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**B.A.ECONOMICS
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**Computer Applications in Economics
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COMPUTER APPLICATIONS IN ECONOMICS

UNIT	Contents
I	<p>Introduction to Computers</p> <p>Computer and Peripherals: Meaning, Types, Features and Limitations – Basic Components – Input and output Devices – Primary Memory and secondary storage – Computer software – Types – Malicious Software – Operating Systems: Functions and Types.</p>
II	<p>MS Office</p> <p>Windows Explorer – MS Word: Basic operations in word – Formatting – Text Creation of Tables and Volumes – MS Power point presentation – creating, opening and Saving Slideshow and Animations – MS Excel: Worksheet and Work Book – Opening and Formatting.</p>
III	<p>Data Processing</p> <p>Data processing Techniques using MS Excel: concept of Data – Record and File – Types of Data – Data Entry – File Handling and operations – Opening, Appending and Cascading – Closing and Attribute Controls – Data Storage and Retrieval.</p>
IV	<p>Introduction to MS Excel</p> <p>Calculation Operators: Arithmetic Operators – Comparison Operators Logical Operations – Excel Tool Bars – Formatting of Text, Tables and Graphs.</p>
V	<p>Application of MS Excel in Statistics and Economics</p> <p>Descriptive Statistics: Mean, Median, Mode and Standard Deviation Variance – Index Numbers and Growth Rates – Demand Function – Supply Function, Production Function and Consumption Function – Demand for and Supply of Money – Correlation – Regression.</p>

Text Books

1. Hem Chand Jain and H.N.Tiwari (2019), Computer Applications in Business, 5th Edition Taxmann Publication.
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Table of Content

Unit No	Title	Page No.
I	Introduction to Computers	1-33
II	MS Office	34-73
III	Data Processing	74-81
IV	Introduction to MS Excel	82-100
V	Application of MS Excel in Statistics and Economics	101-120

UNIT - I

INTRODUCTION TO COMPUTERS

1.1 Introduction

Computer is a machine that performs calculations and processes information with astonishing speed and precision. A computer can handle vast amounts of information and solve complicated problems. It can take thousands of individual pieces of data and turn them into more usable information – with blinding speed and almost unfailing accuracy. The most powerful computers can perform billions of calculations in a second. A computer is a programmable machine. Modern computers are electronic and digital. The actual machinery – wires, transistors, and circuits is called hardware; the instructions and data are called software. Computers have changed the way people work. Computers handle many tasks in business, education, manufacturing, transportation, and other fields.

1.2. Computer and Peripherals: Meaning

A computer is an electronic device that can receive a set of instruction, program and then carry out this program by performing calculations on numerical data or by manipulating other forms of information.

The two principal characteristics of a computer are:

- It responds to a specific set of instructions in a well-defined manner.
- It can execute a pre-recorded list of instruction (a program).

1.3. Types of computers

Computers come in many forms and sizes, with the capacity to perform a variety of applications and designed for use by either a single individual or by a large number of users. Once there were two basic types of computers, classified as analog and digital. At present, the categories of computers are more specialized forms of the digital computer: computers are generally classified on the basis of operational principle as:

- Analog computers
- Digital computers
- Hybrid computers

Modern computers are also classified based on the purpose and application as: 1. Special Purpose Computer. 2. General Purpose Computers.

The relation between analog, digital, special purpose and general purpose computers can be understood only if we know about each of them. All analog computers measure continuous types of data and use a physical quantity like electric current flow. A digital computer operates and represents data in terms of discrete numbers and process data using standard arithmetic operations. Special purpose computers are designed to solve specific problems. General purpose computers are designed to solve a large variety of problems.

1.3.1 Analog, Digital and Hybrid Computers

Analog Computers:

They represent numbers by a physical quantity, that is, they assign numeric values by physically measuring some actual property, such as the length of an object, an angle created by two lines, or the amount of voltage passing through a point in an electrical circuit. Analog computers derive all their data from some form of measurement. Though effective for some applications, this method of representing numbers is a limitation of the analog computer. The accuracy of the data used in an analog computer is a limitation of the analog computer. This accuracy of the data used in an analog computer is directly related to the precision of its measurements.

Digital Computers:

They represent data as numbers or separate units. Counting on your fingers is the simplest form of digital computer. Each finger represents one unit of the item being counted. Unlike the analog computer which is limited to the accuracy of the measurements made, the digital computer can accurately represent data using as many positions and numbers as necessary. Adding machines and pocket calculators are common examples of devices constructed on the principles of the digital computer. All future discussions will concentrate on digital computers. Digital computers work in highly specialised applications and in a wide range of general processing tasks.

Hybrid computers:

They combine the best features of analog and digital computers. They have the speed of analog computers and accuracy of digital computers. They

are usually used for special problems in which input data derived from measurements is converted into digits and processed by computers. Hybrid computers, for example, control national defense and passenger flight radar. It controls manufacturing and prepares production data on inventory and costs. The computer accepts data both from sensors within the production area and from conventional input/output (I/O) devices.

General Purpose and Special Purpose Computers

Computers are classified on the basis of purpose and application as:

1. Special Purpose Computer.
2. General Purpose Computers.

1. Special Purpose Computer:

They incorporate many features of general purpose computers but support highly specialized data processing tasks. They are designed to handle specific problems and are not applied to other computerized activities. For example, special purpose computers may be designed to process only numeric data or to completely control automated manufacturing processes. Special purpose computers are often used as training simulators. A simulator is a computer controlled device for training people under simulated, or artificially created, conditions. The computer creates test conditions the trainee must respond to, records and evaluates the response, and provides results to both trainee and supervisor.

2. General Purpose Computers:

They are versatile and process business data as readily as they process complex mathematical formulas. General purpose computers can store large amounts of data and the programs necessary to process them. Because they are so versatile, most business today use general purpose computers.

1.4. CLASSIFICATION OF COMPUTERS:

Computers can be classified by their size and power as micro computers, workstations, portable computers, minicomputers, mainframes and super computers.

- 1. Micro Computer: Micro computers are small, single user computer** based on a microprocessor. In addition to the microprocessor, these computers have a keyboard for entering data, a monitor for displaying

information, and a storage device for saving data. The micro computers are further classified as personal computers, workstations, portable computers, etc.

- 2. Mini Computer:** Minicomputer is a multi-user computer capable of supporting ten to hundreds of users simultaneously.
- 3. Main Frame Computer:** Mainframes are powerful multiuser computers capable of supporting many hundreds of users simultaneously. Mainframes are mainly used by insurance companies, banks, airline and railway reservation systems, etc.
- 4. Super Computer:** A super computer is an extremely fast computer that can perform hundreds of millions of instructions per second. Most supercomputers are used by government agencies. These machines are for applications requiring very large programs and huge amounts of data that must be processed quickly. Examples of such tasks are weather forecasting, oil exploration, weapons research, and large scale simulation. The difference between a super computer and a mainframe is that a supercomputer channels all its power into executing a few programs as fast as possible, whereas a mainframe used its powers to execute many programs concurrently.

1.5. FEATURES OF COMPUTER

All computers have certain common characteristics irrespective of their type and size. Computers are not just adding machines; they are capable of doing complex activities and operations. They can be programmed to do complex, tedious and monotonous tasks. Computers are what they are because of the following characteristics.

1. Speed

Executing mathematical calculation, a computer works faster and more accurately than human. Computers have the ability to process so many millions (1,000,000) of instructions per second. Computer operations are performed in micro and nano seconds. A computer is a time saving device. It performs several calculations and tasks in few seconds that we take hours

to solve. The speed of a computer is measure in terms of Gigahertz and Megahertz.

2. Diligence

A human cannot work for several hours without resting, yet a computer never tires. A computer can conduct millions of calculations per second with complete precision without stopping. A computer can consistently and accurately do millions of jobs or calculations. There is no weariness or lack of concentration. Its memory ability also places it ahead of humans.

3. Reliability

A computer is reliable. The output results never differ unless the input varies. The output is totally depend on the input. When an input is the same the output will also be the same. A computer produces consistent results for similar sets of data, if we provide the same set of input at any time we will get the same result.

4. Automation

The world is quickly moving toward AI (Artificial Intelligence)-based technology. A computer may conduct tasks automatically after instructions are programmed. By executing jobs automatically, this computer feature replaces thousands of workers. Automation in computing is often achieved by the use of a program, a script, or batch processing.

5. Versatility

Versatility refers to a capacity of computer. Computer perform different types of tasks with the same accuracy and efficiency. A computer can perform multiple tasks at the same time this is known as versatility. For example, while listening to music, we may develop our project using PowerPoint and WordPad, or we can design a website.

6. Memory

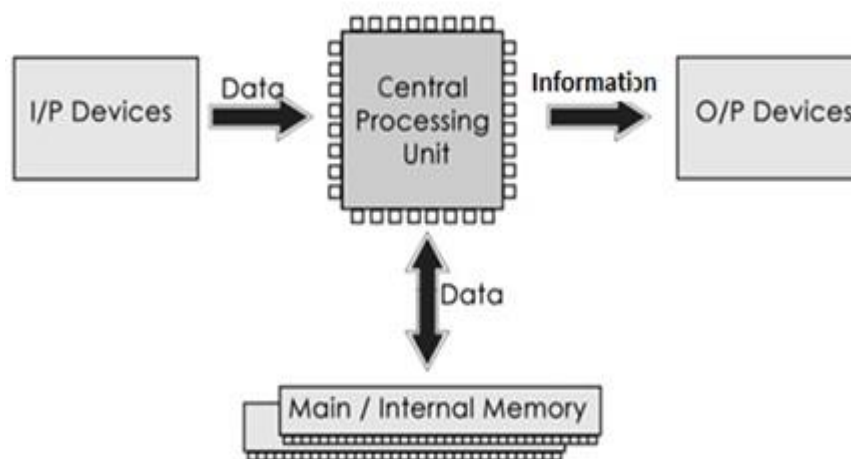
A computer can store millions of records. These records may be accessed with complete precision. Computer memory storage capacity is measured in Bytes, Kilobytes (KB), Megabytes (MB), Gigabytes (GB), and Terabytes (TB). A computer has built-in memory known as primary memory.

7. Accuracy

When a computer performs a computation or operation, the chances of errors occurring are low. Errors in a computer are caused by human's submitting incorrect data. A computer can do a variety of operations and calculations fast and accurately.

1.6. COMPONENTS OF COMPUTER

Computer systems consist of three components: Central Processing Unit, Input devices and Output devices. Input devices provide data to the processor (processing unit), which processes it and generates useful information that's displayed to the user through output devices. Output devices are used to show the processed data to the user on computer screen or in print form. Below figure depicts the major components of computer systems:



Components of Computer

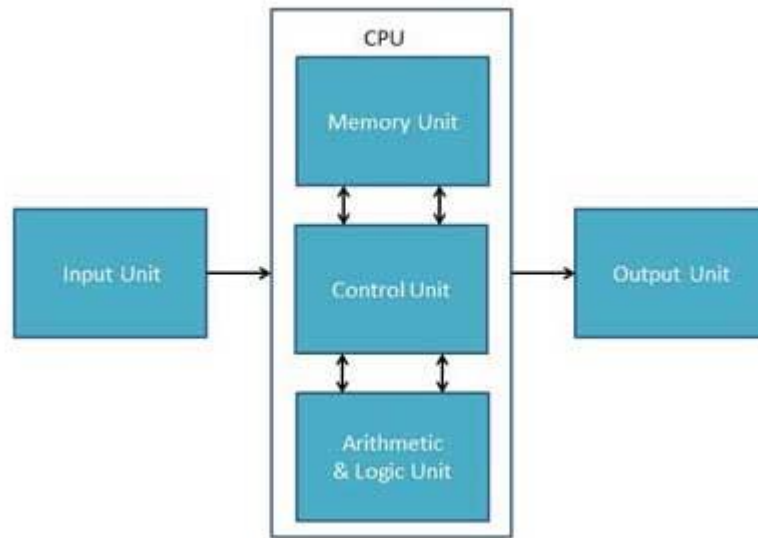
1. Central Processing Unit (CPU):

The Central Processing Unit or CPU is also known as the brain of the computer. CPU executes all types of data processing functions. It saves data/intermediate results/instructions (program) and controls the operation of all parts of the computer.

Following are the points to remember for Central Processing Unit (CPU):

- The CPU is taken as the brain of the computer.
- CPU facilitates all types of data processing operations.
- It saves data, intermediate results, and instructions (program).

- It handles the operating of all parts of the computer.



The CPU itself has the following three components.

- a. Memory or Storage Unit
- b. Control Unit
- c. ALU (Arithmetic Logic Unit)

a. Memory or Storage Unit

This part of the computer system works to store instructions, data, and intermediate results. This unit passes data to other parts of the computer when required. It is also referred to as an internal storage unit or most commonly, the main memory or the primary storage or Random Access Memory (RAM). It comes in various speeds, power, and capability. Primary memory and secondary memory are two important types of memories used in the computer system. Responsibilities of the memory unit are:

Works to store all the data and the instructions required for processing.

- Works to store intermediate results of processing.
- Works to store the final results of processing before these results are forwarded to an output device.
- All inputs and outputs are supplied through the main memory.

b. Control Unit

This unit manages the operations of all parts of the computer but does not carry out any calculations or comparisons or actual data processing operations. Responsibilities of this unit are:

- For facilitating the transfer of data and instructions among other units of a system.
- It manages and correlates all the units of the system.
- It receives the instructions from the memory, interprets them, and directs the operation of the system.
- It interacts with Input/output units to transfer data/results from storage.
- It does not perform processes or store data.

c. Arithmetic Logic Unit (ALU)

This unit consists of two subsections namely,

Arithmetic Section: The responsibility of the arithmetic unit is to execute arithmetic operations like addition, subtraction, multiplication, and division. A complete set of complex operations are executed by making iterative use of the above operations.

Logic Section: The responsibility of the logic unit is to execute logic operations like comparing, selecting, matching, and merging data.

2. Output Unit:

This part of the computer encapsulates devices with the help of which the user receives the information from the computer. Output devices transform the output from the computer into a form understandable by the users. Thus, output units generate the data formatted by the computer as per users' interests. Some of the output devices are; Monitor, Printer, projector, speakers, headphones, etc.

3. Input Unit:

This unit contains devices with the help of which we enter data into the computer. This unit creates a link between the user and the computer. The input devices translate the information into a form understandable by the computer.

1.7. Input and Output devices:

An input/output device, often known as an IO device, is any hardware that allows a human operator or other systems to interface with a computer. Input/output devices, as the name implies, are capable of delivering data (output) to and receiving data from a computer (input). An input/output (I/O) device is a piece of hardware that can take, output, or process data. It receives data as input and provides it to a computer, as well as sends computer data to storage media as a storage output.

1.7.1. Input Devices

Input devices are the devices that are used to send signals to the computer for performing tasks. The receiver at the end is the CPU (Central Processing Unit), which works to send signals to the output devices. Some of the classifications of Input devices are:

1. Keyboard Devices
2. Pointing Devices
3. Composite Devices
4. Game Controller
5. Visual Devices
6. Audio Input Devices

Some of the input devices are described below.

Keyboard devices:

The keyboard is the most frequent and widely used input device for entering data into a computer. Although there are some additional keys for performing other operations, the keyboard layout is similar to that of a typical typewriter. Generally, keyboards come in two sizes: 84 keys or 101/102 keys but currently keyboards with 104 keys or 108 keys are also available for Windows and the Internet.

Types of Keys

- **Numeric Keys:** It is used to enter numeric data or move the cursor. It usually consists of a set of 17 keys.
- **Typing Keys:** The letter keys (A-Z) and number keys (09) are among these keys.

- **Control Keys:** These keys control the pointer and the screen. There are four directional arrow keys on it. Home, End, Insert, Alternate (Alt), Delete, Control (Ctrl), etc., and Escape are all control keys (Esc).
- **Special Keys:** Enter, Shift, Caps Lock, Number Locks, Tab, etc., and Print Screen are among the special function keys on the keyboard.
- **Function Keys:** The 12 keys from F1 to F12 are on the topmost row of the keyboard.

Mouse

The most common pointing device is the mouse. The mouse is used to move a little cursor across the screen while clicking and dragging. The cursor will stop if you let go of the mouse. The computer is dependent on you to move the mouse; it won't move by itself. As a result, it's an input device. A mouse is an input device that lets you move the mouse on a flat surface to control the coordinates and movement of the on-screen cursor/pointer. The left mouse button can be used to select or move items, while the right mouse button when clicked displays extra menus.

Joystick

A joystick is a pointing device that is used to move the cursor on a computer screen. A spherical ball is attached to both the bottom and top ends of the stick. In a socket, the lower spherical ball slides. You can move the joystick in all four directions. The joystick's function is comparable to that of a mouse. It is primarily used in CAD (Computer-Aided Design) and playing video games on the computer.

Track Ball

Track Ball is an accessory for notebooks and laptops, which works on behalf of a mouse. It has a similar structure to a mouse. Its structure is like a half-inserted ball and we use fingers for cursor movement. Different shapes are used for this like balls, buttons, or squares.

Light Pen

A light pen is a type of pointing device that looks like a pen. It can be used to select a menu item or to draw on the monitor screen. A photocell and an optical system are enclosed in a tiny tube. When the tip of a light pen is

moved across a monitor screen while the pen button is pushed, the photocell sensor element identifies the screen location and provides a signal to the CPU.

Scanner

A scanner is an input device that functions similarly to a photocopier. It's employed when there's information on paper that needs to be transferred to the computer's hard disc for subsequent manipulation. The scanner collects images from the source and converts them to a digital format that may be saved on a disc. Before they are printed, these images can be modified.

Optical Mark Reader (OMR)

An Optical Mark Reader is a device that is generally used in educational institutions to check the answers to objective exams. It recognizes the marks present by pencil and pen.

Optical Character Reader (OCR)

OCR stands for optical character recognition, and it is a device that reads printed text. OCR optically scans the text, character by character turns it into a machine-readable code, and saves it to the system memory.

Magnetic Ink Card Reader (MICR)

It is a device that is generally used in banks to deal with the cheques given to the bank by the customer. It helps in reading the magnetic ink present in the code number and cheque number. This process is very fast compared to any other process.

Bar Code Reader

A bar code reader is a device that reads data that is bar-coded (data that is represented by light and dark lines). Bar-coded data is commonly used to mark things, number books, and so on. It could be a handheld scanner or part of a stationary scanner. A bar code reader scans a bar code image, converts it to an alphanumeric value, and then sends it to the computer to which it is connected.

Web Camera

Because a web camera records a video image of the scene in front of it, a webcam is an input device. It is either built inside the computer (for example, a laptop) or attached through a USB connection. A webcam is a

computer-connected tiny digital video camera. It's also known as a web camera because it can take images and record video. These cameras come with software that must be installed on the computer in order to broadcast video in real-time over the Internet. It can shoot images and HD videos, however, the video quality isn't as good as other cameras (In Mobiles or other devices or normal cameras).

Digitizer

Digitizer is a device that is used to convert analog signals to digital signals. It converts signals into numeric values. An example of a Digitizer is Graphic Tablet, which is used to convert graphics to binary data.

Microphone

The microphone works as an input device that receives input voice signals and also has the responsibility of converting it also to digital form. It is a very common device that is present in every device which is related to music.

1.7.2. Output Devices

Output Devices are the devices that show us the result after giving the input to a computer system. Output can be of many different forms like image, graphic audio, video, etc. Some of the output devices are described below.

Monitor

Monitors, also known as Visual Display Units (VDUs), are a computer's primary output device. It creates images by arranging small dots, known as pixels, in a rectangular pattern. The amount of pixels determines the image's sharpness.

The two kinds of viewing screens used for monitors are described below.

Cathode-Ray Tube (CRT) Monitor: Pixels are minuscule visual elements that make up a CRT display. The higher the image quality or resolution, the smaller the pixels.

Flat-Panel Display Monitor: In comparison to the CRT, a flat-panel display is a type of video display with less volume, weight, and power consumption. They can be hung on the wall or worn on the wrist.

Flat-panel displays are currently used in calculators, video games, monitors, laptop computers, and graphical displays.

Television

Television is one of the common output devices which is present in each and every house. It portrays video and audio files on the screen as the user handles the television. Nowadays, we are using plasma displays as compared to CRT screens which we used earlier.

1.7.3. Printers

Printers are output devices that allow you to print information on paper.

There are certain types of printers which are described below.

Impact Printers

Characters are printed on the ribbon, which is subsequently crushed against the paper, in impact printers. The following are the characteristics of impact printers:

- Exceptionally low consumable cost.
- Quite noisy
- Because of its low cost, it is ideal for large-scale printing.
- To create an image, there is physical contact with the paper.

Types of Impact Printer:

- Character Printers
- Line Printers
- Non-Impact Printers
- Laser Printers
- Inkjet Printers

Character Printers

Character Printer has the capability to print only one character at a time. It is of two types.

- Dot Matrix Printer
- Daisy Wheel

Line Printers

Line Printers are printers that have the capability to print one line at a time. It is of two types.

- Drum Printer
- Chain Printer

Non-Impact Printers

Characters are printed without the need for a ribbon in non-impact printers. Because these printers print a full page at a time, they're also known as Page Printers. The following are the characteristics of non-impact printers:

- Faster
- They don't make a lot of noise.
- Excellent quality
- Supports a variety of typefaces and character sizes

Laser Printers

Laser Printers use laser lights for producing dots which will produce characters on the page.

Inkjet Printers

Inkjet printers are printers that use spray technology for printing papers. High-quality papers are produced in an Inkjet printer. They also do color printing.

Speakers

Speakers are devices that produce sound after getting a command from a computer. Nowadays, speakers come with wireless technology also like Bluetooth speakers.

Projector

Projectors are optical devices that have the work to show visuals on both types of screens, stationary and moving both. It helps in displaying images on a big screen. Projectors are generally used in theatres, auditoriums, etc.

Plotter

Plotter is a device that helps in making graphics or other images to give a real view. A graphic card is mandatorily required to use these devices. These are the pen-like devices that help in generating exact designs on the computer.

Braille Reader

Braille Reader is a very important device that is used by blind users. It helps people with low vision or no vision to recognize the data by running their fingers over the device to understand easily. It is a very important device

for blind persons as it gives them the comfort to understand the letters, alphabets, etc which helps them in study.

Video Card

A video Card is a device that is fitted into the motherboard of the computer. It helps in improvising digital content in output devices. It is an important tool that helps people in using multiple devices.

Headphones

Headphones are just like a speaker, which is generally used by a single person or it is a single-person usable device and is not commonly used in large areas. These are also called headsets having a lower sound frequency.

1.8. PRIMARY MEMORY AND SECONDARY MEMORY

Memory is the main component of every system that stores data and instructions. A computer's memory is mainly categorized into two types: primary and secondary memory. Primary memory is the main memory of the system, and it is often random access memory (RAM) and is used to store data that the CPU requires quick access to. Secondary memory is the additional memory of the system. It is used to store the data that the CPU does not require immediate access to, which is typically in the form of hard drives, solid-state drives, or detachable storage devices (such as USB drives).

1.8.1. Define Primary memory

The primary memory of a PC system is its primary memory. The instructions that must be performed at the time are copied to primary memory because the CPU may directly access data from the primary memory. Accessing data from this memory is faster because it is the internal memory, and the CPU accesses data from primary memory via the data bus.

Primary memory is typically volatile in nature, which implies that information in primary memory doesn't exist if the information is not stored in the event of a power loss. It is more costly than secondary memory because it is made of semiconductors, and primary memory capacity in a computer is restricted and is always less than secondary memory.

1.8.2. Types of Primary Memory

RAM (Random Access Memory) *and* ROM (Read Only Memory) *are* the two types of primary memory.

1. RAM (Random Access Memory)

RAM is both a read and writes type of memory. The information that has to be currently processed is stored in RAM, which the CPU may immediately access. It is a volatile memory that loses data when the electricity is turned off. RAM may be static or dynamic in nature.

2. ROM (Read Only Memory)

ROM is a read-only memory, which implies that its contents may not be altered. It contains the instructions that are executed when the system boots up. It is a non-volatile memory, which implies that it preserves its contents even after the power is turned off. It has three types of ROM, such as PROM, EPROM, and EEPROM.

1.8.3. Features of Primary Memory

There are various features of Primary Memory. Some important features of Primary Memory are as follows:

- It is faster to access when compared to secondary memory.
- If the power is turned off, you may lose data.
- It is the computer's working memory.
- It is known as primary memory.
- Without primary memory, the system cannot function.
- It is also known to as volatile memory.

1.8.4. Define Secondary Memory

Secondary memory is additional computer memory. Secondary memory stores data that must be preserved permanently. The CPU cannot directly access secondary memory data, and the data must first be copied to primary memory before the CPU can process it. As a result, accessing data from secondary memory takes longer. The secondary memory may be accessed via the input-output channel.

It is non-volatile memory, which implies that its content remains even after the power is turned off. It is optical or magnetic memory, which is less expensive than primary memory.

Secondary memory is always more plentiful than primary memory. As an external memory, a computer may even function without secondary memory. Secondary memory includes hard disks, CDs, DVDs, floppy disks, etc.

1.8.5. Types of Secondary Memory

There are various types of secondary memory. Some of them are as follows:

1. Floppy Disk

It is a magnetic disk that is enclosed in a square plastic box. Its main goal is to store information and then move it from one system to another. Floppy disks come in two sizes (1) Size: 3.5 inches, storage capacity: *1.44 MB* (2) *5.25-inch* display and *1.2-MB storage capacity*. A system contains a floppy disk drive to use a floppy disk. DVDs, CDs, and flash drives have mostly replaced this type of storage media.

2. Hard Disk

Hard disks are storage devices that may hold a large amount of data. Hard disks are often known as hard disk drives. It comes in a range of storage capacities (For instance, 256 GB, 500 GB, 1 TB, and 2 TB). It is constructed of platters, which are collections of disks. The plates are piled on top of one another and covered in a magnetic coating. Each plate is composed of a series of invisible circles, each with an identical core track. Hard disks are classified into two types: internal and external.

3. Blu-ray Disk

It looks like a CD/DVD; however, it may carry up to 25 Gigabytes of data. You'll require a Blu-ray reader if you want to utilize a Blu-ray disk. The name Blu-ray is derived from the technology that is utilized to read the *disk*: 'Blu' stands for a blue-violet laser, and 'ray' stands for an optical ray.

4. SD Card

It is a type of memory card that is often utilized to store data in portable devices like cameras and cell phones. It is available in several capacities, such as 1, 2, 4, 8, 16, 32, and 64 GB. The data on the SD card can be accessed by removing it from the system and placing it into a system through a card reader. The SD card data is stored in memory chips, and there are no moving parts, as there are on a hard disk.

1.8.6. Features of Secondary Memory

There are various features of Secondary Memory. Some important features of Secondary Memory are as follows:

- These are optical and magnetic memories.
- It is a sort of non-volatile memory.
- It aids in the storage of data in a PC.
- The data is stored permanently, even when the system is turned off.
- The system can function without secondary memory.
- It is slower than the primary memory.

1.9. Computer software:

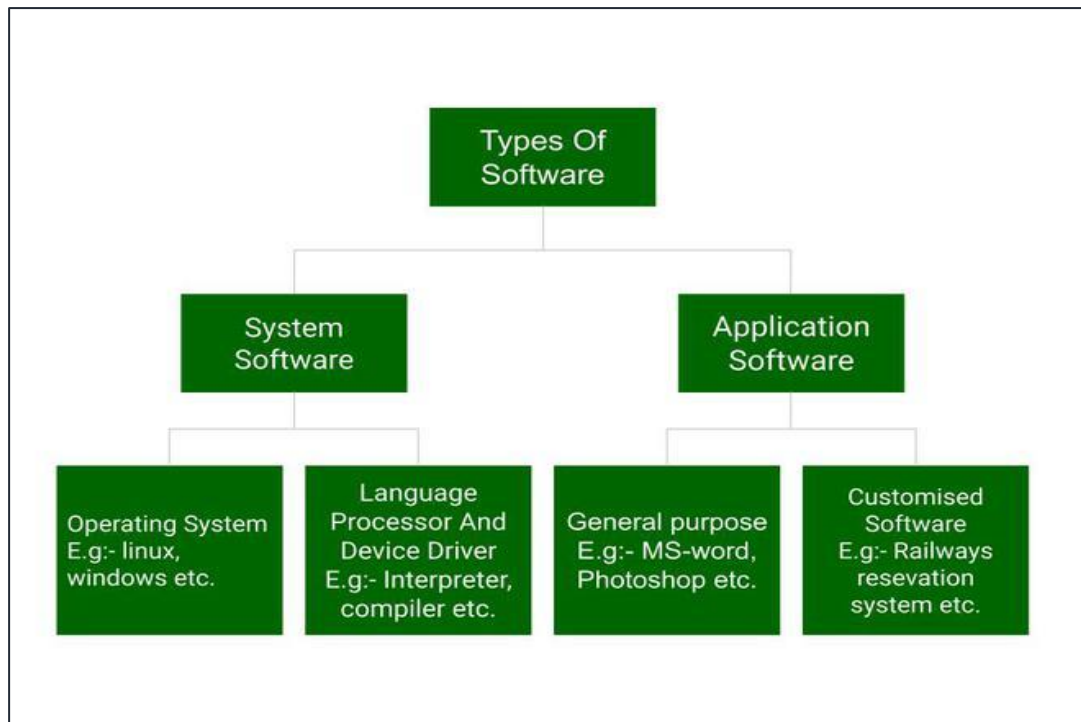
1.9.1. Introduction:

A Computer is an electronic device that can perform various operations of computation at a greater speed than what an ordinary machine or human mind can do. It is driven by many entities including the physical and tangible components that we can touch or feel, called the Hardware and programs and commands that drive the hardware, called the Software. The Software refers to the set of instructions fed in form of programs to govern the computer system and process the hardware components. For example:

- The antivirus that we use to protect our computer system is a type of Software.
- The media players that we use to play multimedia files such as movies, music etc. are Software.
- The Microsoft Office we use to edit the documents is a Software.

1.9.2. Definition of software:

Software is a collection of instructions, data, or computer programs that are used to run machines and carry out particular activities. In a computer system, the software is basically a set of instructions or commands that tell a computer what to do. In other words, the software is a computer program that provides a set of instructions to execute a user's commands and tell the computer what to do. For example like MS-Word, MS-Excel, PowerPoint, etc.



1.9.3. Types of Software

It is a collection of data that is given to the computer to complete a particular task. The chart below describes the types of software: Now we will briefly describe each type and its subtypes:

A. System Software

1. Operating System
2. Language Processor
3. Device Driver

B. Application Software

1. General Purpose Software
2. Customize Software
3. Utility Software

A. System Software

System software is software that directly operates the computer hardware and provides the basic functionality to the users as well as to the other software to operate smoothly. Or in other words, system software basically controls a computer's internal functioning and also controls hardware devices such as monitors, printers, and storage devices, etc. It is

like an interface between hardware and user applications, it helps them to communicate with each other because hardware understands machine language(i.e. 1 or 0) whereas user applications are work in human-readable languages like English, Hindi, German, etc. so system software converts the human-readable language into machine language and vice versa.

Types of System Software

It has two subtypes which are:

Operating System: It is the main program of a computer system. When the computer system ON it is the first software that loads into the computer's memory. Basically, it manages all the resources such as computer memory, CPU, printer, hard disk, etc., and provides an interface to the user, which helps the user to interact with the computer system. It also provides various services to other computer software. Examples of operating systems are Linux, Apple Mac OS, Microsoft Windows, etc.

Language Processor: As we know that system software converts the human-readable language into a machine language and vice versa. So, the conversion is done by the language processor. It converts programs written in high-level programming languages like Java, C, C++, Python, etc (known as source code), into sets of instructions that are easily readable by machines(known as object code or machine code).

Device Driver: A device driver is a program or software that controls a device and helps that device to perform its functions. Every device like a printer, mouse, modem, etc. needs a driver to connect with the computer system eternally. So, when you connect a new device with your computer system, first you need to install the driver of that device so that your operating system knows how to control or manage that device.

Features of System Software

Let us discuss some of the features of System Software:

- System Software is closer to the computer system.
- System Software is written in a low-level language in general.
- System software is difficult to design and understand.
- System software is fast in speed (working speed).

- System software is less interactive for the users in comparison to application software.

B. Application Software

Software that performs special functions or provides functions that are much more than the basic operation of the computer is known as application software. Or in other words, application software is designed to perform a specific task for end-users. It is a product or a program that is designed only to fulfill end-users' requirements. It includes word processors, spreadsheets, database management, inventory, payroll programs, etc.

Types of Application Software

There are different types of application software and those are:

General Purpose Software: This type of application software is used for a variety of tasks and it is not limited to performing a specific task only. For example, MS-Word, MS-Excel, PowerPoint, etc.

Customized Software: This type of application software is used or designed to perform specific tasks or functions or designed for specific organizations. For example, railway reservation system, airline reservation system, invoice management system, etc.

Utility Software: This type of application software is used to support the computer infrastructure. It is designed to analyze, configure, optimize and maintains the system, and take care of its requirements as well. For example, antivirus, disk fragmenter, memory tester, disk repair, disk cleaners, registry cleaners, disk space analyzer, etc.

Features of Application Software

Let us discuss some of the features of Application Software:

- An important feature of application software is it performs more specialized tasks like word processing, spreadsheets, email, etc.
- Mostly, the size of the software is big, so it requires more storage space.
- Application software is more interactive for the users, so it is easy to use and design.
- The application software is easy to design and understand.
- Application software is written in a high-level language in general.

1.10. MALICIOUS SOFTWARE

Any malicious software intended to harm or exploit any programmable device, service, or network is referred to as malware. Cybercriminals typically use it to extract data they can use against victims to their advantage in order to profit financially. Financial information, medical records, personal emails, and passwords are just a few examples of the types of information that could be compromised.

In simple words, malware is short for malicious software and refers to any software that is designed to cause harm to computer systems, networks, or users. Malware can take many forms. It's important for individuals and organizations to be aware of the different types of malware and take steps to protect their systems, such as using antivirus software, keeping software and systems up-to-date, and being cautious when opening email attachments or downloading software from the internet.

Malware is a program designed to gain access to computer systems, generally for the benefit of some third party, without the user's permission. Malware includes computer viruses, worms, Trojan horses, ransom ware, spyware, and other malicious programs.

1.10.1. Types of Malware

- 1. Viruses** – A Virus is a malicious executable code attached to another executable file. The virus spreads when an infected file is passed from system to system. Viruses can be harmless or they can modify or delete data. Opening a file can trigger a virus. Once a program virus is active, it will infect other programs on the computer.
- 2. Worms** – Worms replicate themselves on the system, attaching themselves to different files and looking for pathways between computers, such as computer network that shares common file storage areas. Worms usually slow down networks. A virus needs a host program to run but worms can run by themselves. After a worm affects a host, it is able to spread very quickly over the network.
- 3. Trojan horse** – A Trojan horse is malware that carries out malicious operations under the appearance of a desired operation such as

playing an online game. A Trojan horse varies from a virus because the Trojan binds itself to non-executable files, such as image files, and audio files.

- 4. Ransom ware** – Ransom ware grasps a computer system or the data it contains until the victim makes a payment. Ransom ware encrypts data in the computer with a key that is unknown to the user. The user has to pay a ransom (price) to the criminals to retrieve data. Once the amount is paid the victim can resume using his/her system
- 5. Adware** – It displays unwanted ads and pop-ups on the computer. It comes along with software downloads and packages. It generates revenue for the software distributor by displaying ads.
- 6. Spyware** – Its purpose is to steal private information from a computer system for a third party. Spyware collects information and sends it to the hacker.
- 7. Logic Bombs** – A logic bomb is a malicious program that uses a trigger to activate the malicious code. The logic bomb remains non-functioning until that trigger event happens. Once triggered, a logic bomb implements a malicious code that causes harm to a computer. Cyber security specialists recently discovered logic bombs that attack and destroy the hardware components in a workstation or server including the cooling fans, hard drives, and power supplies. The logic bomb overdrives these devices until they overheat or fail.
- 8. Rootkits** – A rootkit modifies the OS to make a backdoor. Attackers then use the backdoor to access the computer distantly. Most rootkits take advantage of software vulnerabilities to modify system files.
- 9. Backdoors** – A backdoor bypasses the usual authentication used to access a system. The purpose of the backdoor is to grant cyber criminals future access to the system even if the organization fixes the original vulnerability used to attack the system.

1.10.2. Protect From Malware

The good news is that there are just as many ways to protect yourself from malware as there are different types of malware.

- Protect your devices.

- Update your operating system and software. Install updates as soon as they become available because cybercriminals search for vulnerabilities in out-of-date or outdated software.
- Never click on a popup's link. Simply click the "X" in the message's upper corner to close it and leave the page that generated it.
- Don't install too many apps on your devices. Install only the apps you believe you will regularly use and need.
- Be cautious when using the internet.
- Do not click on unidentified links. If a link seems suspicious, avoid clicking it whether it comes from an email, social networking site, or text message.
- Choose the websites you visit wisely. Use a safe search plug-in and try to stick to well-known and reputable websites to avoid any that might be malicious without your knowledge.
- Emails requesting personal information should be avoided. Do not click a link in an email that appears to be from your bank and asks you to do so in order to access your account or reset your password. Log in immediately at your online banking website.

