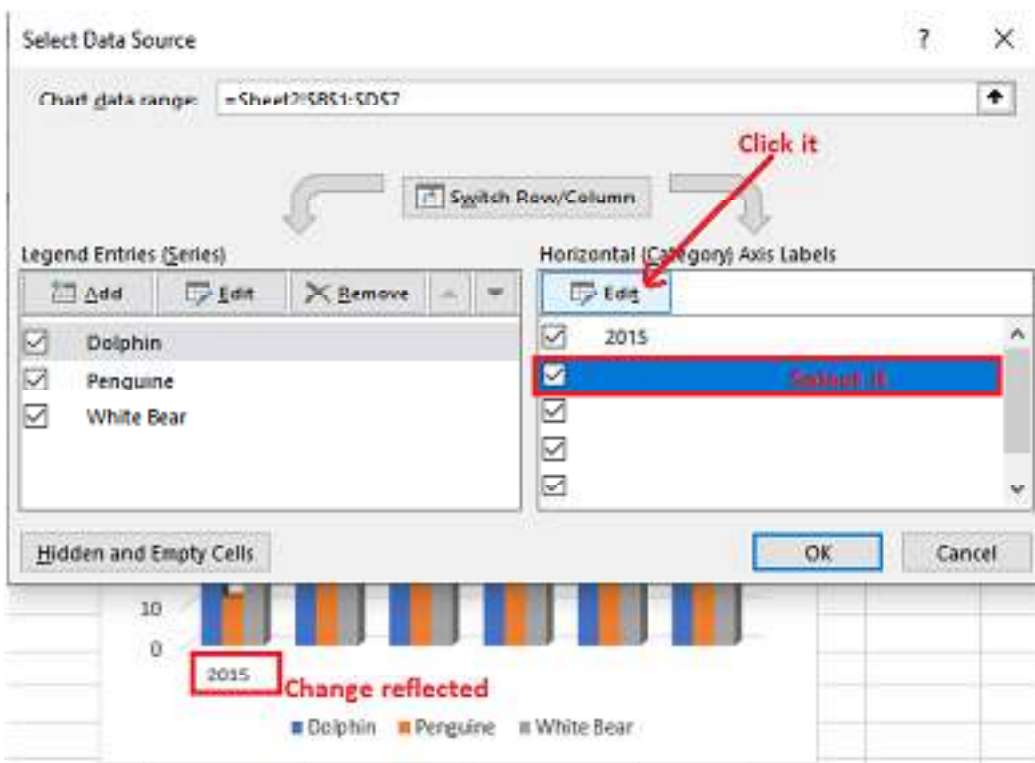
Step 12: Add more years from 2016 to 2020 inside curly braces separated by a comma and click OK.

{2015,2016,2017,2018,2019,2020}
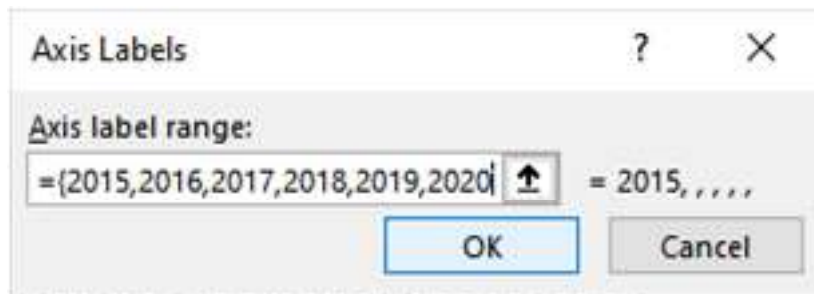
Step 13: All values are now added. So, click OK.
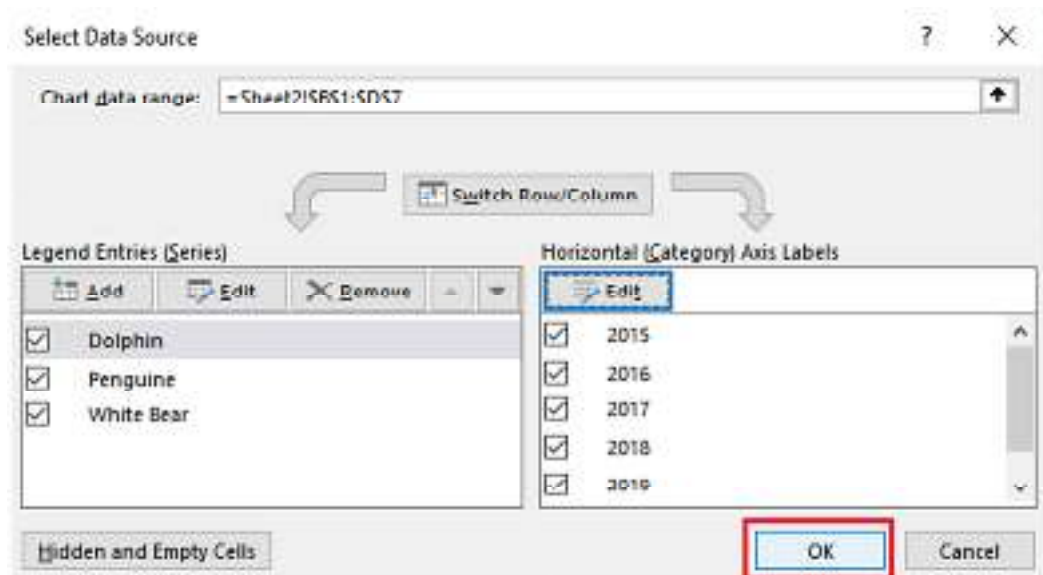
Step 14: See the charts that the years are reflected on the chart correspond to each vertical bar.
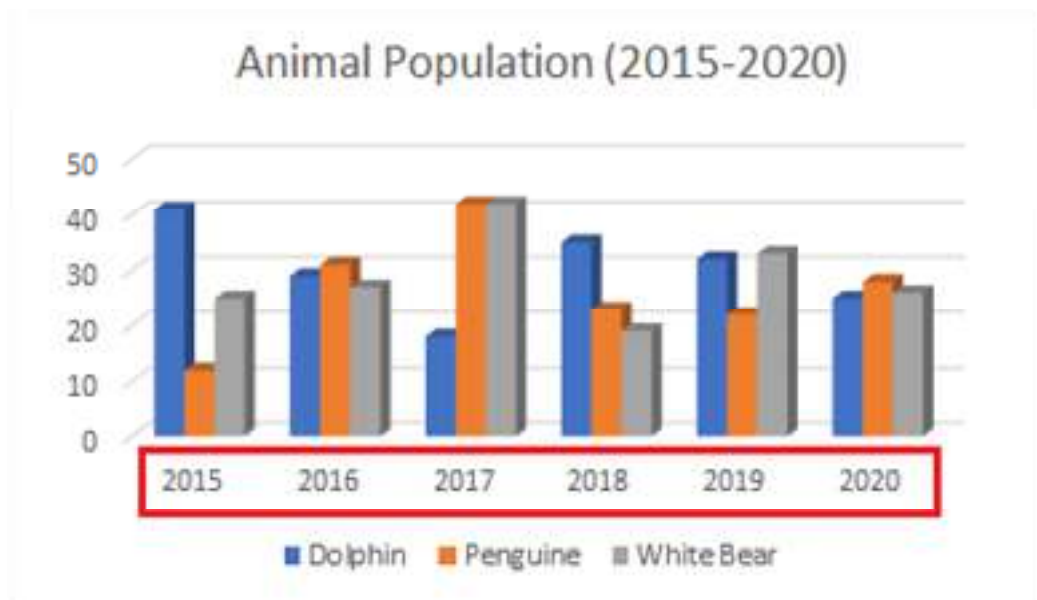
You can see that the exact value is not defined at the end of each bar. Only the graph is showing. Excel enables the users to choose a detailed bar.

Step 15: Choose another chart style for the Column chart for detailed description from the Chart Style in the ribbon. We have chosen Style 2.
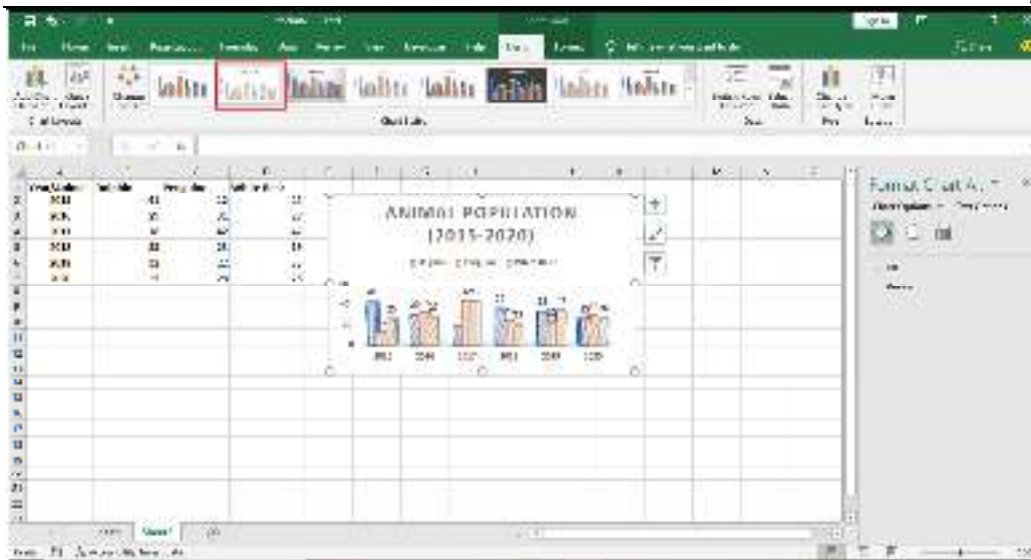
Note: The Chart Style option enables only when the chart inserted in your Excel sheet is selected. So, make sure chart is selected.

Step 16: You can now see the exact value is also showing for each bar in this chart.
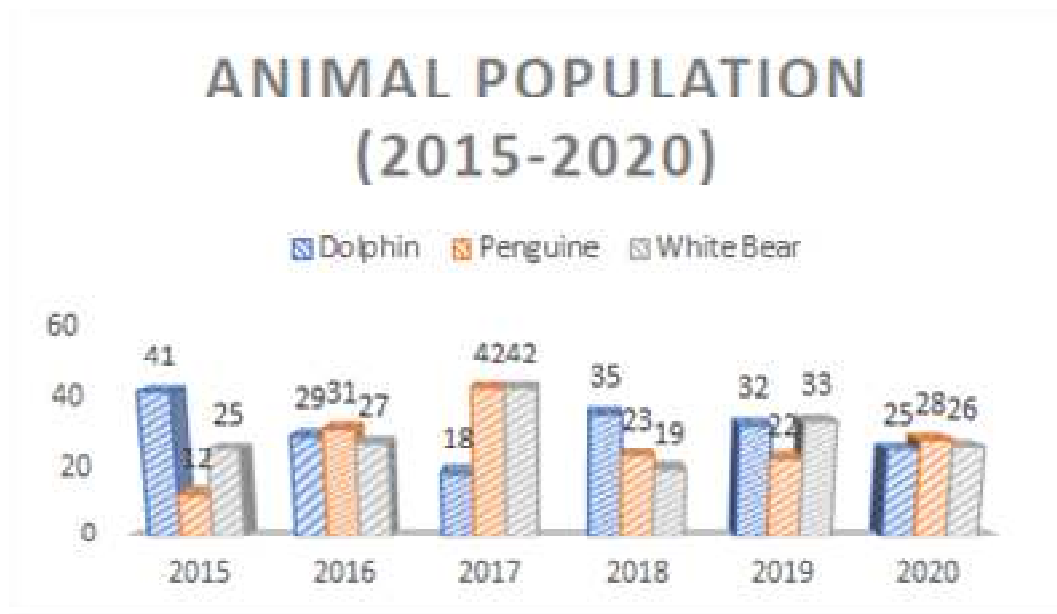
Similarly, you can insert, create, and modify other charts in your Excel worksheet for your data.

7.2   Move and Resize Charts

In Excel, by default, the charts are moved and sized with cells. Whenever we change the size of cells in an excel sheet, the excel will automatically adjust the size of the chart accordingly. Excel also provides us the option for chart positioning without changing the cell's size. Usually, we move or change the size of the chart within excel to ensure that the chart will not cover its underlying data. We can move the chart to a new location in the worksheet or to a new or existing worksheet. Also, we resize or change the size of the chart for a better fit in the worksheet.

Note: We can resize the chart, move a chart within a worksheet or we can also move to a new worksheet.

Moving Charts in Excel

In Excel, We can easily move charts. Let us discuss with the help of an example. Suppose we have a chart that represents random sales data in different cities of 3 different states(You can use any

dataset and insert a chart using the dataset and implement the following moving and resizing behavior). Now we will move this chart.

Move a chart within a worksheet

In this example, we will move a char within the same excel worksheet. Usually, we perform these operations in order to avoid the overlapping between the data and the charts. Following is the step-by-step implementation.

Step 1: Insert and Select the chart

In this step, first, we'll need to insert a chart(Here, we are using Bar Chart). Once we have created a chart then we need to select it, for this, we have to click over our chart and select it.

Step 2: Position the chart

Once we have selected the chart, we can position the chat to a new location by dragging it using the chart's border (We can also do that by double-clicking to hold the chart and drag to a new position and rest it there).
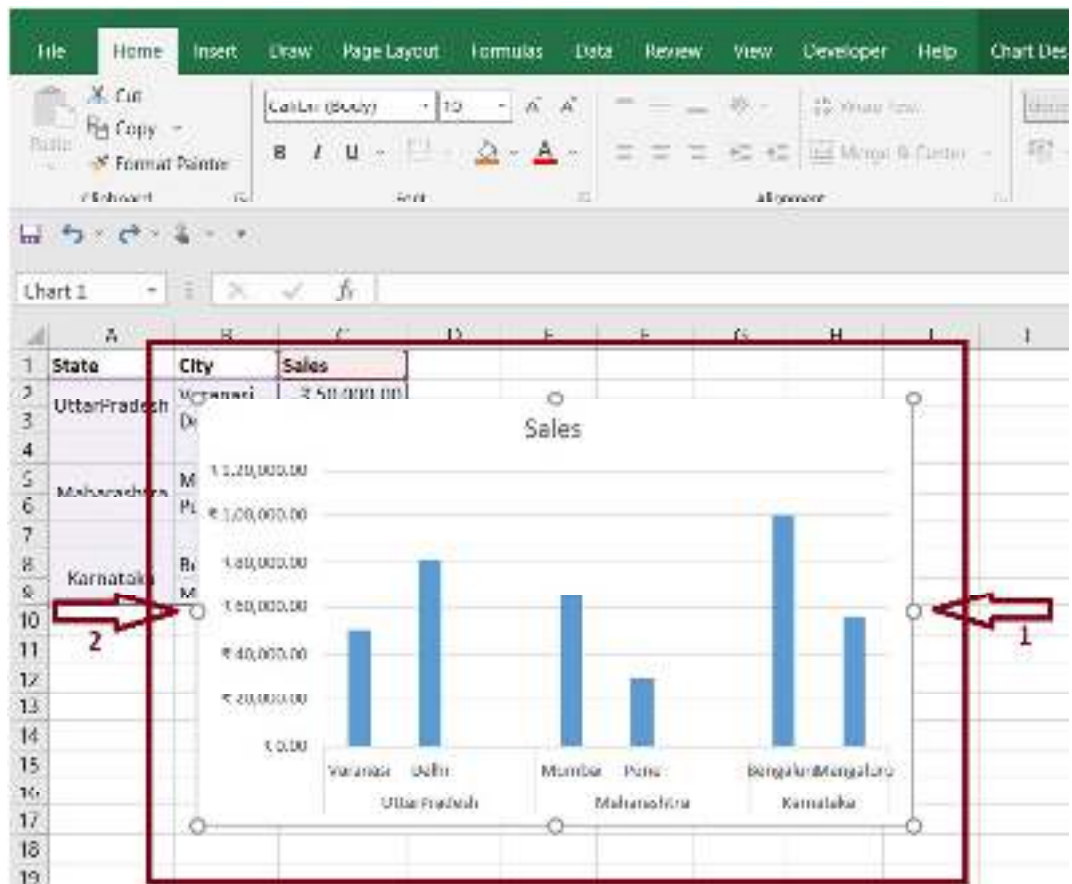
Move a chart to another worksheet

In this example, we will learn to move our chart to a new worksheet. This will create a new worksheet with the specified sheet name and contains the chart. to do this follow the step by step implementation

Step 1: Insert and Select the chart

In this step, first, we will need to insert a chart(Here, we are using Bar Chart). Once we have created our chart we need to select it, for this, we have to click over the chart and select it.

Step 2: Position the char on a new worksheet

Once we have selected the chart we need to go to Chart Design > Move Chart it will pop up a window asking about the new position to place the chart.
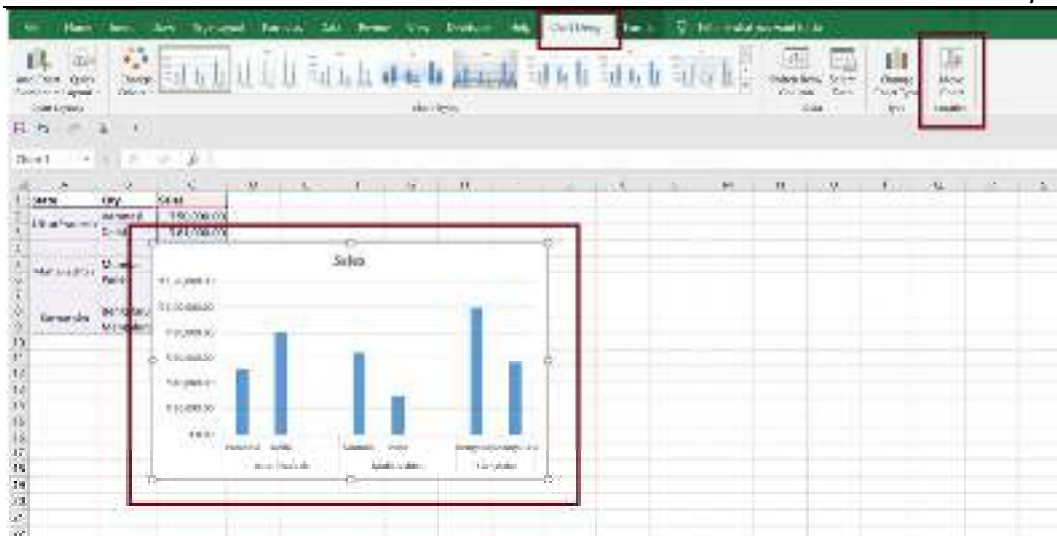
After we click on the Move Chart option, the excel will popup window where we need to put the new worksheet.
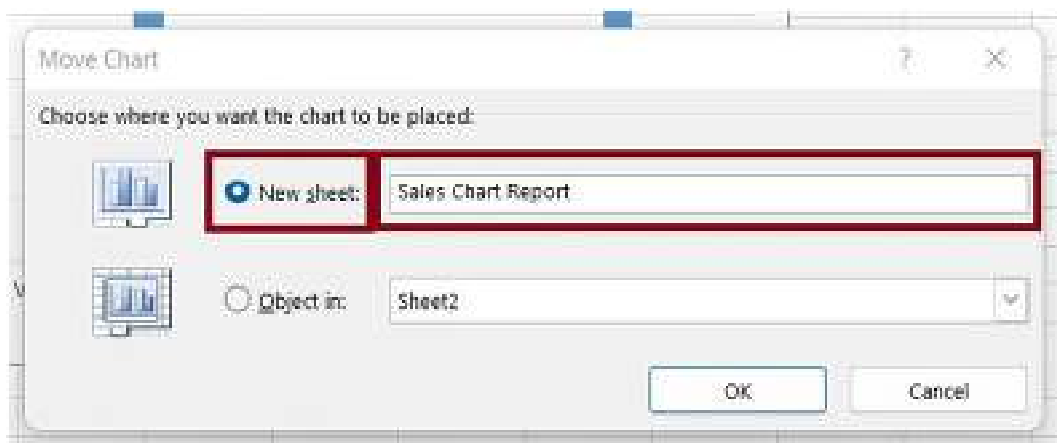
Once we click on the OK button excel will create a new worksheet with the name we have provided as "Sales Chart Report".
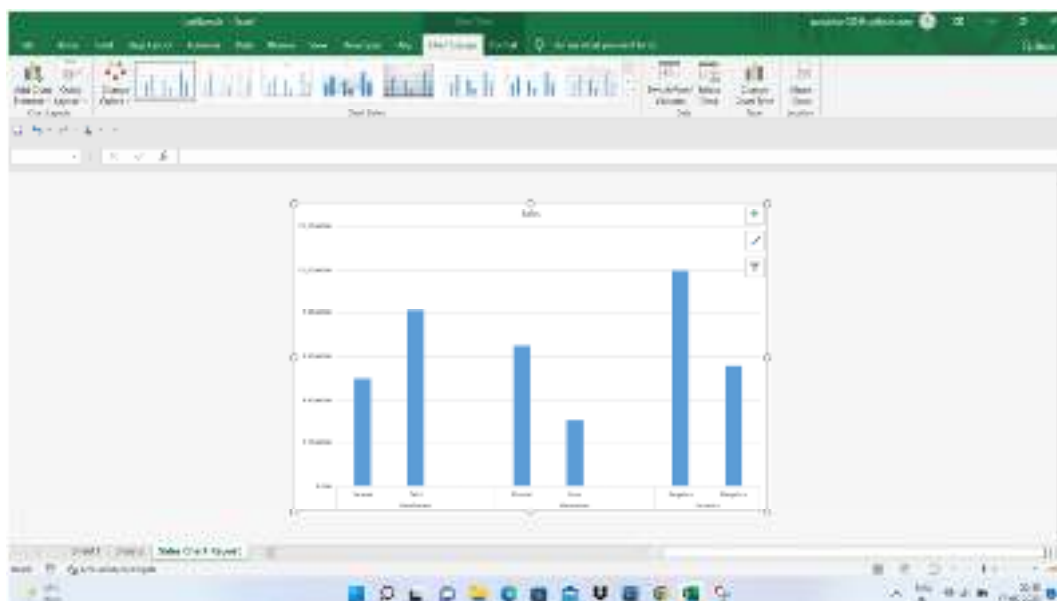
Resizing Charts in Excel

Resizing of the chart includes an increase or decrease in the length or breadth of the chart. This could be easily done by holding the graph's endpoint and dragging them to increase or decrease the size of the graph. Following is the step-by-step implementation.

Step 1: Insert and Select the chart

In this step, first, we will need to insert a chart(Here, we are using Bar Chart). Once we have created the chart we need to select it, for this, we have to click over our chart and select it.

Step 2: Resizing the chart

In this step, we will resize the chart. For resizing the chart excel provides eight sizing handles in the chart. We can click on these handles and drag the size of the chart according to our requirements.
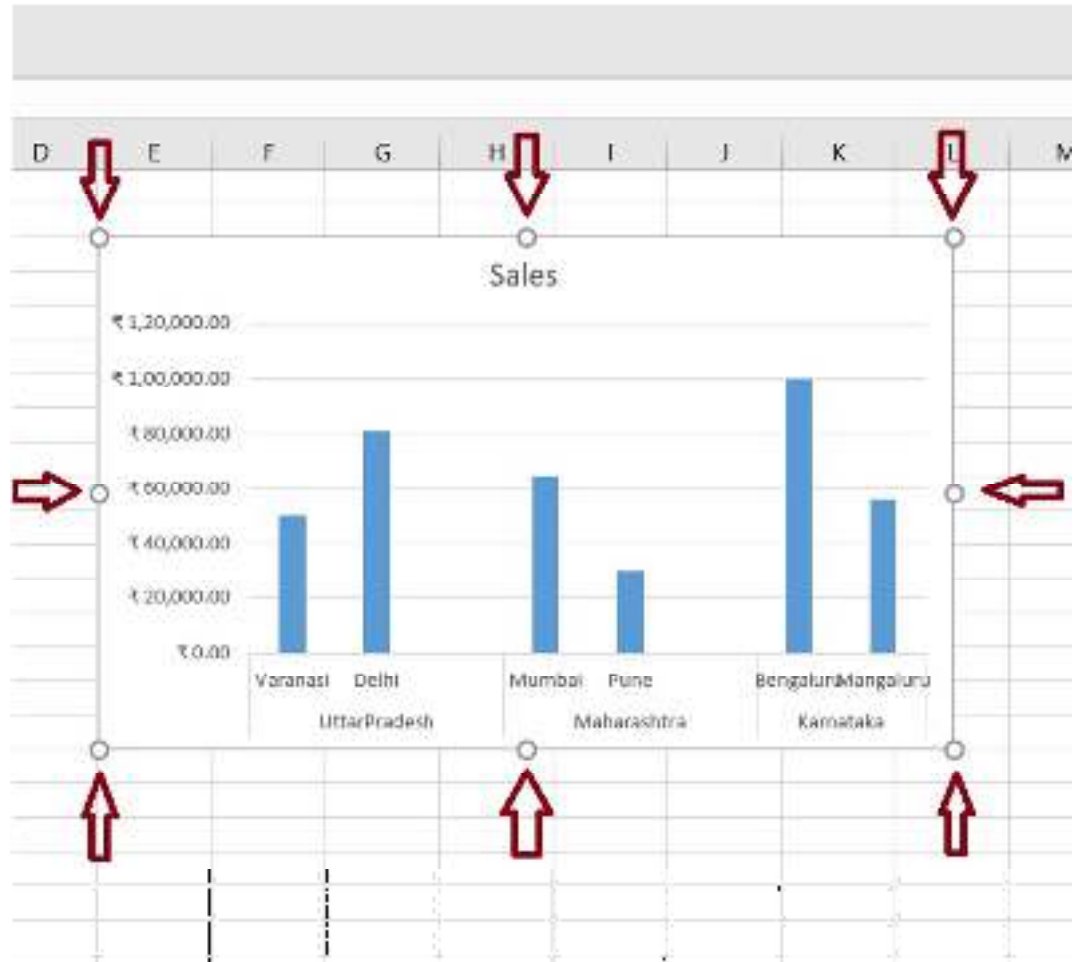
7.3 Change Chart Styles and Types

An easy way to change the look and feel of a chart is by applying one of the built-in layouts or styles that are available in Excel.

Apply a Chart Layout

Built-in chart layouts can quickly adjust the overall layout of a chart with different combinations of titles, labels, and chart orientations.

1. Select the chart you want to format.

2. Click the Design tab.

3. Click the Quick Layout button.

4. Select the layout you want to use.

The selected layout is applied to the chart.

Apply a Chart Style

Built-in chart styles allow you to adjust the format of several chart elements all at once. Styles quickly change colors, shading, and other formatting properties.

1. Select the chart
2. Click the **Design** tab.
3. Click the **Chart Styles More** button.

If the style you want to use is already displayed in the gallery, there is no need to expand the menu, just select it.

1. Select a new style.

Spreadsheet Modelling (Using Excel)

Change Colors

You can maintain the general look of a style while updating just the colors to better suit your needs.

1. Select the chart
2. Click the Design tab.
3. Click the Change **Colors** button.
4. Select a new color set.
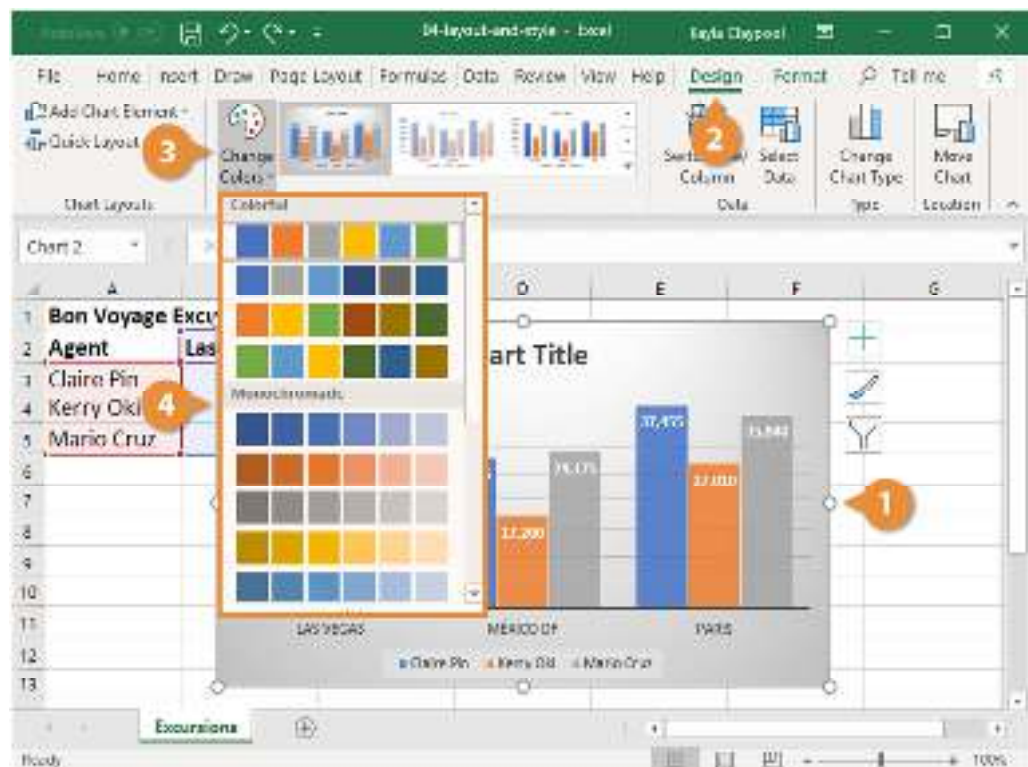
The new color set is applied to the chart.

Assume you have a data set like the below one.

Step 1 – We must select the data and **insert the COLUMN chart in Excel**.
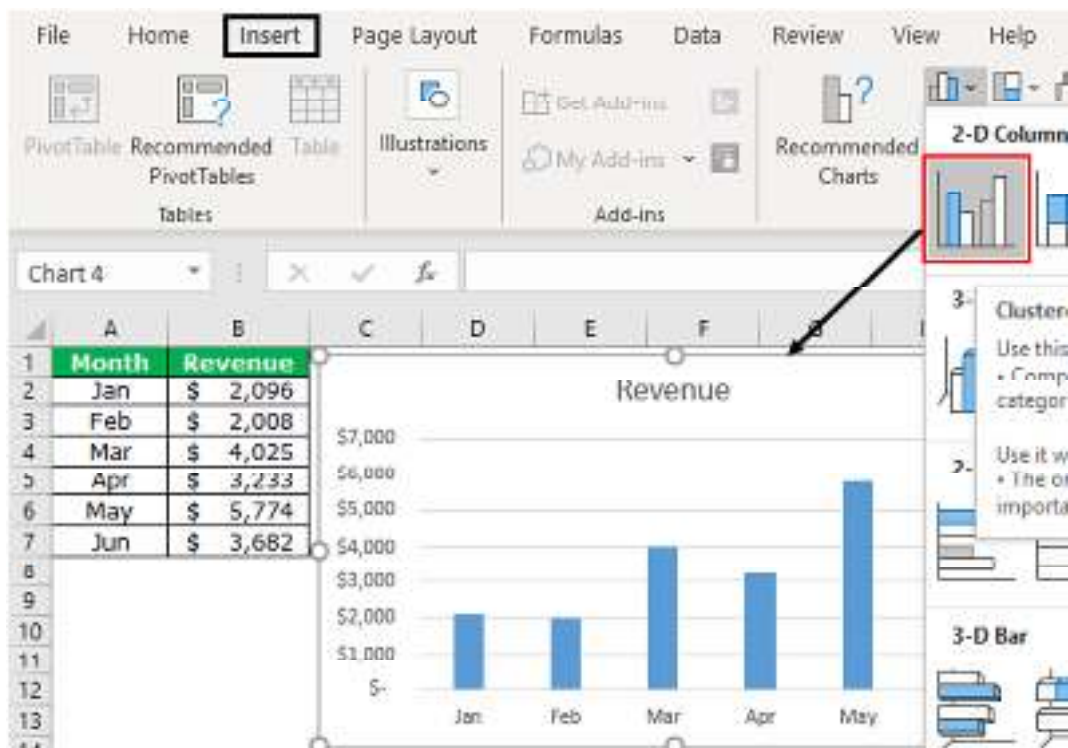
When inserting the column chart for the selected data range, we get this default chart. However, most people do not go beyond this step because they do not care about the beauty of the chart.

Step 2 – To open the "FORMAT DATA SERIES" option, select the bars and press "Ctrl + 1."

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Spreadsheet Modelling (Using Excel)
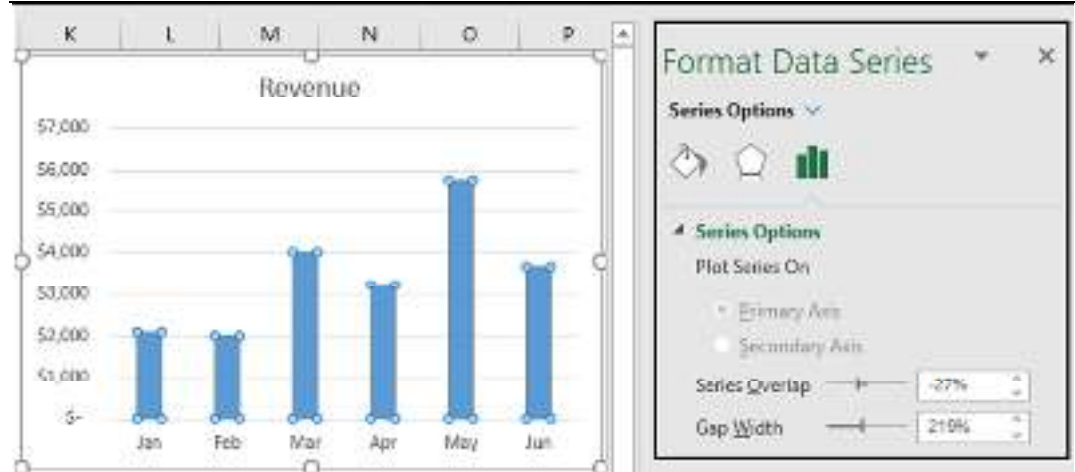
Step 3 – In the "FORMAT DATA SERIES" window, choose the "FILL" option, click on "FILL," and check the box "Vary color by point."
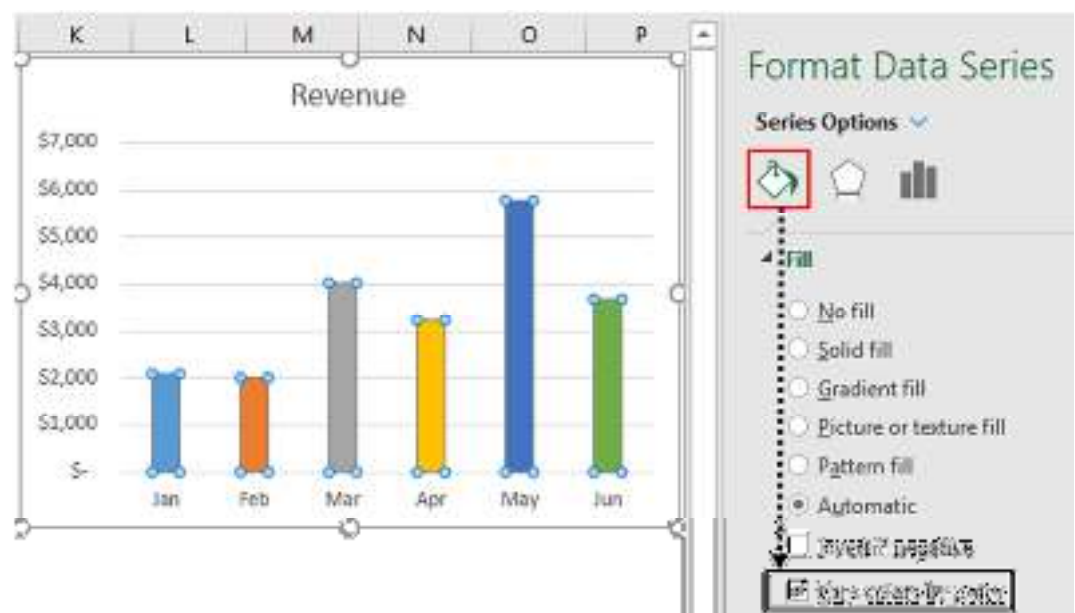
Steps to Apply Different Themes or Styles to The Chart

We need to apply some themes or different styles to the chart. For this, we need to follow the below simple steps.

- Step 1: First, we must select the chart first.

- Step 2: Two extra tabs open on the ribbon as soon as we choose the chart.
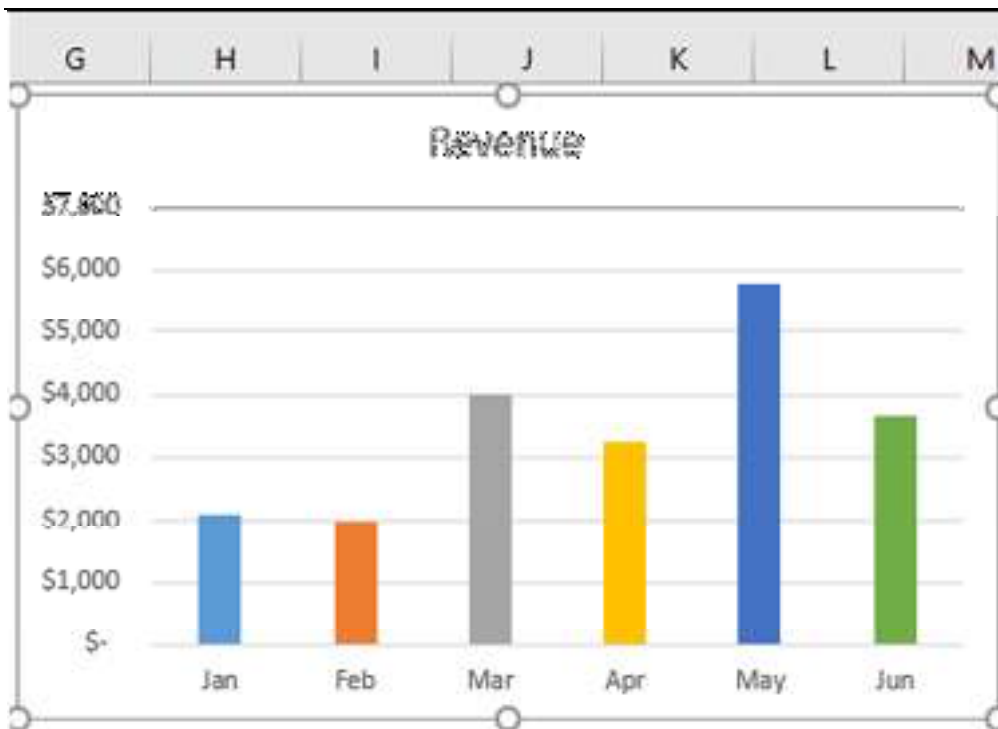
We can see the main heading as "Chart Tools," and under this, we have two tabs, i.e., "Design" and "Format."

- Step 3: We must go to the "DESIGN" tab. Under this, we can see many design options. Next, go to the "Chart Style" section.

- Step 4: As we can see under "Chart Styles," we can see many designs. As per our current chart style, the first one will appear.
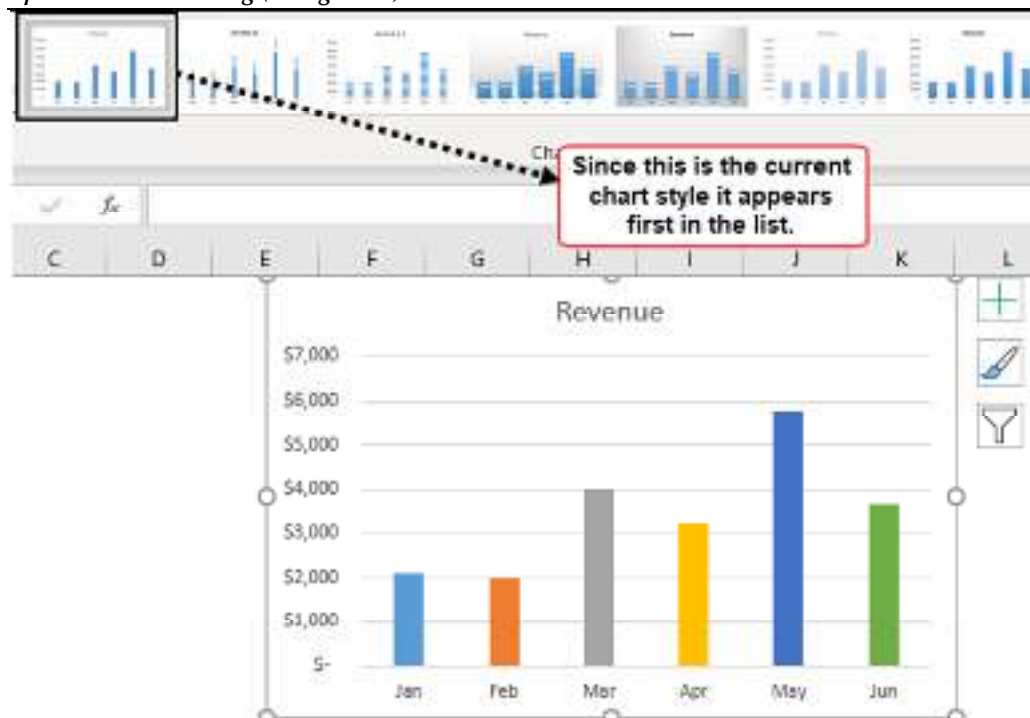
In Excel 2013, we have a total of 16 chart styles. So, click on the drop-down list of the chart style to see the list.

There is no specific name for each chart style. Rather, these styles are referred to as "Style 1", "Style 2", "Style 3," and so on.

We will see each style and how they look when we apply them.

Style 1: Apply only Grid Lines.

If we choose the first style, it will display only GRIDLINES in Excel to the chart. Below is a preview of the same.
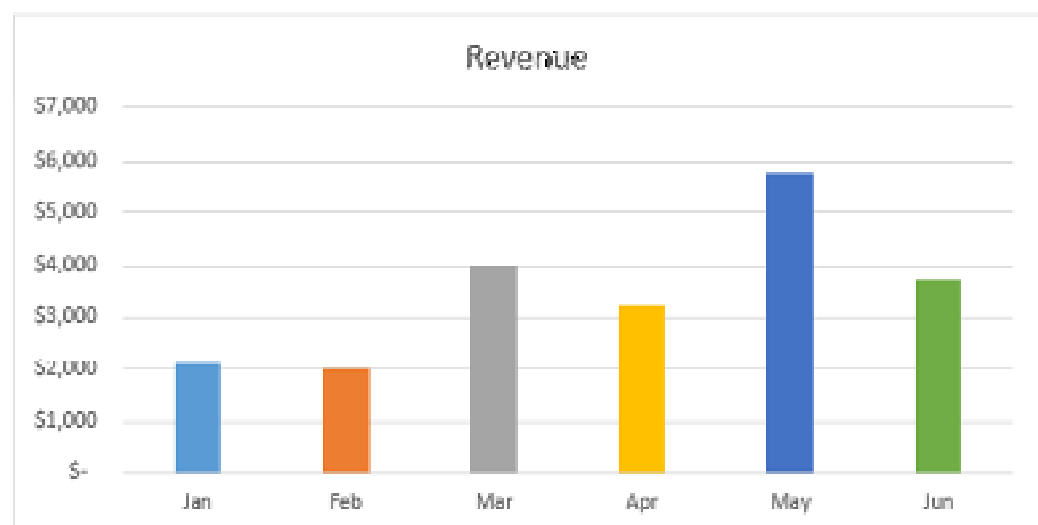
Style 2: Show Data Labels in a Vertical way

"Data Labels" are the data or numbers of each column bar. Suppose we select the "Style 2" option. We will get below the chart style.
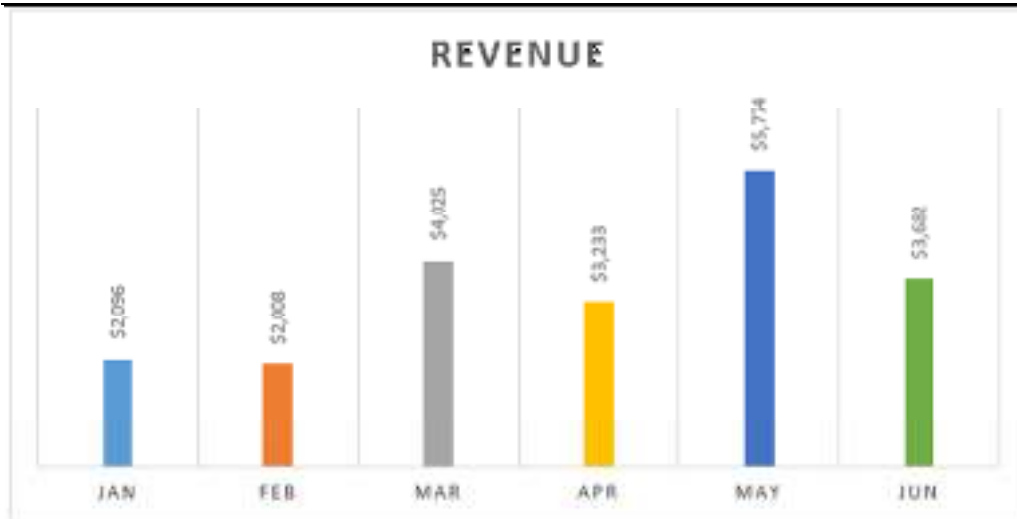
Style 3: To Apply Shaded Column Bars

This style will modify the style of the bars from plain to shades. Below is a preview of the same.

Note: "Data Labels" do not default in this style since we have selected "Style 2" in the previous step; it has come automatically.

Style 4: To Apply Increased Width of Column Bars and Shadow of Column Bars.

This style will increase the width of the column bars and give each bar's shadow.
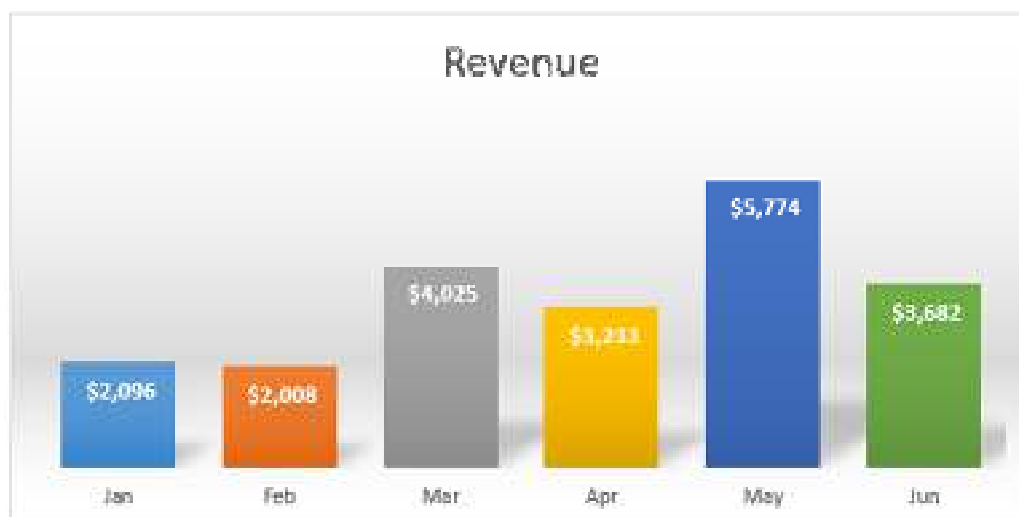
Spreadsheet Modelling (Using Excel)

Style 5: To Apply Grey Background.

This style will apply a grey background to "Style 4."
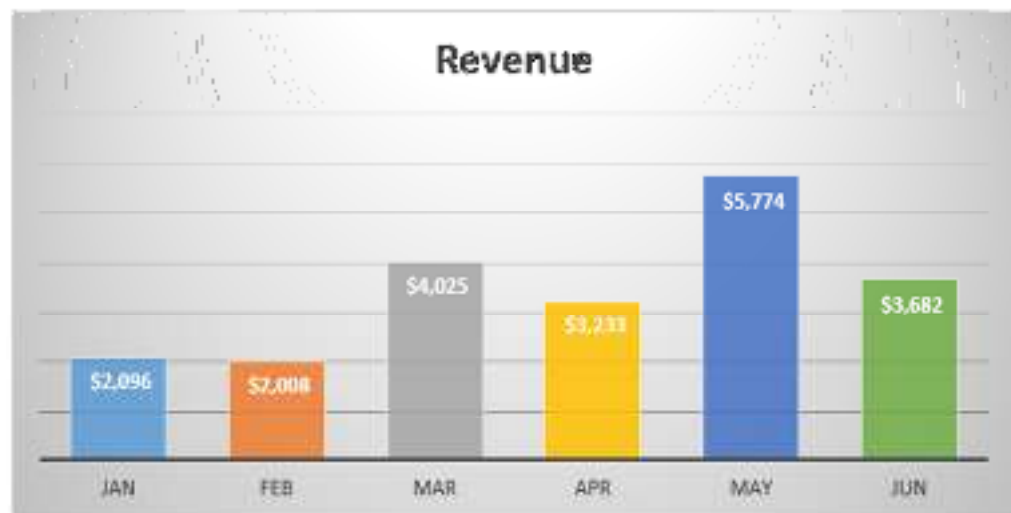
Style 6: To Apply Light Color to the Column Bars.

This style will apply light colors to the column bars.
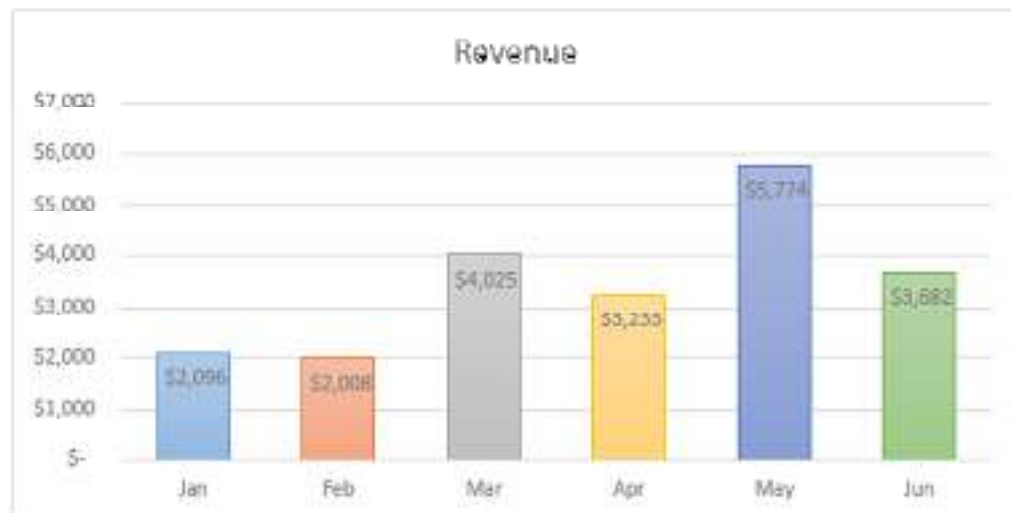
Style 7: To Apply Light Gridlines.

This style will apply light grid lines to the chart.
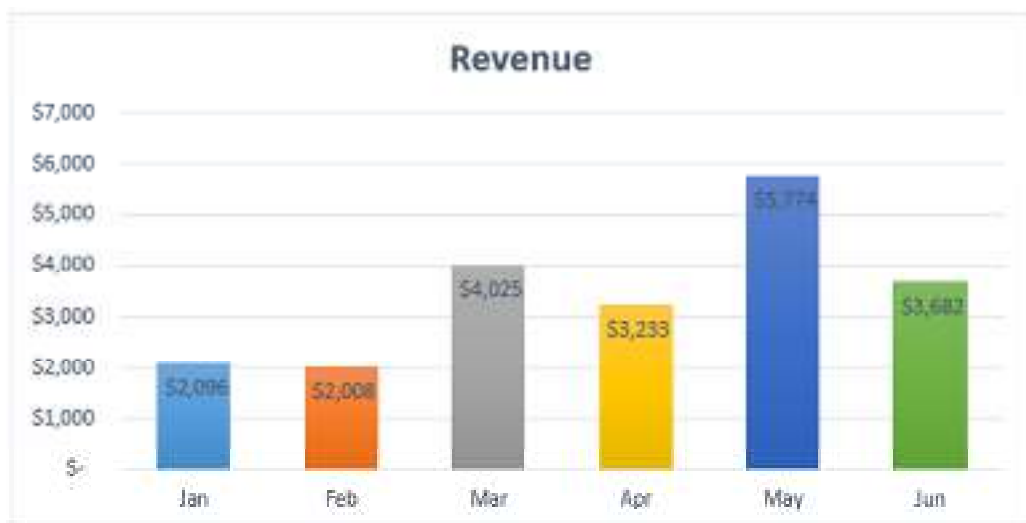
Style 8: To Apply rectangular Gridlines.

This style will apply a rectangular box type of gridline with shades.
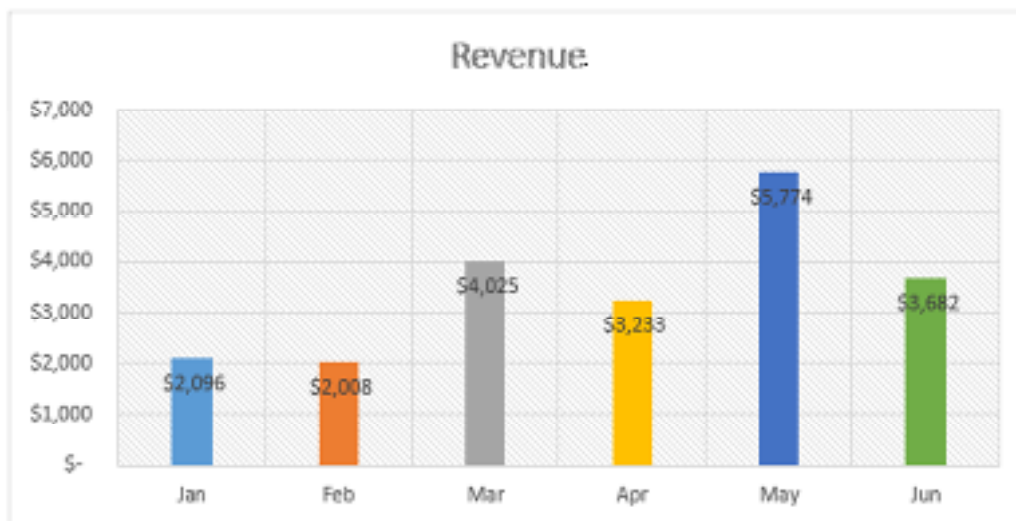
Style 9: To Apply Black Background.

This style will apply a dark black colored background.

Style 10: To Apply Smoky Bottom to the Column Bars.

This style will apply the bottom of each column bar as smoky.
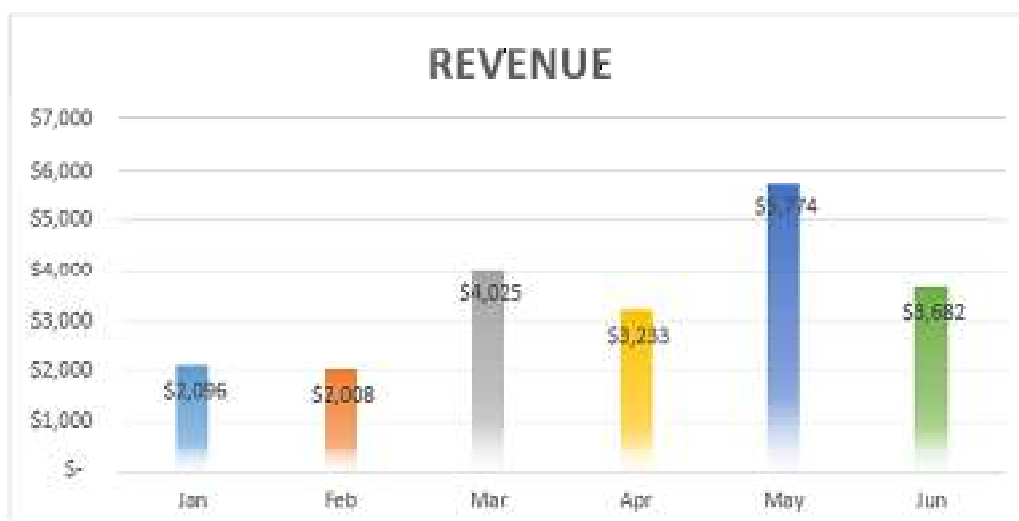
Style 11: Apply only borders to the Column Bars.

This style will apply only outside borders to the column bars.
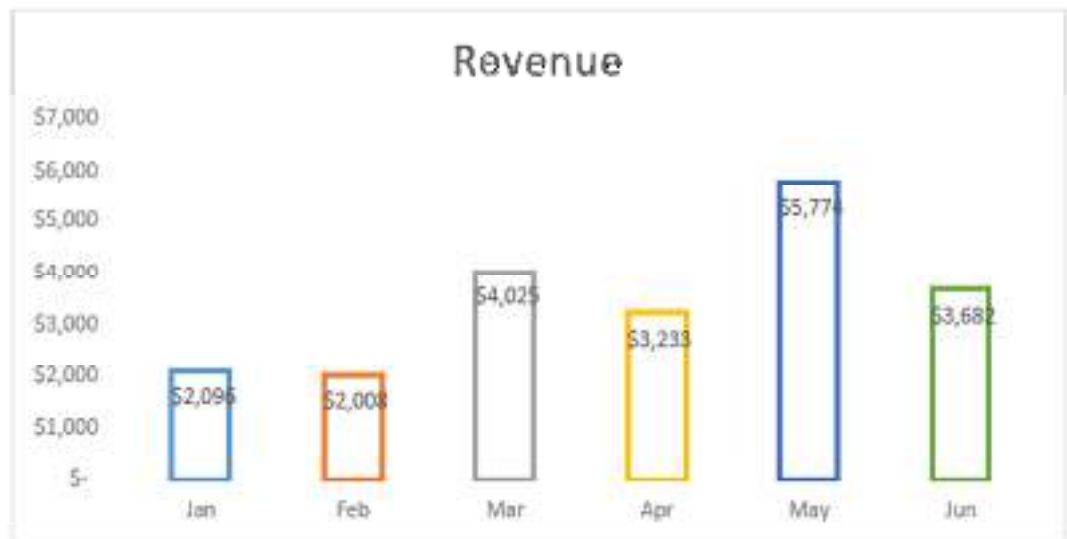
Style 12: Similar to Style 1.

This style is similar to "Style 1."
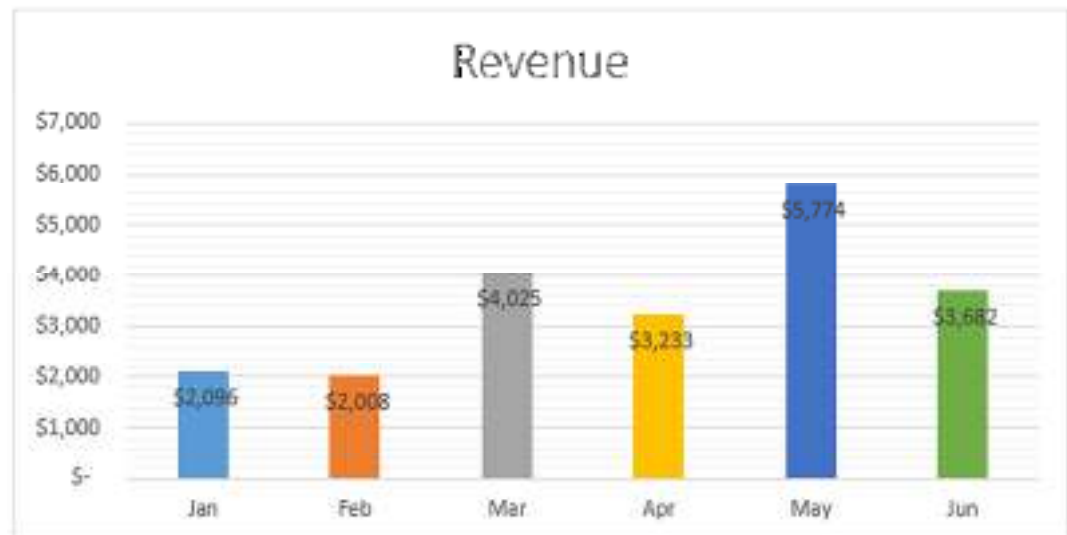
Style 13: To Apply Classy Style Type 1

This style will make the chart more beautiful, as shown below.

Style 14: To Apply Classy Style Type 2

This style will make the chart more beautiful, as below.
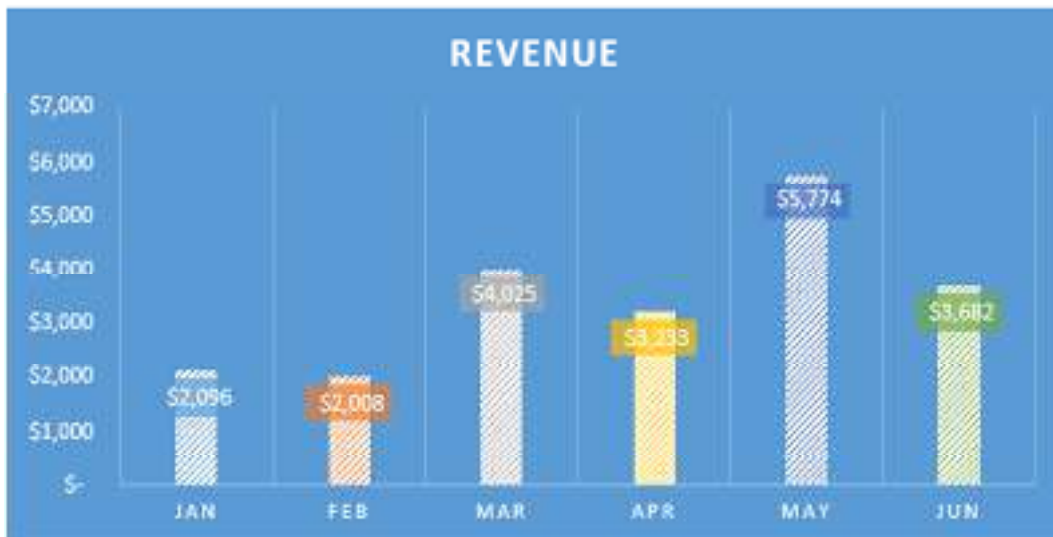
Style 15: To Apply Increased bar without Gridlines

This style will remove gridlines but increase the width of the column bars.
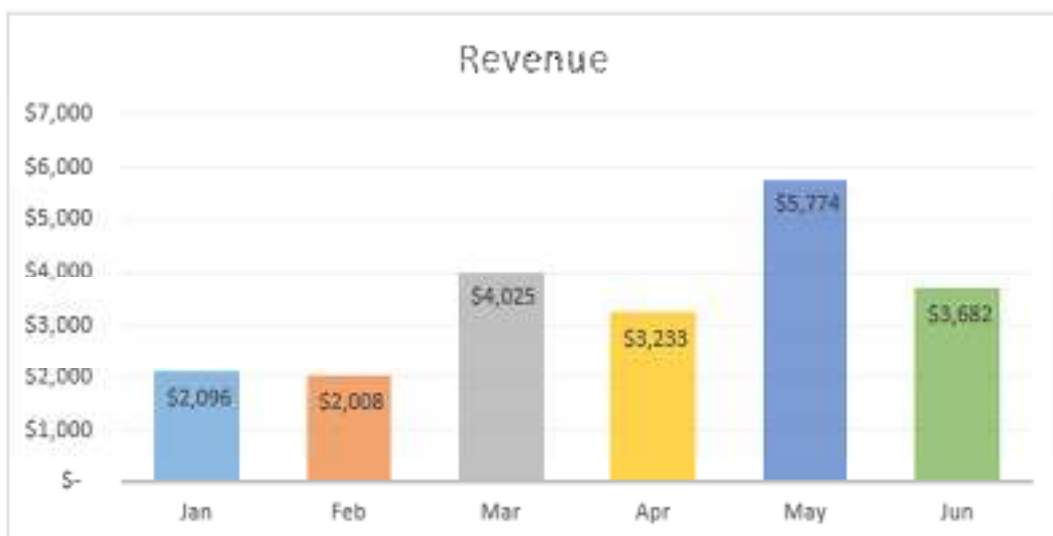
Style 16: To Apply Intense Effect to the Column Bars

This style will apply the "Intense Effect" to the column bars.
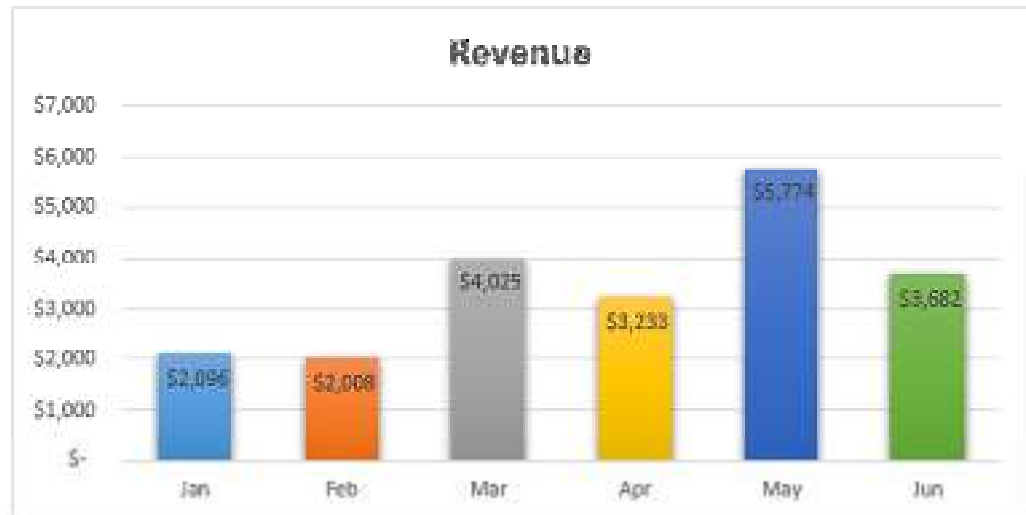
7.4   Modification in Chart Elements

After you have created a chart in Excel, what's the first thing you usually want to do with it? Make the graph look exactly the way you've pictured it in your mind!

In modern versions of Excel, customizing charts is easy and fun. Microsoft has really made a big effort to simplify the process and place the customization options within easy reach.

How to add title to Excel chart

This section demonstrates how to insert the chart title in different Excel versions so that you know where the main chart features reside. And for the rest of the tutorial, we will focus on the most recent versions of Excel.

Add title to chart in Excel

In Excel 2013 - 365, a chart is already inserted with the default "*Chart Title*". To change the title text, simply select that box and type your title:

You can also link the chart title to some cell on the sheet, so that it gets updated automatically every time the liked cell is updated. The detailed steps are explained in Linking axis titles to a certain cell on the sheet.

If for some reason the title was not added automatically, then click anywhere within the graph for the Chart Tools tabs to appear. Switch to the *Design* tab, and click *Add Chart Element* > *Chart*

Title > Above   *Chart*   *I* (or *Centered*   *Overlay*).
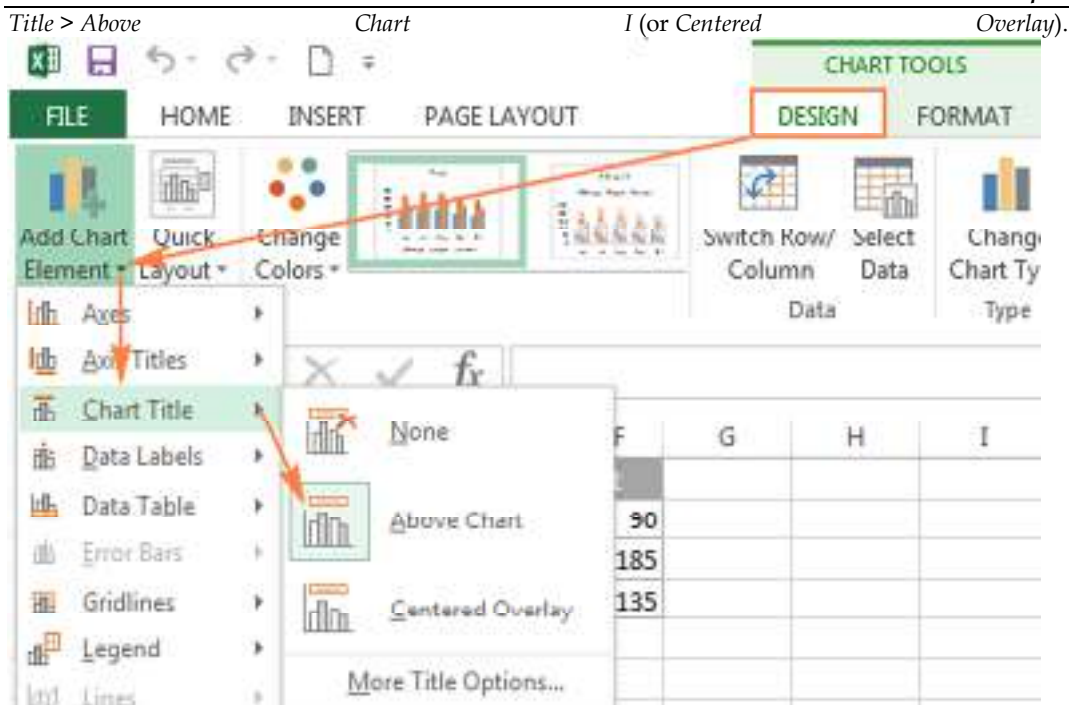
Or, you can click the Chart Elements button in the upper-right corner of the graph, and put a tick in the **Chart Title** checkbox.
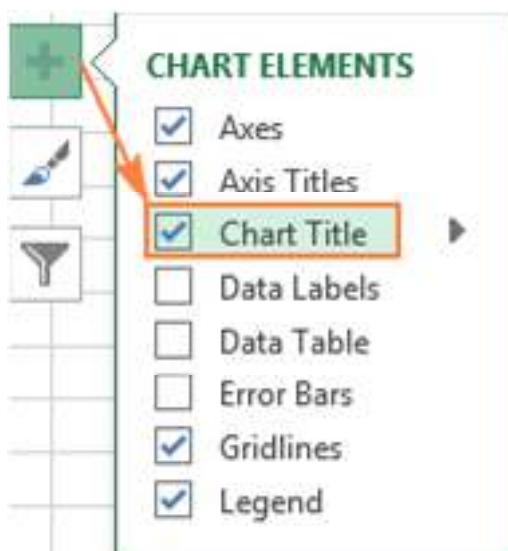
Additionally, you can click the arrow next to Chart Title and chose one of the following options:

- *Above Chart* - the default option that displays the title at top of the chart area and changes the graph's size.

- *Centered Overlay* - overlays the centered title on the chart without resizing the graph.

For more options, go to the Design tab > Add Chart Element > Chart Title > More Options.

Or, you can click the Chart Elements button and click Chart Title > More Options…

Clicking the *More Options* item (either on the ribbon or in the context menu) opens the Format Chart Title pane on the right side of your worksheet, where you can select the formatting options of your choosing.

Add title to chart in Excel 2010 and Excel 2007

To add a chart title in Excel 2010 and earlier versions, execute the following steps.

1. Click anywhere within your Excel graph to activate the Chart Tools tabs on the ribbon.

2. On the *Layout* tab, click Chart Title > *Above Chart* or *Centered Overlay*.
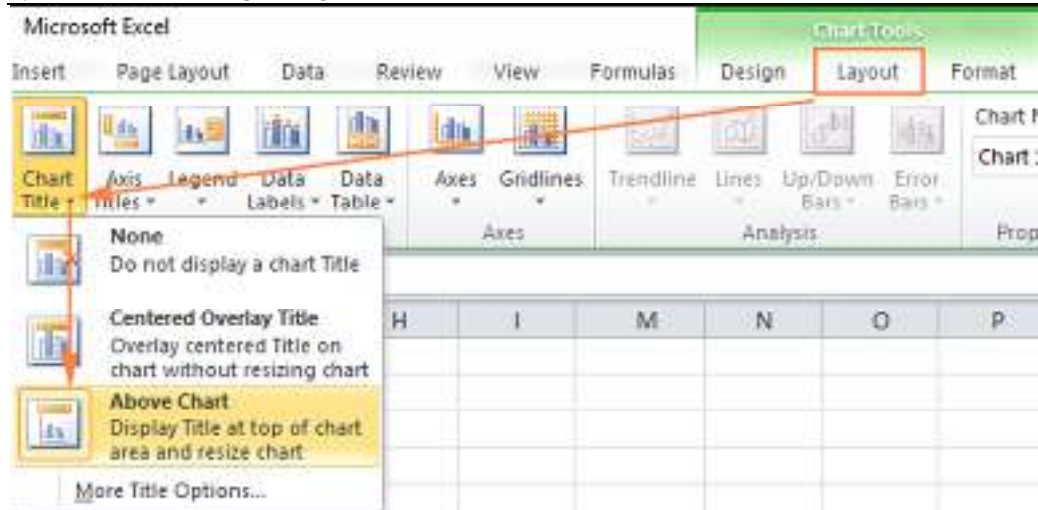
Link the chart title to some cell on the worksheet

For most Excel chart types, the newly created graph is inserted with the default Chart Title placeholder. To add your own chart title, you can either select the title box and type the text you want, or you can link the chart title to some cell on the worksheet, for example the table heading. In this case, the title of your Excel graph will be updated automatically every time you edit the linked cell.

To link a chart title to a cell, perform the following steps:

1. Select the chart title.

2. On your Excel sheet, type an equal sign (=) in the formula bar, click on the cell that contains the needed text, and press Enter.

In this example, we are linking the title of our Excel pie chart to the merged cell A1. You can also select two or more cells, e.g. a couple of column headings, and the content of all selected cells will appear in the chart title.
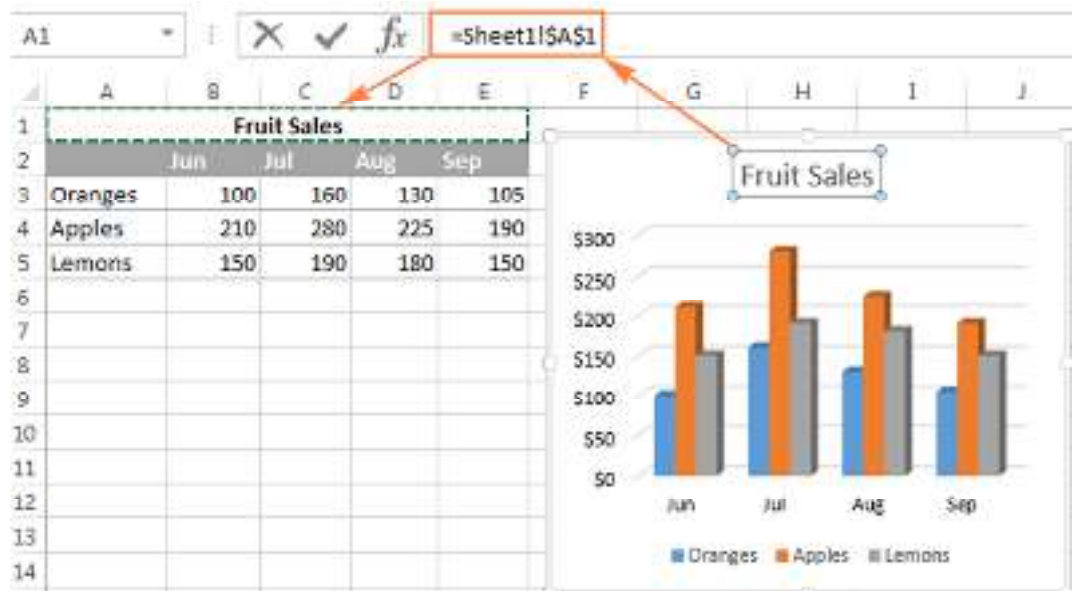
Move the title within the chart

If you want to move the title to a different place within the graph, select it and drag using the mouse:
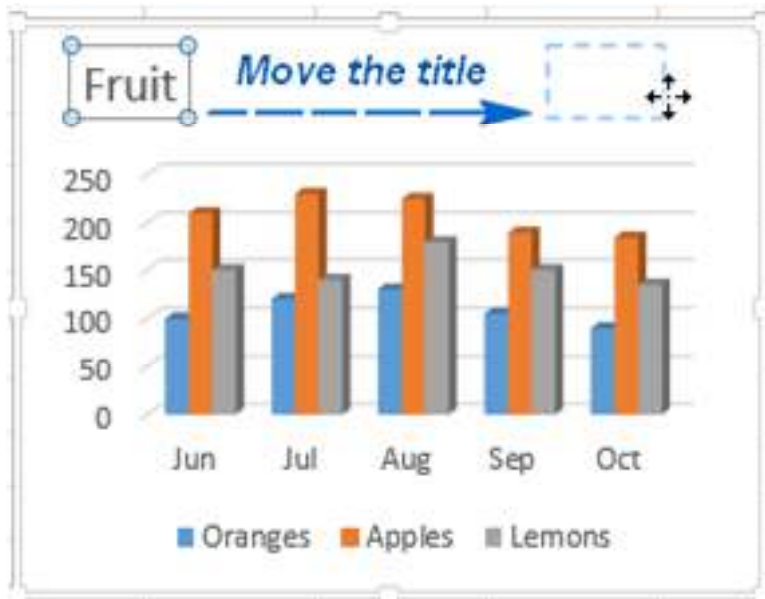
Remove the chart title

If you don't want any title in your Excel graph, you can delete it in two ways:

- On the Design tab, click Add Chart Element > Chart Title > None.
- On the chart, right-click the chart title, and select Delete in the context menu.
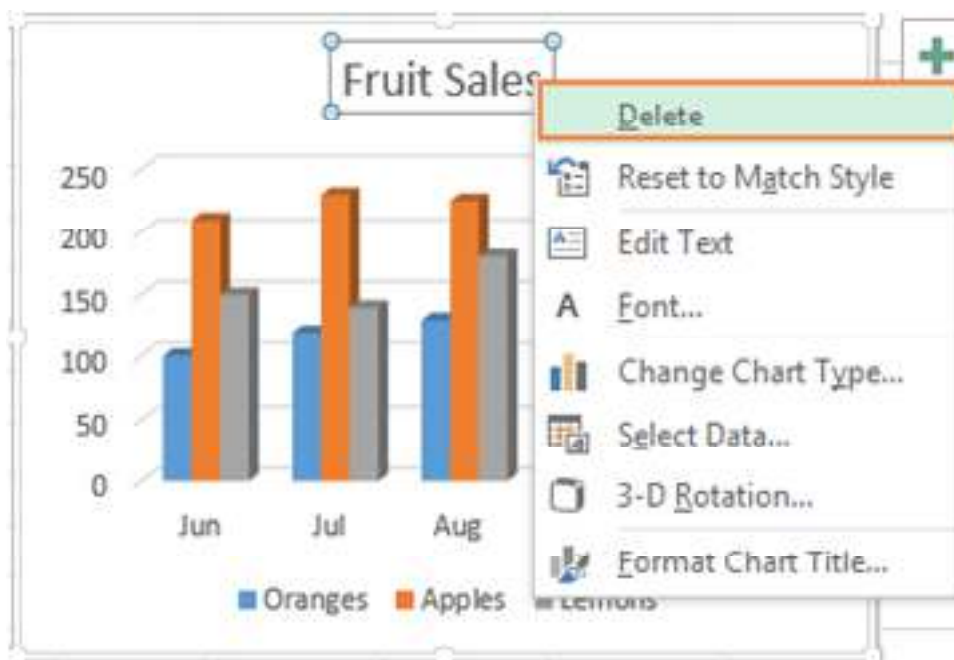
Change font and formatting of chart title

To change the font of the chart title in Excel, right-click the title and choose Font in the context menu. The Font dialog window will pop up where you can choose different formatting options.
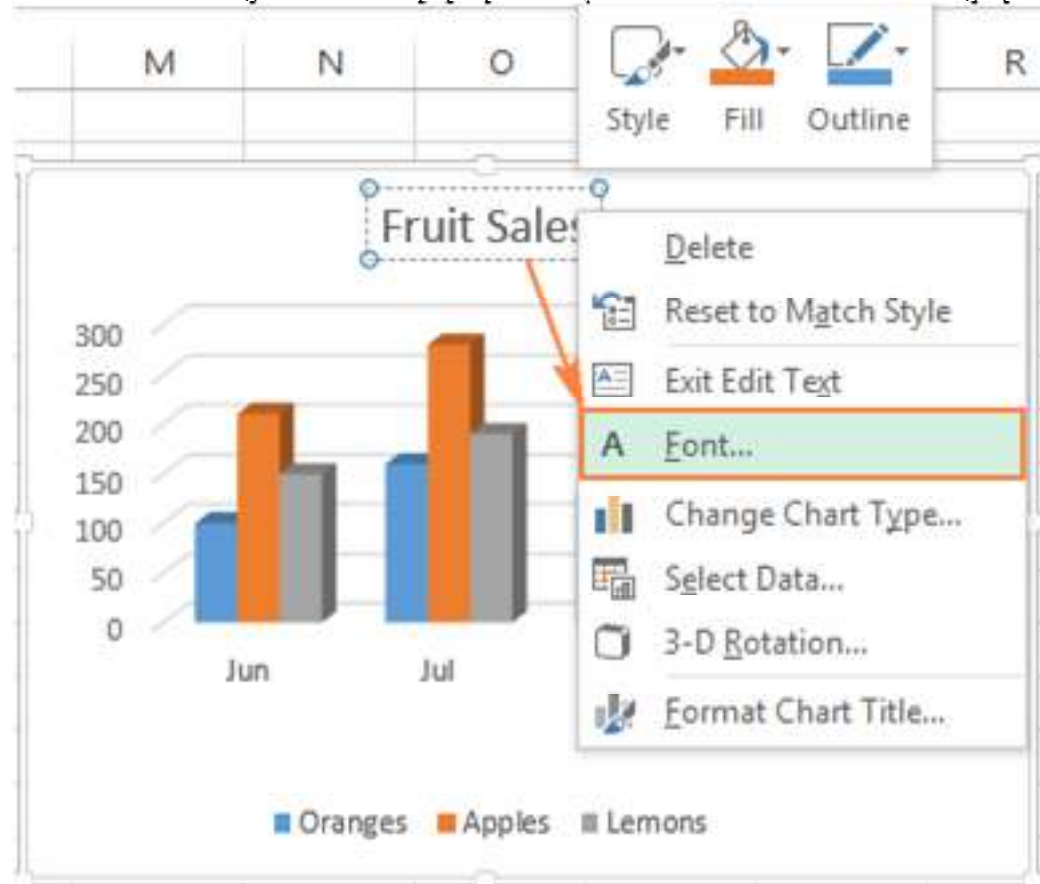
For more formatting options, select the title on your chart, go to the Format tab on the ribbon, and play with different features. For example, this is how you can change the title of your Excel graph using the ribbon:
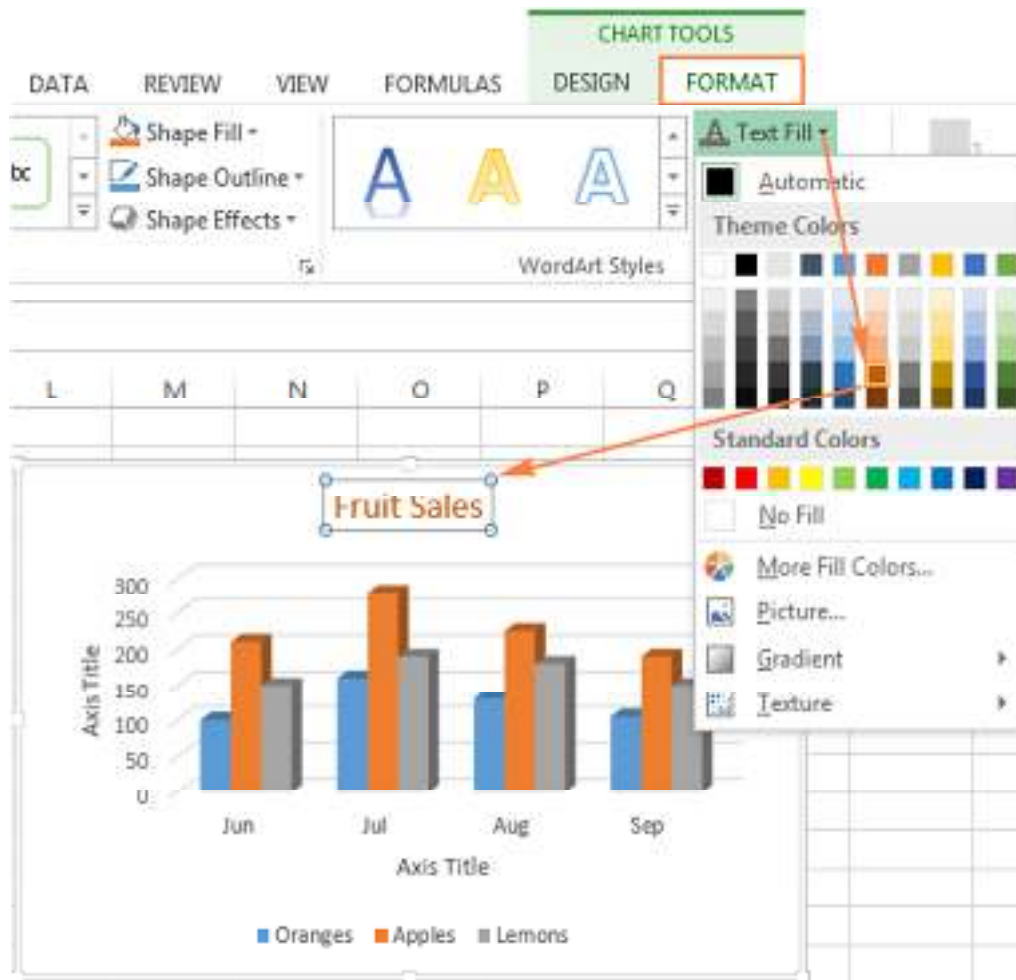
In the same way, you can change the formatting of other chart elements such as axis titles, axis labels and chart legend.

For more information about chart title, please see How to add titles to Excel charts.

Customizing axes in Excel charts

For most chart types, the vertical axis (aka value or Y axis) and horizontal axis (aka category or X axis) are added automatically when you make a chart in Excel.

You can show or hide chart axes by clicking the *Chart Elements* button [+], then clicking the arrow next to Axes, and then checking the boxes for the axes you want to show and unchecking those you want to hide.

For some graph types, such as combo charts, a secondary axis can be displayed:

Spreadsheet Modelling (Using Excel)

When creating 3-D charts in Excel, you can make the depth axis to appear:
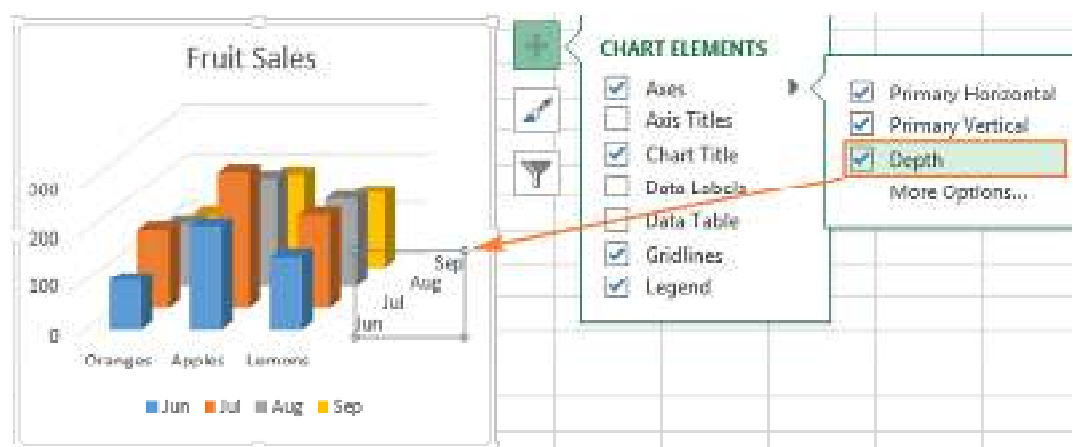
You can also make different adjustments to the way that different axis elements are displayed in your Excel graph (the detailed steps follow below):
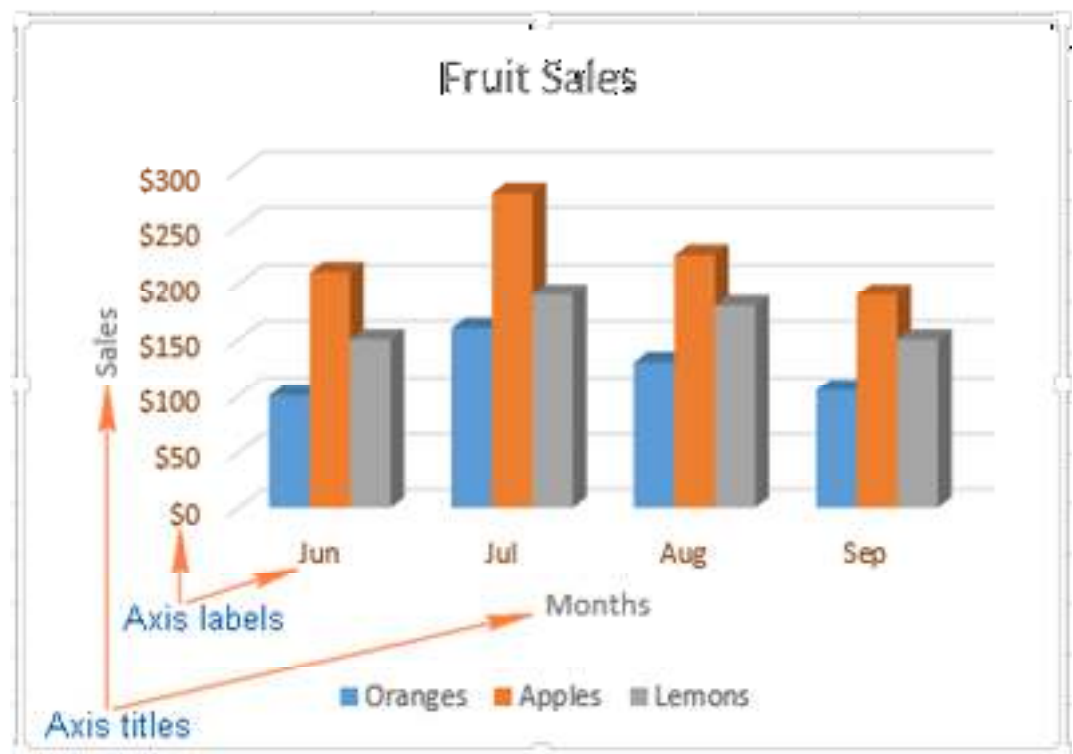
Add axis titles to a chart

When creating graphs in Excel, you can add titles to the horizontal and vertical axes to help your users understand what the chart data is about. To add the axis titles, do the following:

1. Click anywhere within your Excel chart, then click the *Chart Elements* button and check the Axis Titles box. If you want to display the title only for one axis, either horizontal or vertical, click the arrow next to *Axis Titles* and clear one of the boxes:
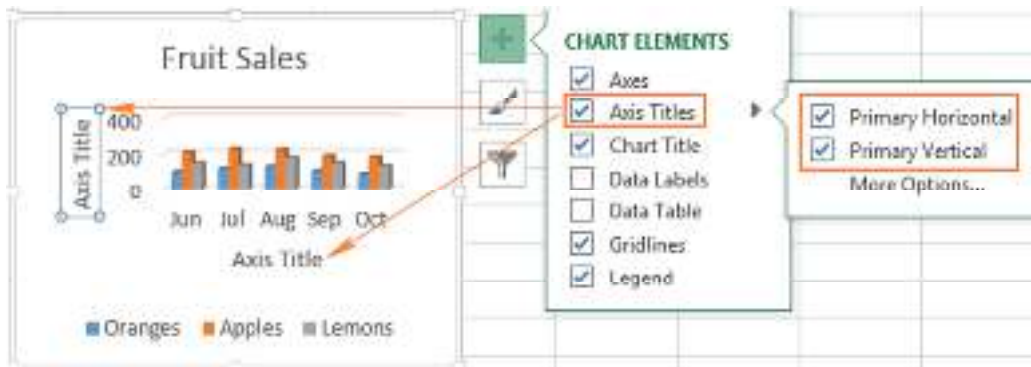
2. Click the axis title box on the chart, and type the text.

To format the axis title, right-click it and select *Format Axis Title* from the context menu. The *Format Axis Title* pane will appear with lots of formatting options to choose from. You can also try different formatting options on the Format tab on the ribbon, as demonstrated in <u>Formatting the chart title</u>.

Link axis titles to a certain cell on the sheet

As is the case with chart titles, you can link an axis title to some cell on your worksheet to have it automatically updated every time you edit the corresponding cells on the sheet.

Spreadsheet Modelling (Using Excel)

To link an axis title, select it, then type an equal sign (=) in the formula bar, click on the cell you want to link the title to, and press the Enter key.
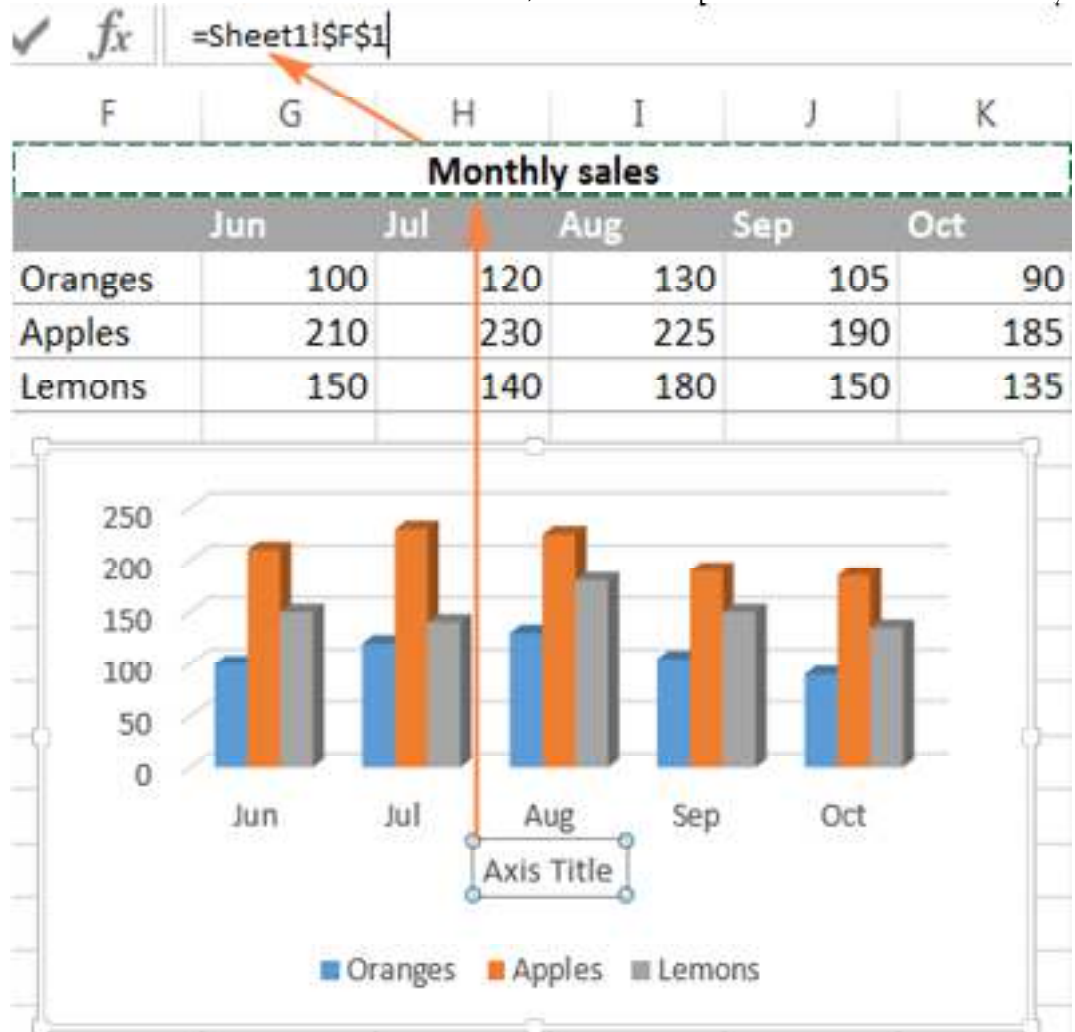
Change the axis scale in the chart

Microsoft Excel automatically determines the minimum and maximum scale values as well as the scale interval for the vertical axis based on the data included in the chart. However, you can customize the vertical axis scale to better meet your needs.

1. Select the vertical axis in your chart, and click the *Chart Elements* button .

2. Click the arrow next to *Axis*, and then click *More options…* This will bring up the *Format Axis* pane.

3. On the *Format Axis* pane, under *Axis Options,* click the value axis that you want to change and do one of the following:

   - To set the starting point or ending point for the vertical axis, enter the corresponding numbers in the *Minimum* or *Maximum*

   - To change the scale interval, type your numbers in the *Major* unit box or *Minor* unit box.

   - To reverse the order of the values, put a tick in the *Values in reverse order* box.

Format Axis ▼

AXIS OPTIONS ▼   TEXT OPTIONS

◇ ⬠ 🖽 ᖰ�ᖭ

◢ **AXIS OPTIONS**

Bounds

| Minimum | 0.0 | Auto |
| Maximum | 300.0 | Auto |

Set starting and ending points ←

Units

| Major | 50.0 | Auto |
| Minor | 10.0 | Auto |

Change scale interval ←

Floor crosses at

⦿ Automatic
◯ Axis value   0.0
◯ Maximum axis value

Display units   None   ▼

☐ Show display units label on chart

☐ Logarithmic scale   Base   10

☐ Values in reverse order   ← *Reverse the order of values*

Because a horizontal axis displays text labels rather than numeric intervals, it has fewer scaling options that you can change. However, you can alter the number of categories to display between tick marks, the order of categories, and the point where the two axes cross:

Spreadsheet Modelling (Using Excel)

Format Axis ▾ ✕

AXIS OPTIONS ▾   TEXT OPTIONS

◇ ⬠ ▣ ▊▊

▲ **AXIS OPTIONS**

Axis Type

⦿ Automatically select based on data

◯ Text axis

◯ Date axis

Vertical axis crosses

◯ Automatic

⦿ At category number | 1 |

◯ At maximum category

Axis position

☐ Categories in reverse order

▲ **TICK MARKS**

Interval between marks | 2 |

Major type | Outside ▾ |

Minor type | None ▾ |

Change the format of axis values

If you want the numbers of the value axis labels to display as currency, percentage, time or in some other format, right-click the axis labels, and choose *Format Axis* in the context menu. On the *Format Axis* pane, click Number and choose one of the available format options:
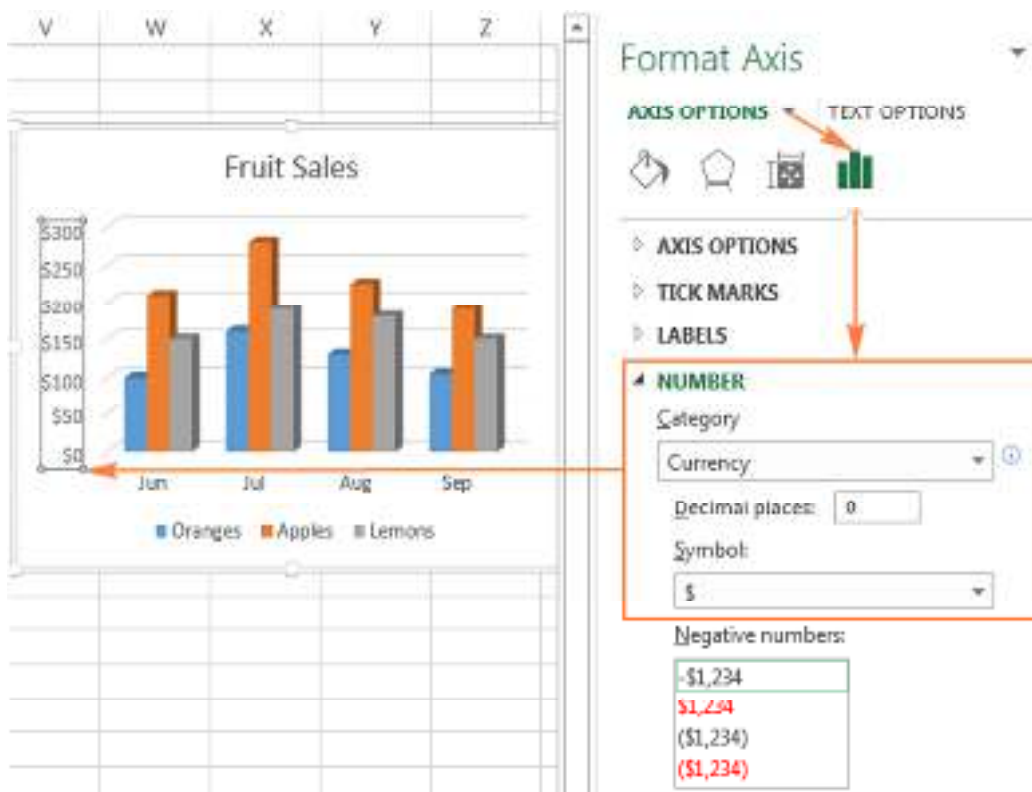
Tip. To revert back to the original number formatting (the way the numbers are formatted in your worksheet), check the *Linked to source* box.

If you don't see the *Number* section in the *Format Axis* pane, make sure you've selected a value axis (usually the vertical axis) in your Excel chart.

Adding data labels to Excel charts

To make your Excel graph easier to understand, you can add data labels to display details about the data series. Depending on where you want to focus your users' attention, you can add labels to one data series, all the series, or individual data points.

1. Click the data series you want to label. To add a label to one data point, click that data point after selecting the series.
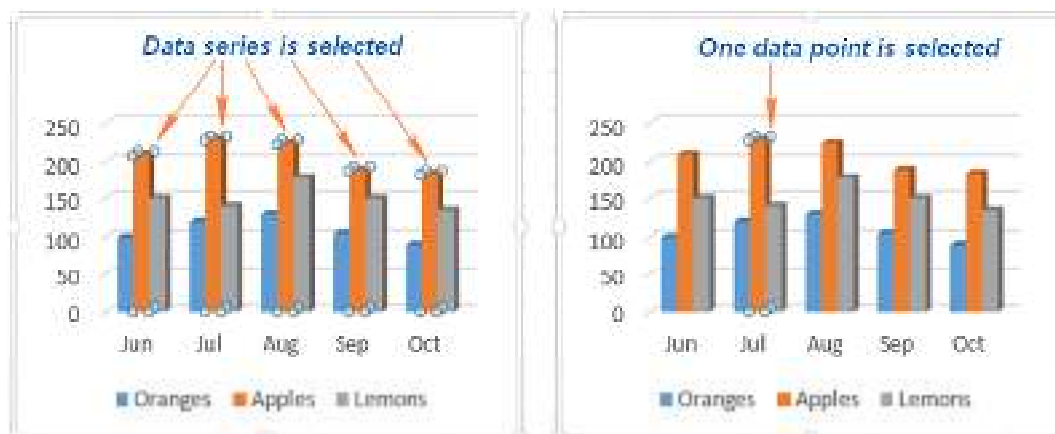
2. Click the *Chart Elements* button, and select the *Data Labels* option.

For example, this is how we can add labels to one of the data series in our Excel chart:

Spreadsheet Modelling (Using Excel)
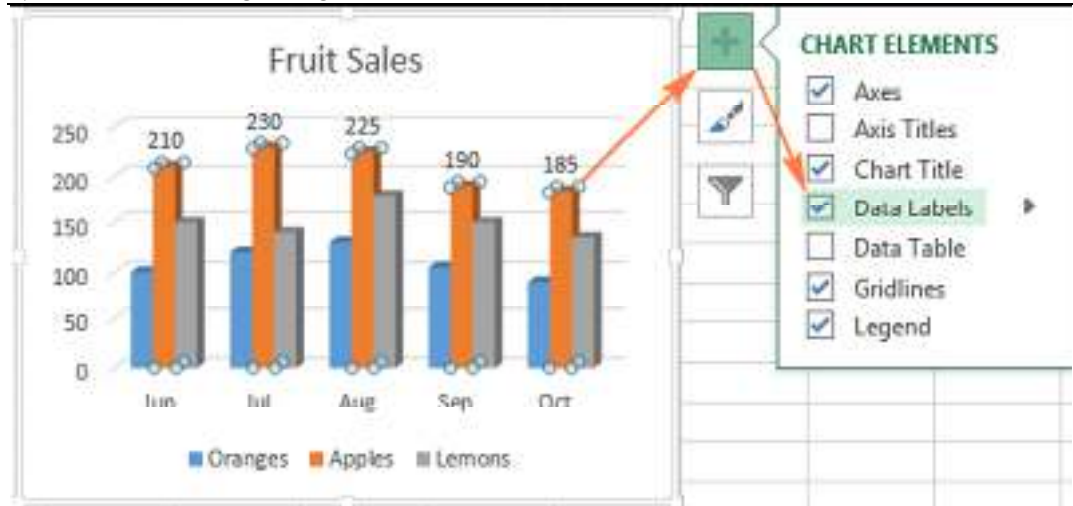
For specific chart types, such as pie chart, you can also choose the labels location. For this, click the arrow next to *Data Labels*, and choose the option you want. To show data labels inside text bubbles, click *Data Callout*.
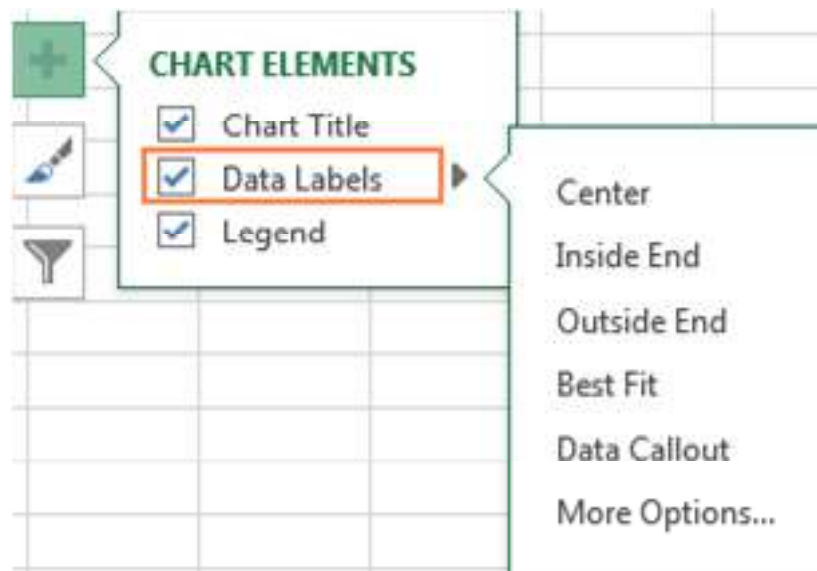
How to change data displayed on labels

To change what is displayed on the data labels in your chart, click the *Chart Elements* button > *Data Labels* > *More options…* This will bring up the *Format Data Labels* pane on the right of your worksheet. Switch to the *Label Options* tab, and select the option(s) you want under *Label Contains*:
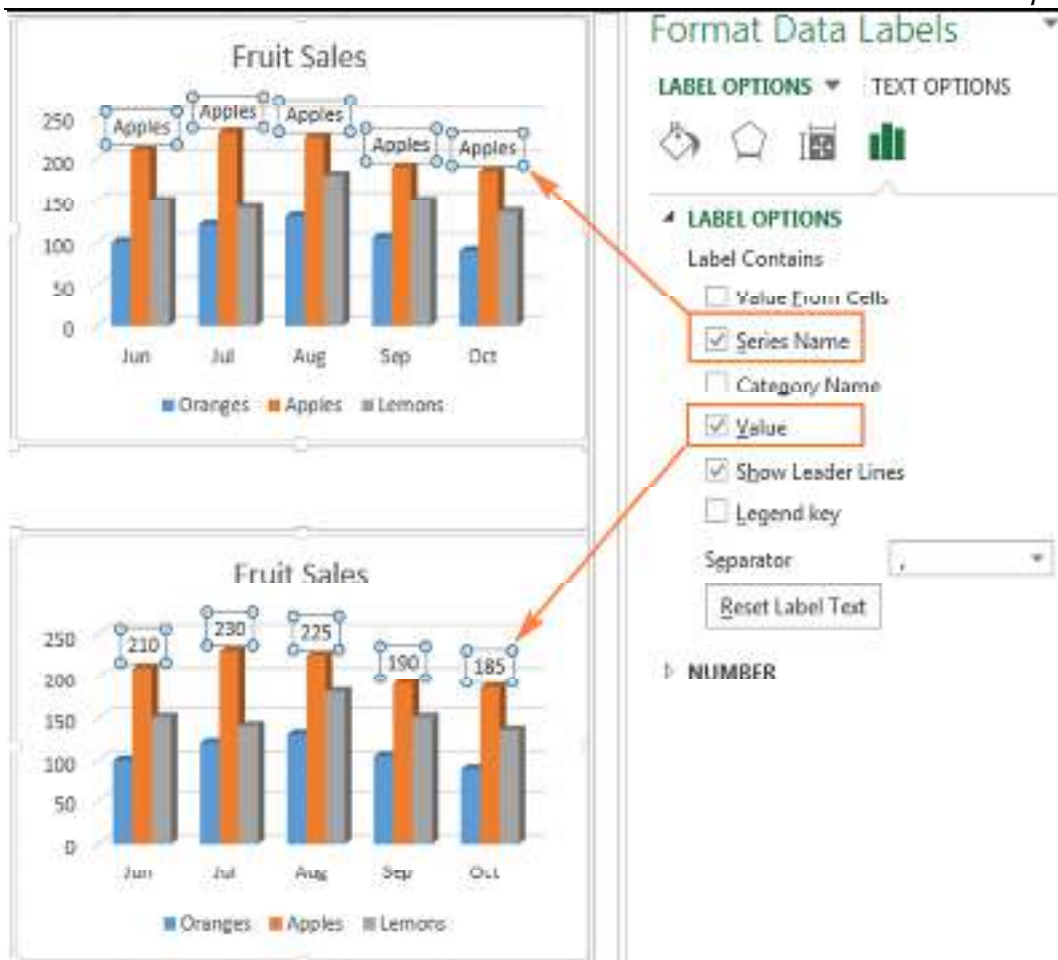
If you want to add your own text for some data point, click the label for that data point and then click it again so that only this label is selected. Select the label box with the existing text and type the replacement text:
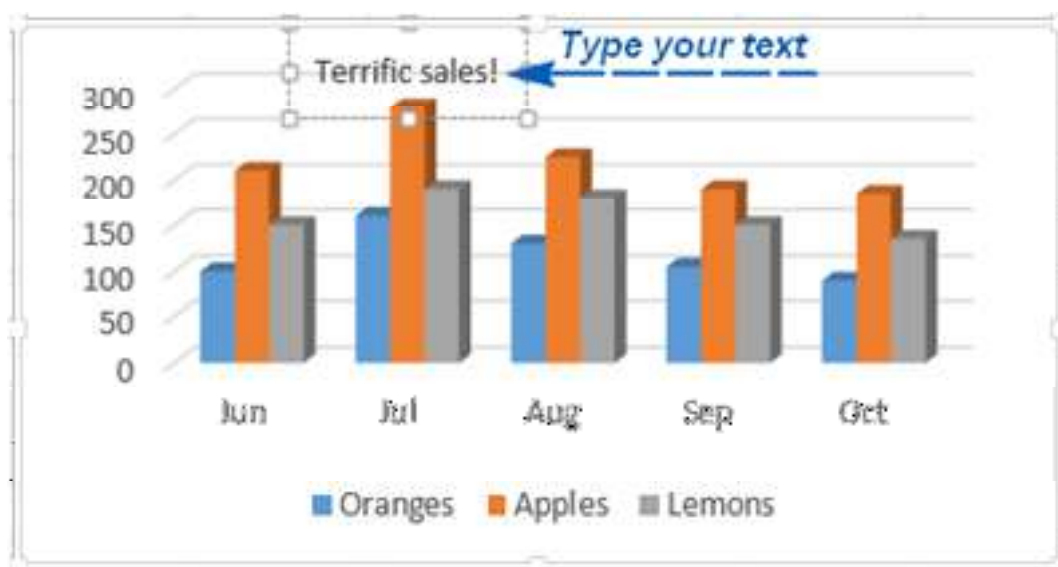
If you decide that too many data labels clutter your Excel graph, you can remove any or all of them by right-clicking the label(s) and selecting Delete from the context menu.

Data label tips:

- To change the position of a given data label, click it and drag to where you want using the mouse.

Spreadsheet Modelling (Using Excel)

- To change the labels' font and background color, select them, go to the *Format* tab on the ribbon, and choose the formatting options you want.

Moving, formatting or hiding the chart legend

When you create a chart in Excel, the default legend appears at the bottom of the chart, and to the right of the chart in Excel 2010 and earlier versions.

To hide the legend, click the *Chart Elements* button ![plus icon] in the upper-right corner of the chart and uncheck the Legend box.

To move the chart legend to another position, select the chart, navigate to the *Design* tab, click *Add Chart Element* > *Legend* and choose where to move the legend. To remove the legend, select *None*.
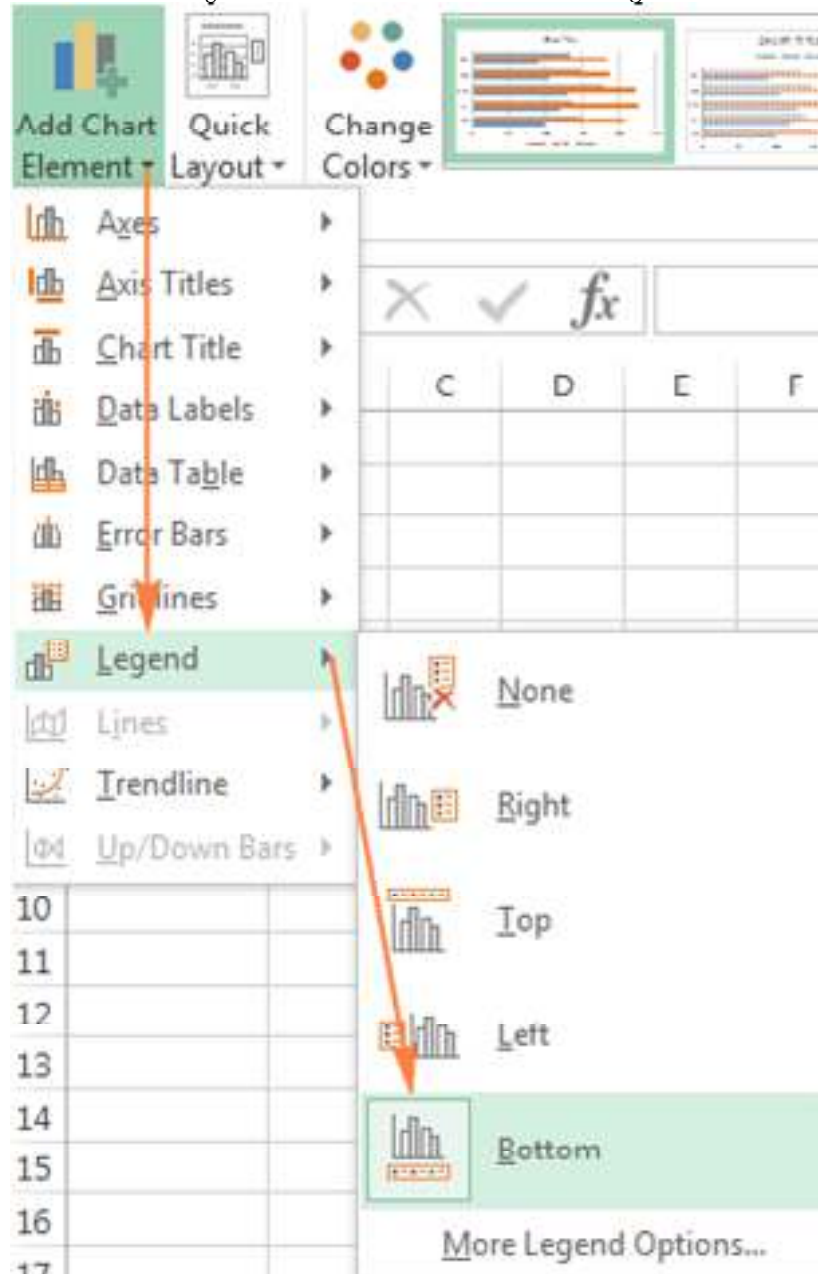
Another way to move the legend is to double-click on it in the chart, and then choose the desired legend position on the *Format Legend* pane under *Legend Options*.
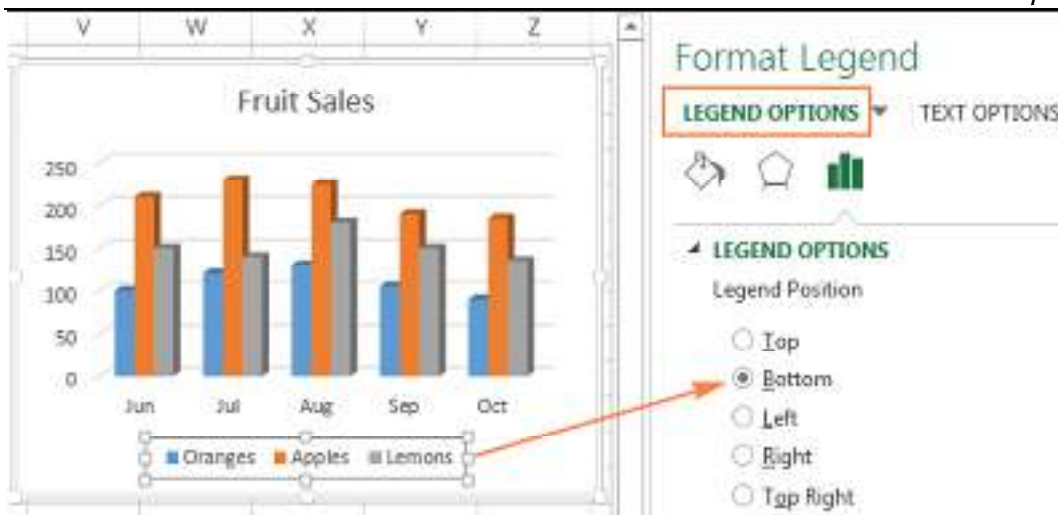
To change the legend's formatting, you have plenty of different options on the *Fill & Line* and *Effects* tabs on the *Format Legend* pane.

Showing or hiding the gridlines on the Excel chart

In Excel 2013, 2016 and 2019, turning the gridlines on or off is a matter of seconds. Simply click the *Chart Elements* button and either check or uncheck the Gridlines box.
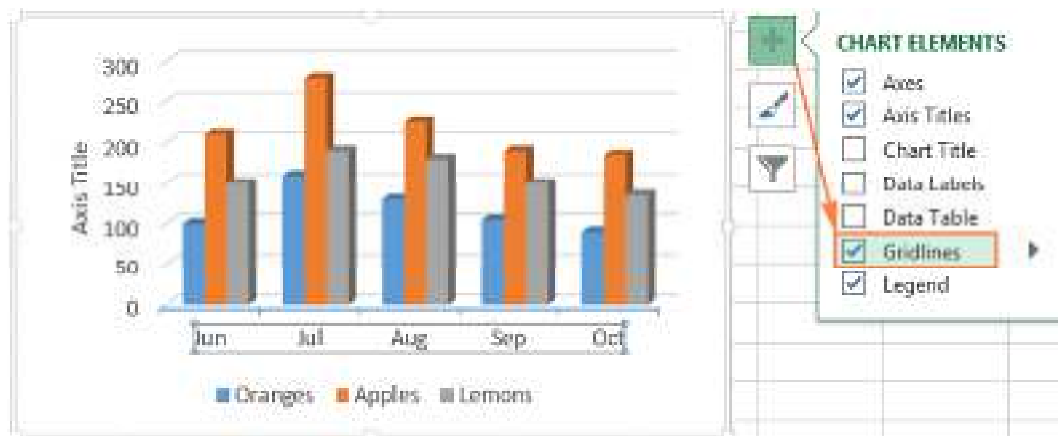
Microsoft Excel determines the most appropriate gridlines type for your chart type automatically. For example, on a bar chart, major vertical gridlines will be added, whereas selecting the Gridlines option on a column chart will add major horizontal gridlines.

To change the gridlines type, click the arrow next to Gridlines, and then choose the desired gridlines type from the list, or click More Options… to open the pane with advanced Major

Spreadsheet Modelling (Using Excel)

Gridlines options.
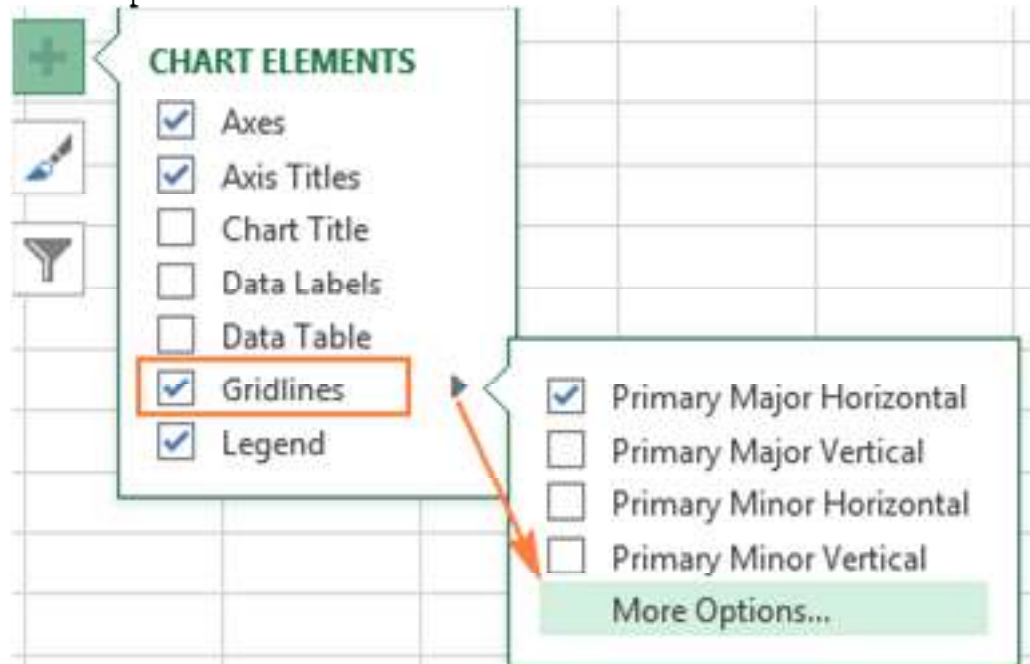
Hiding and editing data series in Excel graphs

When a lot of data is plotted in your chart, you may want to temporary hide some data series so that you could focus only on the most relevant ones.

To do this, click the Chart Filters button [icon] on the right of the graph, uncheck the data series and/or categories you want to hide, and click *Apply*.

To edit a data series, click the *Edit Series* button to the right of the data series. The *Edit Series* button appears as soon as you hover the mouse on a certain data series. This will also highlight the corresponding series on the chart, so that you could clearly see exactly what element you will be

editing.
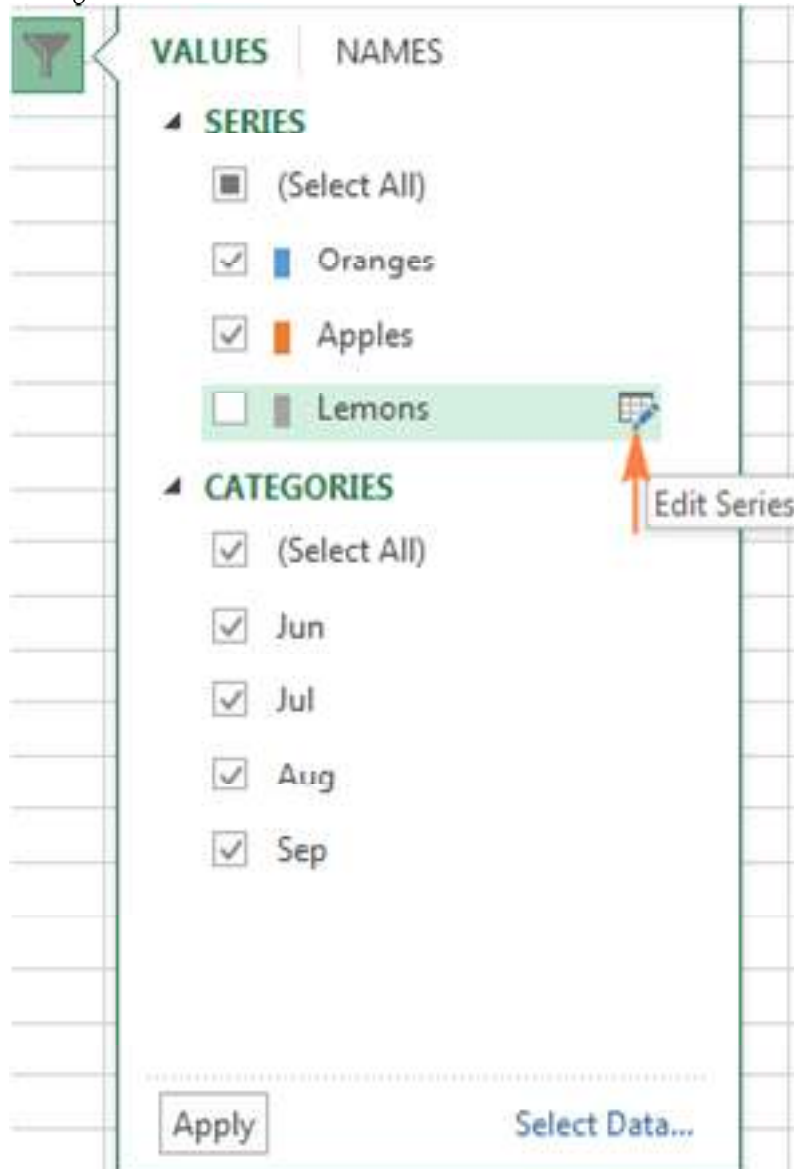
Changing chart type and style

If you decide that the newly created graph is not well-suited for your data, you can easily change it to some other chart type. Simply select the existing chart, switch to the *Insert* tab and choose another chart type in the *Charts* group.

Alternatively, you can right-click anywhere within the graph and select *Change Chart Type…* from the context menu.

Spreadsheet Modelling (Using Excel)
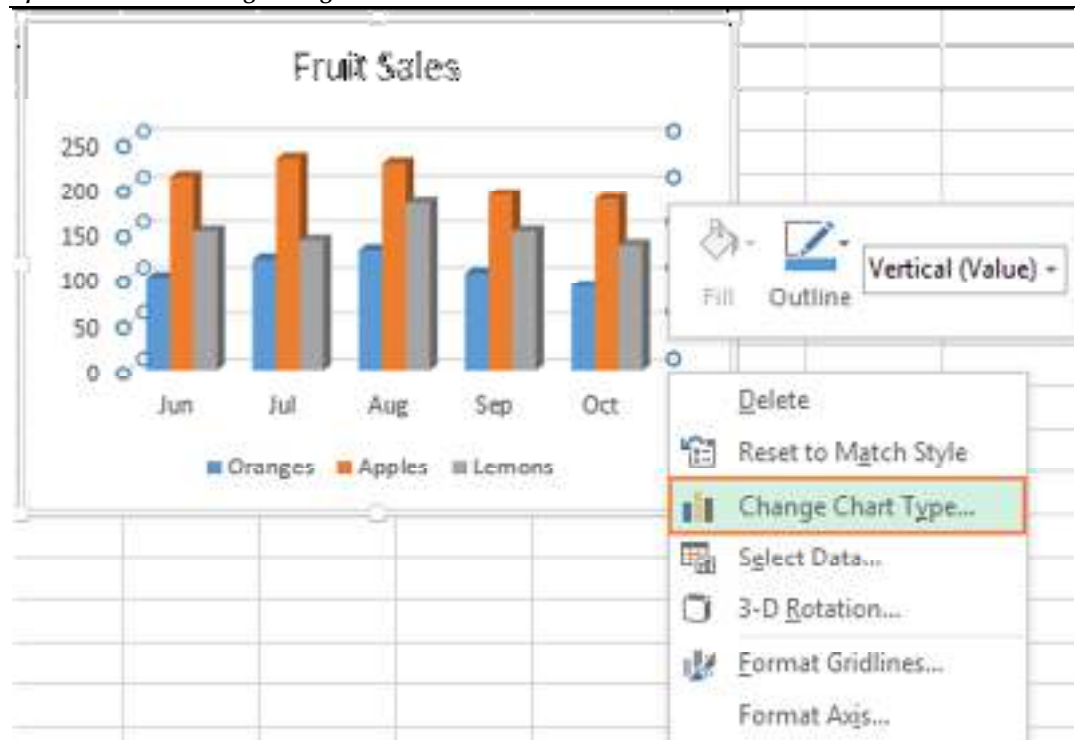
To quickly **change the style** of the existing graph in Excel, click the *Chart Styles* button [icon] on the right of the chart and scroll down to see the other style offerings.

Or, choose a different style in the *Charts Styles* group on the *Design* tab:

Changing chart colors

To change the color theme of your Excel graph, click the Chart Styles button, switch to the Color tab and select one of the available color themes. Your choice will be immediately reflected in the chart, so you can decide whether it will look well in new colors.

To choose the color for each data series individually, select the data series on the chart, go to the *Format* tab > *Shape Styles* group, and click the Shape Fill button:

Spreadsheet Modelling (Using Excel)
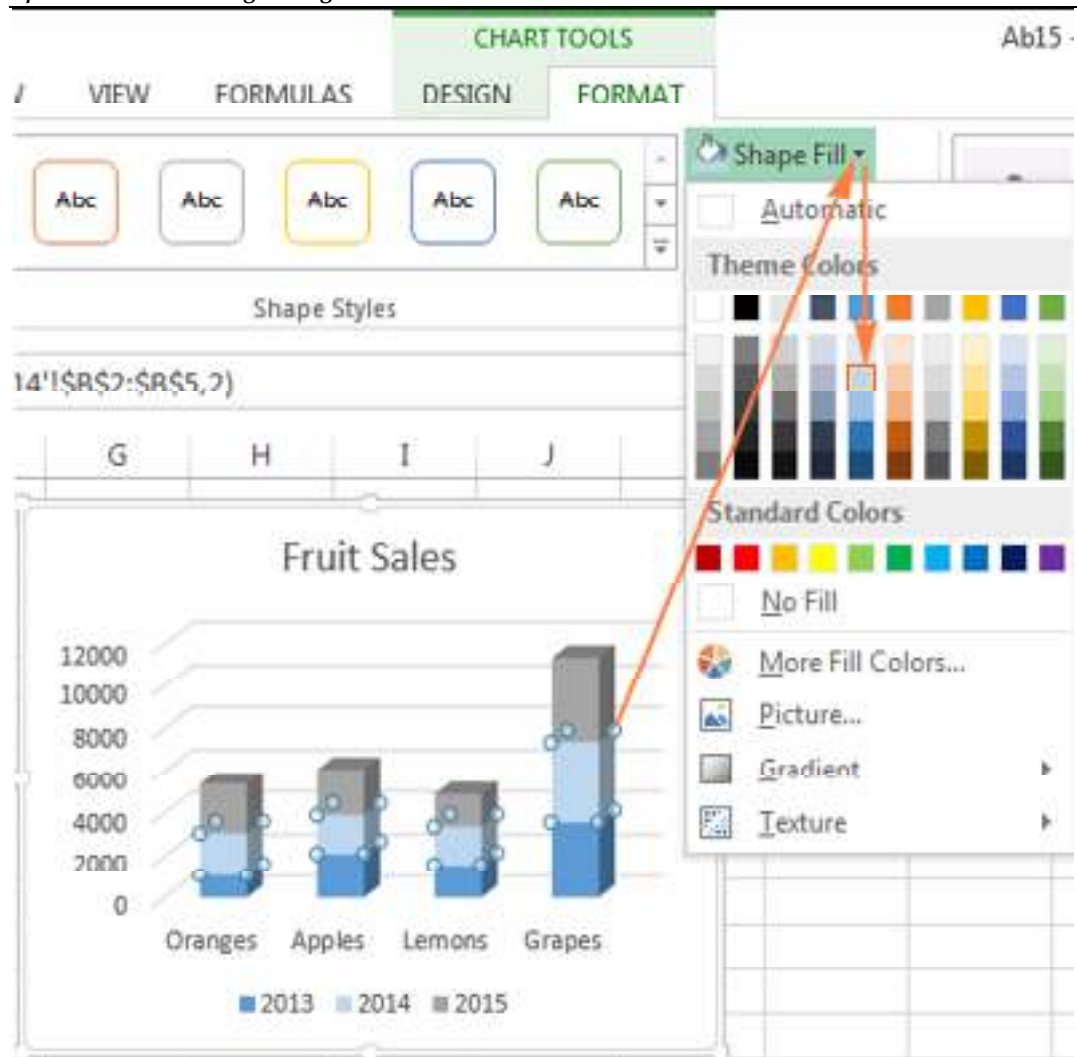
How to swap X and Y axes in the chart

When you make a chart in Excel, the orientation of the data series is determined automatically based on the number of rows and columns included in the graph. In other words, Microsoft Excel plots the selected rows and columns as it considers the best.

If you are not happy with the way your worksheet rows and columns are plotted by default, you can easily swap the vertical and horizontal axes. To do this, select the chart, go to the *Design* tab and

click   the **Switch**   **Row/Column** button.
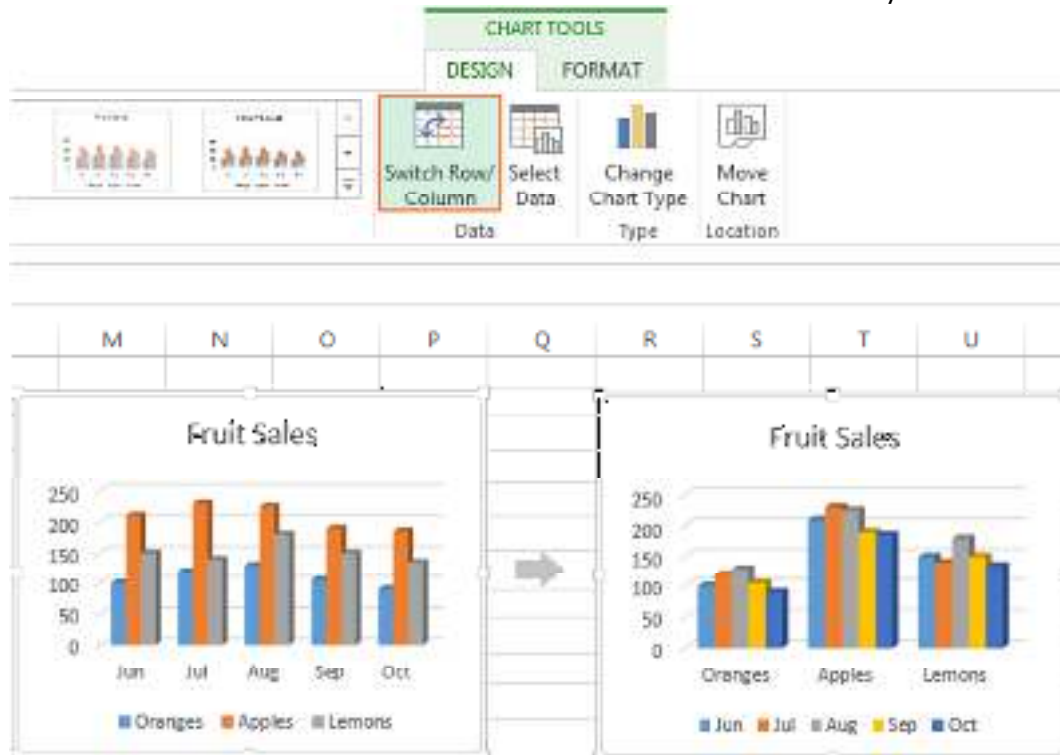
How to flip an Excel chart from left to right

Have you ever made a graph in Excel only to find out that data points appear backwards from what you expected? To rectify this, reverse the plotting order of categories in a chart as shown below.

Right click on the horizontal axis in your chart and select Format Axis... in the context menu.
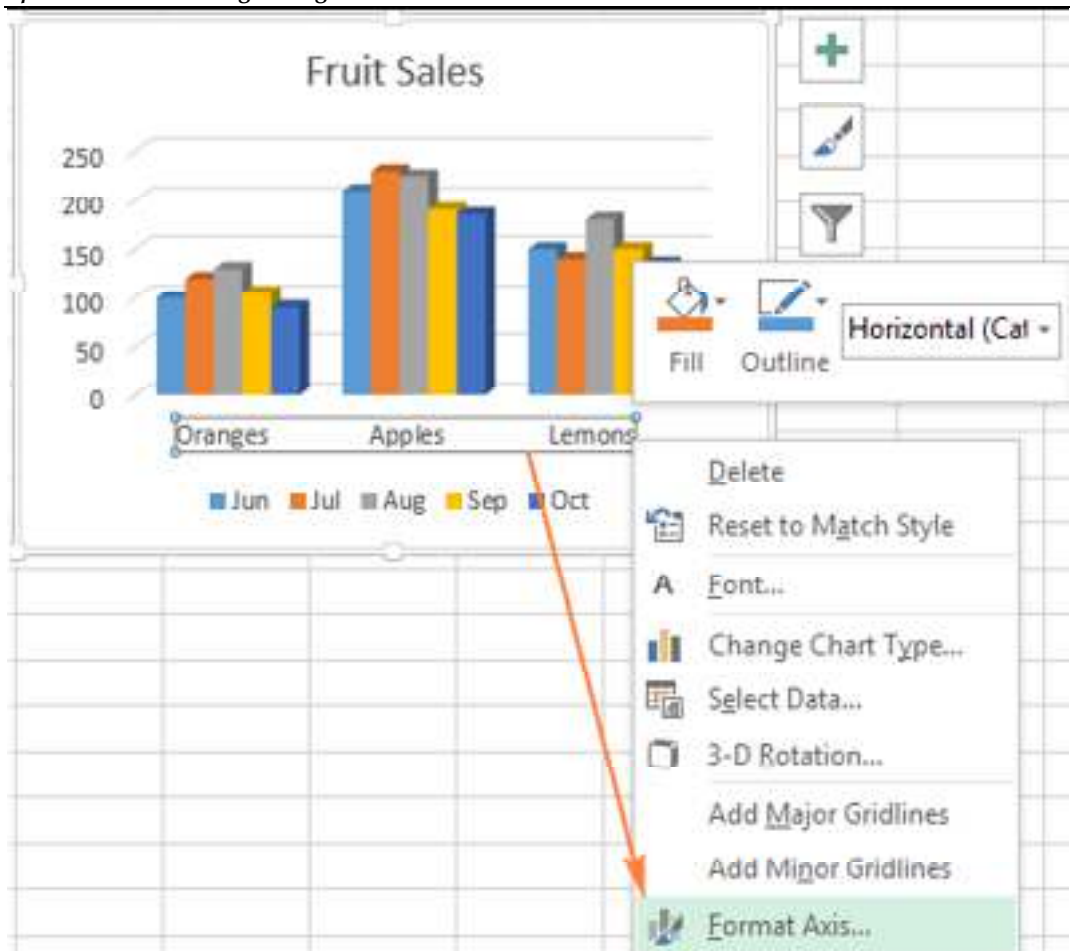
If you prefer working with the ribbon, go to the *Design* tab and click *Add Chart Element > Axes > More Axis Options…*
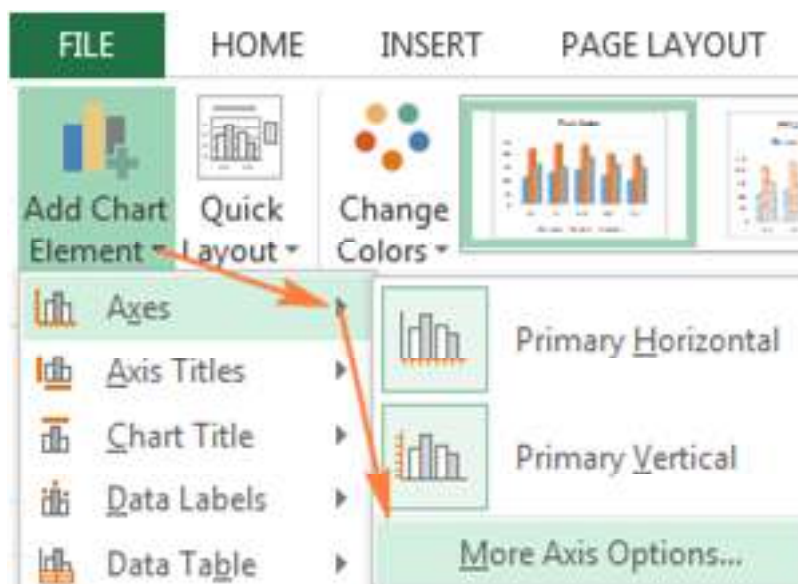
Either way, the *Format Axis* pane will show up, you navigate to the *Axis Options* tab and select the Categories in reverse order option.
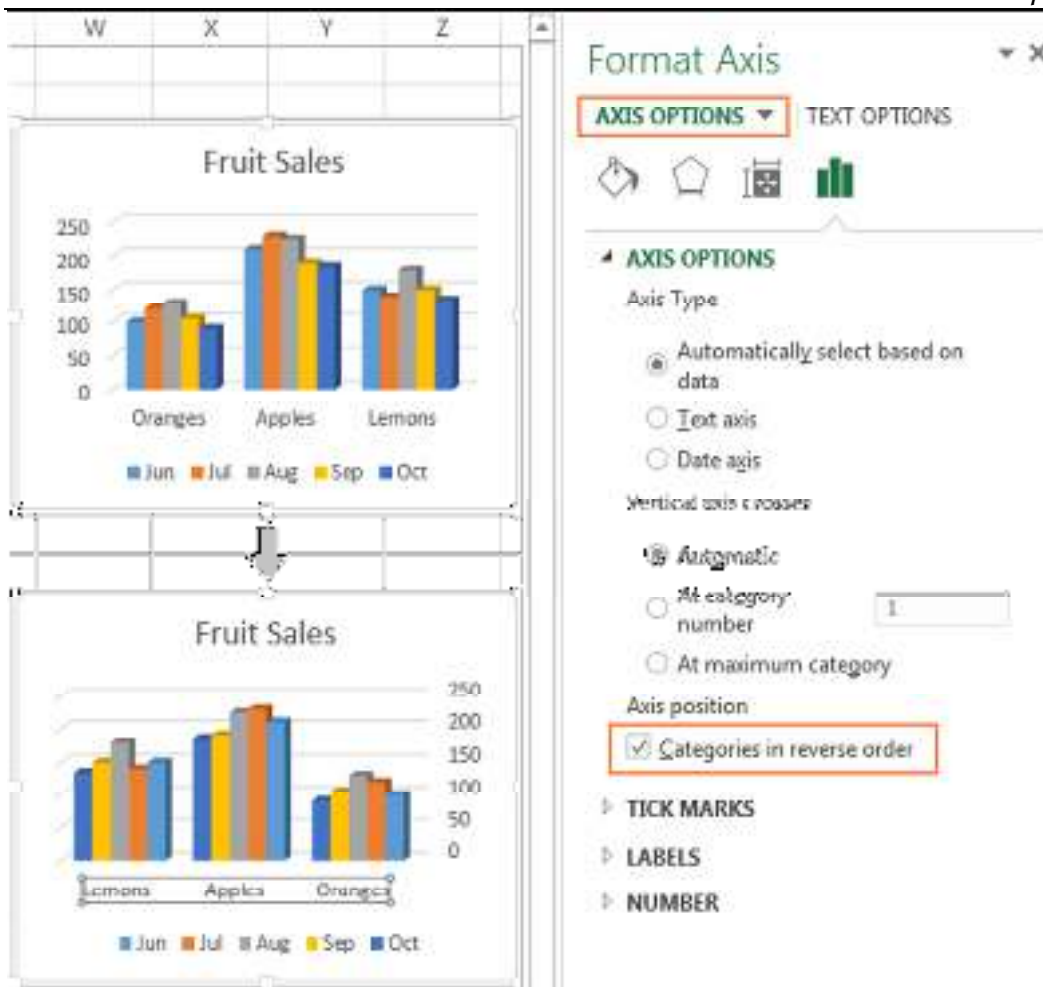
Apart from flipping your Excel chart from left to right, you can also change the order of categories, values, or series in your graph, reverse the plotting order of values, rotate a pie chart to any angle, and more.

Summary

- Basic Chart Types: Excel offers various chart types such as bar charts, line charts, pie charts, and more to represent data visually.

- Inserting Charts: You can insert charts by selecting your data and then going to the "Insert" tab, choosing the desired chart type, and customizing it as needed.

- Moving and Resizing Charts: To reposition a chart, click and drag it to a new location on the worksheet. To resize, click and drag the chart's corner or edge.

- Changing Chart Styles: Excel provides preset chart styles that you can apply to change the appearance of your chart, such as colors and fonts.

- Changing Chart Types: You can switch between chart types easily by selecting the chart and going to the "Design" tab, then choosing a new chart type from the "Change Chart Type" option.

- Modifying Chart Data: To update the data in a chart, you can right-click on the chart and choose "Select Data." This allows you to add or remove data series or edit the data range.

- Formatting Chart Elements: Excel allows you to format specific elements of a chart like titles, axes, data points, and legends. Simply select the element and apply formatting changes.

- Data Labels and Data Tables: You can add data labels to display values on data points or include a data table to show the underlying data in your chart.

- Chart Titles and Axis Labels: Customize the chart title and axis labels to make your chart more informative and visually appealing.

- Legend and Gridlines: You can show or hide the legend, which explains the data series, and gridlines, which aid in reading values on the chart.

Keywords

- Basic Chart Types: Different fundamental visual representations of data, such as bar charts, pie charts, and line charts, used to convey information in Microsoft Excel.

- Move Charts: The action of relocating a chart within an Excel worksheet to a different position, typically to improve layout or visibility.

- Resize Charts: Changing the dimensions of a chart in Excel, either by adjusting its width and height or by scaling it to fit within a specified area.

- Change Chart Styles: Altering the visual appearance of a chart, including its colors, fonts, and other design elements, to better suit the desired presentation.

- Change Chart Types: The process of switching from one chart format to another in Excel, such as changing a bar chart to a line chart or a pie chart to a scatter plot.

- Modification: The act of making adjustments or alterations to various aspects of a chart in Excel, such as data series, titles, labels, or formatting.

- Chart Elements: The individual components that make up a chart, including axes, data points, legends, titles, and other graphical and textual elements used to represent data visually.

- Microsoft Excel: A popular spreadsheet software application developed by Microsoft, widely used for data analysis, organization, and presentation, including the creation of charts and graphs.

- Data Visualization: The practice of presenting data in a visual format, like charts and graphs, to make complex information more accessible and understandable.

- Chart Customization: The ability to personalize the appearance and content of charts in Excel, allowing users to tailor them to specific needs and preferences.

Self Assessment

1. Which of the following is not a basic chart type in Excel?
A. Scatter Plot
B. Gantt Chart
C. Bar Chart
D. Line Chart

2. What is the purpose of moving a chart in Excel?
A. To copy the chart
B. To resize the chart
C. To change its data
D. To change its position on the worksheet

3. How can you resize a chart in Excel?
A. Right-click and select "Resize Chart"
B. Click and drag the chart's corner or edge
C. Use the "Format Chart" dialog box
D. Double-click the chart title

4. Which tab in Excel allows you to change chart styles and types?

A. Data

B. Home

C. Insert

D. Design

5. What does modifying chart elements in Excel involve?

A. Changing the software version

B. Altering the data source

C. Making adjustments to various chart components

D. Deleting the chart

6. Which Excel function allows you to switch from one chart type to another?

A. SWITCHCHART

B. CHARTCHANGE

C. CHARTSWITCH

D. Change Chart Type

7. What is the purpose of a legend in a chart**?**

A. Show data labels

B. Explain the data series

C. Change the chart's colors

D. Resize the chart

8. Which of the following is an example of a basic chart type for comparing data values across different categories**?**

A. Scatter Plot

B. Pie Chart

C. Radar Chart

D. Histogram

9. What does the "Select Data" option in Excel allow you to do?

A. Choose a different chart type

B. Pick a new chart style

C. Add or edit data series in a chart

D. Resize the chart area

10. In Excel, what can you format within a chart element?

A. Only the chart title

B. Only data points

C. Specific elements like titles, axes, labels, and more

D. The entire worksheet

11. Which of the following is not a type of data label in Excel charts?

A. Category Name

B. Series Name

C. Data Point Value

D. Chart Title

12. What is the primary function of gridlines in Excel charts?

A. To add a decorative border to the chart

B. To highlight the legend

C. To assist in reading values on the chart

D. To create a background color

13. Which Excel feature is used for personalizing the appearance and content of charts?

A. Format Painter

B. Chart Wizard

C. Chart Customization

D. Graphical Editor

14. What is a common use of a line chart in Excel?

A. Showing the distribution of data

B. Comparing values across different categories

C. Displaying hierarchical data

D. Analyzing trends over time

15. Which chart type is often used for displaying hierarchical data with branches and sub-branches?

A. Bar Chart

B. Tree Map

C. Radar Chart

D. Scatter Plot

16. What is a secondary axis used for in Excel charts?

A. To adjust chart dimensions

B. To change the chart type

C. To compare two different data series with different scales

D. To hide the legend

Answers for Self Assessment

1.	B	2.	D	3.	B	4.	D	5.	C
6.	D	7.	B	8.	B	9.	C	10.	C
11.	D	12.	C	13.	C	14.	D	15.	B
16.	C								

Review Questions

1. What is the purpose of using basic chart types in Excel?

2. How do you insert a chart in Microsoft Excel?

3. Explain why it is important to move a chart within an Excel worksheet.

4. Describe two methods for resizing a chart in Excel.

5. Where can you find the options to change chart styles and types in Excel?

6. What does "modification in chart elements" refer to in Excel?

7. How can you change the chart type of an existing chart in Excel?

8. Why is it useful to add data labels to a chart?

9. Name three chart elements in Excel that you can format.

10. How do you edit the data source for a chart in Excel?

11. What is the purpose of a legend in an Excel chart?

12. Explain the role of gridlines in Excel charts.

13. What is chart customization, and why is it important?

14. When would you typically use a line chart in Excel?

15. What is the significance of a secondary axis in an Excel chart?

Further Readings

- https://www.javatpoint.com/type-of-charts-in-excel
- https://www.geeksforgeeks.org/how-to-move-and-resize-a-chart-in-excel/
- https://edu.gcfglobal.org/en/excelxp/editing-charts/1/
- https://www.customguide.com/excel/change-chart-style-in-excel
- https://www.tutorialspoint.com/excel_charts/excel_charts_styles.htm
- https://www.wallstreetmojo.com/change-chart-style-in-excel/
- https://www.tutorialspoint.com/excel_charts/excel_charts_elements.htm
- https://www.ablebits.com/office-addins-blog/excel-charts-title-axis-legend/

Unit 08: Elementary Modelling

Objectives

After this lecture , you will gain insight to the following topics:

- If Statement Analysis
- Nested If
- Count If and Count Ifs
- Sum If and Sum Ifs
- Average If and Average Ifs

Introduction

Elementary modeling is a foundational concept in various fields, including mathematics and computer science. It involves simplifying complex systems or real-world scenarios to create mathematical or computational representations. These models provide a framework for analysis and decision-making, making it easier to understand and manipulate complex data or situations.

8.1   What is an Excel IF Statement?

The Excel IF Statement tests a given condition and returns one value for a TRUE result and another value for a FALSE result. For example, if sales total more than $5,000, then return a "Yes" for Bonus; otherwise, return a "No" for Bonus. We can also use the IF function to evaluate a single function, or we can include several IF functions in one formula. Multiple IF statements in Excel are known as nested IF statements.

Excel IF Statement

= IF (Cell C2 >= Cell D2, "Yes it is", "No it isn't")

i.e.

When C2 is 9 and D2 is 7, the result = "Yes it is"

When C2 is 3 and D2 is 5, the result = "No it isn't"

As a financial analyst, the IF function is used often to evaluate and analyze data by evaluating specific conditions.

The function can be used to evaluate text, values, and even errors. It is not limited to only checking if one thing is equal to another and returning a single result. We can also use mathematical operators and perform additional calculations, depending on our criteria. We can also nest multiple IF functions together to perform multiple comparisons.

IF Formula

=IF(logical_test, value_if_true, value_if_false)

The function uses the following arguments:

1. Logical_test (required argument) – This is the condition to be tested and evaluated as either TRUE or FALSE.

2. Value_if_true (optional argument) – The value that will be returned if the logical_test evaluates to TRUE.

3. Value_if_false (optional argument) – The value that will be returned if the logical_test evaluates to FALSE.

When using the IF function to construct a test, we can use the following logical operators:

- = (equal to)
- > (greater than)
- >= (greater than or equal to)
- < (less than)
- <= (less than or equal to)
- <> (not equal to)

How to use the Excel IF Function

To understand the uses of the Excel IF statement function, let's consider a few examples:

Example 1 – Simple Excel IF Statement

Suppose we wish to do a very simple test. We want to test if the value in cell C2 is greater than or equal to the value in cell D2. If the argument is true, then we want to return some text stating "Yes it is", and if it's not true, then we want to display "No it isn't".

You can see exactly how the Excel IF statement works in the simple example below.

Result when true:

Result when false:

Example 2 – Excel IF Statement

Suppose we wish to test a cell and ensure that an action is taken if the cell is not blank. We are given the data below:

In the worksheet above, we listed AGM-related tasks in Column B. Remarks contain the date of completion. In Column C, we will use a formula to check if the cells in Column D are empty or not.

If a cell is blank, the formula will assign the status "Open." However, if a cell contains a date, then the formula will assign a status of "Closed." The formula used is:

We get the results below:

Example 3 – Excel IF Statement

Sellers frequently provide a discount based on the quantity purchased. Suppose we are given the following data:

Lovely Professional University

◢	A	B	C	D
1				
2		**IF Function**		
3				
4		**Unit quantity**	**Price per unit**	
5		1 to 10	$30	
6		11 to 25	$28	
7		26 to 65	$25	
8		65 and above	$22	

Using multiple IF functions, we can create a formula to check multiple conditions and perform different calculations depending on what amount range the specified quantity falls in. To calculate the total price for 100 items, the formula will be:

We get the result below:

Things to remember about the IF Function

1. The Excel IF function will work if the logical_test returns a numeric value. In such a case, any non-zero value is treated as TRUE and zero is treated as FALSE.

2. #VALUE! error – Occurs when the given logical_test argument cannot be evaluated as TRUE or FALSE.

3. When any of the arguments are provided to the function as arrays, the IF function will evaluate every element of the array.

4. If we wish to count conditions, we should use the COUNTIF and COUNTIFS functions.

5. If we wish to add up conditions, we should use the SUMIF and SUMIFS functions.

Reasons to use an Excel IF Statement

There are many reasons why an analyst or anyone who uses Excel would want to build IF formulas.

Common examples include:

- To test if an argument is true or false

- To output a NUMBER

- To output some TEXT

- To generate a conditional formula (e.g., the result is C3+B4 if true and N9-E5 if false)

- To create scenarios to be used in financial modeling

- To calculate a debt schedule or a fixed asset depreciation schedule in accounting

8.2   Nested If

In Excel, the Nested IF function means we can use another logical or conditional function with the IF function to test more than one condition. For example, suppose there are two conditions to be tested. In that case, we can use the logical AND or OR function depending upon the situation, or we can use the other conditional functions, even more, IFs inside a single IF.

For example, suppose we have a dataset consisting of the age and names of employees. We need to check if any employees are less than the required eligibility to work, i.e., 20 years. We can use the Nested IF function in Excel in such a scenario. Using this function may display "TRUE" if it met with the first condition, i.e., age is more or equal to 20 years. Conversely, it may indicate "FAIL" if it does not satisfy the first condition. If the logical test is "FALSE," we can execute the second IF. It will perform until the formula finds the "TRUE" test result. If none of the results is "TRUE," it will execute the final "FALSE" result.

Example 1. Classic nested IF formula

Here's a typical example of Excel If with multiple conditions. Supposing you have a list of students in column A and their exam scores in column B, and you want to classify the scores with the following conditions:

- Excellent: Over 249

- Good: between 249 and 200, inclusive

- Satisfactory: between 199 and 150, inclusive

- Poor: Under 150

And now, let's write a nested IF function based on the above criteria. It's considered a good practice to begin with the most important condition and keep your functions as simple as possible. Our Excel nested IF formula goes as follows:

=IF(B2>249, "Excellent", IF(B2>=200, "Good", IF(B2>150, "Satisfactory", "Poor")))

And   works   exactly   as   it   should:

=IF(B2>249, "Excellent", IF(B2>=200, "Good", IF(B2>150, "Satisfactory", "Poor ")))

	A	B	C	D	E	F
1	Student name	Score	Result		Scores	
2	Brian	274	Excellent		Excellent	Over 249
3	Christian	280	Excellent		Good	249 to 200
4	Colin	170	Satisfactory		Satisfactory	199 to 150
5	Laura	237	Good		Poor	Under 150
6	Melissa	210	Good			
7	Mike	186	Satisfactory			
8	Neal	240	Good			
9	Peter	146	Poor			
10	Rachel	287	Excellent			

Understanding Excel nested IF logic

I've heard some people say that Excel multiple If is driving them crazy :) Try looking at it at a different   angle:

=IF(B2>249, "Excellent",

    IF(B2>=200, "Good",

        IF(B2>150, "Satisfactory", "Poor ")))

What the formula actually tells Excel to do is to evaluate the logical_test of the first IF function and, if the condition is met, return the value supplied in the value_if_true argument. If the condition of the 1st If function is not met, then test the 2nd If statement, and so on.