1.10.3. Remove Malware

A large number of security software programs are made to both find and stop malware as well as to eliminate it from infected systems.

An antimalware tool that handles malware detection and removal is malware bytes. Malware can be eliminated from Windows, macOS, Android, and iOS operating systems. A user's registry files, currently running programs, hard drives, and individual files can all be scanned by Malware bytes. Malware can then be quarantined and removed if it is found. Users cannot, however, set automatic scanning schedules like they can with some other tools.

Advantages of Detecting and Removing Malware

- 1. Improved Security:** By detecting and removing malware, individuals, and organizations can improve the security of their systems and reduce the risk of future infections.

- 2. Prevent Data Loss:** Malware can cause data loss, and by removing it, individuals and organizations can protect their important files and information.
- 3. Protect Reputation:** Malware can cause harm to a company's reputation, and by detecting and removing it, individuals and organizations can protect their image and brand.
- 4. Increased Productivity:** Malware can slow down systems and make them less efficient, and by removing it, individuals and organizations can increase the productivity of their systems and employees.

Disadvantages of Detecting and Removing Malware

- 1. Time-Consuming:** The process of detecting and removing malware can be time-consuming and require specialized tools and expertise.
- 2. Cost:** Antivirus software and other tools required to detect and remove malware can be expensive for individuals and organizations.
- 3. False Positives:** Malware detection and removal tools can sometimes result in false positives, causing unnecessary alarm and inconvenience.
- 4. Difficulty:** Malware is constantly evolving, and the process of detecting and removing it can be challenging and require specialized knowledge and expertise.
- 5. Risk of Data Loss:** Some malware removal tools can cause unintended harm, resulting in data loss or system instability.

1.11. OPERATING SYSTEMS:

Operating System lies in the category of system software. It basically manages all the resources of the computer. An operating system acts as an interface between the software and different parts of the computer or the computer hardware. The operating system is designed in such a way that it can manage the overall resources and operations of the computer. Operating System is a fully integrated set of specialized programs that handle all the operations of the computer. It controls and monitors the execution of all other programs that reside in the computer, which also includes application programs and other system software of the computer. Examples of Operating Systems are Windows, Linux, Mac OS, etc. An Operating System (OS) is a

collection of software that manages computer hardware resources and provides common services for computer programs. The operating system is the most important type of system software in a computer system.

The operating system helps in improving the computer software as well as hardware. Without OS, it became very difficult for any application to be user-friendly. The Operating System provides a user with an interface that makes any application attractive and user-friendly. The operating System comes with a large number of device drivers that make OS services reachable to the hardware environment. Each and every application present in the system requires the Operating System. The operating system works as a communication channel between system hardware and system software. The operating system helps an application with the hardware part without knowing about the actual hardware configuration. It is one of the most important parts of the system and hence it is present in every device, whether large or small device.

1.11.1. Functions of the Operating System

- **Resource Management:** The operating system manages and allocates memory, CPU time, and other hardware resources among the various programs and processes running on the computer.
- **Process Management:** The operating system is responsible for starting, stopping, and managing processes and programs. It also controls the scheduling of processes and allocates resources to them.
- **Memory Management:** The operating system manages the computer's primary memory and provides mechanisms for optimizing memory usage.
- **Security:** The operating system provides a secure environment for the user, applications, and data by implementing security policies and mechanisms such as access controls and encryption.
- **Job Accounting:** It keeps track of time and resources used by various jobs or users.
- **File Management:** The operating system is responsible for organizing and managing the file system, including the creation, deletion, and manipulation of files and directories.

- **Device Management:** The operating system manages input/output devices such as printers, keyboards, mice, and displays. It provides the necessary drivers and interfaces to enable communication between the devices and the computer.
- **Networking:** The operating system provides networking capabilities such as establishing and managing network connections, handling network protocols, and sharing resources such as printers and files over a network.
- **User Interface:** The operating system provides a user interface that enables users to interact with the computer system. This can be a Graphical User Interface (GUI), a Command-Line Interface (CLI), or a combination of both.
- **Backup and Recovery:** The operating system provides mechanisms for backing up data and recovering it in case of system failures, errors, or disasters.
- **Virtualization:** The operating system provides virtualization capabilities that allow multiple operating systems or applications to run on a single physical machine. This can enable efficient use of resources and flexibility in managing workloads.
- **Performance Monitoring:** The operating system provides tools for monitoring and optimizing system performance, including identifying bottlenecks, optimizing resource usage, and analyzing system logs and metrics.
- **Time-Sharing:** The operating system enables multiple users to share a computer system and its resources simultaneously by providing time-sharing mechanisms that allocate resources fairly and efficiently.
- **System Calls:** The operating system provides a set of system calls that enable applications to interact with the operating system and access its resources. System calls provide a standardized interface between applications and the operating system, enabling portability and compatibility across different hardware and software platforms.

- **Error-detecting Aids:** These contain methods that include the production of dumps, traces, error messages, and other debugging and error-detecting methods.

1.11.2. Types of Operating Systems

There are several types of Operating Systems which are mentioned below

1. Batch Operating System
2. Multi-Programming System
3. Multi-Processing System
4. Multi-Tasking Operating System
5. Time-Sharing Operating System
6. Distributed Operating System
7. Network Operating System

1. Batch Operating System:-

This type of operating system does not interact with the computer directly. There is an operator which takes similar jobs having the same requirement and groups them into batches. It is the responsibility of the operator to sort jobs with similar needs.

Advantages of Batch Operating System:-

- The system accepts the various jobs from the user and place them in queue for getting CPU time. Processors of the batch systems know how long the job would be when it is in the queue.
- Multiple users can share the batch systems.
- The idle time for the batch system is very less.
- It is easy to manage large work repeatedly in batch systems.

Disadvantages of Batch Operating System:-

- The computer operators should be well known with batch systems.
- Batch systems are hard to debug.
- It is sometimes costly.
- The other jobs will have to wait for an unknown time if any job fails.
- Examples of Batch Operating Systems: Payroll Systems, Bank Statements, etc.

2. Multi-Programming Operating System

Multiprogramming Operating Systems can be simply illustrated as more than one program is present in the main memory and any one of them can be kept in execution. This is basically used for better execution of resources.

Advantages of Multi-Programming Operating System

- Multi Programming increases the Throughput of the System.
- It helps in reducing the response time.

Disadvantages of Multi-Programming Operating System

- There is not any facility for user interaction of system resources with the system.

3. Multi-Processing Operating System

Multi-Processing Operating System is a type of Operating System in which more than one CPU is used for the execution of resources. It betters the throughput of the System.

Advantages of Multi-Processing Operating System

- It increases the throughput of the system.
- As it has several processors, so, if one processor fails, we can proceed with another processor.

Disadvantages of Multi-Processing Operating System

- Due to the multiple CPU, it can be more complex and somehow difficult to understand.

4. Multi-Tasking Operating System

Multitasking Operating System is simply a multiprogramming Operating System with having facility of a Round-Robin Scheduling Algorithm. It can run multiple programs simultaneously.

There are two types of Multi-Tasking Systems which are listed below.

- Pre-emptive Multi-Tasking
- Cooperative Multi-Tasking

Advantages of Multi-Tasking Operating System

- Multiple Programs can be executed simultaneously in Multi-Tasking Operating System.
- It comes with proper memory management.

Disadvantages of Multi-Tasking Operating System

- The system gets heated in case of heavy programs multiple times.

5. Time-Sharing Operating Systems

Each task is given some time to execute so that all the tasks work smoothly. Each user gets the time of the CPU as they use a single system. These systems are also known as Multitasking Systems. The task can be from a single user or different users also. The time that each task gets to execute is called quantum. After this time interval is over OS switches over to the next task.

Advantages of Time-Sharing OS

- Each task gets an equal opportunity.
- Fewer chances of duplication of software.
- CPU idle time can be reduced.
- **Resource Sharing:** Time-sharing systems allow multiple users to share hardware resources such as the CPU, memory, and peripherals, reducing the cost of hardware and increasing efficiency.
- **Improved Productivity:** Time-sharing allows users to work concurrently, thereby reducing the waiting time for their turn to use the computer. This increased productivity translates to more work getting done in less time.
- **Improved User Experience:** Time-sharing provides an interactive environment that allows users to communicate with the computer in real time, providing a better user experience than batch processing.

Disadvantages of Time-Sharing OS

- Reliability problem.
- One must have to take care of the security and integrity of user programs and data.
- Data communication problem.
- High Overhead: Time-sharing systems have a higher overhead than other operating systems due to the need for scheduling, context switching, and other overheads that come with supporting multiple users.

- Complexity: Time-sharing systems are complex and require advanced software to manage multiple users simultaneously. This complexity increases the chance of bugs and errors.
- Security Risks: With multiple users sharing resources, the risk of security breaches increases. Time-sharing systems require careful management of user access, authentication, and authorization to ensure the security of data and software.

Examples of Time-Sharing OS with explanation

IBM VM/CMS: IBM VM/CMS is a time-sharing operating system that was first introduced in 1972. It is still in use today, providing a virtual machine environment that allows multiple users to run their own instances of operating systems and applications.

TSO (Time Sharing Option): TSO is a time-sharing operating system that was first introduced in the 1960s by IBM for the IBM System/360 mainframe computer. It allowed multiple users to access the same computer simultaneously, running their own applications.

6. Distributed Operating System

These types of operating system is a recent advancement in the world of computer technology and are being widely accepted all over the world and, that too, at a great pace. Various autonomous interconnected computers communicate with each other using a shared communication network. Independent systems possess their own memory unit and CPU. These are referred to as loosely coupled systems or distributed systems. These systems' processors differ in size and function. The major benefit of working with these types of the operating system is that it is always possible that one user can access the files or software which are not actually present on his system but some other system connected within this network i.e., remote access is enabled within the devices connected in that network.

Advantages of Distributed Operating System

- Failure of one will not affect the other network communication, as all systems are independent of each other.
- Electronic mail increases the data exchange speed.

- Since resources are being shared, computation is highly fast and durable.
- Load on host computer reduces.
- These systems are easily scalable as many systems can be easily added to the network.
- Delay in data processing reduces.

Disadvantages of Distributed Operating System

- Failure of the main network will stop the entire communication.
- To establish distributed systems the language is used not well-defined yet.
- These types of systems are not readily available as they are very expensive. Not only that the underlying software is highly complex and not understood well yet.

7. Network Operating System

These systems run on a server and provide the capability to manage data, users, groups, security, applications, and other networking functions. These types of operating systems allow shared access to files, printers, security, applications, and other networking functions over a small private network. One more important aspect of Network Operating Systems is that all the users are well aware of the underlying configuration, of all other users within the network, their individual connections, etc. and that's why these computers are popularly known as tightly coupled systems.

Advantages of Network Operating System

- Highly stable centralized servers.
- Security concerns are handled through servers.
- New technologies and hardware up-gradation are easily integrated into the system.
- Server access is possible remotely from different locations and types of systems.

Disadvantages of Network Operating System

- Servers are costly.
- User has to depend on a central location for most operations.
- Maintenance and updates are required regularly.

- Examples of Network Operating Systems are Microsoft Windows Server 2003, Microsoft Windows Server 2008, UNIX, Linux, Mac OS X, Novell NetWare, BSD, etc.

1.12. Limitations of computers:

- **Virus and hacking attacks:** A virus may be a worm and hacking is just unauthorized access over a computer for a few illicit purposes. Viruses can go to another system from email attachments, viewing an infected website advertisement, through removable devices like USBs etc.
- **Online Cyber Crimes:** Online cybercrime means computers and networks may have been utilized in order to commit a crime.
- **High cost:** Computers are expensive. Even the foremost affordable computers are still very expensive.
- **Health problems:** Prolonged use of computers can lead to various health hazards. Too much sitting near the screen results in eye strain and drying up of the eyes.
- **Inadequate Intelligence:** A computer is an artificial mechanism or object lacking the same intelligence level as humans. They behave as programmed machines that rely primarily on the input we provide. They cannot make any logical decisions independently due to their lack of intelligence, which is defined by this.
- **Power Dependency:** A power supply is necessary for the desktop computer to turn on and perform fully. The PC greatly depends on electricity to carry out its essential functions.

Conclusion:

Computers have unleashed a world of possibilities, offering immense advantages such as lightning fast processing, vast storage capabilities, and automation of tasks and wealth of information. They including health issues, security risks, job displacement and privacy concerns.

UNIT – II

MS OFFICE

2.1. Introduction

Microsoft word is a word processor software developed by Microsoft in 1983. It is the most commonly used word processor software. It is used to create professional quality documents, letters, reports, resumes, etc. and also allows you to edit or modify your new or existing document. The file saved in Ms Word has .docx extension. It is a component of the Microsoft Office suite, but you can buy it separately and is available for both Windows and macOS.

2.2. WINDOWS EXPLORER

Microsoft Windows File Explorer is a graphical file management utility for the Windows operating system (OS). Windows Explorer was introduced with Windows 95 and later renamed File Explorer. Each time a computer user accesses a disk or opens a folder containing files, they are using the Windows File Explorer utility. Windows Explorer took on the File Explorer name in 2012 with the release of Windows 8 and Windows Server 2012. The file manager application's graphical user interface includes a toolbar and a file operation dialog that displays more detailed options.

How does File Explorer work?

The goal of the file management utility is to let users conveniently work with the files and directories on any connected disk. Users open Windows File Explorer by clicking the File Explorer icon on the taskbar or from the Start menu. When a file is selected in the File Explorer interface, users can select from numerous context-aware actions such as renaming, moving, copying, publishing, emailing, printing and deleting the file. Entire folders can be opened, explored, shared, copied, cut, pasted, moved and deleted. Files can be searched, users can drag and drop them between folders, and folders can be moved into other folders and disk drives.

Windows File Explorer can present files and folders in several formats such as thumbnail image arrays, icons, lists and details, including name, size, type, date and time. The choice of display format depends on the user's preferences and type of content being explored. A folder with an extensive

library of image, video or music file types might be displayed in thumbnail format, while a folder of documents might be viewed as a detailed list.

How is File Explorer organized?

File Explorer in Windows 10 is divided into three main sections on a graphical toolbar that's divided into following three tabs:

Home tab. Windows 10 displays the toolbar's Home tab by default. It contains general-purpose icons for basic functions, such as copy, paste, move to, rename and properties.

Share tab. Windows 10 File Explorer's Share tab contains icons providing options for sharing a selected item with others. They let users e-mail, print or fax an item or even burn it to disk.

View tab. The toolbar's View tab is used to customize File Explorer's appearance. View options include extra-large icons, large icons, medium icons, small icons, list, details, tiles or content. The View tab can be used to display or hide filename extensions, item checkboxes and hidden items. It contains options for viewing and hiding the navigation, preview and details panes.

The second of Windows 10 File Explorer's three areas is the navigation pane. It's displayed along the left side of the interface in a tree-like view. It exposes network drives and their folders and libraries, such as the desktop, documents, downloads, music, pictures and videos libraries. The navigation pane can also contain quick-access shortcuts to commonly used folders.

The third area of the Windows File Explorer interface displays the files and folders in the currently selected location. From here, a user can navigate the file system, double click on a file to open it and right-click on a file to access a context-sensitive menu with options such as share, open with, send to or properties.

The File Explorer interface can appear differently depending on which item is selected. For example, clicking on the This PC icon found in the navigation pane causes File Explorer to display the computer's libraries, devices and drives, and network locations. For each local drive and mapped network drive, File Explorer displays a graphical view of the drive's total capacity and space remaining. This view replaces the toolbar's Home tab with a Computer tab

that provides options to access media, map network drives, add a network location, open settings and uninstall or change programs. The Share tab doesn't exist when This PC is selected.

File Explorer in Windows 11 has a simplified toolbar that replaces the Windows 10 File Explorer ribbon. It uses icons to provide much the same basic functionality, however, and its tabs simplify file organizing and toggling among folders. Windows 11 File Explorer's right-click menu also has changed; it uses icons for the cut, copy, paste, rename and delete functions rather than the words.

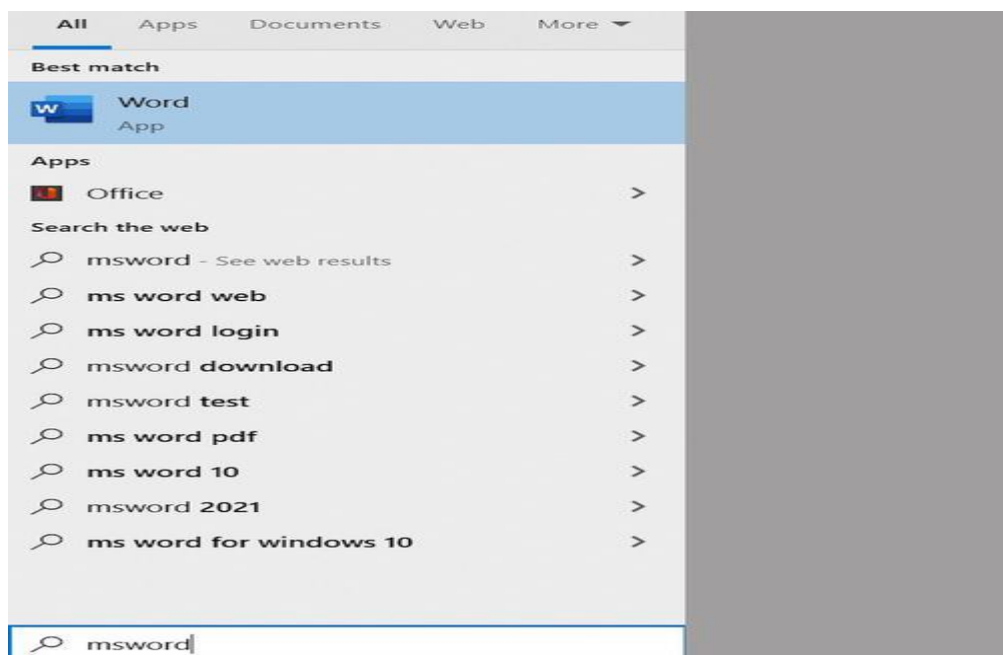
2.3. MS Word: Basic operations in word

Microsoft word is a word processor software developed by Microsoft in 1983. It is the most commonly used word processor software. It is used to create professional quality documents, letters, reports, resumes, etc and also allows you to edit or modify your new or existing document. The file saved in Ms Word has .docx extension. It is a component of the Microsoft Office suite, but you can buy it separately and is available for both Windows and macOS. The latest version of Ms Word is 2019.

2.3.1. How to open MS Word?

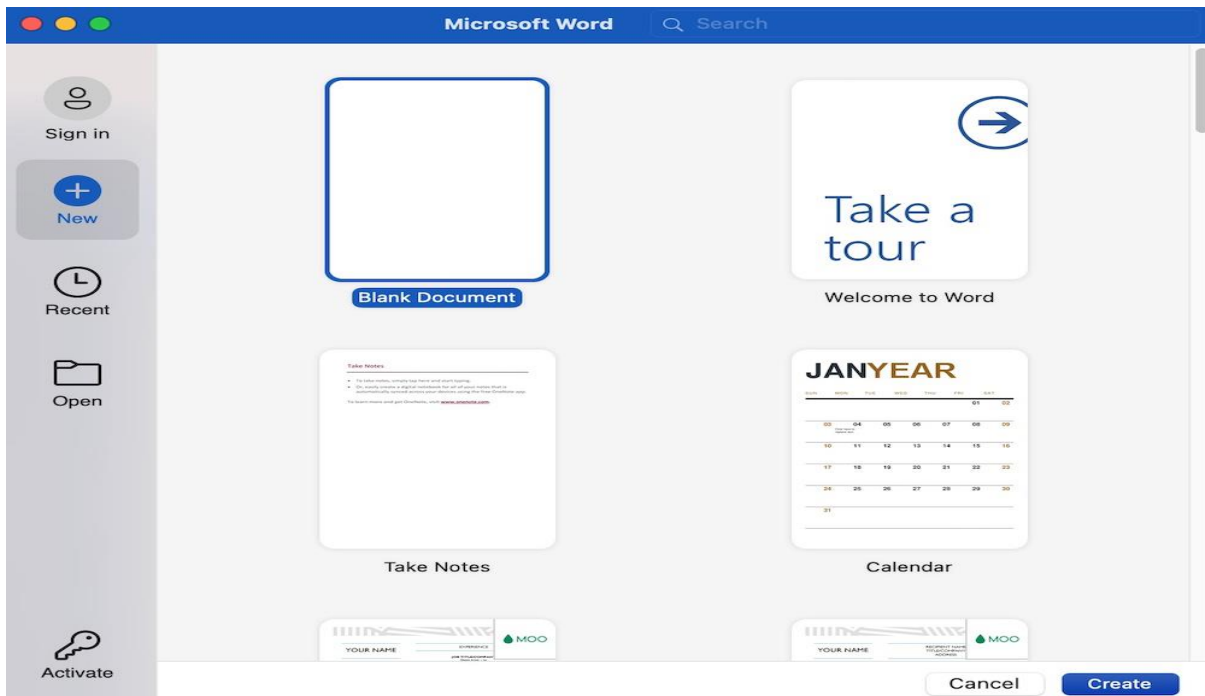
The following step shows how to open MS words:

Step 1: Type Ms Word in the search bar.

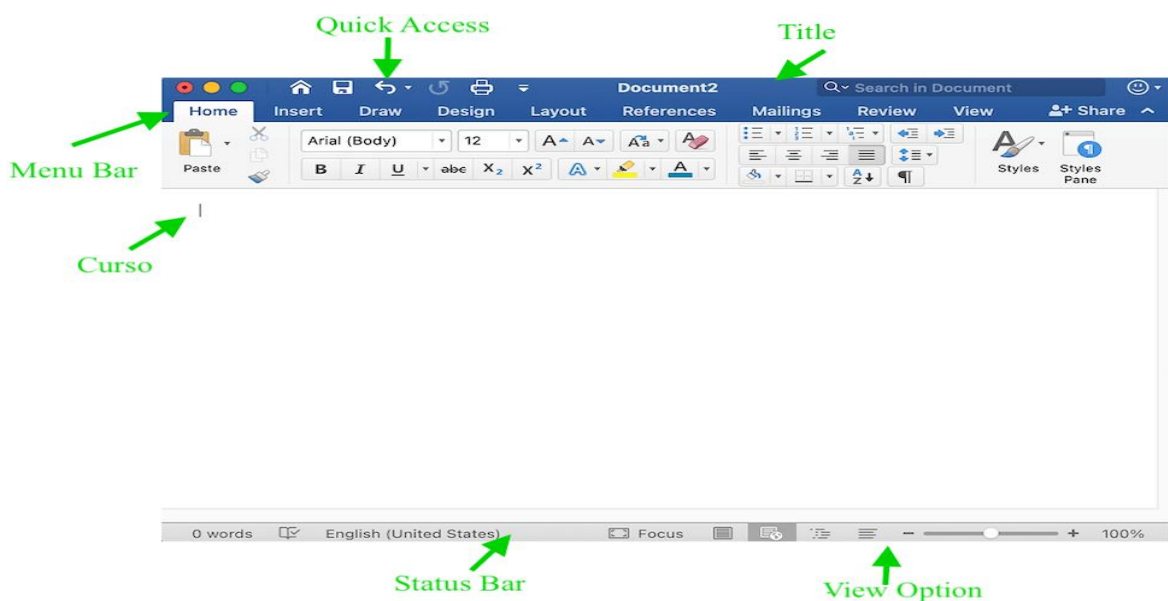


Step 2: Select Ms Word application.

Step 3: Select a blank document and press create button.



Then you will get a window like in the image below where you can write your content and perform different types of operations on that content, like font type, style, bold, italic, etc. You can also add images, tables, charts to your document. Then you will get a window like in the image below where you can write your content and perform different types of operations on that content, like font type, style, bold, italic, etc. You can also add images, tables, charts to your document.

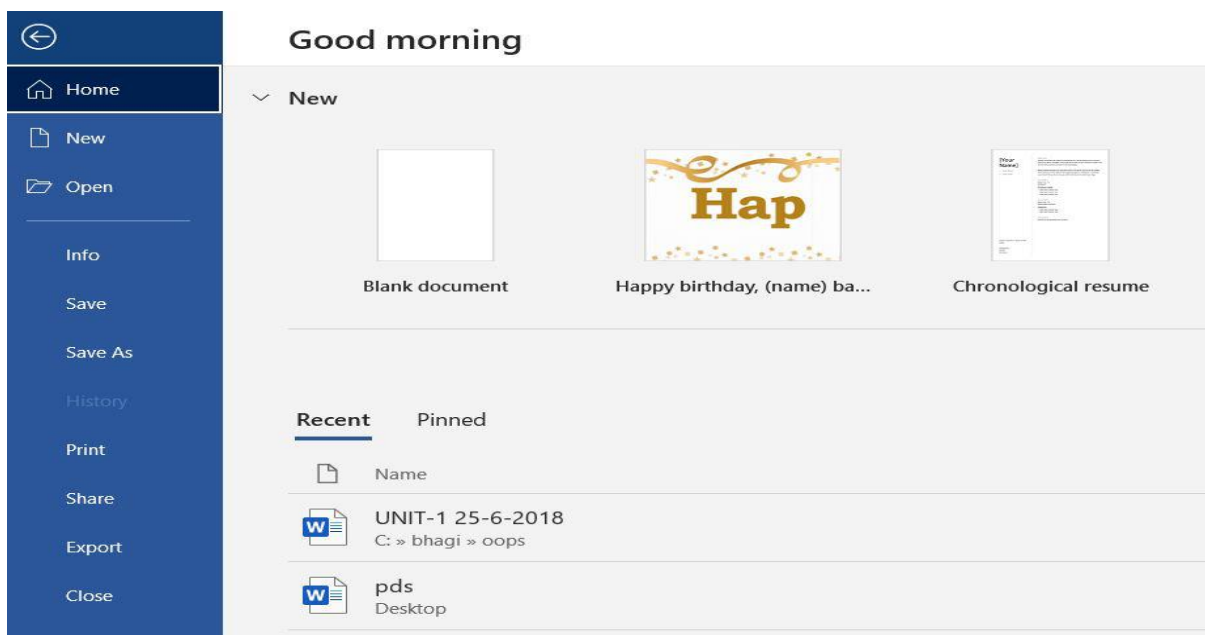


2.3.2. Features of Micro Soft Word

Now let us discuss the features or components of the Ms Word. Using these features, you can perform different types of operations on your documents, like you can create, delete, and style, modify, or view the content of your document.

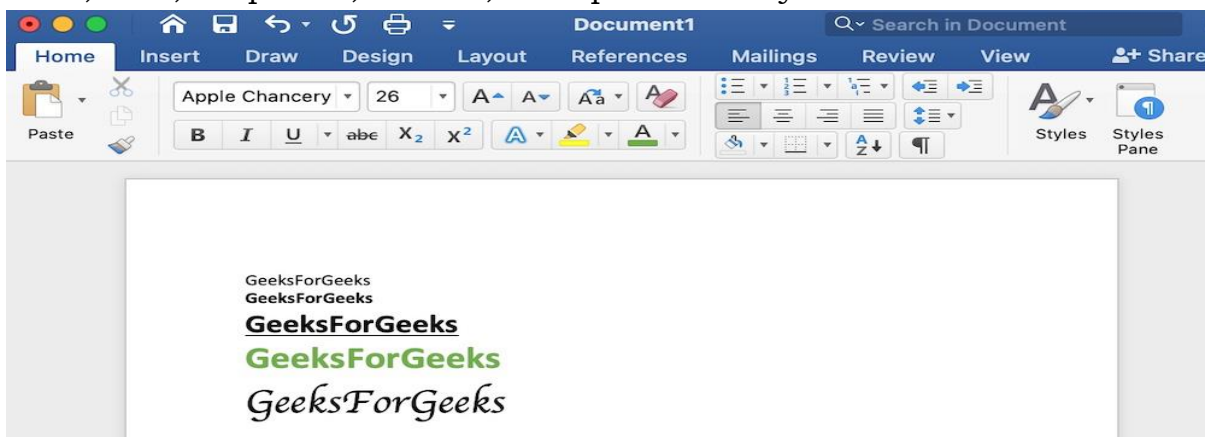
1. File

It contains options related to the file, like New (used to create a new document), Open (used to open an existing document), Save (used to save document), Save As(used to save documents), History, Print, Share, Export, Info, etc.



2. Home

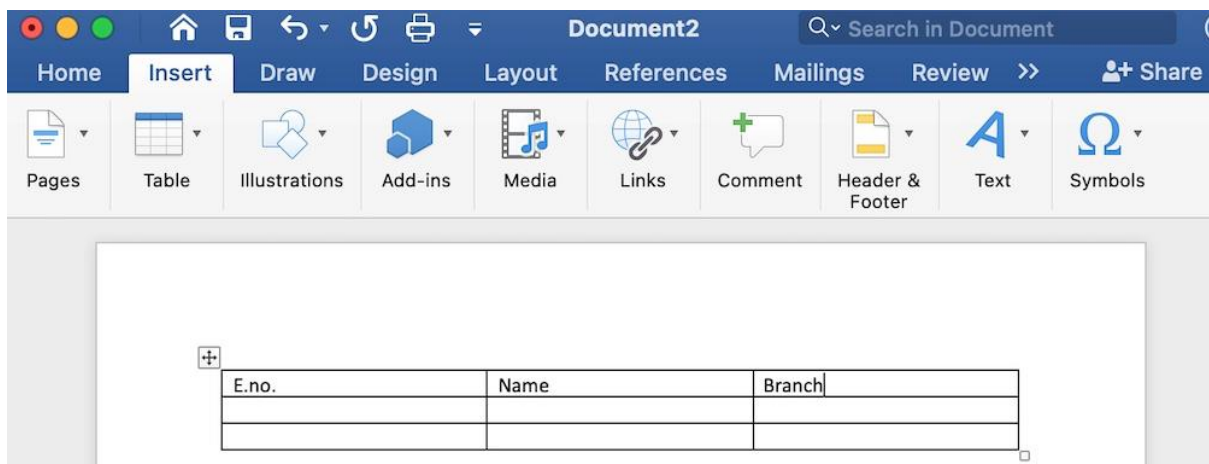
It is the default tab of Ms Word and it is generally divided into five groups, i.e., Clipboard, Font, Paragraph, Style and Editing. It allows you to select the color, font, emphasis, bullets, and position of your text. It also contains



options like cut, copy, and paste. After selecting the home tab you will get below options:

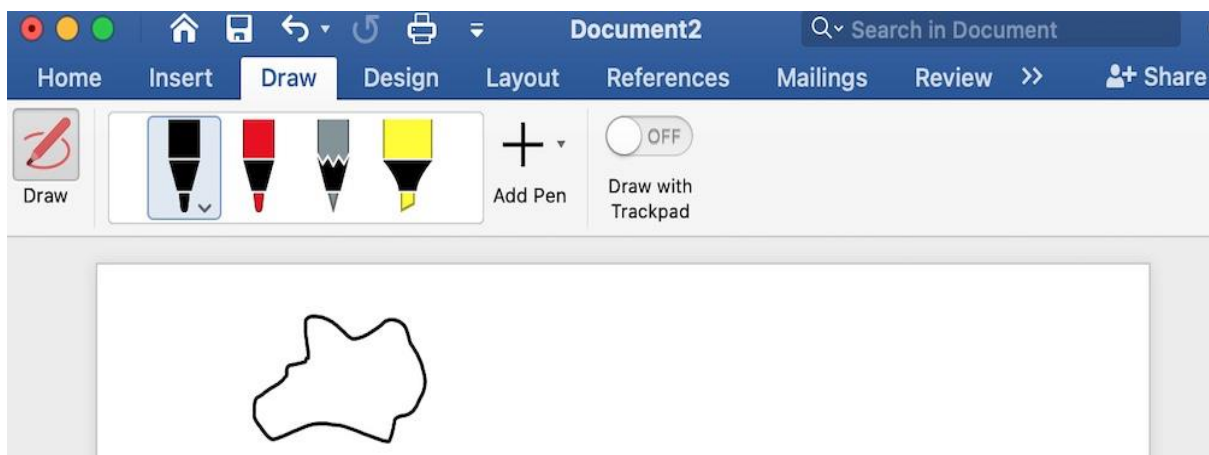
3. Insert

It is the second tab present on the menu bar or ribbon. It contains various items that you may want to insert into a Microsoft word. It includes options like tables, word art, hyperlinks, symbols, charts, signature line, date and time, shapes, header, footer, text boxes, links, boxes, equations, etc., as shown in the below image:



4. Draw

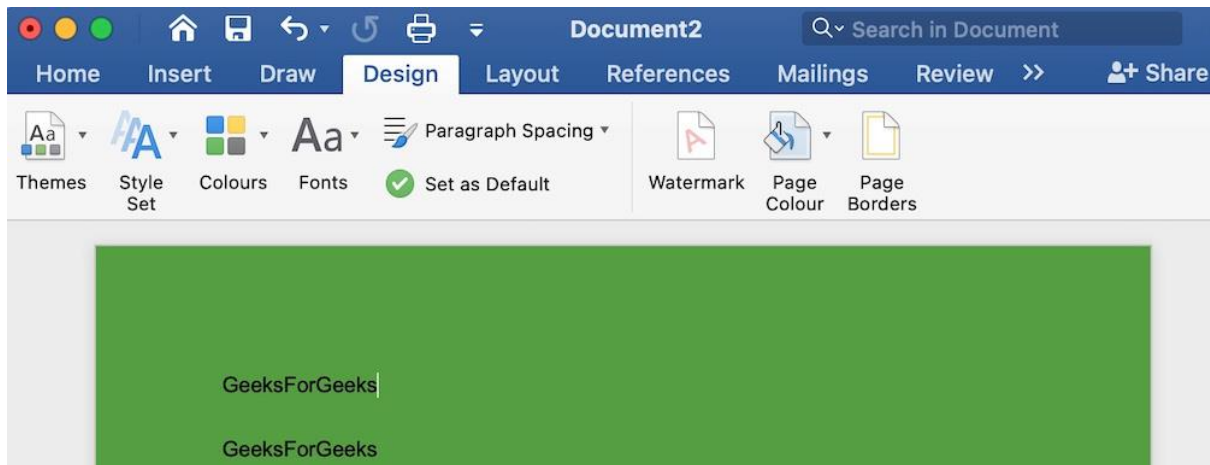
It is the third tab present in the menu bar or ribbon. It is used for freehand drawing in Ms Word. It provides different types of pens for drawing as shown below:



5. Design

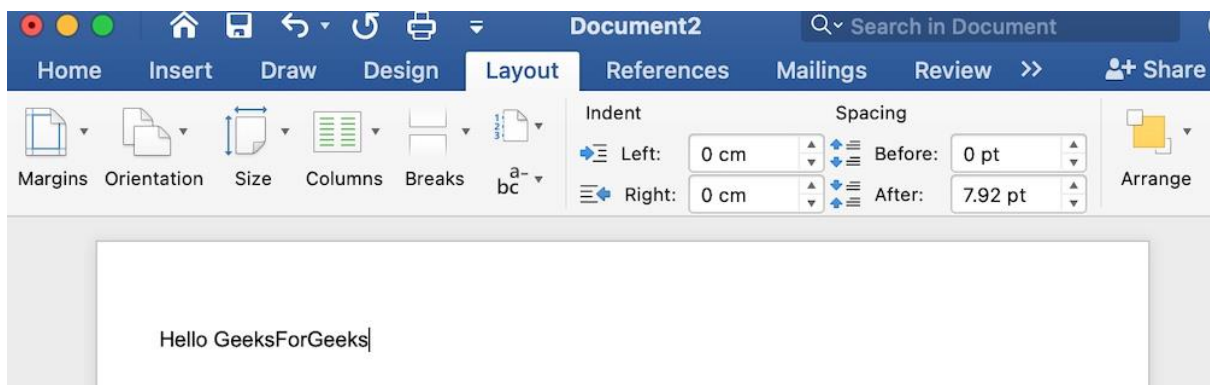
It is the fourth tab present in the menu bar or ribbon. The design tab contains document designs that you can select, such as documents with centered

titles, offset headings, left-justified text, page borders, watermarks, page color, etc., as shown in the below image:



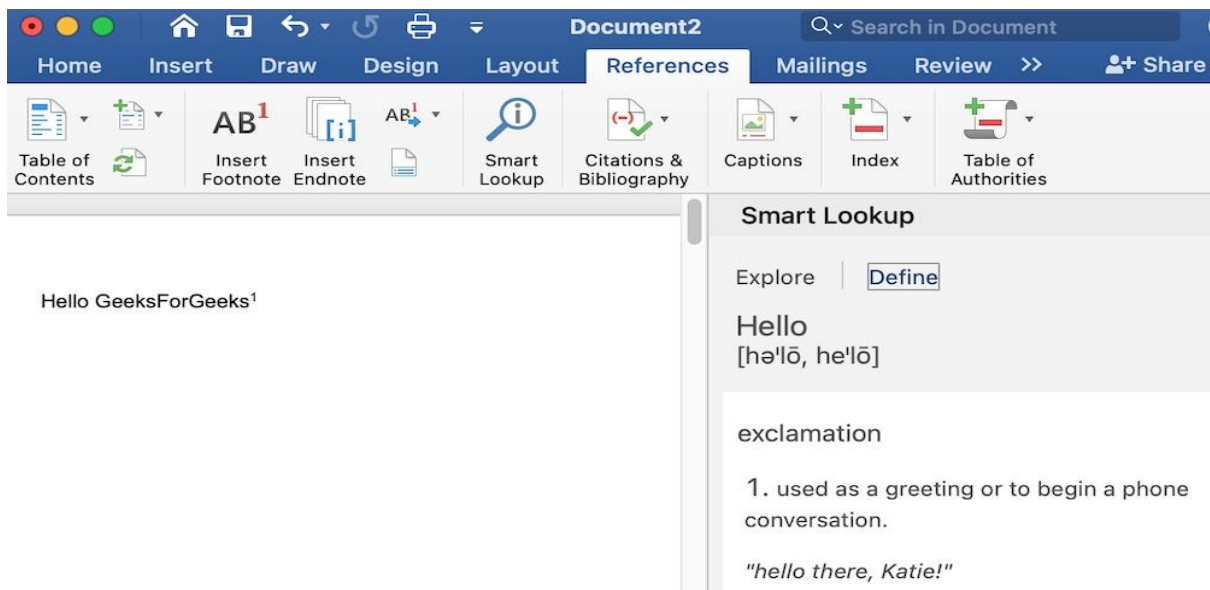
6. Layout

It is the fifth tab present on the menu bar or ribbon. It holds all the options that allow you to arrange your Microsoft Word document pages just the way you want them. It includes options like set margins, display line numbers, set paragraph indentation, and lines apply themes, control page orientation and size, line breaks, etc., as shown in the below image:



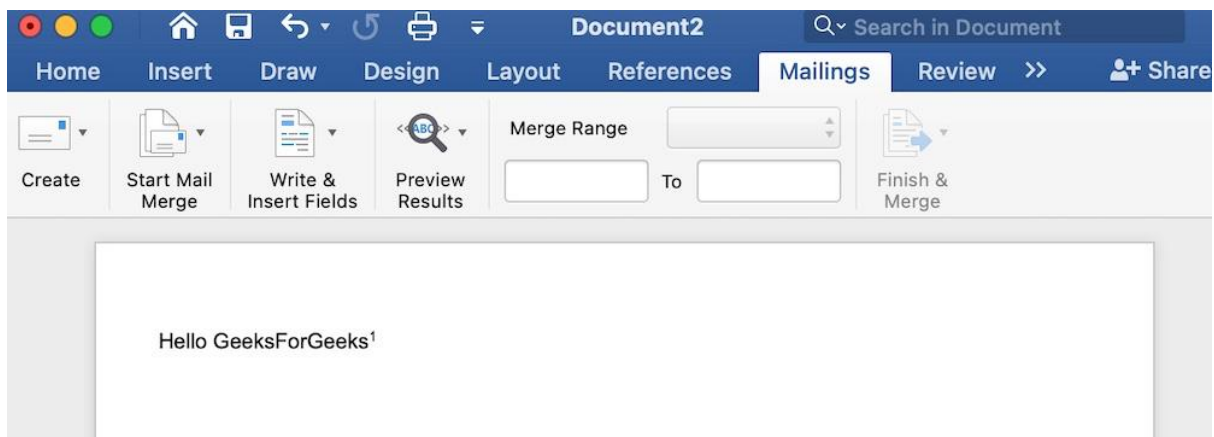
7. References

It is the sixth tab present in the menu bar or ribbon. The references tab lets you add references to a document, then create a bibliography at the end of the text. The references are generally stored in a master list, which is used to add references to further documents. It includes options like, Table of Contents, Footnotes, Citations & Bibliography, Captions, Index, Table of Authorities, smart look, etc. After selecting References tab, you will get the below options:



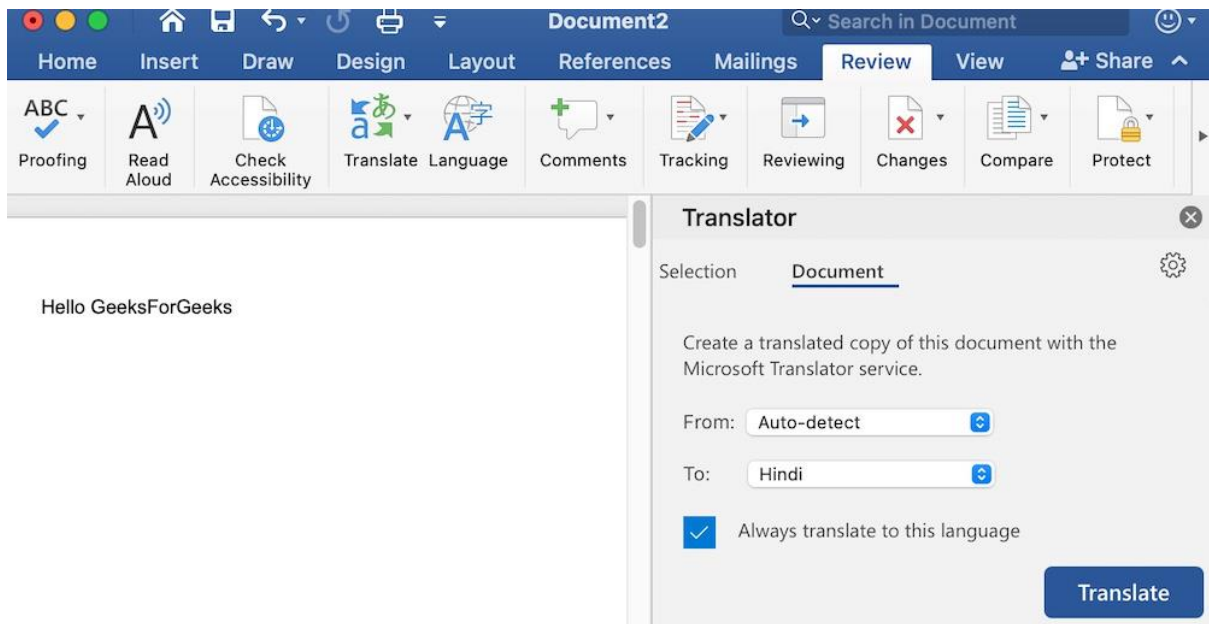
8. Mailings

It is the seventh tab present in the menu bar or ribbon. It is a least used tab in the menu bar. This tab is where you would create labels, print them on envelopes, do mail merge, etc. After selecting mailing, you will get the below options:



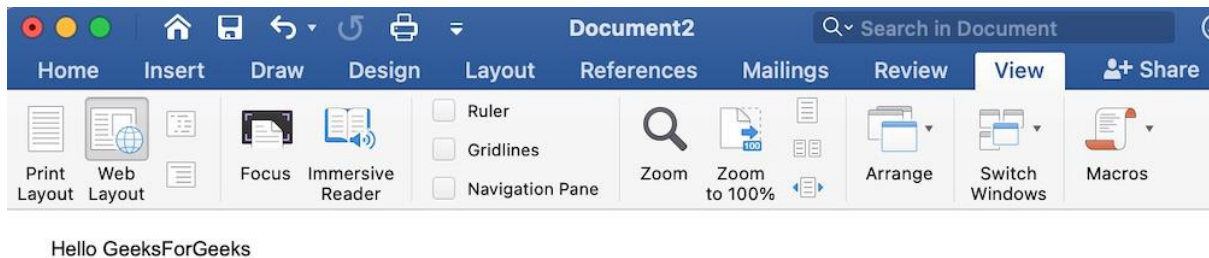
9. Review

It is the eighth tab present in the menu bar or ribbon. The review tab contains, commenting, language, translation, spell check, word count tools. It is good for quickly locating and editing comments. After selecting a review tab, you will get the options below:



10. View

It is the ninth tab present in the menu bar or ribbon. View tab allows you to switch between single page or double page and also allows you to control the layout tools. It includes print layout, outline, web layout, task pane, toolbars, ruler, header and footer, footnotes, full-screen view, zoom, etc. as shown in the below image:



2.4. Formatting in MS Word

In MS Word there are multiple types of formatting we can apply to a given text such as Fonts, Font Styles, Font Colors, Font Sizes, Text Highlight Colors, Clearing Formats, Change Cases, etc. Let us apply these techniques to some texts in the Word Processor and see what result it produces.

1. Font

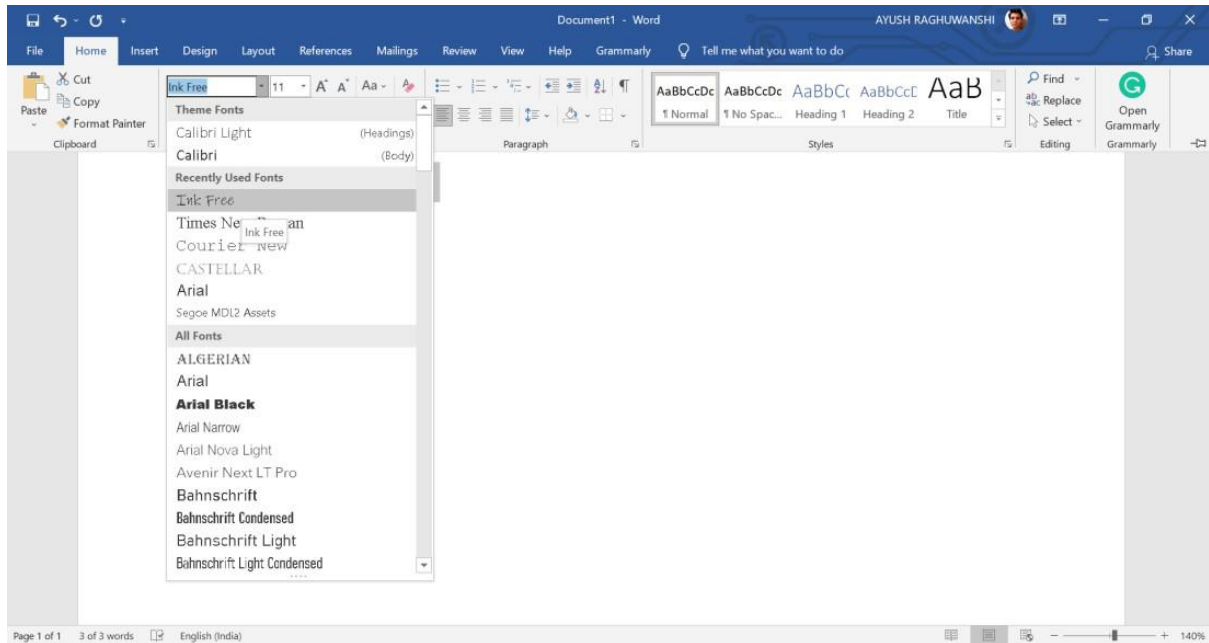
Fonts are used to change the display of the text or Word Document, look more appealing, and as per the requirement of the situation. There are

multiple types of fonts available in MS Word-like: *Calibri*, *Times New Roman*, *Algerian*, *Arial*, *Century*, etc.

Steps to Apply:

Step 1: Select the text you want to change the font of.

Step 2: Now, select the font of your choice from the **Home** menu bar in MS Word.



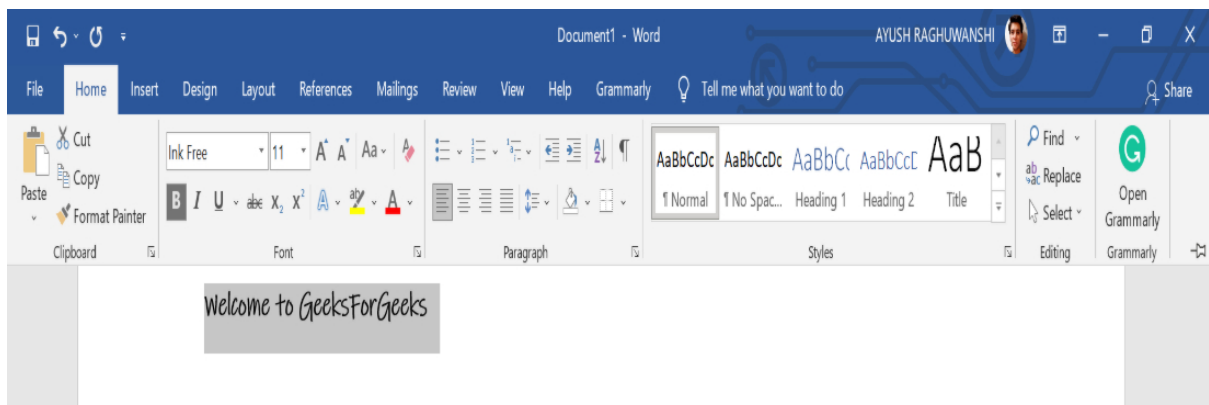
2. Font Style

Font Styles are used to change the Look ability of the text or give more emphasis on some texts in the Word Document. There are three types of font styles in MS Word: Bold, Italics, and Underline.

Steps to Apply Bold Font Style:

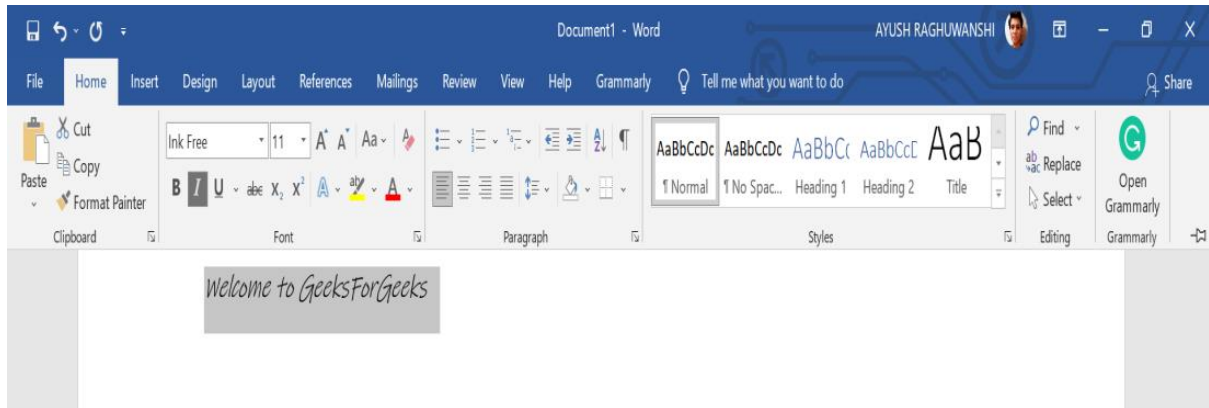
Step 1: Select the text you want to change the Font Style.

Step 2: Now, select the Font Style of your choice from the Font Style bar under the Home menu bar.



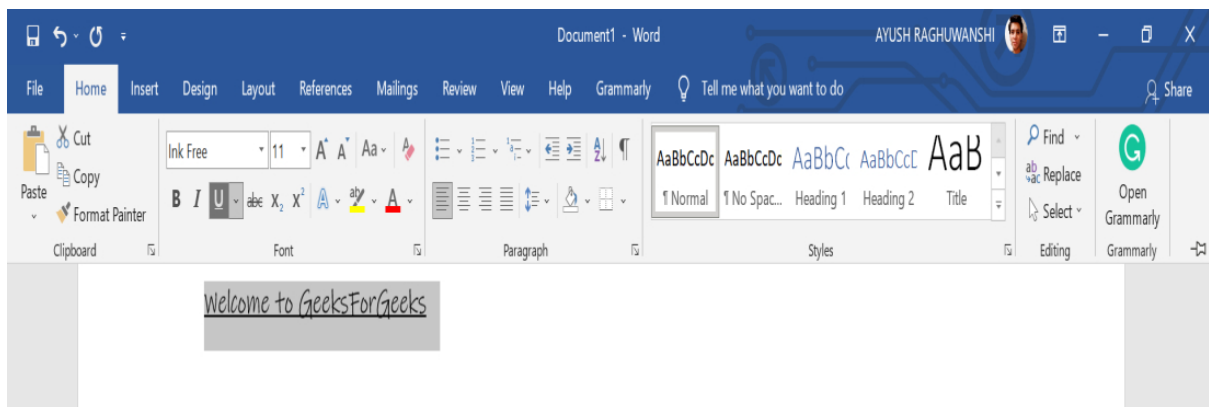
Steps to Apply *Italics* Font Style:

Step 1: Now, select the Font Style of your choice from the Font Style bar under the Home menu bar.



Steps to Apply Underline Font Style:

Step 1: Now, select the Font Style of your choice from the Font Style bar under the Home menu bar.



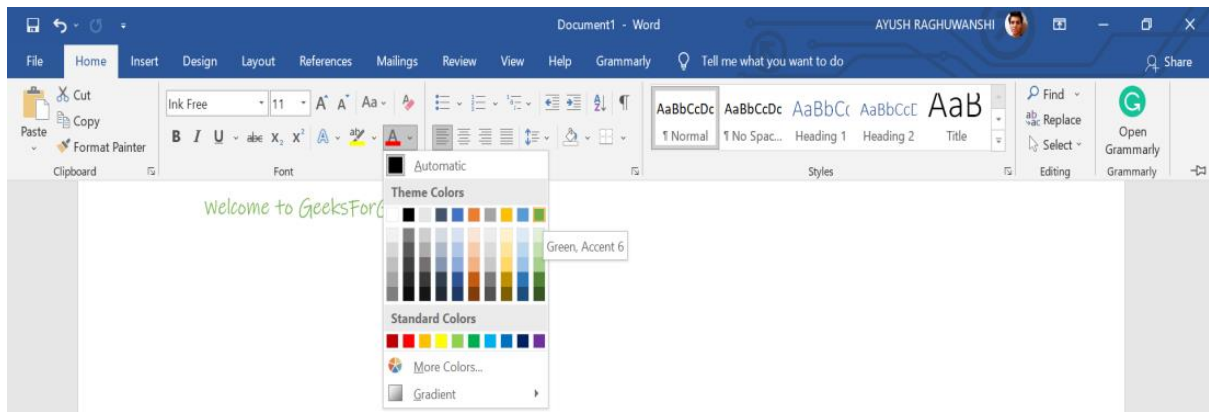
3. Font Color

Font Colors have wide use in real life when using the Word Document. Be it highlighting the main points of the document or want to convey some important information. There are multiple types of Font Colors available in MS Word-like: *Red, Blue, Yellow, and Orange, Light blue, etc.*

Steps to Apply:

Step 1: Select the text you want to change the Font Color.

Step 2: Now, select the Font Color of your choice from the Font Color bar under the Home menu bar.



4. Font Size

Font Sizes are used to display the text in the Word Document larger or smaller according to our needs. We generally display a heading with a Font Size of 15, Subheadings with a Font Size of 14 or 13, and paragraphs with a Font Size of 12. Many Font Sizes are available in MS Word-like: 8, 9, 10, 11, 12, 14, 16, etc.

Steps to Apply:

Step 1: Select the text you want to change the Font Size.

Step 2: Now, select the Font Size of your choice from the Font Size bar under the Home menu bar.

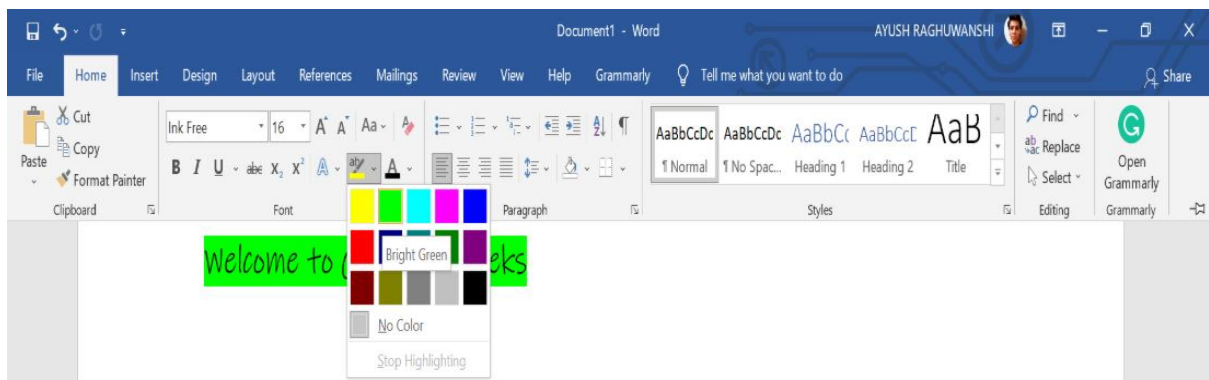
5. Text Highlight Color

As the name itself suggests, the text highlight Color is used to highlight text in the Word Document. There are many Text Highlight Colors available in MS Word-like: *Yellow, Bright Green, Turquoise, Pink, Red, etc.*

Steps to Apply:

Step 1: Select the text you want to change the Highlight Colors.

Step 2: Now, select the Color of your choice from the Text Highlight Color bar under the Home menu bar.



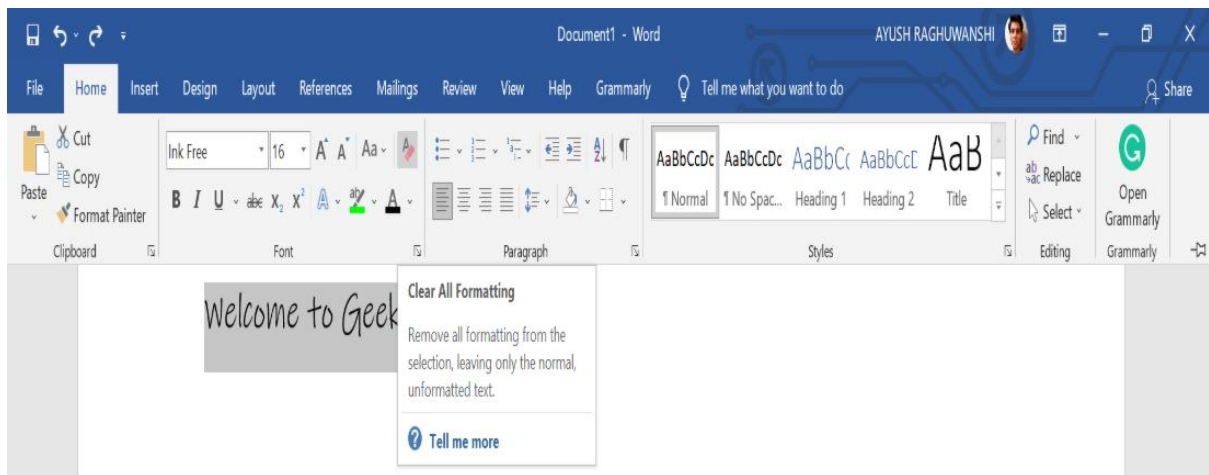
6. Clear Formats

MS Word provides a feature to clear the pre-formatted text. When we copy some text or information from somewhere it has some formatting applied already, so to remove it and use it according to our need in our Word Document we have to clear the Formatting.

Steps to Apply:

Step 1: Select the text you want to clear the formatting.

Step 2: Now, select the Clear All Formatting bar under the Home menu bar.



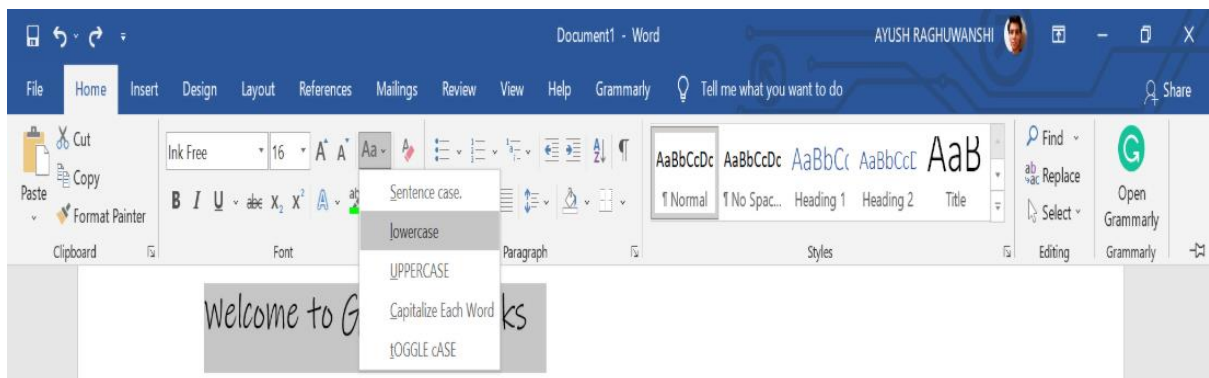
7. Change Case

Change Case is used to display the text in the way we want in our Word Document. There are five types of Change Cases available in MS Word-like: *Sentence case*, *Lowercase*, *Uppercase*, *Capitalize each word*, and *toggle case*.

Steps to Apply:

Step 1: Select the text you want to change the Case.

Step 2: Now, select the case of your choice from the Change Case bar under the Home menu bar.



2.5. Text Creation of Tables and Volumes

Microsoft Word or MS-WORD is a graphical word processing program that users can type with. It allows the users to type and save documents very similar to other word processors. There are many versions of MS-word in market, which the user can install as per te. In this tutorial, we will learn about the tables in MS-Word.

Tables in MS Word are made up of rows and columns with an organized arrangement of text. These tables can be used to align numbers in columns and then various operations can be performed on them. Tables can also be used to create page layouts. Rows in a table are series of data banks laid out horizontally in a table or spreadsheet. Columns are vertical series of cells in a chart, table, or spreadsheet.

Create a Table

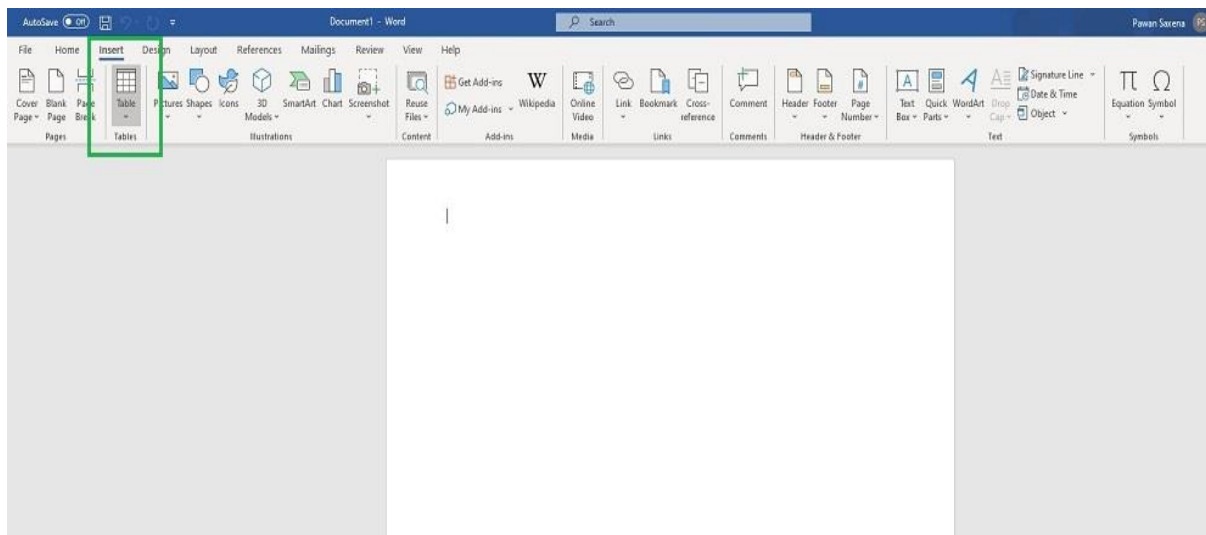
Tables in MS Word can be created in the following two ways:

1. Using the Grid
2. Using Table Dialogue Box

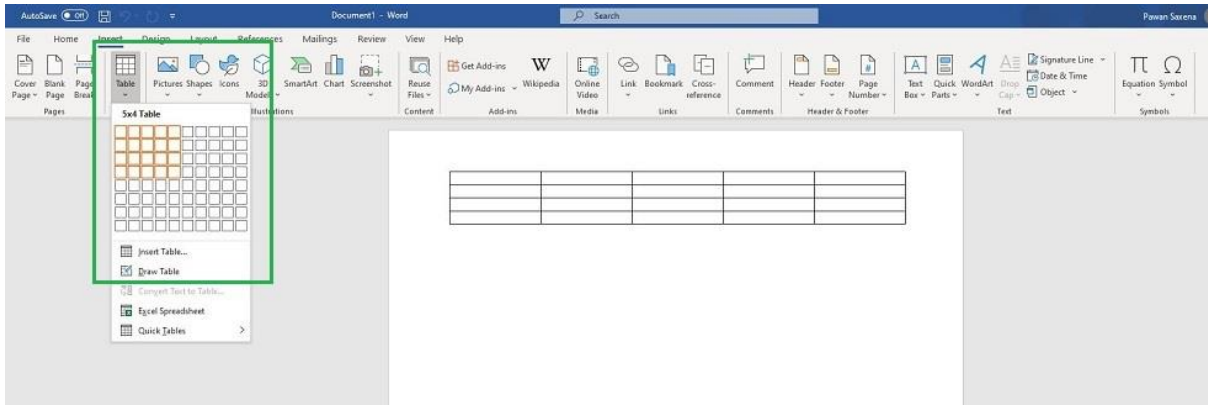
1. Using the Grid

Following are the steps of creating a table using the Grid provided in MS Word:

Step 1: Go to the Insert tab and click on the Table button.



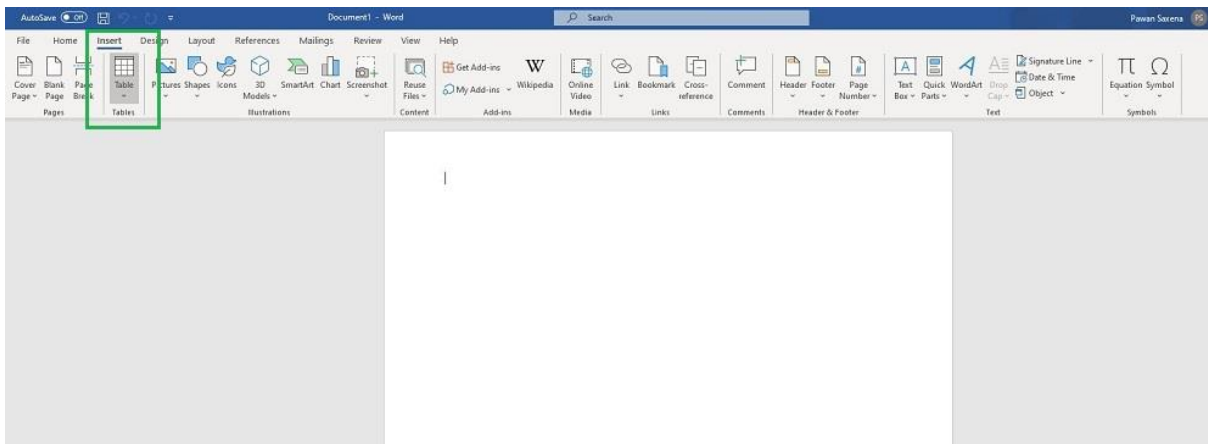
Step 2: In the dropdown menu, select the number of rows and columns from the Grid.



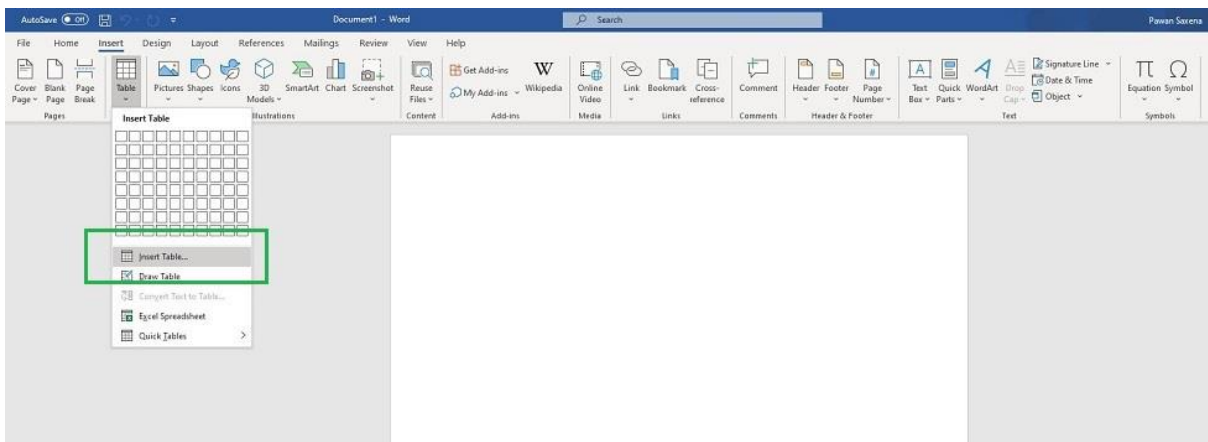
2. Using Table Dialogue Box

Following are the steps of creating a table using Table Dialogue Box in MS Word:

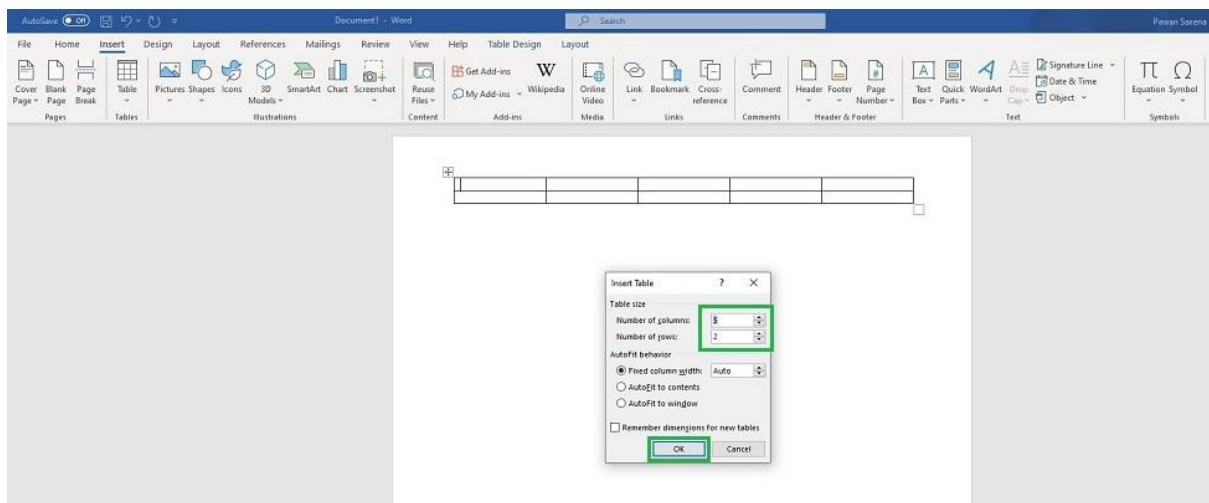
Step 1: Go to the Insert tab and click on the Table button.



Step 2: Under the grid, you will see an Insert Table button. Click on it.



Step 3: In the Insert Table Dialogue box, mention the number of rows and number of columns as per the requirement and click on OK button.



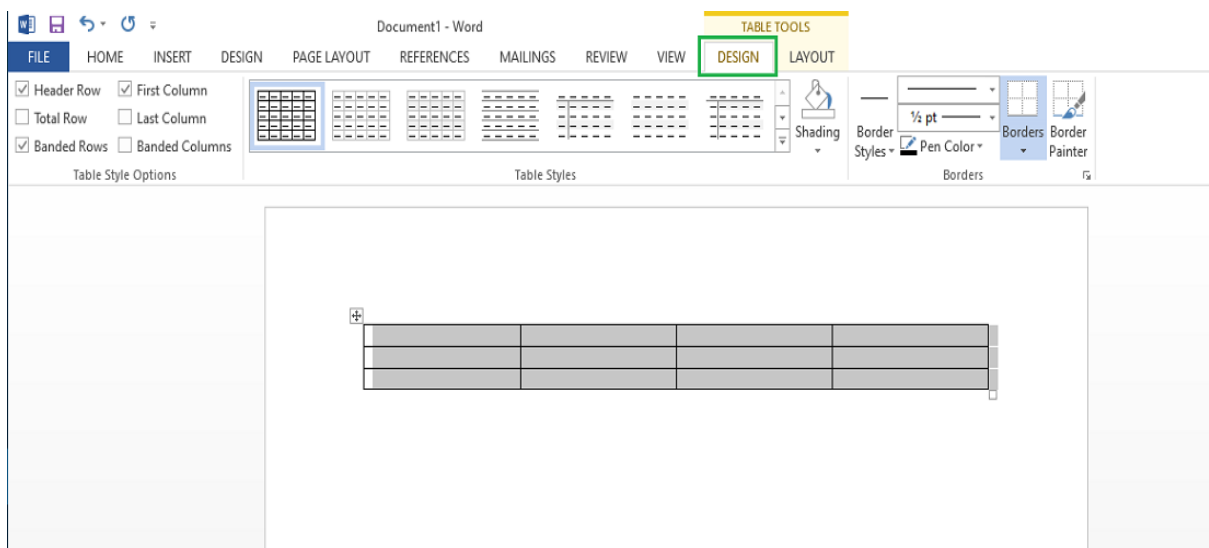
Modify a Table

We can also edit/modify a table to make it more creative. Multiple operations can be performed on a table like changing the layout, splitting of cells, merging the cells, applying borders, etc. Here, we will see some of the operations performed on a table in MS Word.