IF(check if B2>=249, if true - return "Excellent", or else

IF(check if B2>=200, if true - return "Good", or else

IF(check if B2>150, if true - return "Satisfactory", if false - return "Poor")))

Example 2. Multiple If with arithmetic calculations

Here's another typical task: the unit price varies depending on the specified quantity, and your goal is to write a formula that calculates the total price for any amount of items input in a specific cell. In other words, your formula needs to check multiple conditions and perform different calculations depending on what amount range the specified quantity falls in:

Unit Quantity	Price per unit
1 to 10	$20
11 to 19	$18
20 to 49	$16
50 to 100	$13
Over 101	$12

Spreadsheet Modelling (Using Excel)

This task can also be accomplished by using multiple IF functions. The logic is the same as in the above example, the only difference is that you multiply the specified quantity by the value returned by nested IFs (i.e. the corresponding price per unit).

Assuming the user enters the quantity in cell B8, the formula is as follows:

=B8*IF(B8>=101, 12, IF(B8>=50, 13, IF(B8>=20, 16, IF(B8>=11, 18, IF(B8>=1, 20, "")))))

And the result will look something like similar to this:

=B8*IF(B8>=101, 12, IF(B8>=50, 13, IF(B8>=20, 16, IF(B8>=11, 18, IF(B8>=1, 20, "")))))

	A	B	C	D	E	F	G
1	**Unit Quantity**	**Price per unit**					
2	1 to 10	$20					
3	11 to 19	$18					
4	20 to 49	$16					
5	50 to 100	$13					
6	Over 101	$12					
7							
8	**Qty.**	100					
9	**Total**	$1,300					

As you understand, this example demonstrates only the general approach, and you can easily customize this nested If function depending on your particular task.

For example, instead of "hard-coding" the prices in the formula, you can reference the cells containing those values (cells B2 to B6). This will enable your users to edit the source data without having to update the formula:

=B8*IF(B8>=101,B6, IF(B8>=50, B5, IF(B8>=20, B4, IF(B8>=11, B3, IF(B8>=1, B2, "")))))

=B8*IF(B8>=101,B6, IF(B8>=50, B5, IF(B8>=20, B4, IF(B8>=11, B3, IF(B8>=1, B2, "")))))

	A	B	C	D	E	F	G
1	**Unit Quantity**	**Price per unit**					
2	1 to 10	$20					
3	11 to 19	$18					
4	20 to 49	$16					
5	50 to 100	$13					
6	Over 101	$12					
7							
8	**Qty.**	100					
9	**Total**	=B8*IF(B8>=101,					

Or, you may want to include an additional IF function(s) that fixes an upper, lower or both bounds of the amount range. When the quantity is outside the range, the formula will display an "out of the range" message. For example:

=IF(OR(B8>200,B8<1), "Qty. out of range", B8*IF(B8>=101,12, IF(B8>=50, 13, IF(B8>=20, 16, IF(B8>=11, 18, IF(B8>=1, 20, ""))))))

```
=IF(OR(B8>200,B8<1), "Qty. out of range", B8*IF(B8>=101,B6,
IF(B8>=50, B5, IF(B8>=20, B4, IF( B8>=11, B3, IF(B8>=1, B2, ""))))))
```

	A	B	C	D	E
1	**Unit Quantity**	**Price per unit**			
2	1 to 10	$20			
3	11 to 19	$18			
4	20 to 49	$16			
5	50 to 100	$13			
6	101 to 200	$12			
7					
8	Qty.	201			
9	**Total**	Qty. out of range			

The nested IF formulas described above work in all versions of Excel. In Excel 365 and Excel 2021, you can also use the IFS function for the same purpose.

8.3 Count(), Countif(), Countifs() function

Count() function is used to count the number cells between two ranges that contains numberical data; it doesn't count the cell containing string data.

Let's take below as an example. In 'I4', we have written '=COUNT(A4:G4)', it count 7 columns data.

	A	B	C	D	E	F	G	H	I	J	K	L
1												
2												
3	Sl. No.	First Name	LastName	Age	Salary	PPF (15%)	Total	Active				
4	1 Shco	Narayan		₹35.00	₹85,256.00	₹5,288.40	₹40,579.40	TRUE	=COUNT(A4:G4)			
5	2 Ram	Sita		₹22.00	₹5,465.00	₹819.75	₹122.96	FALSE	COUNT(value1, [value2]...)			
6	3 Sita	Ram		₹25.00	₹5,486.00	₹819.90		TRUE	0			
7	4 Gita	ram		₹30.00	₹454.00	₹68.10		FALSE				
8	5 Sohan	Kumar		₹30.00	₹578.00	₹86.70		TRUE				

The result is only 5 as shown below because only 5 columns (Sl. No., Age, Salary, PPF, Total) columns having numberical data.

	A	B	C	D	E	F	G	H	I	J
1										
2										
3	Sl. No.	First Name	LastName	Age	Salary	PPF (15%)	Total	Active		
4	1 Shco	Narayan		₹33.00	₹35,250.00	₹5,288.40	₹40,579.40	TRUE	5	
5	2 Ram	Sita		₹22.00	₹5,465.00	₹819.75	₹122.96	FALSE		
6	3 Sita	Ram		₹25.00	₹5,460.00	₹819.90		TRUE	0	
7	4 Gita	ram		₹30.00	₹454.00	₹68.10		FALSE		

Similarly, we are trying to count the rows that contains numberical data.

	A	B	C
1			
2			
3	Sl. No.	First Name	LastName
4	1	Sheo	Narayan
5	2	Ram	Sita
6	3	Sita	Ram
7	4	Gita	ram
8	5	Sohan	Kumar
9	6	Jack	Luis
10	7	Greg	Kambakth
11	8	Ajay	Sir
12	9	Raghu	Kaushal
13	10	Raju	Pandey
14	11	Jay	Shankar
15	12	Namah	Shivaya
16	13	Ganesh	Mata
17	14	Mahesh	Sharma
18			
19	=COUNT(A3:A17)		0

	A	B	C
1			
2			
3	Sl. No.	First Name	LastName
4	1	Sheo	Narayan
5	2	Ram	Sita
6	3	Sita	Ram
7	4	Gita	ram
8	5	Sohan	Kumar
9	6	Jack	Luis
10	7	Greg	Kambakth
11	8	Ajay	Sir
12	9	Raghu	Kaushal
13	10	Raju	Pandey
14	11	Jay	Shankar
15	12	Namah	Shivaya
16	13	Ganesh	Mata
17	14	Mahesh	Sharma
18			
19	14	=COUNT(B3:B17)	

As you can see that both A19 and B19 cell is using same formula to count row 3 to 17 but the result would be below.

Spreadsheet Modelling (Using Excel)

	A	B	C
1			
2			
3	Sl. No.	First Name	LastName
4	1	Sheo	Narayan
5	2	Ram	Sita
6	3	Sita	Ram
7	4	Gita	ram
8	5	Sohan	Kumar
9	6	Jack	Luis
10	7	Greg	Kambakth
11	8	Ajay	Sir
12	9	Raghu	Kaushal
13	10	Raju	Pandey
14	11	Jay	Shankar
15	12	Namah	Shivaya
16	13	Ganesh	Mata
17	14	Mahesh	Sharma
18			
19	14	0	0
20			

As A column contains numberic data so it is giving number of rows, but B column has all string data so the result is 0.

CountIf() function

CountIf function is used to count cells based on one criteria only (less than, greater than, equal to etc.). The criteria can be either for numerical value or string value.

Look at the below example. In D21 cell, the formula is written as '=COUNTIF(D4:D17, "<18")', it means that Count only those cells having value less than 18 and in this case only one cell D13 valid so the result we are getting is 1.

| | | fx | =COUNTIF(D4:D17, "<18") |

	A	B	C	D	E	
1						
2						
3	SI. No.	First Name	LastName	Age	Salary	PPF
4	1	Sheo	Narayan	₹ 35.00	₹ 35,256.00	₹
5	2	Ram	Sita	₹ 22.00	₹ 5,465.00	
6	3	Sita	Ram	₹ 25.00	₹ 5,466.00	
7	4	Gita	ram	₹ 30.00	₹ 454.00	
8	5	Sohan	Kumar	₹ 30.00	₹ 578.00	
9	6	Jack	Luis	₹ 30.00	₹ 45,487.00	₹
10	7	Greg	Kambakth	₹ 19.00	₹ 54,464.00	₹
11	8	Ajay	Sir	₹ 20.00	₹ 556,423.00	₹
12	9	Raghu	Kaushal	₹ 56.00	₹ 1,313.00	
13	10	Raju	Pandey	₹ 12.00	₹ 4,564.00	
14	11	Jay	Shankar	₹ 40.00	₹ 1,456.00	
15	12	Namah	Shivaya	₹ 62.00	₹ 15,465.00	₹
16	13	Ganesh	Mata	₹ 289.00	₹ 16,465.00	₹
17	14	Mahesh	Sharma	₹ 59.00	₹ 1,456.00	
18				Total	₹ 744,312.00	₹ 1
19				Average	₹ 53,165.14	₹
20						
21				1		

We can even use wildcard characters in CountIf function.

Spreadsheet Modelling (Using Excel)

B21			✕	✓	f_x	=COUNTIF(B4:B17, "S*")	

	A	B	C	D	E	F	
1							
2							
3	Sl. No.	First Name	LastName	Age	Salary	PPF (15%)	Tot
4	1	Sheo	Narayan	₹35.00	₹35,256.00	₹5,288.40	
5	2	Ram	Sita	₹22.00	₹5,465.00	₹819.75	
6	3	Sita	Ram	₹25.00	₹5,466.00	₹819.90	
7	4	Gita	ram	₹30.00	₹454.00	₹68.10	
8	5	Sohan	Kumar	₹30.00	₹578.00	₹86.70	
9	6	Jack	Luis	₹30.00	₹45,487.00	₹6,823.05	
10	7	Greg	Kambakth	₹19.00	₹54,464.00	₹8,169.60	
11	8	Ajay	Sir	₹20.00	₹556,423.00	₹83,463.45	
12	9	Raghu	Kaushal	₹56.00	₹1,313.00	₹196.95	
13	10	Raju	Pandey	₹12.00	₹4,564.00	₹684.60	
14	11	Jay	Shankar	₹40.00	₹1,456.00	₹218.40	
15	12	Namah	Shivaya	₹62.00	₹15,465.00	₹2,319.75	
16	13	Ganesh	Mata	₹289.00	₹16,465.00	₹2,469.75	
17	14	Mahesh	Sharma	₹59.00	₹1,456.00	₹218.40	
18				Total	₹744,312.00	₹111,646.80	
19				Average	₹53,165.14	₹7,974.77	
20							
21		3		1			

This is counting cells whose string value starts with "S".

CountIfs() function

CountIfs function is used to count cells based on multiple criteria (separated by comma). In below example, D21 cell contains '=COUNTIFS(B4:B17, "S*", D4:D17, "<26")' formula that says

- count those cells from B4:B17 (cell range) whose string starts with "S*" (this will give 3 records) and also
- D4:D17 cells whose value is '<26' (this will remove two records 'Sheo' & 'Sohan').

So if both criteria is met then only that particular record will be counted.

| D21 | | ▾ | ⋮ | ✕ | ✓ | *fx* | =COUNTIFS(B4:B17, "S*", D4:D17, "<26") |

▲	A	B	C	D	E	F	Tot:
1							
2							
3	Sl. No.	First Name	LastName	Age	Salary	PPF (15%)	Tot:
4	1	Sheo	Narayan	₹ 35.00	₹ 35,256.00	₹ 5,288.40	
5	2	Ram	Sita	₹ 22.00	₹ 5,465.00	₹ 819.75	
6	3	Sita	Ram	₹ 25.00	₹ 5,466.00	₹ 819.90	
7	4	Gita	ram	₹ 30.00	₹ 454.00	₹ 68.10	
8	5	Sohan	Kumar	₹ 30.00	₹ 578.00	₹ 86.70	
9	6	Jack	Luis	₹ 30.00	₹ 45,487.00	₹ 6,823.05	
10	7	Greg	Kambakth	₹ 19.00	₹ 54,464.00	₹ 8,169.60	
11	8	Ajay	Sir	₹ 20.00	₹ 556,423.00	₹ 83,463.45	
12	9	Raghu	Kaushal	₹ 56.00	₹ 1,313.00	₹ 196.95	
13	10	Raju	Pandey	₹ 12.00	₹ 4,564.00	₹ 684.60	
14	11	Jay	Shankar	₹ 40.00	₹ 1,456.00	₹ 218.40	
15	12	Namah	Shivaya	₹ 62.00	₹ 15,465.00	₹ 2,319.75	
16	13	Ganesh	Mata	₹ 289.00	₹ 16,465.00	₹ 2,469.75	
17	14	Mahesh	Sharma	₹ 59.00	₹ 1,456.00	₹ 218.40	
18				Total	₹ 744,312.00	₹ 111,646.80	
19				Average	₹ 53,165.14	₹ 7,974.77	
20							
21			3	1			
22							

So the result is 1.

How to count cells with specific text in Excel?

To count cells with specific text in Excel, we can use CountIf() function. Select a blank cell and write formula like this '=COUNTIF(B4:B17, "Sheo")'. In this case I want to find 'Sheo' text.

Spreadsheet Modelling (Using Excel)

| | B21 | | ▾ | ⋮ | ✕ | ✓ | *fx* | =COUNTIF(B4:B17, "Sheo") |

	A	B	C	D	E	
1						
2						
3	Sl. No.	First Name	LastName	Age	Salary	PPF
4	1	Sheo	Narayan	₹ 35.00	₹ 35,256.00	₹
5	2	Ram	Sita	₹ 22.00	₹ 5,465.00	
6	3	Sita	Ram	₹ 25.00	₹ 5,466.00	
7	4	Gita	ram	₹ 30.00	₹ 454.00	
8	5	Sohan	Kumar	₹ 30.00	₹ 578.00	
9	6	Jack	Luis	₹ 30.00	₹ 45,487.00	₹
10	7	Greg	Kambakth	₹ 19.00	₹ 54,464.00	₹
11	8	Ajay	Sir	₹ 20.00	₹ 556,423.00	₹
12	9	Raghu	Kaushal	₹ 56.00	₹ 1,313.00	
13	10	Raju	Pandey	₹ 12.00	₹ 4,564.00	
14	11	Jay	Shankar	₹ 40.00	₹ 1,456.00	
15	12	Namah	Shivaya	₹ 62.00	₹ 15,465.00	₹
16	13	Ganesh	Mata	₹ 289.00	₹ 16,465.00	₹
17	14	Mahesh	Sharma	₹ 59.00	₹ 1,456.00	
18				Total	₹ 744,312.00	₹ 1
19				Average	₹ 53,165.14	₹
20						
21		1				
22						

and here is my result in B21.

As written earlier, we can use wild card characters also to count the occurences, like

1. Count cells starting with 'Sh' - '=COUNTIF(B4:B17, "Sh*")'
2. Count cells ending with 'eo' - '=COUNTIF(B4:B17, "*eo")'
3. Count cells contains 'h' - '=COUNTIF(B4:B17, "*h*")'

How to count non blank cells in Excel?

To count Non Blank cell in excel, use the same COUNTIF function but the 2nd parameter would be '<>'. So the formula to count non blank cells is '=COUNTIF(G4:G19, "<>")' where the range of cells it is counting is G4 to G19.

=COUNTIF(G4:G19, "<>")

D	E	F	G	Acti\
Age	**Salary**	**PPF (15%)**	**Total**	
₹ 35.00	₹ 35,256.00	₹ 5,288.40	₹ 40,579.40	
₹ 22.00	₹ 5,465.00	₹ 819.75	₹ 122.96	|
₹ 25.00	₹ 5,466.00	₹ 819.90		
₹ 30.00	₹ 454.00	₹ 68.10		|
₹ 30.00	₹ 578.00	₹ 86.70	₹ 13.01	
₹ 30.00	₹ 45,487.00	₹ 6,823.05	₹ 1,023.46	|
₹ 19.00	₹ 54,464.00	₹ 8,169.60		
₹ 20.00	₹ 556,423.00	₹ 83,463.45		|
₹ 56.00	₹ 1,313.00	₹ 196.95		
₹ 12.00	₹ 4,564.00	₹ 684.60	₹ 102.69	|
₹ 40.00	₹ 1,456.00	₹ 218.40	₹ 32.76	
₹ 62.00	₹ 15,465.00	₹ 2,319.75	₹ 347.96	
₹ 289.00	₹ 16,465.00	₹ 2,469.75	₹ 370.46	
₹ 59.00	₹ 1,456.00	₹ 218.40	₹ 32.76	|
Total	₹ 744,312.00	₹ 111,646.80		
Average	₹ 53,165.14	₹ 7,974.77		
			9	

See here non blank cell is 9.

How to count blank cells in Excel?

To count blank cells in Excel, use the COUNTIF function with 2nd parameter as "". So here is the formula '=COUNTIF(G4:G19, "")'.

=COUNTIF(G4:G19, "")

D	E	F	G	A
Age	Salary	PPF (15%)	Total	
₹ 35.00	₹ 35,256.00	₹ 5,288.40	₹ 40,579.40	
₹ 22.00	₹ 5,465.00	₹ 819.75	₹ 122.96	
₹ 25.00	₹ 5,466.00	₹ 819.90		
₹ 30.00	₹ 454.00	₹ 68.10		
₹ 30.00	₹ 578.00	₹ 86.70	₹ 13.01	
₹ 30.00	₹ 45,487.00	₹ 6,823.05	₹ 1,023.46	
₹ 19.00	₹ 54,464.00	₹ 8,169.60		
₹ 20.00	₹ 556,423.00	₹ 83,463.45		
₹ 56.00	₹ 1,313.00	₹ 196.95		
₹ 12.00	₹ 4,564.00	₹ 684.60	₹ 102.69	
₹ 40.00	₹ 1,456.00	₹ 218.40	₹ 32.76	
₹ 62.00	₹ 15,465.00	₹ 2,319.75	₹ 347.96	
₹ 289.00	₹ 16,465.00	₹ 2,469.75	₹ 370.46	
₹ 59.00	₹ 1,456.00	₹ 218.40	₹ 32.76	
Total	₹ 744,312.00	₹ 111,646.80		
Average	₹ 53,165.14	₹ 7,974.77		
			7	

The number of blank cells between G4 to G19 is 7.

8.4 Sumif() and Sumifs() Function

Without a doubt, one of the most useful functions of Excel is the SUMIF function.

It enables conditional summing up in Excel. And so, you can make sense of large diverse datasets by only summing up the values that meet a specified criterion.

And what if that's not a criterion but multiple criteria? No worries – to deal with multiple conditions, we have the SUMIFS function to the rescue.

How to use SUMIF

The SUMIF function sums up only those values (from a defined range) that meet a specified condition. Let's see how.

The dataset below shows the sale of four products.

	A	B	C
1	**Prodcuts**	**Sales (in USD)**	
2	Apple	$ 400.00	
3	Banana	$ 375.00	
4	Apple	$ 230.00	
5	Gauva	$ 165.00	
6			

Out of this data, can we quickly sum up the sales for "Apple" only? To do so:

1. Begin writing the SUMIF function as shown below.

=SUMIF (

2. Create a reference to the range (based on which the sum is to be performed).

=SUMIF (A2:A5,

We have created a reference to the cell range A2:A5.

This range contains the product names (and we want to sum up the sales for apples only). So our range is the "Products" column.

3. Next, define the criteria based on which Excel must sum the values.

We want to sum up the sales for "Apple" only and that makes our criteria.

=SUMIF (A2:A5, "Apple",

We have defined "Apple" as the next argument. This tells Excel to look out for the word "Apple" in the range specified above.

4. Create a reference to the range to be summed up (Sales in this case).

As we want Excel to sum up the sales for "Apple", we are creating a reference to cells B2:B5.

=SUMIF (A2:A5, "Apple", B2:B5)

5. Hit "Enter" and there you go.

Excel displays the sum of sales of "Apple" only.

SUMIF formula examples

The basic application of the SUMIF function is more like child's play.

But that's not it – the criteria of the SUMIF function can take different formats. Like the number, text, and date format.

Look into the examples for each criteria format below.

SUMIF with number criteria

Here comes the sales data for three different cities for different months.

Out of this data, can we only sum up the sales that exceed $225? To do so:

1. Start writing the SUMIF function as follows.

=SUMIF (

2. Define the range (based on which the cells are to be summed up) as the first argument.

=SUMIF (C2:C10,

We want to sum up the sales that exceed $225, so our range is sales.

3. Define the criteria for summing up the values as shown in the following formula.

=SUMIF(C2:C10,">225"

As we want to filter out sales greater than $225, we have defined the criteria using a "greater than" operator (>225).

4. Create a reference to the range to be summed up (the sales) as the third argument.

The sum range argument, in this case, is the same as our criteria range (C2:C10).

=SUMIF(C2:C10,">225",C2:C10)

Now, hit enter.

And here comes the sum of the sales that exceed $225.

Turns out $2,243 is the sum of all the sales that exceed $225.

SUMIF with text criteria

Continuing with the previous example, what if we want to sum sales of New York only?

	A	B	C	D
1	**Months**	**Cities**	**Sales (in USD)**	
2	31/1/2022	New York	$ 225.00	
3	28/2/2022	London	$ 325.00	
4	31/3/2022	Berlin	$ 450.00	
5	31/1/2022	London	$ 220.00	
6	31/3/2022	New York	$ 375.00	
7	31/3/2022	London	$ 445.00	
8	28/2/2022	New York	$ 383.00	
9	31/1/2022	Berlin	$ 218.00	
10	28/2/2022	Berlin	$ 265.00	
11				

1. Write the SUMIF function as follows.

= SUMIF (

2. Define the range against which the criterion must be evaluated (Cities).

=SUMIF (B2:B10,

We want to sum the sales for NewYork (a particular city) only so our range is the Cities column.

3. Define the criterion for summing up sales.

This time our criteria is a text i.e. "New York".

=SUMIF(B2:B10,"New York",

4. Select the sum range (the sales) as the third argument.

=SUMIF(B2:B10,"New York",C2:C10)

5. Hit "Enter".

B12		▼	:	×	✓	*fx*	=SUMIF(B2:B10,"New York",C2:C10)	

	A	B	C	D
1	**Months**	**Cities**	**Sales (in USD)**	
2	31/1/2022	New York	$ 225.00	
3	28/2/2022	London	$ 325.00	
4	31/3/2022	Berlin	$ 450.00	
5	31/1/2022	London	$ 220.00	
6	31/3/2022	New York	$ 375.00	
7	31/3/2022	London	$ 445.00	
8	28/2/2022	New York	$ 383.00	
9	31/1/2022	Berlin	$ 218.00	
10	28/2/2022	Berlin	$ 265.00	
11				
12	**New York Sales**	$ 983.00		
13				

And there you have the total sales of New York City for all the months

SUMIF with date criteria.

So far we've learned how the SUMIF function works with a number and text criteria.

It's time we check if the SUMIF function works with the date criteria too.

With the same data as above, let's now sum the sales for 31/1/2022 only.

	A	B	C	D
1	**Months**	**Cities**	**Sales (in USD)**	
2	31/1/2022	New York	$ 225.00	
3	28/2/2022	London	$ 325.00	
4	31/3/2022	Berlin	$ 450.00	
5	31/1/2022	London	$ 220.00	
6	31/3/2022	New York	$ 375.00	
7	31/3/2022	London	$ 445.00	
8	28/2/2022	New York	$ 383.00	
9	31/1/2022	Berlin	$ 218.00	
10	28/2/2022	Berlin	$ 265.00	
11				

1. Start writing the SUMIF function as follows.

=SUMIF(

2. Define the range as the first argument (Months in this case).

=SUMIF(A2:A10,
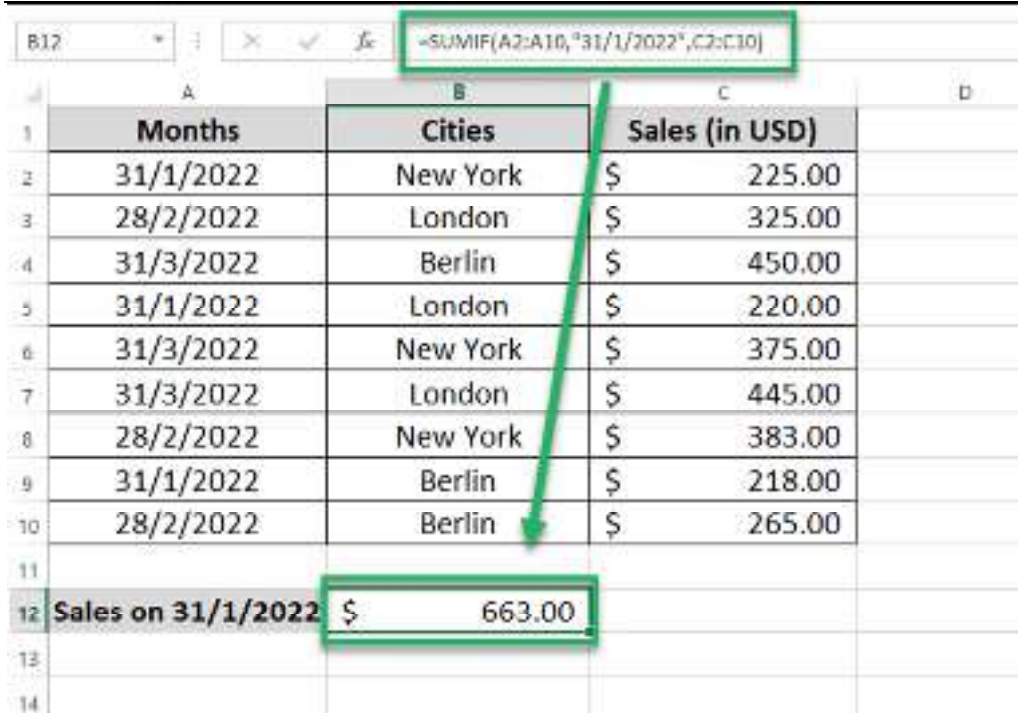
3. Define the criteria as "31/1/2022"; the date for which we want to sum up the sales.

=SUMIF(A2:A10,"31/1/2022",

5. Press "Enter" to get the results as follows.

And there you go! Excel sums up the sales for 31/1/2022 only.

8.5 Average Function

The AVERAGE function in Excel calculates the arithmetic mean of the supplied values. Such values can be numbers, percentages or times. In the mean (or average), the sum of all the items is divided by the number of items on the list. Apart from numbers, an average of Boolean values (true and false) can also be found if they are typed directly in the AVERAGE formula.

For example, the formula "=AVERAGE(10,24,35,true,false)" returns 14. The "true" and "false" values are counted as 1 and 0 respectively. So, the mean is (10+24+35+1+0)/5=14.

The purpose of using the AVERAGE function in Excel is to calculate the center or mean of a list. A mean includes every value of the list in the calculation. As a result, it is impacted by the extreme values or outliers (very small or very big values) of a list. The AVERAGE function is categorized as a Statistical function of Excel.

Syntax of the AVERAGE Function of Excel

The syntax of the AVERAGE function of Excel is shown in the following image:
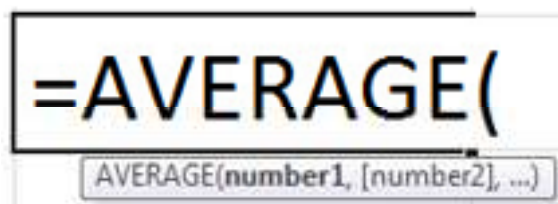
The AVERAGE function of Excel accepts the following arguments:

- Number 1: This is the first number for which the average is to be calculated.
- Number 2, number 3,…number n: These are the subsequent numbers for which the average is to be calculated.

The numbers can be supplied as direct numbers, named ranges or cell references containing numeric values. The first number is required, while the subsequent numbers are optional. However, for computing an average, at least two numbers are needed.

Note: The output of other Excel functions can also serve as an input to the AVERAGE function. However, such an output must necessarily be a numeric value.

Features of the AVERAGE function of Excel

The features of the AVERAGE function of Excel are listed as follows:

- It can be supplied with a maximum of 255 arguments in a single formula.

- It ignores the logical values (or Boolean values) if they have been supplied as cell references. However, logical values entered directly in the formula are counted by the function.

- It counts those cell references that contain numbers formatted as text.

- It treats the text strings as follows:

    - If the entire range reference consists of a few numbers and some text strings, the average of only the numbers is returned. In this case, the text strings supplied in the range reference are ignored by the function.
    - If the entire range reference consists of text strings, the "#DIV/0!" error is returned by the function.
    - If text strings are entered directly in the formula, it returns the "#VALUE!" error.

- It excludes the empty cells from the count. But, the cells containing the number zero are counted.

- It returns an error if the arguments supplied are error values.

Note: To include the zero values and exclude the empty cells from the count, follow the listed steps:

a. Click "options" from the File tab. The "Excel options" window opens.
b. Click "advanced" displayed on the left side.
c. Under "display options for this worksheet," select the checkbox of "show a zero in cells that have zero value."

The zero values of cells will be displayed and included in the count by the AVERAGE function of Excel. Deselecting the checkbox in point "c" will hide the zero values and display empty cells in their place.

How to Use the AVERAGE Function of Excel?

The AVERAGE function is one of the most used functions of Excel. It is frequently used in the financial sector to calculate the average revenue generated by an organization in a specific time period. It is also used to do financial modeling and analyze datasets.

Let us consider a few examples to understand the working of the AVERAGE function of Excel.

Example #1–Average in Five Different Cases

The following image shows a list of numbers in the range B3:B7. Use the AVERAGE function of Excel to perform the tasks stated within the following cases:

- Case 1: Calculate the average by supplying a vertical range reference.

- Case 2: Calculate the average by supplying the numbers directly to the function.

- Case 3: Calculate the average by supplying the numbers in words. Enclose the text strings within double quotation marks.

- Case 4: Calculate the average by supplying the references of cells containing the number names.

- Case 5: Calculate the average by supplying the numbers directly within double quotation marks.

Write a conclusion for each case.

Spreadsheet Modelling (Using Excel)

Case 1: Supply a vertical range reference

The steps are listed as follows:

Step 1: Enter the following formula in cell C3.

"=AVERAGE(B3:B7)"

Step 2: Press the "Enter" key. The output in cell C3 is 4. So, the mean of the given numbers is 4. This is shown within a red box in the following image.

Conclusion: For calculating the average, the numbers can be supplied as a range reference. It is also possible to supply **cell references** of non-adjacent cells.

Simply select the cell or range in order to supply it to the AVERAGE function. Further, ensure that the non-contiguous cells or ranges are separated by commas.

Case 2: Supply the numbers directly to the AVERAGE function

The steps are listed as follows:

Step 1: Enter the following formula in cell C4.

"=AVERAGE(2,3,5,4,6)"

Step 2: Press the "Enter" key. The output is shown in cell C4 of the following image. Hence, the mean is again 4.

Spreadsheet Modelling (Using Excel)

Conclusion: It is possible to supply the numbers directly to the AVERAGE function. One need not enclose such numbers within double quotation marks.

However, when there are too many numbers in the list, it becomes difficult to enter them directly. In such cases, it is easier to supply cell references.

Case 3: Supply the numbers in words

The steps are listed as follows:

Step 1: Enter the following formula in cell C5.

"=AVERAGE("Two","Three","Five","Four","Six")"

Step 2: Press the "Enter" key. The output in cell C5 is the "#VALUE!" error. This is shown in the following image.

Conclusion: When the number names are supplied directly to the AVERAGE function, it returns the"#VALUE!" error. This implies that the AVERAGE function does not work with text strings, even if such strings are enclosed within double quotation marks.

Case 4: Supply the references to cells containing the number names

The steps are listed as follows:

Step 1: Write the names of the numbers in the range A3:A7. Next, enter the following formula in cell C6.

"=AVERAGE(A3:A7)"

Step 2: Press the "Enter" key. The output in cell C6 is the "#DIV/0!" error. This is shown in the following image.

Conclusion: If number names are supplied as cell references, the AVERAGE function returns the "#DIV/0!" error. This implies that whether text strings are supplied directly or as cell references, the AVERAGE function does not work with them.

Notice the green triangles appearing on the top-left corner of cells C5 and C6. These triangles indicate that there is an error in the formulas of these cells.

Note: To include the text strings supplied as cell references, use the AVERAGEA function of Excel. This function counts such text strings as zero and ignores the empty cells. However, the text strings entered directly in the AVERAGEA formula can cause errors.

Case 5: Supply the numbers directly within double quotation marks

The steps are listed as follows:

Step 1: Enter the following formula in cell C7.

"=AVERAGE("2","3","5","4","6")"

Spreadsheet Modelling (Using Excel)

Step 2: Press the "Enter" key. The output in cell C7 is 4. Hence, the mean is 4. This is shown within a red box in the following image.

	A	B	C	D
1	AVERAGE Function			
2				
3	Two	2	4	=AVERAGE(B3:B7)
4	Three	3	4	=AVERAGE(2,3,5,4,6)
5	Five	5	#VALUE!	=AVERAGE("Two","Three","Five","Four","Six")
6	Four	4	#DIV/0!	=AVERAGE(A3:A7)
7	Six	6	4	=AVERAGE("2","3","5","4","6")
8				

Conclusion: If numbers are supplied directly within double quotation marks, the AVERAGE function returns their average (or mean). Hence, whether numbers are supplied as cell references or direct values (with or without double quotation marks), the AVERAGE function returns their mean.

Example #2–Average by Supplying a Horizontal Range Reference

The following image shows the names (column C), IDs (column B), and scores (in five subjects in columns D to H) of 20 students of a class. Given that the maximum marks of each subject are 100, calculate the average score obtained by each student.

Use the AVERAGE function of Excel.

	A	B	C	D	E	F	G	H
1	AVERAGE Function							
2								
3		ID	Name	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5
4		11201	Ashwin	67	90	73	78	89
5		11202	Ayush	73	78	87	85	65
6		11203	Brijesh	89	67	77	67	68
7		11204	Dhruv	67	89	68	73	84
8		11205	Manish	89	69	84	67	78
9		11206	Ruchi	89	67	78	73	67
10		11207	Sashi	65	90	85	56	89
11		11208	Rahul	68	90	67	78	89
12		11209	Ankush	84	78	73	56	65
13		11210	Sachin	90	67	77	78	68
14		11211	Akhil	76	56	68	85	84
15		11212	Rishi	56	90	84	67	78
16		11213	Arya	78	76	89	56	67
17		11214	Shikha	85	87	69	90	89
18		11215	Rini	78	90	84	76	76
19		11216	Vrish	85	78	78	89	87
20		11217	Kelh	67	67	85	89	90
21		11218	Nikki	73	56	67	69	84
22		11219	Mayank	56	90	73	67	78
23		11220	Rama	73	76	89	90	67

The steps to calculate the average are listed as follows:

Step 1: Enter the following formula in cell I4.

"=AVERAGE(D4:H4)"

So, we have supplied the cell references of row 4 to the AVERAGE function of Excel.

Step 2: Press the "Enter" key. The output in cell I4 is 79.4. Hence, the average score of the student Ashwin is 79.4.

Step 3: Drag the formula of cell I4 till cell I23. For dragging, use the **excel fill handle** appearing at the bottom-right side of cell I4.

The outputs are shown in the following image. The formula bar shows the formula of the currently selected cell (I23).

Spreadsheet Modelling (Using Excel)

123			f_x =AVERAGE(D23:H23)					
A	B	C	D	E	F	G	H	I
2								
3	ID	Name	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	
4	11201	Ashwin	67	90	73	78	89	79.4
5	11202	Ayush	73	78	87	85	65	77.6
6	11203	Brijesh	89	67	77	67	68	73.6
7	11204	Dhruv	67	89	68	73	84	76.2
8	11205	Manish	89	69	84	67	78	77.4
9	11206	Ruchi	89	67	78	73	67	74.8
10	11207	Sashi	65	90	85	56	89	77
11	11208	Rahul	68	90	67	78	89	78.4
12	11209	Ankush	84	78	73	56	65	71.2
13	11210	Sachin	90	67	77	78	68	76
14	11211	Akhil	76	56	68	85	84	73.8
15	11212	Rishi	56	90	84	67	78	75
16	11213	Arya	78	76	89	56	67	73.2
17	11214	Shikha	85	87	69	90	89	84
18	11215	Rini	78	90	84	76	76	80.8
19	11216	Vrish	85	78	78	89	87	83.4
20	11217	Kelh	67	67	85	89	90	79.6
21	11218	Nikki	73	56	67	69	84	69.8
22	11219	Mayank	56	90	73	67	78	72.8
23	11220	Rama	73	76	89	90	67	79

Example #3–Average and Maximum Average Revenue by AVERAGE, LOOKUP, and MAX Functions

The following image shows the monthly revenues (in $ in columns C to F) generated by an organization from four zones, namely, east, west, central, and north-south. We want to perform the listed tasks:

a. Calculate the average revenue for each month.

b. Calculate the average revenue for each zone.

c. Find the zone with the maximum average revenue.

Use the AVERAGE function of Excel for tasks "a" and "b." For task "c," use the LOOKUP and MAX functions. Further, explain the formula used for task "c."

	A	B	C	D	E	F
1	AVERAGE Function					
2						
3		Month	East Zone	West Zone	Central Zone	North-South Zone
4		Jan	100000	110000	120000	90000
5		Feb	50000	90000	130000	80000
6		Mar	110000	150000	80000	50000
7		Apr	60000	80000	110000	150000
8		May	90000	60000	60000	80000
9		Jun	80000	90000	90000	60000
10		Jul	40000	80000	50000	120000
11		Aug	120000	40000	110000	130000
12		Sep	130000	120000	60000	120000
13		Oct	80000	130000	150000	110000
14		Nov	150000	120000	80000	60000
15		Dec	120000	130000	60000	90000

a. The steps to calculate the average revenue for each month are listed as follows:

Step 1: Enter the following formula in cell C18.

"=AVERAGE(C4:F4)"

Since the average for each row of the dataset needs to be calculated, we have supplied the range reference of row 4.

AVERAGE	▼	X ✓ ƒx	=AVERAGE(C4:F4)		
	A	B	C	D	E	F
2						
3		**Month**	**East Zone**	**West Zone**	**Central Zone**	**North-South Zone**
4		Jan	100000	110000	120000	90000
5		Feb	50000	90000	130000	80000
6		Mar	110000	150000	80000	50000
7		Apr	60000	80000	110000	150000
8		May	90000	60000	60000	80000
9		Jun	80000	90000	90000	60000
10		Jul	40000	80000	50000	120000
11		Aug	120000	40000	110000	130000
12		Sep	130000	120000	60000	120000
13		Oct	80000	130000	150000	110000
14		Nov	150000	120000	80000	60000
15		Dec	120000	130000	60000	90000
16						
17						
18		Jan	=AVERAGE(C4:F4)			
19		Feb				
20		Mar				

Step 2: Press the "Enter" key to obtain the output. This is shown in cell C18 of the following image. So, the average revenue for January is $105,000.

Spreadsheet Modelling (Using Excel)

C18			f_x	=AVERAGE(C4:F4)	
	A	B	C	D	E	F

	A	B	C	D	E	F
2						
3		Month	East Zone	West Zone	Central Zone	North-South Zone
4		Jan	100000	110000	120000	90000
5		Feb	50000	90000	130000	80000
6		Mar	110000	150000	80000	50000
7		Apr	60000	80000	110000	150000
8		May	90000	60000	60000	80000
9		Jun	80000	90000	90000	60000
10		Jul	40000	80000	50000	120000
11		Aug	120000	40000	110000	130000
12		Sep	130000	120000	60000	120000
13		Oct	80000	130000	150000	110000
14		Nov	150000	120000	80000	60000
15		Dec	120000	130000	60000	90000
16						
17						
18		Jan	105000			
19		Feb				
20		Mar				
21		Apr				
22		May				
23		Jun				
24		Jul				
25		Aug				

Step 3: Drag the formula of cell C18 till cell C29 with the help of the fill handle. The average revenues for all the months are shown in the following image. In this image, the formula bar displays the formula of the currently active cell (C29).

	C29	▼	*fx*	=AVERAGE(C15:F15)	
◢	A	B	C	D	
17					
18		Jan	105000		
19		Feb	87500		
20		Mar	97500		
21		Apr	100000		
22		May	72500		
23		Jun	80000		
24		Jul	72500		
25		Aug	100000		
26		Sep	107500		
27		Oct	117500		
28		Nov	102500		
29		Dec	100000		
30					

b. The steps to calculate the average revenue for each zone are listed as follows:

Step 1: Enter the following formula in cell G18.

"=AVERAGE(C4:C15)"

This time we supply the cell references of column C in the AVERAGE formula. This is because the average for the entire column needs to be calculated.

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AVERAGE		▾	× ✓ ƒ*	=AVERAGE(C4:C15)			
	A	B	C	D	E	F	G	H
2								
3		Month	East Zone	West Zone	Central Zone	North-South Zone		
4		Jan	100000	110000	120000	90000		
5		Feb	50000	90000	130000	80000		
6		Mar	110000	150000	80000	50000		
7		Apr	60000	80000	110000	150000		
8		May	90000	60000	60000	80000		
9		Jun	80000	90000	90000	60000		
10		Jul	40000	80000	50000	120000		
11		Aug	120000	40000	110000	130000		
12		Sep	130000	120000	60000	120000		
13		Oct	80000	130000	150000	110000		
14		Nov	150000	120000	80000	60000		
15		Dec	120000	130000	60000	90000		
16								
17								
18		Jan	105000			East Zone	=AVERAGE(C4:C15)	
19		Feb	87500			West Zone		
20		Mar	97500			Central Zone		
21		Apr	100000			North-South Zone		

Step 2: Press the "Enter" key. The output of cell G18 is shown in the following image. Likewise, we have entered the following formulas in cells G19, G20, and G21 respectively:

- "=AVERAGE(D4:D15)"
- "=AVERAGE(E4:E15)"
- "=AVERAGE(F4:F15)"

Hence, the averages for each zone have been calculated in the range G18:G21.

G18		▾	:	× ✓ ƒ*	=AVERAGE(C4:C15)		
	A	B	C	D	E	F	G
1							
2							
3		Month	East Zone	West Zone	Central Zone	North-South Zone	
4		Jan	100000	110000	120000	90000	
5		Feb	50000	90000	130000	80000	
6		Mar	110000	150000	80000	50000	
7		Apr	60000	80000	110000	150000	
8		May	90000	60000	60000	80000	
9		Jun	80000	90000	90000	60000	
10		Jul	40000	80000	50000	120000	
11		Aug	120000	40000	110000	130000	
12		Sep	130000	120000	60000	120000	
13		Oct	80000	130000	150000	110000	
14		Nov	150000	120000	80000	60000	
15		Dec	120000	130000	60000	90000	
16							
17							
18		Jan	105000			East Zone	94166.67
19		Feb	87500			West Zone	100000
20		Mar	97500			Central Zone	91666.67
21		Apr	100000			North-South Zone	95000
22		May	72500				

c. The steps to find the zone with the maximum average revenue are listed as follows:

Step 1: Enter the following formula in cell H18.

"=LOOKUP(MAX(G18:G21),G18:G21,F18:F21)"

This is shown in the following image.

Step 2: Press the "Enter" key. The output is shown in the following image. Hence, the average revenue of the west zone is maximum.

Explanation of the formula: In the formula of step 1, we have used the vector form of the LOOKUP function. This formula works as follows:

a. The **MAX function** looks for the maximum number of the range G18:G21. The output of the MAX function is 100000. This output becomes the "lookup_value" of the LOOKUP function.

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b. Next, the **LOOKUP function** searches the number 100000 (lookup_value) in the range G18:G21 (lookup_vector). It returns the result from the range F18:F21 (result_vector). So, the given "lookup_value" corresponds with the west zone.

Hence, the output of the formula of step 1 is "west zone."

Note: The LOOKUP function searches for a value (lookup_value) in a one-row or one-column range (lookup_vector) and returns a corresponding match from the same position of another range (result_vector). The MAX function returns the maximum number from a dataset of numeric values.

For the syntax of the LOOKUP and MAX functions, click the hyperlinks of points "b" and "a" respectively.

Example #4–Average of Top Four Scores by AVERAGE and LARGE Functions

The following image shows the names (column B) and scores (columns C to G) of 16 students in five subjects. We want to perform the listed tasks:

a. Calculate the average of five scores of the student Lini (row 4). Use the AVERAGE function of Excel.

b. Calculate the average of the top four scores of each student. Use the AVERAGE and LARGE functions of Excel.

Explain the formula used for task "b."

	A	B	C	D	E	F	G	
1	AVERAGE Function							
2								
3		Name	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	
4		Lini	67	89	76	78	89	
5		Abhishek	78	65	89	85	65	
6		Dia	67	68	89	67	68	
7		Dhruv	89	84	69	76	84	
8		Vishu	78	78	73	56	78	
9		Sachin	90	67	77	78	90	
10		Rishi	56	90	84	67	56	
11		Krish	78	76	89	56	78	
12		Shikha	85	87	69	90	85	
13		Rini	78	90	84	76	76	
14		Vrish	85	78	78	89	87	
15		Kelh	67	67	85	89	90	
16		Nikki	73	56	67	69	84	
17		Mayank	56	90	73	67	78	
18		Jaya	73	76	89	90	67	
19		Manish	89	78	67	87	78	
20								

a. The steps to calculate the average of the five scores of row 4 are listed as follows:

Step 1: Enter the following formula in cell H4.

"=AVERAGE(C4:G4)"

AVERAGE	▾	✕ ✓ fx	=AVERAGE(C4:G4)					
	A	B	C	D	E	F	G	H	I
2									
3		Name	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5		
4		Lini	67	89	76	78	89	=AVERAGE(C4:G4)	
5		Abhishek	78	65	89	85	65		
6		Dia	67	68	89	67	68		
7		Dhruv	89	84	69	76	84		
8		Vishu	78	78	73	56	78		
9		Sachin	90	67	77	78	90		
10		Rishi	56	90	84	67	56		
11		Krish	78	76	89	56	78		
12		Shikha	85	87	69	90	85		
13		Rini	78	90	84	76	76		
14		Vrish	85	78	78	89	87		
15		Kelh	67	67	85	89	90		
16		Nikki	73	56	67	69	84		
17		Mayank	56	90	73	67	78		
18		Jaya	73	76	89	90	67		
19		Manish	89	78	67	87	78		

Step 2: Press the "Enter" key. The output is 79.8, as shown in the following image. Hence, Lini's average of five scores is 79.8.

Note: To find the average (of five scores) for all the students, simply drag the formula of cell H4 till cell H19. For dragging, use the fill handle at the bottom-right corner of cell H4.

H4	▾		fx	=AVERAGE(C4:G4)				
	A	B	C	D	E	F	G	H
2								
3		Name	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	
4		Lini	67	89	76	78	89	79.8
5		Abhishek	78	65	89	85	65	
6		Dia	67	68	89	67	68	
7		Dhruv	89	84	69	76	84	
8		Vishu	78	78	73	56	78	
9		Sachin	90	67	77	78	90	
10		Rishi	56	90	84	67	56	
11		Krish	78	76	89	56	78	
12		Shikha	85	87	69	90	85	
13		Rini	78	90	84	76	76	
14		Vrish	85	78	78	89	87	
15		Kelh	67	67	85	89	90	
16		Nikki	73	56	67	69	84	
17		Mayank	56	90	73	67	78	
18		Jaya	73	76	89	90	67	
19		Manish	89	78	67	87	78	

b. The steps to calculate the average of the top four scores of each student are listed as follows:

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Step 1: Enter the following formula in cell H4.

"=AVERAGE(LARGE(C4:G4,{1,2,3,4}))"

AVERAGE	▾	× ✓ fx	=AVERAGE(LARGE(C4:G4,{1,2,3,4}))			H	I	J	K
	B	C	D	E	F	G				
2										
3	Name	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5				
4	Lini	67	89	76	78	89	=AVERAGE(LARGE(C4:G4,{1,2,3,4}))			
5	Abhishek	78	65	89	85	65				
6	Dia	67	68	89	67	68				
7	Dhruv	89	84	69	76	84				
8	Vishu	78	78	73	56	78				
9	Sachin	90	67	77	78	90				
10	Rishi	56	90	84	67	56				
11	Krish	78	76	89	56	78				
12	Shikha	85	87	69	90	85				
13	Rini	78	90	84	76	76				
14	Vrish	85	78	78	89	87				
15	Kelh	67	67	85	89	90				
16	Nikki	73	56	67	69	84				
17	Mayank	56	90	73	67	78				
18	Jaya	73	76	89	90	67				
19	Manish	89	78	67	87	78				

Step 2: Press the "Enter" key. The output is shown in cell H4 of the following image. Hence, Lini's average of the top four scores is 83.

H4	▾ (		fx	=AVERAGE(LARGE(C4:G4,{1,2,3,4}))			
	B	C	D	E	F	G	H
2							
3	Name	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	
4	Lini	67	89	76	78	89	83
5	Abhishek	78	65	89	85	65	
6	Dia	67	68	89	67	68	
7	Dhruv	89	84	69	76	84	
8	Vishu	78	78	73	56	78	
9	Sachin	90	67	77	78	90	
10	Rishi	56	90	84	67	56	
11	Krish	78	76	89	56	78	
12	Shikha	85	87	69	90	85	
13	Rini	78	90	84	76	76	
14	Vrish	85	78	78	89	87	
15	Kelh	67	67	85	89	90	
16	Nikki	73	56	67	69	84	
17	Mayank	56	90	73	67	78	
18	Jaya	73	76	89	90	67	
19	Manish	89	78	67	87	78	

Step 3: Drag the formula of cell H4 till cell H19. The outputs for all rows are shown in the following image. Notice that all these outputs are the averages of the top four scores of each student.

H19			f_x	=AVERAGE(LARGE(C19:G19,{1,2,3,4}))			
	B	C	D	E	F	G	H
2							
3	Name	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	
4	Lini	67	89	76	78	89	83
5	Abhishek	78	65	89	85	65	79.25
6	Dia	67	68	89	67	68	73
7	Dhruv	89	84	69	76	84	83.25
8	Vishu	78	78	73	56	78	76.75
9	Sachin	90	67	77	78	90	83.75
10	Rishi	56	90	84	67	56	74.25
11	Krish	78	76	89	56	78	80.25
12	Shikha	85	87	69	90	85	86.75
13	Rini	78	90	84	76	76	82
14	Vrish	85	78	78	89	87	84.75
15	Kelh	67	67	85	89	90	82.75
16	Nikki	73	56	67	69	84	73.25
17	Mayank	56	90	73	67	78	77
18	Jaya	73	76	89	90	67	82
19	Manish	89	78	67	87	78	83

Explanation of the formula: In the formula of step 1, the inner function (LARGE function) is processed first, followed by the outer function (AVERAGE function). This formula works as follows:

a. An array of numbers {1,2,3,4} has been supplied to the **LARGE function**. These numbers represent the position from which values will be returned. So, the LARGE function searches for the first highest, second highest, third highest, and fourth highest values in the range C4:G4. As a result, the LARGE function returns an array of numbers, which is {89,89,78,76}.

b. The array of numbers returned by the LARGE function {89,89,78,76} serves as the argument of the AVERAGE function. The AVERAGE function calculates the average of these numbers, which is (89+89+78+76)/4=83.

Likewise, the average of the top four scores has been obtained for all the students of the range B4:B19.

Note: The LARGE function returns a value from the specified position of the supplied range. This position begins from the highest value of the dataset. So, the number 1 corresponds to the maximum value of the dataset, 2 corresponds to the second highest value, 3 corresponds to the third highest value, and so on.

For the syntax of the LARGE function, click the hyperlink given in point "a" of the preceding explanation.

Example #5–Average of Last Three Numbers by AVERAGE, LOOKUP, LARGE, IF, ISNUMBER, and ROW Functions

The following image shows some numeric and textual values in column B. Calculate the average of the last three numeric values, which are in cells B15, B17, and B18.

Use the AVERAGE, LOOKUP, LARGE, IF, ISNUMBER, and ROW functions of Excel. Further, explain the formula used for the given task.

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	A	B	C
1		**AVERAGE Function**	
2			
3		110000	
4		90000	
5	A12d		
6		80000	
7		60000	
8		90000	
9		80000	
10	B13e		
11		120000	
12		130000	
13	C14f		
14		130000	
15		110000	
16	D15g		
17		90000	
18		50000	
19			

The steps to calculate the average of the last three numeric cells are stated as follows:

Step 1: Enter the following formula in cell C3.

"=AVERAGE(LOOKUP(LARGE(IF(ISNUMBER(B3:B18),ROW(B3:B18)),{1,2,3}),ROW(B3:B18),B3:B18))"

Step 2: Press the keys "Ctrl+Shift+Enter" together. For Excel for Mac, press the keys "Command+Shift+Enter."

Once the CSE (Ctrl+Shift+Enter) keys are pressed, the formula is enclosed within curly braces. This is shown in the following image. The output is also shown in cell C3.

Hence, the average of the last three numeric values (110000, 90000, and 50000) is 83333.3.

Explanation of the formula: The formula of step 1 works as follows:

a. In the formula "ISNUMBER(B3:B18),ROW(B3:B18)," the **ROW function** returns the row numbers of the range B3:B18. So, the ROW function returns the following array of values:

{3;4;5;6;7;8;9;10;11;12;13;14;15;16;17;18}.

b. The **ISNUMBER function** processes each value returned by the ROW function. The ISNUMBER function returns "true" if a cell of column B contains a number. It returns "false" if a cell of column

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B contains a text string. Consequently, the ISNUMBER function returns the following array of logical values:

{TRUE;TRUE;FALSE;TRUE;TRUE;TRUE;TRUE;FALSE;TRUE;TRUE;FALSE;TRUE;TRUE;FALSE;TRUE;TRUE}

c. Next, the **IF function** operates. The "logical_test" of the IF function is "ISNUMBER(B3:B18)" and the "value_if_true" is "ROW(B3:B18)." The "value_if_false" has been omitted. Therefore, the IF function processes each value of the array returned by the ISNUMBER function. The IF function returns the row number for each "true" value and "false" for each "false" value. So, the IF function returns the following array of values:

{3;4;FALSE;6;7;8;9;FALSE;11;12;FALSE;14;15;FALSE;17;18}

d. The LARGE function has been supplied the array {1,2,3} in the formula "LARGE(IF(ISNUMBER(B3:B18),ROW(B3:B18)),{1,2,3})." So, the LARGE function searches for the first highest, second highest, and third highest values in the array returned by the IF function. The LARGE function returns the following array of three values:

{18,17,15}

e. Next, the LOOKUP function processes the formula "LOOKUP({18,17,15},ROW(B3:B18),B3:B18)." So, the LOOKUP function searches for the values 18, 17, and 15 in the array returned by the formula "ROW(B3:B18)." The array returned by this ROW formula is the same as that of point "a." Therefore, the LOOKUP function returns a corresponding match of the values 18, 17, and 15 from the range B3:B18. As a result, the following array is returned by the LOOKUP function:

{50000,90000,110000}

f. Finally, the AVERAGE function calculates the mean of the three values returned by the LOOKUP function. It returns 83333.3 [(50000+90000+110000)/3] as the average.

Notice that the formula of step 1 works as an array formula as it has been completed by pressing the CSE (Ctrl+Shift+Enter) keys. Therefore, the LOOKUP function also returns an array of corresponding matches (50000, 90000, and 110000) for the multiple "lookup_values" (18, 17, and 15) supplied to it.

However, the regular LOOKUP function looks for a single "lookup_value" and returns a single corresponding match. Moreover, it is completed by pressing the "Enter" key.

Note 1: The ROW function returns the row numbers of the supplied cell reference. The ISNUMBER function checks whether the supplied value or cell reference is numeric or not. It returns "true" if the supplied value (or reference) is numeric, otherwise it returns "false."

The IF function checks whether the supplied condition (logical_test) is true or false. If the condition is true, it returns the "value_if_true." If the condition is false, it returns the "value_if_false." If the logical test evaluates to false and the "value_if_false" is omitted, the IF function returns "false."

For the syntax of the ROW, ISNUMBER, and IF functions, click the hyperlinks given in points "a," "b," and "c" of the preceding explanation. The definitions of the LOOKUP and LARGE functions are given in the notes at the end of examples #3 and #4 respectively.

Note 2: To view the array returned by each function, follow the listed steps:

   a. Select cell C3 that contains the formula.

   b. Double-click within the selected cell. Alternatively, press the key F2 to enter the Edit mode.

   c. Select that part of the formula whose array needs to be viewed. For instance, to view the array returned by the ISNUMBER function, select "ISNUMBER(B3:B18)."

   d. Press the key F9 once a selection has been made in the preceding step.

To stop editing the formula, press the escape (Esc) key.

Summary

- IF statements allow you to perform conditional logic in Excel.

- They evaluate a specified condition and return one value if the condition is true and another value if it's false.
- Nested IF statements in Excel allow you to have multiple levels of conditional logic.
- You can use them to create more complex decision trees by embedding one IF statement within another.
- COUNTIF counts the number of cells within a range that meet a single specified condition.
- COUNTIFS extends this functionality by allowing you to count cells based on multiple criteria simultaneously.
- SUMIF calculates the sum of values in a range that meet a single specified condition.
- SUMIFS can sum values based on multiple criteria, making it useful for more complex calculations.
- AVERAGEIF calculates the average of values in a range that meet a single specified condition.
- AVERAGEIFS extends this capability to calculate the average based on multiple criteria.
- In IF statements, the logical test is a condition that is evaluated as either true or false.
- It determines which value (value_if_true or value_if_false) is returned by the IF statement.
- These are the values that the IF statement returns based on whether the logical test is true or false.
- Value_if_true is returned when the condition is true, and Value_if_false is returned when the condition is false.
- COUNTIFS, SUMIFS, AVERAGEIFS, and nested IF statements are valuable when you need to evaluate and work with multiple conditions simultaneously.
- The syntax for these functions typically includes specifying a range of cells and one or more criteria to apply to those cells.
- It's essential to ensure that your conditions and ranges are correctly specified to avoid errors in your IF statements and related functions.

Keywords

- IF Statement - A logical function in Excel that allows you to perform conditional calculations and return different values based on a specified condition.
- Nested IF - Using multiple IF statements within one another to create complex conditional logic with multiple levels of conditions.
- Countif - An Excel function used to count the number of cells within a range that meet a single specified condition.
- Countifs - An Excel function that extends the functionality of COUNTIF by allowing you to count cells based on multiple criteria simultaneously.
- Sumif - An Excel function used to calculate the sum of values in a range that meet a single specified condition.
- Sumifs - An Excel function that extends the capability of SUMIF by allowing you to sum values based on multiple criteria.
- Averageif - An Excel function used to calculate the average of values in a range that meet a single specified condition.
- Averageifs - An Excel function that extends the capability of AVERAGEIF by allowing you to calculate the average based on multiple criteria.
- Logical Test - The condition or expression in an IF statement that determines whether a specified action is taken.

- Criteria - The conditions or requirements that you specify in functions like COUNTIF, COUNTIFS, SUMIF, SUMIFS, AVERAGEIF, and AVERAGEIFS to filter and calculate values in a dataset.

Self Assessment

1. What is the purpose of an IF statement in Excel?
A. To count cells
B. To sum numbers
C. To perform conditional logic
D. To format text

2. Which function is used in Excel to check if a condition is true or false and return different values accordingly?
A. SUMIF
B. AVERAGEIF
C. IF
D. COUNTIF

3. In Excel, which of the following functions can be used to count the number of cells that meet a specific condition?
A. SUMIF
B. AVERAGEIF
C. IF
D. COUNTIF

4. What is the syntax for a simple IF statement in Excel?
A. IF(logical_test, value_if_true)
B. IF(value_if_true, logical_test)
C. IF(logical_test, value_if_true, value_if_false)
D. IF(value_if_true, value_if_false, logical_test)

5. In Excel, which function can be used to perform conditional calculations based on multiple criteria?
A. SUMIF
B. AVERAGEIF
C. COUNTIFS
D. IF

6. What does a nested IF statement in Excel allow you to do?
A. Combine multiple Excel workbooks
B. Perform calculations on large datasets
C. Perform multiple levels of conditional testing
D. Sum a range of values

7. In a nested IF statement, what happens if none of the conditions are met?
A. The first condition is applied
B. The last condition is applied

C. An error is returned

D. The default value is applied

8. What is the purpose of the COUNTIFS function in Excel?

A. To count cells that meet multiple criteria

B. To sum cells that meet multiple criteria

C. To average cells that meet multiple criteria

D. To perform conditional formatting

9. Which function is used in Excel to sum the values in a range based on a specified condition?

A. SUMIF

B. AVERAGEIF

C. COUNTIF

D. IF

10. Which of the following Excel functions is used to calculate the average of values in a range that meet a specific condition?

A. AVERAGEIF

B. SUMIF

C. COUNTIF

D. IF

11. In Excel, what is the primary difference between SUMIF and SUMIFS?

A. SUMIF can only handle one condition, while SUMIFS can handle multiple conditions.

B. SUMIF can handle multiple conditions, while SUMIFS can only handle one condition.

C. SUMIF and SUMIFS are used interchangeably.

D. There is no difference between SUMIF and SUMIFS.

12. Which Excel function can be used to count the number of cells that meet multiple conditions?

A. COUNTIF

B. AVERAGEIF

C. COUNTIFS

D. IF

13. In Excel, what is the purpose of the AVERAGEIFS function?

A. To find the average of a range of values

B. To find the sum of a range of values

C. To count the number of cells that meet multiple conditions

D. To average a range of values based on multiple criteria

14. How is the logical_test parameter structured in an IF statement?

A. It is a required parameter.

B. It is optional.

C. It can only be a number.

D. It can only be text.

15. Which Excel function is used to sum a range of values based on a single condition?

A. SUMIF

B. AVERAGEIF

C. COUNTIF

D. IF

16. In a nested IF statement, how many levels of conditions can you have?

A. Two

B. Three

C. Four

D. Unlimited

17. What does the COUNTIF function return in Excel?

A. The sum of values that meet a condition

B. The average of values that meet a condition

C. The count of values that meet a condition

D. The maximum value that meets a condition

18. In Excel, which function can be used to find the sum of values that meet multiple conditions?

A. SUMIF

B. AVERAGEIF

C. SUMIFS

D. IF

19. What is the primary purpose of using the IF function in Excel?

A. To perform mathematical calculations

B. To format cells

C. To perform conditional testing and return different values

D. To create charts

20. Which of the following is NOT a valid function in Excel for conditional calculations?

A. IF

B. SUM

C. COUNT

D. AVERAGE

Answers for Self Assessment

1.	C	2.	C	3.	D	4.	A	5.	C
6.	C	7.	D	8.	A	9.	A	10.	A
11.	A	12.	C	13.	D	14.	A	15.	A
16.	D	17.	C	18.	C	19.	C	20.	B

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Review Questions

1. What is the main purpose of an IF statement in Excel?
2. How does a nested IF statement differ from a regular IF statement?
3. When would you use the COUNTIF function in Excel, and what does it return?
4. Explain the difference between SUMIF and SUMIFS in Excel.
5. What does the SUMIF function do, and how is it structured?
6. In Excel, when might you use the AVERAGEIF function, and how does it work?
7. What is the primary purpose of the COUNTIFS function in Excel, and how is its syntax different from COUNTIF?
8. How do you structure a simple IF statement in Excel?
9. Describe a scenario in which you might use the SUMIFS function.
10. How does the AVERAGEIFS function differ from AVERAGEIF, and what kind of calculations can it perform?

Further Reading

- https://corporatefinanceinstitute.com/resources/excel/excel-if-statement-guide/
- https://www.w3schools.com/excel/excel_if.php
- https://www.perfectxl.com/excel-glossary/how-to-use-if-function-excel/
- https://www.wallstreetmojo.com/if-excel-function/
- https://www.excel-easy.com/examples/if.html
- https://exceljet.net/formulas/nested-if-function-example
- https://www.ablebits.com/office-addins-blog/excel-nested-if-statement/
- https://www.ablebits.com/office-addins-blog/nested-if-excel-multiple-conditions/
- https://www.javatpoint.com/nested-if-function-in-excel
- https://www.wallstreetmojo.com/excel-nested-if-function/
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- https://www.makeuseof.com/use-countif-countifs-function-excel/
- https://trumpexcel.com/multiple-criteria-in-excel-countif/
- https://spreadsheeto.com/sumif-and-sumifs/
- https://www.ablebits.com/office-addins-blog/excel-sumifs-multiple-criteria/#:~:text=SUMIF%20can%20evaluate%20just%20one,the%20first%20and%20required%20argument.
- https://www.wallstreetmojo.com/average-function-in-excel/
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- https://www.kmacims.com.ng/the-averageif-and-averageifs-function-in-excel/

Unit 09 : Look Up Functions

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Objectives

After this unit, you will be able to

- Understand the concept and use of VLOOKUP function in MS-EXCEL.
- Understand the concept and use of HLOOKUP function in MS-EXCEL.
- Understand the concept and use of Index and Match function in MS-EXCEL.

Introduction

Look-up functions are a crucial component in spreadsheet software and programming languages. They enable users to search for specific data within a dataset or table and retrieve corresponding information. Common examples include VLOOKUP and HLOOKUP in Excel, which are essential for data analysis and organization.

9.1   VLOOKUP Function

The VLOOKUP function is a premade function in Excel, which allows searches across columns.

It is typed =VLOOKUP and has the following parts:

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

Note: The column which holds the data used to lookup must always be to the left.

Note: The different parts of the function are separated by a symbol, like comma , or semicolon ;

The symbol depends on your Language Settings.

Lookup_value: Select the cell where search values will be entered.

Table_array: The table range, including all cells in the table.

Col_index_num: The data which is being looked up. The input is the number of the column, counted from the left:

	A	B	C	D	E
1	**1**	**2**	**3**	**4**	**5**
2	#	Name	Type 1	Type 2	Total
3	1	Bulbasaur	Grass	Poison	318
4	2	Ivysaur	Grass	Poison	405
5	3	Venusaur	Grass	Poison	525
6	4	Charmander	Fire		309
7	5	Charmeleon	Fire		405
8	6	Charizard	Fire	Flying	534
9	7	Squirtle	Water		314
10	8	Wartortle	Water		405
11	9	Blastoise	Water		530
12	10	Caterpie	Bug		195
13	11	Metapod	Bug		205
14	12	Butterfree	Bug	Flying	395
15	13	Weedle	Bug	Poison	195
16	14	Kakuna	Bug	Poison	205
17	15	Beedrill	Bug	Poison	395
18	16	Pidgey	Normal	Flying	251
19	17	Pidgeotto	Normal	Flying	349
20	18	Pidgeot	Normal	Flying	479
21	19	Rattata	Normal		253
22	20	Raticate	Normal		413

Range_lookup: TRUE if numbers (1) or FALSE if text (0).

Note: Both 1 / 0 and True / False can be used in Range_lookup.

How to use the VLOOKUP function.

1. Select a cell (H4)

2. Type =VLOOKUP

3. Double click the VLOOKUP command

4. Select the cell where search value will be entered (H3)

5. Type (,)

6. Mark table range (A2:E21)

7. Type (,)

8. Type the number of the column, counted from the left (2)

9. Type True (1) or False (0) (1)

10. Hit enter

11. Enter a value in the cell selected for the Lookup_value H3(7)

Let's have a look at an example!

Use the VLOOKUP function to find the Pokemon names based on their ID#:

H4 is where the search result is displayed. In this case, the Pokemons names based on their ID#.

H3 selected as lookup_value. This is the cell where the search query is entered. In this case the Pokemons ID#.

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The range of the table is marked at table_array, in this example A2:E21.

The number 2 is entered as col_index_number. This is the second column from the left and is the data that is being looked up.

An illustration for selecting col_index_number 2.

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Ok, so next - 1 (True) is entered as range_lookup. This is because the most left column has numbers only. If it was text, 0 (False) would have been used.

Good job! The function returns the #N/A value. This is because there have not been entered any value to the Search ID# H3.

Let us feed a value to it, type H3(7):

	A	B	C	D	E	F	G	H
1	ID#	Name	Type 1	Type 2	Total			
2	1	Bulbasaur	Grass	Poison	318			
3	2	Ivysaur	Grass	Poison	405		Search ID#	7
4	3	Venusaur	Grass	Poison	525		Name	Squirtle
5	4	Charmander	Fire		309			
6	5	Charmeleon	Fire		405			
7	6	Charizard	Fire	Flying	534			
8	7	Squirtle	Water		314			
9	8	Wartortle	Water		405			
10	9	Blastoise	Water		530			
11	10	Caterpie	Bug		195			
12	11	Metapod	Bug		205			
13	12	Butterfree	Bug	Flying	395			
14	13	Weedle	Bug	Poison	195			
15	14	Kakuna	Bug	Poison	205			
16	15	Beedrill	Bug	Poison	395			
17	16	Pidgey	Normal	Flying	251			
18	17	Pidgeotto	Normal	Flying	349			
19	18	Pidgeot	Normal	Flying	479			
20	19	Rattata	Normal		253			
21	20	Raticate	Normal		413			
22								

Have a look at that! The VLOOKUP function has successfully found the Pokemon Squirtle which has the ID# 7.

One more time, type (H3)4:

	A	B	C	D	E	F	G	H
1	ID#	Name	Type 1	Type 2	Total			
2	1 Bulbasaur		Grass	Poison	318			
3	2 Ivysaur		Grass	Poison	405		Search ID#	4
4	3 Venusaur		Grass	Poison	525		Name	Charmander
5	4 Charmander		Fire		309			
6	5 Charmeleon		Fire		435			
7	6 Charizard		Fire	Flying	534			
8	7 Squirtle		Water		314			
9	8 Wartortle		Water		405			
10	9 Blastoise		Water		530			
11	10 Caterpie		Bug		195			
12	11 Metapod		Bug		205			
13	12 Butterfree		Bug	Flying	395			
14	13 Weedle		Bug	Poison	195			
15	14 Kakuna		Bug	Poison	205			
16	15 Beedrill		Bug	Poison	395			
17	16 Pidgey		Normal	Flying	251			
18	17 Pidgeotto		Normal	Flying	349			
19	18 Pidgeot		Normal	Flying	479			
20	19 Rattata		Normal		253			
21	20 Raticate		Normal		413			
22								

It still works! The function returned Charmanders name, which has 4 as its ID#. That's great.

9.2 HLOOKUP Function

How to use HLOOKUP in Excel

HLOOKUP in Excel stands for 'Horizontal Lookup'. It is a function that makes Excel search for a certain value in a row (the so called 'table array'), in order to return a value from a different row in the same column.

Definition HLOOKUP function

A HLOOKUP function in Excel exists of 4 components:

1. The value you want to look up;

2. The range in which you want to find the value and the return value;

3. The number of the row within your defined range, that contains the return value;

4. 0 or FALSE for an exact match with the value your are looking for; 1 or TRUE for an approximate match.

Syntax: HLOOKUP([value], [range], [row number], [false or true])

HLOOKUP example

In our example we show how many pieces of fruits are sold per day in the first week of May. We want to find out how many oranges were sold each day of the week.

First, select a cell in which you want to publish the sold amount of oranges. We start with 'Day 1':

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In our example we show how many pieces of fruits are sold per day in the first week of May. We want to find out how many oranges were sold each day of the week.

First, select a cell in which you want to publish the sold amount of oranges. We start with 'Day 1':

Then we select the value (from row 1) we want to look up, in this case it's 'Orange' in cell F1.

We can insert this value as a string: "Orange" (image 1), or as a cell reference: F1 (image 2):

Image 1, Value as a String

Image 2, Value as a Cell Reference

Next we enter ';' and select the range (or table array) in which we want to find the lookup value and the return value. In this case it is range (B1:H8):

Then we enter ';' and the number of the row within the defined range in which we want to look for the return value. In this case it is row 2 (for day 1), followed by ';' and '0' or 'FALSE for an exact match with the lookup value 'Orange':

When we press enter, we get the amount of oranges sold on day 1:

Spreadsheet Modelling (Using Excel)

B12   fx   =HLOOKUP("Orange";A1:H8;2;0)

	A	B	C	D	E	F	G	H	I
1		Apple	Banana	Kiwi	Lemon	Orange	Peach	Pear	
2	May 1st	21	15	19	19	17	20	22	
3	May 2nd	25	17	20	23	24	22	17	
4	May 3rd	30	20	22	24	30	23	19	
5	May 4th	29	21	21	22	22	23	11	
6	May 5th	20	18	18	21	18	19	13	
7	May 6th	18	16	16	20	16	17	17	
8	May 7th	32	21	19	18	20	16	18	
9	Total week 1	175	128	135	147	146	140	117	
10									
11		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	
12	Oranges sold	17							
13									
14									

To look up the value for day 2, we can copy the HLOOKUP formula, and replace row 2 with row 3:

=HLOOKUP("Orange";B1:H8;3;0):

C12   fx   =HLOOKUP("Orange";B1:H8;3;0)

	A	B	C	D	E	F	G	H	I
1		Apple	Banana	Kiwi	Lemon	Orange	Peach	Pear	
2	May 1st	21	15	19	19	17	20	22	
3	May 2nd	25	17	20	23	24	22	17	
4	May 3rd	30	20	22	24	29	23	19	
5	May 4th	29	21	21	22	22	23	11	
6	May 5th	20	18	18	21	18	19	13	
7	May 6th	18	16	16	20	16	17	17	
8	May 7th	32	21	19	18	20	16	18	
9	Total week 1	175	128	135	147	146	140	117	
10									
11		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	
12	Oranges sold	17	24	29	22	18	16	20	
13									
14									

We can repeat this process for each formula within the formula range B12:H12.

In this example we only have a small list of dates, but imagine you have a long list that publishes several years and you wish to use a certain value in other worksheets! Using HLOOKUP (and VLOOKUP) the user only has to change a certain value in one worksheet and it will automatically be changed in all other relevant places.

But what if you're not certain about your lookup value? Then you can consider an approximate match (set False to True).

Approximate Match in HLOOKUP

When we enter the word 'Ornage' in our HLOOKUP function, because we are not sure about the spelling of the value that we're looking for. The formula as we designed it gets confused, because it can't find this value in the table array. It returns the standard Excel error #N/A:

B12 | | ✕ ✓ *fx* =HLOOKUP("Ornage";B1:H8;2;0)

	A	B	C	D	E	F	G	H	I
1		Apple	Banana	Kiwi	Lemon	Orange	Peach	Pear	
2	May 1st	21	15	19	19	17	20	22	
3	May 2nd	25	17	20	23	24	22	17	
4	May 3rd	30	20	22	24	29	23	19	
5	May 4th	29	21	21	22	22	23	11	
6	May 5th	20	18	18	21	18	19	13	
7	May 6th	18	16	16	20	16	17	17	
8	May 7th	32	21	19	18	20	15	18	
9	Total week 1	175	128	135	147	146	140	117	
10									
11		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	
12	Oranges sold	#N/A	24	29	22	18	16	20	
13									
14									

Let us change the '0' (or 'False') component of our HLOOKUP function to '1' or 'TRUE':

=HLOOKUP("Ornage";B1:H8;2;1)

Now we have asked the function to look for an approximate match with 'Ornage'. If it can't find the exact match, it will look for the closest match to the value 'Ornage', less than 'Ornage', which is 'Orange':

B12 | | ✕ ✓ *fx* =HLOOKUP("Ornage";B1:H8;2;1)

	A	B	C	D	E	F	G	H	I
1		Apple	Banana	Kiwi	Lemon	Orange	Peach	Pear	
2	May 1st	21	15	19	19	17	20	22	
3	May 2nd	25	17	20	23	24	22	17	
4	May 3rd	30	20	22	24	29	23	19	
5	May 4th	29	21	21	22	22	23	11	
6	May 5th	20	18	19	21	18	19	13	
7	May 6th	18	16	16	20	16	17	17	
8	May 7th	32	21	19	18	20	15	18	
9	Total week 1	175	128	135	147	146	140	117	
10									
11		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	
12	Oranges sold	17	24	29	22	18	15	20	
13									
14									

Would we enter 'Arange' instead of "Orange", the function returns 21, because then 'Apple' is the closest match less than 'Orange' (based on the alphabet):

B12 | | ✕ ✓ *fx* =HLOOKUP("Arange";B1:H8;2;1)

	A	B	C	D	E	F	G	H	I
1		Apple	Banana	Kiwi	Lemon	Orange	Peach	Pear	
2	May 1st	21	15	19	19	17	20	22	
3	May 2nd	25	17	20	23	24	22	17	
4	May 3rd	30	20	22	24	29	23	19	
5	May 4th	29	21	21	22	22	23	11	
6	May 5th	20	18	18	21	18	19	13	
7	May 6th	18	16	16	20	16	17	17	
8	May 7th	32	21	19	18	20	16	18	
9	Total week 1	175	128	135	147	146	140	117	
10									
11		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	
12	Oranges sold	21	24	29	22	18	16	20	
13									
14									

9.3   INDEX and MATCH Functions

Since the aim of this tutorial is to demonstrate an alternative way to do a vlookup in Excel by using a combination of INDEX and MATCH functions, we won't dwell much on their syntax and uses. We will cover only the minimum necessary for understanding the general idea and then take an in-

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depth look at formula examples that reveal all the advantages of using INDEX MATCH instead of VLOOKUP.

INDEX function - syntax and usage

The Excel INDEX function returns a value in an array based on the row and column numbers you specify. The syntax of the INDEX function is straightforward:

INDEX(array, row_num, [column_num])

Here is a very simple explanation of each parameter:

- array - a range of cells that you want to return a value from.

- row_num - the row number in array from which you want to return a value. If omitted, the column_num is required.

- column_num - the column number in array from which you want to return a value. If omitted, row_num is required.

For more information, please see Excel INDEX function.

And here is an example of the INDEX formula in its simplest form:

=INDEX(A1:C10,2,3)

The formula searches in cells A1 through C10 and returns a value of the cell in the 2nd row and the 3rd column, i.e. cell C2.

Very easy, right? However, when working with real data you would hardly ever know which row and column you want, that's where the MATCH function comes in handy.

MATCH function - syntax and usage

The Excel MATCH function searches for a lookup value in a range of cells and returns the relative position of that value in the range.