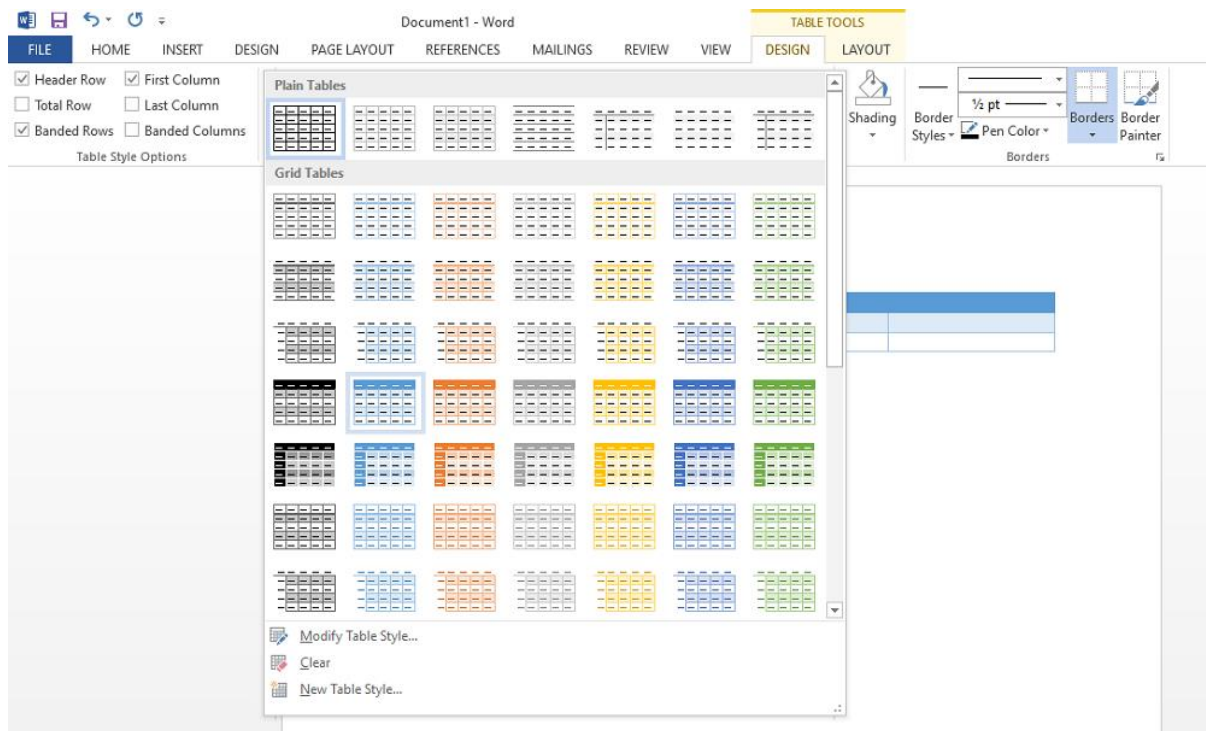
1. Changing Layout of a Table

Changing the layout of a table can be done with the help of the following steps:

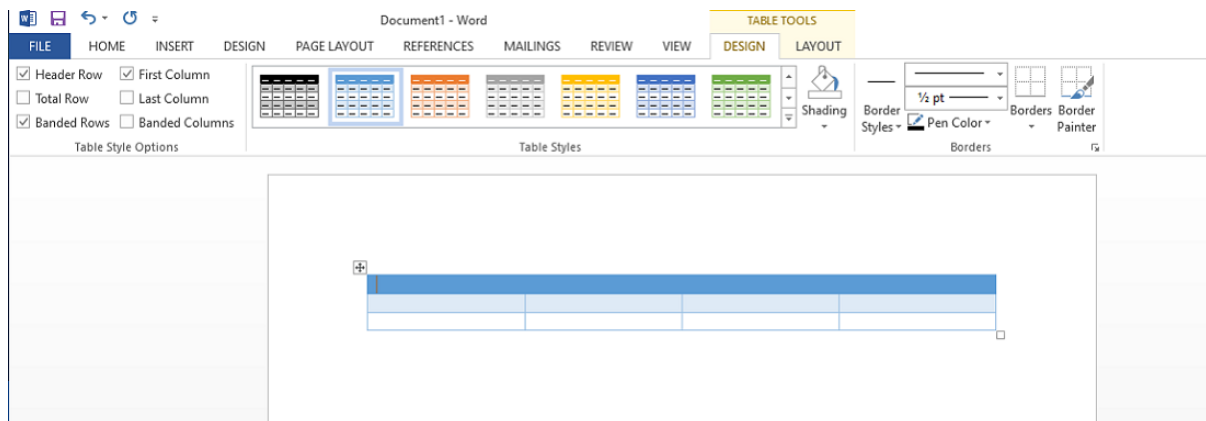
Step 1: Select the table for which the layout is to be changed. Go to the design tab.



Step 2: Click on the dropdown menu to get various different types of layouts for your table.



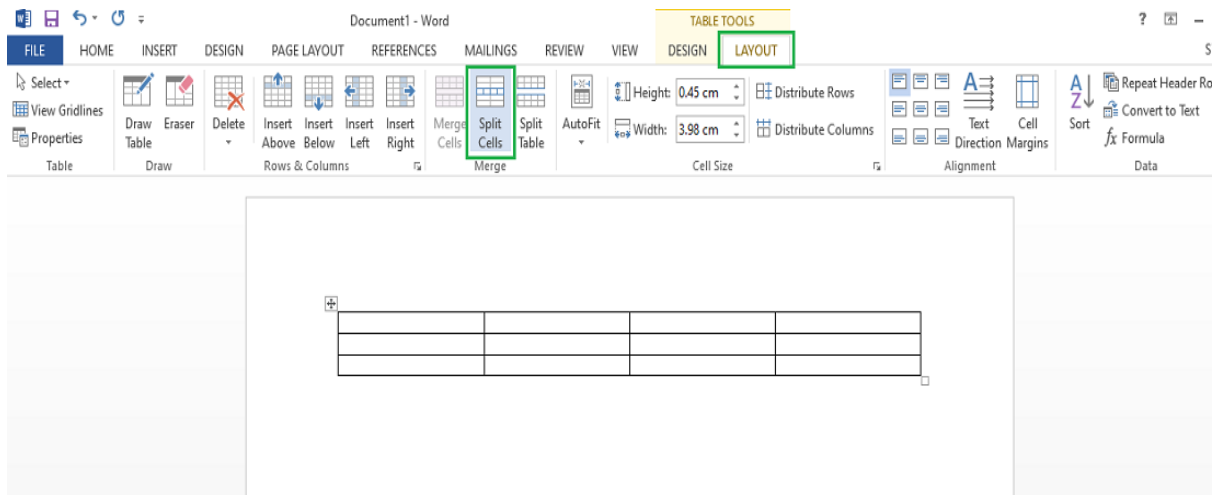
Step 3: Select any layout as per the need.



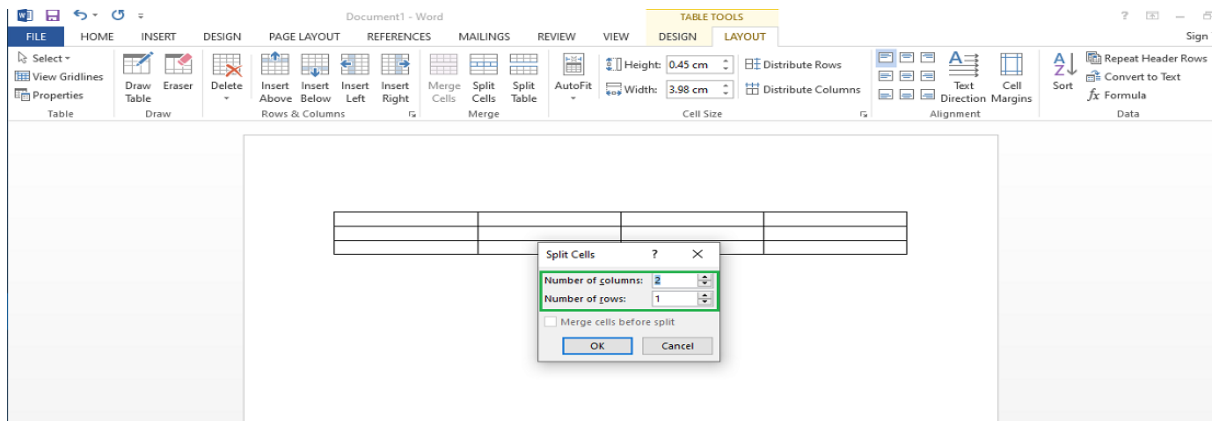
2. Splitting the Cell

Splitting of a cell can be done with the help of the following steps:

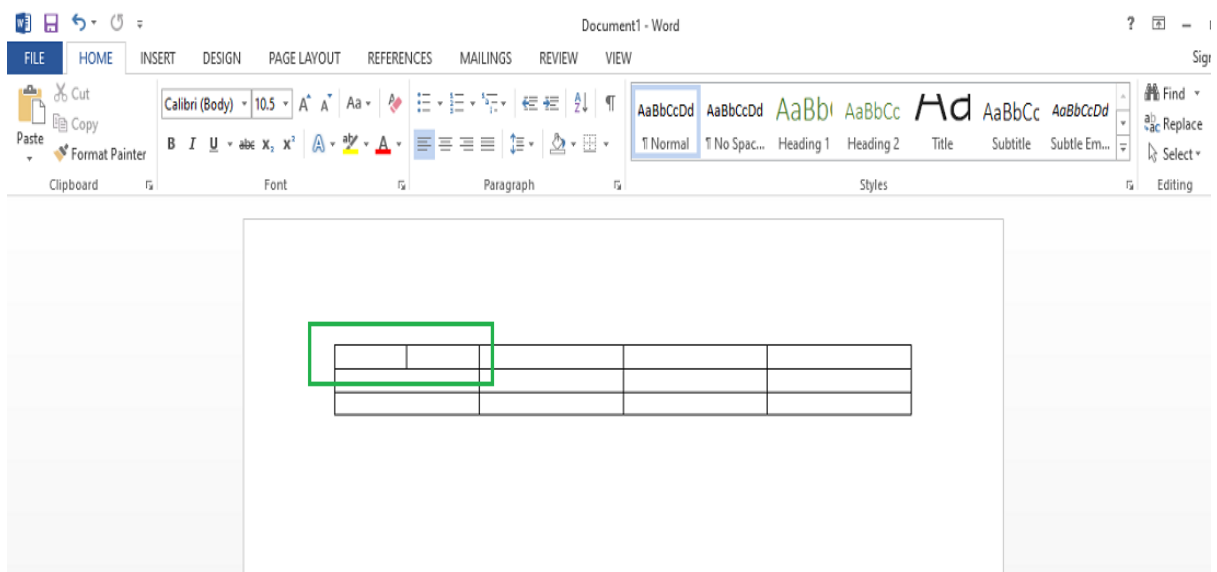
Step 1: Select the cell that you want to split into multiple cells. Then go to the Layout tab and click on the Split Cells button.



Step 2: In the dialogue box, mention the new dimensions as per the requirement.



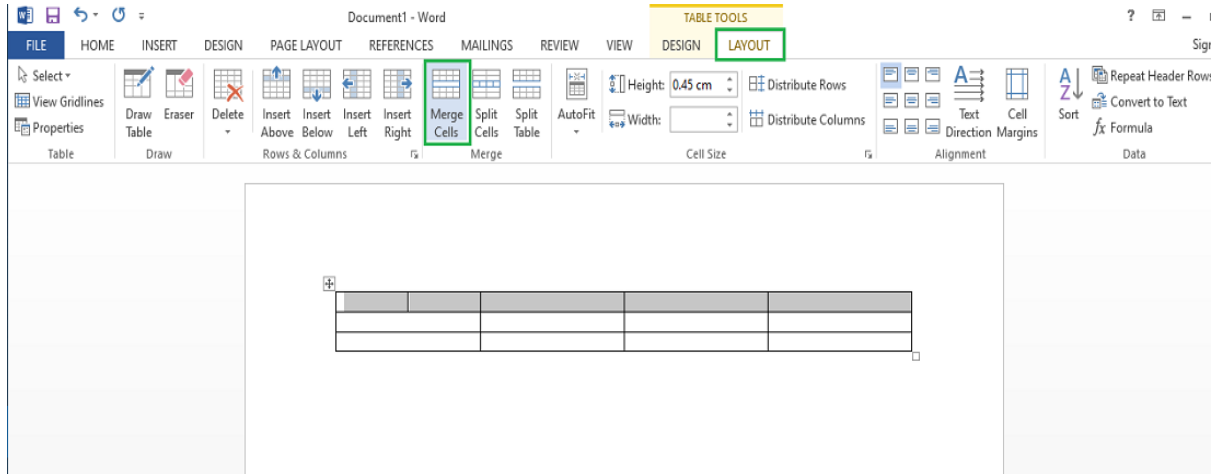
Step 3: Click on the Ok button.



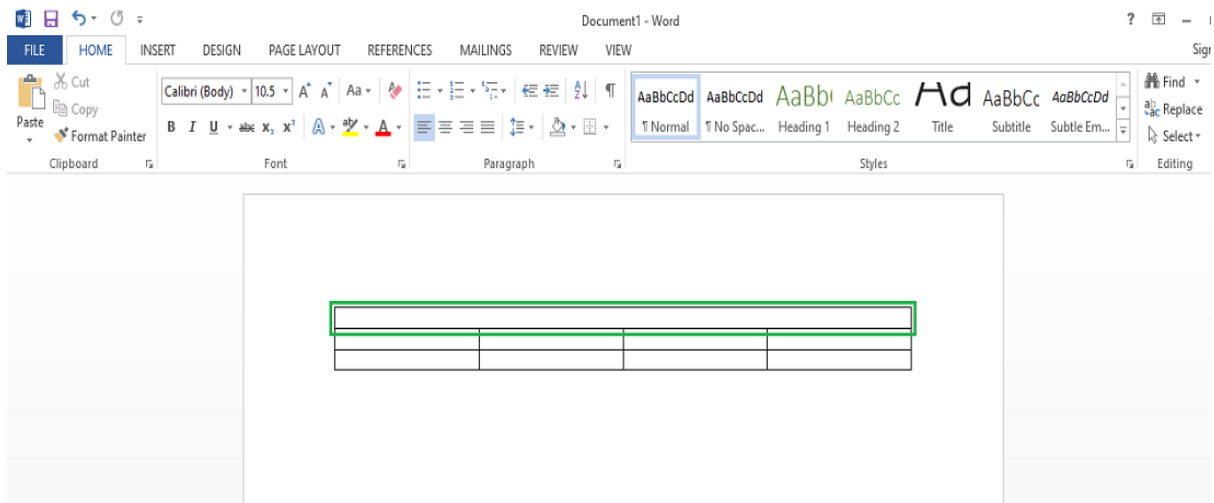
3. Merging the Cells

Merging of various cells can be done by the following steps:

Step 1: Select all the cells that are to be merged into a single cell. Then go over the layout tab, and you will see a Merge Cell button.



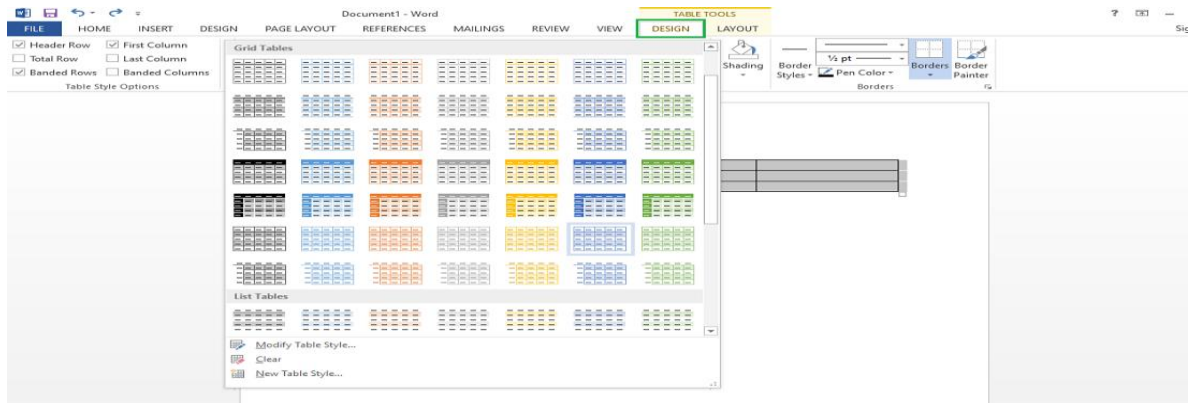
Step 2: Now click on the Merge Cell button and the selected cells will be merged.



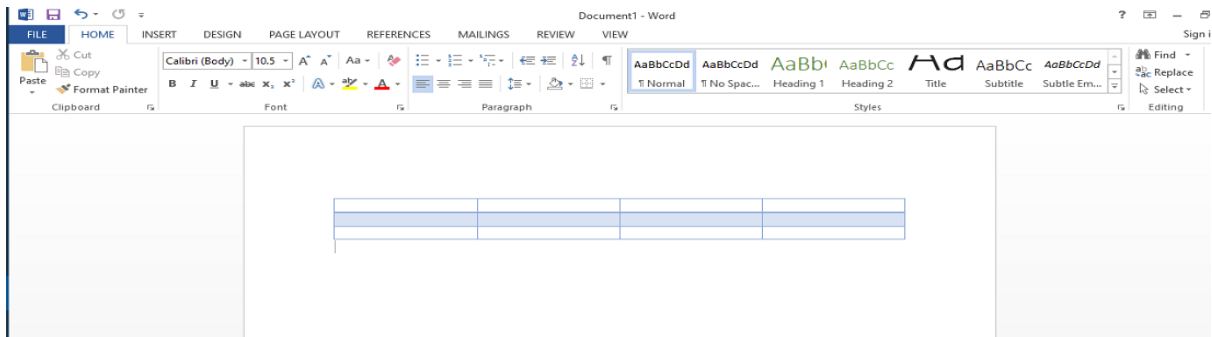
4. Applying Borders and Styles on a Table

Borders and styles can also be applied to a table in a similar way as the layout of a table is changed. Go through the following steps to do the same:

Step 1: Select the entire table and go over the design tab.



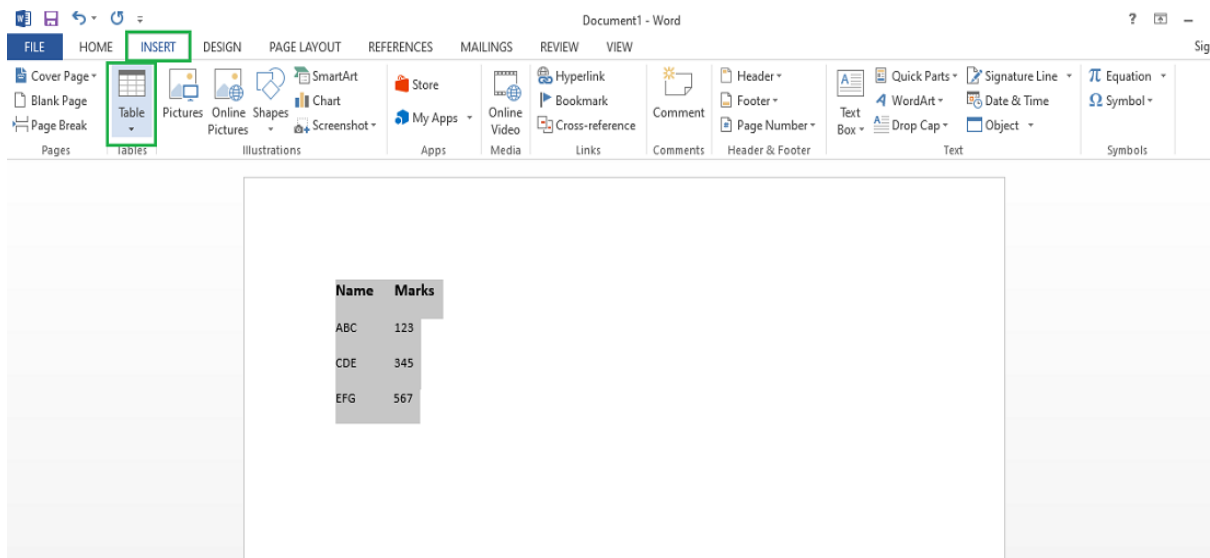
Step 2: Select the style that you want to apply to your table.



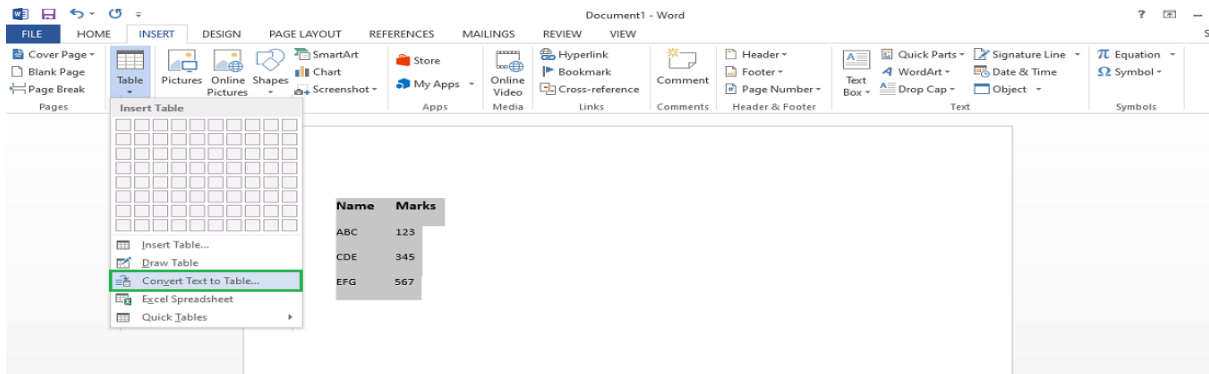
5. Converting Text to a Table

MS Word allows the conversion of existing text into a table with the help of the following steps:

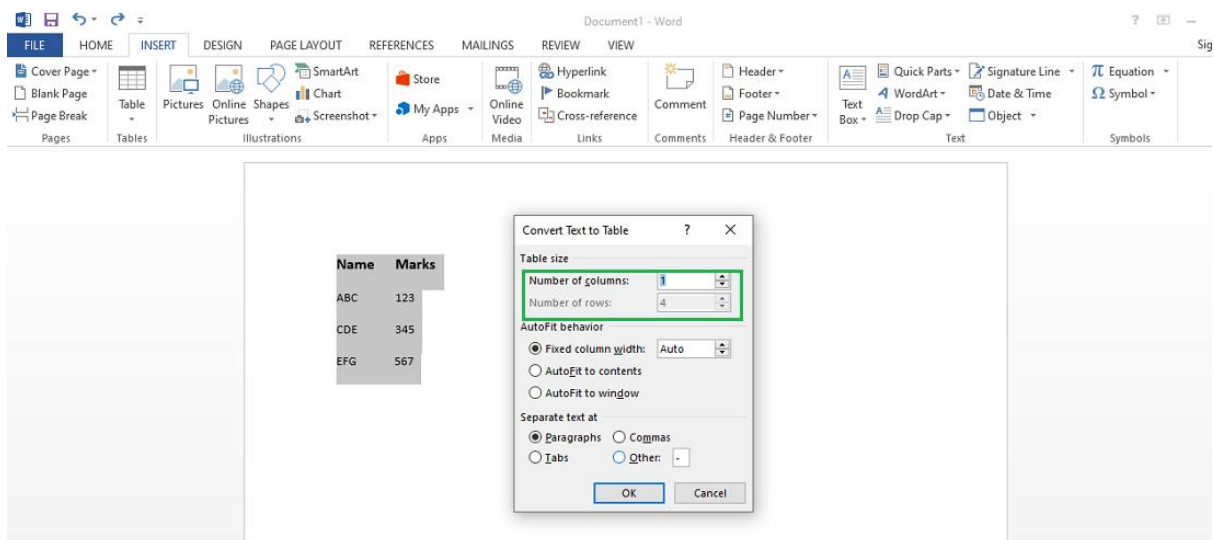
Step 1: Select the text that is to be converted into the table. Now go to the Insert Tab and you will see a Table button.



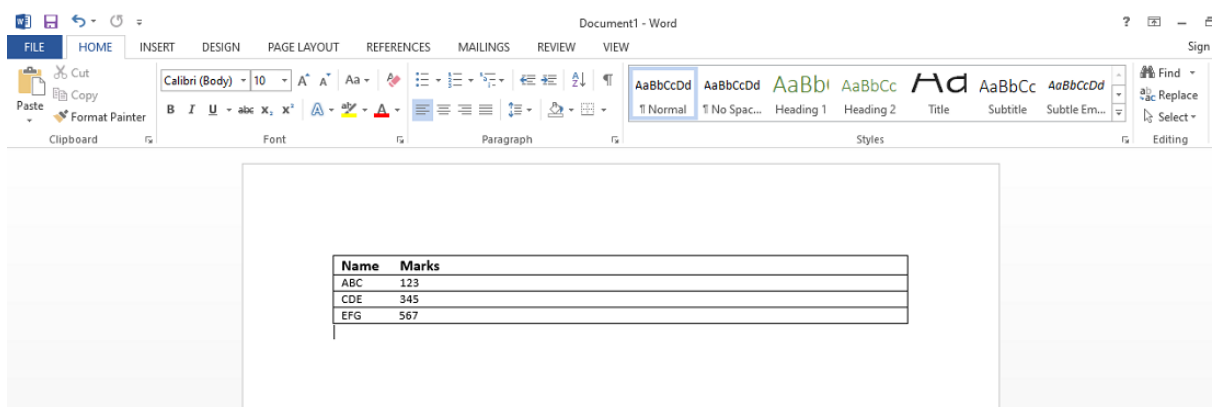
Step 2: Click on the Insert Table button and in the drop-down menu, click on the Convert Text to Table button.



Step 3: In the dialogue box, mention the dimensions of the required table and other data that is required.



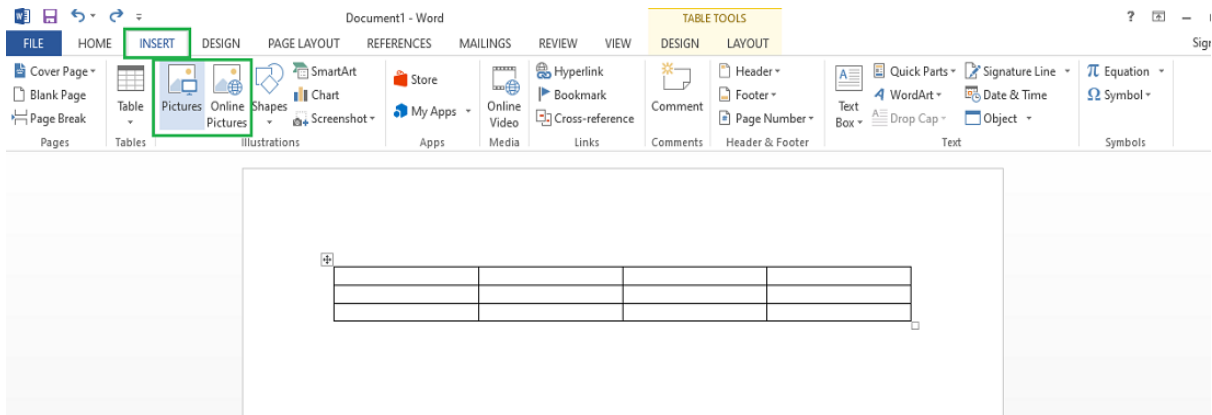
Step 4: Click on the OK button and the selected text will be converted to a Table.



6. Inserting Images in a Table

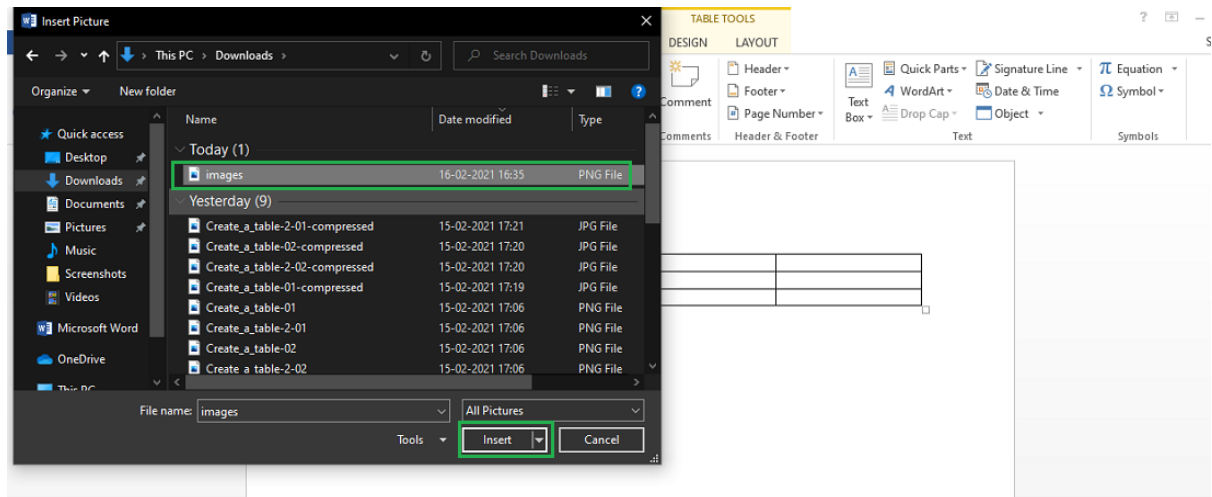
MS Word allows adding images inside the table cells. To insert an image in a table, go through the following steps:

Step 1: Select the cell in which you want to add the Image. Go to the Insert tab and select the Pictures button.

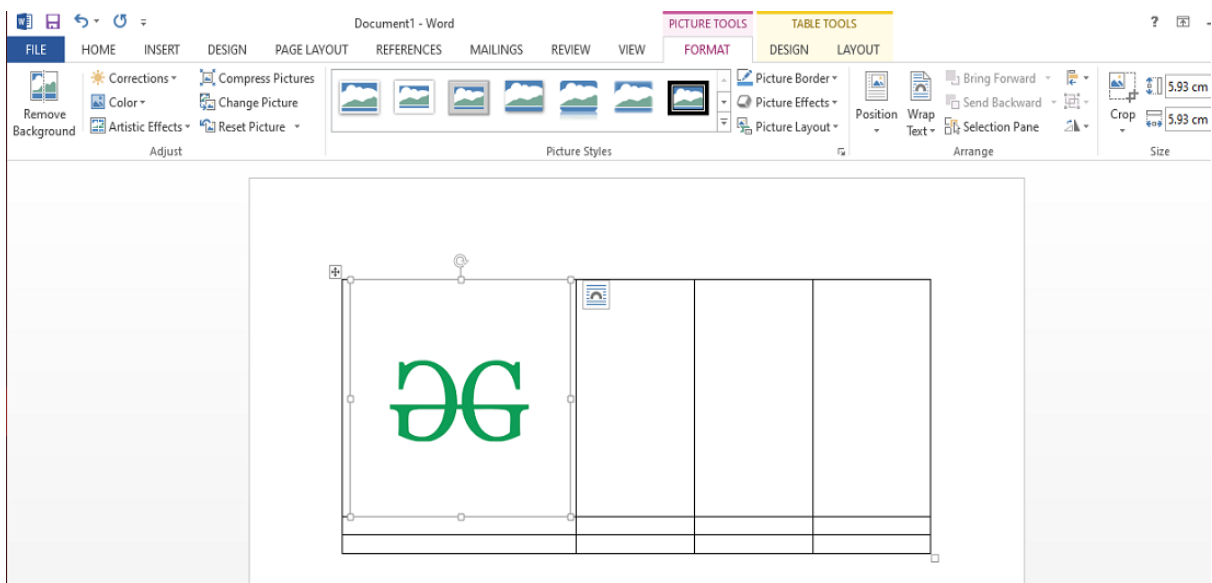


Step 2: You can either choose a picture from your device or select one online.

Step 3: Choose a picture from the browser window and click on the Insert button.



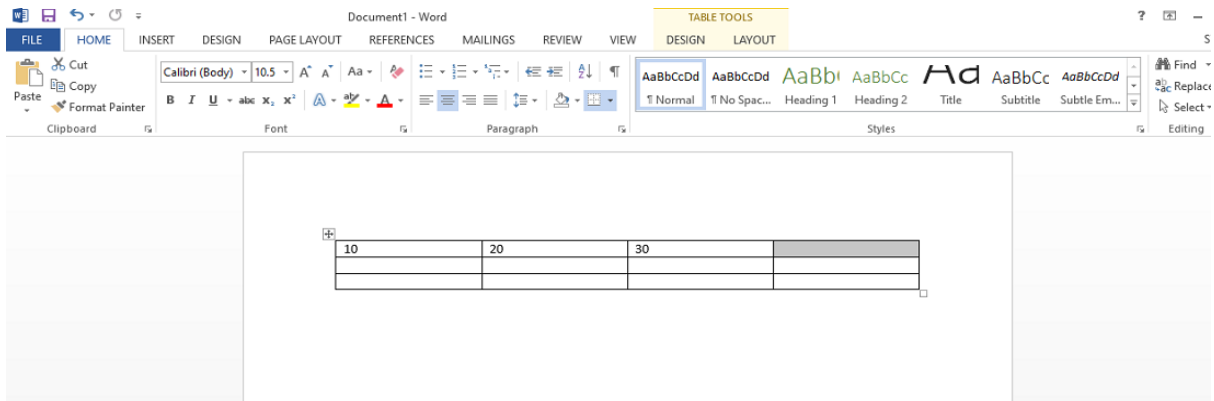
Step 4: Selected Image will be added in the cell selected.



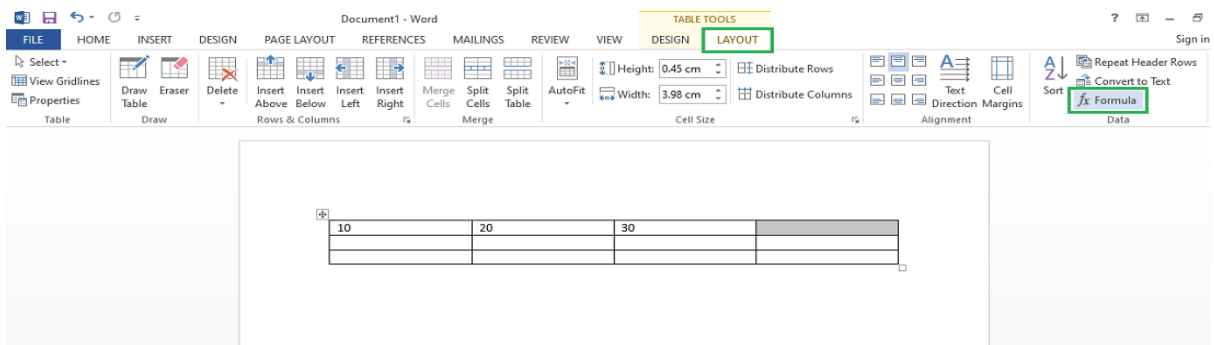
7. Performing Calculations in a Table

Mathematical calculations can also be performed on the values present in the table. Microsoft provides various formulas to perform these operations. By default, the sum of the values lying in the rows to the left or column lying above are calculated by Word. Following are the steps to do the same:

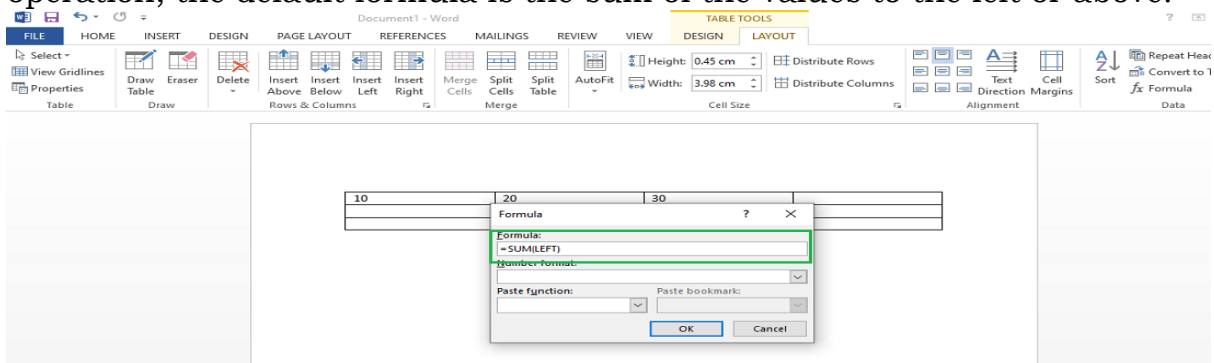
Step 1: Select the cell in which the result of the mathematical operations is required.