The syntax of the MATCH function is as follows:

MATCH (lookup_value, lookup_array, [match_type])

- lookup_value - the number or text value you are looking for.
- lookup_array - a range of cells being searched.
- match_type - specifies whether to return an exact match or the nearest match:
  - 1 or omitted - finds the largest value that is less than or equal to the lookup value. Requires sorting the lookup array in ascending order.
  - 0 - finds the first value that is exactly equal to the lookup value. In the INDEX / MATCH combination, you almost always need an exact match, so you set the third argument of your MATCH function to 0.
  - -1 - finds the smallest value that is greater than or equal to lookup_value. Requires sorting the lookup array in descending order.

For example, if the range B1:B3 contains the values "New-York", "Paris", "London", the below formula returns the number 3, because "London" is the third entry in the range:

=MATCH("London",B1:B3,0)

For more information, please see Excel MATCH function.

At first sight, the usefulness of the MATCH function may seem questionable. Who cares about the position of a value in a range? What we do want to know is the value itself.

Let me remind you that the relative position of the lookup value (i.e. row and column numbers) is exactly what you need to supply to the *row_num* and *column_num* arguments of the INDEX function. As you remember, Excel INDEX can find the value at the juncture of a given row and column, but it cannot determine which exactly row and column you want.

How to use INDEX MATCH function in Excel

Now that you know the basics, I believe it has already started making sense how MATCH and INDEX work together. In a nutshell, INDEX finds the lookup value by column and row numbers, and MATCH provides those numbers. That's it!

For vertical lookup, you use the MATCH function only to determine the row number and supply the column range directly to INDEX:

INDEX (column to return a value from, MATCH (*lookup value, column to look up against,* 0))

Still having difficulties to figure that out? It might be easier to understand from an example. Suppose you have a list of national capitals and their population:

	A	B	C
1	Country	Capital	Population
2	China	Beijing	20,693,000
3	India	New Delhi	17,838,842
4	Japan	Tokyo	13,189,000
5	Russia	Moscow	11,541,000
6	South Korea	Seoul	10,528,774
7	Indonesia	Jakarta	10,187,595
8	Iran	Tehran	9,110,347
9	Mexico	Mexico City	8,851,080
10	Peru	Lima	8,481,415

To find the population of a certain capital, say the capital of Japan, use the following INDEX MATCH formula:

=INDEX(C2:C10, MATCH("Japan", A2:A10, 0))

Now, let's analyze what each component of this formula actually does:

- The MATCH function searches for the lookup value "Japan" in the range A2:A10, and returns the number 3, because "Japan" is third in the lookup array.
- The row number goes directly to the *row_num* argument of INDEX instructing it to return a value from that row.

So, the above formula turns into a simple INDEX(C2:C,3) that says to search in cells C2 through C10 and pull the value from the 3rd cell in that range, i.e. C4 because we start counting from the second row.

Don't want to hardcode the city in the formula? Input it in some cell, say F1, supply the cell reference to MATCH, and you will get a dynamic lookup formula:

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=INDEX(C2:C10,   **MATCH(F1,A2:A10,0))**

	A	B	C	D	E	F
						=INDEX(C2:C10, MATCH(F1,A2:A10,0))
1	Country	Capital	Population		Country	Japan
2	China	Beijing	20,693,000		Capital population	13,189,000
3	India	New Delhi	17,838,842			
4	Japan	Tokyo	13,189,000			
5	Russia	Moscow	11,541,000			
6	South Korea	Seoul	10,528,774			
7	Indonesia	Jakarta	10,187,595			
8	Iran	Tehran	9,110,347			
9	Mexico	Mexico City	8,851,080			
10	Peru	Lima	8,481,415			

Important note! The number of rows in the *array* argument of INDEX should match the number of rows in the *lookup_array* argument of MATCH, otherwise the formula will produce an incorrect result.

Wait, wait… why don't we simply use the following Vlookup formula? What's the point in wasting time trying to figure out the arcane twists of Excel MATCH INDEX?

=VLOOKUP(F1, A2:C10, 3, FALSE)

In this case, no point at all :) This simple example is for demonstration purposes only, so that you get a feel of how the INDEX and MATCH functions work together. Other examples that follow below will show you the real power of this combination that easily copes with many complex scenarios when VLOOKUP stumbles.

Excel INDEX MATCH - formula examples

Knowing the reasons to learn the MATCH INDEX function, let's get to the most interesting part and see how you can apply the theoretical knowledge in practice.

INDEX MATCH formula to look up from right to left

As already mentioned, VLOOKUP cannot look at its left. So, unless your lookup values are is the leftmost column, there's no chance that a Vlookup formula will bring you the result you want. The INDEX MATCH function in Excel is more versatile and does not really care where the lookup and return columns are located.

For this example, we will add the Rank column to the left of our sample table and try to figure out how the Russian capital, Moscow, ranks in terms of population.

With the lookup value in G1, use the following formula to search in C2:C10 and return a corresponding value from A2:A10:

=INDEX(A2:A10,MATCH(G1,C2:C10,0))

	A	B	C	D	E	F	G
	Return column		Lookup column			=INDEX(A2:A10, MATCH(G1,C2:C10,0))	
1	Rank	Country	Capital	Population		Capital	Moscow
2		1 China	Beijing	20,693,000		Rank	4
3		2 India	New Delhi	17,838,842			
4		3 Japan	Tokyo	13,189,000			
5		4 Russia	Moscow	11,541,000			
6		5 South Korea	Seoul	10,528,774			
7		6 Indonesia	Jakarta	10,187,595			
8		7 Iran	Tehran	9,110,347			
9		8 Mexico	Mexico City	8,851,080			
10		9 Peru	Lima	8,481,415			

Tip. If you plan to use your INDEX MATCH formula for more than one cell, be sure to lock both ranges with absolute cell references (like $A$2:$A$10 and $C$2:4C$10) so they won't get distorted when copying the formula.

INDEX MATCH MATCH to search in rows and columns

In the above examples, we used INDEX MATCH as the replacement for classic VLOOKUP to return a value from a predefined one-column range. But what if you need to look up in multiple rows and columns? In other words, what if you want to perform the so-called *matrix* or *two-way* lookup?

This may sound tricky, but the formula is very similar to the basic Excel INDEX MATCH function, with just one difference. Guess what?

Simply, use two MATCH functions – one to get a row number and the other to get a column number. And I congratulate those of you who have guessed right :)

INDEX (array, MATCH (*vlookup value, column to look up against*, 0), MATCH (*hlookup value, row to look up against*, 0))

And now, please take a look at the below table and let's build an INDEX MATCH MATCH formula to find the population (in millions) in a given country for a given year.

With the target country in G1 (vlookup value) and the target year in G2 (hlookup value), the formula takes this shape:

=INDEX(B2:D11, MATCH(G1,A2:A11,0), MATCH(G2,B1:D1,0))

G3		fx	=INDEX(B2:D11, MATCH(G1,A2:A11,0), MATCH(G2,B1:D1,0))				
	A	B	C	D	E	F	G
1	Country	1950	2000	2015		Country:	China
2	India	357,561	1,008,937	1,230,484		Year:	2015
3	China	554,760	1,275,133	1,410,217		Population (M):	1,410,217
4	USA	157,813	283,230	321,225			
5	Pakistan	39,659	141,256	204,267			
6	Indonesia	79,538	212,092	250,068			
7	Nigeria	29,790	113,862	165,313			
8	Bangladesh	41,783	137,439	183,159			
9	Brazil	53,975	170,406	201,393			
10	Congo	12,184	50,948	84,045			
11	Ethiopia	18,434	62,908	89,765			

How this formula works

Whenever you need to understand a complex Excel formula, break it down into smaller parts and see what each individual function does:

MATCH(G1,A2:A11,0) – searches through A2:A11 for the value in cell G1 ("China") and returns its position, which is 2.

MATCH(G2,B1:D1,0)) – searches through B1:D1 to get the position of the value in cell G2 ("2015"), which is 3.

The above row and column numbers go to the corresponding arguments of the INDEX function:

INDEX(B2:D11, 2, 3)

As the result, you get a value at the intersection of the 2nd row and 3rd column in the range B2:D11, which is the value in cell D3. Easy? Yep!

Excel INDEX MATCH to look up multiple criteria

If you had a chance to read our Excel VLOOKUP tutorial, you have probably already tested a formula to Vlookup with multiple criteria. However, a significant limitation of that approach is the necessity to add a helper column. The good news is that Excel's INDEX MATCH function can look up with two or more criteria too, without modifying or restructuring your source data!

Here's the generic INDEX MATCH formula with multiple criteria:

{=INDEX(return_range, MATCH(1, (criteria1=range1) * (criteria2=range2), 0))}

Spreadsheet Modelling (Using Excel)

Note. This is an array formula that must be completed with the Ctrl + Shift + Enter shortcut.

In the sample table below, supposing you want to find the amount based on 2 criteria, *Customer* and *Product*.

The following INDEX MATCH formula works a treat:

=INDEX(C2:C10, MATCH(1, (F1=A2:A10) * (F2=B2:B10), 0))

Where C2:C10 is the range to return a value from, F1 is criteria1, A2:A10 is the range to compare against criteria1, F2 is criteria 2, and B2:B10 is the range to compare against criteria2.

Remember to enter the formula correctly by pressing Ctrl + Shift + Enter, and Excel will automatically enclose it curly brackets as shown in the screenshot:

If you'd rather not use array formulas in your worksheets, add one more INDEX function to the formula and complete it with a usual Enter hit:

Summary

VLOOKUP:

1. Purpose: VLOOKUP is used to search for a value in the leftmost column of a table or range and retrieve a corresponding value from a specified column.

2. Structure: VLOOKUP consists of four main arguments: the lookup value, table array, column index number, and range lookup (which determines if it's an exact or approximate match).

3. Table Format: VLOOKUP works best with data arranged in vertical tables, with the lookup column on the left.

4. Approximate Match: By default, VLOOKUP performs an approximate match, returning the closest value if an exact match isn't found.

5. Exact Match: To perform an exact match, set the range lookup argument to FALSE or 0.

6. Error Handling: If the lookup value is not found, VLOOKUP returns a #N/A error, which can be managed using error handling techniques.

HLOOKUP:

7. Purpose: HLOOKUP performs a horizontal lookup, searching for a value in the top row of a table and returning a corresponding value from a specified row.

8. Table Format: HLOOKUP is suitable for data organized in horizontal tables, with the lookup row at the top.

9. Usage: HLOOKUP is less commonly used than VLOOKUP but can be valuable when dealing with transposed data.

INDEX and MATCH:

10. Purpose: INDEX and MATCH functions are often used together to provide a more flexible and powerful way to look up values in Excel.

11. INDEX: The INDEX function returns the value of a cell in a specified row and column within a range or array.

12. MATCH: The MATCH function is used to find the relative position of a value within a range or array.

13. Flexibility: INDEX and MATCH can handle both vertical and horizontal data arrangements, making them versatile for various lookup scenarios.

14. Multiple Criteria: INDEX and MATCH can be used to perform lookups based on multiple criteria, which is challenging with VLOOKUP or HLOOKUP.

15. Error Handling: If a value is not found using MATCH, it returns a #N/A error, and INDEX can be used to manage this error and return customized results.

16. Two-Way Lookups: INDEX and MATCH are especially useful for two-way lookups, where you need to find a value at the intersection of a row and column.

17. Array Formulas: When used together, INDEX and MATCH often require being entered as array formulas (Ctrl+Shift+Enter) to handle multiple results.

18. Performance: In some cases, INDEX and MATCH can be more resource-efficient than VLOOKUP, especially in large datasets.

19. Versatility: The combination of INDEX and MATCH provides a versatile alternative to VLOOKUP and HLOOKUP, offering greater control and adaptability in lookup tasks.

Keywords

- VLOOKUP: A function in Excel used to vertically look up a value in a table and retrieve a corresponding value from a specified column.

- HLOOKUP: A function in Excel used to horizontally look up a value in a table and retrieve a corresponding value from a specified row.

- INDEX: A function in Excel that returns the value of a cell within a specified range or array based on row and column numbers.

- MATCH: A function in Excel used to find the relative position of a value within a range or array.
- Lookup Value: The value you want to find in a table when using VLOOKUP or HLOOKUP, or the value you want to locate with MATCH.
- Table Array: The range or array where the data is stored from which you want to retrieve a value using VLOOKUP or HLOOKUP, or the range within which you want to search using MATCH.
- Column Index Number: The argument in VLOOKUP that specifies which column from the table array to return a value from, or the argument used with INDEX to specify the column number.
- Range Lookup: An optional argument in VLOOKUP that determines whether to perform an approximate or exact match; it's typically set to TRUE for approximate matches and FALSE for exact matches.

Self Assessment

1. What does the V in VLOOKUP stand for?
A. Vertical
B. Value
C. Variable
D. Viable

2. Which Excel function is used to look up a value in a vertical table and return a corresponding value from a specified column?
A. HLOOKUP
B. VSEARCH
C. MATCH
D. VLOOKUP

3. In a VLOOKUP function, which column is used to find the lookup value?
A. Lookup column
B. Result column
C. Table array column
D. Index column

4. What happens if the lookup value is not found in the table array for a VLOOKUP function?
A. An error is returned
B. The last value in the table array is returned
C. The first value in the table array is returned
D. None of the above

5. In Excel, what is the purpose of the HLOOKUP function?
A. To look up values in a vertical table
B. To look up values in a horizontal table
C. To perform mathematical calculations
D. To create charts

6. Which of the following is not a required parameter for the VLOOKUP function?
A. Lookup value
B. Table array
C. Column index number
D. Match type

7. What does the H in HLOOKUP stand for?
A. Horizontal
B. Highlight
C. Header
D. Helper

8. Which function is used to search for a value in the top row of a table and return a corresponding value from a specified row?
A. VLOOKUP
B. HSEARCH
C. INDEX
D. HLOOKUP

9. What does the INDEX function in Excel do?
A. Looks up values in a table and returns corresponding values
B. Returns the position of a specified value in a range
C. Returns the value of a specified cell
D. Returns the row or column number of a specified cell

10. Which function is used to search for a value in a range and return its relative position within that range?
A. MATCH
B. LOOKUP
C. INDEX
D. SEARCH

11. What is one advantage of using the INDEX and MATCH functions over VLOOKUP?
A. INDEX and MATCH can handle multiple criteria
B. VLOOKUP is faster than INDEX and MATCH
C. INDEX and MATCH are easier to use
D. VLOOKUP can handle multiple lookup values

12. In the INDEX function, what does the "row_num" argument specify?
A. The column number
B. The row number
C. The lookup value
D. The table array

13. Which function combination is commonly used to perform a two-way lookup in Excel?
A. VLOOKUP and HLOOKUP

B. INDEX and MATCH

C. LOOKUP and SEARCH

D. IF and THEN

14. What is the primary advantage of using the INDEX and MATCH combination over VLOOKUP or HLOOKUP?

A. INDEX and MATCH can handle more extensive datasets

B. INDEX and MATCH are faster in processing

C. VLOOKUP and HLOOKUP are obsolete functions

D. VLOOKUP and HLOOKUP can't perform two-way lookups

15. In a MATCH function, what does the "match_type" argument specify?

A. The type of lookup to perform

B. The position of the match

C. The lookup value

D. The table array

16. In Excel, which of the following is a limitation of the VLOOKUP function that can be overcome by using INDEX and MATCH?

A. Inability to perform approximate matches

B. Inability to handle text values

C. Inability to work with tables with multiple criteria

D. None of the above

17. What does the INDEX function return if no match is found?

A. #N/A error

B. 0

C. The first value in the specified range

D. Blank cell

18. What type of lookup can the VLOOKUP function perform by default?

A. Exact match

B. Approximate match

C. Partial match

D. Case-sensitive match

19. When would you use the INDEX function with multiple parameters?

A. To return an entire row or column of data

B. To search for a value in a specific range

C. To perform arithmetic calculations

D. To create a chart

20. In a MATCH function, which argument is optional and typically omitted when performing an exact match?

A. Lookup_value

B. Lookup_array

C. Match_type

D. All arguments are required

Answers for Self Assessment

1.	A	2.	D	3.	A	4.	A	5.	B
6.	D	7.	A	8.	D	9.	A	10.	A
11.	A	12.	B	13.	B	14.	A	15.	A
16.	C	17.	A	18.	B	19.	A	20.	C

Review Questions

1. What is the primary purpose of the VLOOKUP function in Excel?
2. Explain the key components of a VLOOKUP function, including the lookup value, table array, column index number, and range lookup.
3. What does the "range_lookup" argument in the VLOOKUP function control, and what are the two possible values for it?
4. In Excel, how does the HLOOKUP function differ from the VLOOKUP function in terms of table orientation and operation?
5. When using VLOOKUP, what should you do if you want to find an exact match in the lookup table?
6. What does the "#N/A" error mean when it appears as a result of a VLOOKUP function, and how can you handle it?
7. What is the primary purpose of the INDEX function in Excel, and how does it differ from VLOOKUP?
8. Describe the syntax and parameters of the INDEX function, including the array and row/column number.
9. How does the MATCH function complement the INDEX function, and what does it return?
10. In what scenarios might you prefer to use the INDEX and MATCH functions instead of VLOOKUP or HLOOKUP, and why?

Further Readings

- https://www.w3schools.com/excel/excel_vlookup.php
- https://www.simplilearn.com/tutorials/excel-tutorial/vlookup-in-excel
- https://edu.gcfglobal.org/en/excel-tips/how-to-use-excels-vlookup-function/1/
- https://www.perfectxl.com/excel-glossary/how-to-use-hlookup-excel/
- https://www.simplilearn.com/tutorials/excel-tutorial/excel-h-lookup
- https://www.ablebits.com/office-addins-blog/excel-hlookup-formula-examples/
- https://exceljet.net/functions/hlookup-function
- https://exceljet.net/articles/index-and-match
- https://www.ablebits.com/office-addins-blog/excel-index-match-function-vlookup/
- https://www.excel-easy.com/examples/index-match.html

- https://www.geeksforgeeks.org/index-and-match-function-in-excel/

Unit 10: Pivot Table and its Applications

Objectives

After this unit, you will be able to understand-

- Introduction to Pivot Table
- Filter Data Using Slicers in Multiple Pivot Table
- Visualize Aggregate Data Using Pivot Table

Introduction

Pivot tables are a powerful tool in data analysis and reporting, widely used in spreadsheet software like Microsoft Excel. They allow users to summarize and transform data, making it easier to draw insights and generate meaningful reports. Pivot tables are invaluable for business intelligence, financial analysis, and any scenario where large datasets need to be distilled into manageable information.

Introduction to Pivot Table

A pivot table is a statistics tool that summarizes and reorganizes selected columns and rows of data in a spreadsheet or database table to obtain a desired report. The tool does not actually change the spreadsheet or database itself, it simply "pivots" or turns the data to view it from different perspectives.

Pivot tables are especially useful with large amounts of data that would be time-consuming to calculate by hand. A few data processing functions a pivot table can perform include identifying sums, averages, ranges or outliers. The table then arranges this information in a simple, meaningful layout that draws attention to key values.

Pivot table is a generic term, but is sometimes confused with the Microsoft trademarked term, PivotTable. This refers to a tool specific to Excel for creating pivot tables.

10.1 How Pivot Tables Work

When users create a pivot table, there are four main components:

1. Columns- When a field is chosen for the column area, only the unique values of the field are listed across the top.

2. Rows- When a field is chosen for the row area, it populates as the first column. Similar to the columns, all row labels are the unique values and duplicates are removed.

3. Values- Each value is kept in a pivot table cell and display the summarized information. The most common values are sum, average, minimum and maximum.

4. Filters- Filters apply a calculation or restriction to the entire table.

For example, a store owner might list monthly sales totals for a large number of merchandise items in an Excel spreadsheet. If they wanted to know which items sold better in a particular financial quarter, they could use a pivot table. The sales quarters would be listed across the top as column labels and the products would be listed in the first column as rows. The values in the worksheet would show the sum of sales for each product in each quarter. A filter could then be applied to only show specific quarters, specific products or averages.

Uses of a pivot table

A pivot table helps users answer business questions with minimal effort. Common pivot table uses include:

- To calculate sums or averages in business situations. For example, counting sales by department or region.

- To show totals as a percentage of a whole. For example, comparing sales for a specific product to total sales.

- To generate a list of unique values. For example, showing which states or countries have ordered a product.

- To create a 2x2 table summary of a complex report.

- To identify the maximum and minimum values of a dataset.

- To query information directly from an online analytical processing (OLAP) server.

Using PivotTables to answer questions

Consider the example below. Let's say we wanted to answer the question What is the amount sold by each salesperson? Answering it could be time consuming and difficult; each salesperson appears on multiple rows, and we would need to total all of their different orders individually. We could use the Subtotal command to help find the total for each salesperson, but we would still have a lot of data to work with.

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

Fortunately, a PivotTable can instantly calculate and summarize the data in a way that will make it much easier to read. When we're done, the PivotTable will look something like this:

Row Labels ▾	Sum of Order Amount
Albertson, Kathy	$2,650.00
Brennan, Michael	$3,700.00
Davis, William	$1,935.00
Dumlao, Richard	$1,490.00
Flores, Tia	$4,565.00
Post, Melissa	$1,690.00
Thompson, Shannon	$3,160.00
Walters, Chris	$4,375.00
Grand Total	$23,565.00

Once you've created a PivotTable, you can use it to answer different questions by rearranging—or pivoting—the data. For example, let's say we wanted to answer What is the total amount sold in each month? We could modify our PivotTable to look like this:

Row Labels ▾	Sum of Order Amount
January	$9,090.00
February	$9,160.00
March	$5,315.00
Grand Total	$23,565.00

To create a PivotTable:

1. Select the table or cells (including column headers) you want to include in your PivotTable.

2. From the Insert tab, click the PivotTable command.
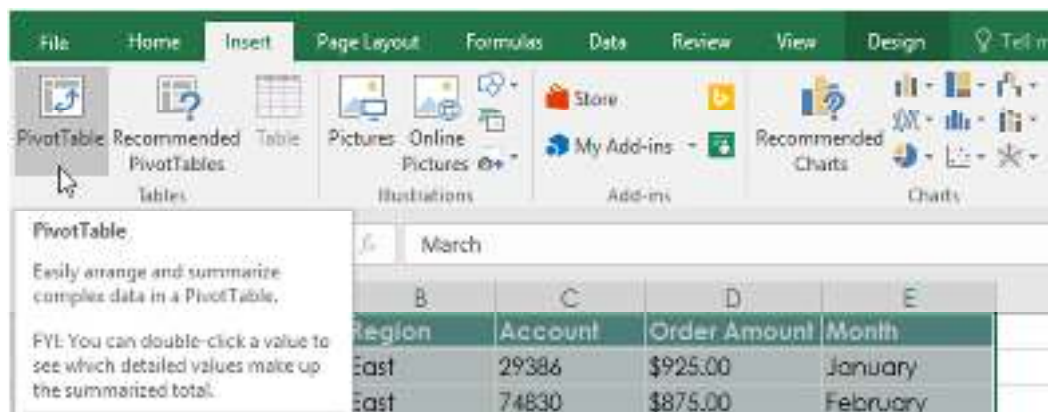
3. The Create PivotTable dialog box will appear. Choose your settings, then click OK. In our example, we'll use Table1 as our source data and place the PivotTable on a new worksheet.
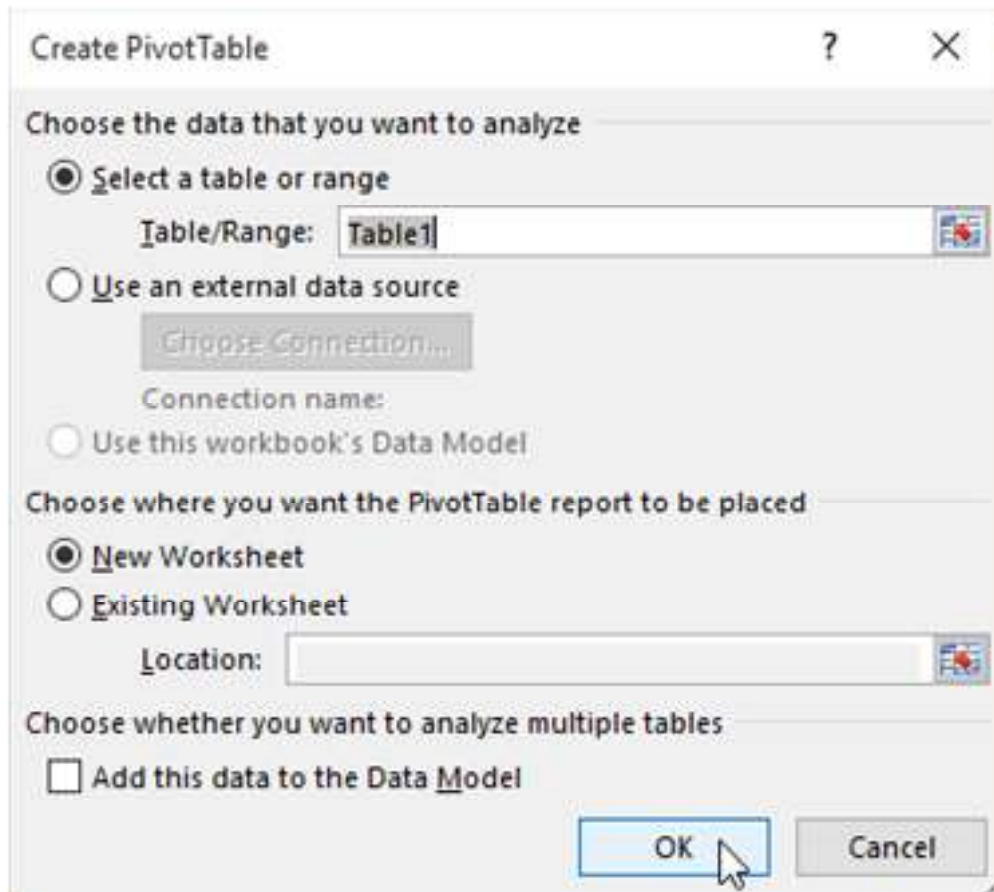
4. A blank PivotTable and Field List will appear on a new worksheet.
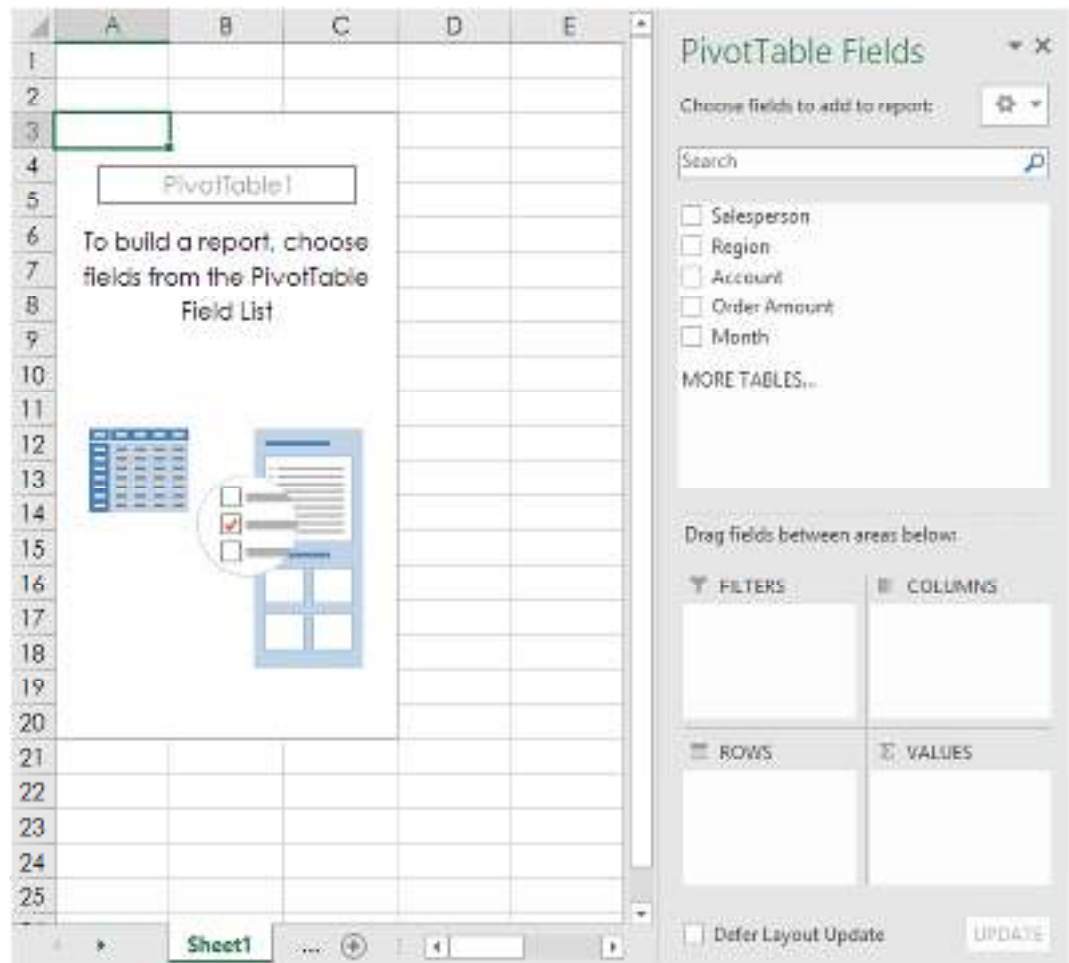
5. Once you create a PivotTable, you'll need to decide which fields to add. Each field is simply a column header from the source data. In the PivotTable Field List, check the box for each field you want to add. In our example, we want to know the total amount sold by each salesperson, so we'll check the Salesperson and Order Amount fields.
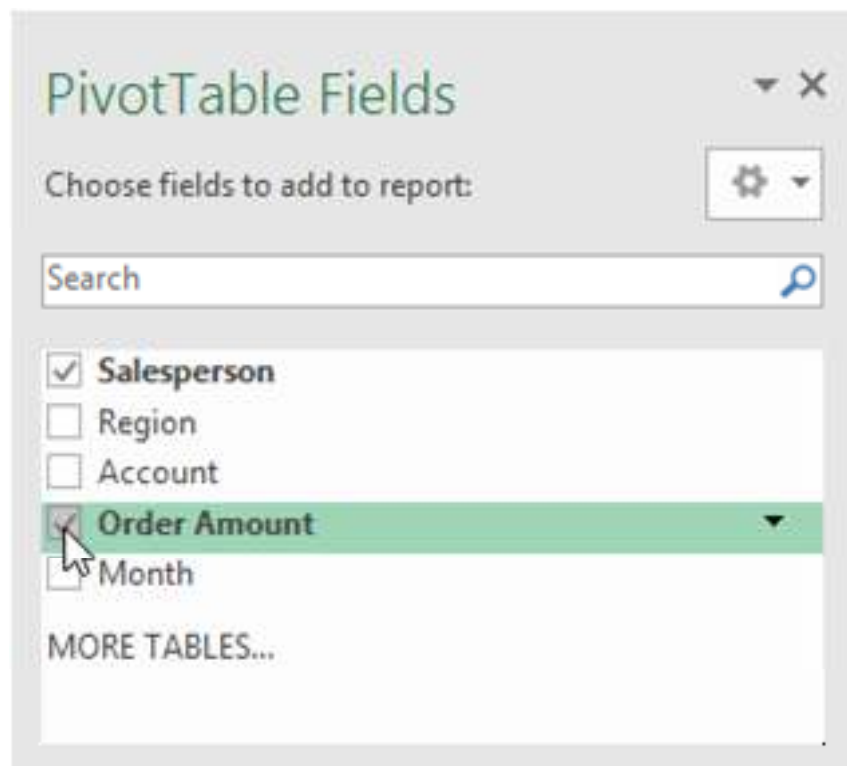
6. The selected fields will be added to one of the four areas below. In our example, the Salesperson field has been added to the Rows area, while Order Amount has been added to Values. Alternatively, you can drag and drop fields directly into the desired area.

7. The PivotTable will calculate and summarize the selected fields. In our example, the PivotTable shows the amount sold by each salesperson.

Just like with normal spreadsheets, you can sort the data in a PivotTable using the Sort & Filter command on the Home tab. You can also apply any type of number formatting you want. For example, you may want to change the number format to Currency. However, be aware that some types of formatting may disappear when you modify the PivotTable.

Row Labels	Sum of Order Amount
Flores, Tia	$4,565.00
Walters, Chris	$4,375.00
Brennan, Michael	$3,700.00
Thompson, Shannon	$3,160.00
Albertson, Kathy	$2,650.00
Davis, William	$1,935.00
Post, Melissa	$1,690.00
Dumlao, Richard	$1,490.00
Grand Total	$23,565.00

If you change any of the data in your source worksheet, the PivotTable will not update automatically. To manually update it, select the PivotTable and then go to Analyze ➡ Refresh.

Pivoting data

One of the best things about PivotTables is that they can quickly pivot—or reorganize—your data, allowing you to examine your worksheet in several ways. Pivoting data can help you

answer different questions and even experiment with your data to discover new trends and patterns.

To add columns:

So far, our PivotTable has only shown one column of data at a time. In order to show multiple columns, you'll need to add a field to the Columns area.

1. Drag a field from the Field List into the Columns area. In our example, we'll use the Month field.
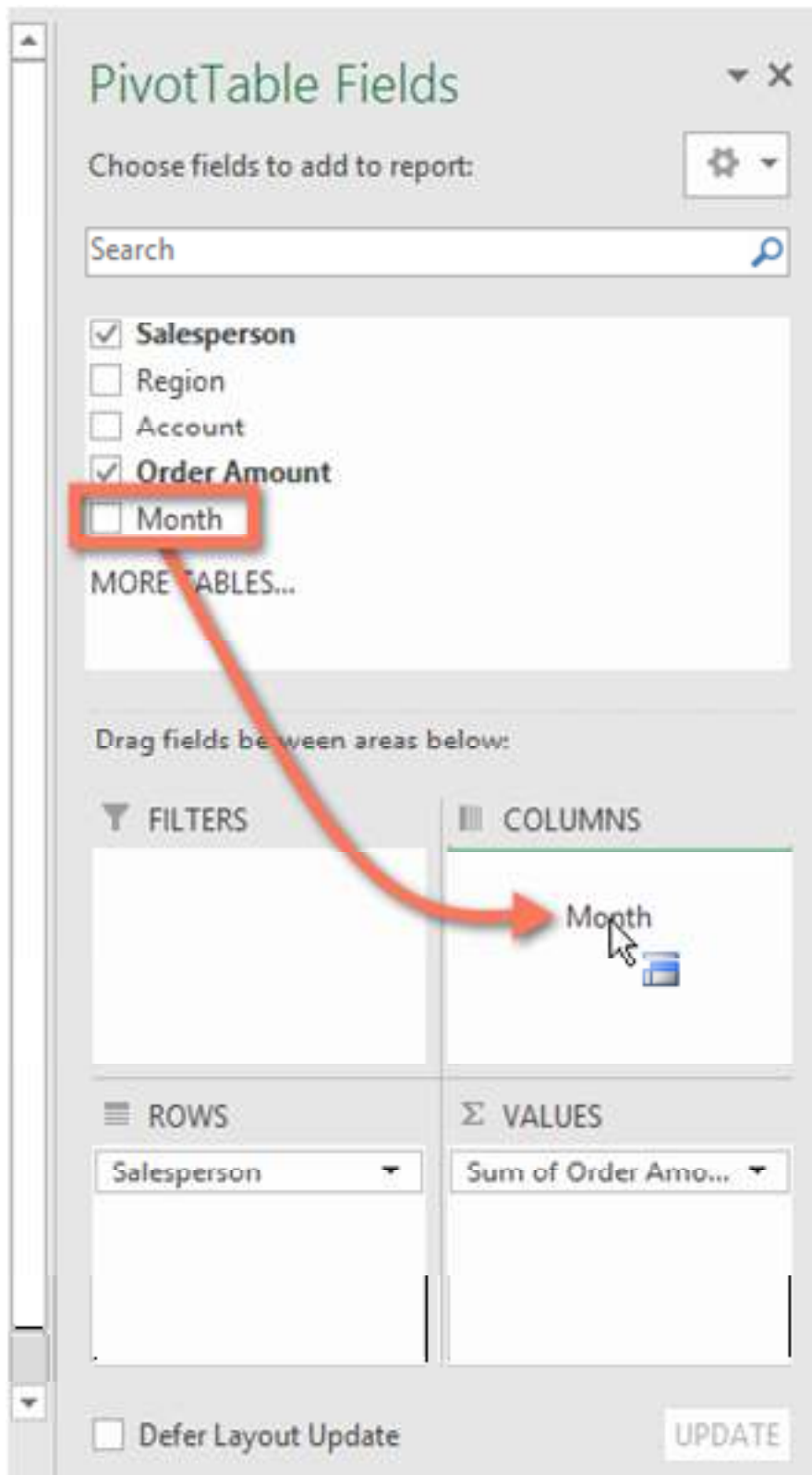
2. The PivotTable will include multiple columns. In our example, there is now a column for each person's monthly sales, in addition to the grand total.

To change a row or column:

Changing a row or column can give you a completely different perspective on your data. All you have to do is remove the field in question, then replace it with another.

1. Drag the field you want to remove out of its current area. You can also uncheck the appropriate box in the Field List. In this example, we've removed the Month and Salesperson fields.
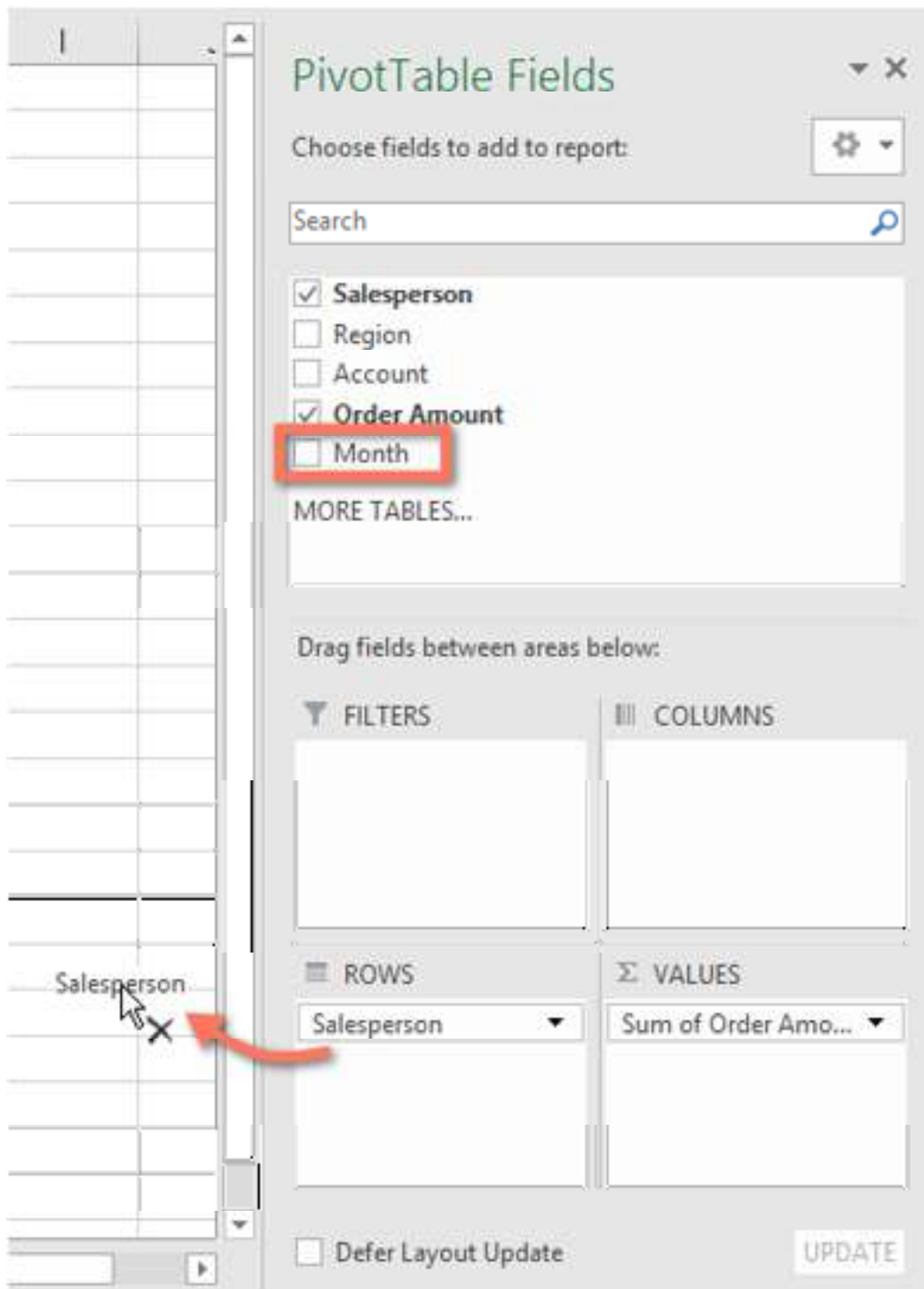
2. Drag a new field into the desired area. In our example, we'll place the Region field under Rows.
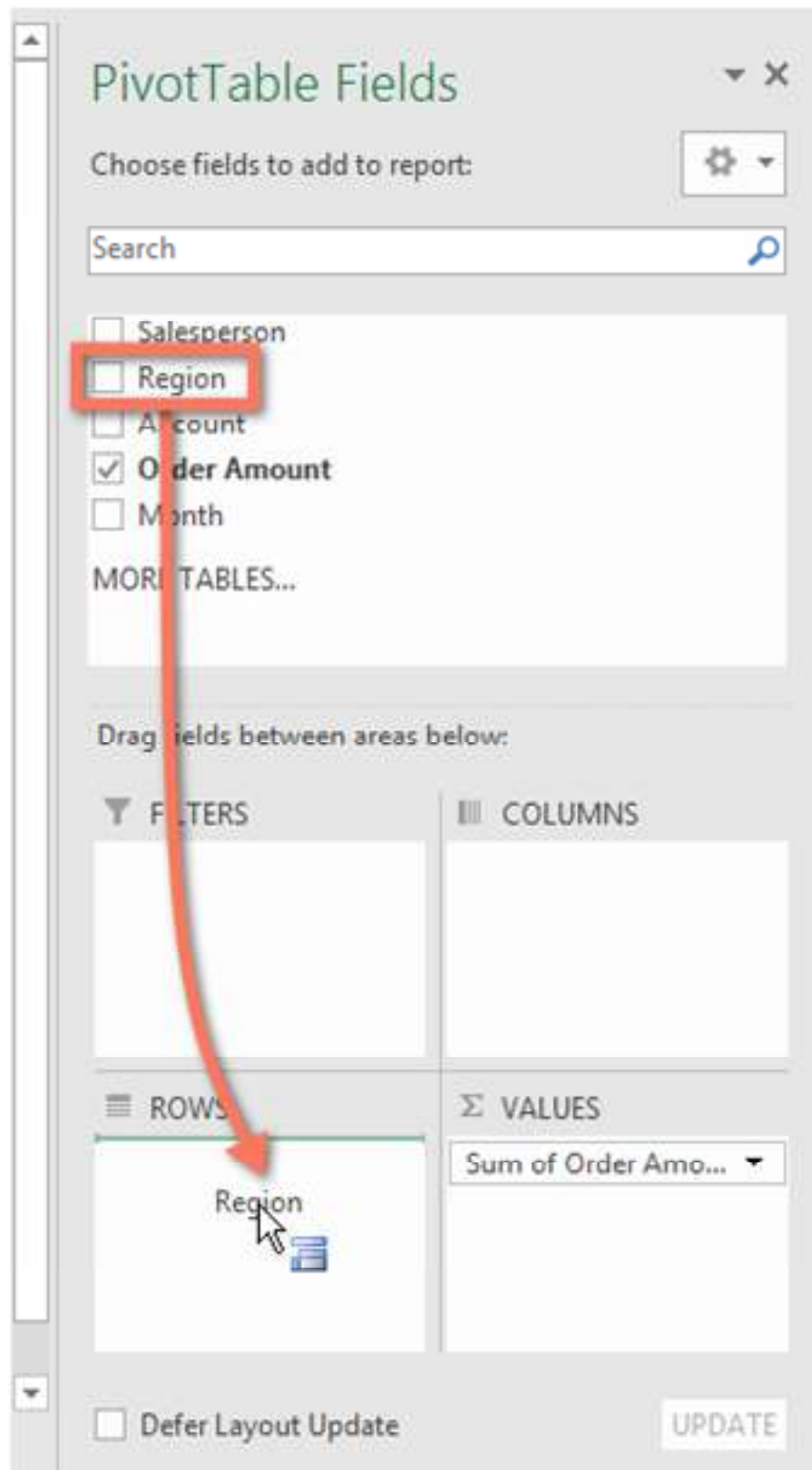
3. The PivotTable will adjust—or pivot—to show the new data. In our example, it now shows the amount sold by each region.

10.2 Filter Data Using Slicers in Multiple Pivot Table

Excel 2010 version of the Pivot Table was jazzed up by the entry of a new super cool feature – Slicers.

A Pivot Table Slicer enables you to filter the data when you select one or more than one options in the Slicer box (as shown below).

In the example above, Slicer is the orange box on the right, and you can easily filter the Pivot Table by simply clicking on the region button in the Slicer.

Inserting a Slicer in Excel Pivot Table

Suppose you have a dataset as shown below:

Lovely Professional University

	A	B	C	D	E	F	G
1	Date	Region	Retailer Type	Customer	Quantity	Revenue	Profit
2	01-01-2016	South	Food & Staples	Winn-Dixie	1,100	22,000	7,480
3	01-01-2016	West	Multiline	Nordstrom	1,600	1,23,200	43,120
4	01-01-2016	West	Food & Staples	Costco	1,600	44,800	11,200
5	02-01-2016	North East	Specialty	Foot Locker	1,700	93,500	31,790
6	02-01-2016	South	Specialty	The Home Depot	800	48,800	6,832
7	02-01-2016	Mid West	Food & Staples	Target	400	9,200	1,288
8	03-01-2016	Mid West	Food & Staples	Casey's	300	15,000	2,100
9	03-01-2016	Mid West	Food & Staples	Casey's	500	9,500	1,710
10	05-01-2016	West	Multiline	Nordstrom	1,600	56,000	14,560
11	05-01-2016	Mid West	Multiline	Kohl's	1,300	32,500	9,425
12	05-01-2016	South	Multiline	Dollar General	1,400	1,06,400	20,216
13	05-01-2016	Mid West	Food & Staples	Target	900	12,600	3,780
14	06-01-2016	North East	Specialty	Foot Locker	1,200	14,400	3,312
15	06-01-2016	Mid West	Multiline	Kohl's	1,500	58,500	21,645
16	06-01-2016	West	Multiline	Nordstrom	200	13,400	2,412

This is a dummy data set (US retail sales) and spans across 1000 rows. Using this data, we have created a Pivot Table that shows the total sales for the four regions.

	A	B
1		
2		
3	**Region**	**Sum of Sales**
4	Mid West	10899100
5	South	21225800
6	West	11670700
7	**Grand Total**	**43795600**
8		

Once you have the Pivot Table in place, you can insert Slicers.

One may ask – Why do I need Slicers?

You may need slicers when you don't want the entire Pivot Table, but only a part of it. For example, if you don't want to see the sales for all the regions, but only for South, or South and West, then you can insert the slicer and quickly select the desired region(s) for which you want to get the sales data.

Slicers are a more visual way that allows you to filter the Pivot Table data based on the selection.

Here are the steps to insert a Slicer for this Pivot Table:

- Select any cell in the Pivot Table.

- Go to Insert –> Filter –> Slicer.

- In the Insert Slicers dialog box, select the dimension for which you the ability to filter the data. The Slicer Box would list all the available dimensions and you can select one or more than one

dimensions at once. For example, if I only select Region, it will insert the Region Slicer box only, and if I select Region and Retailer Type both, then it'll insert two Slicers.
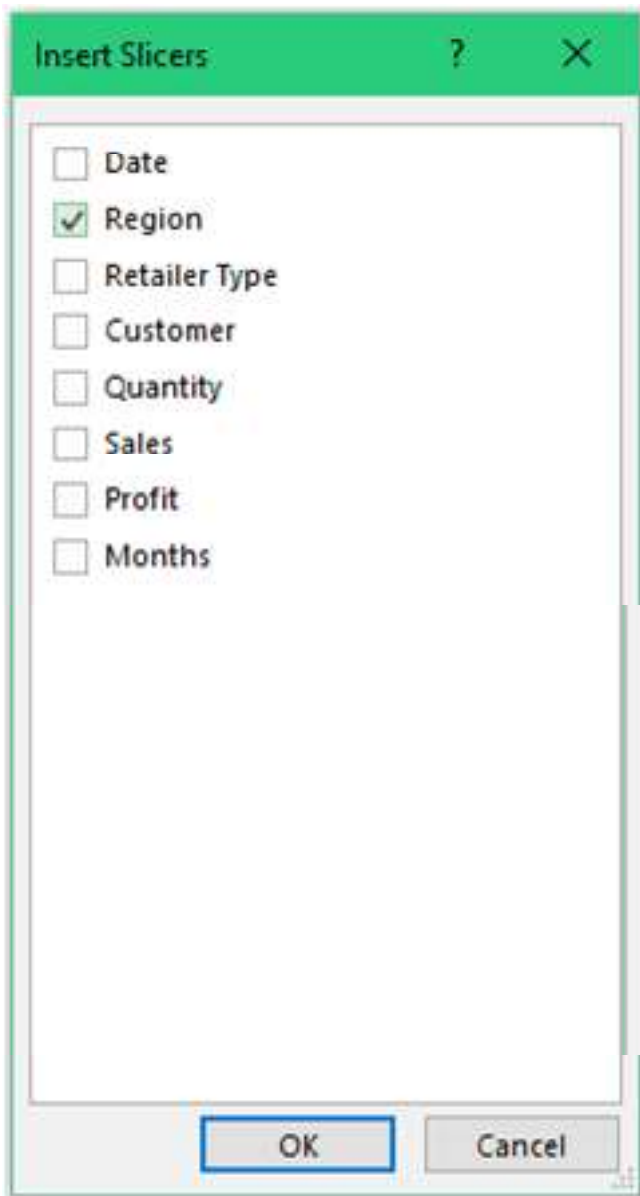
- Click OK. This will insert the Slicer(s) in the worksheet.

Note that Slicer would automatically identify all the unique items of the selected dimension and list it in the slicer box.

Once you have inserted the slicer, you can filter the data by simply clicking on the item. For example, to get the sales for South region only, click on South. You'll notice that the selected item gets a different shade of color as compared with the other items in the list.

Spreadsheet Modelling (Using Excel)

You can also choose to select multiple items at once. To do that, hold the Control Key and click on the ones that you want to select.

If you want to clear the selection, click on the filter icon (with a red cross) at the top right.
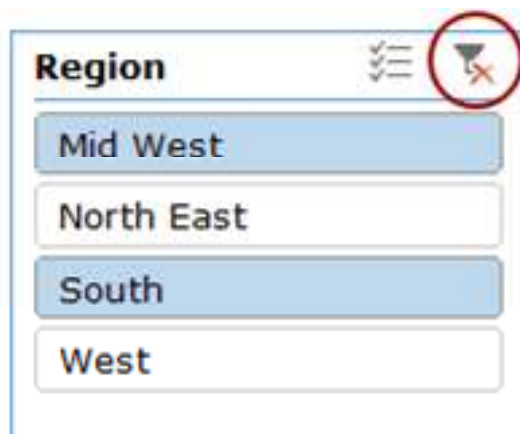
Inserting Multiple Slicers in a Pivot Table

You can also insert multiple slicers by selecting more than one dimension in the Insert Slicers dialog box.

To insert multiple slicers:

- Select any cell in the Pivot Table.
- Go to Insert –> Filter –> Slicer.

- In the Insert Slicers dialog box, select all the dimensions for which you want to get the Slicers.
- Click OK.
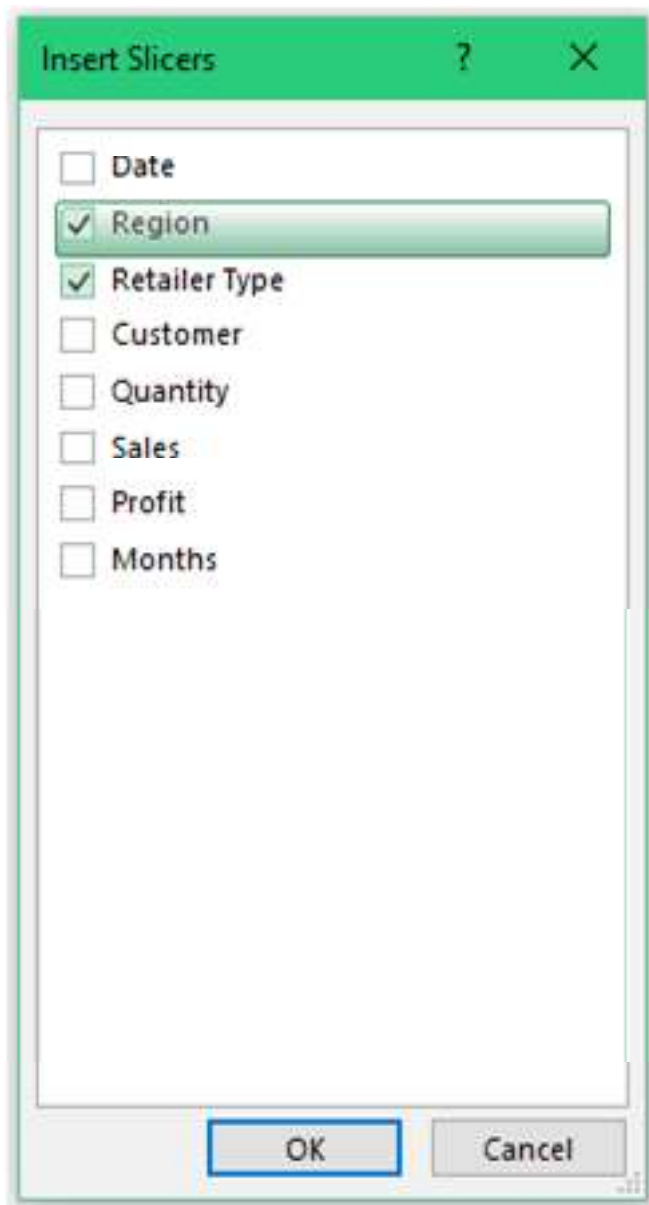
This will insert all the selected Slicers in the worksheet.

Note that these slicers are linked to each other. For example, If I select 'Mid West' in the Region filter and 'Multiline' in the Retailer Type filter, then it will show the sales for all the Multiline retailers in Mid West region only.

Also, if I select Mid West, note that the Specialty option in the second filter gets a lighter shade of blue (as shown below). This indicates that there is no data for Specialty retailer in the Mid West region.

10.3 Visualize Aggregate Data Using Pivot Table

In today's world, Excel is used in almost all industries, whether it be financial services, IT services, automotive, manufacturing, or many others. Excel deals with large amounts of data and finds insights in it. Without summarizing the information in a chart, understanding can become quite hectic. The need for visualization tools in Excel is undeniable.

In a previous guide, we learned about various aspects of PivotTables with very little emphasis on Pivot Charts. In this series of two guides (beginner and advanced) on Pivot Charts, we will further explore the topic and visualize data using Pivot Charts.

Describing Data

We will be using a dummy data set consisting of data related to colleges in various countries, their fee structures, and their minimum acceptable test scores (GRE and GMAT). Given below is the original data set, which holds eight columns and 10 rows:

Country	College	Program	Tuition Fee	Accommodation Fee	Misc Charges	Min GMAT Score	Min GRE Score
United States of America	Institute of Technology	Master's (Engg)	$80,000.00	$20,000.00	$5,000.00		315
United States of America	Brown University	Master's (Engg)	$72,000.00	$22,000.00	$3,000.00		317
United States of America	Institute of Technology	Master's (Engg)	$99,555.00	$34,000.00	$9,000.00		324
United States of America	Harvard University	Master's (Biz)	$10,10,000.00	$42,000.00	$18,000.00	770	
England	University of Cambridge	Ph.D.	$86,000.00	$56,000.00	$12,000.00		317
England	London School of Economics	Master's (Biz)	$85,000.00	$18,000.00	$9,000.00	720	
England	London Business School	Master's (Biz)	$72,000.00	$20,000.00	$8,000.00	700	
India	Indian Institute of Technology	Master's (Engg)	$40,000.00	$15,000.00	$2,000.00		321
Japan	The University of Tokyo	Ph.D.	$68,000.00	$55,000.00	$6,000.00		314
Japan	Kyoto University	Master's (Biz)	$56,000.00	$32,000.00	$8,000.00	715	

Pivot Chart Basics

To build a pivot chart, the first thing you need to do is to construct a PivotTable. Here we have constructed a PivotTable using column names Country and Program under the Rows section and the sum of the tuition fee, accommodation fee, and miscellaneous charges under the Values section.

Row Labels	Sum of Tuition Fee	Sum of Accommodation Fee	Sum of Misc Charges
England	243000	94000	29000
Master's (Biz)	157000	38000	17000
Ph.D.	86000	56000	12000
India	40000	15000	2000
Master's (Engg)	40000	15000	2000
Japan	124000	87000	14000
Master's (Biz)	56000	32000	8000
Ph.D.	68000	55000	6000
United States of America	1261555	118000	35000
Master's (Biz)	1010000	42000	18000
Master's (Engg)	251555	76000	17000
Grand Total	1668555	314000	80000

Next, to build any of the Pivot Charts on the given PivotTable, you first need to select those columns you need to visualize, then in the menu bar click on Insert, and then click on the PivotChart icon. This will popup a new dialog box with the name Insert Chart. Now, you can select any of the given charts to plot your selected data.

Spreadsheet Modelling (Using Excel)

1. Bar Chart

If you are dealing with numerical data, then bar charts are the first visualization tool that comes to mind. There are a variety of bar charts that can help you summarize numerical data and show you its relative importance. To get a brief understanding of how bar charts work, you can visit the bar chart webpage on the Investopedia website.

We will now learn how to make a variety of bar charts on the PivotTable described in the above section. If you are in the Insert Chart popup dialog box, you can click on the Bar tab, which will show you six types of bar charts. There are really three main kinds of these charts, namely, clustered, stacked, and 3D charts; the remaining are merely a combination of these three charts with the inclusion of a hundred percent stacked theme.

Clustered
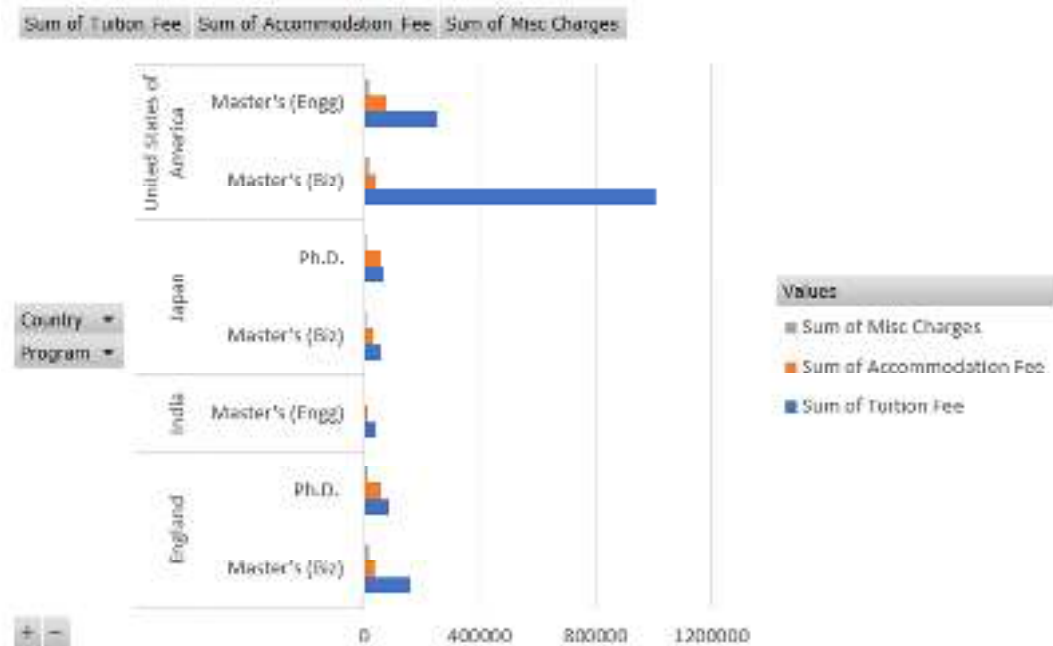
100% Stacked Column
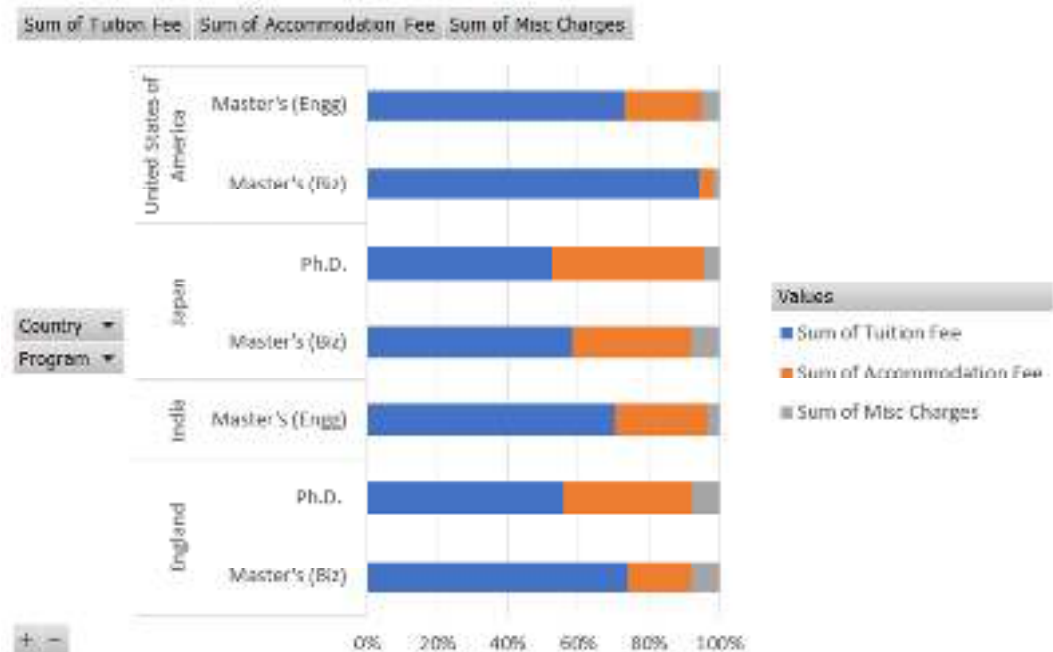
3-D 100% Stacked Column
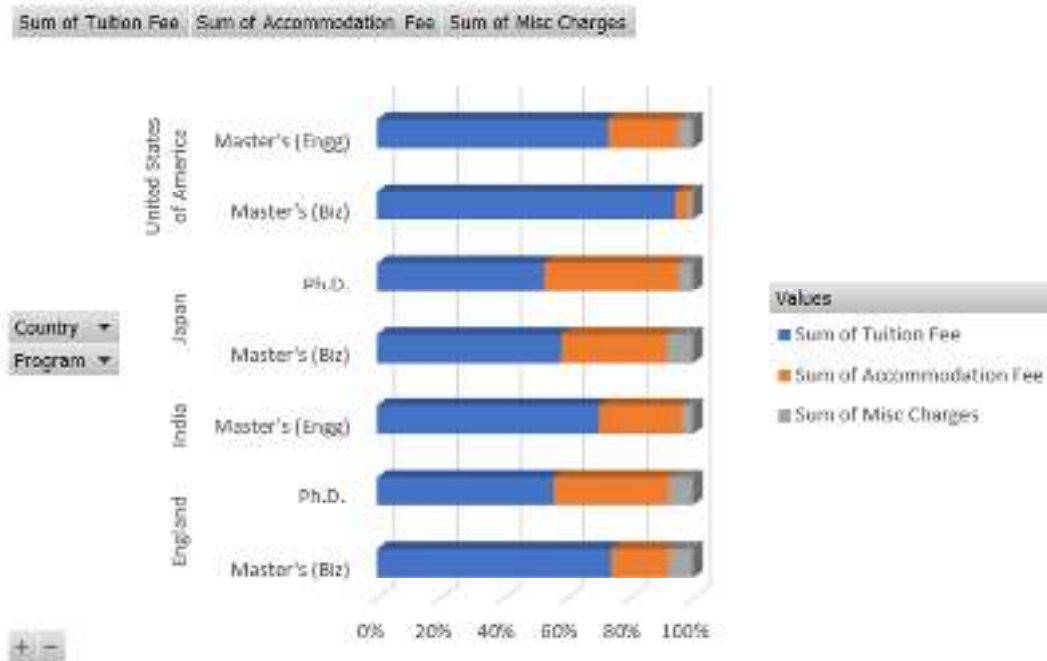
You can use any of the above three charts or the remaining three charts to analyze the given PivotTable data. As you can observe, the bar charts make it very clear as to which program in which country has the highest and the lowest fee structure in terms of tuition, accommodation, and miscellaneous charges.

You can also control the Chart Elements, including Axes, Axis Title, Chart Title, Data Labels, Data Table, Gridlines, and Legend, using the + sign available outside the chart.

2. Line Chart

A line chart can be used to plot either a single or multiple numerical data columns. You can explore more about line charts and their use on the Investopedia line chart web page.

To learn how to make a line chart in Excel's PivotTable, we will be using the same PivotTable as above and all of the three numerical data types, i.e., tuition fee, accommodation fee, and miscellaneous charges.

To create a line chart from multiple numerical data columns, you need to first select the data from the complete PivotTable and follow the same procedure as during the bar chart creation. The only difference is that you need to select line instead of bar inside the Insert Chart dialogue box. Inside the line section, you will observe seven types of available line charts. In this example, we create a line chart with markers, as shown below:

Lovely Professional University
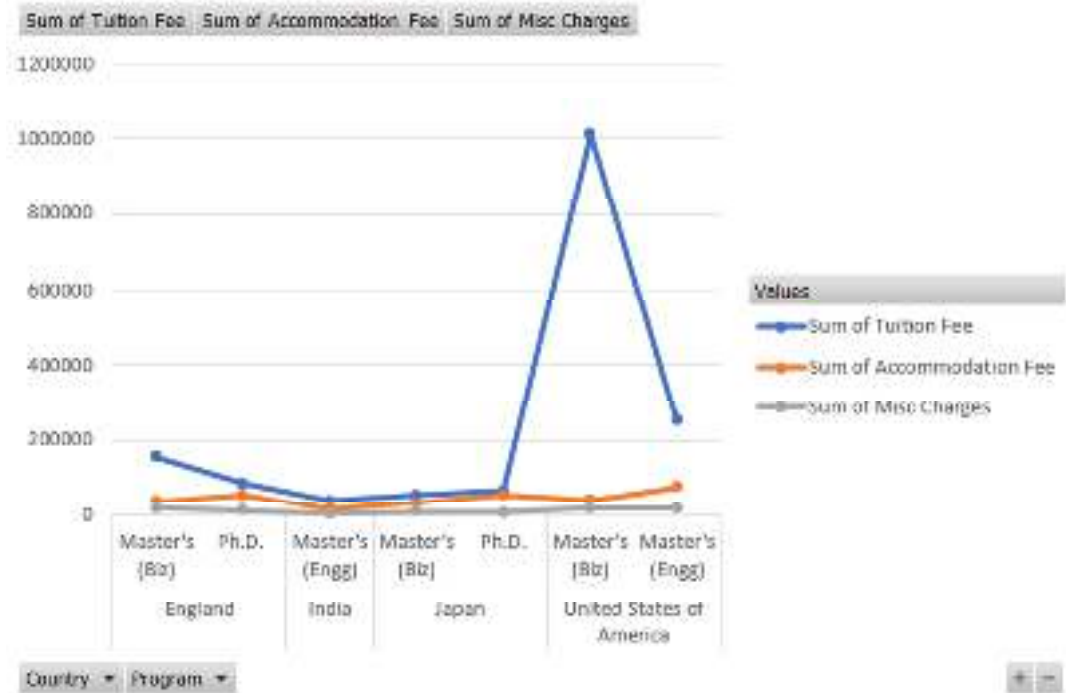
3. Scatter Plot

A scatter plot can be used to show a relationship between two numerical quantities or one numerical and one non-numerical quantity. For a brief overview, you can visit this webpage on the Statistics how to website.

Sadly, we cannot create a scatter plot on a PivotTable directly using its data. However, there is no restriction on copying the data from a PivotTable and then using it to create a scatter plot. In this section, we will learn how to create a basic scatter plot based on one numerical quantity and one non-numerical quantity.

First of all, we create a new PivotTable using the College column under the Rows section and the Min GMAT Score column under the Values section. We filter the result based on the Program column and further select only the Master's (Biz). Once we are done with this process, we have a PivotTable as shown below:

Program Master's (Biz)

Row Labels	Sum of Min GMAT Score
Harvard University	770
Kyoto University	715
London Business School	700
London School of Economics	720
Grand Total	2905

The follow the given steps to create a scatter plot on this PivotTable data: 1. Copy the text and the GMAT score data of these four universities and paste them in two new blank columns somewhere in the same sheet.

Harvard University	770
Kyoto University	715

| London Business School | 700 |
| London School of Economics | 720 |

2. Next, click on a new empty cell and go to the Insert tab under the menu bar. Locate the Charts section, which is available just before the PivotChart section. Click on the scatter plot icon. This will bring an empty scatter plot on the worksheet.

3. Moving ahead, right-click on the empty scatter plot and click on Select Data.... This will open up a new dialogue box as shown below:
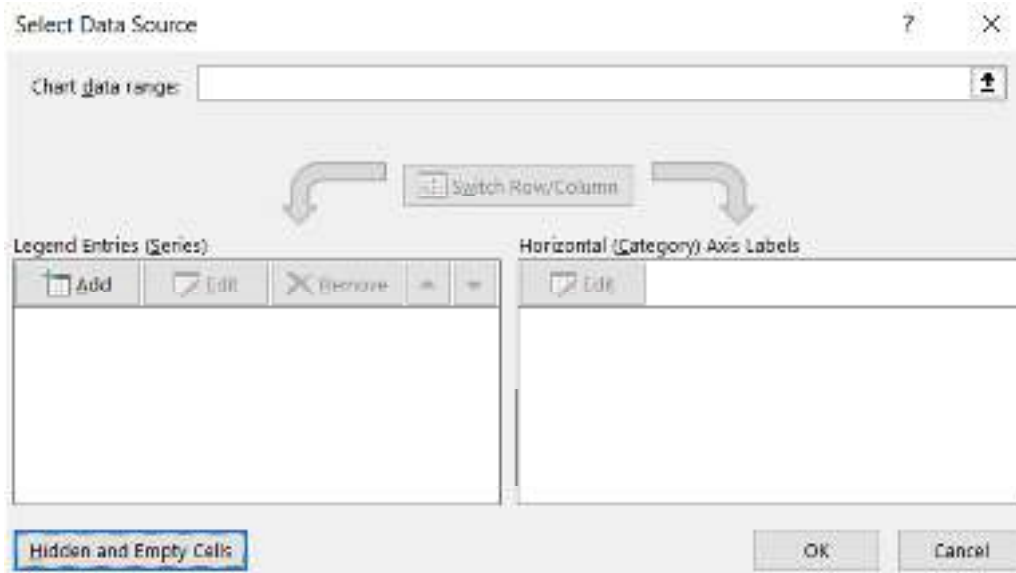
4. Click on the Add button, which opens up a new dialog box where you can input the series name and its X and Y data values. I have used Master's (Biz) as the series name, but you can select anything you want. Now select the college names in the series X data and select the GMAT score as part of the Y data. For me, the completed dialog box looks like this:
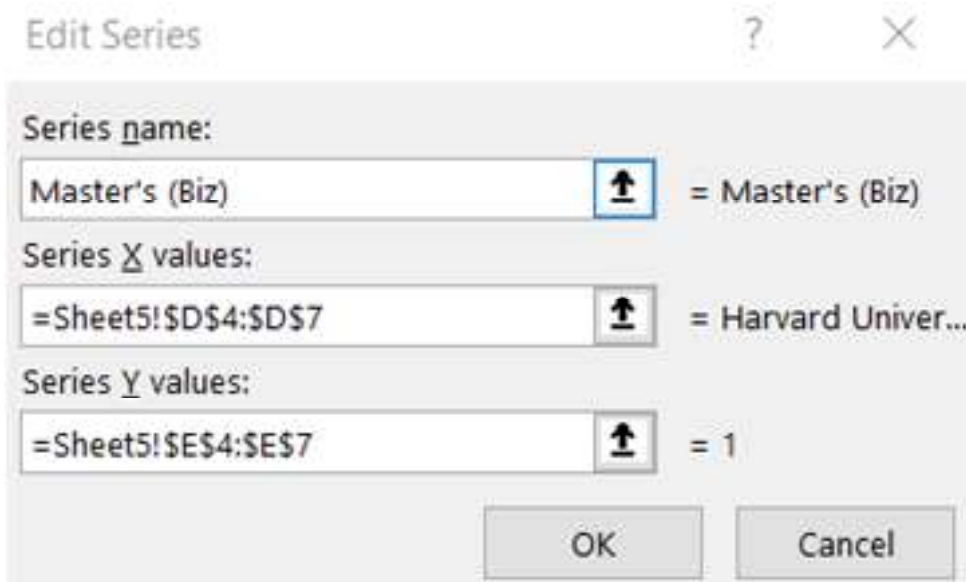
5. Now press OK a few times and after a bit of tweaking the Chart Elements, you can have a scatter plot like this:

Master's (Biz)

Summary

Pivot Table Keywords:

1. Pivot Table: A data summarization tool in Excel that allows you to analyze and manipulate large datasets by creating custom tables.

2. Data Source: The range or table containing the raw data that you want to analyze with a Pivot Table.

3. Field: A column in the data source that you can add to a Pivot Table for analysis. Fields can be categorized as rows, columns, values, or filters.

4. Rows: The area of a Pivot Table where you place fields that will be used as row labels. This defines the structure of the rows in the Pivot Table.

5. Columns: The area of a Pivot Table where you place fields that will be used as column labels. This defines the structure of the columns in the Pivot Table.

6. Values: The area of a Pivot Table where you place fields whose data you want to summarize, such as sum, count, average, etc.

7. Filters: The area of a Pivot Table where you place fields that allow you to filter data within the Pivot Table, making it easier to analyze specific subsets of data.

Slicer Keywords:

8. Slicer: A visual filtering tool in Excel that allows users to easily filter data in a Pivot Table or Pivot Chart by selecting specific items from a list or button interface.

9. Selection: The specific item or items chosen in a slicer to filter the data displayed in the associated Pivot Table or Pivot Chart.

10. Visual Filtering: The process of using slicers to interactively filter data by clicking on items in a slicer's user interface, providing a more user-friendly and intuitive way to filter data compared to traditional methods.

Keywords

- Data Analysis: Pivot Tables are powerful tools for data analysis in Excel, allowing you to summarize and extract meaningful insights from large datasets.

- Structure: Pivot Tables consist of rows, columns, values, and filters, with each component serving a specific purpose in organizing and presenting data.

- Aggregation: You can use Pivot Tables to perform aggregation functions like sum, count, average, and more on your data to analyze trends and patterns.

- Data Source: Pivot Tables require a data source, which can be a range of cells or an external data connection, from which they draw their data.

- Drag-and-Drop: Creating a Pivot Table is user-friendly, as you can simply drag and drop fields to define rows, columns, and values.

- Flexibility: Pivot Tables are highly flexible and allow you to rearrange and modify the structure quickly to view data from different angles.

- Filtering: You can filter data within a Pivot Table using slicers or field filters, enabling you to focus on specific subsets of data.

- Visual Filters: Slicers are visual filtering tools that provide an intuitive way to filter data in a Pivot Table or Pivot Chart by selecting items from a list or button interface.

- Interactivity: Slicers enhance interactivity by allowing users to filter data dynamically, making it easier to explore data without the need for complex filtering options.

- Multiple Pivot Tables: You can use a single slicer to control multiple Pivot Tables or Pivot Charts on the same worksheet, streamlining the analysis process.

- Customization: Slicers can be customized in terms of appearance, size, and style to fit the design of your Excel reports or dashboards.

- Clear Presentation: Slicers provide a clear and user-friendly way to present filtering options, making it easier for others to understand and use your Excel reports.

- Compatibility: Slicers are compatible with both Pivot Tables and Pivot Charts, offering consistent and efficient data filtering across various types of data visualizations.

- Multiple Selections: Users can select multiple items within a slicer, making it possible to filter for multiple criteria simultaneously.

- Clearing Selections: Slicers include a "Clear All" button to quickly reset all selections and display the full dataset.

- Highlighting Selections: When an item is selected in a slicer, it is visually highlighted, providing immediate feedback to users about the active filter.

Self Assessment

1. What is the primary purpose of a Pivot Table in Excel?
A. To create charts and graphs
B. To perform calculations on data
C. To summarize and analyze data
D. To import data from external sources

2. Which Excel feature allows you to group data in a Pivot Table based on specific criteria?
A. Slicers
B. Filters
C. Grouping
D. Sorting

3. What is a "pivot" in the context of a Pivot Table?
A. A mathematical operation
B. A way to rotate data
C. A type of chart
D. A cell reference

4. Which part of an Excel Pivot Table allows you to drag and drop fields to organize and analyze data?
A. The Values area
B. The Columns area
C. The Rows area
D. The PivotTable Field List

5. What is a PivotTable report filter used for?
A. To format the Pivot Table
B. To filter data in the Pivot Table
C. To sort data in the Pivot Table
D. To calculate totals and subtotals

6. In a Pivot Table, what does the "Values" area allow you to do?
A. Group data
B. Sort data
C. Calculate data summaries
D. Filter data

7. Which of the following is NOT a function that can be applied to data in the "Values" area of a Pivot Table?
A. Sum
B. Count
C. Average
D. Concatenate

8. What is the primary purpose of using a slicer in Excel?
A. To slice and dice data
B. To create Pivot Tables
C. To filter Pivot Tables visually
D. To calculate totals and subtotals

9. Which of the following elements can be controlled using a slicer in a Pivot Table?
A. Cell color
B. Font size
C. Chart type
D. Data filtering

10. In Excel, where can you find the slicer option?
A. In the Data tab
B. In the Home tab
C. In the PivotTable Analyze tab
D. In the Insert tab

11. What happens when you select multiple items in a slicer?
A. All selected items are highlighted
B. Only the first selected item is applied
C. A new slicer is created for each selected item
D. An error message appears

12. What type of data visualization does a slicer provide for filtering data?
A. Dropdown menu
B. Checkbox list
C. Slider bar

D. Button interface

13. In Excel, can you use the same slicer to filter multiple Pivot Tables on the same worksheet?

A. Yes, but only if they share the same data source

B. No, each Pivot Table requires a separate slicer

C. Yes, by linking the slicer to all Pivot Tables

D. No, slicers cannot be used for multiple Pivot Tables

14. When applying a slicer to a Pivot Table, what type of filter control does it provide?

A. Dropdown menu

B. Checkbox list

C. Slider bar

D. Radio buttons

15. How can you clear all selections in a slicer in Excel?

A. Right-click and choose "Clear Filter"

B. Click the "Clear All" button within the slicer

C. Use the "Ctrl" key and click each selected item

D. There is no way to clear all selections

16. Can you format a slicer in Excel, such as changing its color or style?

A. Yes, through the slicer's context menu

B. No, slicers cannot be formatted

C. Yes, using the Format tab in the Excel Ribbon

D. Only in Excel Online, not in the desktop version

Answers for Self Assessment

1.	C	2.	C	3.	B	4.	D	5.	B
6.	C	7.	D	8.	C	9.	D	10.	D
11.	A	12.	D	13.	C	14.	D	15.	B
16.	A								

Review Questions

1. Describe the steps to create a Pivot Table in Excel, including selecting the data source and defining rows, columns, and values.