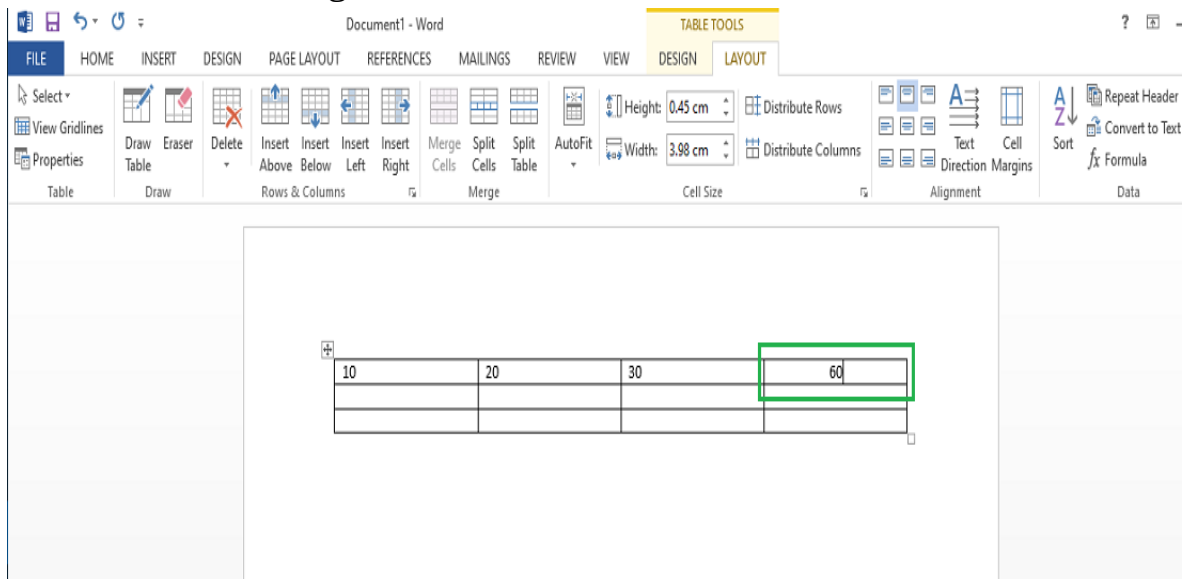
Step 2: Now go to the Layout tab and select the formula button.



Step 3: In the dialogue box, define the formula for the mathematical operation, the default formula is the sum of the values to the left or above.



Step 4: After defining the formula, click on the OK button to apply the formula on the cells given in the formula.



2.6. Micro Soft Power point presentation

Information can be displayed using an electronic presentation application. This information is usually presented as a slide show — the data is displayed on a slide that may be viewed on a computer monitor or projected onto a screen using an LCD projector. A presentation might consist of multiple slides that are exhibited one after the other. The presentation tool in MS Office is MS PowerPoint. Microsoft PowerPoint is a popular presentation application, although there are alternatives such as Corel Presentations OpenOffice.org, Impress, etc.

Three major components of a presentation program are:

- (i)** An editor that allows text to be input and formatted
- (ii)** Inserting visual pictures, audio, and video
- iii)** Slide-show system to display the final content.

I. Open MS PowerPoint:

In Windows 8/above

Step 1: Press Windows + c to open the search bar



Step 2: Type PowerPoint & click on the MS Office version you are having in your system. MS Office window will pop up.

In Windows 7 or below:

Step 1: Go to the program section in the windows start menu.

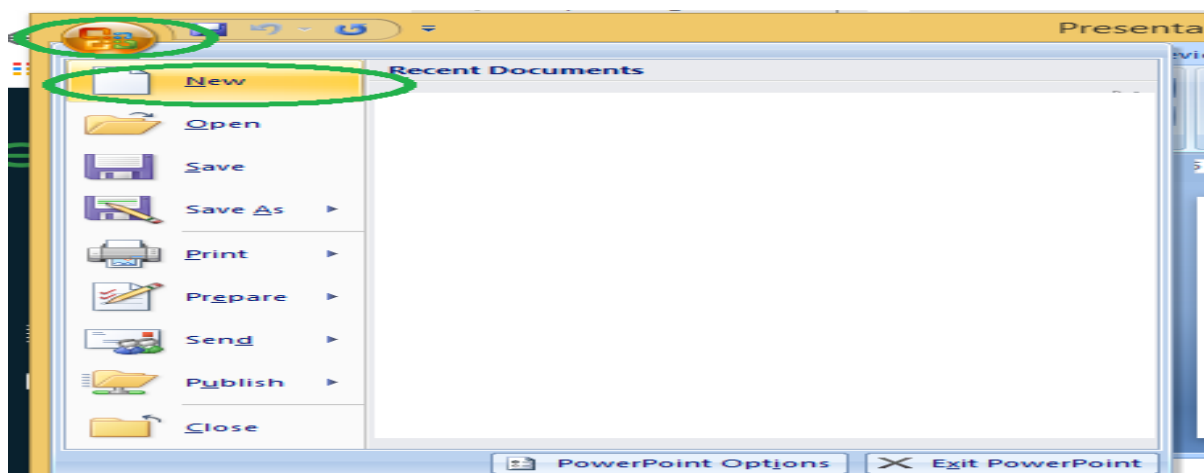
Step 2: Go to MS Office & click on it. A drop-down list is seen

Step 3: Click on MS PowerPoint & MS PowerPoint window will pop up.

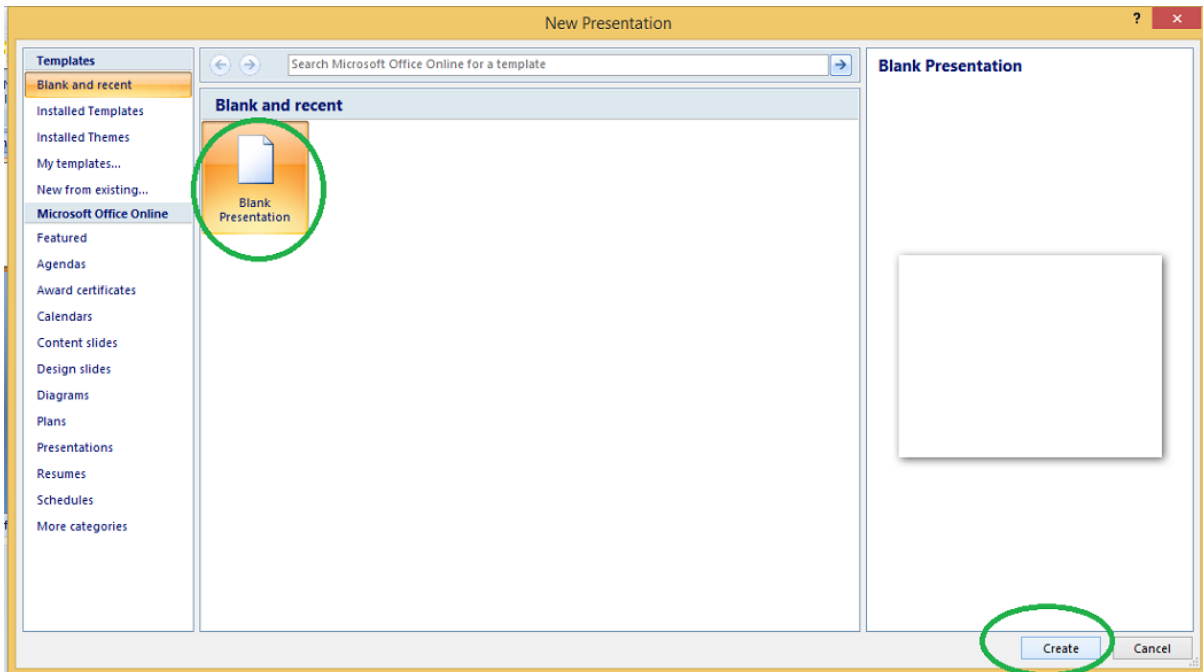
II. Creating a Presentation

Once your MS PowerPoint Window pops up, you can create & save the file by:

Step 1: Click on the Microsoft button on the top left.



Step 2: Click on new, a new Presentation window will pop up.



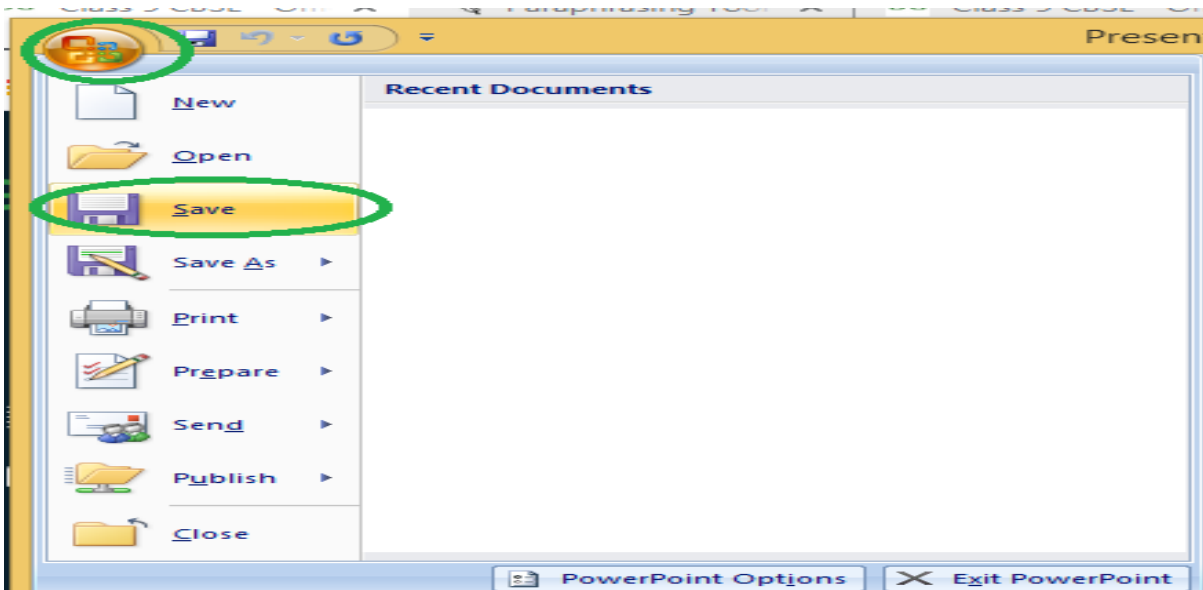
Step 3: Click on Create & a new presentation will be created. (Ctrl +n)

III. Saving a Presentation

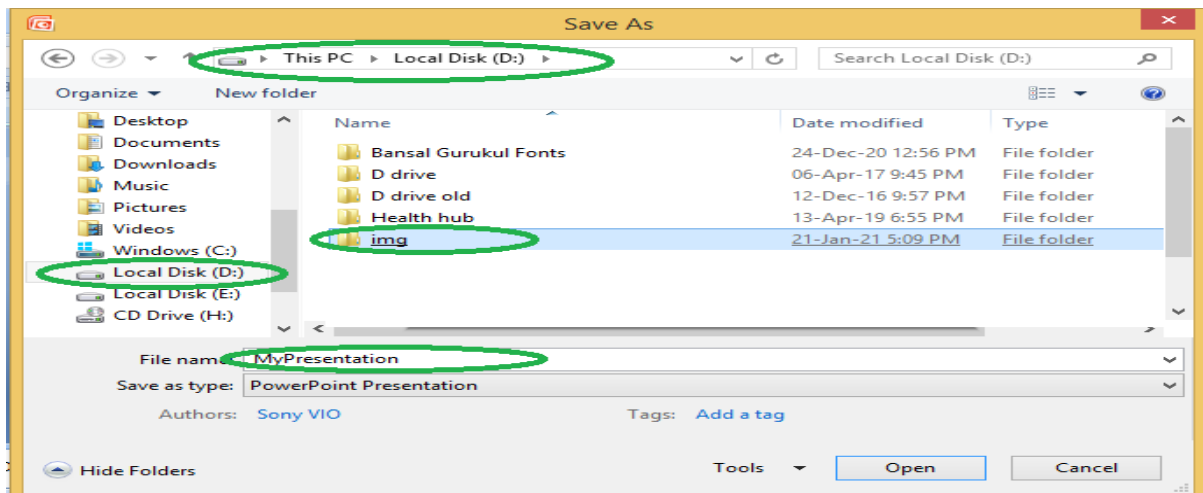
Once you have created a presentation, it can be easily saved with the help of following steps:

Step 1: Click on the Microsoft icon

Step 2: Click on the Save button



Step 3: A new Window for **Save As** will pop up.



Step 4: Select the drive (by clicking on it: Example: Local Drive (D)) in which you want to save the presentation. Then your drive will open up, select the folder in which you want to save the presentation (Example: img folder here) & then give the required name to your presentation (Example: My presentation here). Your presentation is created & saved with the provided name. (Ctrl + s).

2.6.1. Basic Elements of a PowerPoint Window/Slide

You can see various bars in the presentation window. They are:

(i) Title Bar:

This shows the name/title given by you to the current presentation. If user do not save the presentation by any name, default name given by MS PowerPoint appears in this bar.

(ii) Menu Bar:

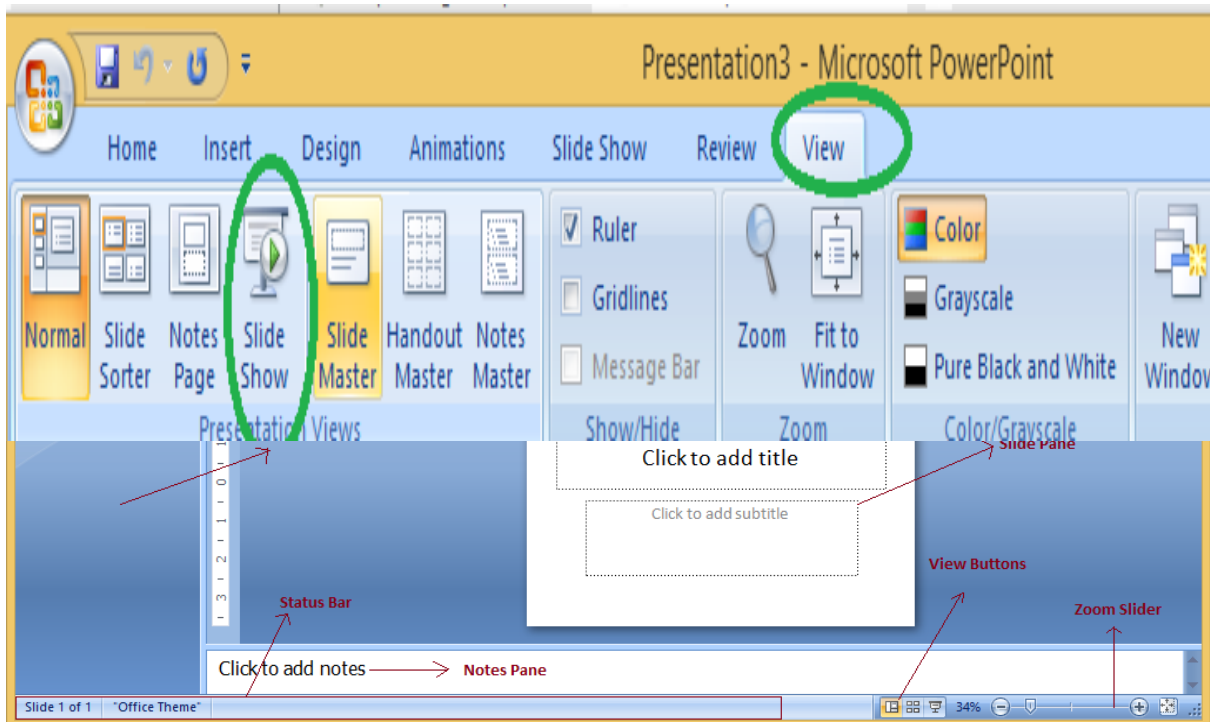
Contains menu items like insert, views, design, animations, etc.,

(iii) Office Button: MS Office button on the left-most top.

(iv) Formatting Toolbar: Have tools like Bold, Italic, Underline, Font shape & size etc. to format your data.

(v) Zoom Slider: To zoom in or zoom out your presentation.

(vi) Slide Sorter Pane: This allows us to choose which slides will be shown in which sequence during the slide show.



(vii) Notes Pane: This allows us to type notes that we may require later when preparing for the presentation, but they will not be displayed during the slide show.

(viii) View Buttons: Provides different views of your presentation like: normal, slide show & slide sorter.

(ix) Slide Pane: This is where we type, format, and otherwise design the slide.

2.7. Concept of Slide Shows

After preparing the presentation, it's time for the slide show. Steps for slide show are:

Step 1. Click on the view Option on the top Menu Toolbar

Step 2. Click on the slide show option.

Step 3. The slide show will start (Press Esc key (escape) to come out of slide show) (F5).

2.8. Animating Objects in MS PowerPoint

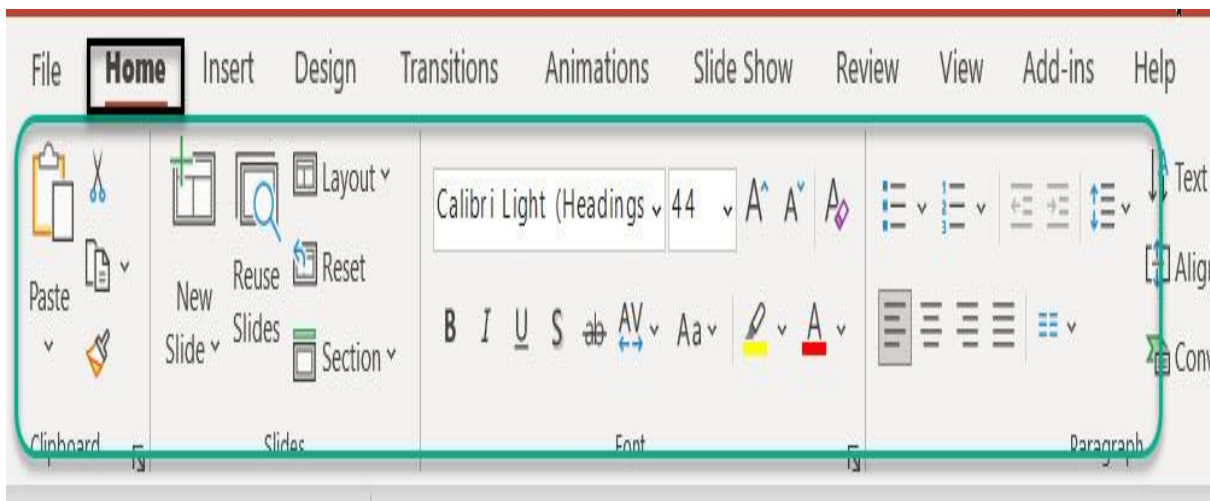
Animations in MS PowerPoint are the most interactive way to present the data to someone. Nowadays, animations keep people engaged with the concept which they are explaining using the help of PowerPoint. PowerPoint animations play a vital role to understand the most complicated topics very

easily. PowerPoint is commonly used by people in business and also the students to create the presentation.

Features of MS PowerPoint

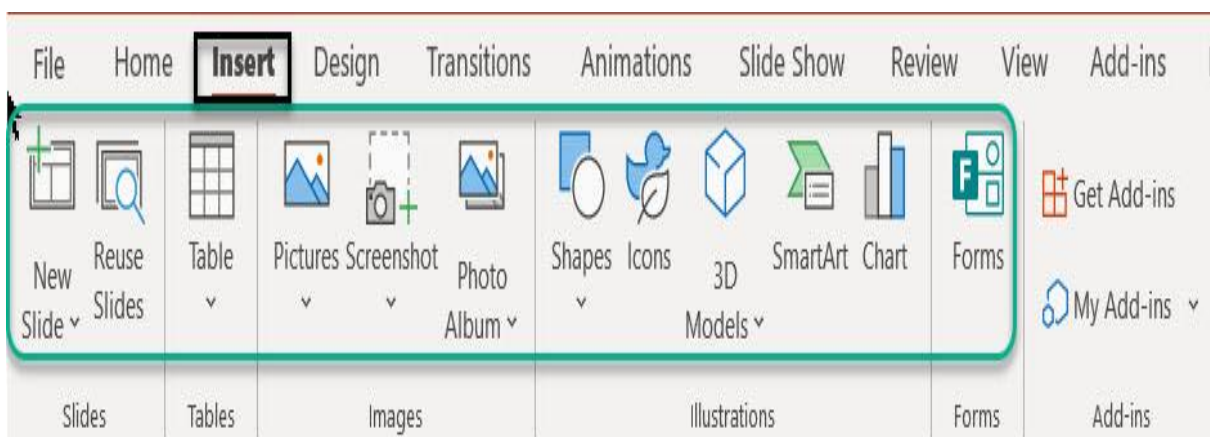
There are multiple features available in MS PowerPoint, among all, we will discuss a few of them below;

1. Slide Layout: There are multiple options available according to the requirement, based on which Presentations can be prepared. You can see the “Add Slide” option under the home tab itself.



2. Insert-audio, video, clipart

We can attach audio, videos, images, etc. inside the PowerPoint presentation to make the presentation more interesting. You can see all of them under the Insert tab.

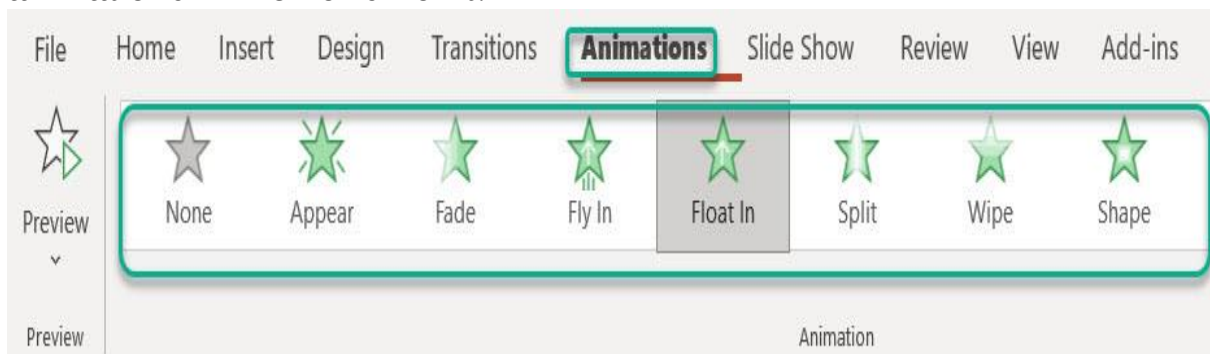


3. Slide-Design: MS PowerPoint has various themes using different types of textures and backgrounds as in-built. We can also create our own type of slide design and use it. You can see this option under the Design tab.



4. Animations

PowerPoint animations are used to create games or movies. But majorly it is used for the purpose of education and business sectors. You can see this option under the Animations tab. Now we will learn more about animations in MS PowerPoint.

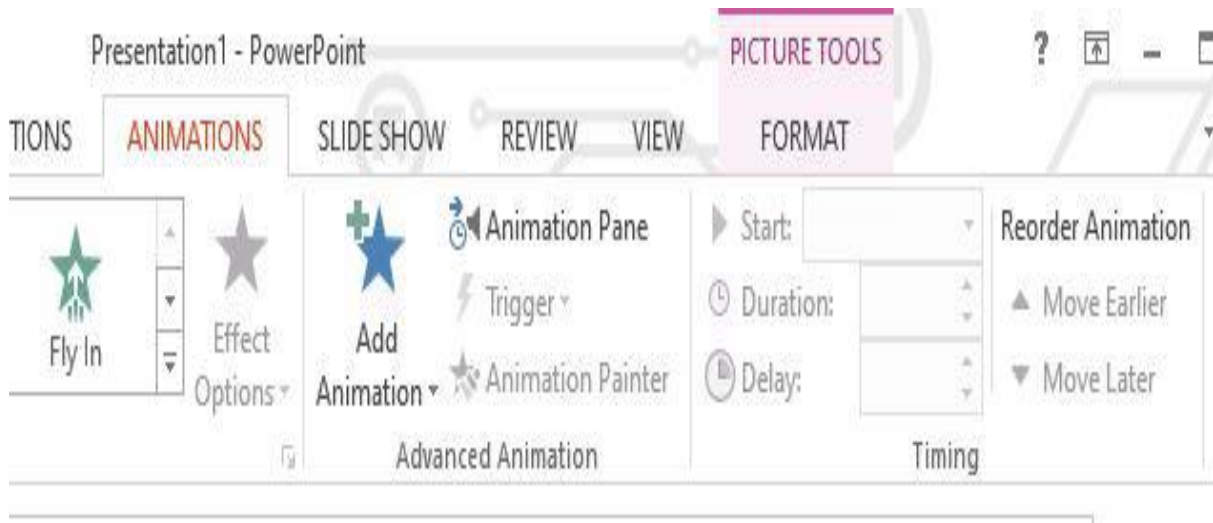


2.9. Animations in PowerPoint

Animations are one of the most important features of MS PowerPoint from which we can make creative templates out of it. Now we see the various options present under the animations tab and discuss them one by one:

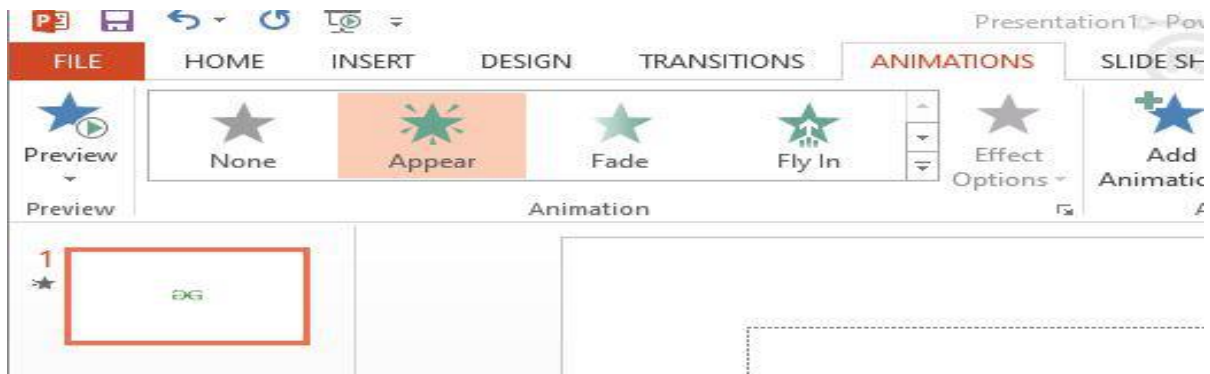
- Preview
- Type of animation
- Effect options
- Add Animation
- Animation Pane

- Trigger (available for new version)



1. Preview

Animation effects that you have applied will show when you play the slide show. You can preview the animations quickly for the current slide without clicking the option of the slideshow.



Steps to preview:

- Navigate to the slide you want to preview.
- From the Animations tab, click the Preview command. The animations for the current slide will play.

2. Type of Animation

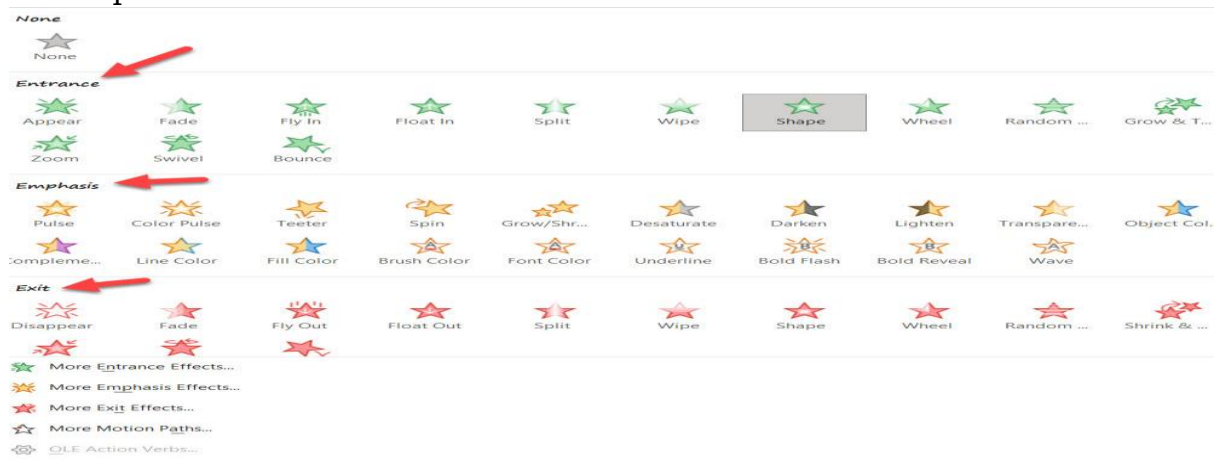
There are so many in-built animation effects provided by MS PowerPoint, and they are categorized into four types:

Entrance: It has animations telling that how an object should enter. For example, with the fly animation, the object will “fly” onto the slide from any of the 4 directions.

Emphasis: This type of animation usually occurs by the mouse clicks i.e when the object is already on the slide. For example, we can make the object wave after the entrance animation has finished.

Exit: These have a set of animations to control the exit animations. For example, in the Fade animation, the object will fade away.

Motion Paths: They are similar to emphasis animation effects, but these animations are a little advanced as the object will move in a specified path. These paths can be edited also.



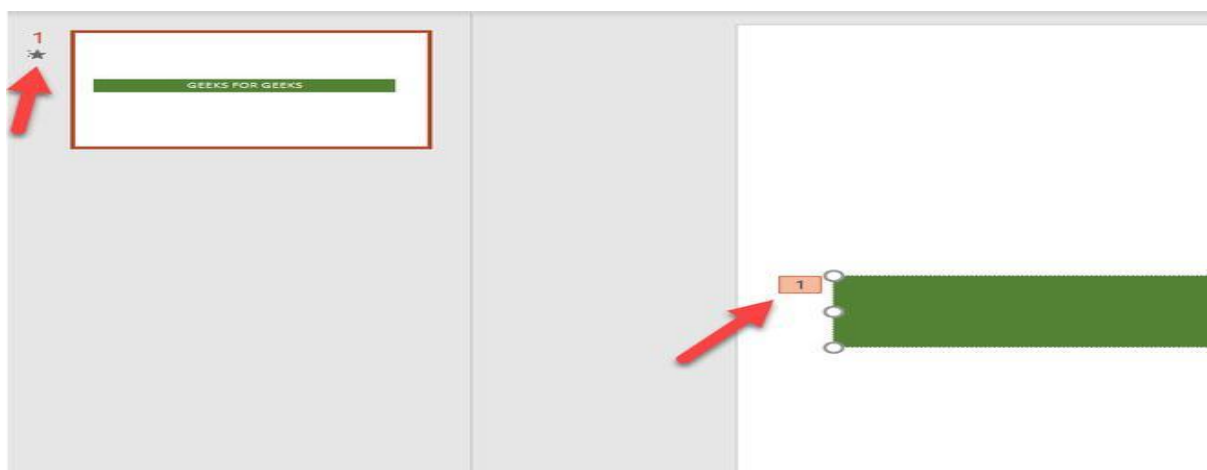
Steps to apply the animation:

Step 1: Select the object you want to animate.

Step 2: Go to the animation tab and click on the dropdown to view all types of animations.

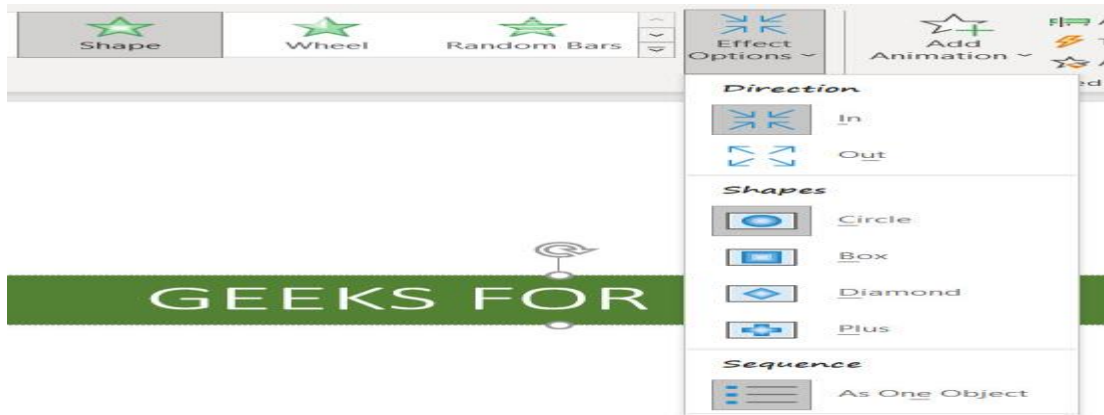
Step 3: A drop-down menu of animation effects will appear. Select the desired effect.

Step 4: The effect will apply to the object. In the Slide pane, a star symbol appears next to the slide, by which we can confirm that animation is applied.



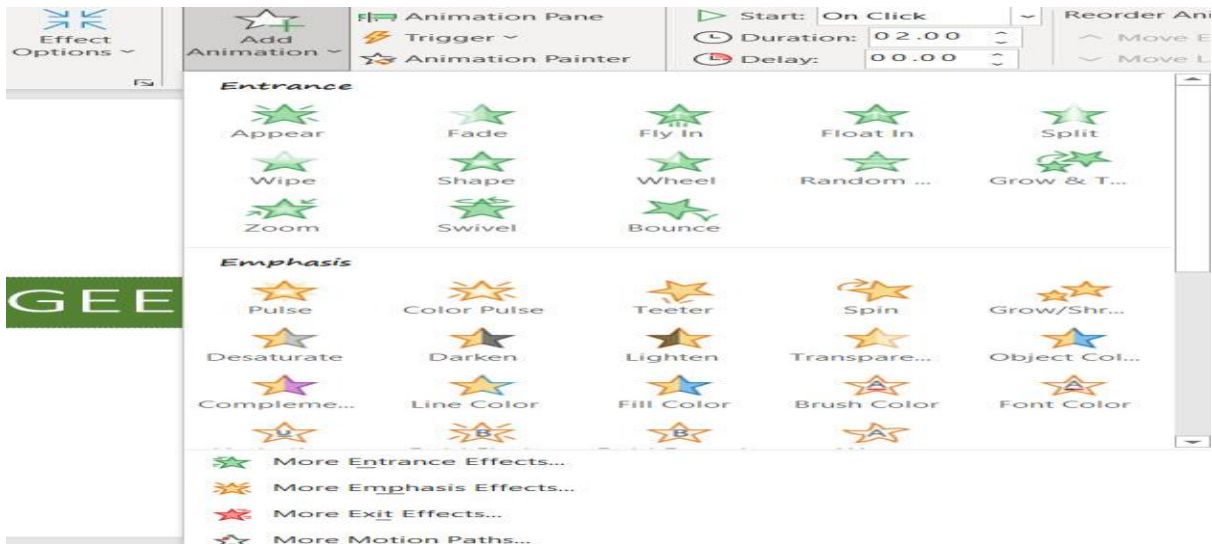
3. Effect Options

Some effects will have options you can change. For example, in the effect of the random bars, we can control that we need vertical or horizontal bars. We can use these options by accessing the Effect Options command in the Animation group. It totally depends on the animation which is selected.



4. Add Animation

If you want to add new animation then we can reselect in the animation group but to add new animation without changing the existing one we use this option. And sometimes to make the content interactive we need to add 2 or more effects. To apply these changes click on Add Animation command, this option will allow adding new animations without changing the old ones.



Steps to apply multiple animations to a single object:

Step 1: Select an object.

Step 2: Click the Animations tab.

Step 3: In the Advanced Animation group, we need to click the Add Animation command to view the available animations.

Step 4: Select the desired animation effect.

Step 5: If the object has multiple effects then for every effect it will show numbers according to the priority i.e numbers indicate the order in which the effects will occur.

5. Animation Pane

The Animation Pane option has the power to manage the timing of particular animations. You can easily modify the effects related to the animations like reordering the animations according to the preference and time interval.