2. What is the role of filters in a Pivot Table, and how do they assist in data analysis?

3. What is the primary function of a slicer in Excel, and how does it improve the user experience when working with Pivot Tables?

4. Explain how to create a slicer for a Pivot Table, including selecting the fields to filter and customizing its appearance.

5. How can you use a slicer to filter data across multiple Pivot Tables on the same worksheet?

6. Describe the difference between a single-select slicer and a multi-select slicer, and provide an example of when each might be used.

7. What are some best practices for designing and formatting slicers to make them more visually appealing and user-friendly in Excel reports?

8. Explain the key components of a Pivot Table, including rows, columns, values, and filters.

Further Readings

*   https://www.techtarget.com/searchdatamanagement/definition/pivot-table
*   https://www.tutorialspoint.com/excel_pivot_tables/excel_pivot_tables_overview.htm
*   https://edu.gcfglobal.org/en/excel2016/intro-to-pivottables/1/#
*   https://www.simplilearn.com/tutorials/excel-tutorial/pivot-table
*   https://excelchamps.com/pivot-table/link-slicer-to-multiple-pivot-tables/
*   https://www.myexcelonline.com/blog/connect-slicers-to-multiple-excel-pivot-tables/
*   https://www.simplesheets.co/blog/Connect-Slicers-to-Multiple-Pivot-Tables
*   https://trumpexcel.com/slicers-excel-pivot-table/
*   https://www.pluralsight.com/guides/visualizing-data-with-pivotchart

Unit 11: VBA Macros programming I

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11.3   VBA Variable Declaration
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Objectives

After this unit, you will be able to understand:

- Understand the concept and use of creating and recording a macro.
- understand the concept and use of Excel VBA MsgBox.
- understand the concept of declaring variables in MS-Excel.
- Understand the concept and use of subroutines and functions in MS-Excel.

Introduction

Macros are sets of automated actions or scripts that can be recorded and executed in spreadsheet programs. They are valuable for automating repetitive tasks, improving efficiency, and reducing human error. Recording a macro simplifies the process, allowing users to create custom functions without extensive programming knowledge. MsgBox, short for Message Box, is a function used in various programming languages, including Visual Basic for Applications (VBA). It displays a pop-up message or prompt to the user, providing information or requesting input. MsgBox is vital for communicating with users in software applications and automating decision-making processes. In programming, declaring variables is the process of specifying the data type and name of a variable that will store data. Proper variable declaration is crucial for memory management, data manipulation, and maintaining code clarity and organization. Subroutines and functions are essential components of VBA programming. Subroutines are sequences of code that perform a specific task, while functions return a value based on the provided input. These are building blocks for creating custom functions and automating tasks within Microsoft Excel and other VBA-supported applications.

11.1 Creating and Recording a Macro

What is a Macro?

If you're a newbie to VBA, let me first tell you what a macro is – after all, I will keep using this term in the entire tutorial.

A macro is a code written in VBA (Visual Basic for Applications) that allows you to run a chunk of code whenever it is executed.

Often, you will find people (including myself) refer to a VBA code as a macro – whether it's generated by using a macro recorder or has been written manually.

When you record a macro, Excel closely watches the steps you're taking and notes it down in a language that it understands – which is VBA.

And since Excel is a really good note taker, it creates a very detailed code (as we will see later in this tutorial).

Now, when you stop the recording, save the macro, and run it, Excel simply goes back to the VBA code it generated and follows the exact same steps.

This means that even if you know nothing about VBA, you can automate some tasks just by letting Excel record your steps once and then reuse these later.

Now let's dive in and see how to record a macro in Excel.

Getting the Developer Tab in the Ribbon

The first step to record a macro is to get the Developer tab in the ribbon.

If you can already see the developer tab in the ribbon, go to the next section, else follow the below steps:

- Right-click on any of the existing tabs in the ribbon and click on 'Customize the Ribbon' option. It will open the Excel Options dialogue box.
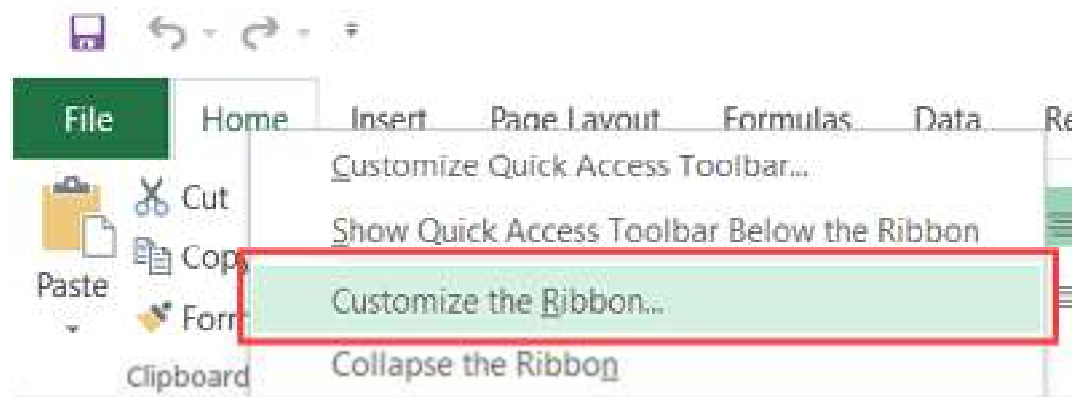
- In the Excel Options dialogue box, you will have the Customize the Ribbon options. On the right, within the Main Tabs pane, check the Developer option.
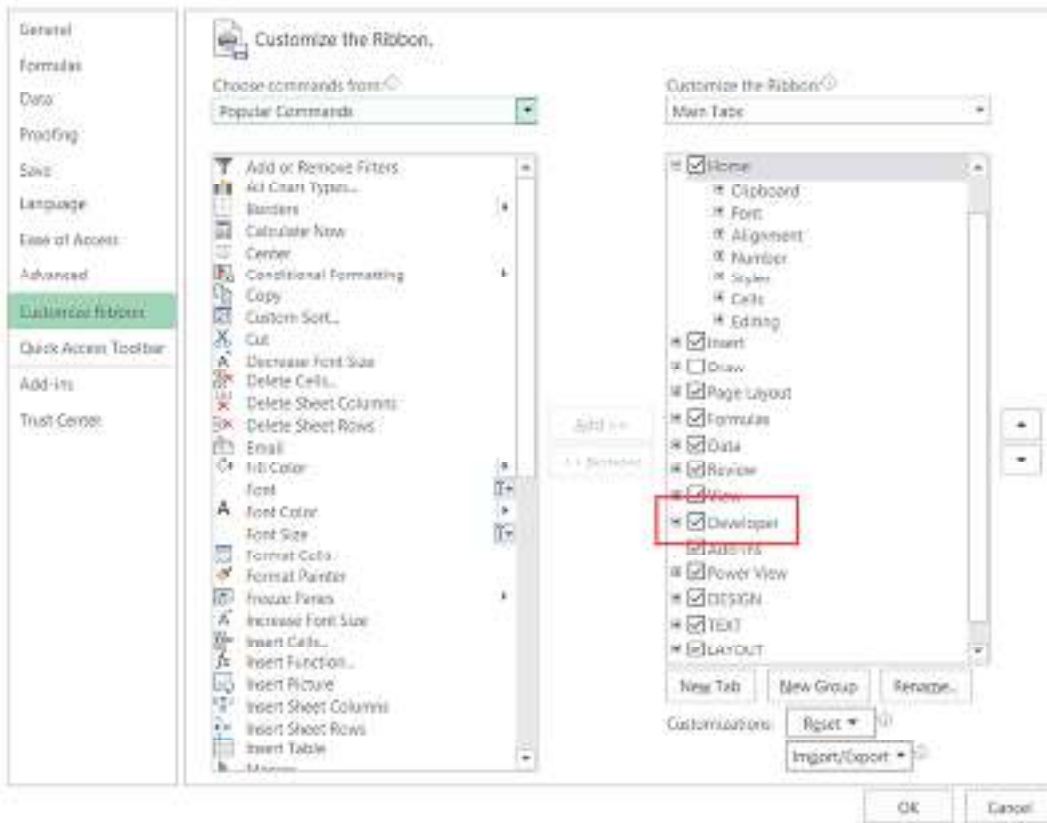
- Click OK.

The above steps would make the Developer tab available in the ribbon area.

Recording a Macro in Excel

Now that we have everything in place, let's learn how to record a macro in Excel.
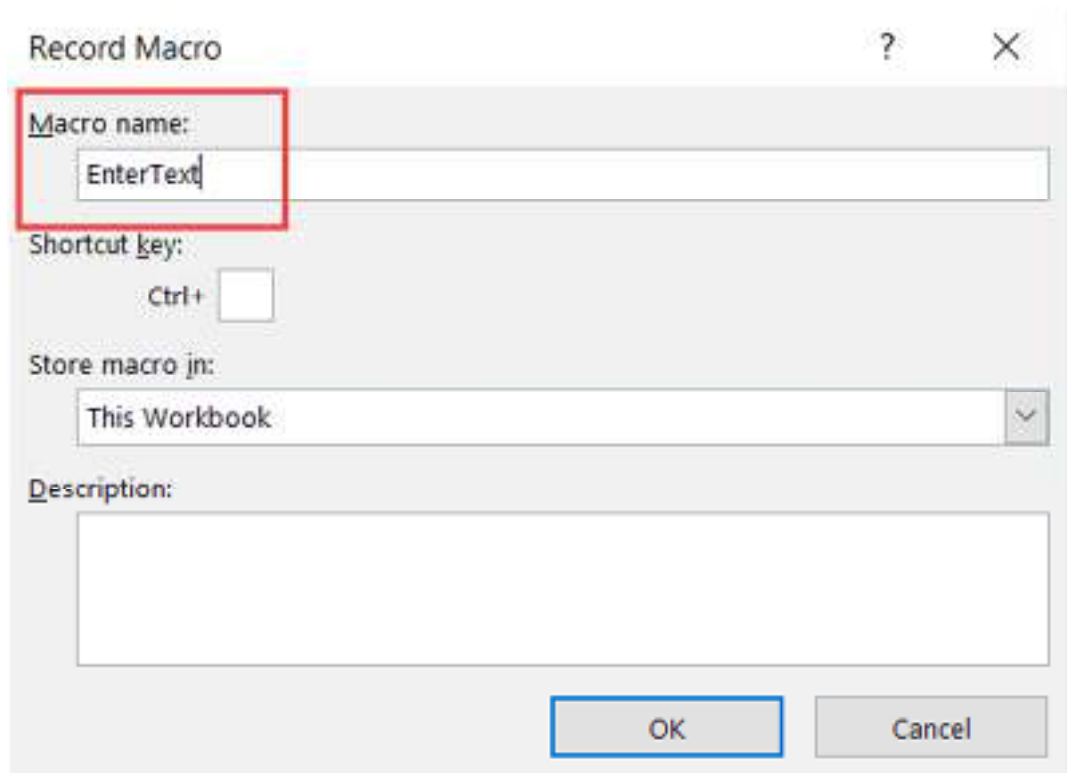
Let's record a very simple macro – one that selects a cell and enters the text 'Excel' in it. I am using the text 'Excel' while recording this macro, but feel free to enter your name or any other text that you like.

Here are the steps to record this macro:

1. Click the Developer tab.

2. In the Code group, click on the Macro button. This will open the 'Record Macro' dialog box.
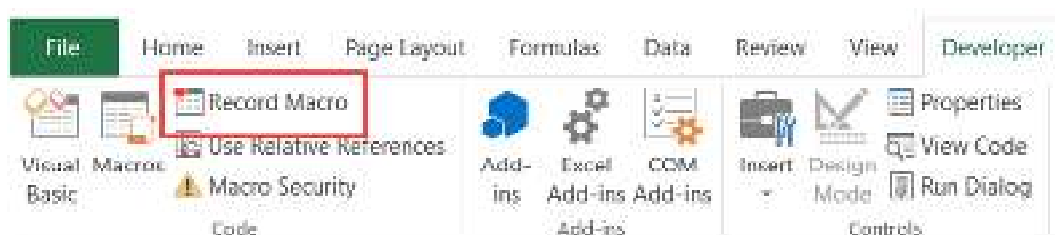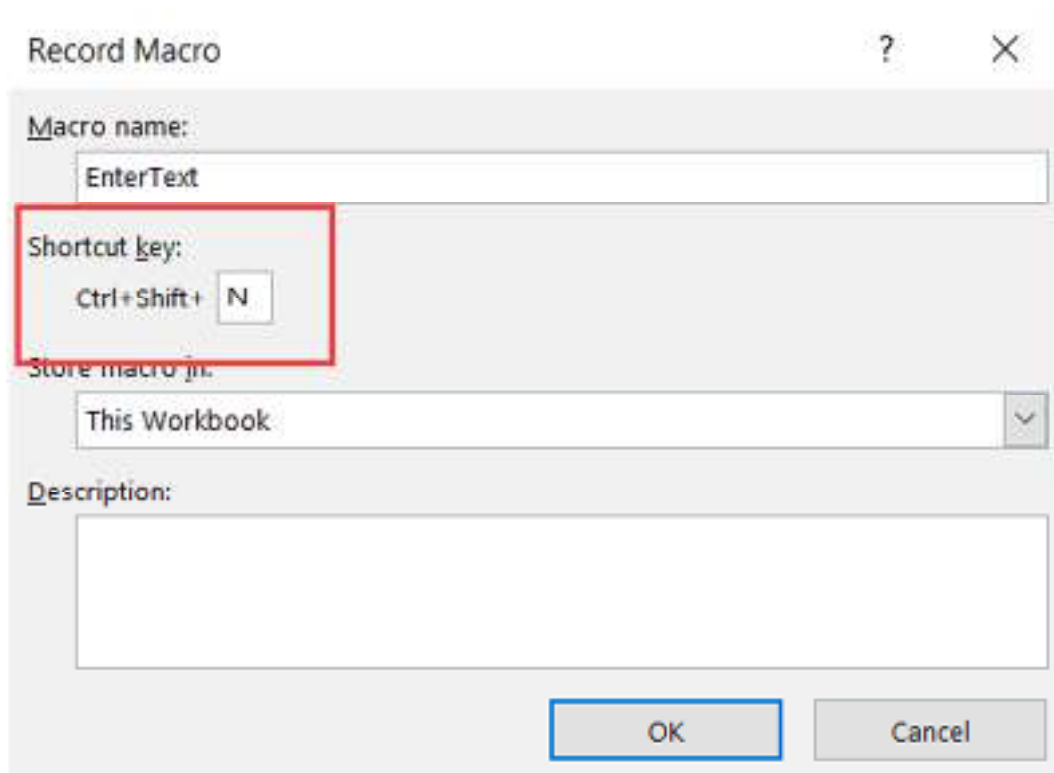
3. In the Record Macro dialog box, enter a name for your macro. I am using the name EnterText. There are some naming conditions that you need to follow when naming a macro. For example, you can not use spaces in between. I usually prefer to keep my macro names as a single word, with different parts with a capitalized first alphabet. You can also use underscore to separate two words – such as Enter_Text.

4. (Optional Step) You can assign a keyboard shortcut if you want. In this case, we will use the shortcut Control + Shift + N. Remember that the shortcut you assign here would override any existing shortcuts in your workbook. For example, if you assign the shortcut Control + S, you will not be able to use this for saving the workbook (instead, every time you use it, it will execute the macro).
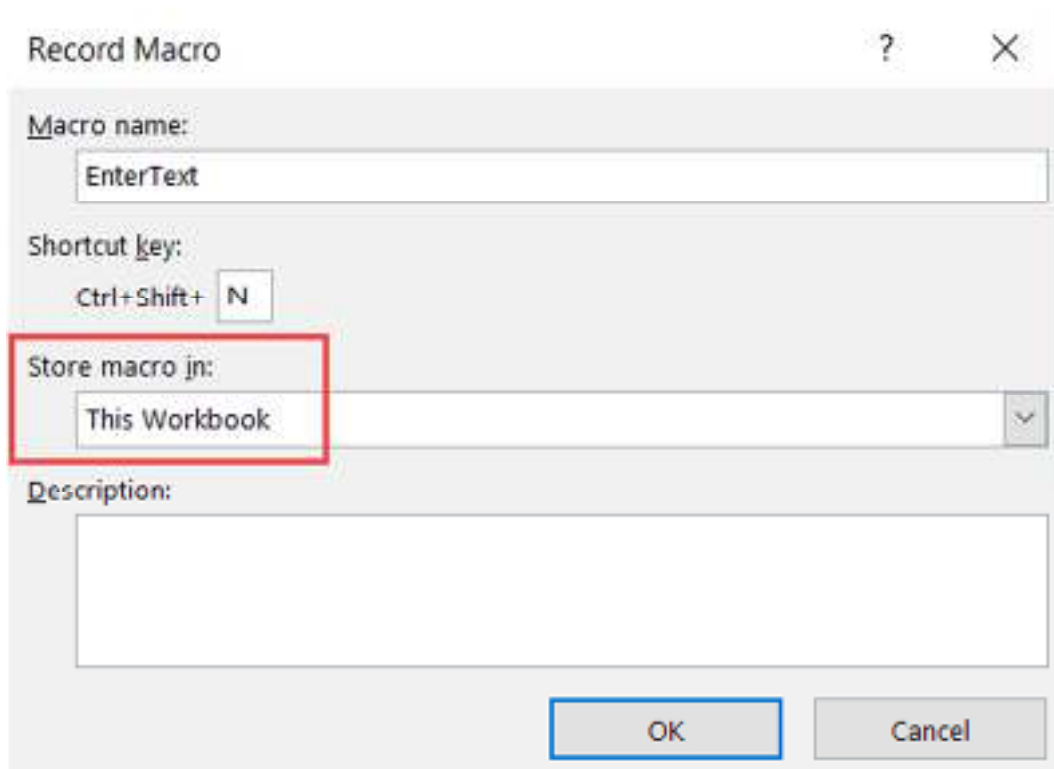
5. In the 'Store macro in' option, make sure 'This Workbook' is selected. This step ensures that the macro is a part of the workbook. It will be there when you save it and reopen again, or even if you share it with someone.

6. (Optional Step) Enter a description. I usually don't do this, but if you're extremely organized, you may want to add what the macro is about.

7. Click OK. As soon as you click OK, it starts to record your actions in Excel. You can see the 'Stop recording' button in the Developer tab, which indicates that the macro recording is in progress.

8. Select cell A2.

9. Enter the text **Excel** (or you can use your name).

10. Hit the Enter key. This will select cell A3.

11. Click on the Stop Recording button the Developer tab.

.

Example of recording a macro in Excel

To see how it works in practice, let's record a macro that applies some formatting to the selected cells. For this, do the following:

1. Select one or more cells that you want to format.

2. On the *Developer* tab or *Status* bar, click Record Macro.

3. In the *Record Macro* dialog box, configure the following settings:

   - Name the macro *Header_Formatting* (because we are going to format column headers).
   - Place the cursor in the *Shortcut key* box, and press Shift + F keys simultaneously. This will assign the Ctrl + Shift + F shortcut to the macro.
   - Choose to store the macro in this workbook.
   - For *Description*, use the following text explaining what the macro does: *Makes text bold, adds fill color, and centers*.
   - Click *OK* to start recording.
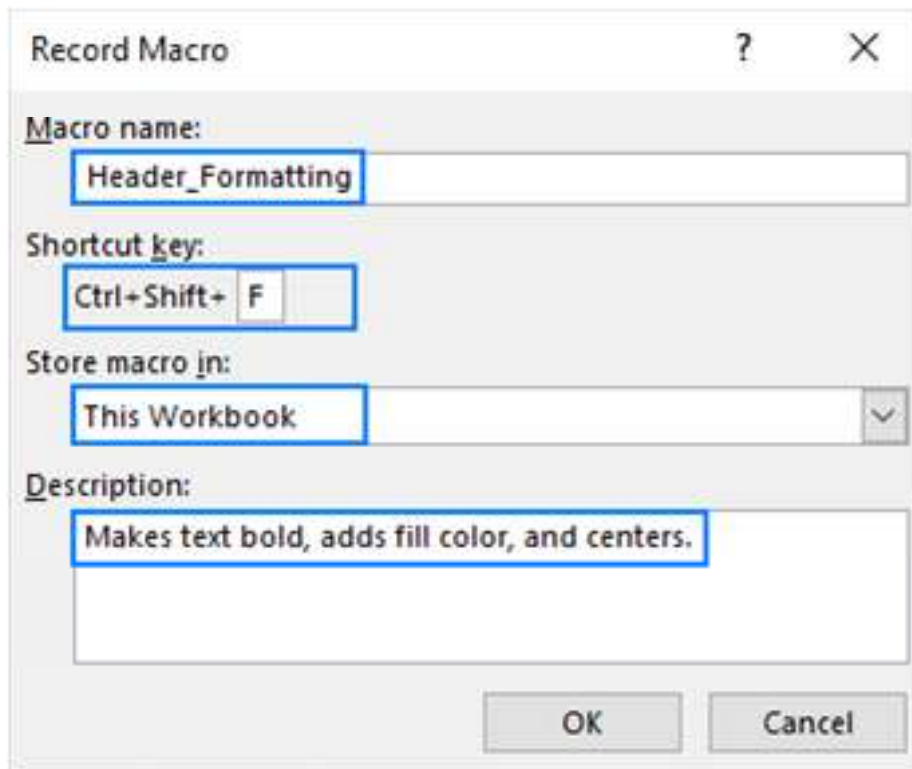
4. Format the pre-selected cells the way you want. For this example, we use the bold text formatting, light blue fill color and center alignment.

Tip. Do not select any cells after you've started recording the macro. This will ensure that all the formatting applis to the selection, not a specific range.
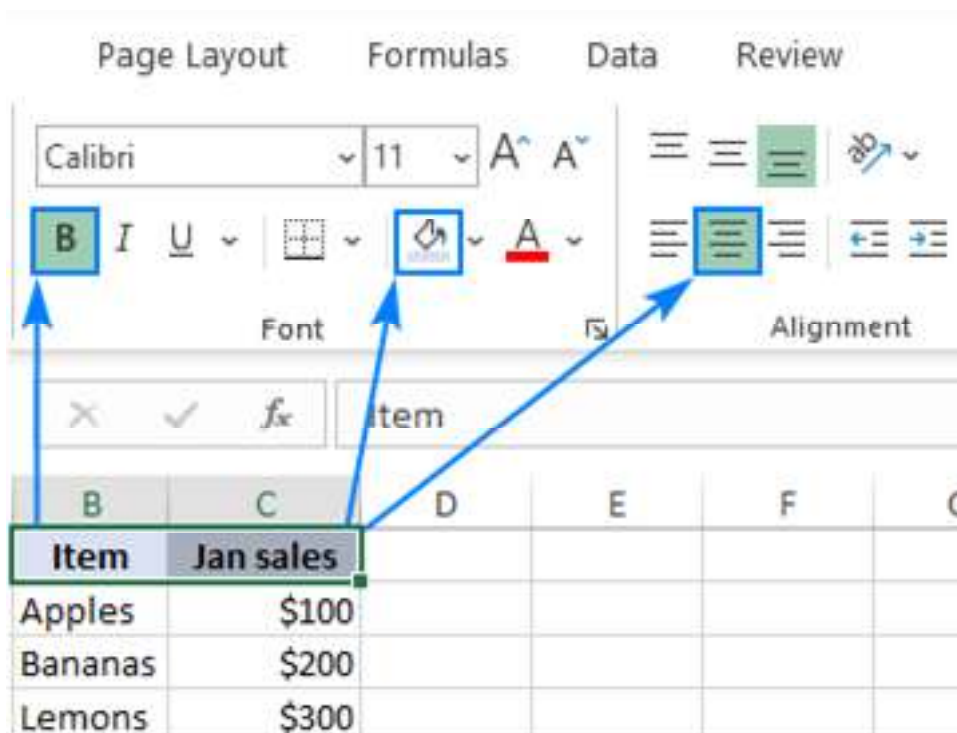
5. Click Stop Recording on either the *Developer* tab or the *Status* bar.

That's it! Your macro has been recorded. Now, you can select any range of cells in any sheet, press the assigned shortcut (Ctrl+ Shift + F), and your custom formatting will be immediately applied to the selected cells.

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Spreadsheet Modelling (Using Excel)

Item	Feb sales	Tax		Item	Feb sales	Tax
Apples	$150	$15	[Ctrl + Shift + F]	Apples	$150	$15
Bananas	$220	$22		Bananas	$220	$22
Lemons	$330	$33		Lemons	$330	$33

How to work with recorded macros in Excel

All main options Excel provides for macros can be accessed via the *Macro* dialog box. To open it, click the Macros button on the *Developer* tab or press the Alt+ F8 shortcut.
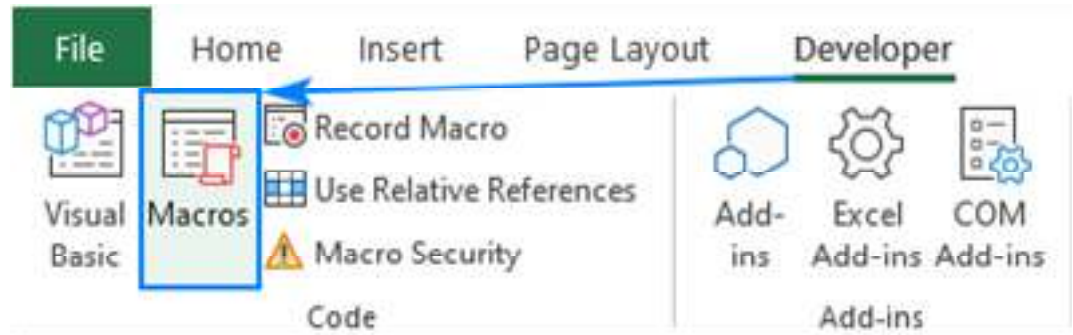
In the dialog box that opens, you can view a list of macros available in all open workbooks or associated with a particular workbook and make use of the following options:

- Run - executes the selected macro.

- Step into - allows you to debug and test the macro in the Visual Basic Editor.

- Edit - opens the selected macro in the VBA Editor, where you can view and edit the code.

- Delete - permanently deletes the selected macro.

- Options – allows changing the macro's properties such as the associated *Shortcut key* and *Description*.
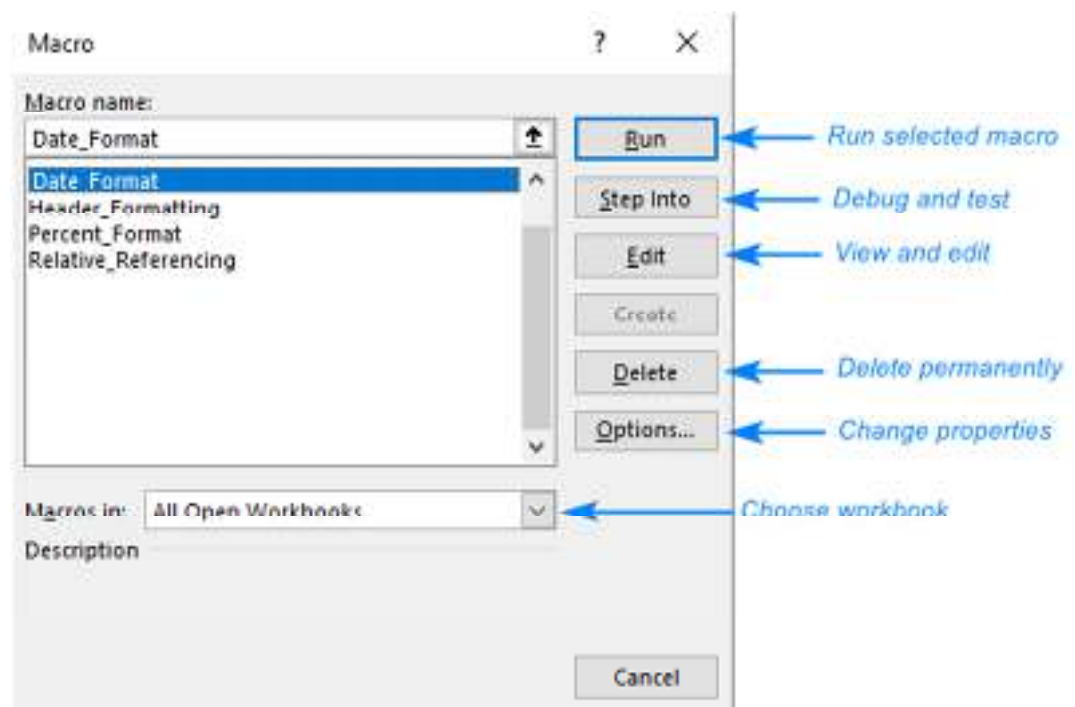
How to view macros in Excel

The code of an Excel macro can be viewed and modified in the Visual Basic Editor. To open the Editor, press Alt + F11 or click the Visual Basic button on the *Developer* tab.
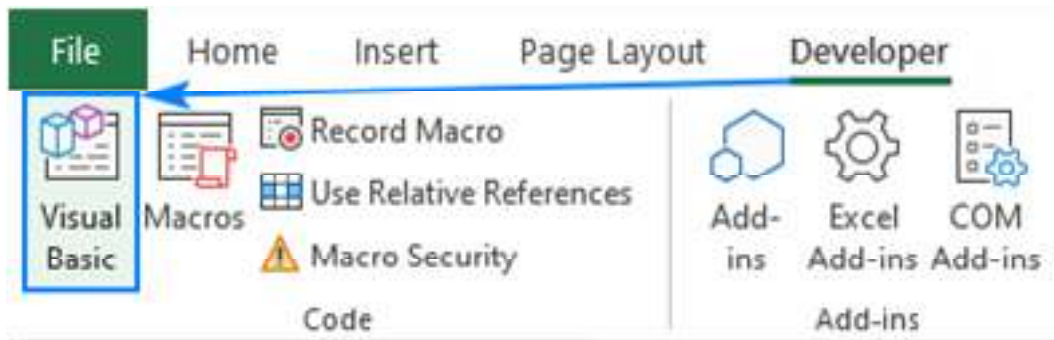
If you see the VB Editor for the first time, please do not feel discouraged or intimidated. We are not going to talk about the structure or syntax of the VBA language. This section will just give you some basic understanding of how Excel macros work and what recording a macro actually does.

The VBA Editor has several windows, but we'll focus on the two main ones:

Project Explorer - displays a list of all open workbooks and their sheets. Additionally, it shows modules, user forms and class modules.

Code Window - this is where you can view, edit and write VBA code for each object displayed in the Project Explorer.
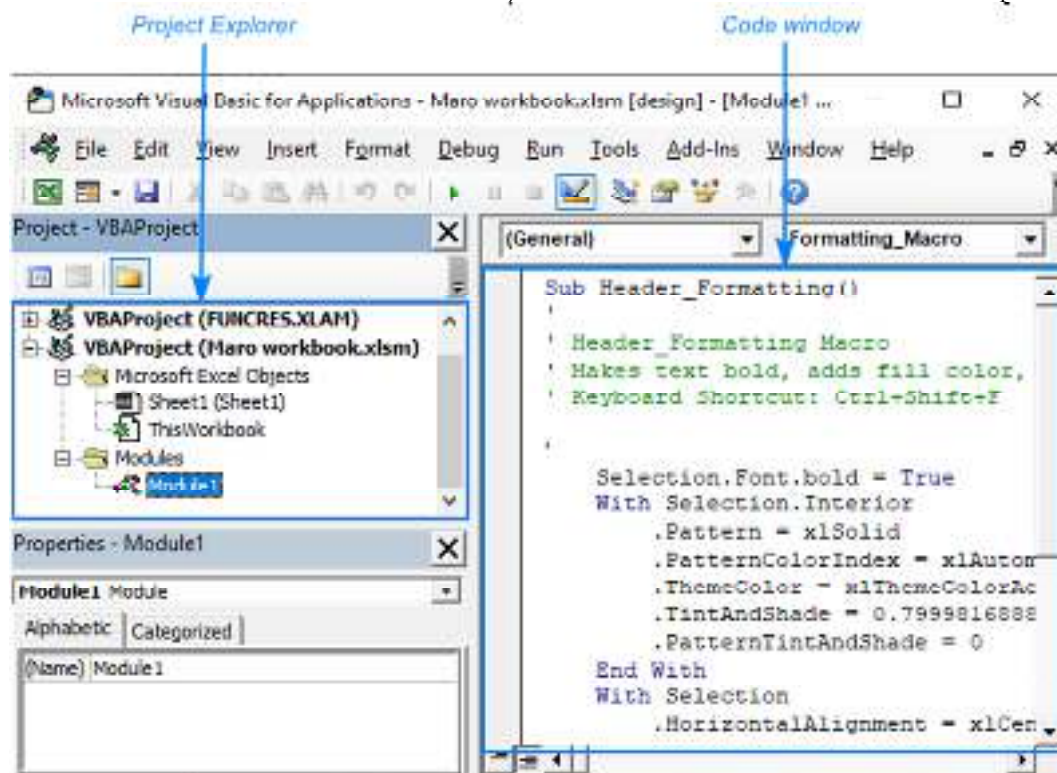
When we recorded the sample macro, the following things occurred in the backend:

- A new module (*Moduel1*) was inserted.
- The VBA code of the macro was written in the Code window.

To see the code of a specific module, double-click the module (Module1 in our case) in the Project Explorer window. Normally, a macro code has these parts:

Macro name

In VBA, any macro starts with Sub followed by the macro name and ends with End Sub, where "Sub" is short for Subroutine (also called Procedure). Our sample macro is named Header_Formatting(), so the code starts with this line:

Sub Header_Formatting()

If you wish to rename the macro, simply delete the current name and type a new one directly in the Code window.

Comments

Lines prefixed with an apostrophe (') and displayed in green by default are not executed. These are comments added for information purposes. The comment lines can be safely removed without affecting the functionality of the code.

Usually, a recorded macro has 1 - 3 comment lines: macro name (obligatory); description and shortcut (if specified before recording).

Executable code

After comments, there comes the code that executes the actions you've recorded. Sometimes, a recorded macro may have a lot of superfluous code, which may still be useful for figuring out how things work with VBA :)

The below image shows what each part of our macro's code does:
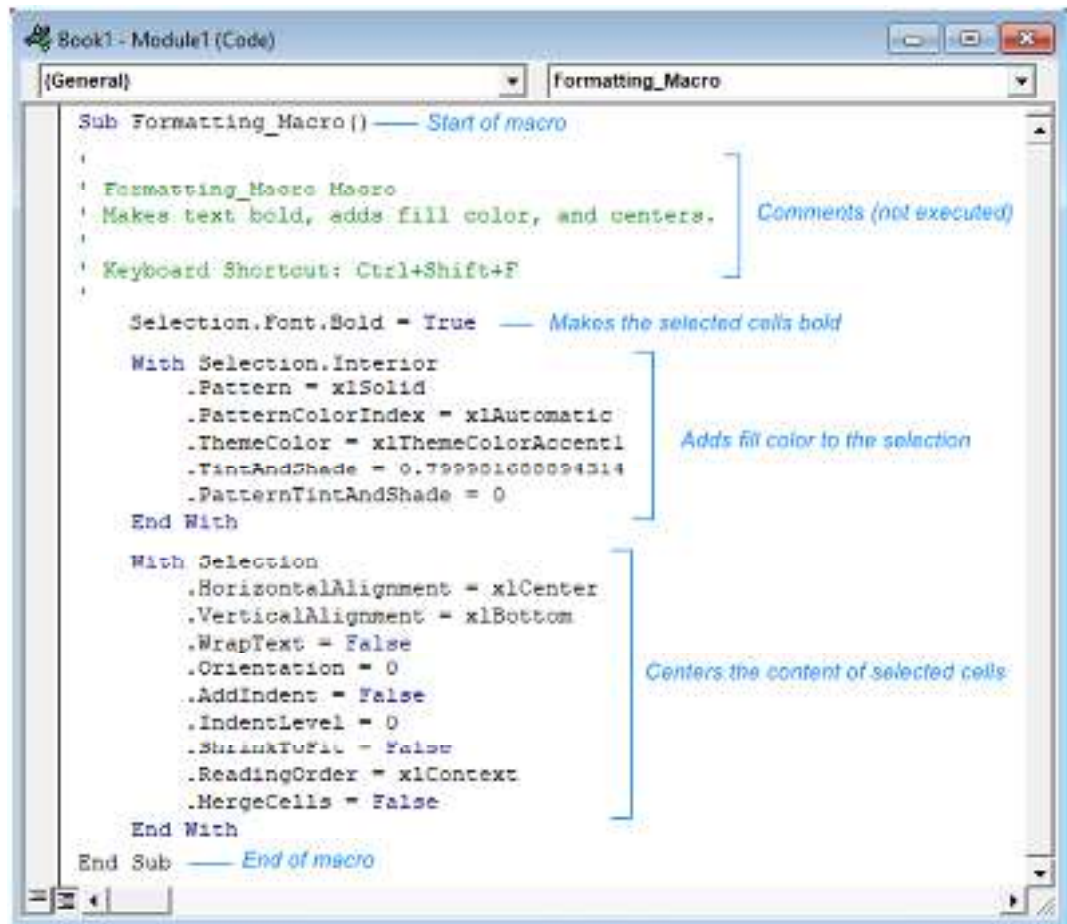
How to run a recorded macro

By running a macro, you tell Excel to go back to the recorded VBA code and execute the exact same steps. There are a few ways to run a recorded macro in Excel, and here are the fastest ones:

- If you've assigned a keyboard shortcut to the macro, press that shortcut.

- Press Alt + 8 or click the *Macros* button on the *Developer* tab. In the *Macro* dialog box, select the desired macro and click Run.
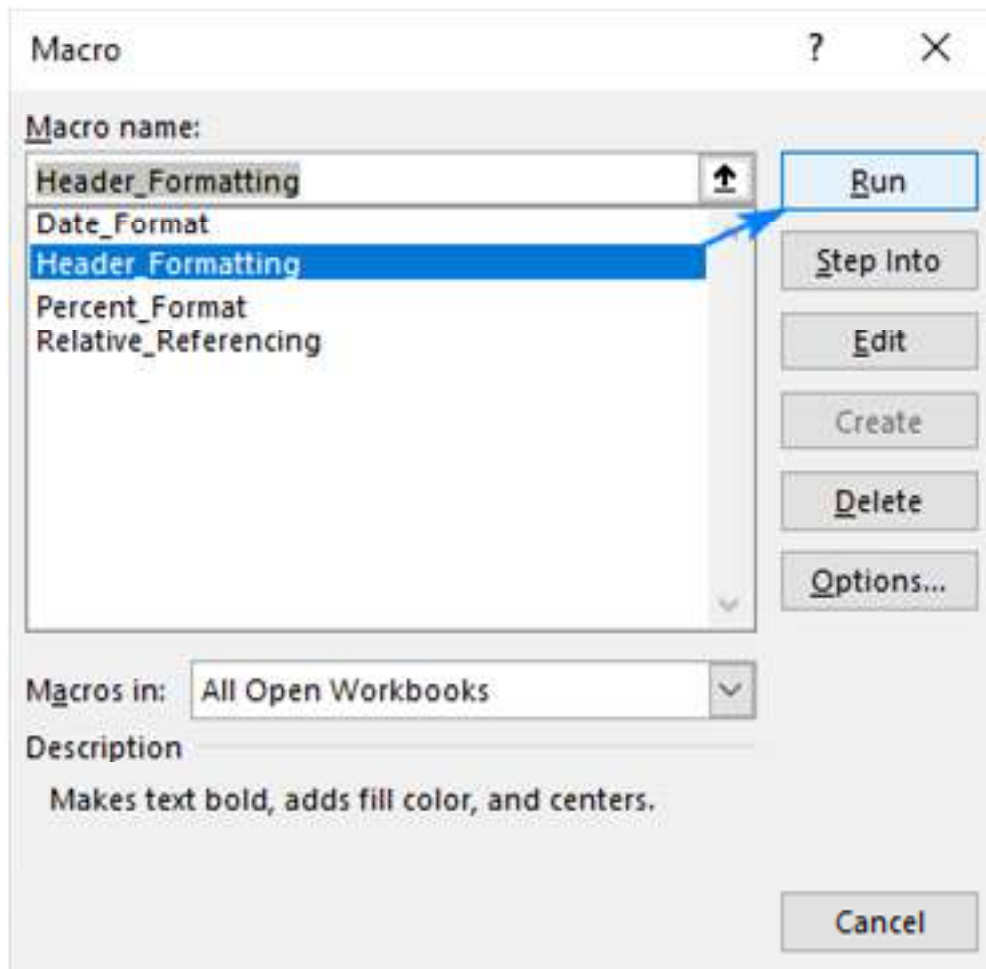
It is also possible to run a recorded macro by clicking your own button. Here are the steps to make one: How to create a macro button in Excel.

How to save macros in Excel

Whether you recorded a macro or wrote VBA code manually, to save the macro, you need to save the workbook as macro enabled (.xlms extension). Here's how:

1. In the workbook containing the macro, click the *Save* button or press Ctrl + S.

2. In the *Save As* dialog box, choose Excel Macro-Enabled Workbook (*.xlsm) from the *Save as type* drop-down list, and then click *Save*:
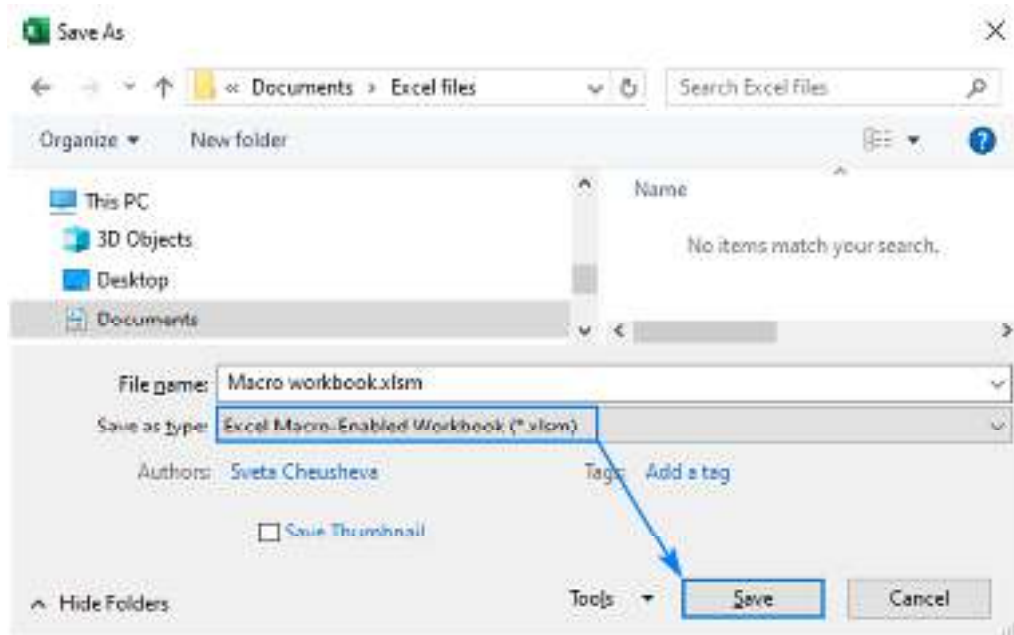
11.2 Excel VBA MsgBox

VBA MsgBox function is like an output function used to display the generalized message provided by the developer. It is like a print statement. This function or statement has no arguments. The personalized messages in this function are written under double quotes, while one must provide the variable reference for the values.

When we start learning VBA, the first thing we try to learn is the Message Box or MsgBox function. It is nothing but a small box that holds the message to the user. This tutorial will show you how to show a message, customize the message box, icon change, button change, and other modalities of the message box.

MsgBox Function Syntax

We can see the syntax in the module when we type the word MsgBox. Now, we will introduce you to the syntax.

- Prompt: This is the first and mandatory argument. In the above example, we must type the word "Welcome to VBA" as the Prompt. It is nothing but the message we need to show. We can show up to 1,024 characters.

- Button: This is nothing but what kind of button we need to show on the MsgBox. For example, In our previous example, the default button was "OK."

- Title: This is the title of the message box. We can customize this title and give our name to the message box in double quotes.

- [HelpFile]: This is nothing but the help icon you want to show users. If they have doubts and if you have already specified the suggestions, then they can click on this hell file to learn more.

- [Context]: This is the numerical value assigned to the appropriate help topic.

How to Create a MessageBox using VBA Code?

Follow the below steps to create a simple msg box using the **VBA code**.

Step 1: Open Visual Basic Editor

Go to the DEVELOPER tab and click on VISUAL BASIC.
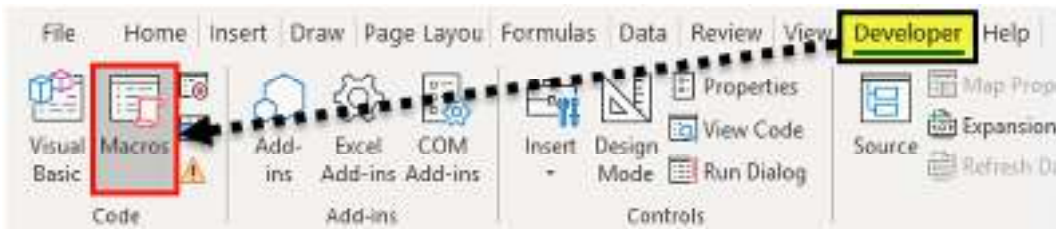
Alternative: You can click the shortcut key ALT + F11.

Step 2: Insert Module

Now, click on INSERT and select MODULE.
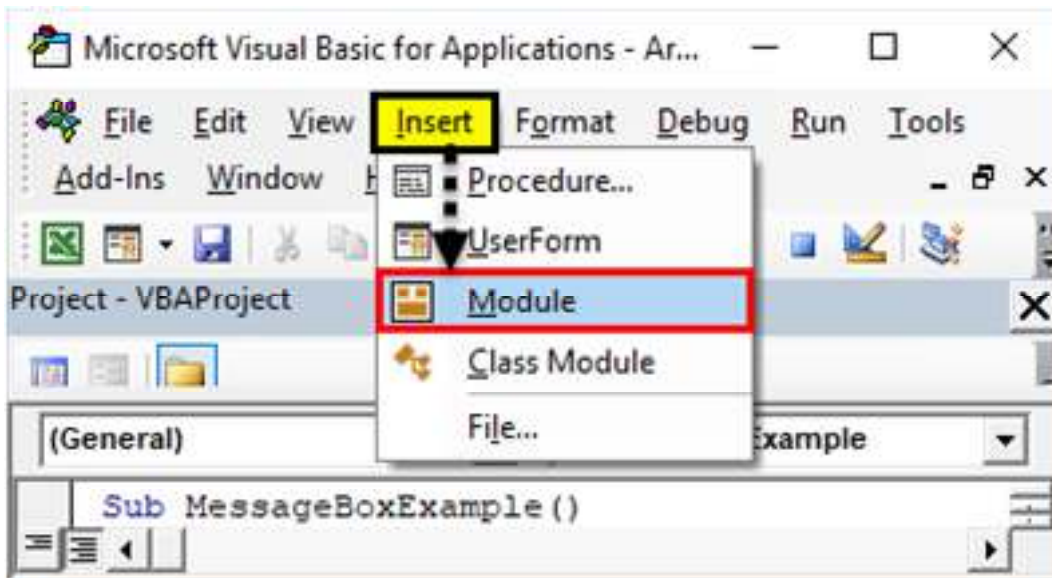
It will insert the new MODULE in your **VBA editor**.

Spreadsheet Modelling (Using Excel)
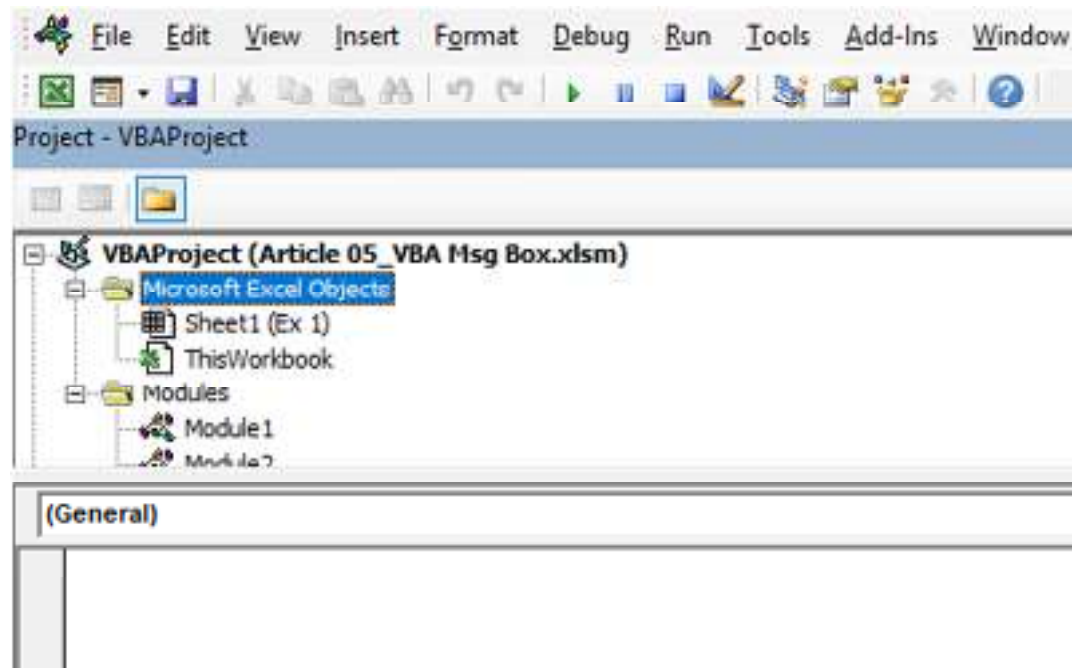
Step 3: Start Subprocedure

Start your excel macro by typing SUB, the head of the macro. Give a MACRO a name and press the "Enter" key.
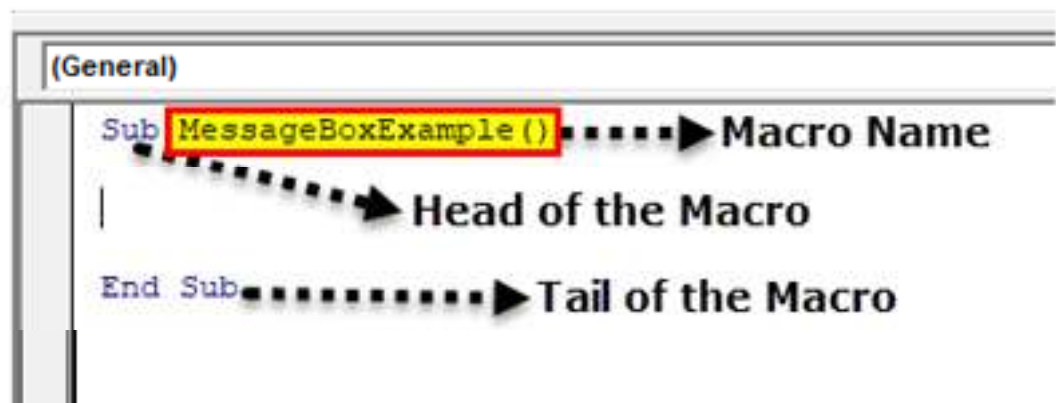
Step 4: Start Writing Code for MsgBox

- In between the Head & Tail of the macro, we need to write the code. So start the word Msgbox. It will display the MsgBox function.
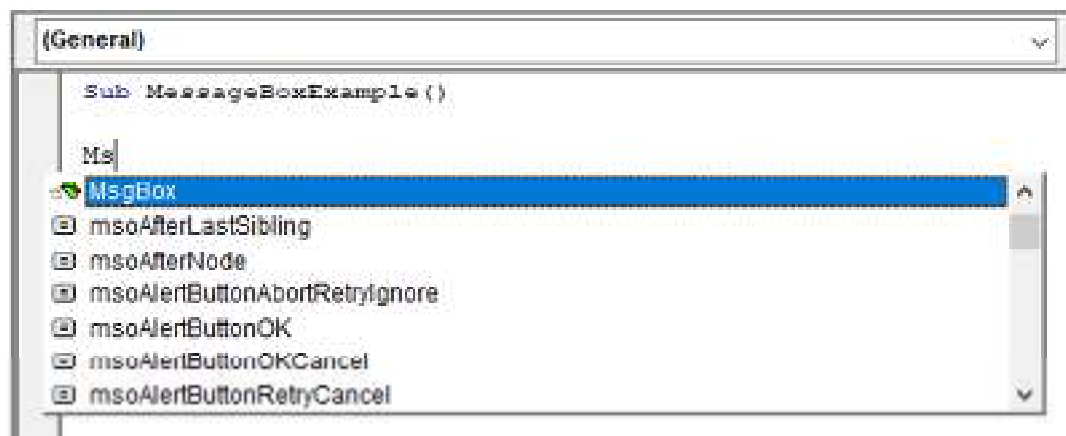
- As soon as you see the word Msgbox press tab, it will start to show the Msgbox syntax.

- Now, type the word Welcome to VBA in double-quotes.

- We have created a simple message box macro.

Step 5: Run the Code

- Now inside the macro, place a cursor and press the key F5, the shortcut key to run a macro.

Step 6: Output

You can see the message box in your Excel window as soon as you run the macro.
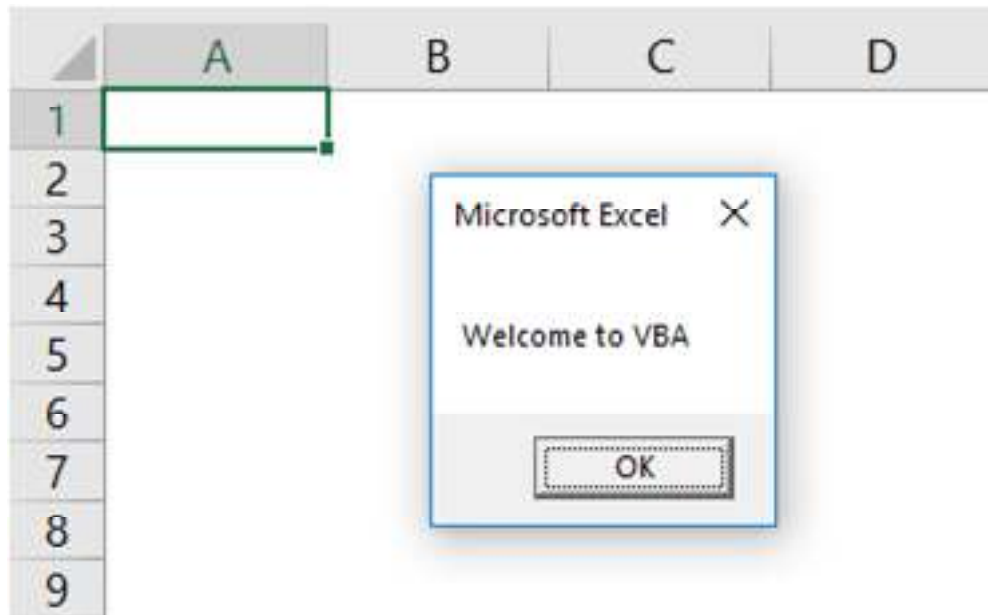
Structure of Message Box

Now, we will introduce you to the structure of the Message Box. It consists of four elements.
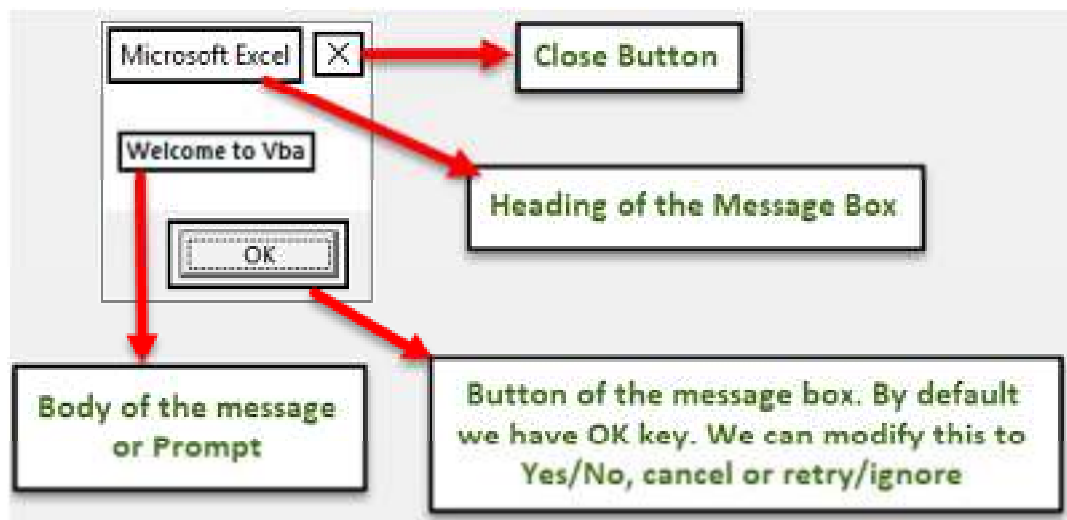
#1 – Title

By default, the message box displays the message box's title as Microsoft Excel. However, we can modify this as well. For example, after we supply Prompt, we can give our name to the MsgBox.

Step 1: First, give a Prompt, i.e., the message you want to show.

Step 2: Now, the next argument is Buttons. Ignore this and jump to the next argument, **i.e., Title.**

Step 3: We have completed it now. Now, run the macro by using the F5 key.
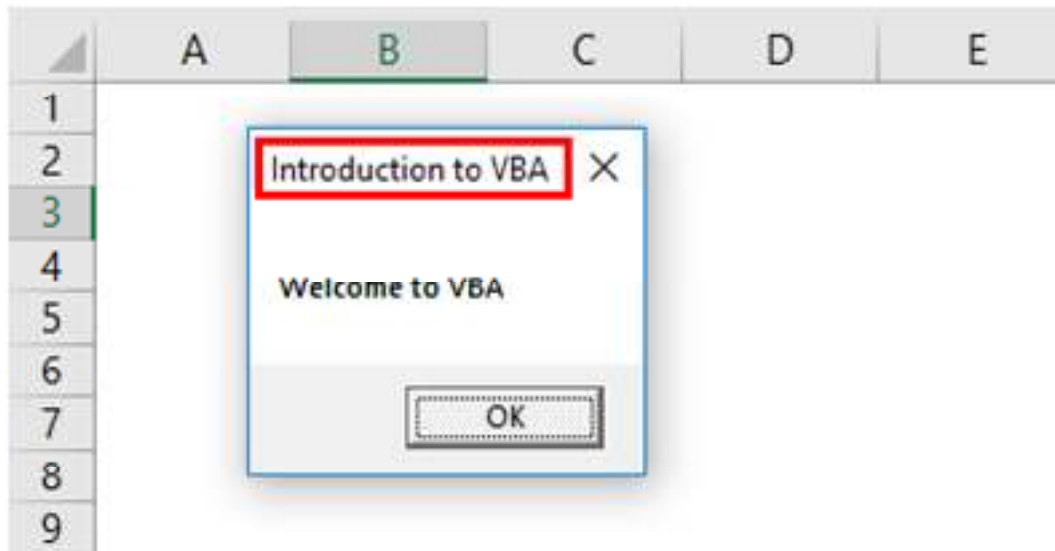
Now, you can see the difference in the title of the message box. Instead of the default title, Microsoft Excel, it now shows Introduction to VBA as the title.

#2 – Buttons

We have learned how to show a message box and alter the message box title. Now, we will see the option of the message box button.

Once we supply the prompt input, the next thing in the syntax is the message box button.

We have as many as 20 kinds of Message Box button options, including Yes/No. You can select any one of the available 20 buttons. For example, we have selected vbYesNoCancel.
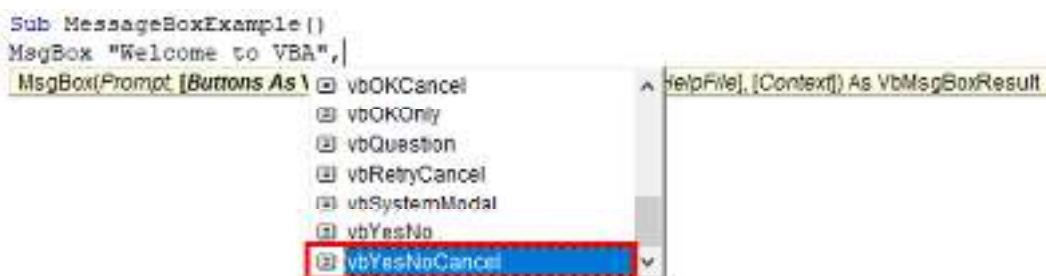
Now, run the macro. We will see different message box buttons instead of the default "OK" button.
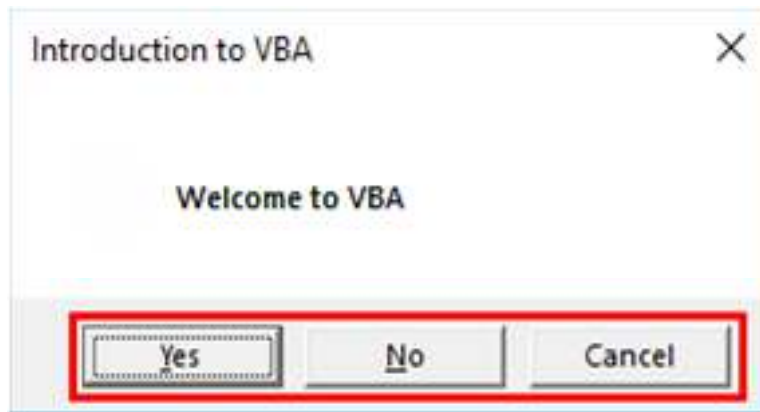
#3 – Combination of Icon & Buttons

We have seen how to modify message box buttons. Along with the message box button, we can also show icons like the image below.
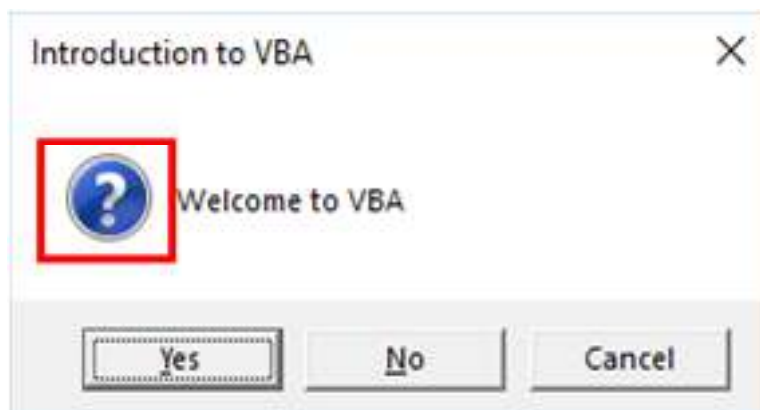
There are four kinds of icons available. vbCritical, vbQuestion, vbExclamation, and vbInformation.

To show the button and the icon, we need to combine both by entering the plus (+) icon together.

#1 – vbQuestion Marks Icon

Code:

```
Sub SerialNumber                                                                    ()
MsgBox    "Welcome    to    VBA", vbYesNoCancel  +  VbQuestion,"Introduction   to   VBA"
End Sub
```

Result:

#2 – vbCritical Marks Icon

Code:

Sub MessageBoxExample   ()
MsgBox   "Welcome   to   VBA", **vbYesNoCancel   +   VbCritical**,   "Introduction   to   VBA"
End Sub
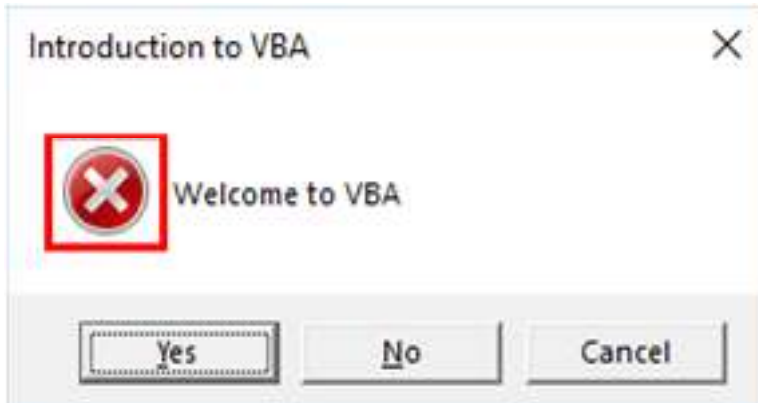
Result:

#3 – vbExclamation Marks Icon

Code**:**

Sub MessageBoxExample   ()
MsgBox   "Welcome   to   VBA", vbYesNoCancel   +   VbExclamation,   "Introduction   to   VBA"
End Sub
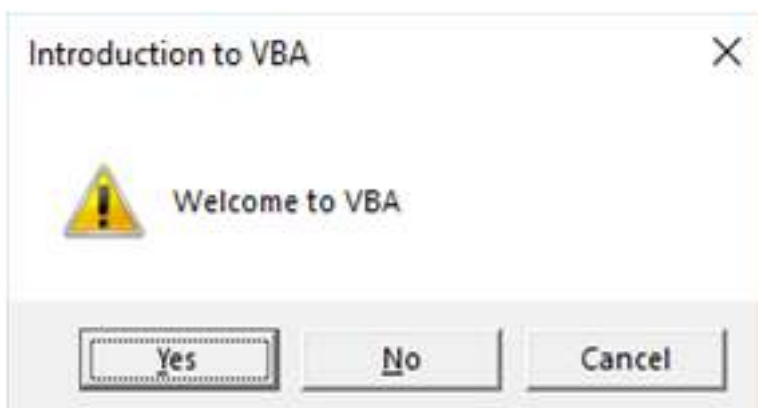
Result:

#4 – vbInformation Marks Icon

Code:

Sub MessageBoxExample   ()
MsgBox   "Welcome   to   VBA", vbYesNoCancel   +   VbInformation,   "Introduction   to   VBA"
End Sub

Result:
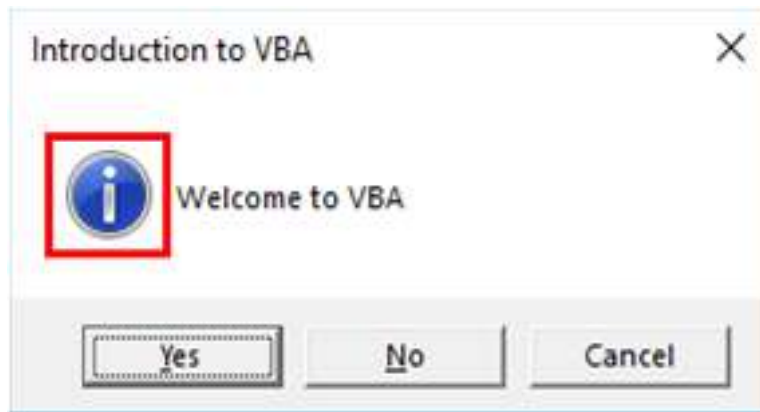
11.3 VBA Variable Declaration

Before moving to the VBA variable declaration, let us first understand what variables are, the use of variables, and when we should use them.

What are the variables in VBA?

The word "variable" defines variables as the name of memory in your location, which holds some value. You can pass a value in a code based on the variable type. The value will be used while executing the code, and you will get the output.

What is the use of Variable?

Creating a program or a code consists of instructions that pass the information to the system about what to do with data. The data consist of two types of values, fixed and variable. Fixed values are also called "constant." One may define variables by certain data types: Integer, Byte, String, etc. It helps us to identify the nature of the data we are entering, i.e., Text, Number, Boolean, etc.

How to Declare a Variable?

To declare a variable in code, you should assign a name to that variable. You can assign any name to a variable. However, selecting a variable name that relates to data is advisable so that other users can understand it easily. For example, if you need to pass Integer data in the code, then the name variables like i_count or out. If you need to pass a string value, you can name that variable like strName.

One can declare variables anywhere in the **VBA code**. However, the coder must declare them at the start of the code so that every user can understand the code very easily. The variable should be declared using Dim.

VBA Variable Declaration
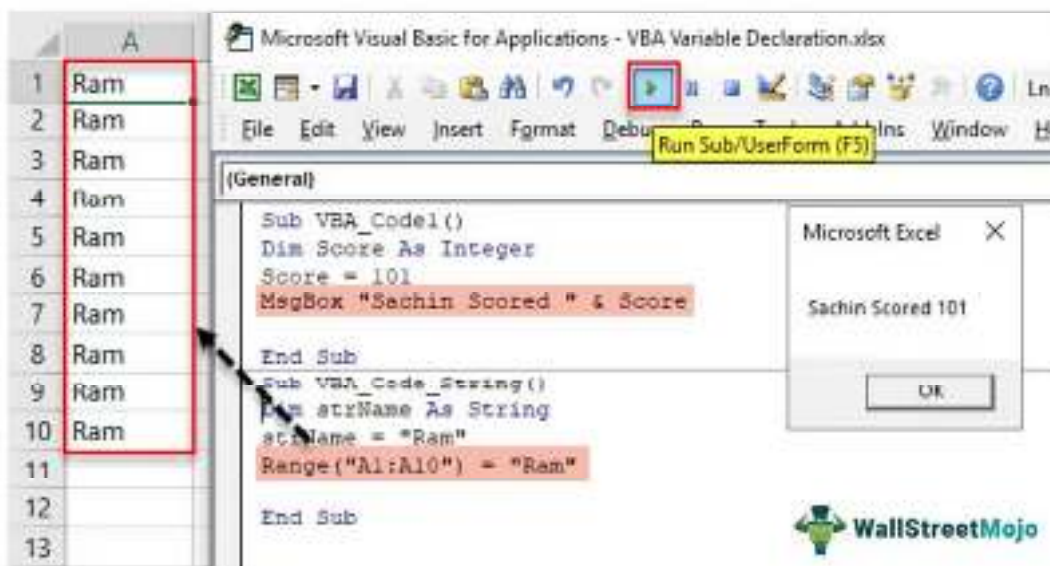
VBA Variable Declaration Example #1 – Integer

One may need the VBA Integer when one needs to store the whole numbers. For example, integers can store values between 32,768 to 32,767. If you need to pass values beyond this, use the Long Data type in VBA.

Code:

Sub VBA_Code1()

 Dim Score As Integer

 Score = 101

 MsgBox "Sachin Scored " & Score

End Sub

The above code's result will show "Sachin Scored 101." See below.
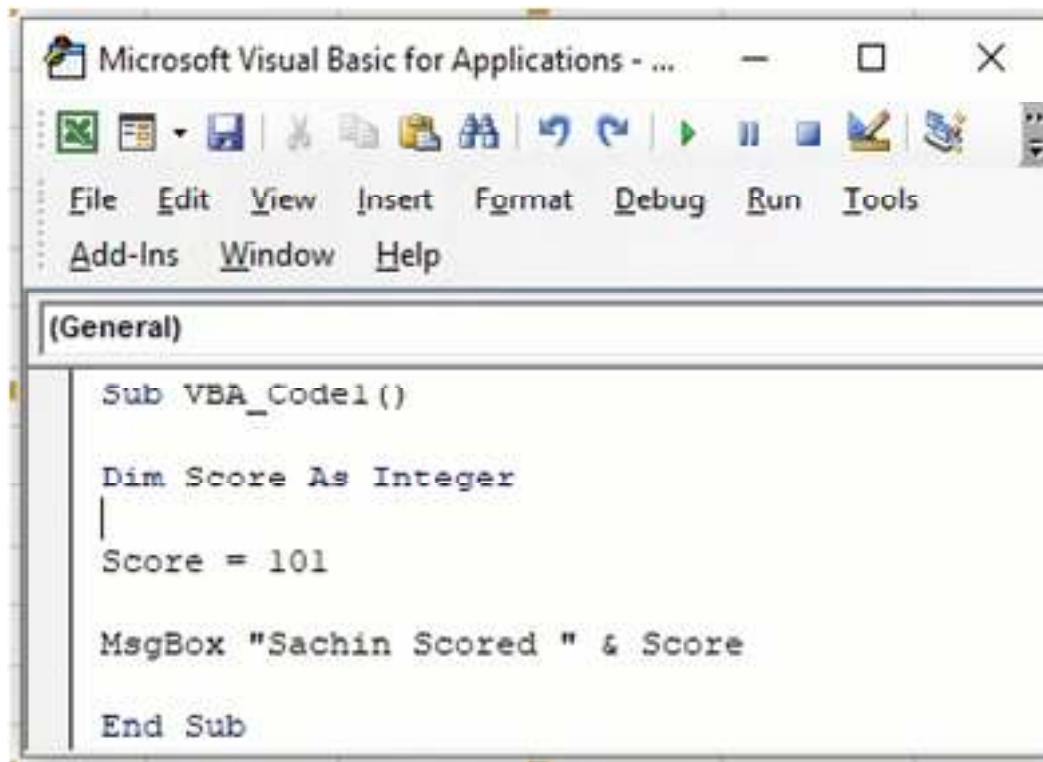
VBA Variable Declaration Example #2 – String

The VBA string data type can store data as text.

Code:

Sub VBA_Code_String()

 Dim strName As String

 strName = "Ram"

 Range("A1:A10") = "Ram"

End Sub

When you run the above code, this will enter "Ram" in every cell between Range A1:A10.
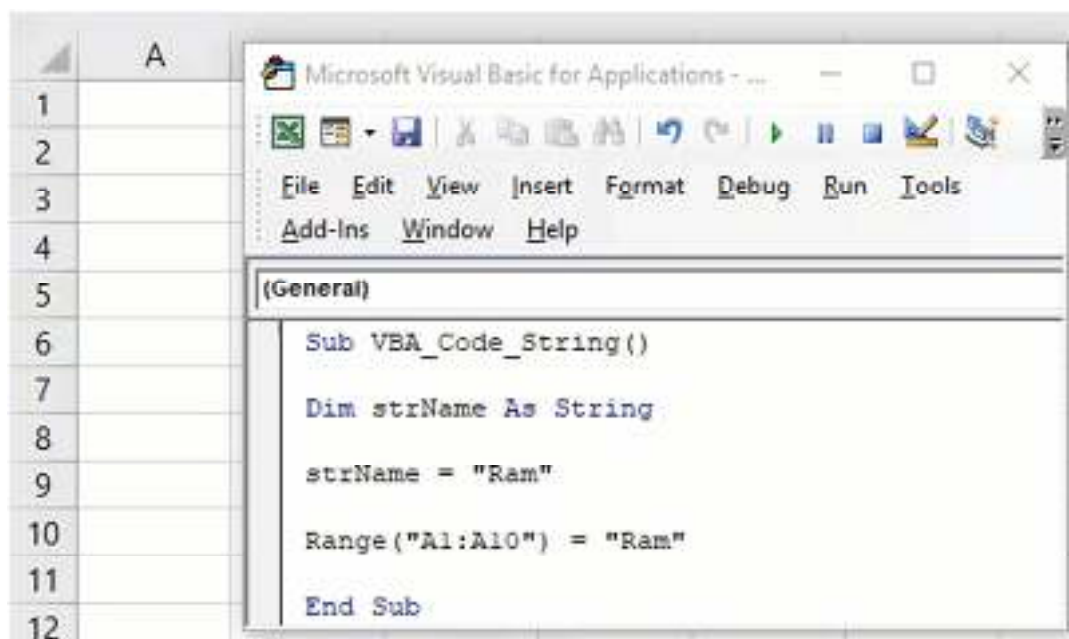
VBA Variable Declaration Example #3 – Date

The date data type in VBA can store data like the date. Therefore, it will be in the format of MM/DD/YYYY.

Code:

Sub VBA_Code_Date()

Dim DOB As Date

 DOB = "04/04/1990"

MsgBox "I was born on " & DOB

End Sub

When you run the above code, this will show the result below.

VBA Variable Declaration Example #4 – Boolean

Boolean Datatype in VBA has only two values True or False.

Code:

Sub VBA_Code_Boolean()

 Dim bgender As Boolean

 bgender = False

 If bgender = True Then

 Range("A1") = "Male"

 Else

 Range("A1") = "Female"

 End If

End Sub

When you run the code, the result in the A1 cell will be "Female."
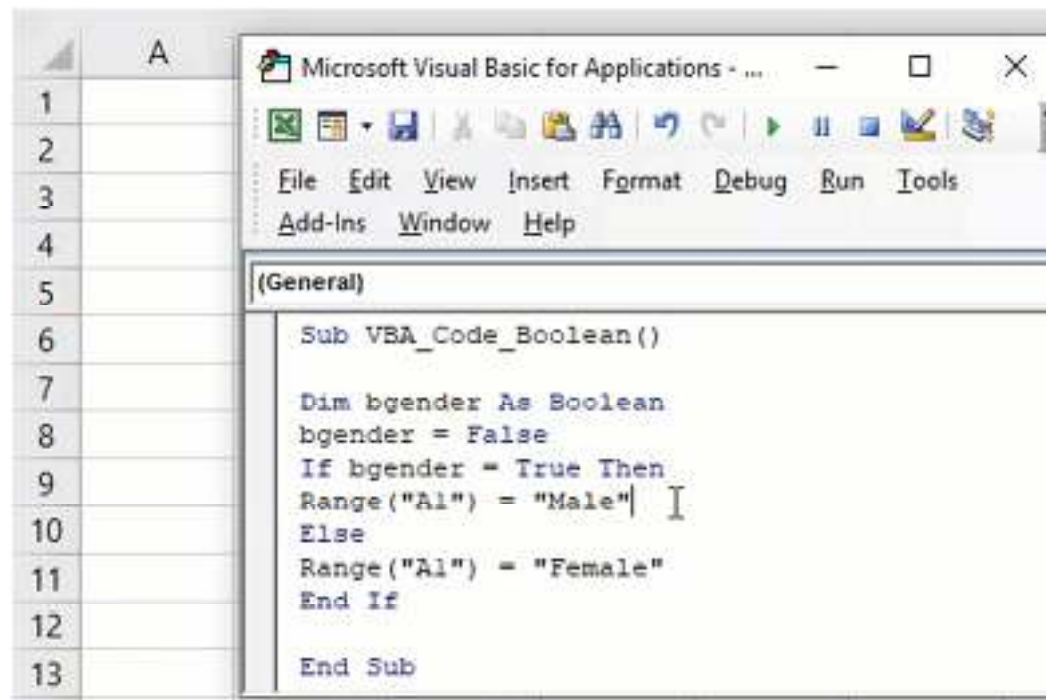
VBA Variable Declaration Example #5 – Long

The Data type Long is also used to store numbers. They can store numbers between -2,147,483,648 to 2,147,483,647. Here, you must have a question: if Integer and Long can store numbers, why do we use Integer?