Steps for Operating Animation pane:

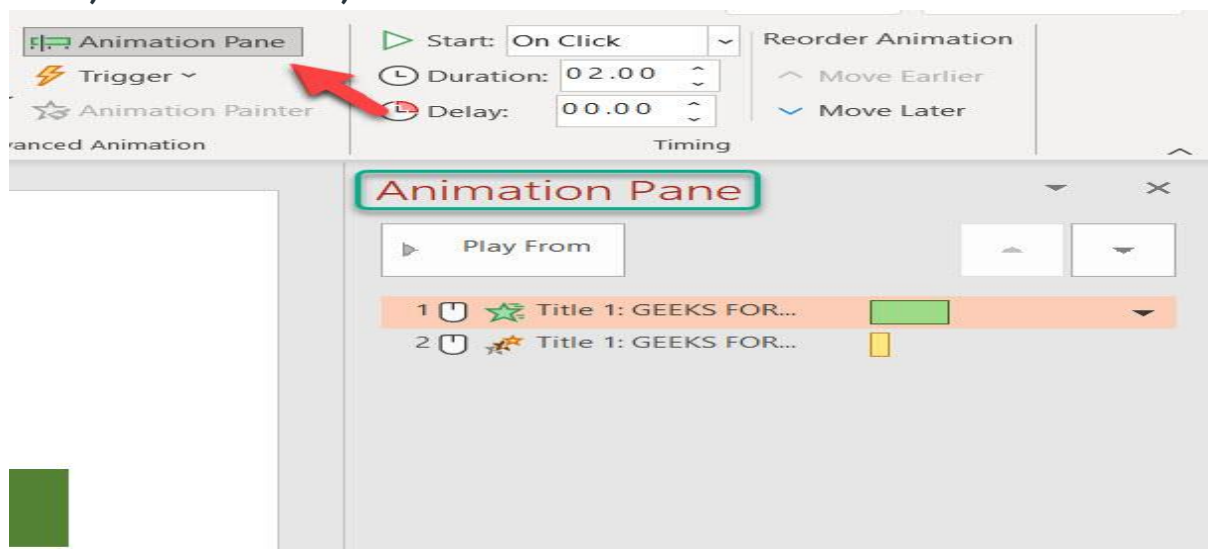
Step 1: Open the Animations tab, on the right side click on the animation pane option.

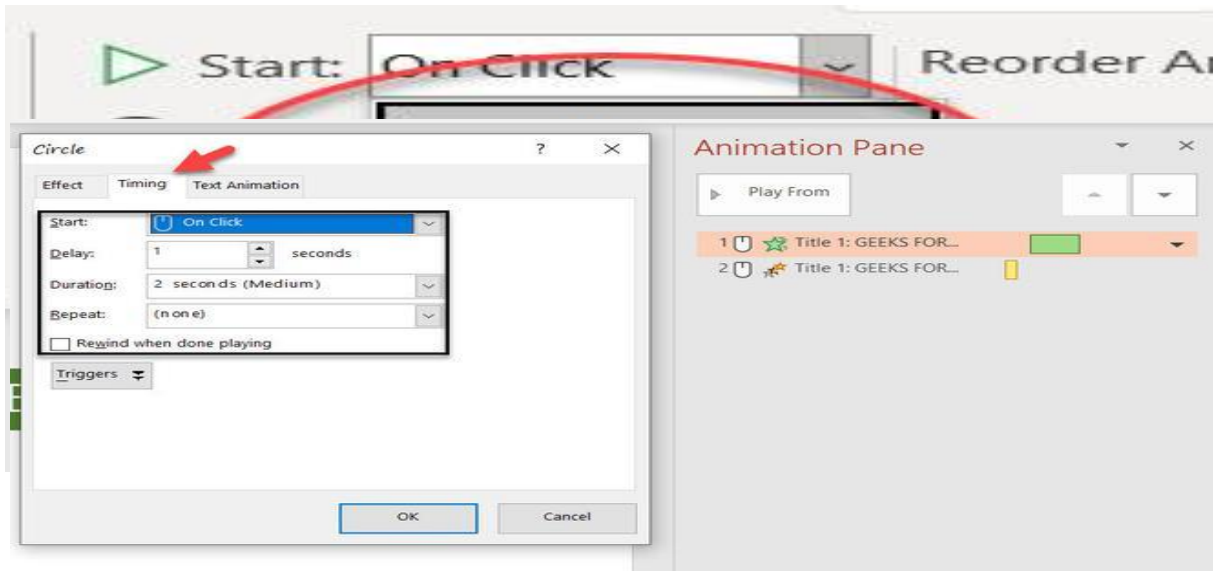
Step 2: A separate dialogue box gets opened on the right side of the window. It shows all the effects for the current slide in which they will appear.

Step 3: We can also set the start time, delay time, and also we can set when to move to the next slide, for this, we have 3 options:

- Start on Click
- Start with Previous
- Start after Previous

Step 4: We can reorder animations with the help of two options which are **a) Move Earlier** **b) Move Later**

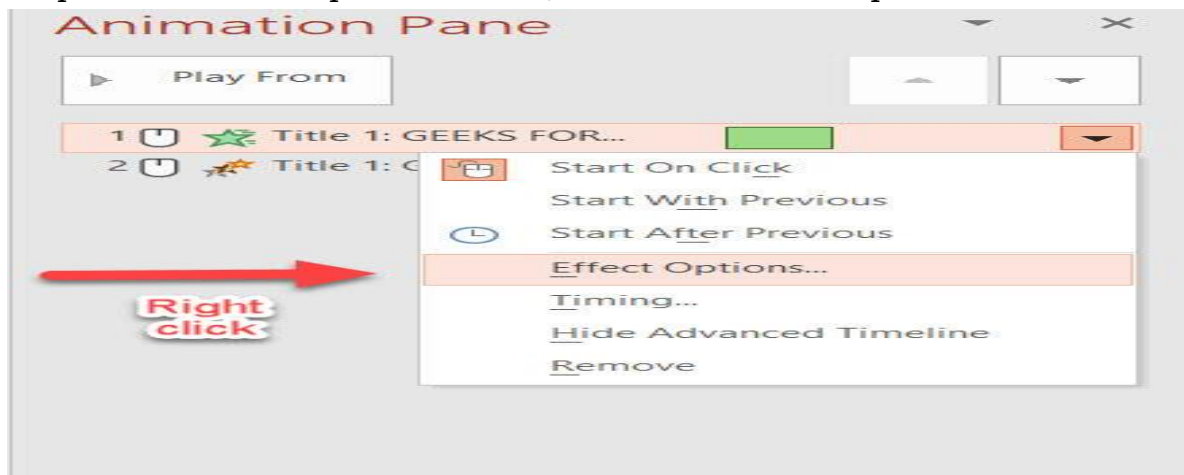




Steps to open the Effect Options dialogue box:

Step 1: From the Animation Pane, select an effect and right-click on it.

Step 2: Click the drop-down arrow, then select Effect Options.



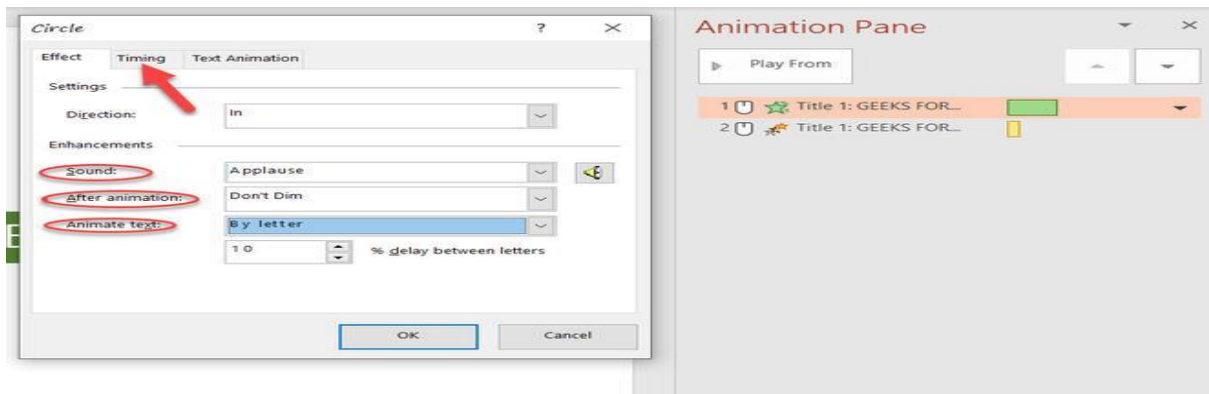
Step 3: The Effect Options dialogue box will appear. You can add extra enhancements to that particular effect:

Sound: Adds a sound effect to the animation

After animation: Changes the color or hides the object after the animation is over

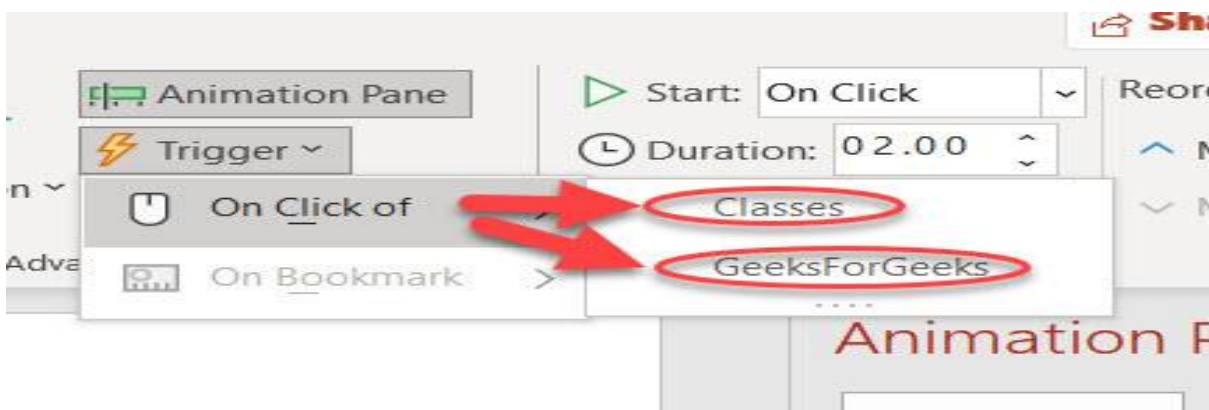
Animate text: This allows you to animate text all at once, one word at a time, or one letter at a time.

Step 4: In the timing tab, we can add the delay before it starts and change the duration of the effect, and control whether the effect repeats or not.



6. Trigger

A trigger is an object that you click to cause the animation to occur on a slide. Animation can be anything like motion, exist emphasis, or entrance motion path. You can click on any one object to trigger the animation of another object, but it is also possible to make the trigger object and the animated object the same. Generally, the animations happen in a pre-set order.



Steps to apply trigger:

Step 1: Firstly select the object to which you want to add a trigger.

Step 2: Now click on the trigger option in the animations tab and select on click option.

Step 3: Now you can see a list of animations applied to that object.

Step 4: We can select what should happen if we click on that object i.e which animation should take place



2.10. MS Excel: Worksheet and Work Book

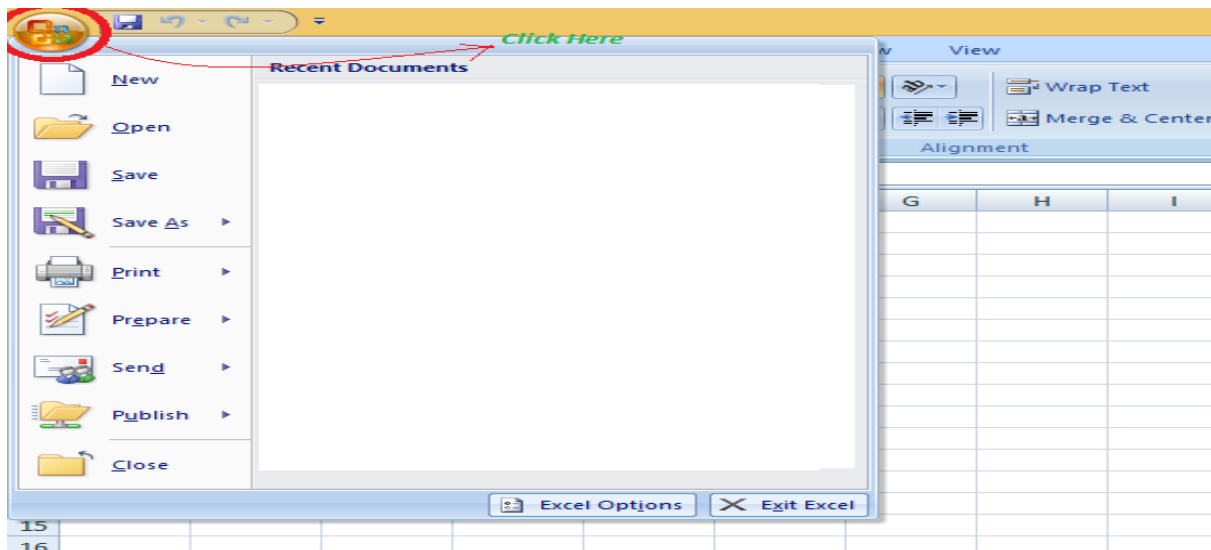
A collection of worksheets is referred to as a workbook (spreadsheets). Workbooks are your Excel files. You'll need to create a new workbook every time you start a new project in Excel. There are various ways to begin working with an Excel workbook. You can either start from scratch or use a pre-designed template to create a new workbook or access an existing one.

I. Creating a new Workbook

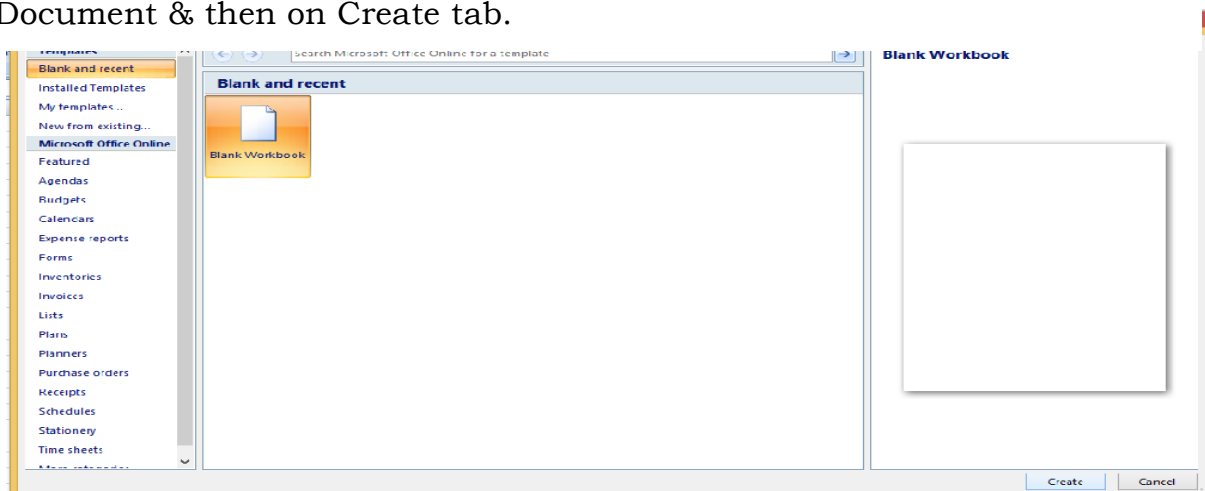
Follow these steps to create a new Blank workbook, giving a name to it & saving it:

Step 1: Click on the Microsoft Office button on the top-left corner.

Step 2: Then click on New.



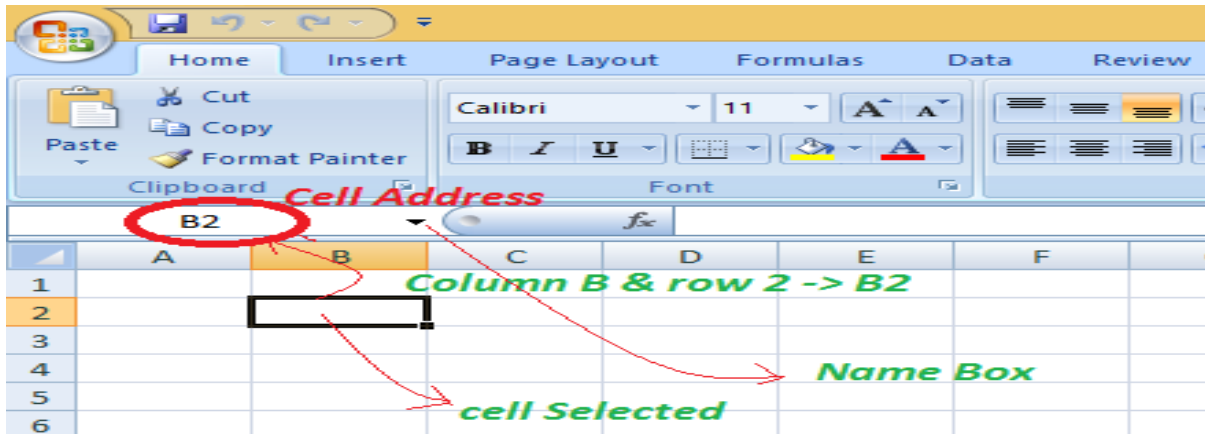
Step 3: A dialog box for New Workbook will pop up. Click on blank Document & then on Create tab.



A new blank workbook is created & it appears on your screen.

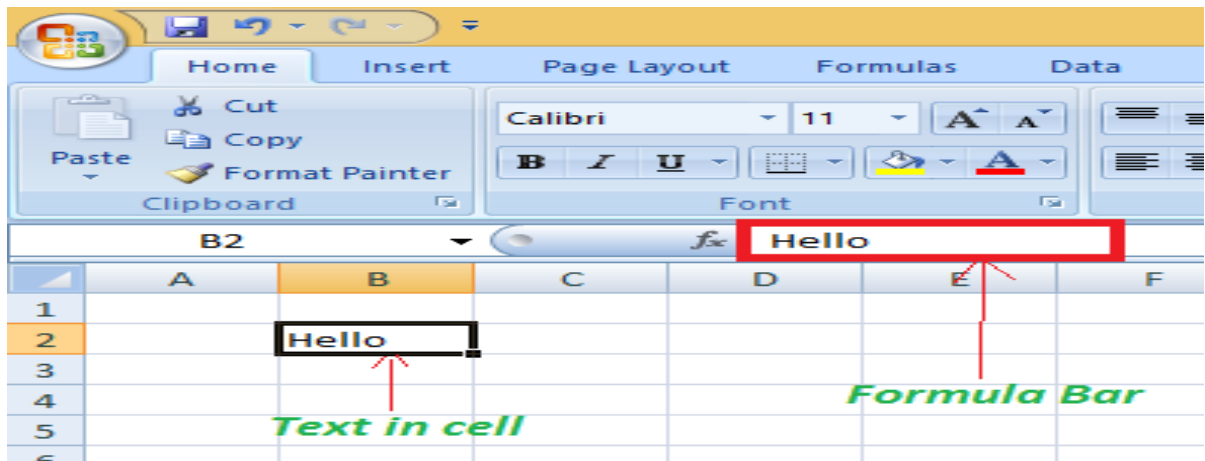
II. Inserting Text in Excel

In Excel, you can see multiple rows & columns, each rectangular box in a row or any column is called a Cell. A cell address on a worksheet can be determined by combining a column letter and a row number. Using these addresses, we can refer to any cell (in Excel formulas) in the worksheet. As you click on any of the cells, you can see its address in the name box (Left most side below the home tab).



Step 1: Select a cell in which you want to insert text.

Step 2: Insert your data by typing something from the keyboard (In that selected cell)



Whatever text you enter, the same text appears in the formula bar too (for that cell).

III. Edit/Delete Cell Contents

Step 1. Select the cell to change or delete the text.

Step 2. To erase text and make a correction, press the Backspace key on your keyboard.

Or, to erase the whole contents of a cell, press the Delete key.

Or, the formula bar also allows you to alter and erase text. Simply select the cell and then position your cursor in the formula bar.

Navigation in Excel

Step 1. Go to the right of the selected cell, press the Tab key.

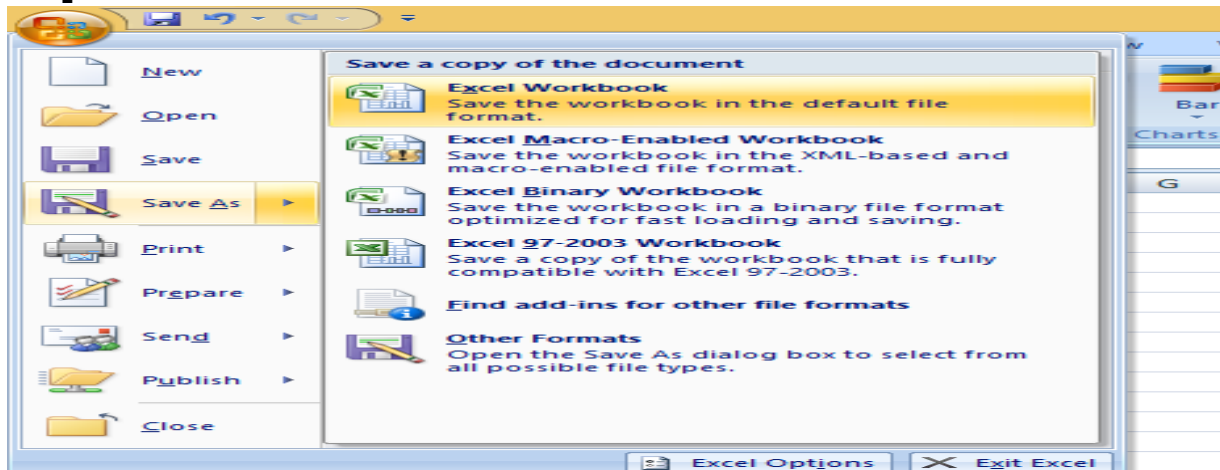
Step 2. To move to the left of the selected cell, hold down Shift and then Tab.

Step 3. To traverse the worksheet, use the Page Up and Page Down keys (with Shift in Laptops).

Step 4. Use the arrow keys to navigate.

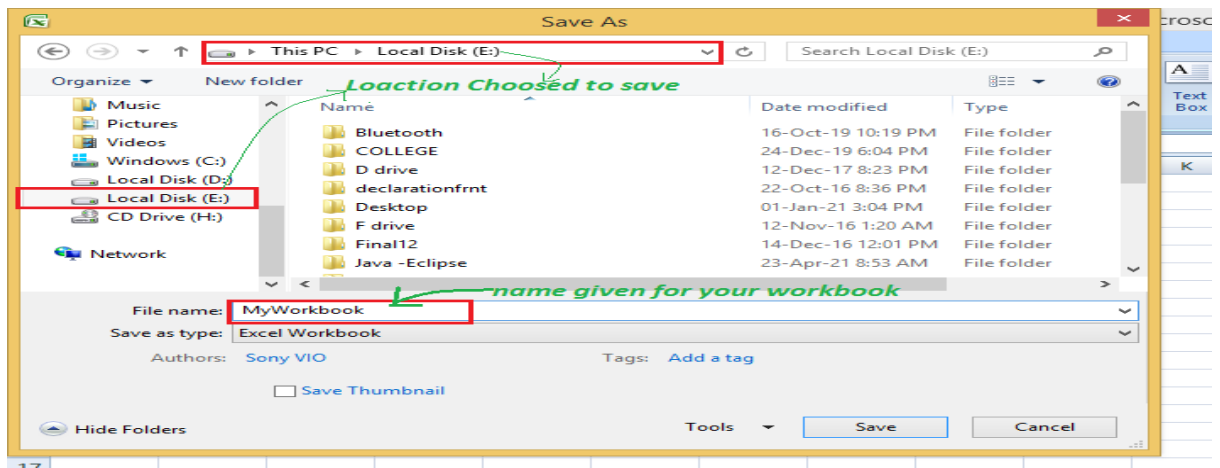
IV. Saving the Workbook

Step 1. Click the Microsoft Office button on the left.



Step 2. Save or Save as are the options, choose one.

Save As – lets you give the spreadsheet a name and save it in a specific location. If you want to save the file for the first time, or if you want to save it under a new name, select Save As. If the file has already been named, just choose Save/press Ctrl + S to save your work.



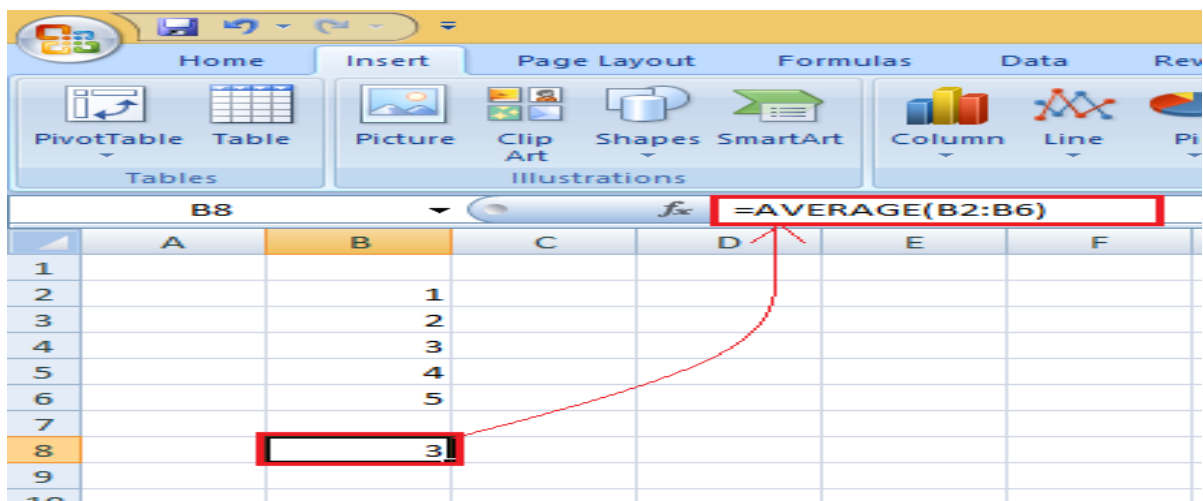
V. Using Formulas in Excel

You can use predefined Excel formulas by just typing: “=**Formula Name (Arguments)**”. When you type the first few characters of any formula, excel provides a drop-down list of formulas matching that sequence of characters.

Example: To get an average of numbers present in the column B from row 2 to row 6, you can use the formula: = *AVERAGE (B2:B6)*

Here B2:B6 defines the range of the numbers on which you want to do average.

You can see the formula in the formula tab near the name box.



Here in the cell: B8 we wrote: = *AVERAGE (B2:B6)*, so we get average as = $(1+2+3+4+5)/5 = 15/5 = 3$.

So, in this way you can easily create a workbook, work on it, and navigate through it & save it.

UNIT – III

DATA PROCESSING

3.1. Introduction

Data Analysis with Excel is a detailed lesson that gives readers a clear understanding of the newest and most sophisticated functions offered by Microsoft Excel. It describes in detail how to use MS-capabilities Excel to carry out various data analysis tasks. The guide includes a good amount of screenshots that step-by-step demonstrate how to use various features. One of the most used programs for data analysis is Microsoft Excel. You can simply import, browse, clean, analyse, and display your data using this all-in-one data management tool.

3.2. Data Analysis

Data analysis is the process of inspecting, cleaning, transforming, and modelling data to discover useful information, draw conclusions, and support decision-making. It involves a variety of techniques and methods for extracting insights from raw data, with the ultimate goal of gaining a deeper understanding of patterns, trends, relationships, and characteristics within the dataset.

Data analysis with Excel is a common and accessible way for individuals and businesses to analyze and visualize data. Microsoft Excel provides a range of tools and functions for performing basic to advanced data analysis tasks. The software enables users to seamlessly import and organize data from various sources, facilitating a structured foundation for analysis. Data cleaning becomes an intuitive process with Excel's capabilities, allowing users to identify and rectify issues like missing values and duplicates. PivotTables, a hallmark feature, empower users to swiftly summarize and explore large datasets, providing dynamic insights through customizable cross-tabulations.

3.3. Types of data

Microsoft Excel software, there are four different Excel data types. These four different data types represent four different values. Each data type enables users to perform a different function, which is why it's extremely valuable to understand each type and understand how to use these different

data types and their functions. The different data types may also change their form in spreadsheets once exported onto them. Excel data types is important because they form the foundation of the advanced functions taught in Microsoft Excel training courses. The four major data types in Excel are:

1. Number

This data type is used to represent numerical values, such as the number of employees, phone numbers of group members, and value of money spent. The number data type also allows you to input percentages, decimals, dates, times, and integers using a workbook in Excel. In Excel, you can input number data from minimal to substantial values, but you should remember that Excel supports a maximum of fifteen digits in a cell. After the fifteenth digit, Excel removes them and replaces them with zeroes.

2. Text

This is the most basic data type in Microsoft Excel. Text data allows you to input characters such as alphabetical, numerical, and special symbols. However, unlike number data, numerical symbols inputted as text data do not support calculations. Excel allows you to manually switch between text and number data to ensure it operates as you want. However, by default, Excel may categorize figures it doesn't recognize as text data. To convert numbers stored as text data to number data, highlight the cells or columns. On the 'Data' tab, click 'Text to Columns,' then click 'Finish.'

3. Logical

Logical data types are some of the most powerful tools you can use on the software. Excel displays logical values as either TRUE (or 1, in Boolean value) or FALSE (or 0 in Boolean value). Unlike the previous data types, you cannot manually type any of the basic Logical data into an Excel worksheet.

Here are the basic Logical Excel functions:

- AND - used when you want to check if your data meets multiple conditions. You can use it to check if the value in one cell is bigger than those in another.
- OR - used to compare values or statements in your data that meet a condition. If none of the data matches your conditions, Excel produces a false value.

- XOR - short for Exclusive OR, XOR is used when only one argument in your data can be marked as True or False.
- NOT - used when you want to filter arguments that don't match your conditions. Arguments that meet your conditions in the data are marked as True, while those that don't are marked False. These functions will also help you extract duplicates in Excel.

4. Error

When Excel recognizes a mistake or missing information while processing your data, it outputs 'Error' data. For example, if the beginning or end quote is missing in a formula, Excel will display #NAME? and #NUM! for an invalid formula or function.

5. Linked Excel Data Types

Microsoft Excel also allows you to input data sourced online into your worksheet. These data types can be inputted as 'Stocks Data' and 'Geography Data.' Both are considered linked data types in Excel. These data types allow you to insert a live value from the stock market or information about geographical locations. The data is sourced from the internet.

You can only use the 'Stocks' and 'Geography' data types with a Microsoft 365 account or with a free Microsoft Account.

3.4. Data Entry

In the dynamic world of Microsoft Excel, there's an often-overlooked gem that can revolutionize how you input, manage, and validate data within your spreadsheets – the Excel Data Entry form. Whether you're a novice user, you can unlock the power of data entry forms and streamline your spreadsheet operations.

Excel Data Entry Form

Data Entry Form is a form that helps to enter the data with the help of a form in which the data can be added, searched, and previous data can be deleted. Data entry in Excel without forms can be very time-consuming. There are two major issues faced while conducting data entry without forms in Excel:

1. Time-consuming: Without forms, data needs to be entered in one cell at a time, then go to the next cell and enter the data for that cell, and so on. Sometimes, due to confusion, the user might need to scroll up and see which column is it and what data needs to be entered and then come back to the current position. Similarly, in the case when the user needs to scroll right and then come back to the beginning.

2. Error-prone: If there is a huge dataset that needs 100 entries to be entered in the form. In that case, there may be a possibility that the user unintentionally enters the wrong data in the cell.

Data entry using forms in Excel helps to overcome all these limitations and makes the task of entering data less time-consuming and less error-prone. In this article, let's have a look into how to Data Entry Forms in Excel.

How to Add the Form Tool to Excel

To add the form tool, we need to make it visible as it's hidden by default. For this, we need to add it to the ribbon.

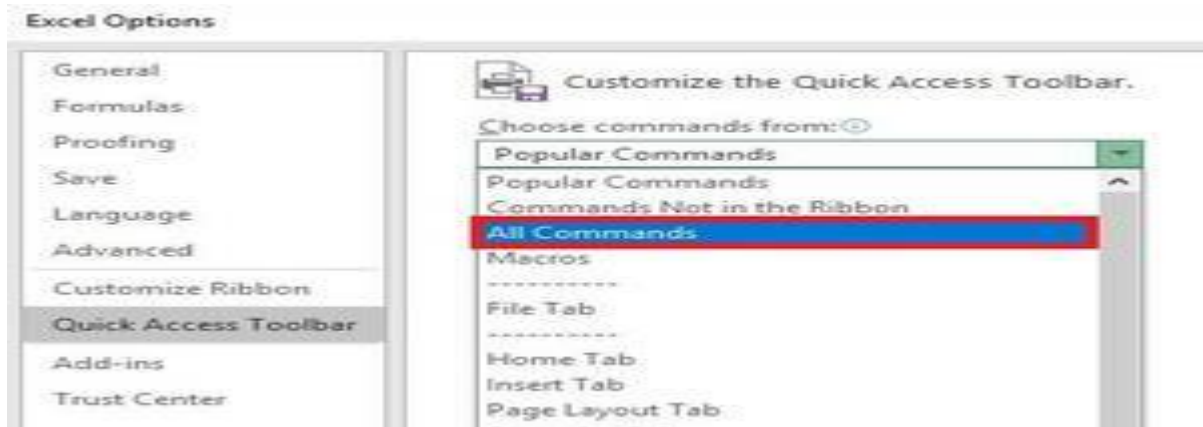
Step 1: Right-click on the Quick Access Toolbar

To add the Data Entry Form option on the Quick Access Toolbar. First, right-click on any of the existing icons in the Quick Access Toolbar. Then, click on "Customize Quick Access Toolbar..."



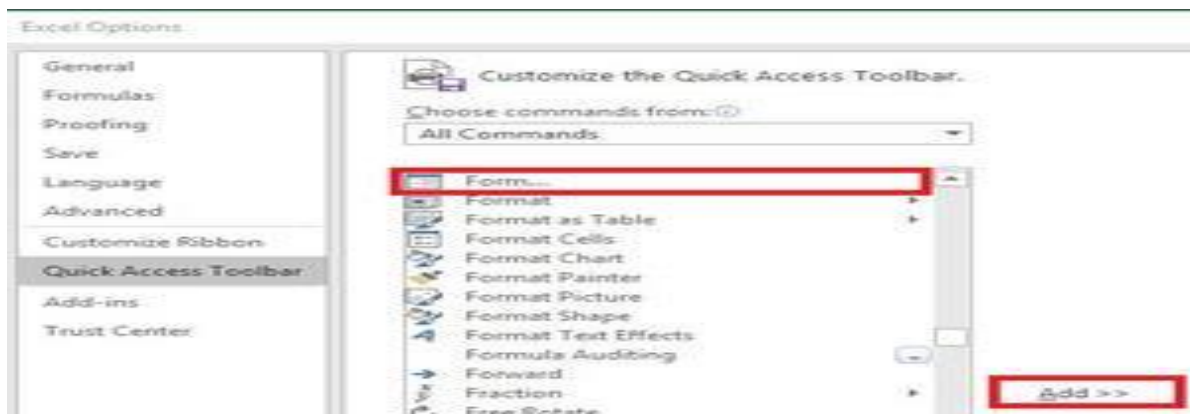
Step 2: Select All Commands

In the "Excel Options" box select "All Commands" in Choose commands from.



Step 3: Select Form and Click Add

Select “Form” from the list of commands then click on “Add>>”, and then click Ok.



Step 4: Preview Form Icon

Now, the Form icon is added on Quick Access Toolbar.



How to Make Data Entry Form in Excel

If you’ve ever struggled with typing data directly into Excel cells, Excel offers a nifty solution called a “Data Entry Form”, designed to make entering, managing, and validating data a breeze. You just need to enter your data in a table and click on form button. Follow the below steps to create a Data Entry form:

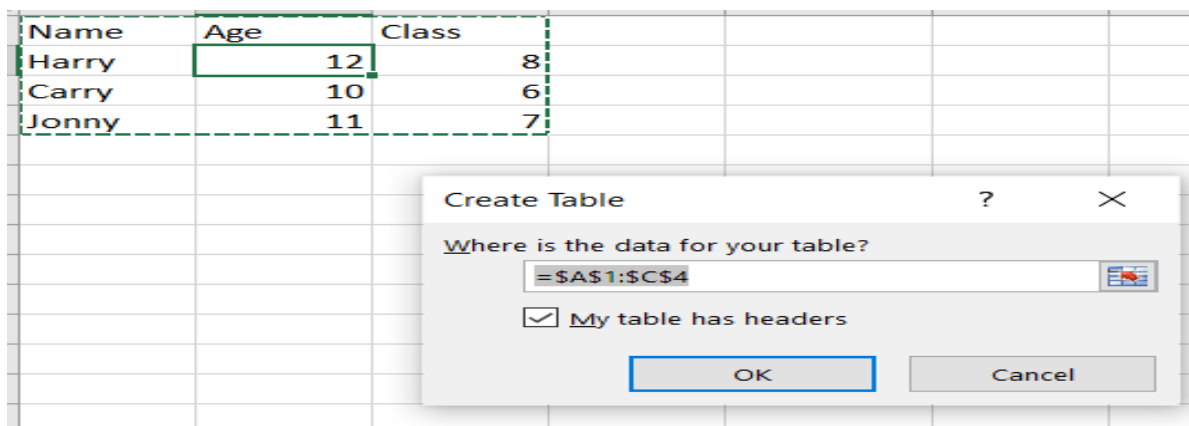
Step 1: Prepare your Data

Begin setting up your data in an Excel table. If you're starting from a scratch, type your column headings in the first row. If you're working with an existing dataset, then you can ignore this step.