Here is the answer. Integer takes two bytes of space. However, Long needs 8 bytes of space. So, you should not use Long when you know one can store a number as an Integer. Else, your program running time will increase.

Suppose you need to show the distance between the North Pole and the South Pole in "Meter." You know that the distance in the meter is outside the range of -32,768 to 32,767. So, you will use the Data type Long.

Code:

```
Sub VBA_Code_long()

Dim distance As Long

distance = 13832000

MsgBox "Distance between the North Pole and

the South Pole is " & distance & " Meter"

End Sub
```

The result will be "Distance between the North Pole. The South Pole is 13832000 Meter.
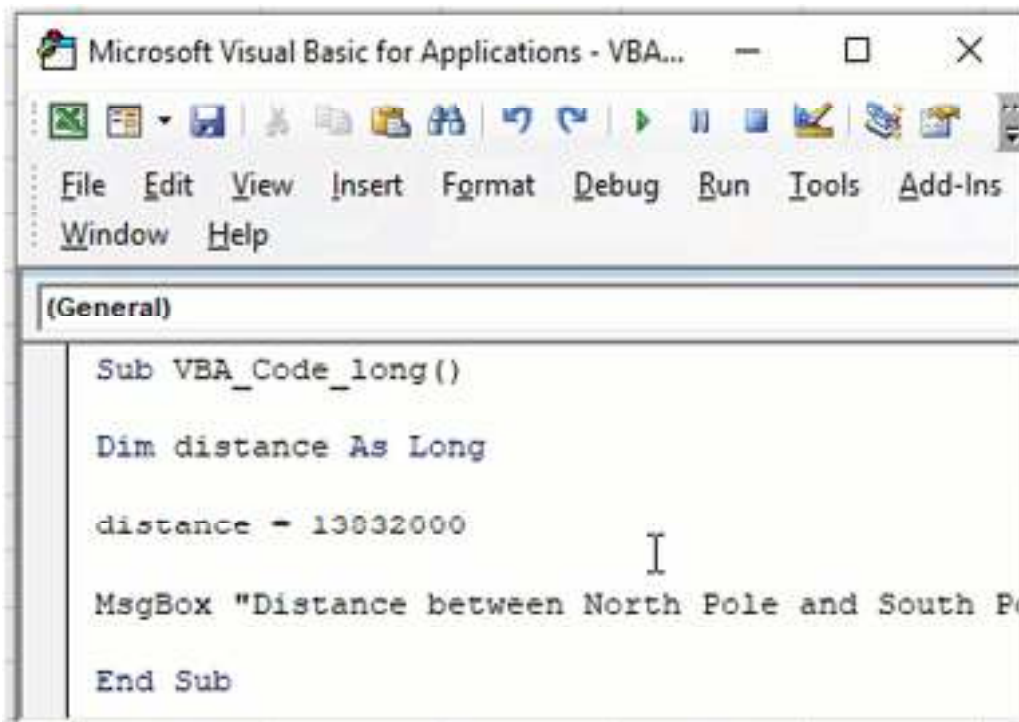
11.4 Subroutines and Functions

VBA has two types of procedures for creating and executing codes: *Subroutine* (or simply *Sub*) and *Function*.

Subroutine

A Sub can be used to execute another Sub:

```
Sub sub_main()
   sub_auxiliary1
   sub_auxiliary2
End Sub
Sub sub_auxiliary1()
   MsgBox "One Sub executing another Sub"
End Sub
Sub sub_auxiliary2()
   MsgBox "One Sub executing a second Sub"
End Sub
```

For this and further examples, just run the **sub_main**. By clicking anywhere between the line Sub sub_main() and the first End Sub.

A Sub can also accept an argument:

```
Sub sub_main()
   sub_argument(10) '10 is an argument
End Sub
Sub sub_argument(x as Integer)
   MsgBox x
End Sub
```

You can assign an argument to the Sub using a single space:

sub_argument 10 '10 is an argument

Or multiple arguments:

```
Sub sub_main()
    Dim score As Single
    Dim student As String
    score=10
    student="Paulo"
    Call sub_argument (score, student) 'score is an argument, student is another argument
End Sub
Sub sub_argument(s_exam as Single, name as String)
    MsgBox name & "'s score was " & s_exam
End Sub
```

To have more than one argument into a Sub, you can use the Call instruction before the name of the Sub you want to call.

You can also execute a Sub with multiple arguments omitting the Call instruction and the parentheses:

sub_argument score, student

Have the practice of declaring the variables in the same data types that the Sub requires as arguments.
E.g.score and s_exam.

Subs can also be accessed from different modules:

Types of Sub

The types of Sub available are Private and Public:

Public Sub: Creates a public procedure that can be accessed by any procedure of any module, and is

displayed in the *Macros* (+   ).

Private Sub: Creates a private procedure that can be accessed only by procedures of the same

module, and is **not** displayed in the *Macros* (+   ).

An undefined Sub is considered Public by VBA.

Functions

Functions work similarly to Subroutines with arguments. The main difference is that the Function will necessarily return a value and should be called by some other procedure.

```
Sub sub_main()
    result = multiply_2(10)
    Msgbox result
End Sub
Function multiply_2(x As Single)
    multiply_2 = x*2
```

End Function

It is not possible to pass arguments to a function through the single space if it is being associated with a variable.

result = multiply_2 10 'Will result in error!

Note that:

MsgBox resultado 'It will not result in an error because there is no association.

You can not run a Function by itself. It is necessary to be called by another procedure. E.g. Sub sub_main().

Once defined, functions can be used normally by the user in the Excel spreadsheet environment. Just call by the name of the function, as with any other predefined function (SUM, AVERAGE, etc.).

We can also define in the declaration the type of result that the Function will return:

Function multiply_2(x As Single) As Integer

multiply_2 = x*2

End Function

Note that now the function will only return rounded results, given the return specification As Integer.

There are many predefined functions in VBA. MsgBox is one of them.

Msgbox "This should be shown" 'MsgBox works without the parentheses

Msgbox ("This should be shown") 'and works with the parentheses

Naming a Function

When you create a function it needs to be followed by a name that must comply with the following rules:

It must initiate with an alphabetical character

It must **not** contain especial characters, such as: #, $, %, &, !

It must **not** contain whitespace characters, dots or commas

It must **not** be a VBA reserved word like: And, Or, Sub

Function Errors

Question: What if the user inserts unexpected values into my function?

Answer: Create an error to warn him.

This procedure can be done through the predefined CVErr function, which uses an integer value to specify an error.

The possible value it accepts are:

2000 (ou xlErrNull) which returns a #NULL! error

2007 (ou xlErrDiv0) which returns a #DIV/0 error

2015 (ou xlErrValue) which returns a #VALUE! error

2023 (ou xlErrRef) which returns a #REF! error

2029 (ou xlErrName) which returns a #NAME? error

2036 (ou xlErrNum) which returns a #NUM! error

2042 (ou xlErrNA) which returns a #N/A error

Compare how an User Defined Function (UDF) to calculate the area of a triangle should be changed to apply the CVErr

Function AreaTriangle(Base As Single, Height As Single) As Double

   'As Double above specifies the return type of AreaTriangle

   AreaTriangle = (Base * Height) / 2

End Function

Negative values are not expected for the area calculation, so let's create an error if the user enters them:

Function AreaTriangle(Base As Single, Height As Single) As Variant

'As Variant is defining the data type of AreaTriangle

   If Base < 0 Or Height < 0 Then

     AreaTriangle = CVErr(2036)

   Else

     AreaTriangle = (Base * Height) / 2

   End If

End Function

In this way, if the user inserts negative values, the following error will appear in the cell of the

function:

The data type of CVErr(2036) is Error. This data type besides not being common is also incompatible with numeric data (that will be necessary for the calculation of the area). Therefore we assign to AreaTriangle the data type Variant. In this way, AreaTriangle will accept both the **Error** data type, if it occurs, and the Double data type, which will be returned if the calculation proceeded properly.

Sub VS Function

Subroutines do not return values if called. Functions return values

Subroutines can be assigned to buttons and shapes in Excel, Functions can't

Functions created in VBA can be used in your Excel worksheet

Summary

- Macros are sequences of Excel actions that can be recorded and played back to automate repetitive tasks.
- To create a macro, go to the Developer tab, click on "Record Macro," perform the actions you want to record, and then stop recording.
- Recorded macros can be assigned to buttons or keyboard shortcuts for easy execution.
- Macros can save time by automating tasks such as data formatting, calculations, and report generation.
- MsgBox is a VBA function used to display pop-up message boxes in Excel.
- It can be used to provide information, warnings, or prompts to users interacting with an Excel workbook.
- MsgBox syntax includes the message to display, an optional title, and various buttons and icons to customize the appearance.
- Variables in Excel VBA are used to store and manipulate data.

- Variables must be declared before use using the "Dim" statement, specifying the variable's name and data type.

- Proper variable declaration and naming conventions help improve code readability and maintainability.

- Subroutines (Subs) and Functions are reusable blocks of code in VBA.

- Subroutines do not return a value, while Functions return a value.

- Subroutines are defined using the "Sub" keyword, and Functions use the "Function" keyword.

- Subroutines and Functions can accept parameters (inputs) and perform actions or calculations based on them.

- Subroutines and Functions are fundamental for organizing and modularizing VBA code, making it more efficient and easier to maintain.

Keywords

- Macro: A macro is a sequence of automated commands or actions that can be recorded and played back in Microsoft Excel to perform repetitive tasks.

- Excel VBA: Excel Visual Basic for Applications (VBA) is a programming language integrated into Excel that allows users to create and automate custom functions and procedures.

- MsgBox: MsgBox is a VBA function in Excel used to display message boxes or dialog boxes that provide information, warnings, or prompts to users.

- Variable Declaration: Variable declaration is the process of specifying the name and data type of a variable before using it in VBA code. It helps define the variable's purpose and how it will be used.

- Data Types: Data types in VBA specify the type of data that can be stored in a variable. Common data types include Integer, String, Double, and Boolean.

- Subroutine: A subroutine, often referred to as a "Sub," is a block of VBA code that performs a specific task or set of tasks. Subroutines are used for code organization and reusability.

- Function: A function is a reusable block of VBA code that returns a value. It accepts input parameters, processes them, and produces an output result.

- Parameter: A parameter is a variable or value that is passed into a subroutine or function as input. It is used within the subroutine or function to perform specific operations.

- Automation: Automation in Excel VBA refers to the process of using macros and code to perform tasks automatically, reducing the need for manual intervention.

- Code Modularity: Code modularity is a programming concept that involves breaking down a program into smaller, reusable modules or blocks of code, such as subroutines and functions. This makes the code more organized, easier to understand, and maintainable.

Self Assessment

1. What is a macro in Microsoft Excel?
A. A type of chart
B. A sequence of automated actions
C. A data analysis tool
D. A built-in function

2. How can you create a macro in Excel?
A. Using the "Insert" menu

B. By typing code in the formula bar

C. Through the "Developer" tab and "Record Macro" option

D. Using the "File" menu

3. What is the purpose of recording a macro?

A. To generate random data

B. To automate repetitive tasks

C. To create pivot tables

D. To insert images into a worksheet

4. Which tab in Excel contains the "Record Macro" option?

A. Home

B. Insert

C. Data

D. Developer

5. What is the primary purpose of the MsgBox function in Excel VBA?

A. To calculate formulas

B. To create charts

C. To display messages to the user

D. To perform data validation

6. Which parameter of the MsgBox function specifies the message to be displayed?

A. Title

B. Buttons

C. Prompt

D. Icon

7. What does the "Buttons" parameter in the MsgBox function define?

A. The message box title

B. The message to be displayed

C. The buttons and their options in the message box

D. The message box icon

8. Which of the following is NOT a valid icon option for the MsgBox function?

A. vbExclamation

B. vbQuestion

C. vbAlert

D. vbCritical

9. What is variable declaration in Excel VBA?

A. Creating new Excel worksheets

B. Defining the data type of a variable

C. Recording a macro

D. Printing Excel documents

10. Which keyword is used to declare a variable in Excel VBA?

A. Data

B. Dim

C. Variable

D. Define

11. Why is variable declaration important in VBA?

A. It generates random values.

B. It improves code readability and performance.

C. It creates macros.

D. It adds new worksheets to the workbook.

12. Which of the following is NOT a valid data type for a variable in VBA?

A. Integer

B. Text

C. Double

D. Boolean

13. What is the key difference between a subroutine and a function in Excel VBA?

A. Subroutines return values, and functions do not.

B. Subroutines accept parameters, and functions do not.

C. Subroutines can be called from other subroutines, and functions cannot.

D. Functions return values, and subroutines do not.

14. Which keyword is used to define a subroutine in Excel VBA?

A. Func

B. Sub

C. Proc

D. Def

15. In Excel VBA, what is the purpose of passing parameters to a subroutine or function?

A. To display a message box

B. To perform data validation

C. To provide input data for processing

D. To create a new worksheet

16. Which keyword is used to define a function in Excel VBA?

A. Func

B. Sub

C. Proc

D. Def

17. What does a function return in Excel VBA?

A. A message box

B. A Boolean value

C. A result or value

    D.   A chart

Answers for Self Assessment

1.	B	2.	C	3.	B	4.	D	5.	C
6.	C	7.	C	8.	C	9.	B	10.	B
11.	B	12.	B	13.	A	14.	B	15.	C
16.	D	17.	C						

Review Questions

1. What is a macro in Excel, and why are they useful?

2. Describe the basic steps to create a macro in Microsoft Excel.

3. How can you assign a macro to a button or a keyboard shortcut?

4. Give an example of a task that can be automated using a macro.

5. What is the primary purpose of the MsgBox function in Excel VBA?

6. Explain the syntax of the MsgBox function, including its key parameters.

7. Name and describe two commonly used icons in MsgBox.

8. How can you customize the buttons displayed in a MsgBox?

9. Why is it important to declare variables in VBA code?

10. What keyword is used to declare a variable in Excel VBA, and how is it used in code?

11. Name three common data types used when declaring variables in VBA and explain when to use each.

12. What is the main difference between a subroutine and a function in Excel VBA?

13. What is the keyword used to define a subroutine, and how is it structured?

14. How are parameters used in subroutines and functions, and why are they important?

15. Give an example of when you might use a function in Excel VBA.

Further Readings

- https://trumpexcel.com/record-macro-vba/
- https://www.ablebits.com/office-addins-blog/record-macro-excel/
- https://spreadsheeto.com/make-a-macro/
- https://www.javatpoint.com/how-to-record-a-macro-in-excel
- https://www.wallstreetmojo.com/recording-macros-in-excel/
- https://www.wallstreetmojo.com/vba-msgbox/
- https://www.wallstreetmojo.com/vba-variable-declaration/
- https://www.superexcelvba.com/en/tutorial/014-sub-and-function
- https://corporatefinanceinstitute.com/resources/excel/vba-sub-vs-function/

Unit 12: VBA Macros Programming II

Objectives

After this unit, you will be able to understand-

- If Then Statement
- Case Statement
- For Loop
- While Loop and Do Until
- Worksheet and Range Object

Introduction

These are fundamental control structures in programming. The "If-Then" statement is used for conditional execution, the "Case" statement for multiple branching conditions, "For" loops for iterative processes, and "While" and "Do Until" loops for repetitive tasks. They are essential tools for directing the flow of a program and automating complex operations. In spreadsheet programming like VBA, worksheets and ranges are fundamental objects. Worksheets represent individual sheets within a workbook, while ranges define specific cell selections or data subsets. These objects are essential for manipulating data, performing calculations, and formatting within a spreadsheet.

12.1 What is IF Else Statement in VBA?

The If Else or If Then Else statement of VBA executes a set of instructions depending on whether the specified condition is met or not. If the condition (logical test) is true, one set of actions is performed. However, if the condition is false, an alternative set of actions is performed.

For exaxmple, in a call center, an employee is given a target of making 50 outbound calls in a day. If he/she achieves the target, a sum of money is paid as an incentive. However, if the target is not achieved, no incentive is paid.

The condition here is x>=50. So, if x is greater than or equal to 50, an incentive is paid. Otherwise, it is not paid.

Hence, if the condition is true, the output should be the message "incentive paid." Otherwise, the output should be the message "incentive not paid." Rather than checking the number of calls made by each employee manually, one can use the If Else statement of VBA.

A condition is an expression that evaluates to true or false. It is placed between the If and Then keywords. To create a condition, the conditional operators like "equal to" (=), "not equal to" (<>), "greater than" (>), "less than" (<), "less than or equal to" (<=), and "greater than or equal to" (>=) are used.

The purpose of using the If Else statement is to evaluate a condition and perform an action accordingly. If the condition is true, the code following the If Then keywords is run. However, if the condition is false, the code following the Else keyword is run.

The If Else statement works in VBA and not in Excel. However, the logical test of the If Else statement works similar to that of the IF function of Excel.

The Syntax of the VBA If Else Statement

The syntax of the VBA If Else statement is stated as follows:

IF <Logical Test> Then

   If the Logical Test is TRUE

Else

   If the Logical Test is FALSE

End IF

The condition (logical test) is required, while the Else statement is optional.

The Working of the VBA If Else Statement

First, the VBA If Else statement checks the supplied logical test. If the supplied logical test is true, an action (task) is performed. However, if the test is false, an alternative action is performed. An action is performed by the execution of the code.

Let us understand the working of the If Else statement with the help of an example. We want to supply the condition 10>11 as the logical test.

If the given condition is true, the output should be the message "10 is greater." However, if the condition is false, the output should be the message "10 is lesser."

To write the code, the details are specified as follows:

a. Enter the task to be performed if the condition evaluates to true.

b. Enter the keyword Else followed by an alternative task to be performed. This alternative task will be performed if the condition evaluates to false.

The code for the given example is written as follows:

```
Sub IF_Else_Example1()
  If 10 > 11 Then
    MsgBox "10 is greater"
  Else
    MsgBox "10 is lesser"
  End If
End Sub
```

```
(General)

  Sub IF_Else_Example1()

      If 10 > 11 Then
          MsgBox "10 is greater"
      Else
          MsgBox "10 is lesser"
      End If

  End Sub
```
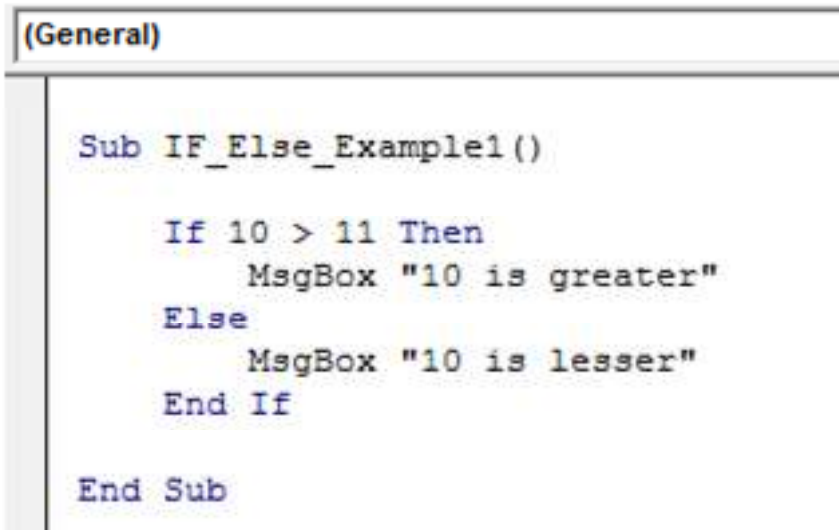
Execute the code and the result appears as shown in the succeeding image. Since the condition (10>11) evaluates to false, the message following the Else statement is returned. Hence, the output is "10 is lesser."

It must be noted that the preceding code returns at least one of the specified messages. This implies that either the If block or the Else block is executed at a given time. Both these blocks cannot be executed together in a single run.

Microsoft Excel

10 is lesser

OK

VBA IF Else Example

The following table shows the cost price (in $ in column B) of seven products (column A). We want to find the status (column C) of each product based on its price. For this, the criteria are mentioned as follows:

- If the cost price>$50, the status should be "expensive."

- If the cost price<$50, the status should be "not expensive."

Spreadsheet Modelling(Using Excel)

	A	B	C	D
1	**Product**	**Cost**	**Status**	
2	A	79	???	
3	B	35	???	
4	C	74	???	
5	D	33	???	
6	E	66	???	
7	F	42	???	
8	G	79	???	
9				

The logical test is cost price>50. If this condition is true, the output in column C should be "expensive." However, if the given condition is false, the alternative result should be "not expensive."

Prior to writing the code, copy and paste the preceding table to an Excel worksheet. The steps for writing the code are listed as follows:

Step 1: Start the sub procedure.

Sub IF_ELSE_Example2()

End Sub

```
(General)

    Sub IF_ELSE_Example2()



    End Sub
```
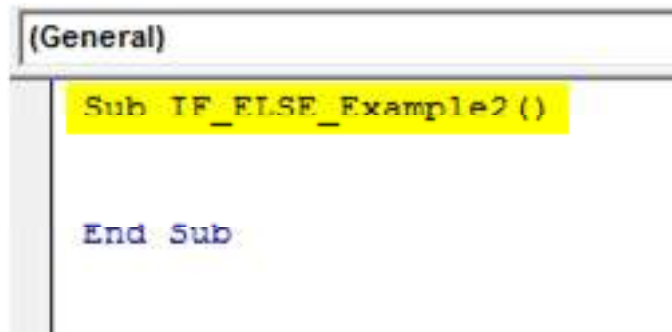
Step 2: Declare the variable "k" as an integer. So, the data type is integers.

Dim k As Integer

```
(General)

    Sub IF_ELSE_Example2()

        Dim k As Integer

    End Sub
```
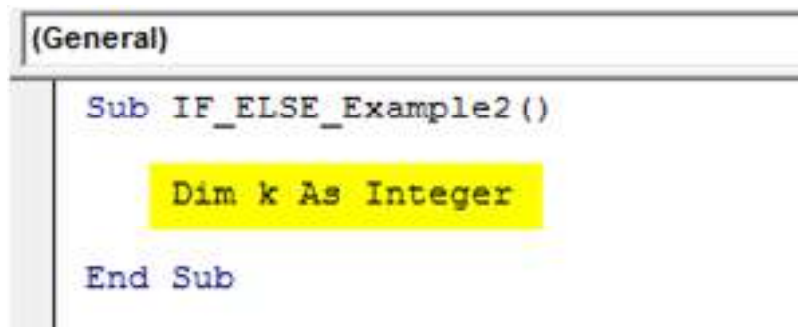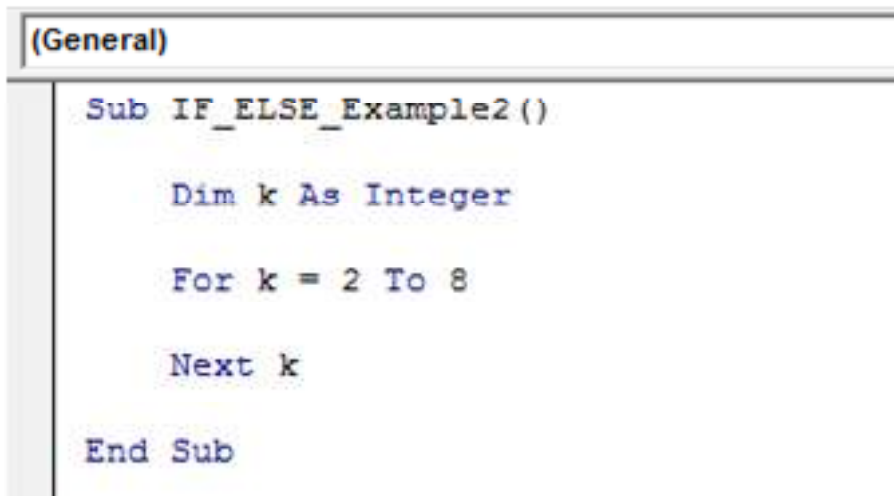
Step 3: Use the For Next loop to loop through the given cells and perform tasks on all of them.

The For Next loop is used because the code needs to be executed a specific number of times. Moreover, multiple cell values need to be tested.

Since the test needs to be conducted on rows 2 to 8, the For Next loop begins from 2 and runs till 8. The same is shown in the following code and image.

For k = 2 To 8

Next k
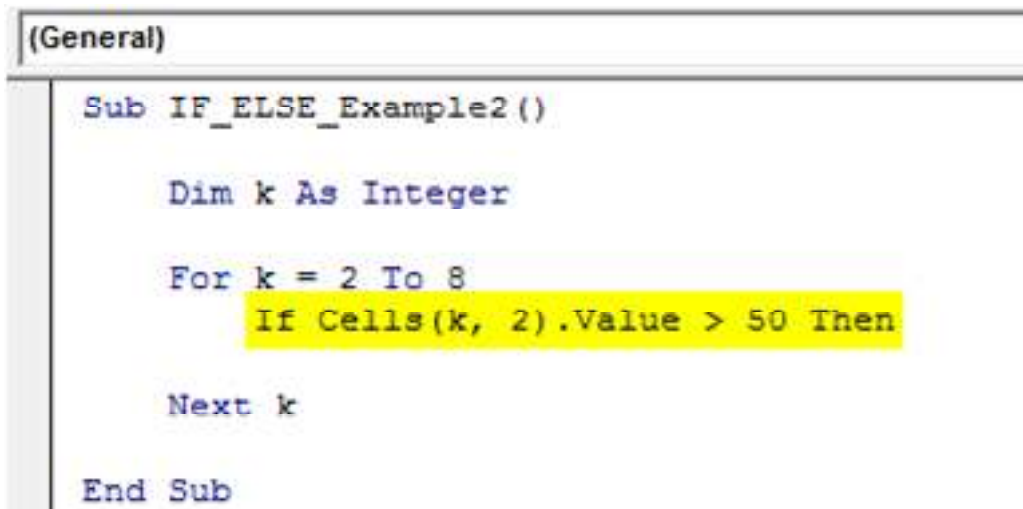
```
(General)

    Sub IF_ELSE_Example2()

        Dim k As Integer

        For k = 2 To 8

        Next k

    End Sub
```

Step 4: Enter the logical test within the For Next loop. For this, open the If statement and select the first cell with the help of the cells property. The cells(k, 2) implies row "k" and column 2.

The same is shown in the following code and image.

If Cells(k, 2).Value > 50 Then

```
(General)

    Sub IF_ELSE_Example2()

        Dim k As Integer

        For k = 2 To 8
                If Cells(k, 2).Value > 50 Then

        Next k

    End Sub
```

Step 5: Enter the action to be performed following the If Then statement.

If the value in cell (k, 2) is greater than 50 (the condition evaluates to true), the output should be "expensive" in the adjacent cell of column C.

The same is shown in the following code and image.

Cells(k, 3).Value = "Expensive"

```
(General)

    Sub IF_ELSE_Example2()

        Dim k As Integer

        For k = 2 To 8
            If Cells(k, 2).Value > 50 Then
                Cells(k, 3).Value = "Expensive"

        Next k

    End Sub
```
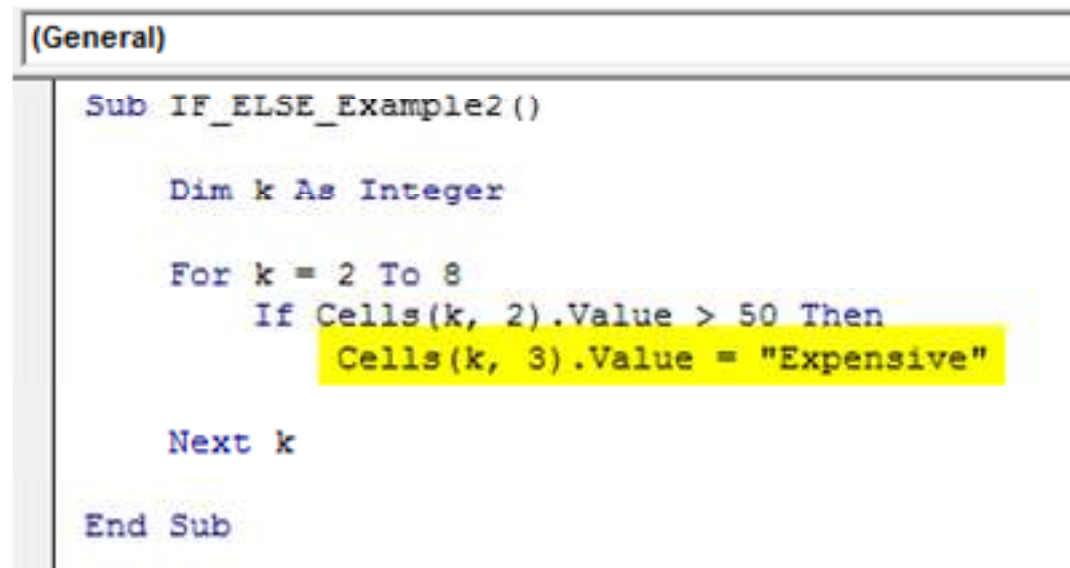
Step 6: Enter the Else statement. This will run if the logical test (cost price>50) evaluates to false. Going by the Else statement, the cells (k, 3) must display the message "not expensive" if the cost price is less than $50.

The same is shown in the following code and image.

```
Sub IF_ELSE_Example2()

  Dim k As Integer

  For k = 2 To 8

    If Cells(k, 2).Value > 50 Then

      Cells(k, 3).Value = "Expensive"

    Else

      Cells(k, 3).Value = "Not Expensive"

    End If

  Next k

End Sub
```

```
(General)

    Sub IF_ELSE_Example2()

        Dim k As Integer

        For k = 2 To 8
            If Cells(k, 2).Value > 50 Then
                Cells(k, 3).Value = "Expensive"
            Else
                Cells(k, 3).Value = "Not Expensive"
            End If
        Next k

    End Sub
```
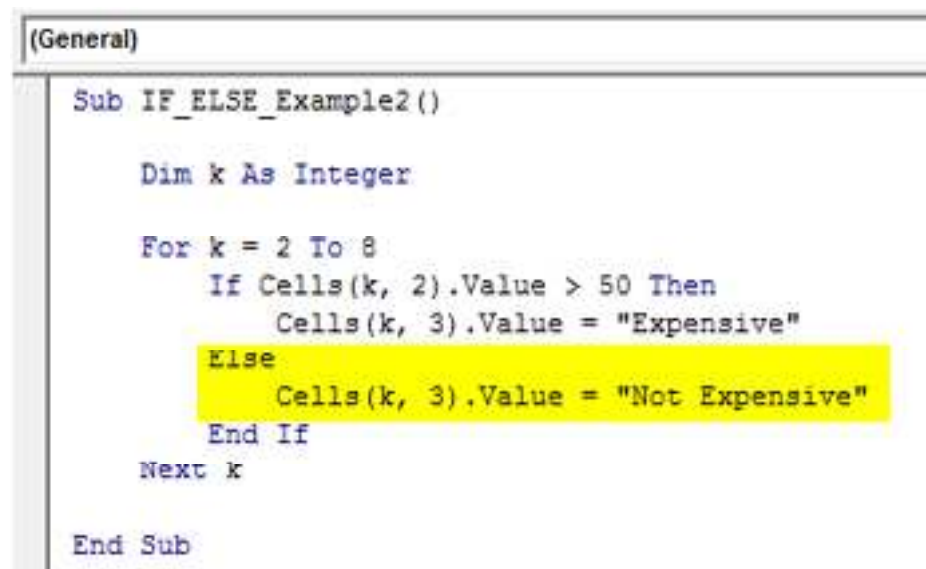
Step 7: Run the code and the output appears, as shown in the following image. The code loops through rows 2 to 8, tests every value of column B, and arrives at a result accordingly.

Hence, the logical test for cells B2, B4, B6, and B8 evaluates to true. So, the status in the corresponding cells of column C appears as "expensive."

For the remaining cells of column C, the status appears as "not expensive." These are the ones whose related cost price is less than $50.
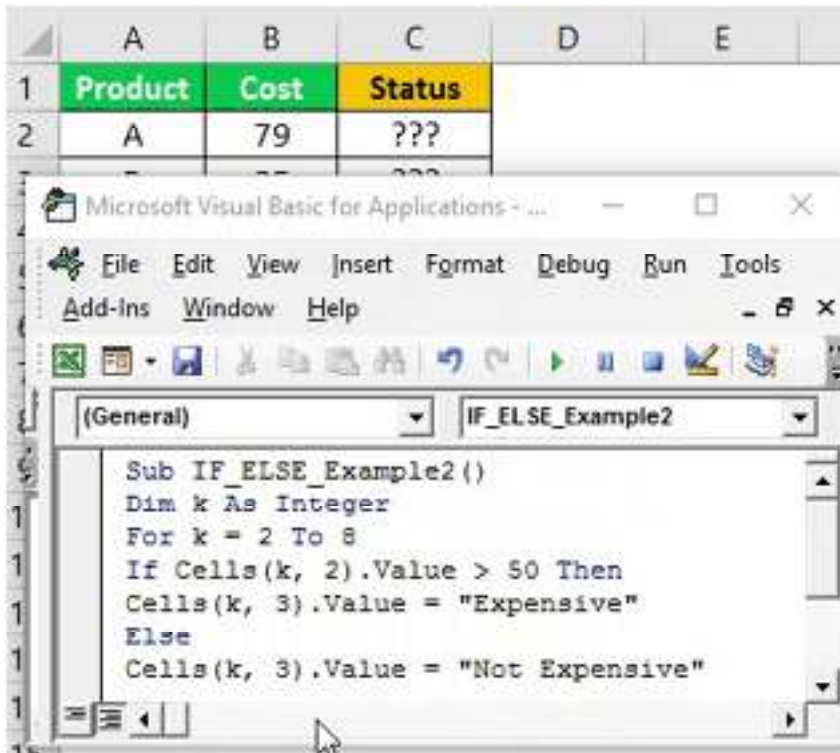
Likewise, the If Else statement can be used to obtain different results.

12.2 Excel VBA Case Statement

VBA Case Statement is one of the logical functions. The Case Statement tests multiple logical tests and arrives at the result in two ways: if the result or logical test is TRUE, one set of results. If the result or logical test is FALSE, then the second set of results.

Typically, one conducts logical tests using IF formulas, whether a worksheet formula or VBA coding. On both platforms, this function helps us to conduct many kinds of complicated calculations. However, few of us realize that we have an alternative to the IF statement in VBA i.e., "Case Statement." This article provides you with full details about this logical statement.

Syntax

Below is the syntax of the "Select Case" statement.

Select Case "Value to be Test"

    Case Is "Logical Test"

        Result if Case 1 is TRUE

    Case Is "Logical Test"

        Result if Case 2 is TRUE

    Case Is "Logical Test"

        Result if Case 3 is TRUE

   Case Else

       If none of the results are TRUE

End Select

It is almost similar to IF statement syntax. But instead of using ELSEIF, we use Case 1, Case 2, Case 3, and so on.

Examples of VBA Case Statement

Example #1

In cell A1, we have entered the number 240.

Now, we will test whether this number is greater than 200 or not by using the SELECT CASE statement.

Step 1: Open the Select Case statement now.

Code:

Sub Select_Case_Example1()

   Select Case

End Sub
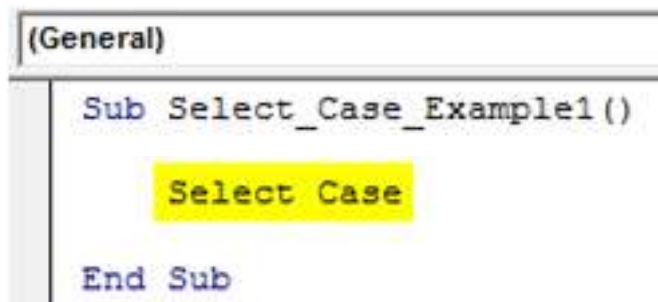
Step 2: Once we open the "Select Case," we need to supply what is the value we are testing. In this case, we are testing cell A1 values.

Code:

Sub Select_Case_Example1()

   Select Case Range("A1").Value

End Sub
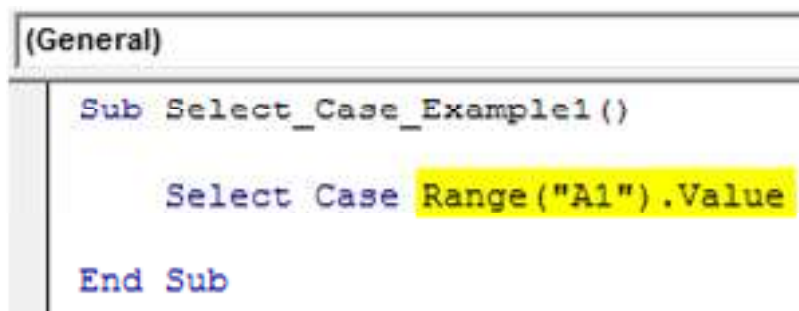
Step 3: Once we give the value to the test, we need to apply logical tests in excel using the "Case Is" word..

Code:

```
Sub Select_Case_Example1()
    Select Case Range("A1").Value
    Case Is > 200
End Sub
```
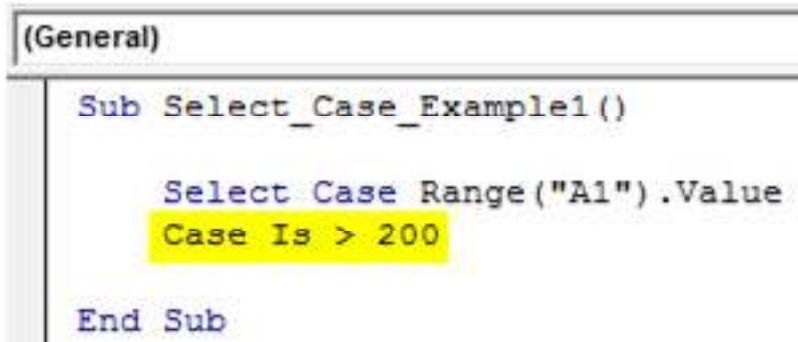

Step 4: In the next line, we need to supply the "result" value if the applied logical test is TRUE. In the message box, we need the result as "Number is >200".

Code:

```
Sub Select_Case_Example1()
    Select Case Range("A1").Value
    Case Is > 200
        MsgBox "Number is >200"
End Sub
```
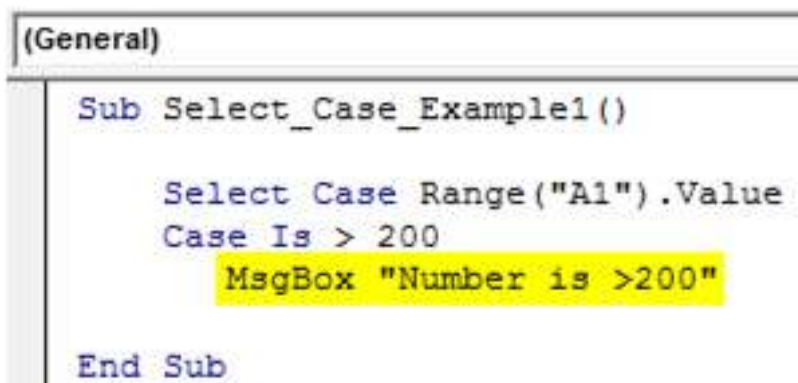

Step 5: We need only two results in this example, so we will not use more "Case Is" statements. Next, we will use the "Case Else" word to close the VBA "Select Case" statement.

Code:

```
Sub Select_Case_Example1()
    Select Case Range("A1").Value
    Case Is > 200
        MsgBox "Number is >200"
    Case Else
        MsgBox "Number is <200"
End Sub
```

```
(General)

    Sub Select_Case_Example1()

        Select Case Range("A1").Value
        Case Is > 200
            MsgBox "Number is >200"
        Case Else
            MsgBox "Number is <200"

    End Sub
```

Step 6: Once we supply all the cases, we need to close the select case statement using the "End Select" word.

Code:

Sub Select_Case_Example1()

   Select Case Range("A1").Value

   Case Is > 200

     MsgBox "Number is >200"

   Case Else

     MsgBox "Number is <200"

   End Select

End Sub

```
(General)

    Sub Select_Case_Example1()

        Select Case Range("A1").Value
        Case Is > 200
            MsgBox "Number is >200"
        Case Else
            MsgBox "Number is <200"
        End Select

    End Sub
```

Step 7: Now, run the code and see what the result we get in the **VBA message box** is.
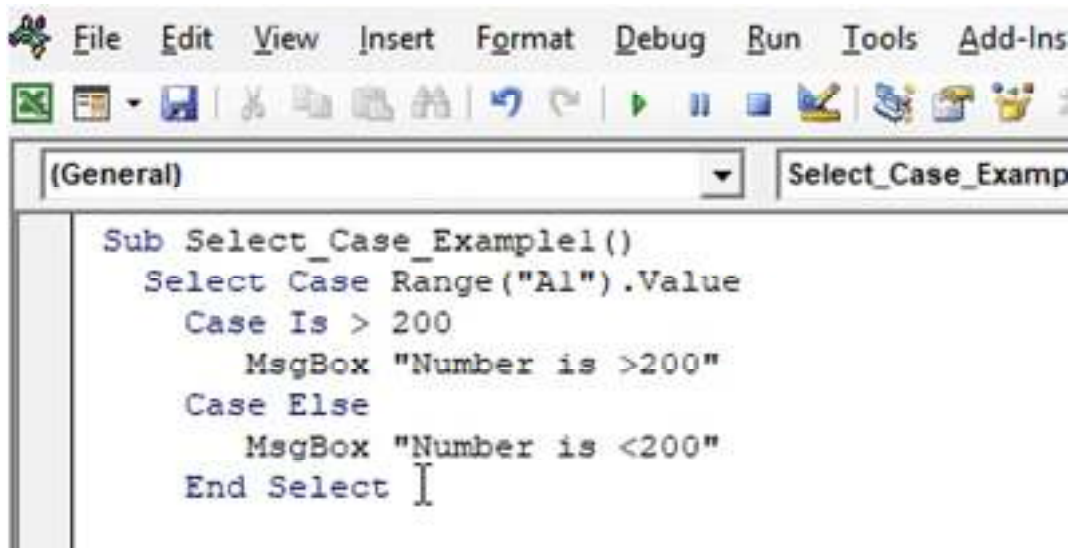
The result is "Number is >200" because, in cell A1, the value is 240, which is >200.

📭 Example #2

Now, we will see some practical real-time examples of testing scores. First, look at the **VBA code** below.

Code:

Sub Select_Case_Example2()

    Dim ScoreCard As Integer

    ScoreCard = Application.InputBox("Score should be b/w 0 to 100", "What is the score you want to test")

    Select Case ScoreCard

      Case Is >= 85

        MsgBox "Distinction"

      Case Is >= 60

        MsgBox "First Class"

      Case Is >= 50

        MsgBox "Second Class"

      Case Is >= 35

        MsgBox "Pass"

      Case Else

        MsgBox "Fail"

    End Select

End Sub

```
(General)

    Sub Select_Case_Example2()

        Dim ScoreCard As Integer
        ScoreCard = Application.InputBox("Score should be b/w 0 to 100",
                    "What is the score you want to test")

            Select Case ScoreCard
                Case Is >= 85
                    MsgBox "Distinction"
                Case Is >= 60
                    MsgBox "First Class"
                Case Is >= 50
                    MsgBox "Second Class"
                Case Is >= 35
                    MsgBox "Pass"
                Case Else
                    MsgBox "Fail"
            End Select
    End Sub
```

Let us explain the code line by line to understand it better.

First, we have declared the variable as "Integer." Then, for this variable, we have assigned the InputBox in VBA, where a user must enter the score between 0 and 100.

When we run the code, we will see the input box like the one below. In this input box, you need to enter the score.
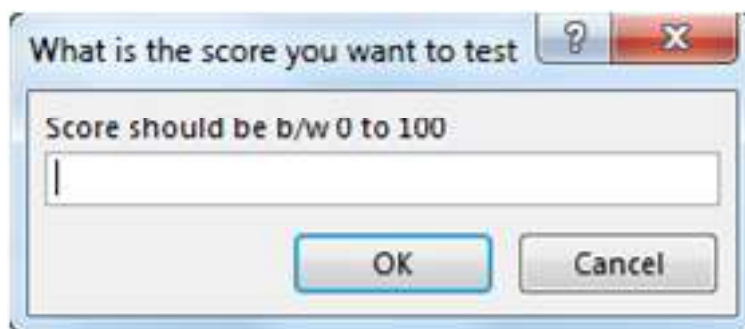
Whatever we enter in the input box will be stored in the variable "ScoreCard."

In the next line, we have applied a select case statement to test this score.

First, it will test whether the ScoreCard >=85 or not. If this is TRUE, we will get the value in the message box as "Distinction."

Select Case ScoreCard

  Case Is >= 85

    MsgBox "Distinction"

Similarly, in the following lines, we have applied the second test as ScoreCard >=60. Again, if this is TRUE, it will show the result as "First."

Case Is >= 60

  MsgBox "First Class"

Like this, we have also applied other tests. In the end, we have used the "Case Else" statement. If all the applied logical tests are FALSE, we will get the result as "Fail."

Case Else

  MsgBox "Fail"

Now, we have supplied 68 as the score. Therefore, we should get the "First Class" result in the message box.
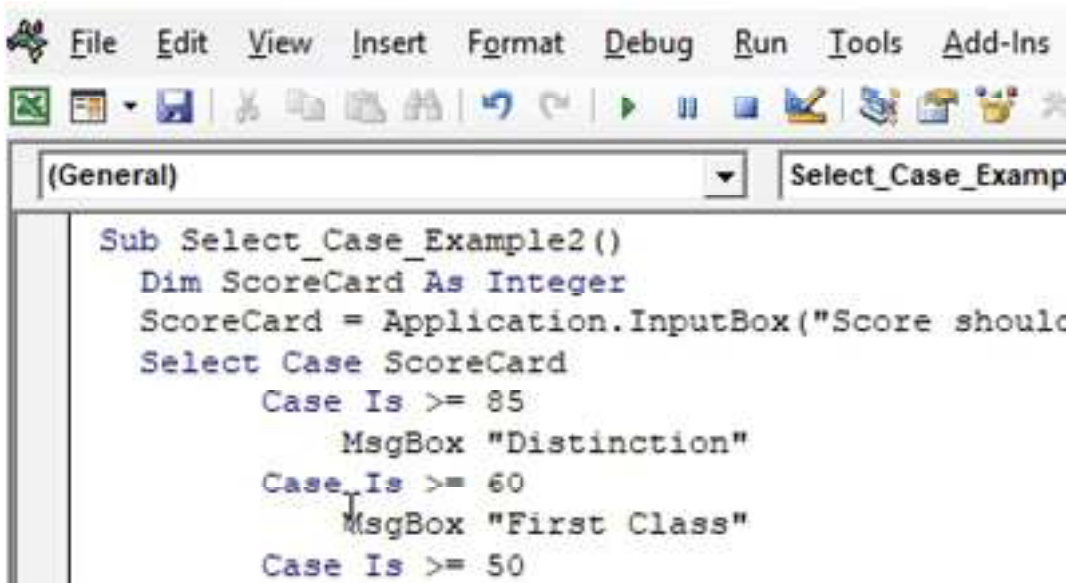
Example #3 – Using the "To" keyword

In the above example, we have used student scores to arrive at the result. However, one can conduct the same test using the "To" word to determine the lower limit and upper limit of the logical test.

Code:

Sub Select_Case_Example3()

 Dim ScoreCard As Integer

 ScoreCard = Application.InputBox("Score should be b/w 0 to 100", "What is the score you want to test")

   Select Case ScoreCard

     Case 85 To 100

       MsgBox "Distinction"

     Case 60 To 84

       MsgBox "First Class"

     Case 50 To 59

       MsgBox "Second Class"

     Case 35 To 49

       MsgBox "Pass"

     Case Else

       MsgBox "Fail"

   End Select

End Sub
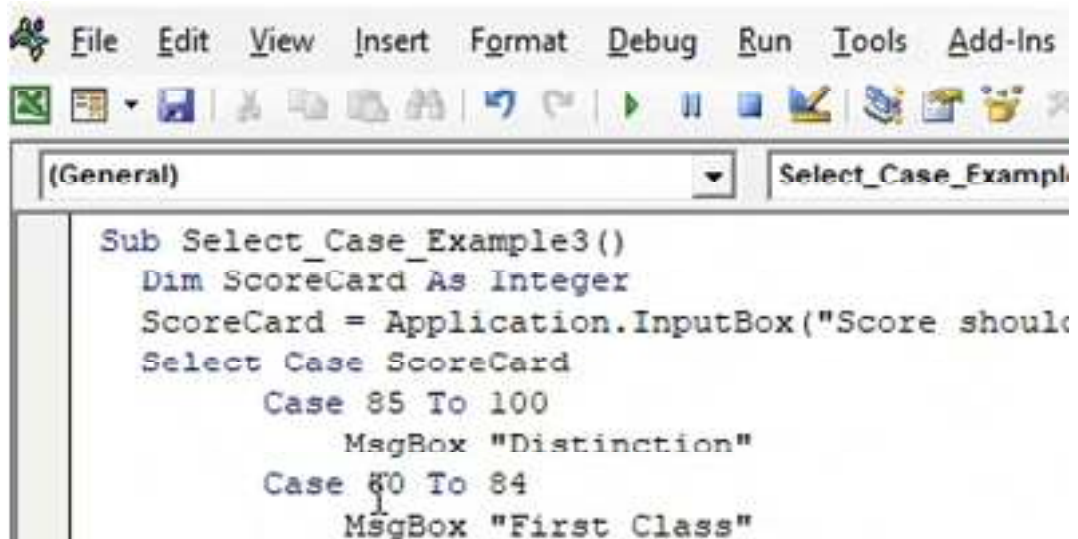
```
(General)

Sub Select_Case_Example3()

    Dim ScoreCard As Integer
    ScoreCard = Application.InputBox("Score should be b/w 0 to 100",
            "What is the score you want to test")

        Select Case ScoreCard
            Case 85 To 100
                MsgBox "Distinction"
            Case 60 To 84
                MsgBox "First Class"
            Case 50 To 59
                MsgBox "Second Class"
            Case 35 To 49
                MsgBox "Pass"
            Case Else
                MsgBox "Fail"
        End Select
End Sub
```

We have used the same code as above. But, the only yellow-colored area we have changed here. We will get the result based on the number we type in the input box accordingly.

```
File    Edit    View    Insert    Format    Debug    Run    Tools    Add-Ins

(General)                                              ▼     Select_Case_Exampl

Sub Select_Case_Example3()
    Dim ScoreCard As Integer
    ScoreCard = Application.InputBox("Score shoul
    Select Case ScoreCard
            Case 85 To 100
                MsgBox "Distinction"
            Case 60 To 84
                MsgBox "First Class"
```

12.3 VBA For Loop In Excel

1. What are VBA For Loops in Microsoft Excel?

VBA for Loops are a programming concept that allows a program to repeat itself. They help to refract your code, reducing the number of specifically-coded actions that are written to help improve the speed and efficiency of your applications.

Loops are flexible tools, giving you the option to repeat a certain action (such as changing cell values) a set number of times. A loop could also be combined with other statements, such as For and If, that help to determine how often, and for how long, a script should run.

2. What are VBA For Loops used for?

Using a VBA For Loop is essential for creating macros that will run continuously as you work through your spreadsheet. Loops like this aren't unique to VBA—indeed, they're a common feature in most programming languages, allowing a program or script to run continuously in a sequence with a start and end point.

In VBA, a For Loop repeats an action (or set of actions) for a set number of times in a sequence. For instance, if you had a macro (written in VBA) that inserted values into a column, you could use a For Loop to do so, filling each cell sequentially (eg. A1, A2, A3, etc) until an end value is reached.
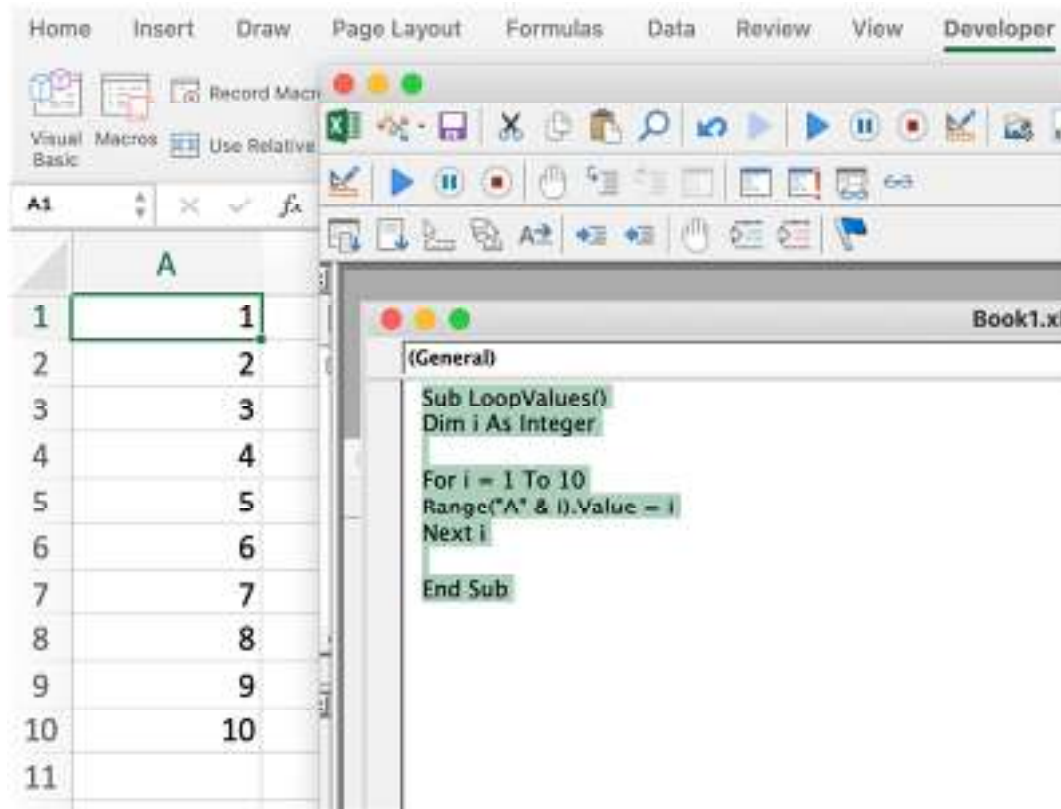
For instance, the VBA code snippet shown previously demonstrates such an action. In this example, the VBA macro is designed to insert values into cells in column A, from 1 to 10, and increase in single-digit increments. Once 10 is reached, the script stops.

This is a basic example, but For Loops are powerful enough to perform almost any action you desire in Excel repeatedly. While this guide isn't a full VBA tutorial (and it assumes you have a certain level of basic VBA experience already), it should allow you to create basic VBA loops using For to repeat an action in sequence.

3. How do VBA For Loops work in Excel?

Let's assume that you already have an idea in mind as to how your VBA macro should work. Introducing a For Loop into the mix allows you to set your code (or part of your code) to repeat itself a certain number of times.

We'll explain the process using a simple-to-understand example. As VBA For Loops are useful for finite repetitive actions, let's assume you want a pop-up to appear when you press a button (with the class name Button).
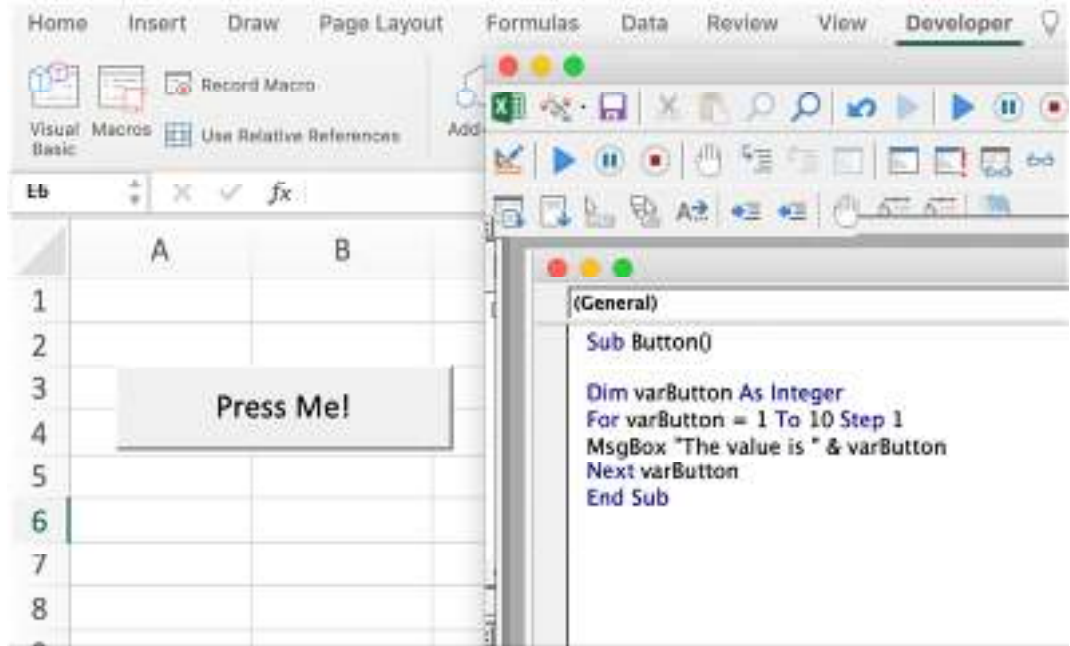
Pressing the button causes a pop-up box to appear a set number of times, in sequence, using the variable varButton as the end number (in this case, **10**). This pop-up box displays the current variable, starting with zero. It then repeats this 9 more times until the varButton variable (10) is reached.

The action of pressing the button begins the loop. As the test has a start and end variable, the loop has a finite number of runs before it finishes. By default, the values increase by 1 (starting with 0, 1, 2, etc) but this can be changed by adding a Step value. For instance, changing this to **5** would mean only three pop-ups appear.
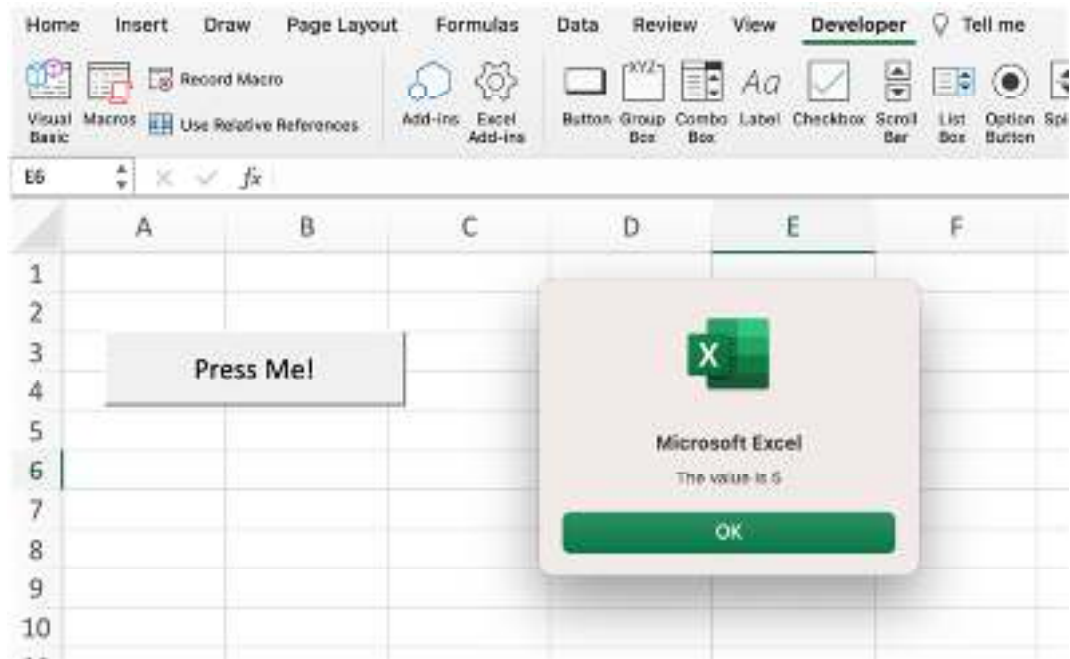
Once the end value is reached, the loop exits and the macro stops. You could, however, add additional actions to perform at this point, such as changing another cell's value or creating a different pop-up message. You could nest the For Loop within other logical tests, such as a Do While or If statement.

This example contains all of the typical criteria needed to complete a For Loop using VBA, however. The code identifies how many times the action will be performed in a sequence (varButton) and the increment value used to iterate through the sequence (Step).

The only optional part of this example is the button used to start the macro. You don't necessarily need to link your macro code to a button press, as you could easily begin this loop and activate the macro manually by pressing Developer > Macros > Run instead.

4. Things to consider before using a VBA For Loop in Excel

A VBA For Loop is a flexible and wide-ranging method that allows your code to perform an action sequentially and only stopping if (and when) certain criteria are met.

To help you create this kind of macro in Excel, there are some pointers you'll need to consider. These include:

- If you want to create a way for your For Loop to end before the final value is reached, you'll need to add an Exit For statement to your code. This exits the loop and moves on to the next line of code outside of the loop (if your code continues). For instance, you could stop the loop when you press a button.

- A VBA For Loop can be used to cycle through a set number of numerical values in sequence in a basic way using a For Next Loop, but you can also cycle through more complex objects (such as workbooks in your spreadsheet) in sequence using a more complex VBA For Each Loop.

- VBA For Loops can be nested with other logical statements, such as an If or Do While statement. This allows you to integrate more complex decision-making into your code.

- A VBA For Loop will iterate in a sequence, but by changing the Step value, you can change how much the loop counter increases by during each iteration. For instance, if you want your loop to move ahead in a sequence that increases the value by 2, you'd need to use a Step value of 2. If you don't provide a Step value, the loop counter will increase in increments of **1**.

- If your VBA For Loop can't be performed, or if your code has errors, VBA will exit into debug mode with an error. You'll need to troubleshoot your code to fix this problem in Excel's built-in VBA Editor.

While these examples are important, you should also consider any known VBA limitations that aren't listed here (such as a lack of an undo function when using VBA) before you write your code.

5. How to add VBA For Loops in Excel using the Visual Basic Editor

You can create, test, and run a VBA For Loop in Excel by using the Visual Basic Editor. This is Excel's built-in VBA editor that allows you to create your own macros using VBA, or edit existing macros created using the Macro Recorder tool.

To begin creating a VBA macro using a For Loop in the Visual Basic Editor, you can follow these steps:

Step 1: Open the VBA Editor

You'll need to start by opening the Visual Basic Editor in your Excel workbook.

You can do this by pressing the Alt + F11 keys on your keyboard (or Option + F11 on Mac). If you've already enabled the Developer tab on the ribbon bar in your Excel's settings menu, you can also press Developer > Visual Basic to open the editor instead.
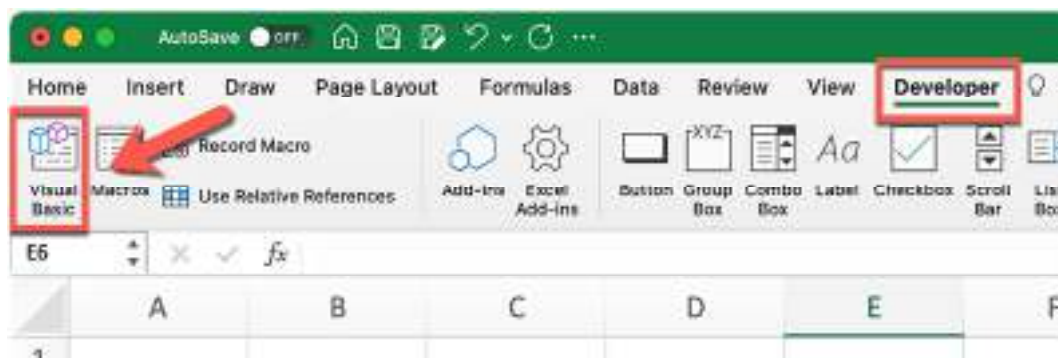
Step 2: Create a new VBA Module

The VBA Editor will open in a new window at this point. The next step is to insert your VBA For Loop (and additional code) as a new VBA module. Modules are used to organize VBA code into groups.

To do this, right-click your workbook listed in the tree menu on the left. From the drop-down menu, select Insert > Module.
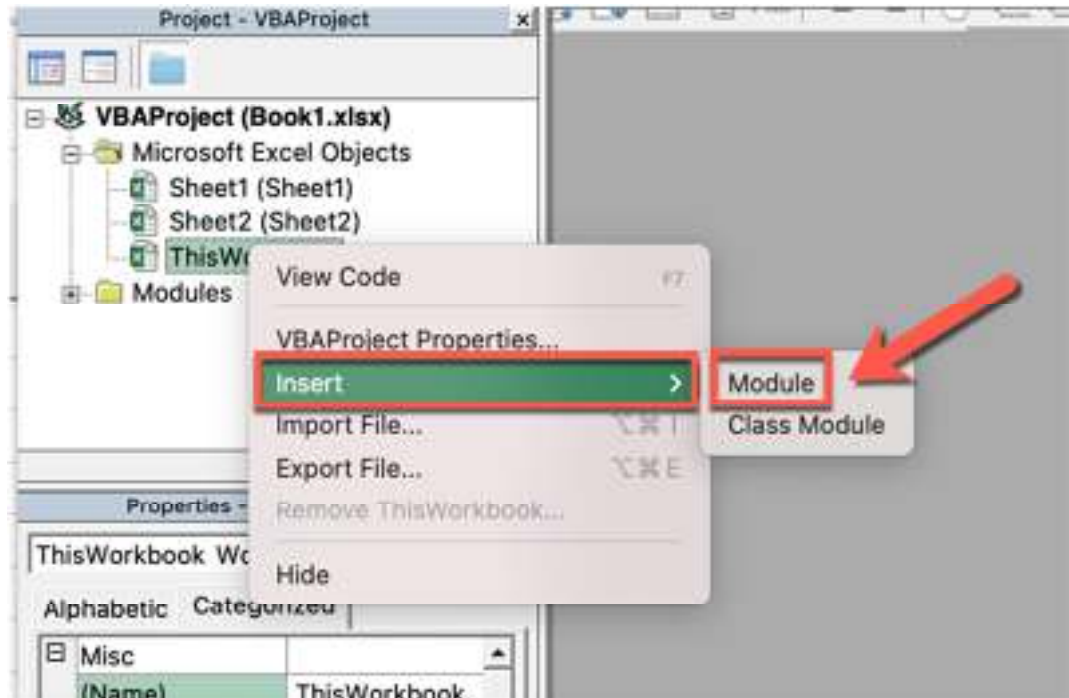
Step 3: Insert your VBA For Loop code

A new window for your code will appear on the right. This is where you can type or insert the VBA code containing your For Loop. For instance, the following code will insert sequential values into cells A1 to A20 on any active worksheet:

```
Sub LoopVal()

Dim i As Integer

For i = 1 To 10

Range("A" & i).Value = i

Next i

End Sub
```
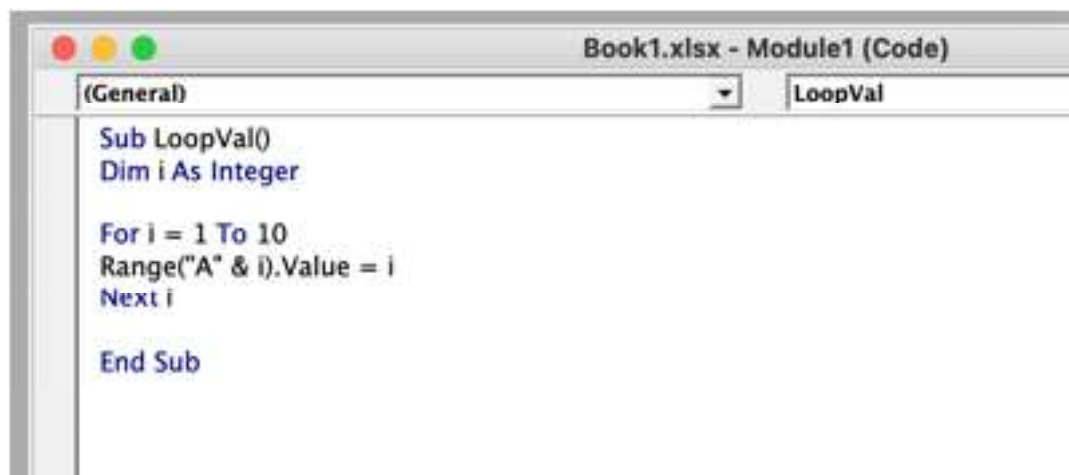
Step 4: Rename your module and test your code

Once you've inserted your code, you'll need to rename the module which contains the code in order to make it easy to refer to later. To do this, select the module name in the tree menu on the left, then rename it by typing a new module name into the Properties box underneath.
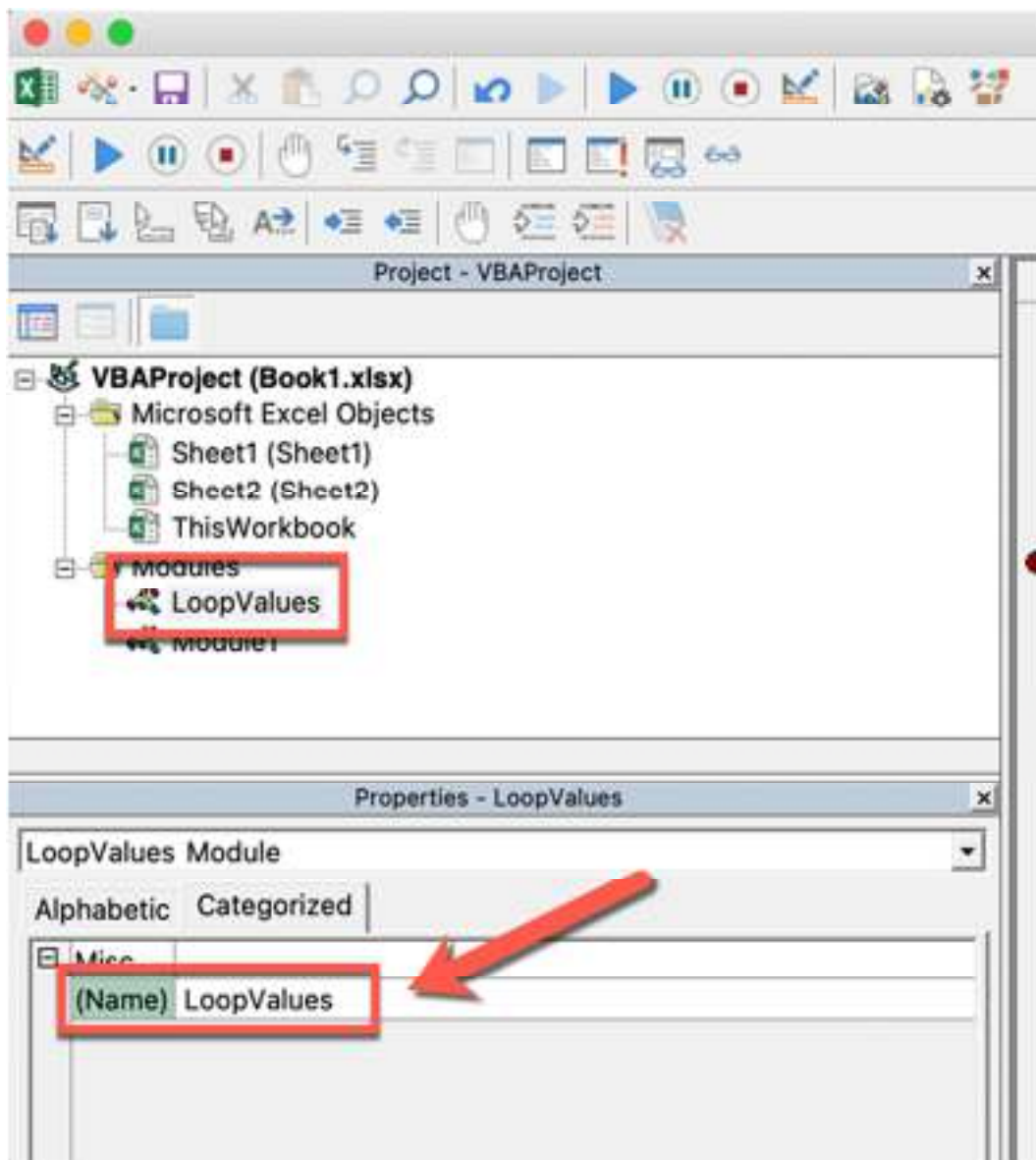
When you're ready to test your code, press the Run Sub/User Form button. This will run the code in your active worksheet, allowing you to see the macro in action.
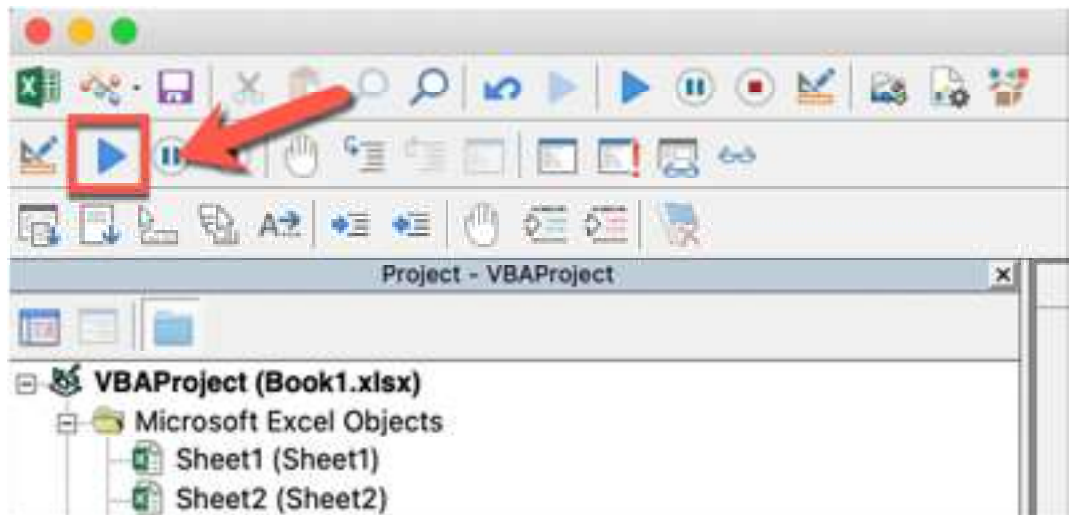
Assuming your VBA code worked as intended, you can then proceed to save your workbook with the macro included.

If it doesn't work, a debug message will appear, and you'll need to troubleshoot the issue further.

Step 5: Save your workbook

With your VBA macro ready, you'll need to save your Excel workbook as a Macro-enabled workbook in the XLSM format.

To do this, press Ctrl + S on your keyboard, or press File > Save As.
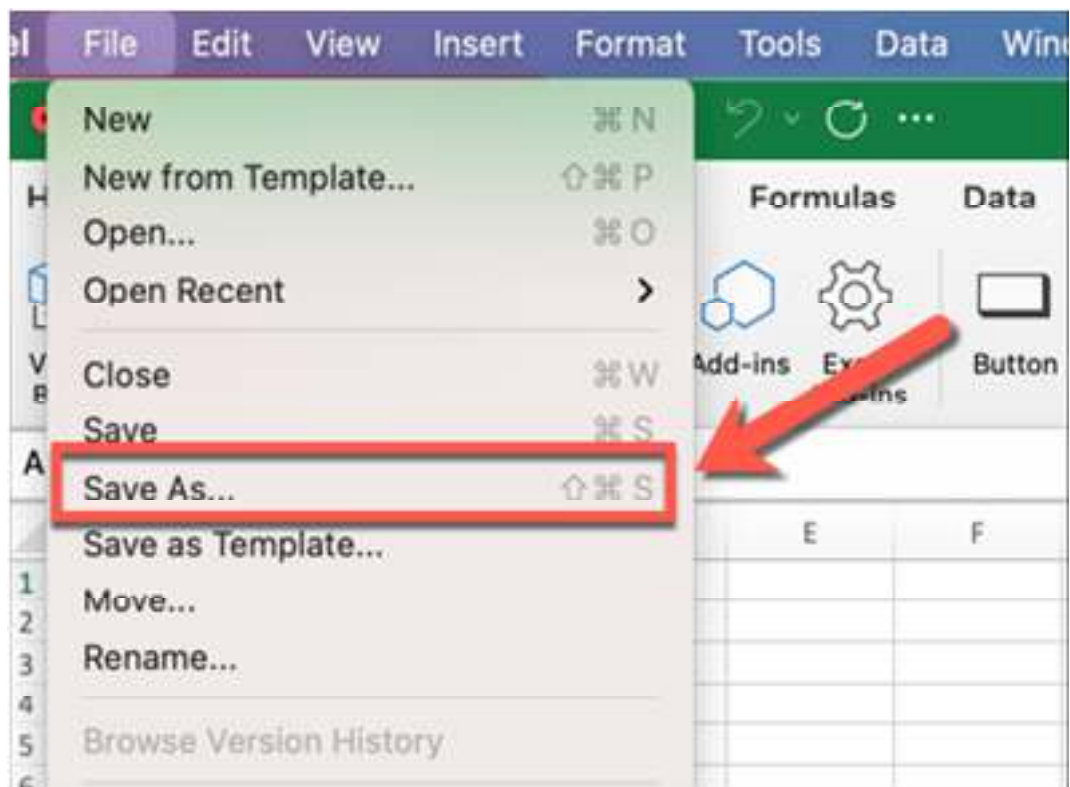
Step 6: Run your VBA code

Your macro (containing a VBA For Loop) is ready to run once you've saved your workbook.