	A	B	C
1	Name	Age	Class
2	Harry	12	8
3	Carry	10	6
4	Jonny	11	7
5			
6			

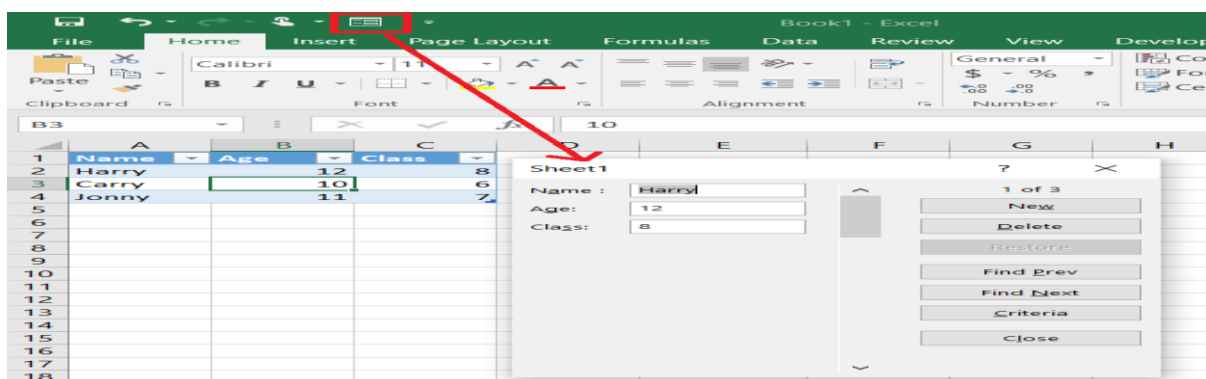
Step 2: Create or Convert to a Table

You can create your table and enter the data in a new spreadsheet or if working on an already existing spreadsheet then select any cell within your dataset and press **“Ctrl +T”** together. This shortcut will transform your data into functional table.



Step 3: Create the Form

Now place your cursor anywhere within the table, and now click on the **“Form”** button.



How to Add a New Record in Data Form

This section will discuss the steps to use the data entry form in Excel.

Step 1: Select the Cell and Click on Form Icon

Select any cell from any column and then click the “Form” icon.



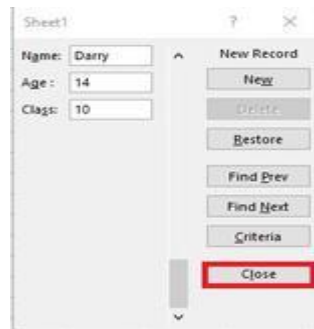
Step 2: Click on New in the Sheet1 Box

After that to add a new row click on “New” in the Sheet1 box.



Step 3: Enter Information and Then Click Close

Then, Add Name, Age, and Class, and then click Close.



Step 4: Preview the Row

Now, our row is added.

	A	B	C
1	Name	Age	Class
2	Harry	12	8
3	Carry	10	6
4	Jonny	11	7
5	Darry	14	10

3.5. Data Storage and Retrieval

Data storage is the process of saving data in a persistent and accessible way. Data can be stored in different formats, such as files, databases, data warehouses, or data lakes. Data storage involves choosing the right storage medium, such as hard disks, solid-state drives, tapes, or cloud services, and the right storage architecture, such as hierarchical, network, relational, or object-oriented. Data storage also requires ensuring data quality, security, and backup.

Data retrieval

Data retrieval is the process of accessing and extracting data from a storage system. Data retrieval involves using queries, commands, or applications to locate and retrieve the data that meets certain criteria or needs. Data retrieval also requires ensuring data integrity, consistency, and availability. Data retrieval can be performed by humans or machines, and it can be done for various purposes, such as analysis, reporting, or decision making.

The relationship between data storage and retrieval

Data storage and retrieval are interdependent and complementary processes. Data storage provides the foundation for data retrieval, as it determines how the data is organized, indexed, and accessed. Data retrieval provides the value for data storage, as it enables the data to be used for various functions and insights. Data storage and retrieval also influence each other in terms of performance and efficiency, as they depend on factors such as data volume, data velocity, data variety, and data veracity.

UNIT – IV

INTRODUCTION TO MS EXCEL

4.1. Introduction

MS-EXCEL is a part of Microsoft Office suite software. It is an electronic spreadsheet with numerous rows and columns, used for organizing data, graphically representing data(s), and performing different calculations. It consists of 1048576 rows and 16384 columns, a row and column together make a cell. Each cell has an address defined by column name and row number example A1, D2, etc. This is also known as a cell reference. Excel has a rich variety of operators to perform calculative actions on a given set of data. Excel operators specify the calculation to be performed on a given set of values. Obviously not restricted to numeric values only, we can use operators over different data types other than numeric (for example, Text/Character data type). In this article, we will see what the different types of Excel operators are and how those can be used to make your day to day life easy.

4.2. Types of Operators in Excel

There are 4 crude types of operators in Excel, mentioned below:

- ❖ Arithmetic Operators
- ❖ Logical/Comparison Operators
- ❖ Text Concatenation Operator
- ❖ Reference Operators

Each type consists of a set of specifically meant operators for that particular group (except the Text Concatenation Operator, which has only one operator). We'll see each of them according to the order mentioned above. Let's understand How Different Types of Operators work in Excel with some examples.

4.2.1. Arithmetic Operators in Excel

In Excel, there are six major arithmetic operators that you can use to perform calculations.

1. Addition (+)
2. Subtraction (-)
3. Multiplication (*)
4. Division (/)

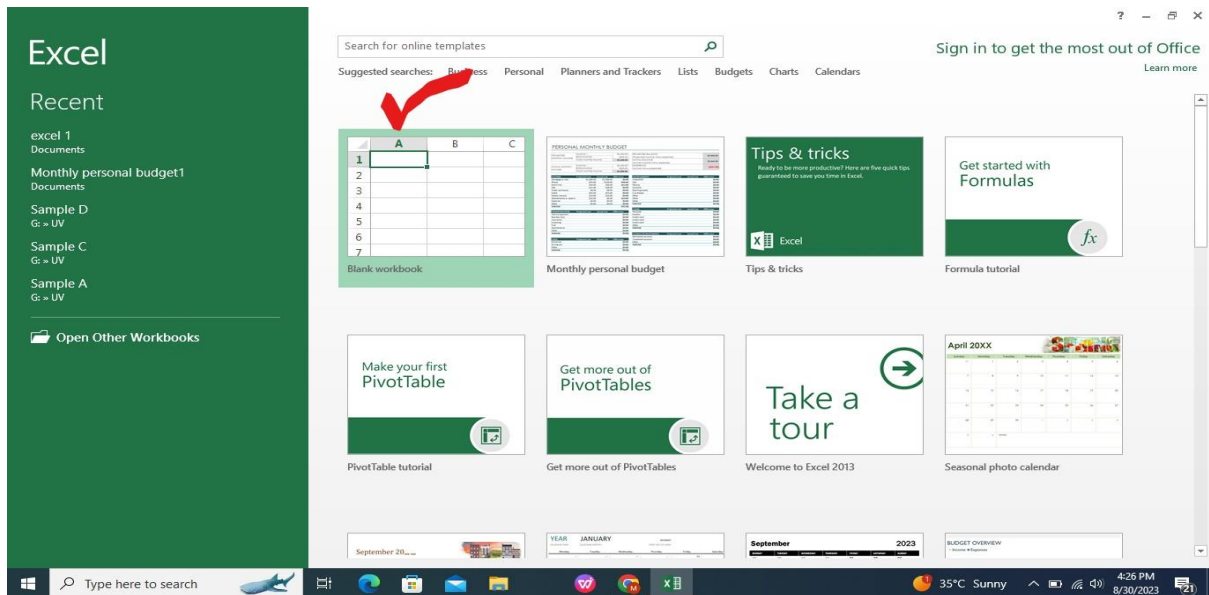
5. Percent (%)
6. Exponentiation (^)

1. Addition (+):

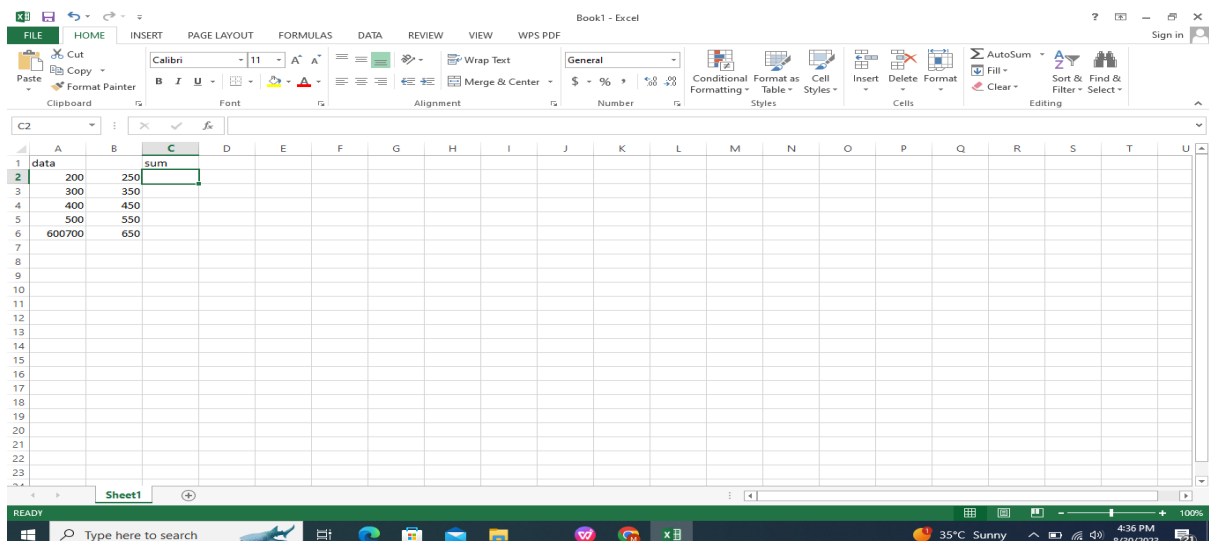
The addition operator in Excel calculates the sum of two or more values. The Syntax of addition operation is: =number1 + number2 Example: =A1 + B1

To use different operators, follow these steps:

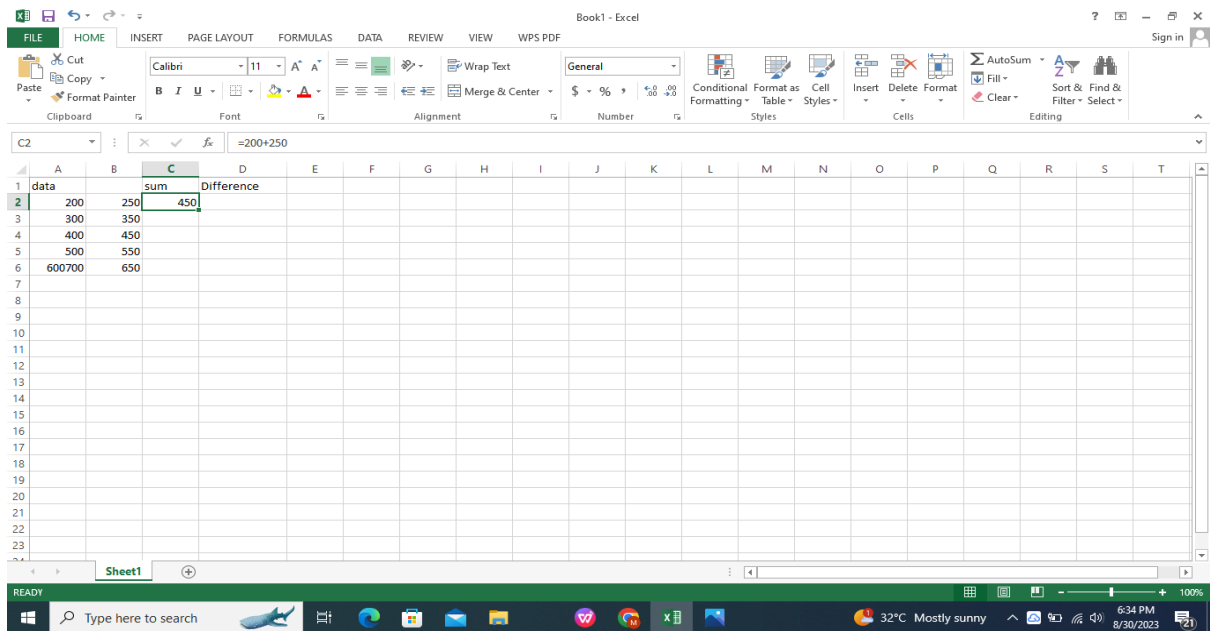
Step 1: Open a blank Workbook in Excel.



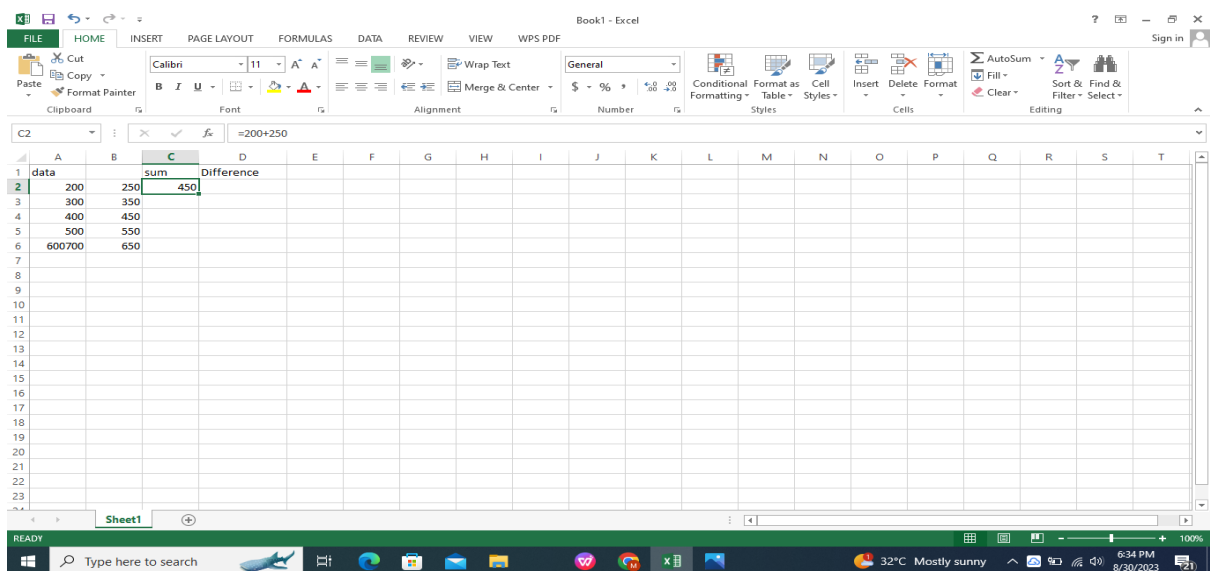
Step 2: Add data in cells to perform calculations. And place the cursor in the cell where you want to put the result.



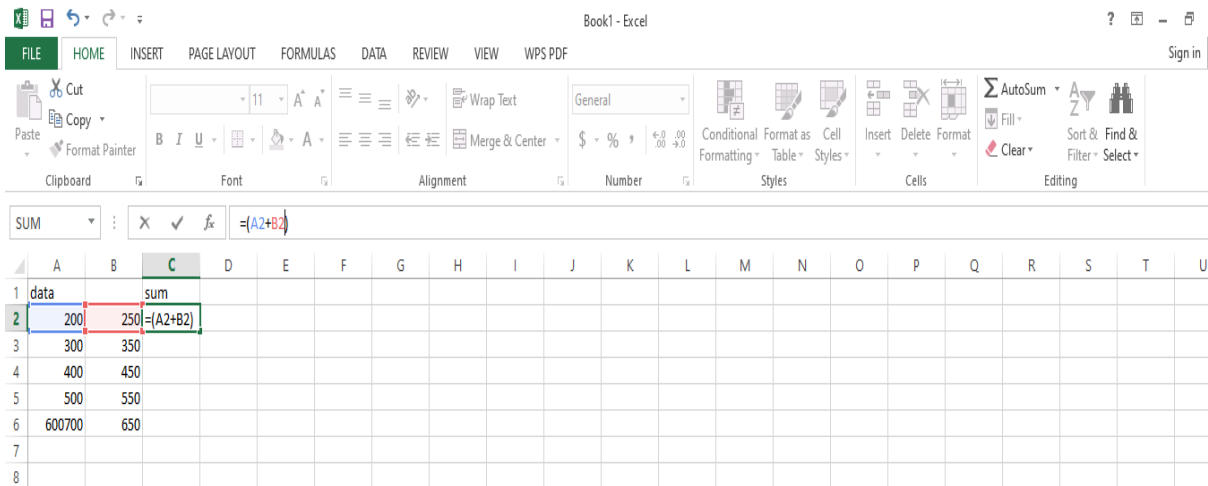
Step 3: Go to the Insert Function tab as shown type =number1 + number2, Press Enter. For example, we used the addition operation for two numbers, 200 and 250, and their sum is 450.



Step 4: Your sum of two values will be added to its designated cell.

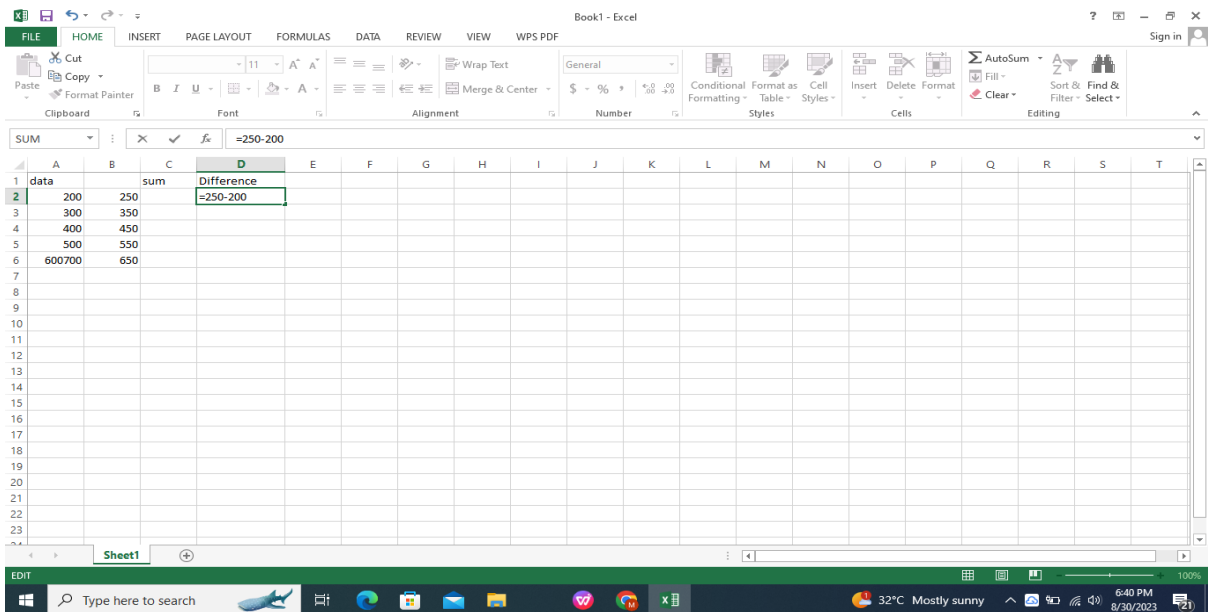


Step 5: Use the cell locations of numbers on which you want to perform addition. When you add the cell location of a number, it will be highlighted, as shown in the picture below. For example, instead of adding values themselves, add their cell locations to add them. I used A2 for "200" and B2 for "250". Because the number "200" lies in the second row of column A and "250" lies in the second row of column B.

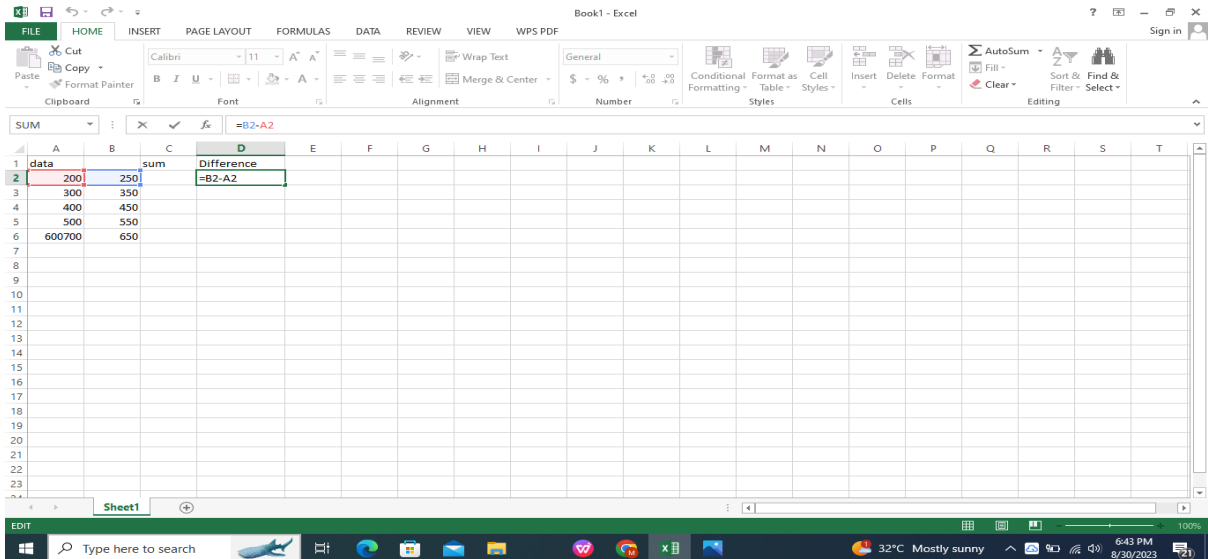


2. Subtraction (-):

The subtraction operator is used to subtract or subtract one value from another. Go to the insert function tab and type =values or cell locations you want to subtract in the formula bar.

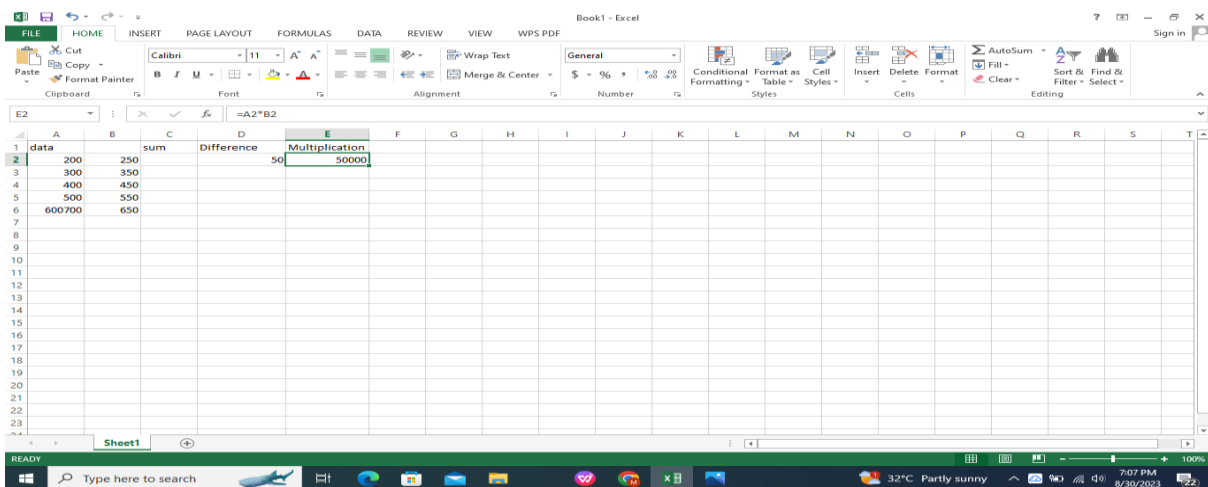
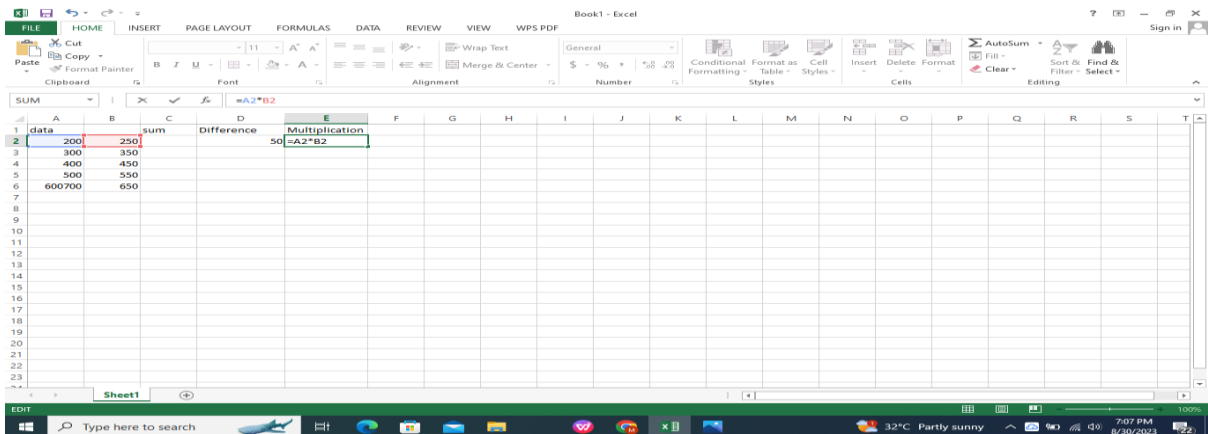


For example, if you want to subtract B2 from A2. Type =B2-A2 or =250-200. Alternatively, Type cell location in formula bar. Type =B2-A2 in formula bar and press enter.



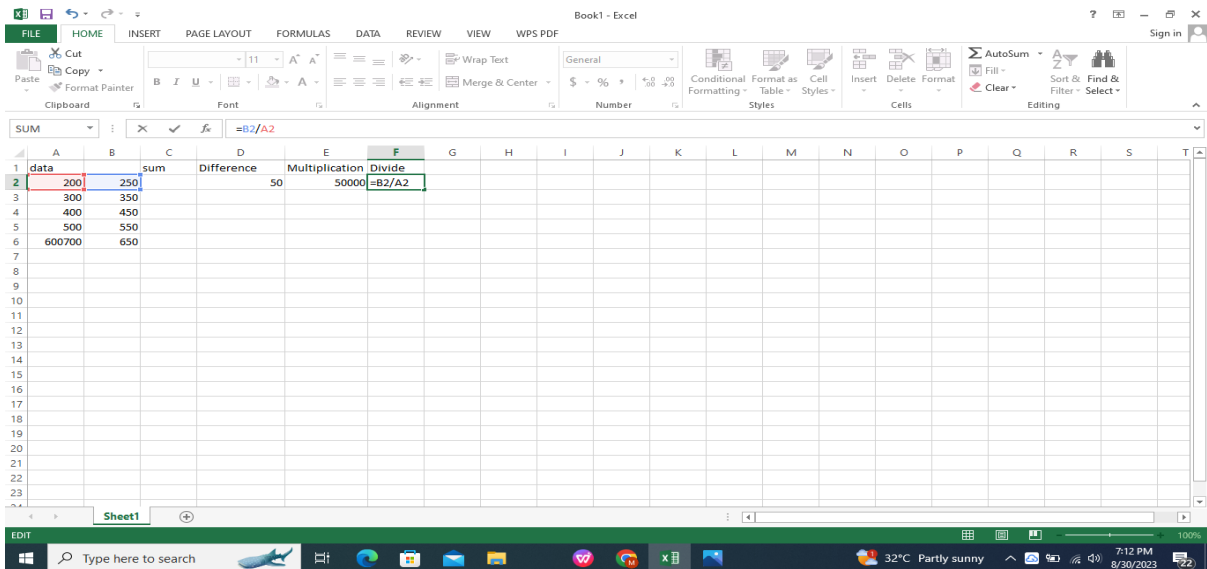
3. Multiplication (*):

Asterisk operator calculates multiplication between the two numbers. Go to the insert function tab. You can insert the cell's location or values to perform multiplication.



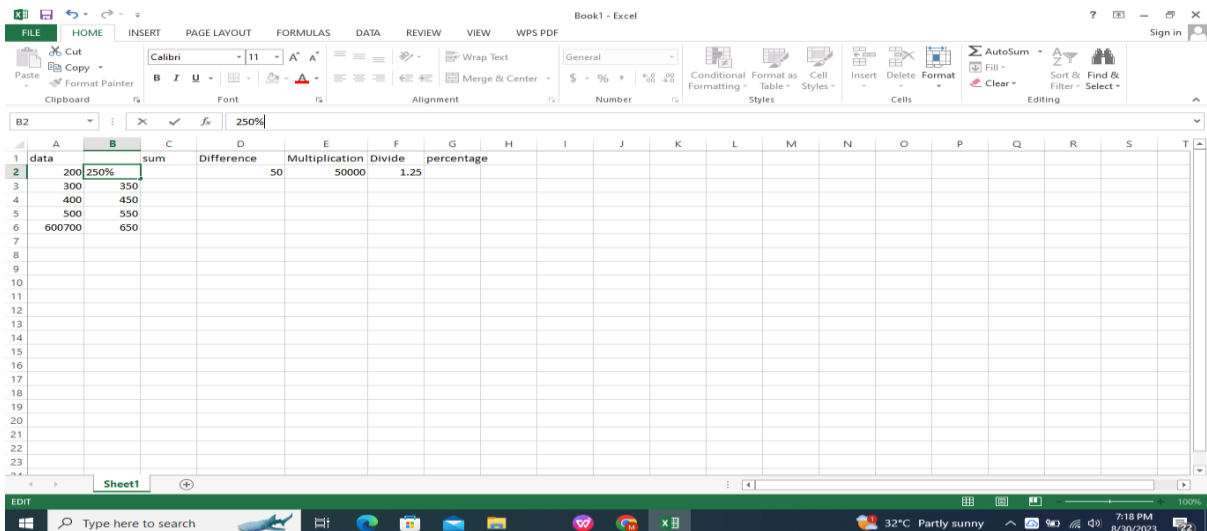
4. Division (/):

The forward slash performs Division between two or more numbers. Use the Syntax: Dividend/divisor. For example, divide B2 with A2.



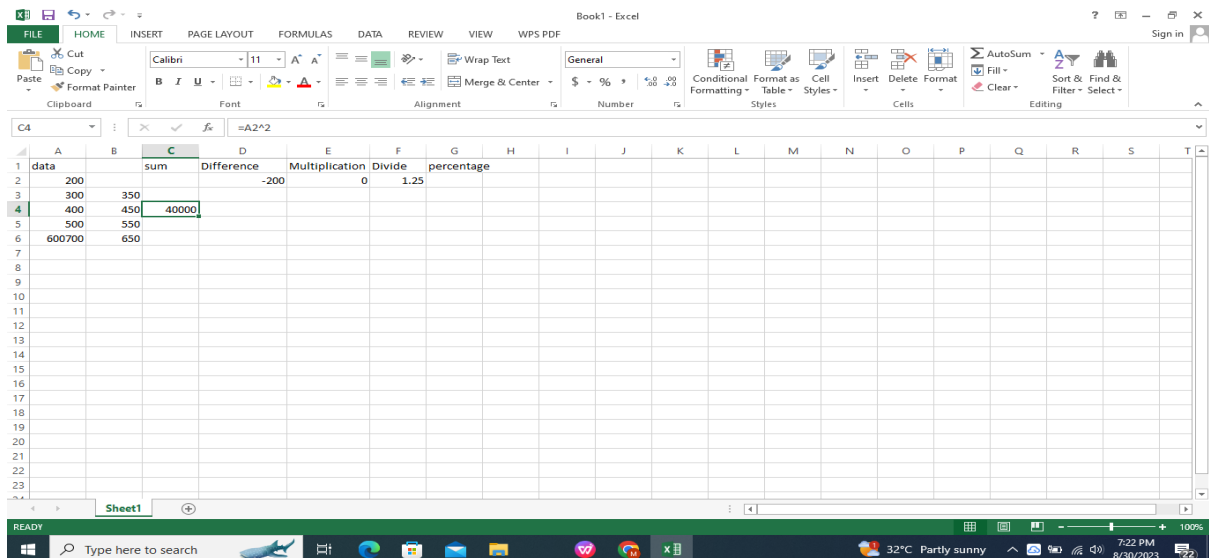
5. Percentage (%):

Percentage operator converts numeric values into percentage. If you want to add a percentage sign with a value in a cell, enter the values in a cell and then the percentage operator from the keyboard.



6. Exponent (^):

Excel allows you to raise the number to any power. You can directly enter an exponent operator from the keyboard and use a number to raise the power. You can calculate squares, cubes, and up to any power you want.



4.3. Comparison operators in excel:

Comparison operators are very helpful in Excel to force a Boolean result from a formula. Once we test two values against each other, we can return a desired result based on whether the outcome is TRUE or FALSE.

Here is a list of the most common comparison operators:

- ★ Equal Sign (=): Checks if two values are equal to each other. Returns TRUE if values are EQUAL
- ★ Not equal (<>): Checks if two values are not equal to each other. Returns TRUE if values are NOT equal.
- ★ Less Than (<): Checks if first value is less than second value. Returns TRUE if first value is less than second value.
- ★ Greater Than (>): Checks if first value is greater than second value. Returns TRUE if first value is greater than second value.

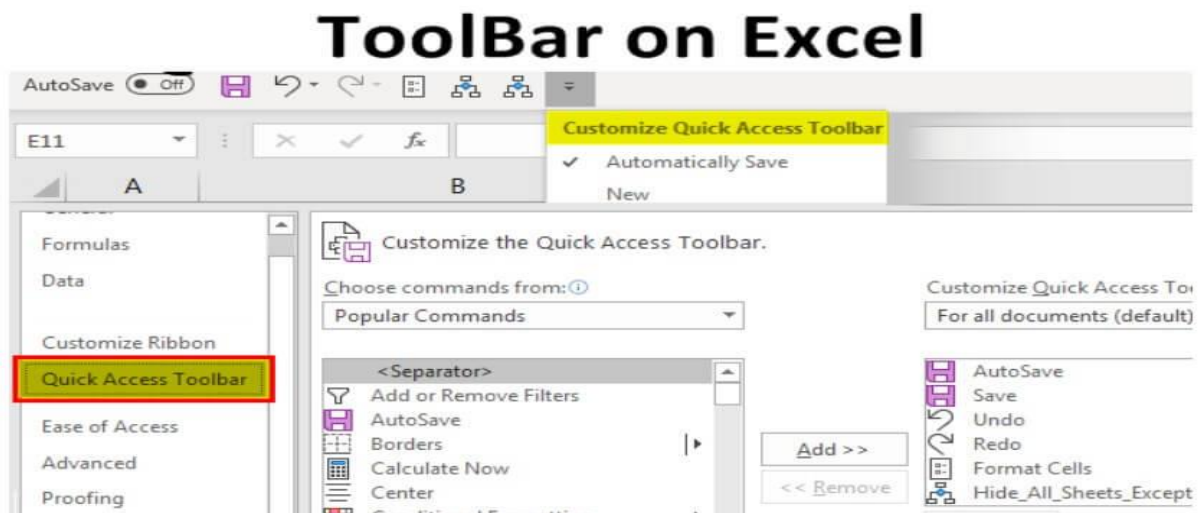
Logical operators in excel:

- ★ Equal to (=) compare one value to another value.
- ★ Not Equal (<>): Test whether the value is not equal to a value or not.
- ★ Greater Than (>): Test whether the value is greater than a value or not.
- ★ Less Than (<): Test whether the value is less than a value or not.
- ★ Greater than or equal to (>=): Test whether the value is greater than or equal to a value.
- ★ Less than or equal to (<=): Test whether the value is less than equal to a value.

4.4. Excel Tool Bars:

Excel toolbar (also called Quick Access Toolbar) is presented to access various commands to perform the operations. In addition, it is presented with an option to add or delete commands to it to access them quickly.

- ❖ Quick Access Toolbar is universal, and access is possible on any tab like “Home,” “Insert,” “Review,” “References,” etc. It is independent of the tab that we are working on simultaneously.
- ❖ It contains the various options used frequently to enhance the speed of working in Excel sheets.
- ❖ Along with the Quick Access Toolbar, another toolbar such as the “Formula Bar,” “Headings,” and Gridlines in excel under the “Show” or “Hide” group of the “View” tab simply selecting and deselecting the checkmark shows or hides this toolbar.
- ❖ “Format” toolbar, “Drawing” toolbar, “Chart” toolbar, and “Standard” toolbar presented in the earlier version of Excel 2003 are modified into the “Home” tab and “Insert” tab in the later versions of Excel 2007 and more.
- ❖ The “Customize Quick Access Toolbar” option is available to access the full toolbars list.