To do this, press Alt + F8 on your keyboard to open the Macro window (or Option + F8 on Mac).
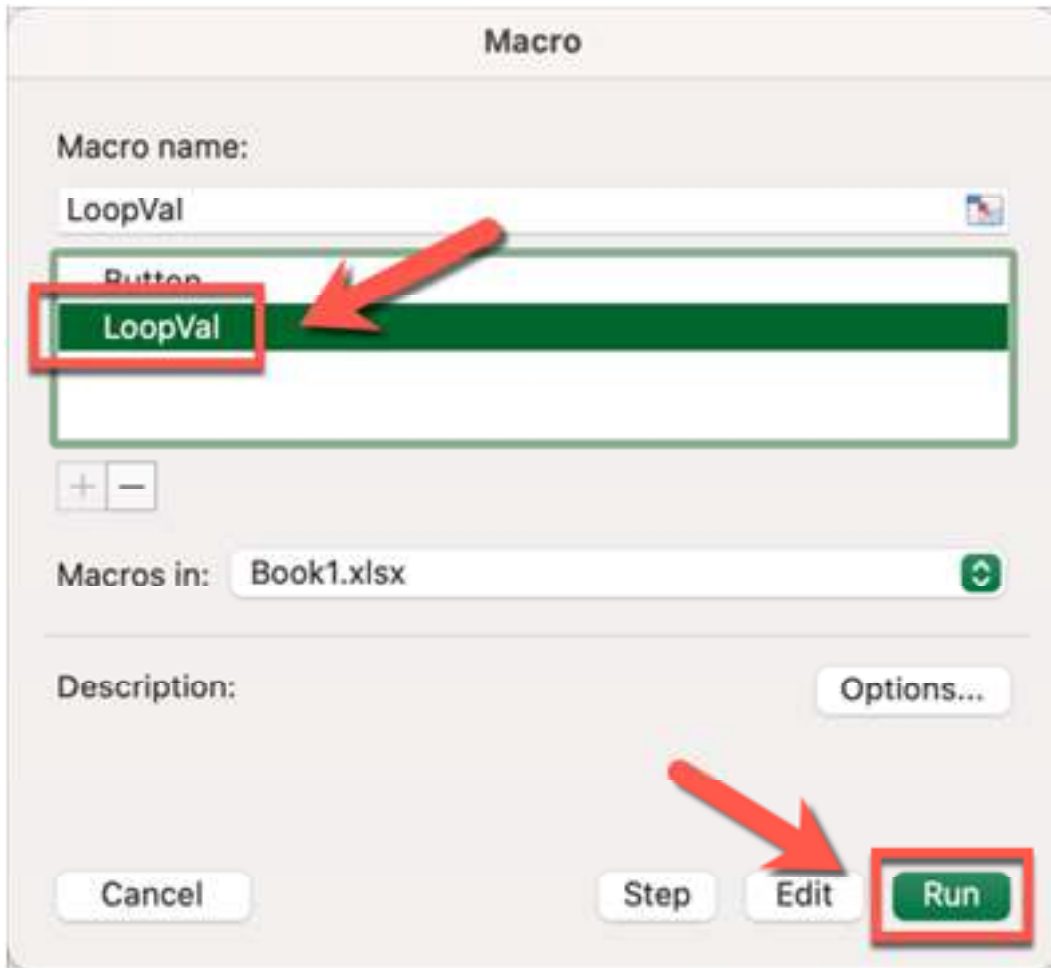
Select your macro (matching the Module name) from the list provided, then press Run.

Alternatively, if your VBA For Loop is scheduled to activate based on another action (such as a cell value being reached, a button being pressed, etc), you'll need to perform this action to begin the process.

12.4 Excel DO Loops

Do While Loop

A 'Do While' loop allows you to check for a condition and run the loop while that condition is met (or is TRUE).

There are two types of syntax in the Do While Loop.

Do [While condition]

[Code block to Execute]

Loop

and

Do

[Code block to Execute]

Loop [While condition]

The difference between these two is that in the first, the While condition is checked first before any code block is executed, and in the second case, the code block is executed first and then the While condition is checked.

This means that if the While condition is False is both the cases, the code will still run at least once in the second case (as the 'While' condition is checked after the code has been executed once).

Now let's see some examples of using Do While loops in VBA.

Example 1 – Add First 10 Positive Integers using VBA

Suppose you want to add the first ten positive integers using the Do While loop in VBA.

To do this, you can use the Do While loop until the next number is less than or equal to 10. As soon as the number is greater than 1o, your loop would stop.

Here is the VBA code that will run this Do While loop and the show the result in a message box.

```
Sub AddFirst10PositiveIntegers()

Dim i As Integer

i = 1

Do While i <= 10

Result = Result + i

i = i + 1

Loop

MsgBox Result

End Sub
```

The above loop continues to work until the value of 'i' becomes 11. As soon as it becomes 11, the loop ends (as the While condition becomes False).

Within the loop, we have used a Result variable that holds the final value Once the loop is completed, a message box shows the value of the 'Result' variable.

```
Sub AddFirst10PositiveIntegers()

Dim i As Integer

i = 1

Do While i <= 10

Result = Result + i

i = i + 1

Loop

MsgBox Result

End Sub
```

The above loop continues to work until the value of 'i' becomes 11. As soon as it becomes 11, the loop ends (as the While condition becomes False).

Within the loop, we have used a Result variable that holds the final value Once the loop is completed, a message box shows the value of the 'Result' variable.

The above code would enter all the dates in the first column of the worksheet (starting from A1). The loops continue till the Month value of the variable 'CMDate' matches that of the current month.

Do Until Loop

'Do Until' loops are very much like the 'Do While' loops.

In 'Do While', the loop runs till the given condition is met, while in 'Do Until', it loops until the specified condition is met.

There are two types of syntax in the Do Until Loop.

Do [Until condition]

[Code block to Execute]

Loop

and

Do

[Code block to Execute]

Loop [Until condition]

The difference between these two is that in the first, the Until condition is checked first before any code block is executed, and in the second case, the code block is executed first and then the Until condition is checked.

This means that if the Until condition is TRUE is both cases, the code will still run at least once in the second case (as the 'Until' condition is checked after the code has been executed once).

Now let's see some examples of using Do Until loops in VBA.

Note: All the examples for Do Until are the same as that of Do While. These have been modified to show you how the Do Until loop works.

Example 1 – Add First 10 Positive Integers using VBA

Suppose you want to add the first ten positive integers using the Do Until loop in VBA.

To do this, you need to run the loop until the next number is less than or equal to 10. As soon as the number is greater than 1o, your loop would stop.

Here is the VBA code that will run this loop and show the result in a message box.

```
Sub AddFirst10PositiveIntegers()
Dim i As Integer
i = 1
Do Until i > 10
Result = Result + i
i = i + 1
Loop
MsgBox Result
End Sub
```

The above loop continues to work until the value of 'i' becomes 11. As soon as it becomes 11, the loop ends (as the 'Until' condition becomes True).

Example 2 – Enter Dates For the Current Month

Let's say you want to enter all the dates of the current month into a worksheet column.

You can do that by using the following Do Until loop code:

```
Sub EnterCurrentMonthDates()
Dim CMDate As Date
Dim i As Integer
i = 0
CMDate = DateSerial(Year(Date), Month(Date), 1)
Do Until Month(CMDate) <> Month(Date)
Range("A1").Offset(i, 0) = CMDate
```

i = i + 1

CMDate = CMDate + 1

Loop

End Sub

The above code would enter all the dates in the first column of the worksheet (starting from A1). The loop continues until the Month of variable CMDate is not equal to that of the current month.

12.5   What is VBA Range?

The VBA Range Object represents a cell or multiple cells in your Excel worksheet. It is the most important object of Excel VBA. By using Excel VBA range object, you can refer to,

- A single cell

- A row or a column of cells

- A selection of cells

- A 3-D range

As we discussed in our previous tutorial, that VBA is used to record and run Macro. But how VBA identify what data from the sheet needs to be executed. This is where VBA Range Objects is useful.

Introduction to Referencing Objects in VBA

Referencing Excel's VBA Range Object and the Object Qualifier.

- Object Qualifier: This is used for referencing the object. It specifies the workbook or worksheet you are referring to.

To manipulate these cell values, Properties and Methods are used.

- Property: A property stores information about the object.

- Method: A method is an action of the object it will perform. Range object can perform actions like selected, copied, cleared, sorted, etc.

VBA follow object hierarchy pattern to refer object in Excel. You have to follow the following structure. Remember the .dot overhere connects the object at each of the different levels.

Application.Workbooks.Worksheets.Range

There are two main types of default objects.

How to refer to Excel VBA Range Object using Range property

Range property can be applied in two different types of objects.

- Worksheet Objects

- Range Objects

Syntax for Range Property

1. The keyword "Range."

2. Parentheses that follow the keyword

3. Relevant Cell Range

4. Quotation (" ")

Application.Workbooks("Book1.xlsm").Worksheets("Sheet1").Range("A1")

When you refer Range object, as shown above, it is referred as fully qualified reference. You have told Excel exactly which range you want, what sheet and in what worksheet.

Example: MsgBox Worksheet("sheet1").Range("A1").Value

Using Range property, you can perform many tasks like,

- Refer to a Single cell using range property

- Refer to a Single cell using the Worksheet.Range Property

- Refer to an entire row or column

- Refer to merged cells using Worksheet.Range Property and many more

As such it will be too lengthy to cover all scenarios for range property. For scenarios mentioned above, we will demonstrate an example only for one. Refer to a Single cell using range property.
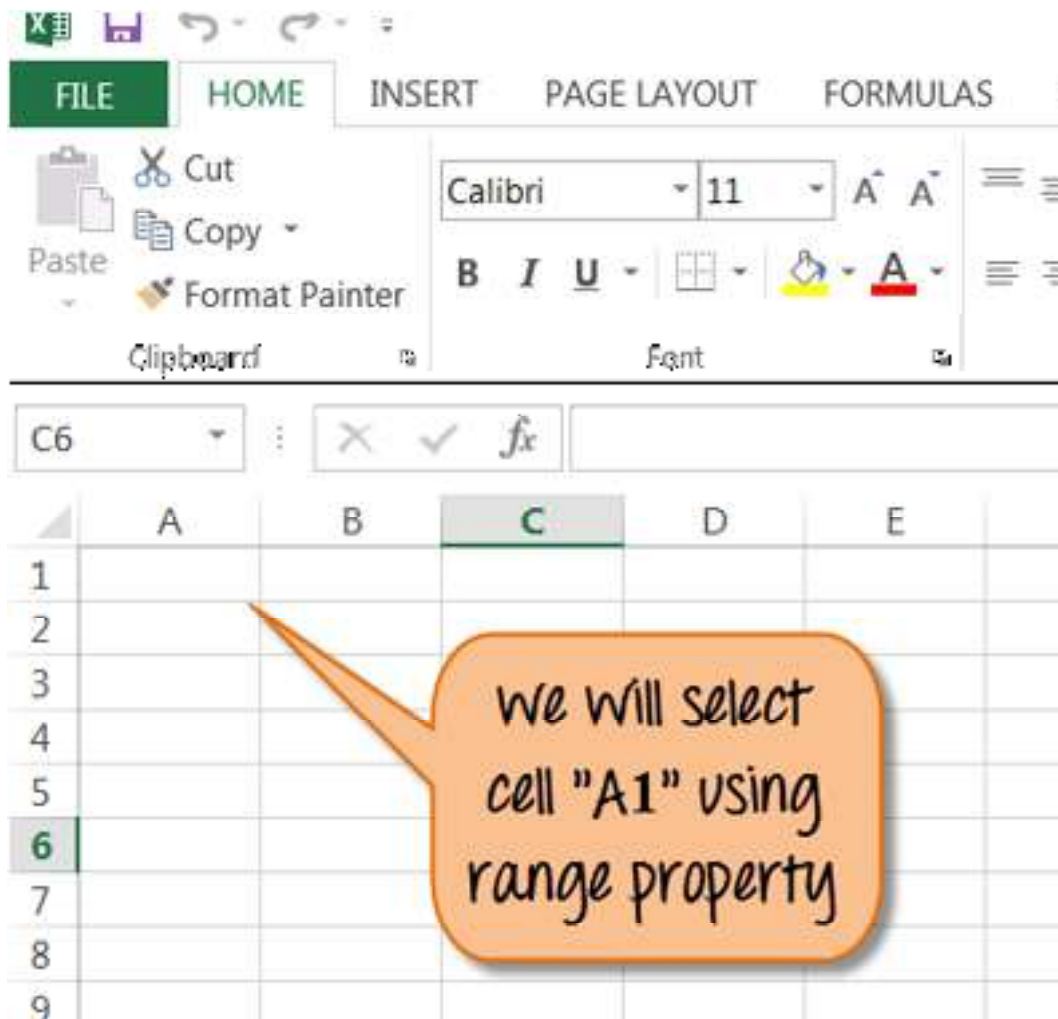
Refer to a Single cell using the Worksheet.Range Property

To refer to a single cell, you have to refer to a single cell.

Syntax is simple "Range("Cell")".

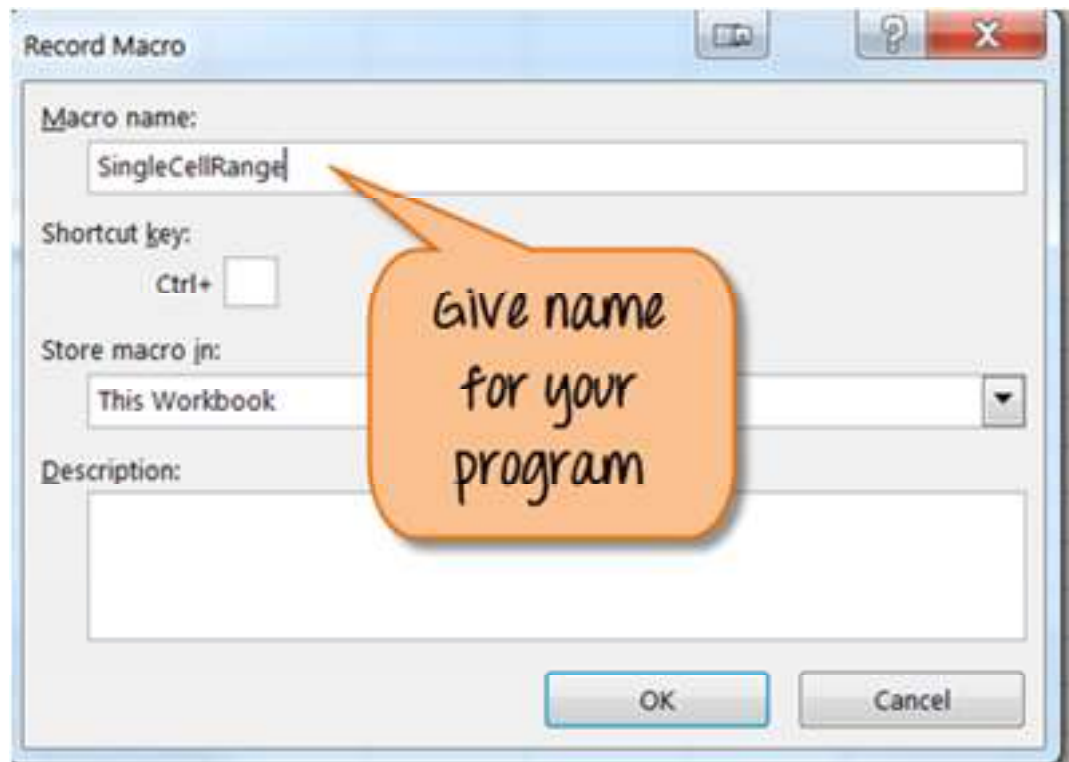Here, we will use ".Select" command to select the single cell from the sheet.

Step 1) In this step, open your excel.

Step 2) In this step.

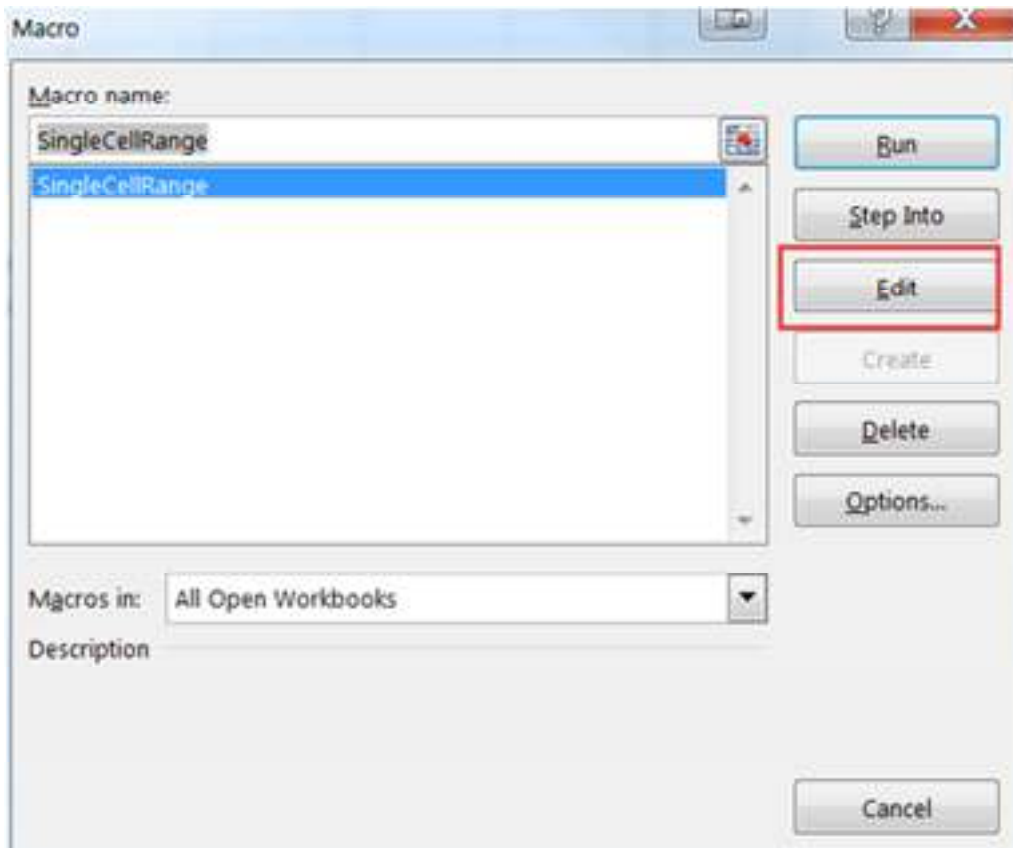- Click on [Record Macro] button.
- It will open a window.

- Enter your program name here and click 'OK' button.
- It will take you to main Excel file, from top menu click on 'stop' record button to stop recording Macro.
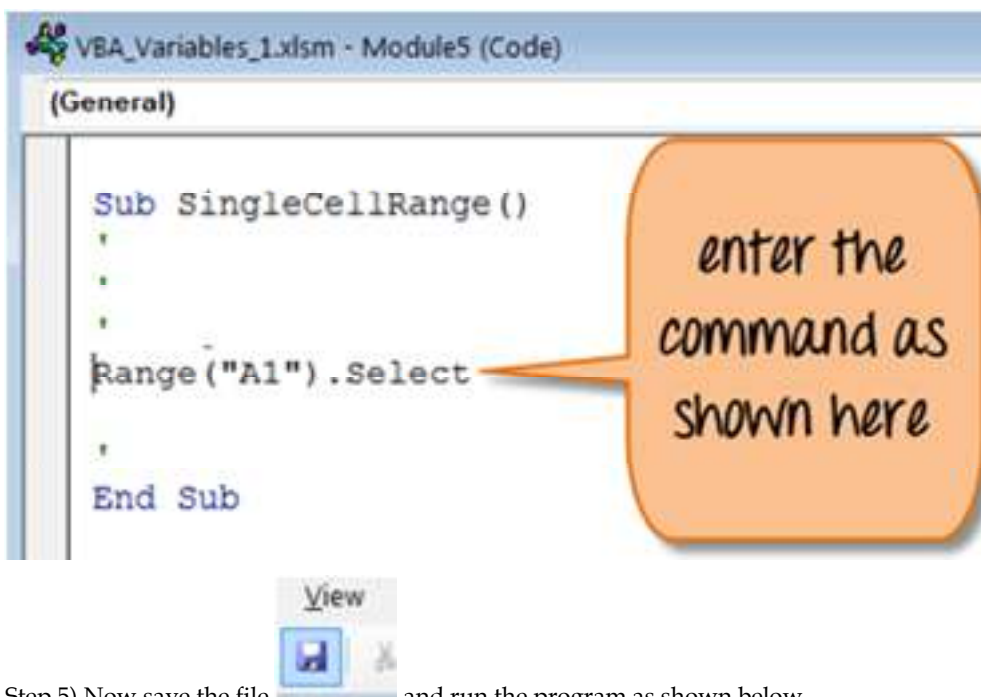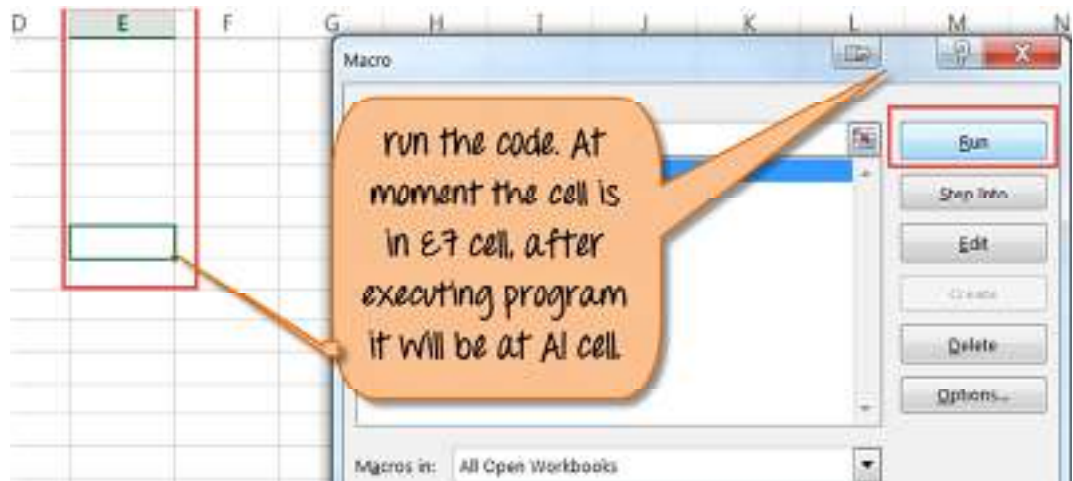

Step 3) In next step,

- Click on Macro button ![Macros] from the top menu. It will open the window below.
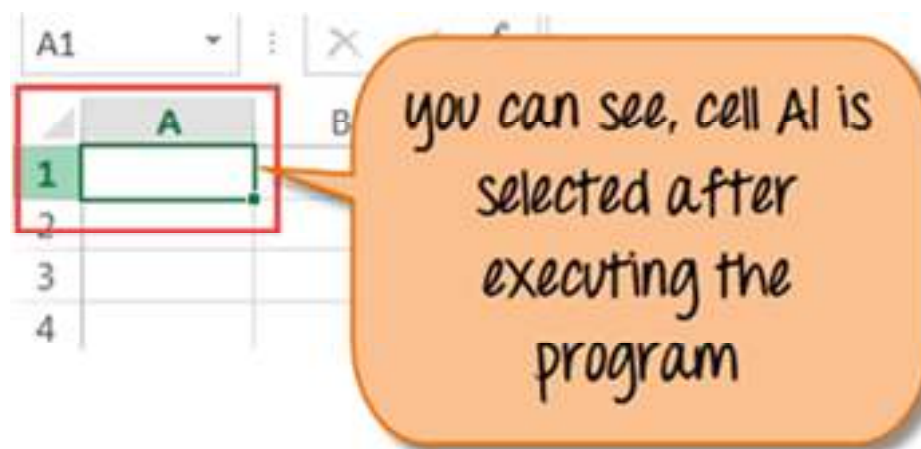- In this window, Click on the 'edit' button.

Step 4) The above step will open VBA code editor for file name "Single Cell Range". Enter the code as shown below for selecting range "A1" from the excel.

Step 5) Now save the file and run the program as shown below.

Step 6) You will see Cell "A1" is selected after execution of the program.

Likewise, you can select a cell with a particular Name. For example, if you want to search cell with name "Guru99- VBA Tutorial". You have to run the command as shown below. It will select the cell with that name.

Range("Guru99- VBA Tutorial").Select

To apply other range object here is the code sample.

Range for selecting cell in Excel	Range declared
For single Row	Range("1:1")
For single Column	Range("A: A")
For Contiguous Cells	Range("A1:C5")
For Non-Contiguous Cells	Range("A1:C5, F1:F5")
For Intersection of two ranges	Range("A1:C5 F1:F5") (For intersection cell, remember there is no comma operator)
To merge Cell	Range("A1:C5") (To merge cell use "merge" command)

Cell Property

Similarly to the range, in VBA you can also you "Cell Property". The only difference is that it has an "item" property that you use to reference the cells on your spreadsheet. Cell property is useful in a programming loop.

For example,

Cells.item(Row, Column). Both the lines below refer to cell A1.

- Cells.item(1,1) OR
- Cells.item(1,"A")

Range Offset property

Range offset property will select rows/columns away from its original position. On the basis of the range declared, cells are selected. See example below.

For example,

Range("A1").offset(Rowoffset:=1, Columnoffset:=1).Select

The result for this will cell B2. The offset property will move A1 cell to 1 column and 1 row away. You can change the value of rowoffset / columnoffset as per requirement. You can use a negative value (-1) to move cells backward.

Summary

- VBA Case Statement: The VBA Case statement is used for conditional branching in Excel VBA. It allows you to compare a value against multiple possible values or conditions and execute different code blocks based on the match.
- VBA IF Else Statement: The VBA IF Else statement is used for conditional execution of code. It checks a condition and executes one block of code if the condition is true and another block if it's false.
- VBA For Loop: The VBA For Loop is used for repetitive execution of a block of code. It allows you to specify the number of times the code should be executed and control the loop with a counter variable.
- Do Until Loop in VBA: The Do Until loop in VBA continues to execute a block of code until a specified condition becomes true. It's useful when you want to repeat a task until a certain condition is met.
- Do While Loop in VBA: Similar to the Do Until loop, the Do While loop in VBA repeats a block of code, but it continues execution as long as a specified condition remains true.
- Excel VBA Range Object: The Range object in Excel VBA represents a cell, a group of cells, or a named range in a worksheet. It's a fundamental object used to interact with and manipulate data within Excel.
- Select Case Statement: This is an extension of the basic Case statement. It allows you to test a single expression against multiple values and execute code blocks based on the matching value.
- For Each Loop in VBA: The For Each loop in VBA is used to iterate through a collection of objects, such as a range of cells or a collection of worksheets, without the need for a counter variable.
- Exit Statement: In VBA, the Exit statement is used to prematurely exit a loop (e.g., For, Do Until, Do While) or a subroutine based on a specified condition, helping to streamline code execution.

- Nested Loops: You can nest loops in VBA, meaning you can place one loop inside another. This is useful for complex scenarios where you need to perform repetitive tasks within repetitive tasks, allowing for more advanced coding techniques.

Keywords

1. VBA Case Statement:

   - Definition: The VBA Case Statement is a conditional control structure in VBA that allows you to evaluate a specific expression against multiple possible values or conditions. It is used to execute different blocks of code depending on the match between the expression and the specified values.

2. VBA IF Else Statement:

   - Definition: The VBA IF Else Statement is a conditional control structure in VBA used to make decisions in code execution. It checks a condition, and if the condition is true, it executes one block of code; otherwise, it executes another block of code.

3. VBA For Loop:

   - Definition: The VBA For Loop is a control structure that allows you to execute a specific block of code repeatedly for a defined number of iterations. It is commonly used to perform tasks that require repetitive actions, such as iterating through a range of cells.

4. Do Until Loop in VBA:

   - Definition: The Do Until Loop in VBA is a type of loop that repeatedly executes a block of code until a specified condition becomes true. It is useful for situations where you want to continue a task until a certain condition is met.

5. Do While Loop in VBA:

   - Definition: The Do While Loop in VBA is another type of loop that repeatedly executes a block of code as long as a specified condition remains true. It is used when you want to continue executing a task while a condition holds true.

6. Excel VBA Range Object:

   - Definition: The Excel VBA Range Object is an object in VBA that represents a single cell, a group of cells, or a named range within an Excel worksheet. It is used to interact with and manipulate data within Excel, such as reading or modifying cell values.

7. Select Case Statement:

   - Definition: The Select Case Statement in VBA is an extended version of the basic Case statement. It allows you to evaluate a single expression against multiple values or conditions and execute different code blocks based on the matching value.

8. For Each Loop in VBA:

   - Definition: The For Each Loop in VBA is used for iterating through a collection of objects, such as a range of cells or a collection of worksheets. It does not require a counter variable and is useful for working with collections.

9. Exit Statement:

   - Definition: The Exit Statement in VBA is used to prematurely exit a loop (e.g., For, Do Until, Do While) or a subroutine based on a specified condition. It allows for early termination of code execution.

10. Nested Loops:

    - Definition: Nested loops in VBA refer to the practice of placing one loop inside another. This technique is used to handle complex scenarios where repetitive tasks need to be performed within other repetitive tasks, allowing for more intricate coding structures.

Self Assessment

1. What is the primary purpose of the VBA Case Statement?
A. To create loops in VBA.
B. To define custom functions.
C. To evaluate a specific expression against multiple conditions.
D. To perform file I/O operations.

2. When is the VBA IF Else Statement used?
A. To define custom functions.
B. To create loops in VBA.
C. To evaluate conditions and execute different code based on the result.
D. To declare variables in VBA.

3. Which VBA construct is used for repetitive execution of a block of code for a defined number of iterations?
A. Do Until Loop
B. Do While Loop
C. For Loop
D. Select Case Statement

   Do Until and Do While Loops VBA:

4. In VBA, which loop continues execution until a specified condition becomes true?
A. For Loop
B. Do Until Loop
C. Do While Loop
D. Select Case Loop

5. In Excel VBA, what does the Range object represent?
A. A collection of worksheets.
B. A single cell.
C. A conditional statement.
D. A custom function.

6. Which of the following operations can you perform with the Excel VBA Range object?
A. Creating custom macros.
B. Calculating complex mathematical formulas.
C. Reading and modifying cell values.
D. Generating random numbers.

7. What does "VBA" stand for?
A. Visual Basic Analysis
B. Virtual Basic Application
C. Visual Basic for Applications

D. Visual Basic Advanced

8. Which VBA construct allows you to prematurely exit a loop or subroutine based on a condition?
A. Select Case Statement
B. Exit Statement
C. Do Until Loop
D. For Each Loop

9. What is the primary purpose of nesting loops in VBA?
A. To increase code readability.
B. To create complex custom functions.
C. To perform repetitive tasks within repetitive tasks.
D. To avoid using conditional statements.

10. Which of the following is not a valid VBA control structure?
A. If Statement
B. For Loop
C. Do Until Loop
D. Cell Formula

11. Which VBA construct is used to iterate through a collection of objects without the need for a counter variable?
A. For Each Loop
B. Do While Loop
C. Select Case Statement
D. Exit Statement

12. In the context of VBA, what is the primary purpose of the "Else" keyword?
A. To define custom functions.
B. To indicate the end of a loop.
C. To execute a code block if a condition is false.
D. To perform mathematical calculations.

13. Which of the following statements is true regarding the VBA Case Statement?
A. It can only evaluate a single condition.
B. It is used for arithmetic operations.
C. It allows you to execute different code blocks based on multiple conditions.
D. It can only be used in conjunction with the For Loop.

14. Which VBA construct is used to perform repetitive tasks while a specified condition is true?
A. For Loop
B. Select Case Statement
C. Do While Loop
D. Exit Statement

15. What is the primary purpose of the VBA Range object?
A. To control the appearance of Excel worksheets.
B. To manage user interface elements.
C. To interact with and manipulate data within Excel.
D. To create custom dialog boxes.

16. Which VBA construct allows you to evaluate a single expression against multiple values or conditions?
A. For Loop
B. Exit Statement
C. Select Case Statement
D. Do Until Loop

17. In VBA, which loop is suitable for situations where you want to continue a task until a certain condition is met?
A. For Each Loop
B. Do Until Loop
C. Select Case Loop
D. Exit Loop

18. Which VBA construct is used for conditional execution of code based on a specified condition?
A. Exit Statement
B. Do While Loop
C. VBA Range Object
D. IF Else Statement

19. What type of Excel VBA object is used to represent a group of cells within a worksheet?
A. Range Object
B. Worksheet Object
C. Cell Object
D. Workbook Object

20. Which VBA construct is used for repetitive execution of a block of code for a defined number of iterations?
A. Do Until Loop
B. Do While Loop
C. For Loop
D. Select Case Statement

Answers for Self Assessment

1.	C	2.	C	3.	C	4.	B	5.	B

6.	C	7.	C	8.	B	9.	C	10.	D
11.	A	12.	C	13.	C	14.	C	15	C
16.	C	17.	B	18.	D	19.	A	20.	C

Review Questions

1. What is the primary purpose of the VBA Case Statement, and how does it differ from an IF Else Statement?

2. Give an example of a situation where you would use a Select Case Statement in VBA.

3. Explain the role of the IF Else Statement in VBA, and provide an example of its usage.

4. How can you handle multiple conditions within an IF Else Statement in VBA?

5. What is the primary use of a For Loop in VBA, and how is it structured?

6. Describe a scenario where you might use a For Loop to automate a task in Excel.

7. How do Do Until and Do While Loops in VBA differ in their behavior? Provide an example for each.

8. When would you choose to use a Do Until Loop over a Do While Loop in VBA, and vice versa?

9. What is the Excel VBA Range Object, and why is it essential in VBA programming for Excel?

10. Give an example of a practical task where you would use the Range Object to interact with Excel data.

📖 Further Readings

*   https://www.wallstreetmojo.com/vba-if-else/#popmake-95356
*   https://www.wallstreetmojo.com/vba-case-statement/
*   https://careerfoundry.com/en/blog/data-analytics/vba-for-loop-excel/
*   https://analystcave.com/vba-for-loop-vs-for-each-loop/
*   https://excelmacromastery.com/vba-for-loop/
*   https://spreadsheeto.com/do-loops/#do-until
*   https://trumpexcel.com/vba-loops/#Do-While-Loop
*   https://www.guru99.com/vba-range-objects.html

Unit 13: Sensitivity Analysis

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Objectives

Introduction

13.1   Goal Seek

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13.3   Scenario Analysis

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Objectives

- Understand the concept of goal seek in sensitivity analysis.
- Understand the concept of data table in sensitivity analysis.
- Understand the concept of scenario analysis in MS - Excel.

Introduction

Sensitivity analysis is a crucial tool in the world of finance, risk management, and decision-making. It allows analysts and decision-makers to understand how small changes in variables can impact financial models or investment decisions. By systematically varying key parameters, sensitivity analysis reveals the sensitivity of financial outcomes to different factors, helping to manage risks effectively.

13.1 Goal Seek

What-If Analysis is one of the most powerful Excel features and one of the least understood. In most general terms, What-If Analysis allows you to test out various scenarios and determine a range of possible outcomes. In other words, it enables you to see the impact of making a certain change without changing the real data. In this particular tutorial, we will focus on one of Excel's What-If Analysis tools - Goal Seek.

What is Goal Seek in Excel?

Goal Seek is Excel's built-in What-If Analysis tool that shows how one value in a formula impacts another. More precisely, it determines what value you should enter in an input cell to get the desired result in a formula cell.

The best thing about Excel Goal Seek is that it performs all calculations behind the scenes, and you are only asked to specify these three parameters:

- Formula cell
- Target/desired value
- The cell to change in order to achieve the target

Spreadsheet Modelling (Using Excel)

The Goal Seek tool is especially useful for doing sensitivity analysis in financial modeling and is widely used by management majors and business owner. But there are many other uses that may prove helpful to you.

For instance, Goal Seek can tell you how much sales you have to make in a certain period to reach $100,000 annual net profit (example 1). Or, what score you must achieve for your last exam to receive an overall passing score of 70% (example 2). Or, how many votes you need to get in order to win the election (example 3).

On the whole, whenever you want a formula to return a specific result but are not sure what input value within the formula to adjust to get that result, stop guessing and use the Excel Goal Seek function!

How to use Goal Seek in Excel

The purpose of this section is to walk you through how to use the Goal Seek function. So, we'll be working with a very simple data set:

	A	B	C
1		**Goal Seek**	
2	**Item price**	$5	
3	**Qty.**	100	Variable
4	**Commission**	10%	
5	**Revenue**	$450	=B2*B3*(1-B4)

The above table indicates that if you sell 100 items at $5 each, minus the 10% commission, you will make $450. The question is: How many items do you have to sell to make $1,000?

Let's see how to find the answer with Goal Seek:

1. Set up your data so that you have a *formula cell* and a *changing cell* dependent on the formula cell.

2. Go to the *Data* tab > *Forecast* group, click the **What if Analysis** button, and select **Goal Seek...**

3. In the *Goal Seek* dialog box, define the cells/values to test and click *OK*:

   - Set cell - the reference to the cell containing the formula (B5).
   - To value - the formula result you are trying to achieve (1000).
   - By changing cell - the reference for the input cell that you want to adjust (B3).
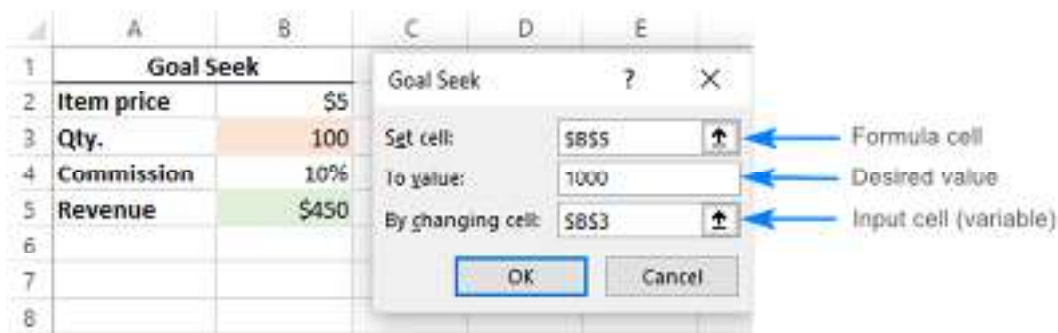
4. The *Goal Seek Status* dialog box will appear and let you know if a solution has been found. If it succeeded, the value in the "changing cell" will be replaced with a new one. Click *OK* to keep the new value or *Cancel* to restore the original one.

In this example, Goal Seek has found that 223 items (rounded up to the next integer) need to be sold to achieve a revenue of $1,000.
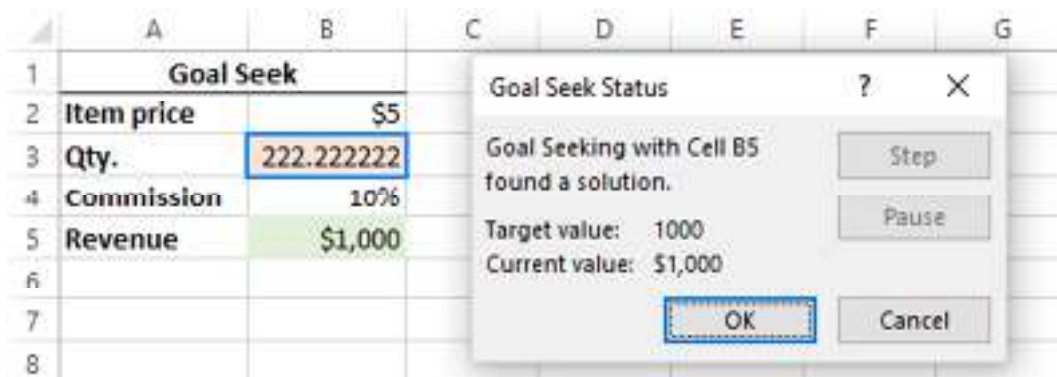
If you are not sure you will be able to sell that many items, then maybe you can reach the target revenue by changing the item price? To test this scenario, do Goal Seek analysis exactly as described above except that you specify a different *Changing cell* (B2):
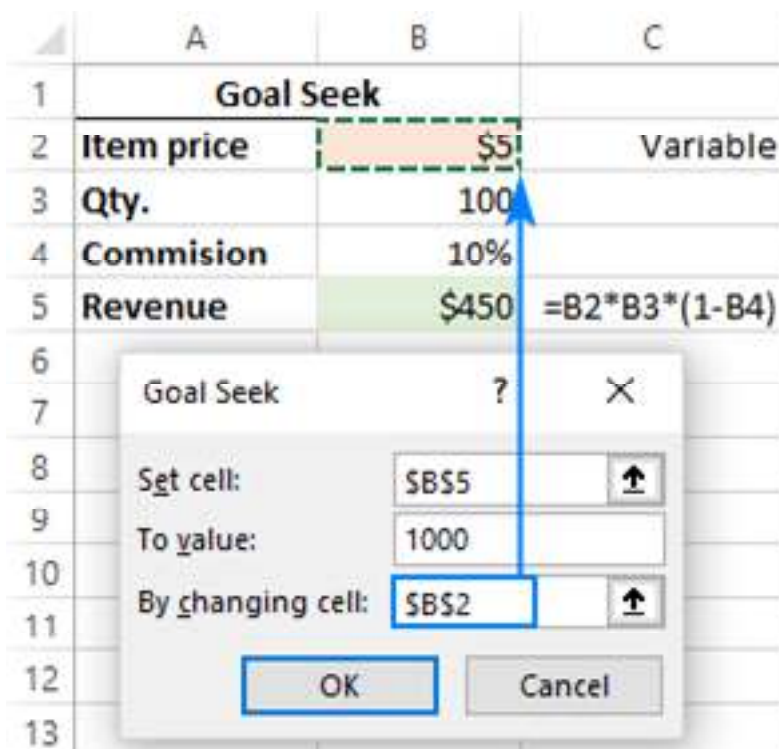
As the result, you will find out that if you increase the unit price to $11, you can reach $1,000 revenue by selling only 100 items:

Spreadsheet Modelling (Using Excel)

Tips and notes:

- Excel Goal Seek does not change the formula, it only changes the input value that you supply to the *By changing cell* box.

- If Goal Seek is not able to find the solution, it displays the closest value it has come up with.

- You can **restore** the original input value by clicking the *Undo* button or pressing the Undo shortcut (Ctrl + Z).

Examples of using Goal Seek in Excel

Below you will find a few more examples of using the Goal Seek function in Excel. The complexity of your business model does not really matter as long as your formula in the Set cell depends on the value in the Changing cell, directly or through intermediate formulas in other cells.

Example 1: Reach the profit goal

Problem: It is a typical business situation - you have the sales figures for the first 3 quarters and you want to know how much sales you have to make in the last quarter to achieve the target net profit for the year, say, $100,000.

Solution: With the source data organized like shown in the screenshot above, set up the following parameters for the Goal Seek function:

- *Set cell* - the formula that calculates the total net profit (D6).
- *To value* - the formula result you are looking for ($100,000).
- *By changing cell* - the cell to contain the gross revenue for quarter 4 (B5).

	A	B	C	D
1		**Gross**	**Profit**	**Net**
2	Q.1	$200,000	12%	$24,000
3	Q.2	$300,000	13%	$39,000
4	Q.3	$100,000	11%	$11,000
5	Q.4		14%	0
6	**Total Net Profit**			$74,000

Goal Seek   ?   ✕

Set cell: $D$6

To value: 100000

By changing cell: $B$5

OK   Cancel

Result: The Goal Seek analysis shows that in order to obtain $100,000 annual net profit, your fourth-quarter revenue must be $185,714.

	A	B	C	D
1		**Gross**	**Profit**	**Net**
2	Q.1	$200,000	12%	$24,000
3	Q.2	$300,000	13%	$39,000
4	Q.3	$100,000	11%	$11,000
5	Q.4	$185,714	14%	$26,000
6	**Total Net Profit**			$100,000

Goal Seek Status   ?   ✕

Goal Seeking with Cell D6 found a solution.   Step

           Pause

Target value: 100000
Current value: $100,000

OK   Cancel

Example 2: Determine the exam passing score

Problem: At the end of the course, a student takes 3 exams. The passing score is 70%. All the exams have the same weight, so the overall score is calculated by averaging the 3 scores. The student has already taken 2 out of 3 exams. The question is: What score does the student need to get for the third exam to pass the entire course?

	A	B	C	D
1	Exam	Score		
2	Exam 1	81%		
3	Exam 2	62%		
4	Exam 3			
5	Final score	72%	=AVERAGE(B2:B4)	

Solution: Let's do Goal Seek to determine the minimum score on exam 3:

- *Set cell* - the formula that averages the scores of the 3 exams (B5).

- *To value* - the passing score (70%).

- *By changing cell* - the 3rd exam score (B4).

	A	B	C
1	Exam	Score	
2	Exam 1	81%	
3	Exam 2	62%	
4	Exam 3		
5	Final score	72%	
6			
7			
8			
9			
10			
11			
12			
13			
14			

Goal Seek dialog box:
- Set cell: $B$5
- To value: 70%
- By changing cell: $B$4
- OK / Cancel

Result: In order get the desired overall score, the student must achieve a minimum of 67% on the last exam:

	A	B	C	D
1	**Exam**	**Score**		
2	Exam 1	81%		
3	Exam 2	62%		
4	Exam 3	67%		
5	**Final score**	**70%**		
6				

Goal Seek Status   ?   ✕

Goal Seeking with Cell B5 found a solution.   [Step]

Target value: 0.7   [Pause]

Current value: 70%

[OK]   [Cancel]

Example 3: What-If analysis of the election

Problem: You are running for some elected position where a two-thirds majority (66.67% of votes) is required to win the election. Assuming there are 200 total voting members, how many votes do you have to secure?

Currently, you have 98 votes, which is quite good but not sufficient because it only makes 49% of the total voters:

	A	B	C	D
1		**YES votes**	**%**	
2	Current	98	49.00%	=B2/B3
3	Total	200	100.00%	

Solution: Use Goal Seek to find out the minimum number of "Yes" votes you need to get:

- *Set cell* - the formula that calculates the percentage of the current "Yes" votes (C2).
- *To value* - the required percentage of "Yes" votes (66.67%).
- *By changing cell* - the number of "Yes" votes (B2).

Result: What-If analysis with Goal Seek shows that to achieve the two-thirds mark or 66.67%, you need 133 "Yes" votes:

13.2 Data Table

What is Sensitivity Analysis in Excel?

Sensitivity analysis in excel helps us study the uncertainty in the model's output with the changes in the input variables. It primarily does stress testing of our modeled assumptions and leads to value-added insights.

In the context of DCF valuation, Sensitivity Analysis in excel is especially useful in finance for modeling share price or valuation sensitivity to assumptions like growth rates or cost of capital.

#1 – One-Variable Data Table Sensitivity Analysis in Excel

Let us take the Finance example (Dividend discount model) below to understand this in detail.

Constant growth DDM gives us the Fair value of a stock as a present value of an infinite stream of dividends growing at a constant rate.

Gordon Growth formula is as per below –

$$Value\_stock = \frac{D_0(1+g)}{(K_e - g)} = \frac{D_1}{(K_e - g)}$$

Where:

- D1 = Value of dividend to be received next year
- D0 = Value of dividend received this year
- g   = Growth rate of dividend
- Ke = Discount rate

Now, let's assume that we want to understand how sensitive the stock price is concerning the Expected Return (ke). There are two ways of doing this –

- Donkey way :-)
- What if Analysis

#1 – Donkey Way

Sensitivity Analysis in Excel using Donkey's way is very straightforward but hard to implement when many variables are involved.

Put the same formula again and again and again!

Do you want to continue making this given 1000 assumptions? Not!

Learn the following sensitivity analysis in excel technique to save yourselves from trouble.

#2 – Using One Variable Data Table

The best way to do sensitivity in excel is to use Data Tables. **Data tables** provide a shortcut for calculating multiple versions in one operation and a way to view and compare the results of all variations on your worksheet.

Below are the steps that you can follow to implement a one-dimensional sensitivity analysis in excel.

1. Create the table in a standard format**.**

In the first column, you have the input assumptions. In our example, inputs are the expected rate of return (ke). Also, please note a blank row (colored in blue in this exercise) below the table heading. This blank row serves an important purpose for this one-dimensional data table, which you will see in Step 2.

Current Year Dividend	$3.0
Expected growth rate (g)	4.0%
Expected return (ke)	10.0%

Expected Return	Price of stock
6.0%	
7.0%	
8.0%	
9.0%	
10.0%	
11.0%	
12.0%	
13.0%	
14.0%	
15.0%	
16.0%	
17.0%	

blank row
above
the table

2. Link the reference Input and Output as given the snapshot below. The space provided by the blank row is now used to provide input (expected return Ke) and the output formula. Why is it done like this? We will use What if Analysis; this is a way to instruct Excel that for the Input (ke), the corresponding formula provided on the right-hand side should be used to recalculate all the other input**.**

Current Year Dividend	$3.0
Expected growth rate (g)	4.0%
Expected return (ke)	10.0%

Expected Return	Price of stock
10.0%	= *(1+)/(-)
6.0%	
0%	
8.0%	
9.0%	
10.0%	
11.0%	
12.0%	
13.0%	
14.0%	
15.0%	
16.0%	
17.0%	

Formula

Link Ke from the input table

3. Select the What-if Analysis tool to perform Sensitivity Analysis in Excel.

It is important to note that this is sub-divided into two steps.

1. Select the table range starting from the left-hand side, starting from 10% until the lower right-hand corner of the table.

2. Click Data – What if Analysis – Data Tables

Select the table from left hand side starting from 10% until the lower right hand corner

4. Data Table Dialog Box Opens Up.

The dialog box seeks two inputs – Row Input and Column Input. Since there is only one input ,Ke, is under consideration, we will provide a single column input.
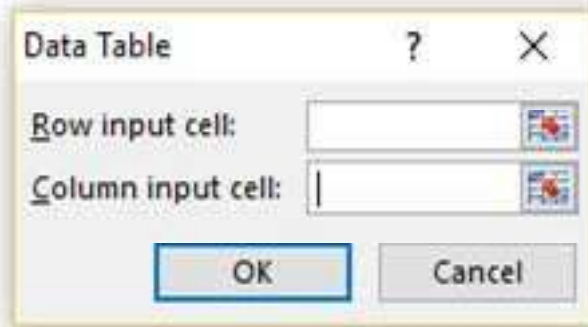
5. Link the Column Input

In our case, all input is provided in a column, and hence, we will link to the column input. Column input is linked to the Expected return (Ke). Please note that the input should be linked from the source and Not from the one inside the table.

Link the column input to Ke.

6. Enjoy the Output

Example : Constant Growth Model – Price of stock

Current Year Dividend	$2.0
Expected growth rate (g)	4.0%
Expected return (kc)	10.0%

Price @ 10% | $52.0

Expected Return	Price of stock
10.0%	$52.0
6.0%	$256.0
7.0%	$104.0
8.0%	$70.0
9.0%	$52.4
10.0%	$52.0
11.0%	=TABLE(,F58)
12.0%	$39.0
13.0%	$34.7
14.0%	$31.2
15.0%	$28.4
16.0%	$26.0
17.0%	$24.0
18.0%	$22.3
19.0%	$20.8
20.0%	$19.5
21.0%	$18.4

calculated automatically

#2 – Two-Variable Data Table Sensitivity Analysis in Excel

Data tables are very useful for Sensitivity analysis in excel, especially in the case of DCF. Once a base case is established, DCF analysis should always be tested under various sensitivity scenarios. Testing involves examining the cumulative effect of changes in assumptions (cost of capital, terminal growth rates, lower revenue growth, higher capital requirements, etc.) on the fair value of the stock.

Let us take the sensitivity analysis in excel with a finance example of Alibaba Discounted Cash Flow Analysis.

With the base assumptions of the Cost of Capital as 9% and constant growth rate of 3%, we arrived at the fair valuation of $191.45 billion.

DCF Valuation Summary

DCF calculation as of	Valuation (RMB)	Valuation (US$)
NPV of explicit period	321,953	51,791
NPV of terminal value	812,148	130,646
Enterprise Value	1,134,100	182,437
+ Cash	$48,550	7,810
- Debt	(340,310)	(6,484)
Equity value	1,142,340	183,851
+ Short term investments, restricted cash, investme	12,587	2,025
+Investment in equity investees	13,009	2,093
+ Alipay valuation	24,866	4,000
Stock Option Value	$3,207	516
Adjusted Equity Value	**1,189,595**	**191,452** $191.5 billion dollars

Let us assume that you do not fully agree with the Cost of Capital Assumptions or the growth rate assumptions I have taken in Alibaba IPO Valuation. You may want to change the assumptions and assess the impact on valuations.

One way is to change the assumptions and check each change's results manually. (codeword – Donkey method!)

Spreadsheet Modelling (Using Excel)

However, we are here to discuss a much better and more efficient way to calculate valuation using sensitivity analysis in excel that saves time and provides us with a way to visualize all the output details in an effective format.

If we perform the What-if analysis in excel professionally on the above data, then we get the following output.

- Here, row inputs consist of changes in Cost of capital or **WACC** (7% to 11%)

- Column inputs consist of changes in growth rates (1% to 6%)

- The point of intersection is Alibaba Valuation. E.g. using our base case of 9% WACC and 3% growth rates, we get the valuation as $191.45 billion.

With this background, let us now look at how we can prepare such a sensitivity analysis in excel using two-dimensional data tables.

Step 1 – Create the Table Structure as given below

- Since we have two sets of assumptions – Cost of Capital (WACC) and Growth Rates (g), you need to prepare a table given below.

- You are free to switch the row and column inputs. Instead of WACC, you may have growth rates and vice-versa.

Step 2 – Link the Point of Intersection to the Output Cell.

The point of intersection of the two inputs should be used to link the desired output. In this case, we want to see the effect of these two variables (WACC and growth rate) on Equity value. Hence, we have linked the intersecting cell to the output.

Link this cell to the output.
Division by 1000 for
converting million to billion

Step 3 – Open Two Dimensional Data Table

- Select the table that you have created
- Then click on Data -> What if Analysis -> Data Tables

Step 4 – Provide the row inputs and column inputs.

- Row input is the Cost of Capital or Ke.
- The column input is the growth rate.
- Please remember to link these inputs from the original assumption source and not from inside the table.

Step 5 – Enjoy the output.

- Most pessimistic output values lie in the right-hand top corner, where the Cost of Capital is 11%, and the growth rate is only 1%

- The most optimistic Alibaba IPO Value is when Ke is 7%, and g is 6%

- The base case we calculated for 9% ke and 3% growth rates lies in the middle.

- This two-dimensional sensitivity analysis in the excel table provides the clients with an easy scenario analysis that saves a lot of time.

Sensitivity Analysis

191.45	7%	8%	9%	10%	11%
1%	214.44	181.46	156.87	137.87	122.78
2%	245.95	202.55	171.69	148.69	130.90
3%	293.17	232.04	191.45	162.59	141.05
4%	371.91	270.31	219.12	181.13	154.10
5%	529.58	350.08	260.61	207.08	171.50
6.0%	1,001.78	497.62	329.78	246.01	195.86

(WACC across top, growth down side)

#3 – Goal Seek for Sensitivity Analysis in Excel

- The **Goal Seek** command is used to bring one formula to a specific value

- It does this by changing one of the cells that is referenced by the formula

- Goal Seek asks for a **cell reference** that contains a formula (the Set cell). It also asks for a value, which is the figure you want the cell to be equal

- Finally, Goal Seek asks for a cell to alter to take the Set cell to the required value

Let us have a look at the DCF of **Alibaba IPO Valuation**.

As we know from **DCF** that growth rates and valuation are directly related. Increasing growth rates increase the share price of the stock.

Let's assume that we want to check at what growth rate will the stock price touches $80.

As always, we can do this manually by changing the growth rates to continue to see the impact on the share price. This will, again, be a tedious process. In our case, we may have to input growth rates many times to ensure that the stock price matches $80.

However, we can use a function like **Goal Seek in excel** to solve this in easy steps.

Step 1 – Click on the cell whose value you wish to set. (The Set cell must contain a formula)

Step 2 – Choose Tools, Goal Seek from the menu, and the following dialog box appears:

- The Goal Seek command automatically suggests the active cell as the Set cell.

- This can be over-typed with a new cell reference, or you may click on the appropriate cell on the spreadsheet.

- Now enter the desired value this formula should reach.

- Click inside the "To Value" box and type in the value you want your selected formula to equal.

- Finally, click inside the "By Changing Cell" box and either type or click on the cell whose value can be changed to achieve the desired result.

- Click the OK button, and the spreadsheet will alter the cell to a value sufficient for the formula to reach your goal.

Step 3 – Enjoy the output.

Goal Seek also informs you that the goal was achieved.

13.3 Scenario Analysis

What is a Scenario Manager in Excel?

- Scenario manager in Excel is a part of three what-if-analysis tools in Excel, which are built-in in Excel. In simple terms, you can see the impact of changing input values without changing the actual data. Like a Data Table in excel, you now input values that must change to achieve a specific goal.

- Scenario manager in Excel allows you to change or substitute input values for multiple cells (maximum up to 32). Therefore, you can view the results of different input values or different scenarios at the same time.

- For example: What if I cut down my monthly traveling expenses? How much will I save? Here, we can store scenarios to apply them with a mouse click.

Scenario Manager in Excel – Example #1

A simple example could be your monthly family budget. You will spend on food, travel, entertainment, clothes, etc., and see how these affect your overall budget.

Step 1: Create a below table that shows your list of expenses and income sources.

	A	B	C
1	**Particulars**	**Amt**	
2	Income from Salary	50,000	
3	Income from wife	25,000	
4	Income from Other Source	15,000	
5	**Total Income**	**90,000**	
6			
7	**Expenses**	**Amt**	
8	Rent	18,000	
9	Electricity Bill	2,500	
10	Mobile Bill	1,250	
11	Internet Bill	1,500	
12	Water Bill	1,200	
13	Clothes	15,000	
14	Fuel	10,000	
15	Food	15,000	
16	Personal Loan	20,000	
17	**Total Expenses**	**84,450**	
18			
19	**Income Left**	**5,550**	
20			

- In cell B5, you have total income.

B5 — fx =SUM(B2:B4)

	A	B
1	**Particulars**	**Amt**
2	Income from Salary	50,000
3	Income from wife	25,000
4	Income from Other Source	15,000
5	**Total Income**	**90,000**
6		

- In cell B17, you have total expenses for the month.

	A	B
7	**Expenses**	**Amt**
8	Rent	18,000
9	Electricity Bill	2,500
10	Mobile Bill	1,250
11	Internet Bill	1,500
12	Water Bill	1,200
13	Clothes	15,000
14	Fuel	10,000
15	Food	15,000
16	Personal Loan	20,000
17	**Total Expenses**	**84,450**
18		

B17 =SUM(B8:B16)

- In cell B19, total money left.

	A	B
7	**Expenses**	**Amt**
8	Rent	18,000
9	Electricity Bill	2,500
10	Mobile Bill	1,250
11	Internet Bill	1,500
12	Water Bill	1,200
13	Clothes	15,000
14	Fuel	10,000
15	Food	15,000
16	Personal Loan	20,000
17	**Total Expenses**	84,450
18		
19	**Income Left**	**5,550**
20		

B19 =B5-B17

You are ending up with only 5,550 after all the expenses. So, it would help if you cut your cost to save more for the future.
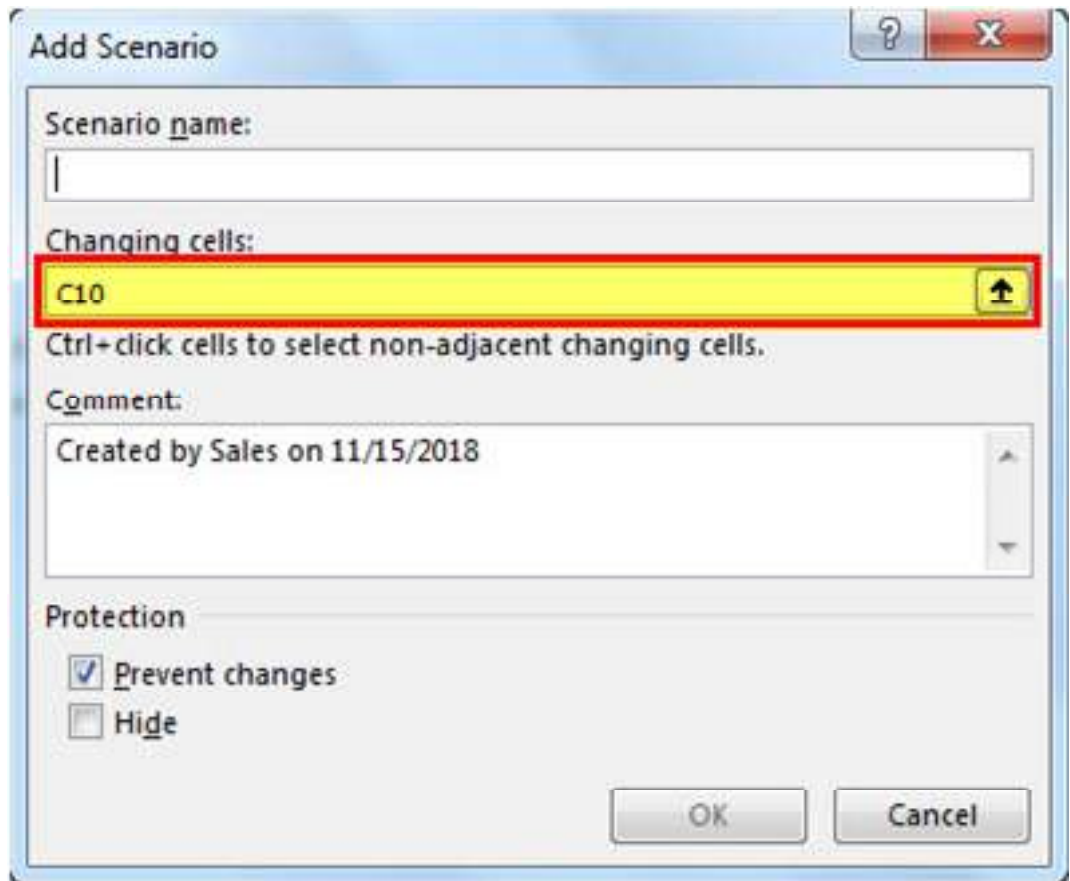
Step 2: From the top of Excel, click the Data menu > On the "Data" menu, locate the "Data Tools" panel > Click on the "What-If-Analysis" item and select the "Scenario Manager" in Excel from the menu.
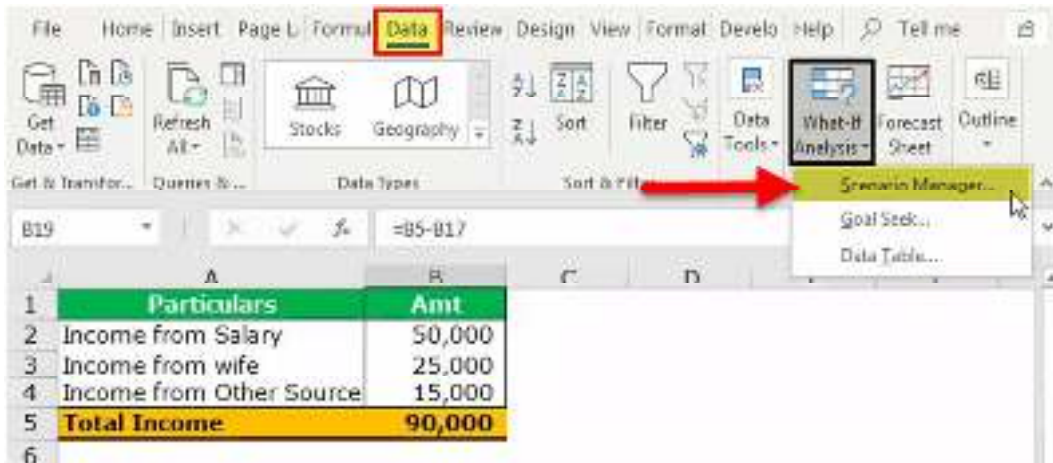
Step 3: When you click on the Scenario Manager below, the dialog box will open.
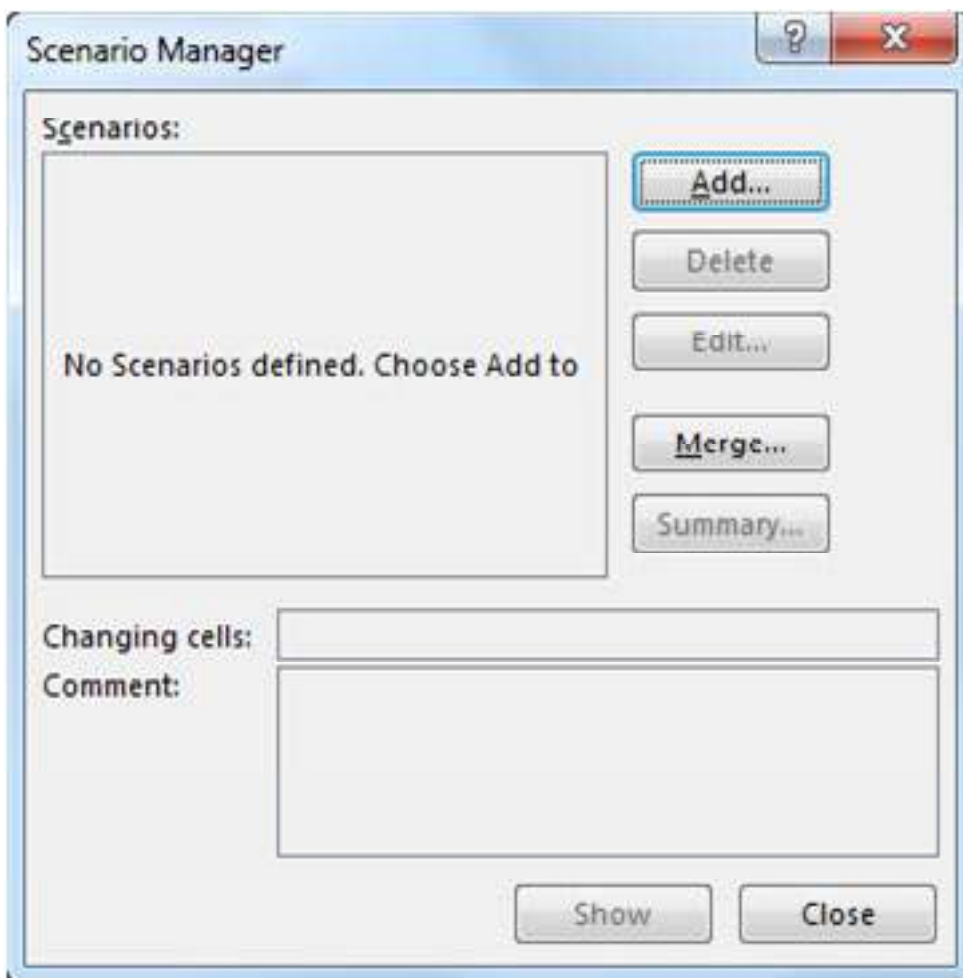
Step 4: You need to create a new scenario. So, click on the Add button. Then, you will get the below dialog box.
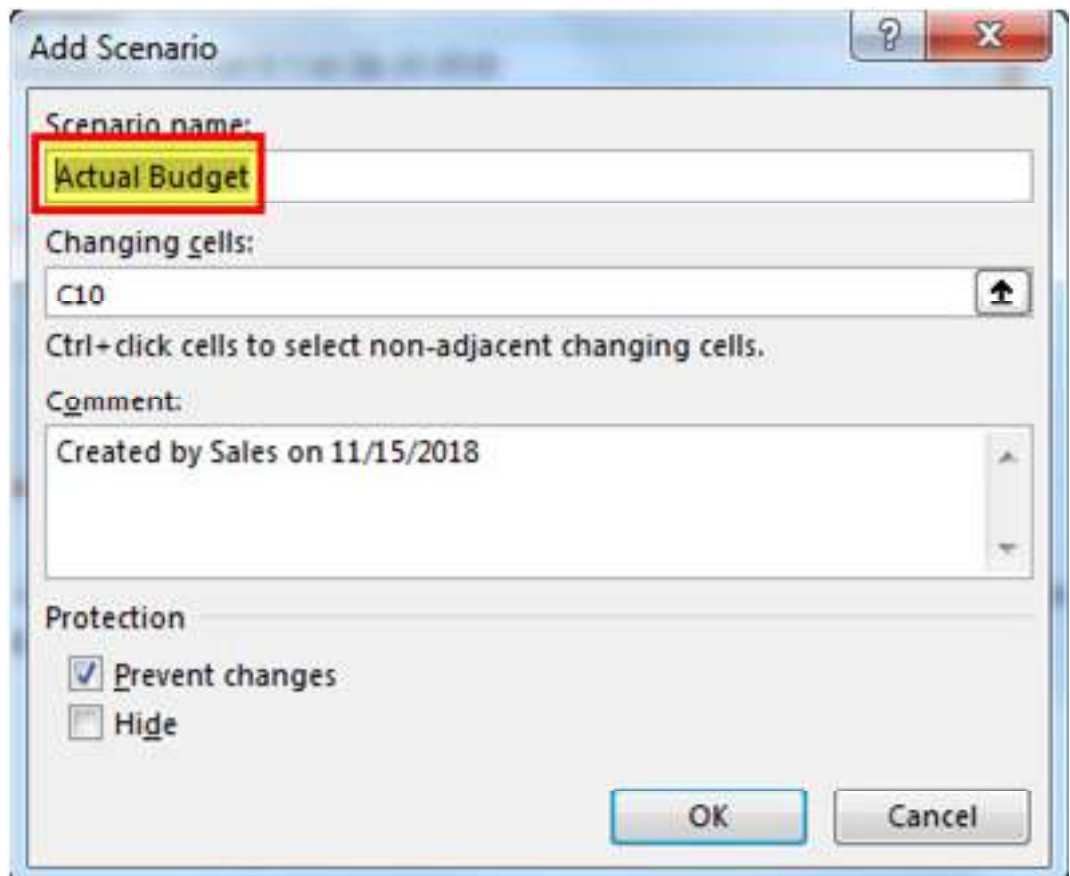
By default, it shows cell C10, which means it is the currently active cell. So, first, type the scenario name in the box as the Actual Budget.

Now, you need to enter which cells your excel sheet will be changing. Nothing will change in this first scenario because this is my actual budget for the month. Still, we need to specify the cells that will be changing.

Now, try to reduce the food expenses and clothes expenses. These are in cells B15 and B13,respectively. Now, the add scenario dialog box should look like this.
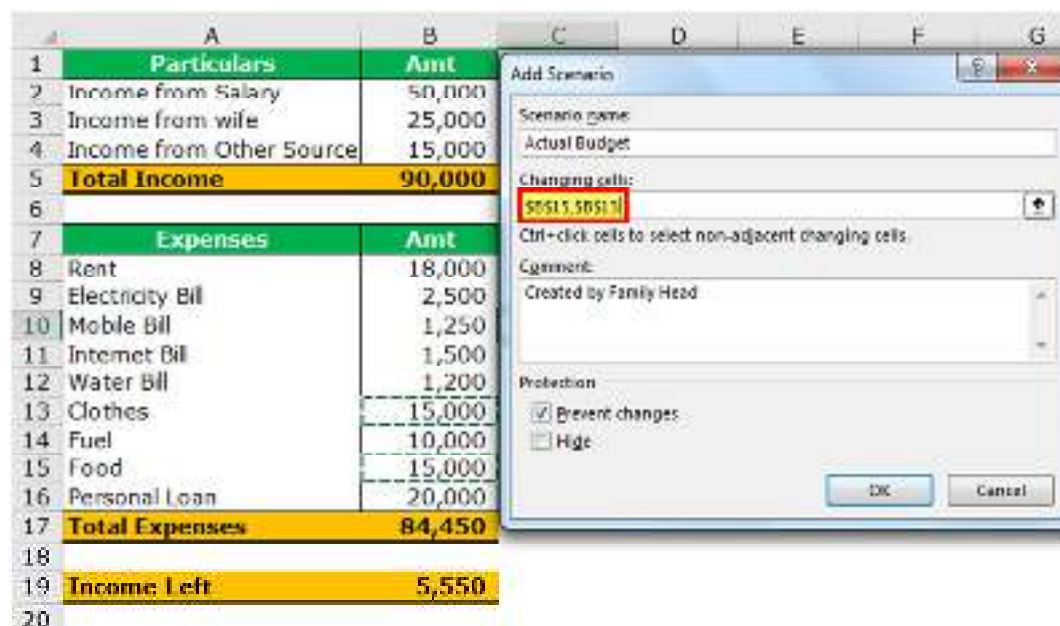
Click "OK." Excel will ask you for some values. Since we do not want any changes to this scenario, click "OK."
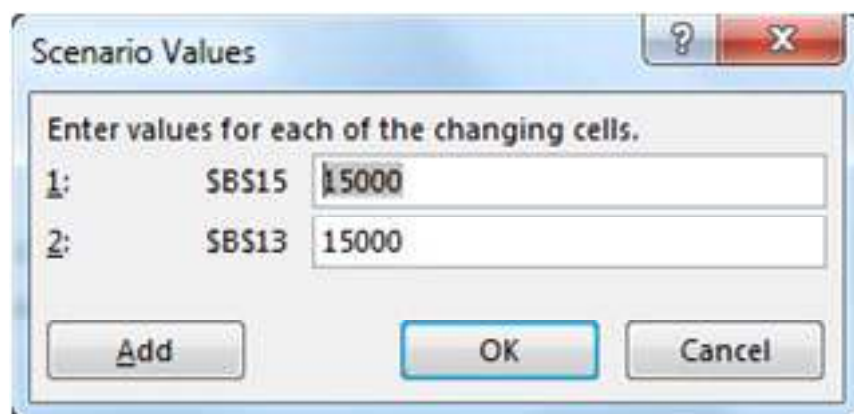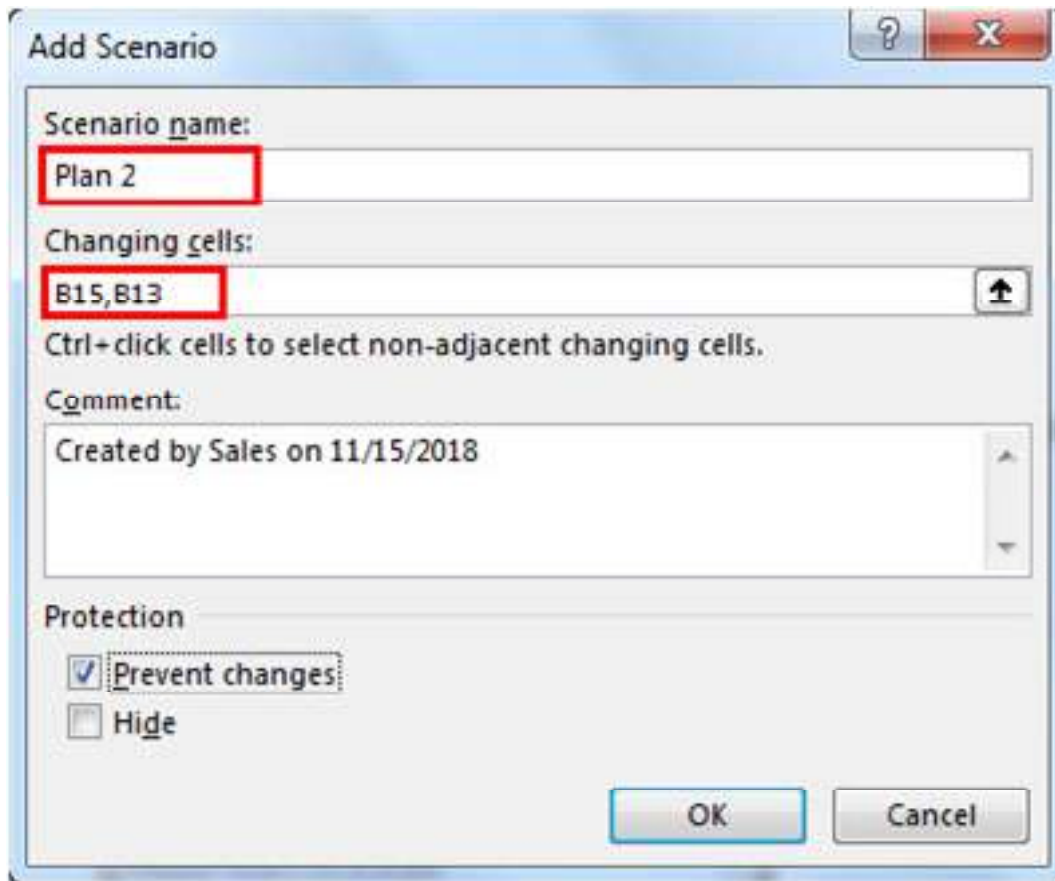
Now, you will be taken back to the scenario manager box. Now, the window will look like this.
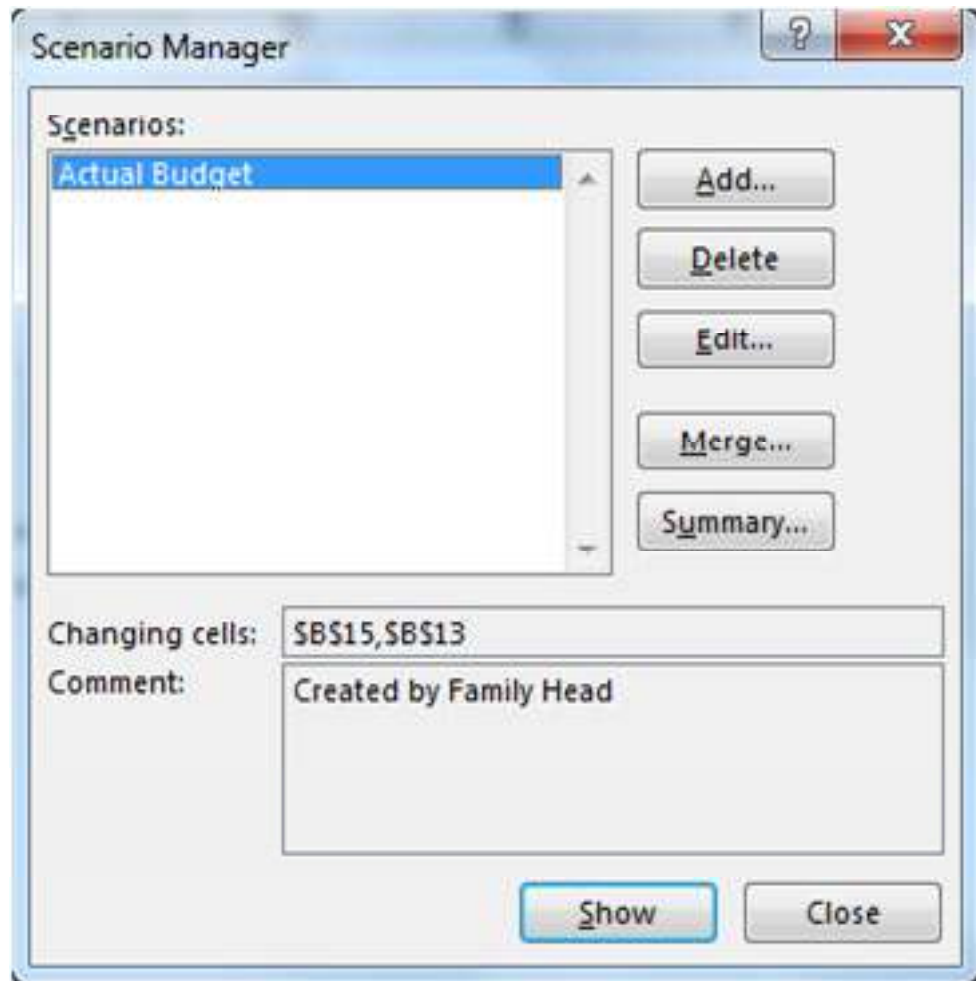
Now, one scenario is done and dusted. Next, create a second scenario where you must change your food and clothes expenses.

Click the Add button and give a "Scenario Name" as "Plan 2". "Changing the cell" will be B15 and B13 (food and cloth expenses).
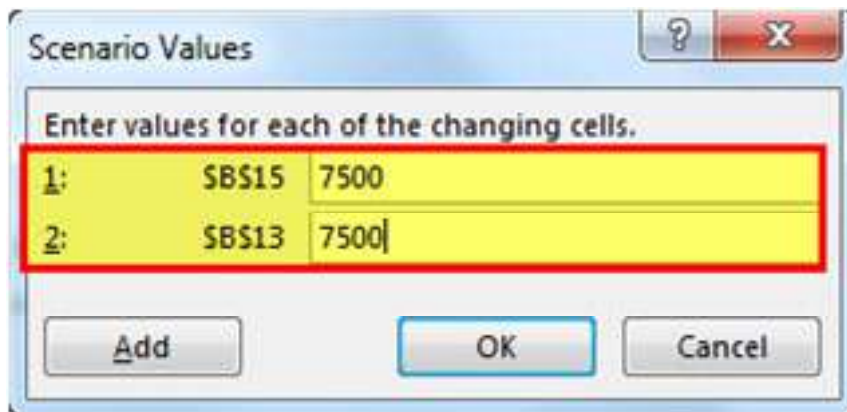
Now, below, the "Scenario Values" dialog box opens again. This time, we want to change the values. Enter the same ones as in the image below:
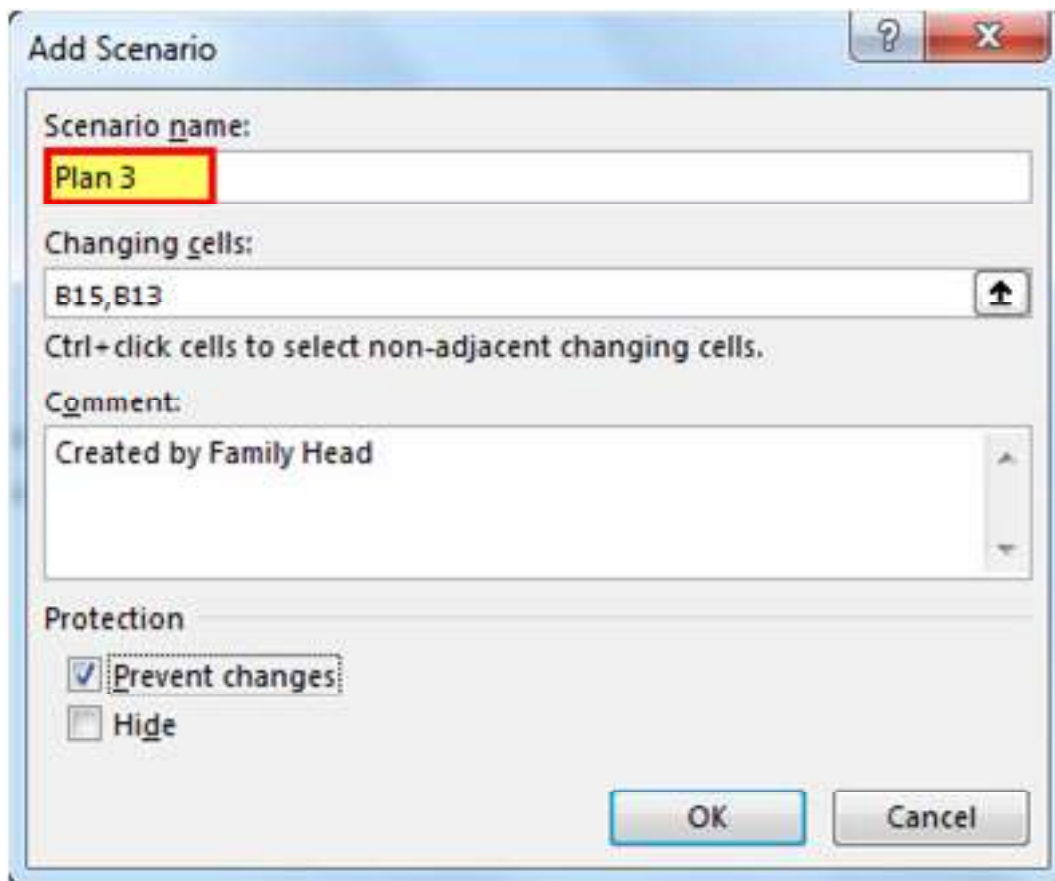
These are the new values for our new scenario, Plan 2. Click "OK." Now, you are back to the Scenario Manager window. Now, we have two scenarios named after Actual Budget and Plan 2.
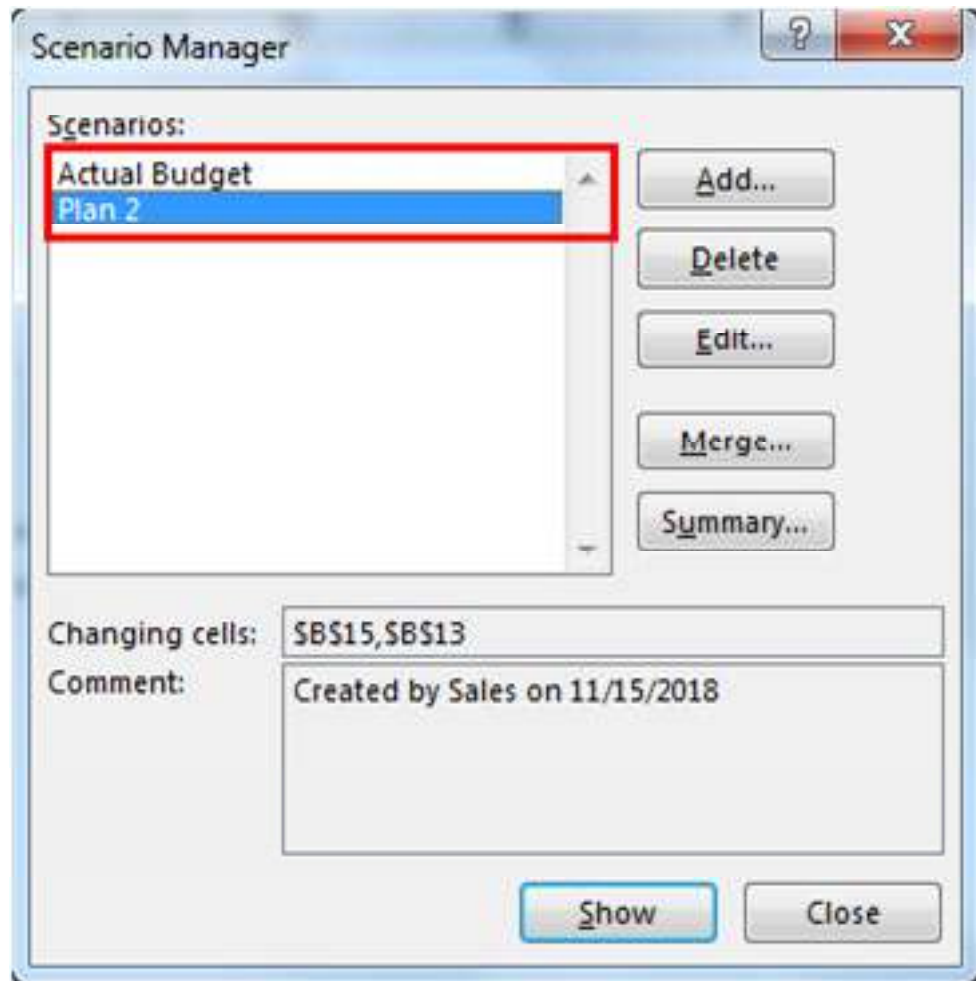
Click the Add button and give a scenario name as "Plan 3." "Changing cells" will be B15 and B13 (food and cloth expenses).
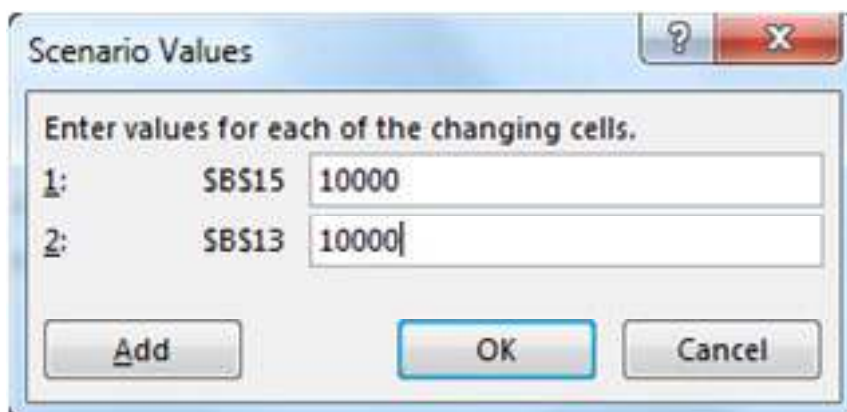
Now, below, the "Scenario Values" dialog box opens again. This time, we do want to change the values. Insert the same ones as in the image below:

These are the new values for our new scenario, Plan 3. Click "OK." Now you are back to the "Scenario Manager" window. Now, you have three scenarios named after Actual Budget, Plan 2, and Plan 3.

Spreadsheet Modelling (Using Excel)
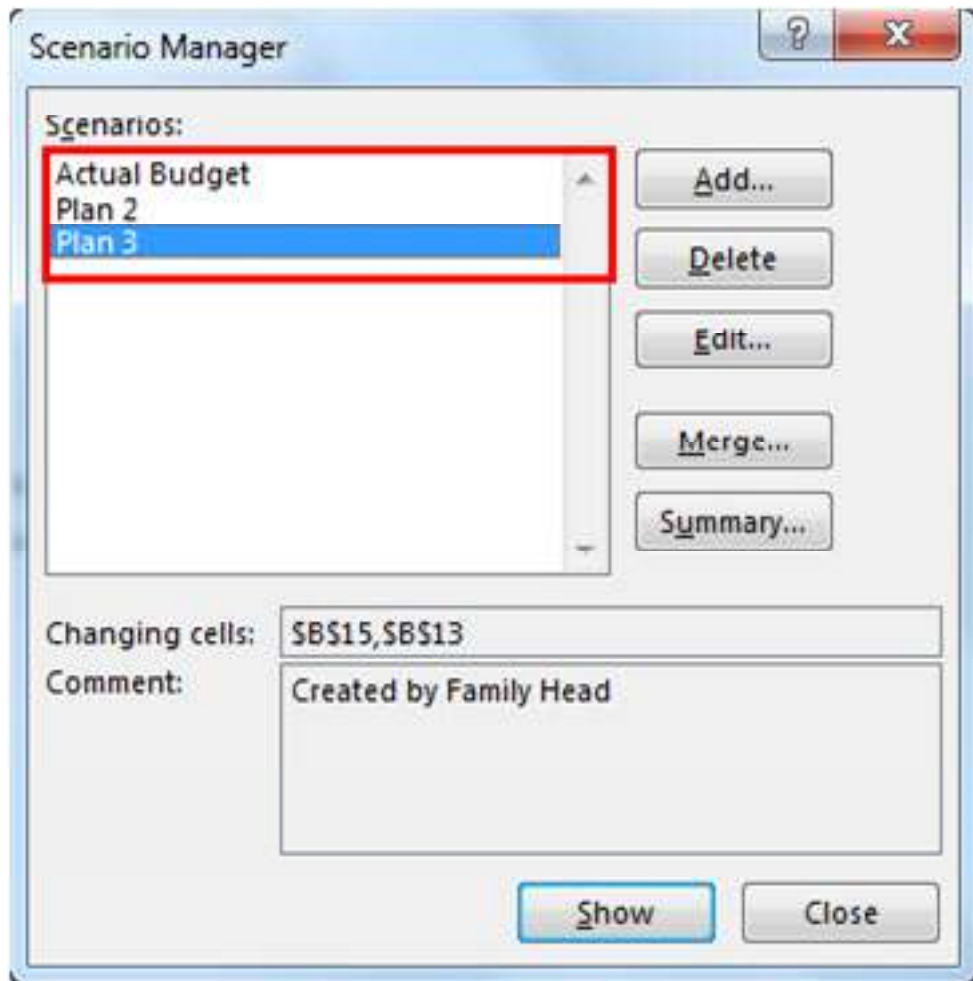
As you can see, we have our "Actual Budget," "Plan 2," and "Plan 3." With "Plan 2" selected, click the "Show" button at the bottom. The values in your Excel sheet will change, and we will calculate the new budget. The image below shows what it looks like.

Click on the Actual Budget and the Show button to see the differences. It will display initial values.

Do the same for "Plan 2" to look at the changes.

So, scenario manager in Excel allows you to set different values and identify the significant changes.

How to Create a Summary Report in Excel?

After adding different scenarios, we can create a summary report in Excel from this scenario manager. To create a summary report in Excel, follow the below steps.

- Click on the Data tab from the Excel menu bar.

- Click on What-If-Analysis.

- Under the what-if-analysis, click Scenario Manager in Excel.

- Now, click on Summary.

- Click "OK" to create the summary report in Excel.

- It will create the summary in the new sheet, as shown in the below image.

- It shows the change in savings in three different scenarios. In the first scenario, the savings was 5,550. In the second scenario, savings are increased to 20,550 due to cost cut down in Food & Clothes section, and finally, the third scenario shows the other scenario.

- All right, now we exercised a simple Family Budget Planner. It looks good enough to understand. Perhaps, this is enough to convince your family to change their lifestyle.

- Scenario manager in Excel is a great tool when you need to do **sensitivity analysis**. You can instantly create the summary report in Excel to compare one plan with the other and decide the best alternative plan to get a better outcome.

Scenario Manager in Excel Example #2: Take the below data and create new scenarios.

Take the below data table and create new scenarios.

- "If the Operating Cost Reduces by 10%."

- "If the Operating Cost Reduces by 15%."

- "If the **Unit Price** increases by five and all others remain the same."

The formula used in cell B4 is =B2*B3 & in cell B11 is = B4 – B9.

In addition, your scenarios will look like the one below.

Spreadsheet Modelling (Using Excel)

		D	E	F	G
1					
2	**Scenario Summary**				
3		Current Values:	Operating Cost Reduces by 10%	ng Cost Reduces By 15%	Unit Price Increases by 5
5	**Changing Cells:**				
6	$B$6	6,500	5,850	5,525	6,500
7	$B$3	30	30	30	35
8	**Result Cells:**				
9	$B$3	30	30	30	35
10	$B$6	6,500	5,850	5,525	6,500
11	$B$11	3,000	3,050	3,975	5,500

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.

Summary

- Purpose: Goal Seek is an Excel tool used for what-if analysis. It helps find the input value needed to achieve a specific result or goal.

- Single Variable: Goal Seek is typically used when you have one input variable and want to determine its value to reach a desired outcome.

- Example: It can be applied in financial modeling to find the required loan payment to reach a specific loan balance.

- Process: To use Goal Seek, you specify a target value, a changing cell (input), and a desired result. Excel calculates the necessary input value.

- Limitations: Goal Seek is limited to one-variable analysis and cannot handle multiple changing inputs or scenarios.

- Purpose: Data Tables in Excel are used to analyze multiple scenarios by changing one or two variables while keeping the rest constant.

- Types: There are one-variable and two-variable Data Tables. One-variable tables vary one input, while two-variable tables vary two inputs simultaneously.

- Input Range: Data Tables require you to define an input range with different values or scenarios and an output cell with a formula to analyze.

- Usage: Data Tables are commonly employed in financial modeling, sensitivity analysis, and assessing the impact of changing variables on outcomes.

- Reports: Data Tables can generate summary reports that display the results of multiple scenarios in a structured format.

- Purpose: Scenario Analysis in Excel allows for the examination of different sets of input values to understand how they affect outcomes.

- Multiple Scenarios: It supports the creation and management of multiple scenarios, each with distinct input values.

- Scenario Manager: Excel's Scenario Manager tool simplifies the creation and comparison of scenarios, offering a user-friendly interface.

- Reports: Scenario Analysis often includes the creation of summary reports that provide a side-by-side comparison of scenario results.

- Applications: Scenario Analysis is valuable in risk assessment, decision-making, and project planning, helping users explore various "what-if" possibilities.

- Data Separation: Scenarios can be stored in separate worksheet cells, making it easy to switch between them for analysis.

Keywords

1. Goal Seek:

- Meaning: Goal Seek is an Excel tool that allows you to find the input value needed to achieve a specific goal or target output by varying a single variable while keeping others constant.

2. What-If Analysis:

- Meaning: What-If Analysis refers to the process of changing input values in a model to observe the resulting changes in outcomes, helping to explore various scenarios.

3. Data Table:

- Meaning: A Data Table in Excel is a tool used to perform sensitivity analysis by changing one or two input variables and observing the impact on one or more output values.

4. One-Variable Data Table:

- Meaning: A one-variable Data Table allows you to vary a single input variable while keeping other variables constant to analyze different scenarios.

5. Two-Variable Data Table:

- Meaning: A two-variable Data Table enables the simultaneous variation of two input variables while keeping the rest constant, allowing for more complex scenario analysis.

6. Scenario Analysis:

- Meaning: Scenario Analysis involves the examination of different sets of input values to understand how they affect outcomes, often used for assessing risks and making informed decisions.

7. Scenario Manager:

- Meaning: Scenario Manager is an Excel tool that facilitates the creation, management, and comparison of multiple scenarios, making it easier to explore "what-if" possibilities.

8. Sensitivity Analysis:

- Meaning: Sensitivity Analysis is a broader term that encompasses various techniques, including Data Tables and Scenario Analysis, to assess how changes in input values impact the results of a model or analysis.

9. Summary Report:

- Meaning: A Summary Report is a document or presentation that provides a concise overview of the results and findings from scenario analysis, often presented in a structured format for decision-makers.

10. Risk Assessment:

- Meaning: Risk Assessment involves evaluating potential risks and uncertainties associated with different scenarios, helping organizations make informed choices to mitigate adverse outcomes.

Self Assessment

1. What is the primary purpose of the Goal Seek tool in Excel?
A. To create data tables.
B. To perform what-if analysis.
C. To create scenarios.
D. To insert comments in cells.

2. When using Goal Seek, which of the following is typically unknown and needs to be determined?
A. The initial input value.
B. The target value or goal.

C. The formula to be used.

D. The data table.

3. In Goal Seek, which value remains constant while you change another value to reach a target?

A. The target value.

B. The formula.

C. The initial input value.

D. The scenario.

4. What is a Data Table in Excel used for?

A. To create custom functions.

B. To format cells with specific colors.

C. To analyze multiple scenarios by changing one or two variables.

D. To insert charts into a worksheet.

5. In a one-variable Data Table, how many input values can you specify?

A. One

B. Two

C. Multiple

D. None

6. When creating a two-variable Data Table, what does the row input cell represent?

A. The variable you want to change.

B. The variable that remains constant.

C. The target value.

D. The formula to be used.

7. What is Scenario Analysis in Excel used for?

A. To create pivot tables.

B. To analyze multiple sets of data by changing input values.

C. To format cells with specific colors.

D. To create custom functions.

8. In Scenario Manager, what is a "scenario"?

A. A type of chart.

B. A defined set of input values.

C. A comment attached to a cell.

D. A data validation rule.

9. How can you create different scenarios in Excel?

A. By using the Goal Seek tool.

B. By applying conditional formatting.

C. By using the Scenario Manager.

D. By inserting pivot tables.

10. In Scenario Analysis, what does the "Summary" option allow you to do?

A. It generates random values for scenarios.

B. It summarizes the results of multiple scenarios in a report.

C. It formats the cells with specific colors.

D. It creates custom formulas for analysis.

11. Which Excel feature allows you to compare different scenarios side by side?

A. Goal Seek

B. Data Validation

C. Scenario Analysis

D. Data Table

12. In Scenario Manager, what happens when you click the "Show" button for a specific scenario?

A. The scenario is deleted.

B. The scenario is added to a report.

C. The scenario is highlighted.

D. The scenario becomes the active data.

13. Which of the following is not a common goal of these Excel tools (Goal Seek, Data Table, Scenario Analysis)?

A. Analyzing historical data.

B. Predicting future outcomes.

C. Conducting what-if analysis.

D. Finding optimal solutions.

14. Which Excel tool is most suitable for determining a single input value needed to achieve a specific result?

A. Goal Seek

B. Data Table

C. Scenario Manager

D. VLOOKUP

15. What is the primary difference between a Data Table and Scenario Analysis?

A. Data Tables involve changing input values, while Scenario Analysis focuses on goal-seeking.

B. Data Tables allow for one-variable analysis, while Scenario Analysis supports multiple variables.

C. Data Tables require a separate worksheet, while Scenario Analysis uses the same worksheet.

D. Data Tables are used for charting, while Scenario Analysis is used for formatting.

Answers for Self Assessment

1.	B	2.	A	3.	A	4.	C	5.	C
6.	A	7.	B	8.	B	9.	C	10.	B

| 11. | C | 12. | D | 13. | A | 14. | A | 15. | B |

Review questions

1. What is the primary purpose of the Goal Seek tool in Excel?

2. How does Goal Seek work, and what does it help you find in a spreadsheet?

3. When is Goal Seek most commonly used in financial modeling or analysis?

4. What is the main purpose of a Data Table in Excel?

5. How does a one-variable Data Table differ from a two-variable Data Table?

6. In a Data Table, what are the input values, and what is the output value?

7. What is Scenario Analysis, and how does it differ from Goal Seek and Data Tables?

8. How does Scenario Manager simplify the process of conducting Scenario Analysis in Excel?

9. Why is Scenario Analysis valuable in risk assessment and decision-making?

10. What is the key benefit of using Summary Reports in Scenario Analysis?

Further Readings

- https://www.ablebits.com/office-addins-blog/goal-seek-excel-what-if-analysis/
- https://www.simplilearn.com/tutorials/excel-tutorial/goal-seek-excel
- https://www.wallstreetmojo.com/sensitivity-analysis-in-excel/
- https://www.tutorialspoint.com/excel_data_analysis/what_if_analysis_with_goal_seek.htm
- https://www.wallstreetmojo.com/sensitivity-analysis-in-excel/
- https://www.wallstreetmojo.com/scenario-manager-in-excel/
- https://trumpexcel.com/scenario-manager-in-excel/
- https://www.investopedia.com/terms/s/scenario_analysis.asp
- https://www.excel-easy.com/data-analysis/what-if-analysis.html
- https://www.exceldemy.com/scenario-analysis-excel/
- https://spreadsheeto.com/scenario-manager/

Unit 14: Simulation and Optimization

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Objectives

- Understand the concept of monte carlo simulations.
- Understand the concept of solver in MS-Excel.
- Understand the concept of linear programming for optimization in MS-Excel
- Understand the concept of calculation of intrinsic values in MS-Excel.

Introduction

Simulation plays a pivotal role in disaster preparedness and response. Emergency services and disaster management agencies use simulations to replicate crisis situations and test response strategies. By simulating various scenarios, such as natural disasters or terrorist attacks, these agencies can refine their protocols and enhance their readiness to mitigate potential threats. Optimization is fundamental in the realm of supply chain management. Businesses use optimization techniques to streamline the allocation of resources, minimize transportation costs, and maximize the efficiency of their supply chains. By optimizing routes, inventory levels, and production schedules, companies can achieve significant cost savings and improved customer service.

14.1   Monte Carlo Simulations

Monte Carlo simulation is a computerized mathematical technique to generate random sample data based on some known distribution for numerical experiments. This method is applied to risk quantitative analysis and decision making problems. This method is used by the professionals of various profiles such as finance, project management, energy, manufacturing, engineering, research & development, insurance, oil & gas, transportation, etc.

This method was first used by scientists working on the atom bomb in 1940. This method can be used in those situations where we need to make an estimate and uncertain decisions such as weather forecast predictions.

Monte Carlo Simulation ─ Important Characteristics

Following are the three important characteristics of Monte-Carlo method −

- Its output must generate random samples.

- Its input distribution must be known.

- Its result must be known while performing an experiment.

Monte Carlo Simulation ─ Advantages

- Easy to implement.

- Provides statistical sampling for numerical experiments using the computer.

- Provides approximate solution to mathematical problems.

- Can be used for both stochastic and deterministic problems.

Monte Carlo Simulation ─ Disadvantages

- Time consuming as there is a need to generate large number of sampling to get the desired output.

- The results of this method are only the approximation of true values, not the exact.

Monte Carlo Simulation Method ─ Flow Diagram

The following illustration shows a generalized flowchart of Monte Carlo simulation.
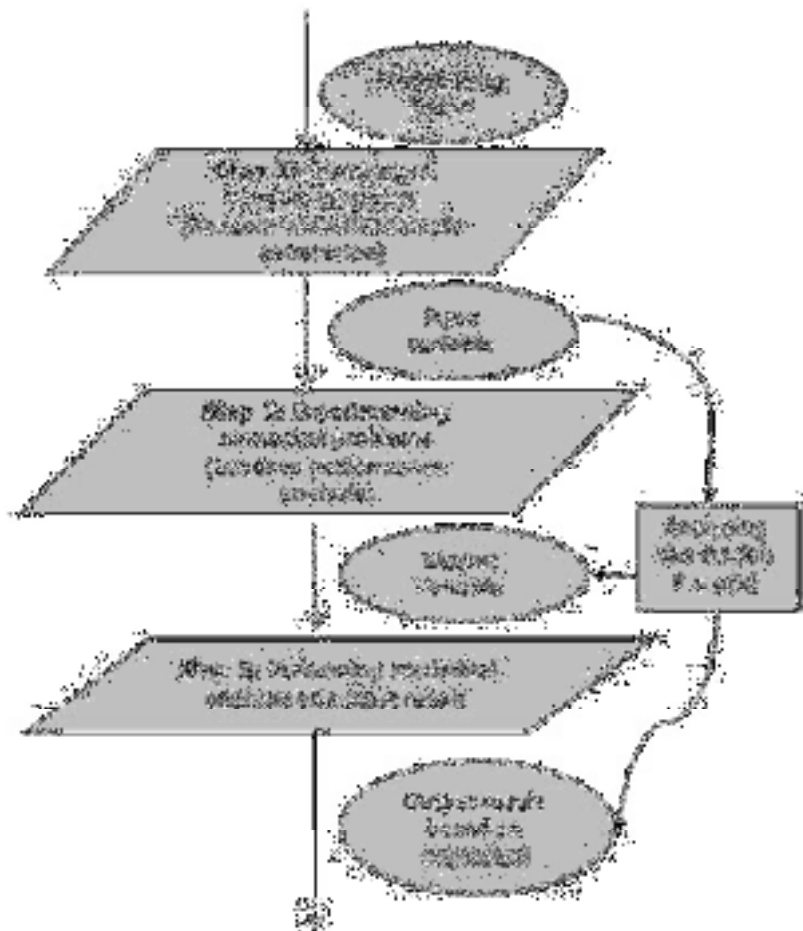
14.2 The Monte Carlo Simulation Formula

Distribution Curves

There are various distribution curves you can use to set up your Monte Carlo simulation. And these curves may be interchanged based on the variable. Microsoft doesn't have a formula called "Do Monte Carlo Simulation" in the menu bar ☐

Uniform Distribution

In a uniform distribution, there is equal likelihood anywhere between the minimum and a maximum. A uniform distribution looks like a rectangle.

Normal (Gaussian) Distribution

This is also your standard bell shaped curve. This Monte Carlo Simulation Formula is characterized by being evenly distributed on each side (median and mean is the same – and no skewness). The tails of the curve go on to infinity. So this may not be the ideal curve for house prices, where a few top end houses increase the average (mean) well above the median, or in instances where there is a hard minimum or maximum. An example of this may be the minimum wage in your locale. Please note that the name of the function varies depending on your version.

Lognormal Distribution

A distribution where the logarithm is normally distributed with the mean and standard deviation. So the setup is similar to the normal distribution, but please note that the mean and standard_dev variables are meant to represent the logarithm.

Poisson Distribution

This is likely the most underutilized distribution. By default, many people use a normal distribution curve when Poisson is a better fit for their models. Poisson is best described when there is a large distribution near the very beginning that quickly dissipates to a long tail on one

side. An example of this would be a call center, where no calls are answered before second ZERO. Followed by the majority of calls answered in the first 2 intervals (say 30 and 60 seconds) with a quick drop off in volume and a long tail, with very few calls answered in 20 minutes (allegedly).
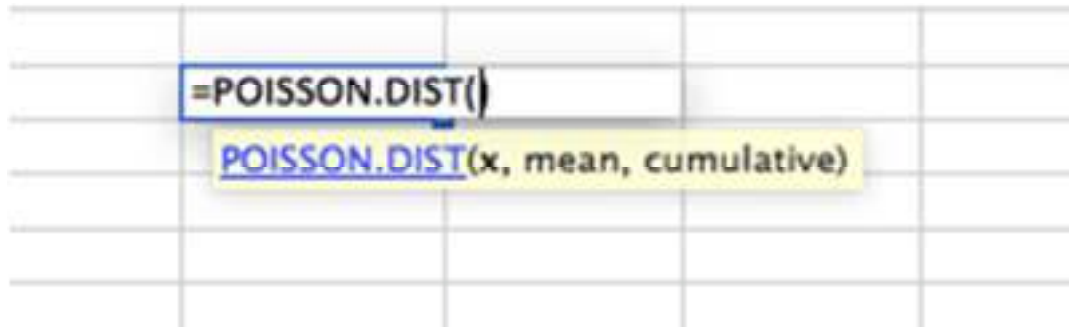
The purpose here is not to show you every distribution possible in Excel, as that is outside the scope of this article. Rather to ensure that you know that there are many options available for your Monte Carlo Simulation. Do not fall into the trap of assuming that a normal distribution curve is the right fit for all your data modeling. To find more curves, to go the Statistical Functions within your Excel workbook and investigate. If you have questions, pose them in the comments section below.

Building The Model

For this set up we will assume a normal distribution and 1,000 iterations.

<u>Input Variables</u>

The setup assumes a normal distribution. A normal distribution requires three variables; probability, mean and standard deviation. We will tackle the mean and standard deviation in our first step. I assume a finance forecasting problem that consists of Revenue, Variable and Fixed Expenses. Where Revenue minus Variable Expenses minus Fixed Expenses equals Profit. The Fixed expenses are sunk cost in plant and equipment, so no distribution curve is assumed. Distribution curves are assumed for Revenue and Variable Expenses.

	A	B	C	D	E	F	
1							
2			Revenue	Variable Expense	Fixed Expense	Profit	
3		Forecast	5,000,000	3,000,000	1,000,000	1,000,000	
4		St Dev	500,000	300,000			
5							

<u>First Simulation</u>

The example below indicates the settings for Revenue. The formula can be copy and pasted to cell D6 for variable expenses. For Revenue and expenses we you the function NORM.INV() where the parameters are:

Probability = the function RAND() to elicit a random number based on the other criteria within the distribution.

Mean = The mean used in the Step 1. For Revenue it is C3.

Standard Deviation = The Standard Deviation used in Step 1. For Revenue it is C4

Since RAND() is used as the probability, a random probability is generated at refresh. We will use this to our advantage in the next step.

1,000 Simulations

There are several ways to do 1,000 or more variations. The simplest option is to take the formula from step #2 and make it absolute. Then copy and paste 1,000 times. That's simple, but not very fancy. And if Ferris Bueller can save the world by showing a new Tic Tac Toe game to a computer, then we can spice up this analysis as well. Let's venture into the world of tables.

First we want to create an outline for a table. We do this by listing the numbers 1 to 1,000 in rows. In the example image below, the number list starts in B12.

in the next column, in cell C12, we will reference the first iteration.

Next highlight the area where we want to house the 1,000 iterations

Select Data > Data Tables

For Column input cell: Select a blank cell. In the download file, cell D11 is selected

Select OK

Spreadsheet Modelling (Using Excel)
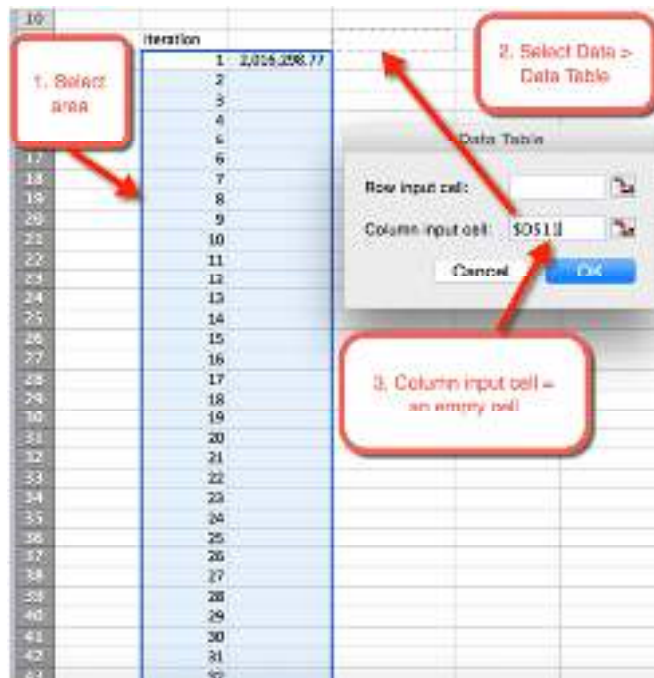
Once OK is selected from the previous step, a table is inserted that autopopulates the 1,000 simulations

14.3 Summary Statistics

Once the simulations are run, it is time to gather summary statistics. This can be done a number of ways. In this example I used the COUNTIF() function to determine the percentage of simulations that are unprofitable, and the likelihood of a profit greater than $1 Million. As expected, the likelihood of greater than $1M hovers around 50%. This is because we used normal distribution curves that are evenly distributed around the mean, which was $1M. The likelihood of losing money is 4.8%. This was gathered by using the COUNTIF() function to count the simulations that were less than zero, and dividing by the 1,000 total iterations.

14.4 Introduction to Solver

A solver is a mathematical tool present in MS-Excel that is used to perform calculations by working under some constraints/conditions and then calculates the solution for the problem. It works on the objective cell by changing the variable cells any by using sum constraints.

Solver is present in MS- Excel but for using it we need to activate it. For activating the solver tool we need to do the following steps:
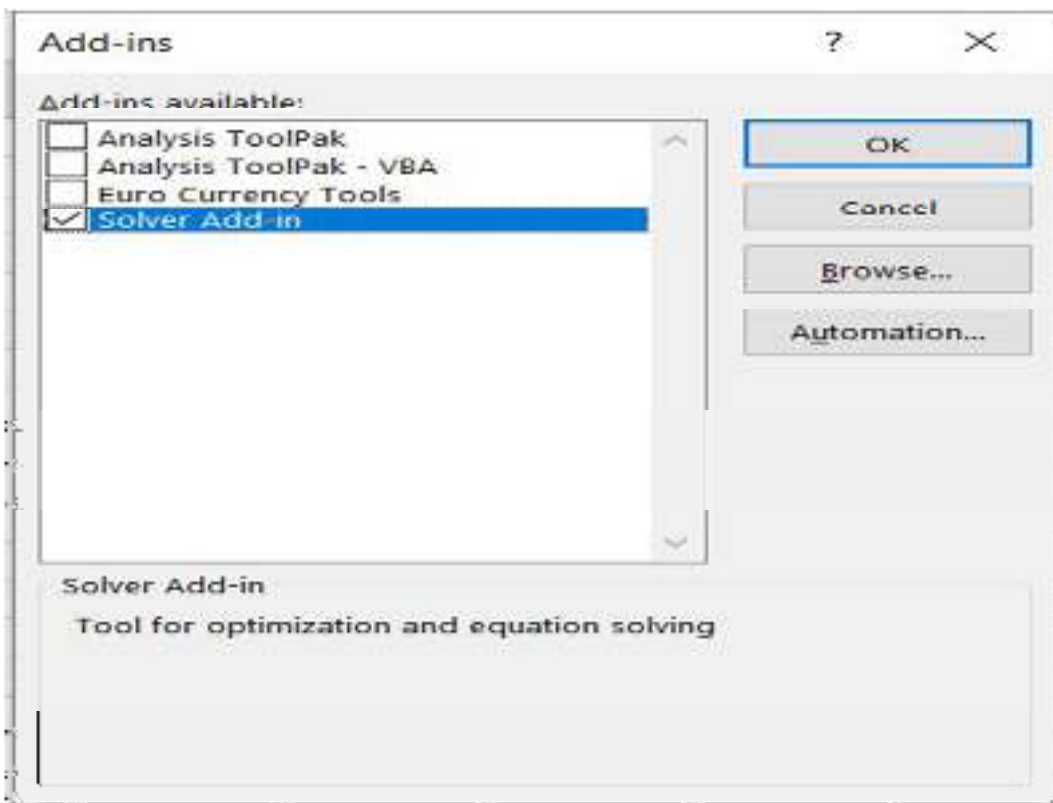
Step 1: Go to **File** and select **options**. The following dialog box will appear.
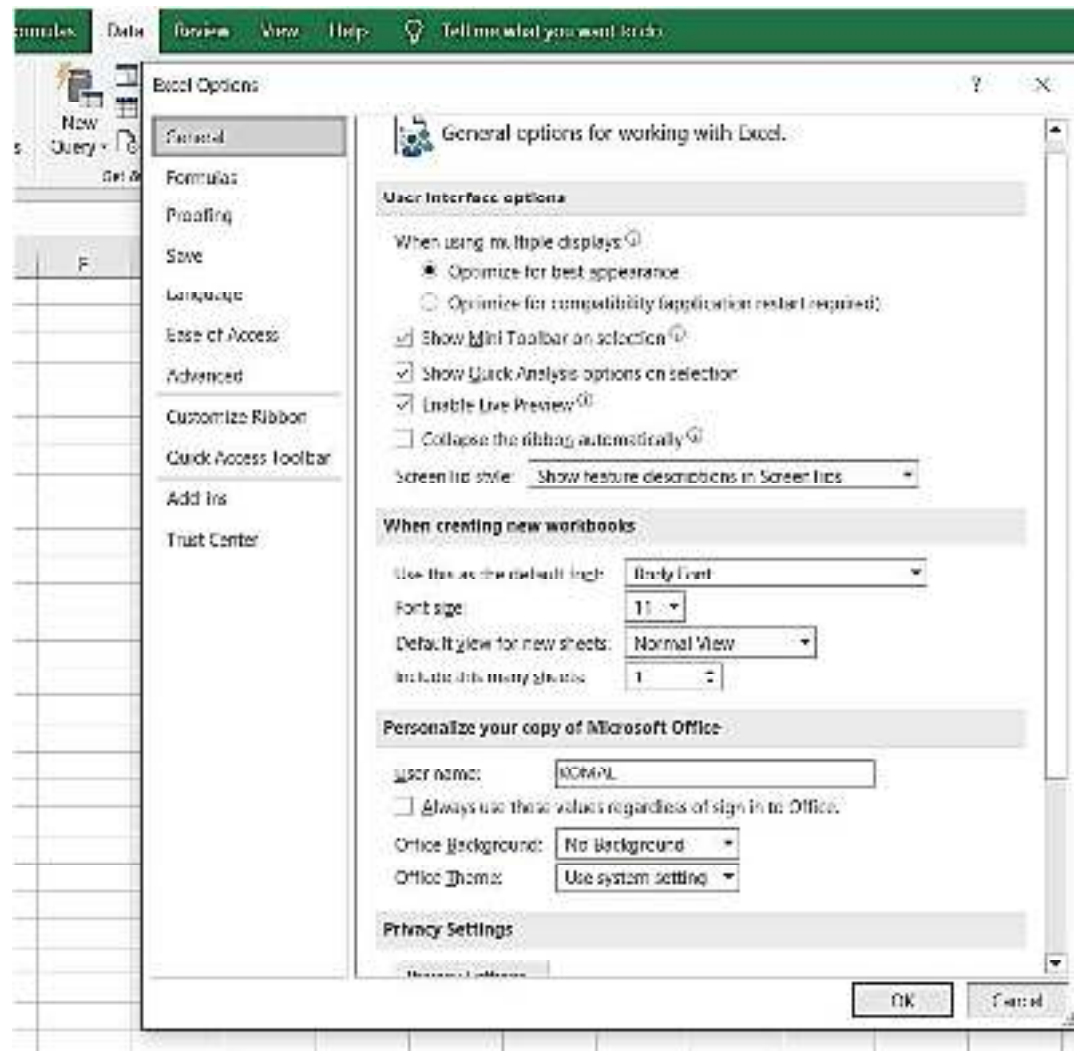
Step 2: Now select the **Add-ins** option and click on **Go** and finally click on **OK**.
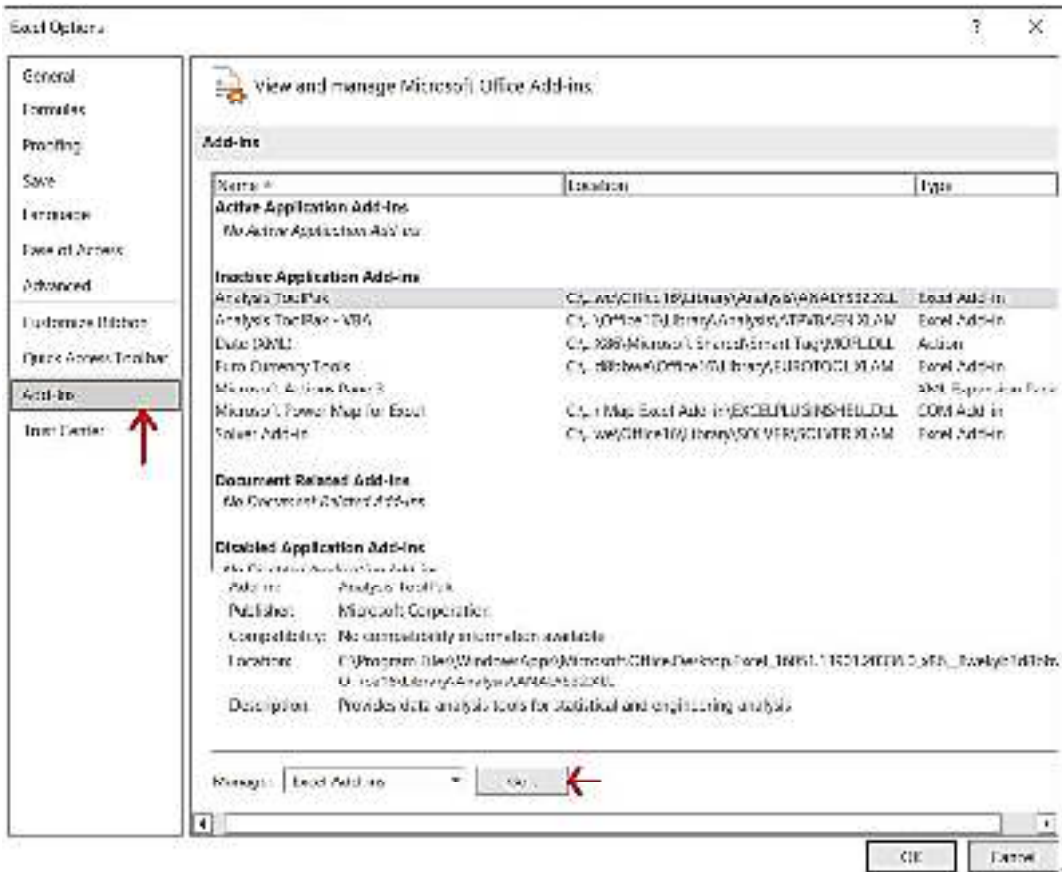
Step 3: After clicking OK, Select **Solver Add-in** and press **OK**. Now solver will be activated in Excel.

Step 4: Now solver will appear in **data section** like this.

Spreadsheet Modelling (Using Excel)

Now let's understand how to use solver with the help of an example.

Example:

We went to a mall and we also have a gift voucher worth rs.10,000 and We want to purchase items in such a manner that all the money of the gift voucher gets utilized.

So, suppose we purchased the following items.

	A	B	C	D	E
1	Items	Quantity	Price	Total	
2	Iron	1	700	700	
3	Mobile	1	5000	5000	
4	Headphones	1	400	400	
5	kettle	1	900	900	
6	watch	1	2300	2300	
7		5		9300	
8					
9					
10					
11		Voucher=	10000		
12					
13					

Suppose we purchased the above items in only one quantity and the total came out to be 9300 but the voucher was for rs.10,000. So now we want to use Solver for this purpose. Now let's see how it will be done.

Step 1: Firstly go on data and find solver there and click it. The following dialog box will appear. Now in this, we have to select the objective in which we want to change our value.

Step 2: In the set objective we have to select the total of the D column because want the value to change from 9300 to 10,000. After clicking on D7 following thing will be displayed on the set objective block.

Spreadsheet Modelling (Using Excel)

Step 3: Now in the 'By changing Variable cell' we will select the Quantity cell because we want to change the quantity in such a way so that the total amount comes to 10,000.
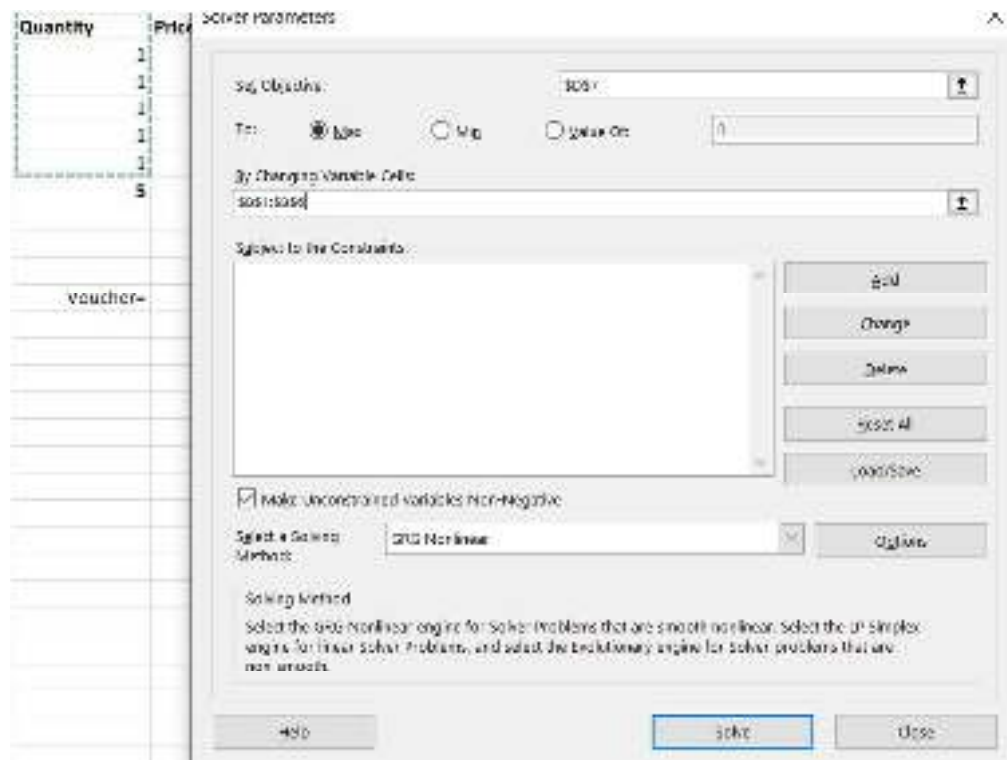
Step 4: Now we have to set some conditions under which we want our work to get done. So for setting some conditions /constraints, we will click on Add.
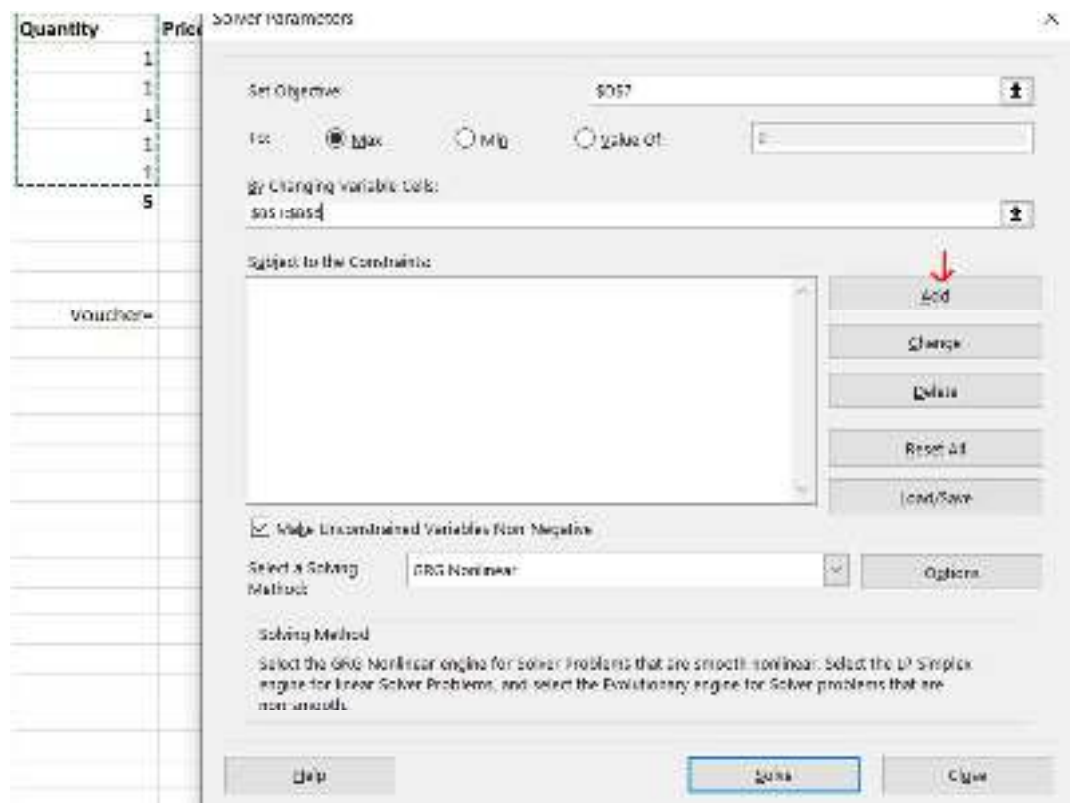
Step 5– Now, a dialog box will appear and we will add 3 conditions. The first condition is that the total amount should be equal to the voucher amount. So we will select cell D7 in a cell reference and then = sign, and finally, we will select cell C11. Now the first condition is added. To add the next condition press Add.

Step 6: For the second condition we will select the Quantity cell because we want the quantity to be an integer value, a whole value. So in cell reference, we will select from B2 to B6 then **int**, and then again will press Add.

Step 7- Now for the third condition, we want that our item quantity should never be un negative which is not possible in real life. So we will select cells from B2 to B6 and should be >= to zero. Then click Add and cancel.

Step 8: Now the following dialog box will show all the 3 conditions that we used and now click on Solve.

Step 9: By clicking Solve the solver will provide the desired output and to keep the answer we will click on keep solver solution.

So, this is what a solver is, How it is activated by not by default present in Excel and this is how it is used.

14.5 Linear Programming for Optimization

Linear Programming is the most important and fascinating aspect of applied mathematics, which helps in resource optimization (either minimizing the losses or maximizing the profit with given resources). If we have constraints and the objective function well defined, we can use the system to

predict an optimal solution for a given problem. In Excel, we have Excel Solver, which helps us solving the Linear Programming Problems a.k.a. LPP. We will see in this article how to use Excel Solver to optimize the resources associated with business problems with the help of Linear Programming.

First thing first. Let's see how we can enable Excel Solver (a key component of LPP under Excel).

Methods to Solve Linear Programming through Excel Solver

Let's understand how to use Linear Programming through Excel Solver with some methods.

Method #1 – Enabling Solver under Microsoft Excel

In Microsoft Excel, we can find Solver under the Data tab, which can be found on the **Excel Ribbon** placed at the uppermost part, as shown below:
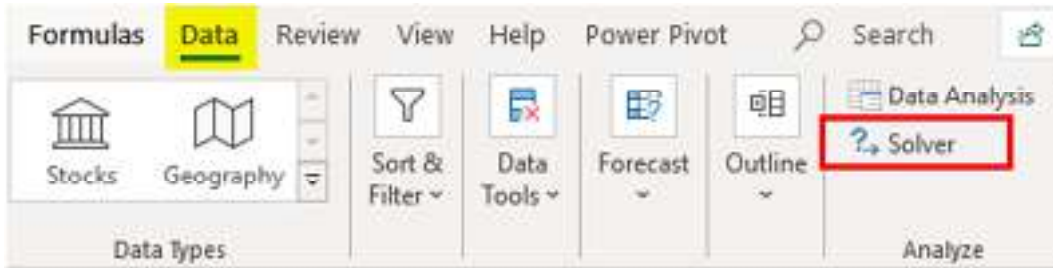
If You can't see this utility tool there, you must enable it through Excel Options. Follow the steps below to enable Solver under Excel.

Step 1: Navigate to the File menu and click on Options, the last thing on that list.
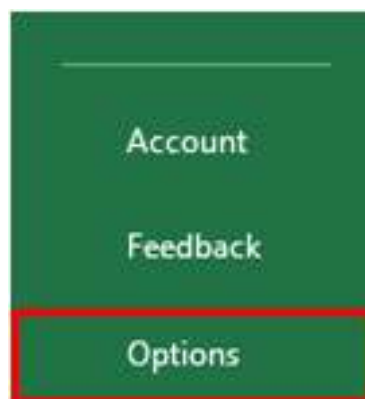
Step 2: A new window will pop up named Excel Options. Click on Add-ins from the list of options present on the left-hand side of the window.

Step 3: Under the Manage section at the bottom of the window, select Excel Add-ins from the dropdown list and click on the Go… button beside.

Step 4: As soon as you click the Go… button, you will see the list of all Add-ins available under Excel in a new window. Tick to select the Solver Add-in so that you can use it under the Data tab for solving the equations. Click the OK button after tick selecting the Solver Add-in.
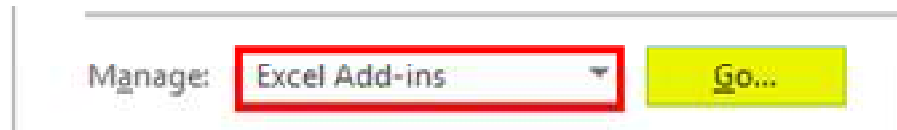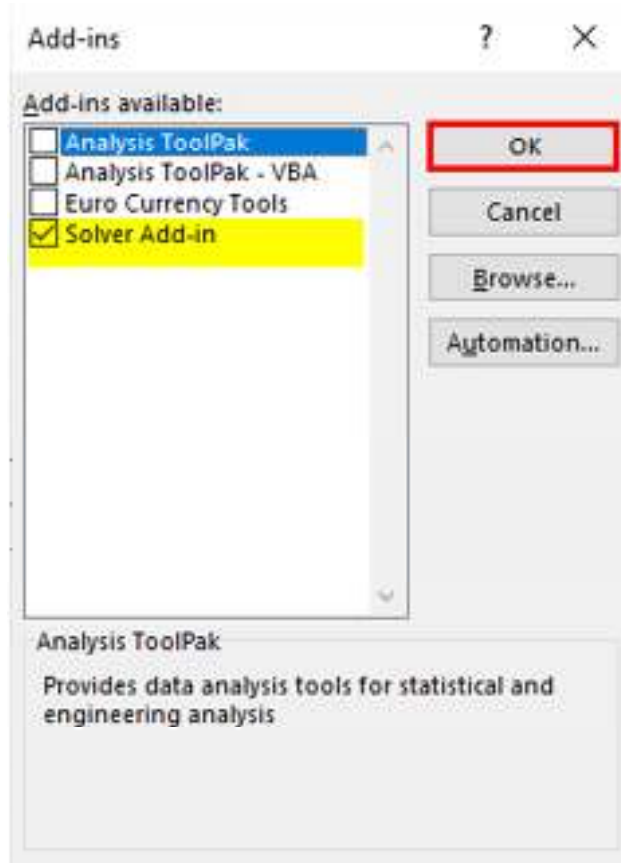

This way, you can enable the Excel Solver under Microsoft Excel.

Method #2 – Solving Linear Programming Problem using Excel Solver

Now, we will try to solve the linear programming problem using the Excel Solver tool.

Example: A chemical plant produces two products:: A. These two products need raw materials as shown below: Product A needs three types of raw materials – Material_1 20KG, Material_2 30KG, and Material_3 as 5 KG. Product B requires 10 kg of Material_1, 30 KG of Material_2, and 10 KG of Material_3 on similar lines. The manufacturer requires a minimum of 460 kg of Material_1, 960 kg of Material_2, and 220 kg of Material_3. If the per-unit cost for Product A is $30 and the cost of Product B is $35, how many products should the manufacturer blend to meet the minimum material requirements at the lowest cost possible? Let's use the information provided in this example for modeling the equations.

Step 1: We can see all the equation constraints we can form using the information in the example above.

$$\text{Minimize } 35X + 30Y \text{ Where,}$$
$$20X + 10Y \geq 460$$
$$30X + 30Y \geq 960$$
$$5X + 10Y \geq 220$$
$$X \geq 0, Y \geq 0$$

Step 2: Use these equations to add the constraints cell-wise under Excel across A2:C8 of the given sheet. See the screenshot below:

Step 3: We need to use the formula Quantity * Per Unit Cost and sum it up for both products to get the actual material requirements. This is formulated under column D for all cells containing constraints B3, B4, C3). Please see the attached screenshot below:

If you look closely at this formula, we have used B3 and C3 as fixed members for each formula across the different cells in column D. B3 and C3 are the cells denoting quantities for Product A and Product B, respectively. The quantities will appear once we solve these equations using an Excel solver.

Step 4: Click on the Data tab and then on Solver, which is present under Analyze section in the tab.

Step 5: Once you click on Solver, a new tab named "Solver Parameter" will open up, under which you need to set the parameters for this set of equations to be solved.
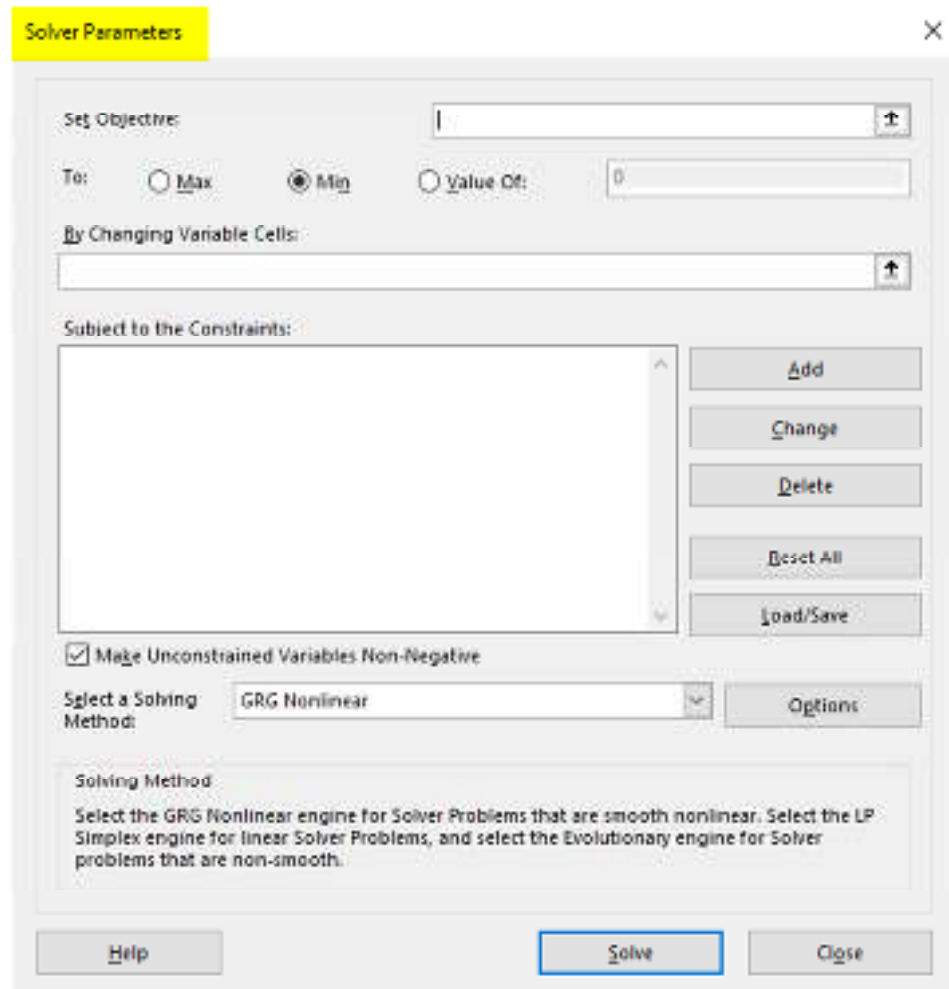
Step 6: The first thing we need to identify is Set Objective: Since our objective is to figure out the total cost involved to minimize it, set this to D4.

Step 7: Since we need to minimize the cost with the highest production possible, set the next parameter as Mi<u>n</u>. You can get this done by clicking on the Min radio button.

Step 8: under By Changing Variable Cells: we need to mention B3 and C3 since these cells will contain Quantities for Product A and Product B, respectively, after the problem gets solved.

Step 9: Now add the constraints. Click on <u>A</u>dd button under the S<u>u</u>bject to the Constraints: section, and it will open up a new window to add constraints. Under that window – B3:C3 as Cell Reference, >= and 0 as Constraints. This we are doing since the basic constraint in any LPP is that X and Y should be greater than zero.

Step 10: Click again on the Add button, and this time use B3:C3 as Cell Reference and F6:F8 as Constraints with inequality as >=. Click the OK button to add this constraint as well under the solver.

Solver now has all the parameters required to solve this set of linear equations, and it looks as below:

Spreadsheet Modelling (Using Excel)

Step 11: Now, click the Solve button at the bottom of the window to solve this linear equation and find the optimal solution.

As soon as we click on the solve button, the system starts searching for an optimal solution for the problem we have provided. We get the values for B3, and C3, using which we also get the values under column F for F4, F6:F8, which are the optimal costs and material values that can be used for Product A and Product B.

	A	B	C	D	E	F
1						
2		Product A	Product B			
3		14	18			
4	Per Unit Cost	35	30	1030		
5						
6	Material 1	20	10	460	>=	460
7	Material 2	30	30	960	>=	960
8	Material 3	5	10	250	>=	220
9						

This solution informs us that if we need to minimize the cost of Production for Product A and Product B with optimal usage of Material_1, Material_2, and Material_3, we should produce 14 quantities of Product A and 18 Quantities of Product B.

14.6 Intrinsic Value Calculation Models

What is an Intrinsic Value Formula?

The formula for Intrinsic value represents the net present value of all the **future free cash flows to equity (FCFE)** of a company during the entire course. It reflects the actual worth of the business underlying the stock, i.e., the amount of money that can receive if the whole business and all of its assets are sold off today.

Intrinsic Value Formula

The intrinsic value formula for business and stock is represented as follows –

#1 – Intrinsic Value Formula of a Business

Mathematically, the intrinsic value formula of a business can be represented as,

$$\text{Intrinsic Value}_{\text{Business}} = \frac{FCFE_1}{(1+r)^1} + \frac{FCFE_2}{(1+r)^2} + \cdots + \frac{FCFE_n}{(1+r)^n} + \frac{\text{Terminal Value}}{(1+r)^n}$$

- where $FCFE_i$ = Free cash flow to equity in the ith year

- $FCFE_i$ = Net income $_i$ + Depreciation & Amortisation $_i$ – Increase in Working Capital $_i$ – Increase in Capital Expenditure $_i$ – Debt Repayment on existing debt $_i$ + Fresh Debt raised $_i$

- r = Discount rate

- n = Last projected year

Intrinsic Value Formula

$$\text{Intrinsic Value of Business} = \frac{FCFE_1}{(1+r)^1} + \frac{FCFE_2}{(1+r)^2} + \cdots + \frac{FCFE_n}{(1+r)^n} + \frac{\text{Terminal Value}}{(1+r)^n}$$

$$\text{Intrinsic Value of Stock} = \frac{\text{Intrinsic Value Business}}{\text{No. of Outstanding Shares}}$$

Spreadsheet Modelling (Using Excel)

#2 – Intrinsic Value Formula of a Stock

The calculation of the intrinsic value formula of the stock is done by dividing the value of the business by the number of **outstanding shares of the company** in the market. The value of stock derived in this way is then compared with the **market price** to check if the stock is trading above / at par / below its intrinsic value

Intrinsic Value Formula $_{Stock}$ **= Intrinsic Value** $_{Business}$ **/ No. of outstanding shares**

Explanation of the Intrinsic Value Formula

The calculation of the formula of the intrinsic value of a stock can be done by using the following steps:

1. Firstly, determine the future FCFE for all the projected years based on the available financial plan. The projected FCFEs can be computed by taking the latest FCFE and multiply it with the expected growth rate.

2. Now, the discount rate is determined based on the current market return from an investment with a similar risk profile. The discount rate is denoted by r.

3. Now, calculate the PV of all the FCF by discounting them using the discount rate.

4. Now, add up the PV of all the FCF calculated in step 3.

$$\frac{FCFE_1}{(1+r)^1} + \frac{FCFE_2}{(1+r)^2} + \dots + \frac{FCFE_n}{(1+r)^n}$$

5. Next, the terminal value is computed by multiplying the FCFE of the last projected year by a factor in the range of 10 to 20 (required rate of return). The terminal value represents the value of the business beyond the projected period until the business is shut down.

$$\text{Terminal value} = FCFE_n * Factor$$

6. To arrive at the value for the entire business, add up the value of step 4 and the discounted value of step 5 along with any cash cash equivalents (if available).

7. Finally, the intrinsic value per share can be derived by dividing the value in step 6 by the number of shares outstanding of the company.

Let us take an example of a company XYZ Limited which is currently trading in the stock market at $40 per share with 60 million shares outstanding. An analyst intends to predict the stock's intrinsic value based on the available market information. The prevailing required rate of return expected by the investors in the market is 5%. On the other hand, the company's free cash flow is expected to grow at 8%.

The following financial estimates are available for CY19 based on which the projections have to be made:

All Amount in Millions	CY19 (E)
Net Profit After Tax	$200.00
Depreciation &	$15.00

All Amount in Millions	CY19 (E)
Amortisation	
Increase in Working Capital	$20.00
Capital Expenditure	$150.00
Debt Repayment on Existing Debt	$50.00
Fresh Debt Raised	$100.00
Required Rate of Return	5.00%
FCFE Growth Rate	8.00%

So, from the above-given data, we will first calculate the FCFE for CY19.

Spreadsheet Modelling (Using Excel)

FCFE $_{CY19}$ (in millions) = Net income + Depreciation & Amortisation – Increase in Working Capital – Increase in Capital Expenditure – Debt Repayment on existing debt + Fresh Debt raised

- FCFE $_{CY19}$ (in millions) = $200.00 + $15.00 – $20.00 – $150.00 – $50.00 + $100.00

- = $95.00

Now, using this FCFE of CY19 and FCFE growth rate we will calculate the Projected FCFE for CY20 TO CY23.

Projected FCFE of CY20

- Projected FCFE $_{CY20}$ = $95.00 Mn * (1 + 8%) = $102.60 Mn

Projected FCFE of CY21

- Projected FCFE $_{CY21}$ = \$95.00 Mn * (1 + 8%)^2 = \$110.81 Mn

Projected FCFE of CY22

- Projected FCFE $_{CY22}$ = \$95.00 Mn * (1 + 8%)^3 = \$119.67 Mn

Projected FCFE of CY23

- Projected FCFE $_{CY23}$ = \$95.00 Mn * (1 + 8%)^4 = \$129.25 Mn

Now we will **calculate the Terminal Value**.

- **Terminal value** = FCFE $_{CY23}$ * (1 / Required rate of return)

- = \$129.25 Mn * (1 / 5%)

- = \$2,584.93 Mn

Therefore, the calculation of Intrinsic value for the company will be as follows –

Calculation of Intrinsic Value for the Company

- Value of the company = $2,504.34 Mn

After this, we will do the calculation of Intrinsic value per share, which is as follows –

Calculation of Intrinsic value per share

- Intrinsic value formula = Value of the company / No. of outstanding shares

- = $2,504.34 Mn / 60 Mn

- = $41.74

Therefore, the stock is trading below its fair value, and as such, it is advisable to purchase the stock at present as it is likely to increase in the future to attain the fair value.

Summary

- Monte Carlo simulations are a computational technique used for modeling and analyzing complex systems through random sampling.

- They are named after the Monte Carlo Casino in Monaco, known for its games of chance, as they rely on random sampling.

- Monte Carlo simulations involve repeated random sampling of input variables to estimate a range of possible outcomes.

- These simulations are used in various fields, including finance, engineering, and science, to assess risk and make informed decisions.

- In Excel, Monte Carlo simulations can be performed using random number generation and data tables.

- You input parameters, create random scenarios, and analyze the results to gain insights into the system's behavior.

- Monte Carlo simulations help in understanding the probability distribution of outcomes and can be valuable for decision-making under uncertainty.

- They are particularly useful for evaluating complex models where analytical solutions are not readily available.

- Sensitivity analysis can be performed to assess how changes in input parameters affect the output.

- Monte Carlo simulations provide a powerful tool for risk assessment, optimization, and decision support in Excel.

- Solver is an Excel add-in tool used for optimization and solving linear and nonlinear programming problems.
- It can be accessed in Excel by enabling the Solver add-in from the Add-Ins menu.
- Solver helps find the optimal values of decision variables that maximize or minimize a defined objective function.
- Decision variables are subject to constraints, such as budget limitations or resource availability.
- Solver uses mathematical optimization techniques to search for the best solution, such as the Simplex method.
- It is commonly used in business and finance for tasks like portfolio optimization and production planning.
- Solver allows users to specify constraints, bounds on variables, and target goals.
- It iteratively adjusts variables to find the optimal solution while respecting constraints.
- Users can choose between linear and nonlinear solving methods based on the problem type.
- Solver is a powerful tool for solving complex optimization problems in Excel, aiding in decision-making and resource allocation.
- Linear programming (LP) is a mathematical technique used for optimizing linear objective functions subject to linear constraints.
- Excel's Solver tool can be used to perform linear programming optimization.
- In LP, decision variables are defined, and an objective function is formulated to maximize or minimize.
- Constraints are established, representing limitations on the decision variables, such as resource availability or budget constraints.
- Excel's Solver can handle both maximization and minimization problems.
- LP is commonly used in supply chain management, production planning, and transportation optimization.
- It provides an efficient way to allocate resources to maximize profits or minimize costs.
- Excel's Solver uses the Simplex algorithm to find the optimal solution to LP problems.
- Sensitivity analysis can be conducted to assess the impact of changes in coefficients or constraints on the optimal solution.
- Linear programming in Excel is a valuable tool for optimizing decision-making processes in various industries.
- Intrinsic value is a financial concept that represents the true or fair value of an asset or investment.
- It is often used in stock valuation to determine whether a stock is overvalued or undervalued.
- In Excel, intrinsic values for stocks can be calculated using various models, such as the discounted cash flow (DCF) method.
- The DCF method involves estimating future cash flows and discounting them to present value using a chosen discount rate.
- Other models, like the Gordon Growth Model for dividends, can also be used for intrinsic value calculations.
- Users input key parameters like cash flows, growth rates, and discount rates into Excel.
- Excel functions like NPV (Net Present Value) and FV (Future Value) can be used for these calculations.

- Intrinsic value calculations are essential for making informed investment decisions by comparing them to the current market price.

- Different investors may use different models and assumptions, leading to varying intrinsic value estimates.

- Excel is a versatile tool for performing these calculations, enabling investors to analyze and evaluate potential investments.

Keywords

- **Random Sampling:** The process of selecting data points or values randomly from a distribution to simulate uncertainty.

- **Stochastic:** Involving randomness or probability in modeling and analysis.

- **Simulation:** The imitation of a real-world process or system using a computer model to understand its behavior.

- **Risk Assessment:** The evaluation of potential risks and uncertainties associated with a decision or scenario.

- **Probability Distribution:** A mathematical function that describes the likelihood of various outcomes in a random event.

- **Sensitivity Analysis:** The examination of how changes in input parameters impact the outcomes of a simulation.

- **Convergence:** The process by which a Monte Carlo simulation approaches stable and reliable results with increasing iterations.

- **Objective Function:** A mathematical function that represents the goal to be maximized or minimized in an optimization problem.

- **Decision Variables:** The variables in an optimization problem that can be adjusted to achieve the desired objective.

- **Decision Support:** The use of data and analysis to assist in making informed decisions.

- **Optimization:** The process of finding the best solution among a set of possible alternatives.

- **Linear Programming:** A mathematical method for solving optimization problems with linear objective functions and constraints.

- **Add-in:** A software component that enhances the functionality of a program when installed.

- **Objective Function:** A mathematical expression that quantifies the goal to be achieved in an optimization problem.

- **Constraints:** Limitations or restrictions that must be satisfied in an optimization problem.

- **Simplex Method:** An algorithm used in linear programming to find the optimal solution by iteratively adjusting variables.

- **Resource Allocation:** The distribution of limited resources among various competing demands or projects.

- **Sensitivity Analysis:** The examination of how changes in coefficients or constraints affect the optimal solution.

- **Decision Variables:** The variables that represent the choices to be made in an optimization problem.

- **Feasible Solution:** A solution that meets all constraints and is within the feasible region of the problem.

- **Intrinsic Value:** The true or fair value of an asset, often used in financial analysis to assess investment opportunities.

- **Discounted Cash Flow (DCF):** A method of estimating the present value of future cash flows by applying a discount rate.

- **Valuation:** The process of determining the worth or value of an asset or investment.

- **Future Value:** The projected value of an investment at a specified point in the future.

- **Net Present Value (NPV):** The difference between the present value of cash inflows and outflows in a DCF analysis.

- **Gordon Growth Model:** A method for valuing stocks based on projected dividends and a constant growth rate.

- **Financial Modeling:** The construction of mathematical models to analyze and forecast financial data.

- **Discount Rate:** The rate used to discount future cash flows to their present value in DCF analysis.

- **Market Price:** The current price at which an asset or security is traded in the market.

- **Assumptions:** The factors, conditions, or variables used in financial modeling and intrinsic value calculations.

Self Assessment

1. Monte Carlo simulations are used primarily for:
A. Solving linear programming problems
B. Analyzing random data
C. Predicting future values with certainty
D. Drawing scatter plots

2. What is the main benefit of using Monte Carlo simulations?
A. Deterministic results
B. Handling complex models with ease
C. Reducing computational time
D. Eliminating randomness

3. In Monte Carlo simulations, what is "random sampling"?
A. A technique for generating random numbers
B. The process of selecting data points randomly from a distribution
C. Eliminating uncertainty from simulations
D. A deterministic approach to modeling

4. Sensitivity analysis in Monte Carlo simulations helps in understanding:
A. The impact of changes in input parameters on the output
B. How to eliminate randomness
C. Deterministic outcomes
D. Probability distributions

5. What type of problems are Monte Carlo simulations particularly useful for?
A. Linear programming

    B. Analyzing deterministic systems

    C. Solving algebraic equations

    D. Evaluating complex models under uncertainty

6. What is the primary purpose of the Solver tool in MS-Excel?

    A. Creating random data sets

    B. Performing Monte Carlo simulations

    C. Solving linear and nonlinear optimization problems

    D. Formatting spreadsheets

7. In linear programming, what are "decision variables"?

    A. Variables used for storing intermediate results

    B. Variables subject to optimization constraints

    C. Randomly generated numbers

    D. Constants with fixed values

8. Which algorithm is commonly used by Solver in MS-Excel for linear programming problems?

    A. Monte Carlo method

    B. Simplex method

    C. Genetic algorithm

    D. Gradient descent

9. What does the term "feasible solution" refer to in the context of linear programming?

    A. A solution that is easily attainable

    B. A solution that meets all constraints

    C. A solution with the highest objective value

    D. A random solution

10. Sensitivity analysis in Solver helps in understanding how changes in constraints affect:

    A. The number of decision variables

    B. The feasibility of the solution

    C. The optimal solution and its objective value

    D. The linear programming model itself

11. What does the term "intrinsic value" represent in financial analysis?

    A. The current market price of an asset

    B. The true or fair value of an investment

    C. The book value of a company

    D. The value of a stock's dividends

12. Intrinsic value calculations often involve which method to estimate future cash flows?

A. Discounted Cash Flow (DCF)

B. Monte Carlo simulations

C. Moving averages

D. Simplex method

13. What is the Net Present Value (NPV) used for in intrinsic value calculations?

A. Calculating future cash flows

B. Determining the current market price

C. Evaluating investment profitability

D. Estimating dividend growth rates

14. What role does the discount rate play in intrinsic value calculations?

A. It represents the stock's current price.

B. It is used to calculate future cash flows.

C. It measures the risk associated with the investment.

D. It determines the optimal solution in Solver.

15. The Gordon Growth Model is commonly used for estimating the intrinsic value of:

A. Real estate properties

B. Government bonds

C. Preferred stocks

D. Common stocks with consistent dividends

Answers for Self Assessment

1.	B	2.	B	3.	B	4.	A	5.	D
6.	C	7.	B	8.	B	9.	B	10.	C
11.	B	12.	A	13.	C	14.	C	15.	D

Review Questions

1. What is the primary objective of Monte Carlo simulations, and in which fields are they commonly applied?

2. Explain the concept of "random sampling" in Monte Carlo simulations and its significance in modeling.

3. How does sensitivity analysis help in the context of Monte Carlo simulations, and why is it important?

4. Give an example of a real-world problem or application where Monte Carlo simulations could be useful.

5. What is the primary purpose of the Solver tool in MS-Excel, and how does it work?

6. Define "decision variables" in the context of linear programming and explain their role in optimization problems.

7. What is the Simplex method, and how is it used by Solver in MS-Excel for solving linear programming problems?

8. What is meant by "feasible solutions" in linear programming, and why are they crucial in optimization?

9. What is the significance of intrinsic value in financial analysis, and how is it typically calculated?

10. Explain the Discounted Cash Flow (DCF) method and its role in estimating the intrinsic value of an investment.

Further Readings

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