4.4.1. Use the toolbar in Excel

- ❖ The toolbar in Excel is used for various purposes. However, few major activities are performed on the Quick Access Toolbar on different versions of Excel.

- ❖ In the 2007 version, only three activities shift the toolbar’s location, including adding extra features or frequently used commands. In addition, deleting an element from the toolbar is possible whenever we do not want to.
- ❖ In higher versions than in 2007, the Quick Access Toolbar is used in many ways, along with adding and removing commands. These include adding commands not presented on the toolbar, modifying commands order, moving the toolbar below or above the ribbon, grouping two or more commands, exporting and importing the toolbar, customizing utilizing the “Options” command, and resetting the default settings.
- ❖ Frequent commands like “Save,” “Open,” “Redo,” “New,” “Undo,” “Email,” “Quick Print,” and print preview in excel are easily added to the toolbar.
- ❖ We can select the commands not listed in the toolbar from the three categories, including “Popular Commands,” “All Commands,” and “Commands Not Listed” on the ribbon.

4.4.2. Examples to Understand Quick Access Excel Toolbar

Below are examples of the Excel toolbar.

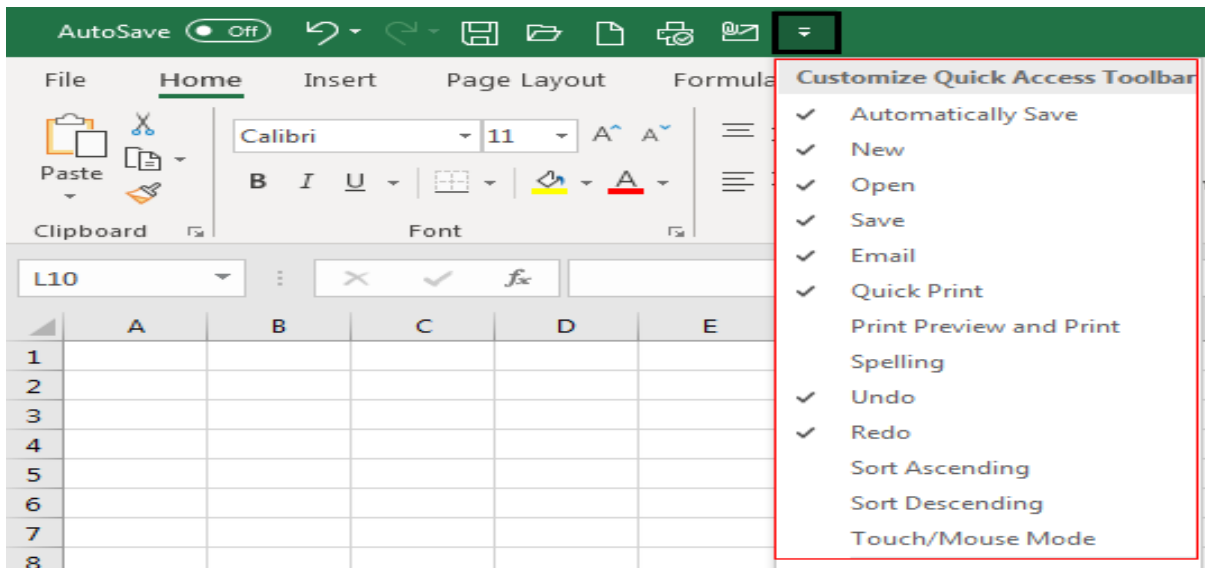
1. Adding Features to the Toolbar

Adding features or commands to the Quick Access Toolbar is essential. It is done in three ways:

- ★ Adding commands located on the ribbon.
- ★ Adding features through the “More Commands” option.
- ★ Adding the elements presented on the different tabs directly to the toolbar.

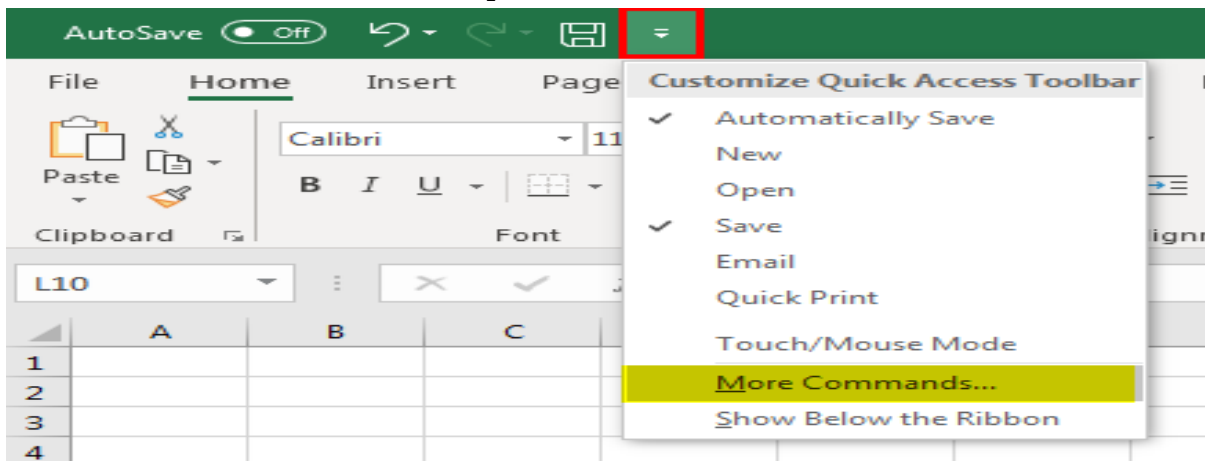
Method 1

We can add “New,” “Open,” “Save,” “Email,” “Quick Print,” and redo in excel features to the toolbar. For that, select the “Customize Quick Access Toolbar” button and click on the command you want to add to the toolbar.

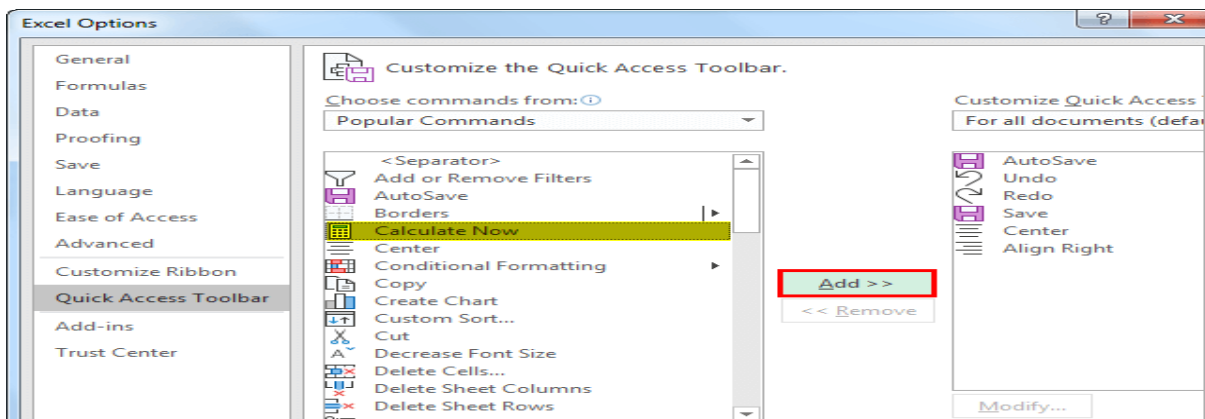


Method 2

In this, a user must select the “Customize Quick Access Toolbar” in Excel and select the “More Commands” option to add the commands.

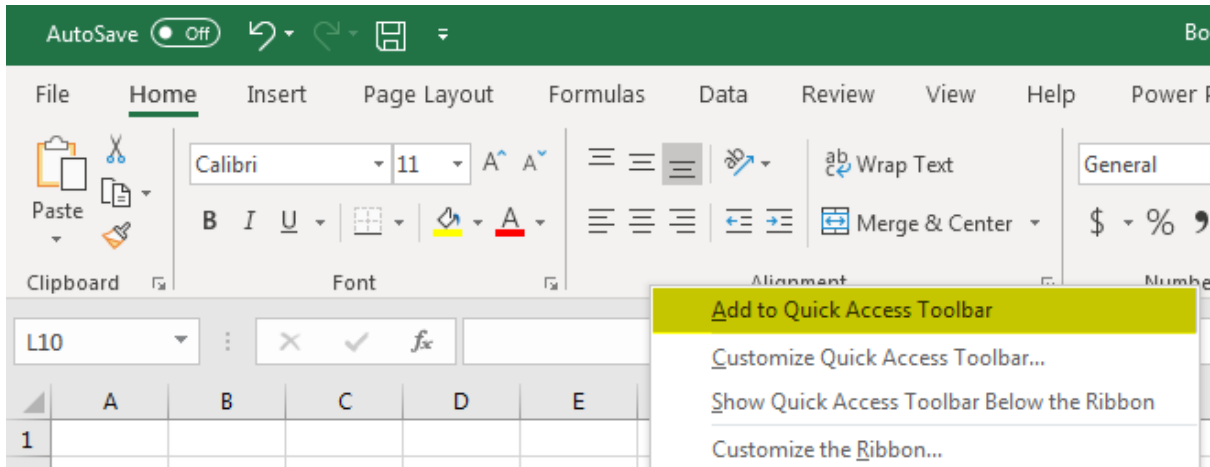


As shown in the below figure of the customize window, the user must select the commands and click on the “Add” option to add the feature to the toolbar. Added features are displayed on the excel ribbon for accessing easily.



Method 3

The user has to right-click on the feature presented on the ribbon and choose “Add to Quick Access Toolbar.”



4.5. FORMATTING OF TEXT

The appearance of your documents helps to convey their message. You can easily format words and paragraphs so that key points stand out and the structure of your document is clear. You can also change the look of major elements within a document by applying predefined sets of formatting called *styles*, and you can change the look of selected text by applying predefined combinations called *text effects*. In addition, you can change the fonts, colors, and effects throughout a document with one click by applying a theme.

1. Applying styles to text

Styles can include character formatting (such as font, size, and color), Paragraph formatting (such as line spacing and outline level), or a combination of both. Styles are stored in the template that is attached to a document. By default, blank new documents are based on the Normal template. The Normal template includes a standard selection of styles that fit the basic needs of most documents. These styles include nine heading levels, various text styles including those for multiple levels of bulleted and numbered lists, index and table of contents entry styles, and many specialized styles such as those for hyperlinks, quotations, placeholders, captions, and other elements. Style sets are available from the Document Formatting menu on the Design tab.

2. Changing a document's theme

Every document you create is based on a template, and the look of the template is controlled by a theme. The theme is a combination of coordinated colors, fonts, and effects that visually convey a certain tone. To change the look of a document, you can apply a different theme by clicking the Themes button in the Document Formatting group on the Design tab, and then making a selection in the Themes gallery. If you like the background elements of one theme but not the colors or fonts, you can mix and match theme elements. First apply the theme that most closely resembles the look you want, and then select colors and fonts from the Theme Colors and Theme Fonts galleries in the Document Formatting group.

3. Changing a document characters

When you enter text in a document, it is displayed in a specific font. By default, the font used for text in a new blank document is 11- point Calibri, but you can change the font of any element at any time. The available fonts vary from one computer to another, depending on the programs installed. Common fonts include Arial, cambria, and Times New Roman.

You can vary the look of a font by changing the following attributes:

- Size almost every font comes in a range of sizes, which are measured in points from the top of letters.
- Style Almost every font has a range of font styles. The most common are regular (or plain), italic, bold, and bold italic.
- Effects Fonts can be enhanced by applying effects, such as underlining, small capital letters (small caps), or shadows.
- Color A palette of coordinated colors is available, and you can also specify custom colors.
- Character spacing: You can alter the spacing between characters.

4. Changing the look of Paragraphs:

A paragraph is created by entering text and then pressing the Enter key. A paragraph can contain one word, one sentence, or multiple sentences. You can change the look of a paragraph by changing its indentation, alignment, and line spacing, as well as the space before and after it. You can also put borders around it and shade its background. Collectively, the settings you use to vary the look of a paragraph are called paragraph formatting. In

Word, you don't define the width of paragraphs and the length of pages by defining the area occupied by the text; instead you define the size of the white space the left, right, top, and bottom margins around the text. You click the Margins button in the Page Setup group on the Page Layout tab to define these margins, either for the whole document or for sections of the document. Although the left and right margins are set for a whole document or section, you can vary the position of the paragraphs between the margins. The quickest way to indent a paragraph from the left is to click the Increase Indent button; clicking the Decrease Indent button has the opposite effect.

5. Applying Borders and Shading

To enhance the appearance of the text in a paragraph, you can quickly add a border and shading to selected text. When you add a border, you can specify what sides you want to include or exclude. For example, you can add a border on just the top and the bottom and leave the sides open. Shading colours the background behind the selected text or paragraph. If you want to customize borders and shading by changing line style, color, and width preferences, you can make changes in the Borders and Shading dialog box.

Apply Paragraph Shading and Borders

- ❖ Select the paragraph text you want to format.
- ❖ Click the Home tab.
- ❖ Click the Borders and Shading button arrow, and then click Borders and Shading.
- ❖ Click the Borders tab.
- ❖ Click to select the type of setting you want for your border.
- ❖ Click to select the type of Style.
- ❖ Apply any other options you want.
- ❖ Look in the preview box to see the new border.
- ❖ Click the Shading tab.
- ❖ Click to select the shading fill colour you want to apply to your table.
- ❖ Apply any other options you want.
- ❖ Look in the preview box to see the new shading color.
- ❖ Click OK.

6. Creating and modifying lists

Lists are paragraphs that start with a character and are formatted with a hanging indent so that the characters stand out on the left end of each list item. Fortunately, Word takes care of the formatting of lists for you.

You simply indicate the type of list you want to create. When the order of items is not important for example, for a list of people or supplies a bulleted list is the best choice. And when the order is important for example, for the steps in a procedure you will probably want to create a numbered list.

You can format an existing set of paragraphs as a list or create the list as you enter information into the document.

To format a new list item as you enter content, start the paragraph as follows:

▪ **Bulleted list**

Bulleted list Enter * (an asterisk) at the beginning of a paragraph, and *Figure 60 Shading Dialog* then press the Spacebar or the Tab key before entering the list item text.

▪ **Numbered list** Enter 1. (The number 1 followed by a period) at the beginning of a paragraph, and then press the Spacebar or the Tab key before entering the list item text.

When you start a list in this fashion, Word automatically formats it as a bulleted or numbered list. When you press Enter to start a new item, Word continues the formatting to the new paragraph. Typing items and pressing Enter adds subsequent bulleted or numbered items. To end the list, press Enter twice; or click the Bullets arrow or Numbering arrow in the Paragraph group on the Home tab, and then in the library, click none.

Choose a multilevel list style from the gallery:

- ★ Click where you want to begin your list.
- ★ On the Home tab, in the Paragraph group, click the arrow next to Multilevel List.
- ★ Click a multilevel list style in the gallery of styles.
- ★ Type your list. Press the TAB key or SHIFT+TAB to change levels.

7. Controlling what appears on each page

When a document includes more content than will fit between its top and bottom margins, Word creates a new page by inserting a soft page break (a

page break that moves if the preceding content changes). If you want to break a page in a place other than where Word would normally break it, you can insert a manual page break in one of three ways:

- Click Page Break in the Pages group on the Insert tab.
- Click Breaks in the Page Setup group on the Page Layout tab, and then click Page.
- Press Ctrl+Enter

If a paragraph breaks so that most of it appears on one page but its last line appears at the top of the next page, the line is called a widow. If a paragraph breaks so that its first line appears at the bottom of one page and the rest of the paragraph appears on the next page, the line is called an orphan. These single lines of text can make a document hard to read, so by default, Word specifies that a minimum of two lines should appear at the top and bottom of each page.

4.6. Tables and Graphs

Charts are used to represent the data into graphical elements, which makes it very too easy to interpret the data; it becomes very useful if our data is very large. Excel provides various charts to represent the excel data and makes it very easy to understand and analyze the data compare to the excel cells data analysis. There are various charts available in excel. Namely, they are,

- ❖ Line Chart
- ❖ Bar Chart
- ❖ Column Chart
- ❖ Area Chart
- ❖ Pie Chart
- ❖ Surface Chart

In this example, we will be using random car sales data, including model name and the number of cars sold, as the dataset and represent it in the various graphs. The charts or graphs are the visual representation of data in both rows and columns. They are used to analyze the trends and patterns in the datasets.

For example, if we want to analyze the sales of different courses for a specific period we can easily do this with the help of charts and get the result of queries such as months having a maximum number of sales etc.

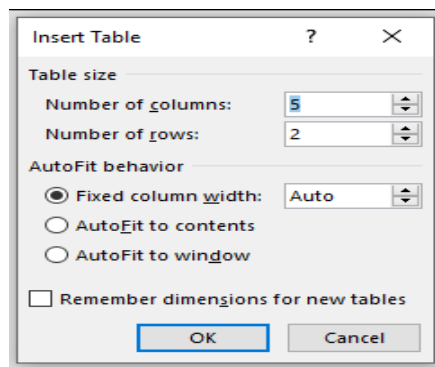
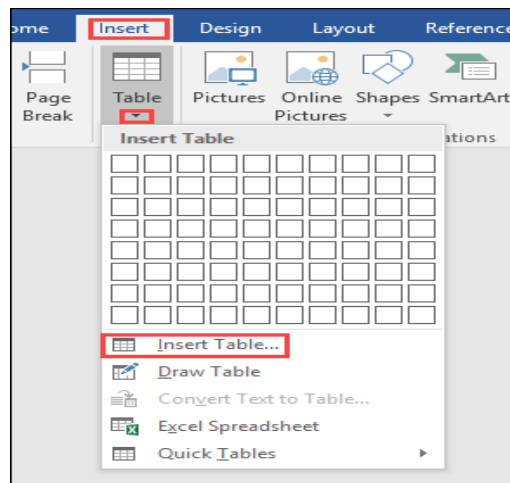
4.6.1. Insert a Table

Tables may be easily added to a text document.

Place cursor in document where you want to insert the table.

1. Click the Insert tab
2. In the Tables group, select dropdown menu.
3. Select Insert Table from the resulting menu.
4. In the Table Size section, enter the number of columns and rows.
5. *Optional:* Select options in the AutoFit behavior
6. Click OK

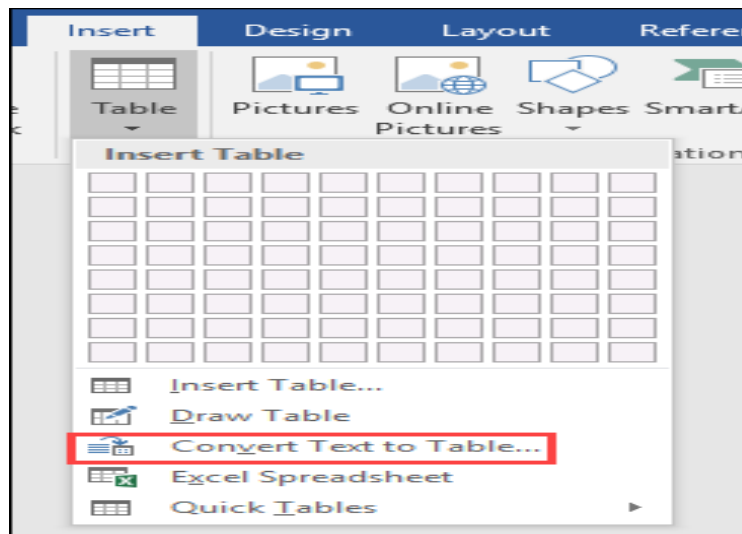
To quickly insert a table, click the Table button in the Tables group and drag to select the number of rows and columns. Click in last selected cell of grid to insert Table.



4.6.2. Converting Text to Table

Sometimes text in a document may be better illustrated as a table. To convert existing text to a table:

- ★ Highlight text to be converted to a Table.
- ★ Click the Insert tab >Table> Convert Text to Table> dialog box opens.
- ★ Complete fields for options: Table Size, Auto fit and Separation character
- ★ Click OK.



4.6.3. Inserting a Picture, Clip Art, Shape, SmartArt, or Screenshot

Pictures and graphics add punch to your document, but remember not to overdo them! They are there to enhance your information, not eclipse it!

Place cursor in the document where you want to insert the item

On the Insert tab, in the Illustrations group, do one of the following:

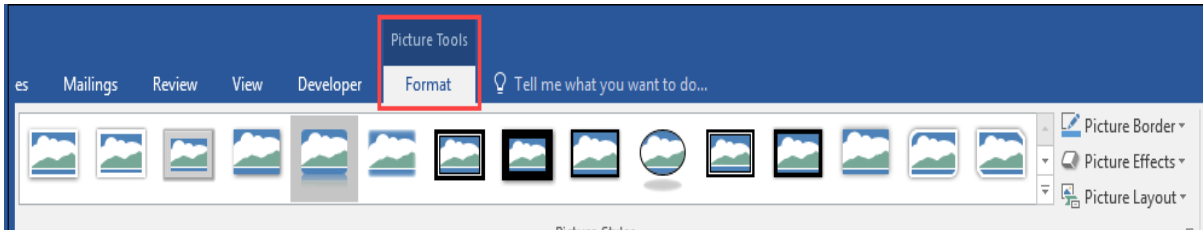
To insert a Picture from a file: select Picture. Locate and select the file you want to insert from your computer and click the Insert

To insert an Online Picture: select Online Pictures. In the task pane, enter a keyword in the Search box and click the magnifying glass icon. Select desired image and click

To insert a Shape: click the Shapes dropdown menu. Select the Shape you want from the resulting menu. Click and drag in the document to create the Shape.

To insert a SmartArt Graphic: select SmartArt. Select the desired SmartArt graphic from the menu. Click OK.

To insert a Screenshot: select Screenshot button. To insert a screen that you have open on your computer, select the screen from the Available Windows. To create your own screenshot, select Screen Clipping. Click and drag the area of your screen you want to insert.

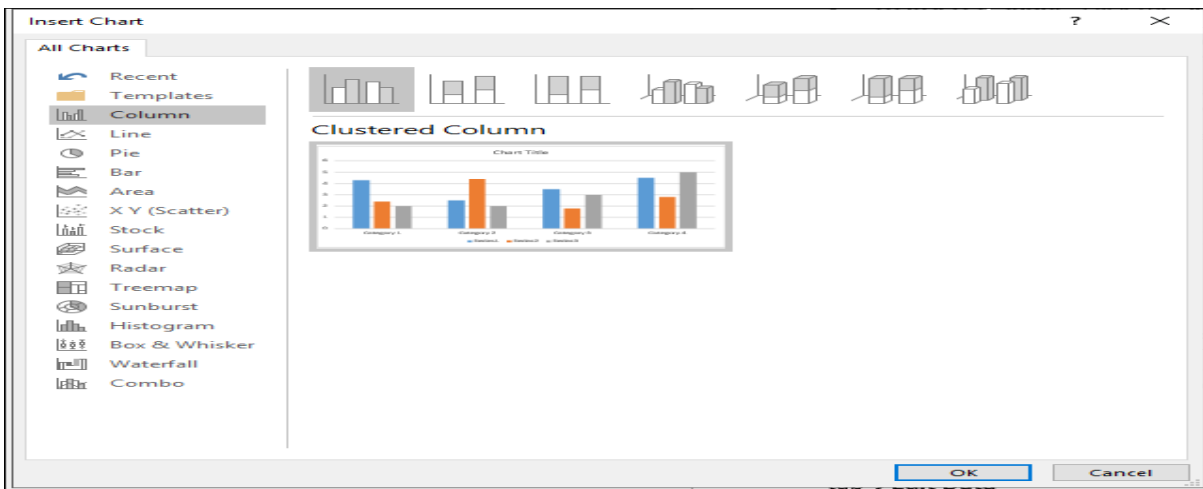


4.6.4. Inserting a Chart or Graph

On the Insert tab, in the Illustrations group, click Chart.

Select the type of chart desired and click OK.

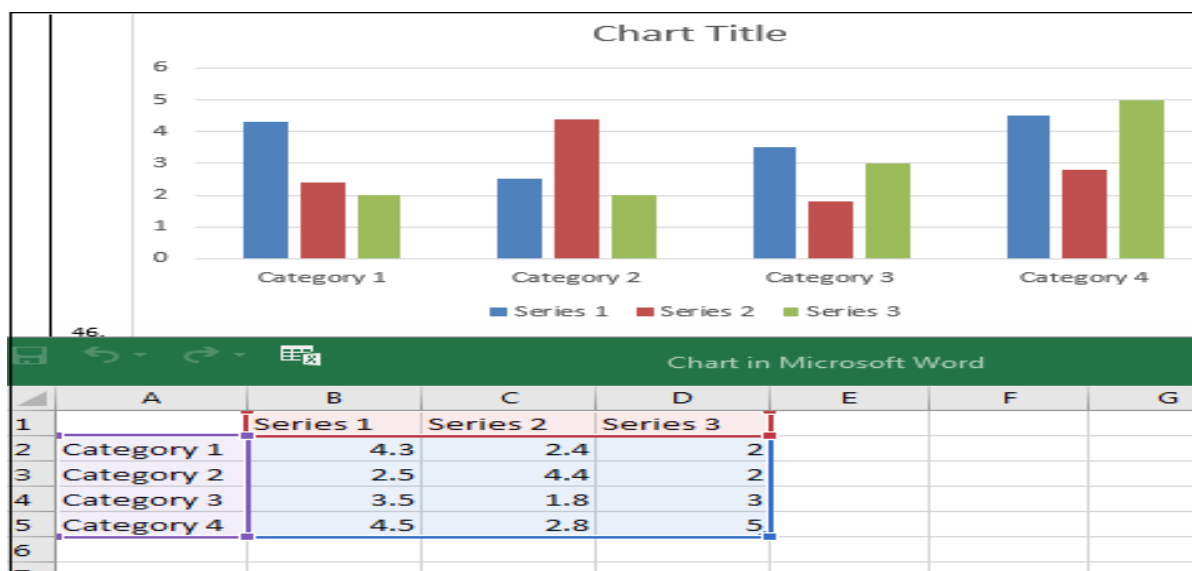
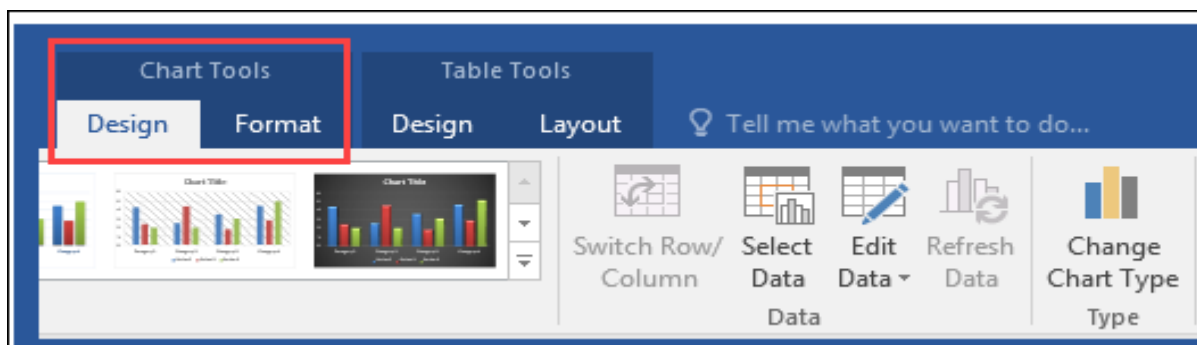
Edit the data in the Excel sheet that opens with the Chart. When you are finished editing the data, close the data sheet.



	A	B	C	D	E	F	G	H	I
1		Series 1	Series 2	Series 3					
2	Category 1	4.3	2.4	2					
3	Category 2	2.5	4.4	2					
4	Category 3	3.5	1.8	3					
5	Category 4	4.5	2.8	5					
6									
7									

4.6.5. Changing data in an existing chart

- ❖ Select the Chart in your document
- ❖ In the Chart Tools contextual tab in the Ribbon, select Design tab>Edit Data
- ❖ A data spreadsheet will open; make desired changes



UNIT – V

Application of MS Excel in Statistics and Economics

5.1. Descriptive statistics

Descriptive statistics is a subfield of statistics that deals with characterizing the features of known data. Descriptive statistics give summaries of either population or sample data. Aside from descriptive statistics, inferential statistics is another important discipline of statistics used to draw conclusions about population data.

Descriptive statistics is divided into two categories:

- ❖ Measures of Central Tendency
- ❖ Measures of Dispersion

Descriptive statistics is a branch of statistics focused on summarizing, organizing, and presenting data in a clear and understandable way. Its primary aim is to define and analyze the fundamental characteristics of a dataset without making sweeping generalizations or assumptions about the entire data set. The main purpose of descriptive statistics is to provide a straightforward and concise overview of the data, enabling researchers or analysts to gain insights and understand patterns, trends, and distributions within the dataset. Descriptive statistics typically involve measures of central tendency (such as mean, median, mode), dispersion (such as range, variance, standard deviation), and distribution shape (including skewness and kurtosis).

5.2. Definition of Descriptive Statistics

Descriptive statistics is a type of statistical analysis that uses quantitative methods to summarize the features of a population sample. It is useful to present easy and exact summaries of the sample and observations using metrics such as mean, median, variance, graphs and charts.

5.3. Types of Descriptive Statistics

There are three types of descriptive statistics:

1. Measures of Central Tendency
2. Measures of Dispersion
3. Measures of Frequency Distribution

1. Measures of Central Tendency

The central tendency is defined as a statistical measure that may be used to describe a complete distribution or dataset with a single value, known as a measure of central tendency. Any of the central tendency measures accurately describes the whole data distribution. In the following sections, we will look at the central tendency measures, their formulae, applications, and kinds in depth.

- ❖ Mean
- ❖ Median
- ❖ Mode

Mean

Mean is the sum of all the components in a group or collection divided by the number of items in that group or collection. Mean of a data collection is typically represented as \bar{x} (pronounced “x bar”). The formula for calculating the mean for ungrouped data to express it as the measure is given as follows: For a series of observations:

$$\bar{x} = \Sigma x / n$$

- ❖ Where,
- ❖ \bar{x} = Mean Value of Provided Dataset
- ❖ Σx = Sum of All Terms
- ❖ n = Number of Terms

Median

Median of a data set is the value of the middle-most observation obtained after organizing the data in ascending order, which is one of the measures of central tendency. Median formula may be used to compute the median for many types of data, such as grouped and ungrouped data.

Ungrouped Data Median (n is odd): $[(n + 1)/2]^{\text{th}}$ term

Ungrouped Data Median (n is even): $[(n / 2)^{\text{th}}$ term + $((n / 2) + 1)^{\text{th}}$ term]/2

Mode

Mode is one of the measures of central tendency, defined as the value that appears the most frequently in the provided data, i.e. the observation

with the highest frequency is known as the mode of data. The mode formulae provided below can be used to compute the mode for ungrouped data.

Mode of Ungrouped Data: Most repeated observation in dataset

2. Measures of Dispersion

If the variability of data within an experiment must be established, absolute measures of variability should be employed. These metrics often reflect differences in a data collection in terms of the average deviations of the observations. The most prevalent absolute measurements of deviation are mentioned below. In the following sections, we will look at the variability measures, their formulae in depth.

- ❖ Range
- ❖ Standard Deviation
- ❖ Variance

Range

The range represents the spread of your data from the lowest to the highest value in the distribution. It is the most straightforward measure of variability to compute. To get the range, subtract the data set's lowest and highest values.

$$\text{Range} = \text{Highest value} - \text{Lowest value}$$

Standard Deviation

Standard deviation (s or SD) represents the average level of variability in your dataset. It represents the average deviation of each score from the mean. The higher the standard deviation, the more varied the dataset is.

To calculate standard deviation, follow these six steps:

Step 1: Make a list of each score and calculate the mean.

Step 2: Calculate deviation from the mean, by subtracting the mean from each score.

Step 3: Square each of these differences.

Step 4: Sum up all squared variances.

Step 5: Divide the total of squared variances by N-1.

Step 6: Find the square root of the number that you discovered.

Variance

Variance is calculated as average of squared departures from the mean. Variance measures the degree of dispersion in a data collection. The more scattered the data, the larger the variance in relation to the mean. To calculate the variance, square the standard deviation. Symbol for variance is s^2

3. Measures of Frequency Distribution

Datasets consist of various scores or values. Statisticians employ graphs and tables to summarize the occurrence of each possible value of a variable, often presented in percentages or numerical figures. Statisticians represent these frequency distributions through graphs or tables.

Univariate Descriptive Statistics

Univariate descriptive statistics focus on one thing at a time. We look at each thing individually and use different ways to understand it better. Programs like SPSS and Excel can help us with this. If we only look at the average (mean) of something, like how much people earn, it might not give us the true picture, especially if some people earn a lot more or less than others. Instead, we can also look at other things like the middle value (median) or the one that appears most often (mode). And to understand how spread out the values are, we use things like standard deviation and variance along with the range.

Bivariate Descriptive Statistics

When we have information about more than one thing, we can use bivariate or multivariate descriptive statistics to see if they are related. Bivariate analysis compares two things to see if they change together. Before doing any more complicated tests, it's important to look at how the two things compare in the middle. Multivariate analysis is similar to bivariate analysis, but it looks at more than two things at once, which helps us understand relationships even better.

Representations of Data in Descriptive Statistics

Descriptive statistics use a variety of ways to summarize and present data in an understandable manner. This helps us grasp the data set's patterns, trends, and properties.

Frequency Distribution Tables: Frequency distribution tables divide data into categories or intervals and display the number of observations (frequency) that fall into each one. For example, suppose we have a class of 20 students and are tracking their test scores. We may make a frequency distribution table that contains score ranges (e.g., 0-10, 11-20) and displays how many students scored in each range.

Graphs and Charts: Graphs and charts graphically display data, making it simpler to understand and analyze. For example, using the same test score data, we may generate a bar graph with the x-axis representing score ranges and the y-axis representing the number of students. Each bar on the graph represents a score range, and its height shows the number of students scoring within that range. These approaches help us summarize and visualize data, making it easier to discover trends, patterns, and outliers, which is critical for making informed decisions and reaching meaningful conclusions in a variety of sectors.

Descriptive Statistics Applications

Descriptive statistics are used in a variety of sectors to summarize, organize, and display data in a meaningful and intelligible way. Here are a few popular applications:

Business and Economics: Descriptive statistics are useful for analyzing sales data, market trends, and customer behaviour. They are used to generate averages, medians, and standard deviations in order to better evaluate product performance, pricing strategies, and financial metrics.

Healthcare: Descriptive statistics are used to analyze patient data such as demographics, medical histories, and treatment outcomes. They assist healthcare workers in determining illness prevalence, assessing treatment efficacy, and identifying risk factors.

Education: Descriptive statistics are useful in education since they summarize student performance on tests and examinations. They assist instructors in assessing instructional techniques, identifying areas for improvement, and monitoring student growth over time.

Market Research: Descriptive statistics are used to analyze customer preferences, product demand, and market trends. They enable businesses

to make educated decisions about product development, advertising campaigns, and market segmentation.

Finance and investment: Descriptive statistics are used to analyze stock market data, portfolio performance, and risk management. They assist investors in determining investment possibilities, tracking asset values, and evaluating financial instruments.

5.4. Index Numbers and Growth Rates

We are a part of a fast-paced economy. Numerous changes in the size of the population, output, money supply, income, and price of commodities are taking place continuously in an ever-changing environment. Economic changes have their effects on the volume of economic activity, income and employment, general price level, and other factors. Most people are interested in learning how much their values have changed over time and how they have changed, and most values evolve. The index number helps in studying changes in consumption, production, imports, exports, cost of living, crimes, accidents, national income, business failures, and other phenomena.

The index number was first constructed by an Indian Statistician, Carli in 1764. It was used for the first time to compare the prices of the year 1750 with that of the year 1500. An index number is a statistical tool for measuring changes in the magnitude of a group of related variables.

An index number is used to display changes in a variable or group of related variables through time, space, or other factors. Comparisons can be made between elements like people, hospitals, schools, etc. It tracks changes in the value of variables such as the cost of living, the volume of production in various industries, the prices of a list of defined commodities, and so on. Also, as the index numbers are used to feel the pulse of the economy, they are also known as the Barometer of Economic Activity.

5.4.1. Characteristics of Index Numbers

The various features of Index Numbers are as follows:

1. Specialized Averages:

To compare two or more series, averages like mean, median and mode can be used. But averages cannot be used for comparison when series are

composed of different types of items, or if two or more series are expressed in different units. Index numbers enable comparing changes in series.

2. Expressed in Percentages:

The magnitude of a group's changes is expressed in terms of percentages, which are independent of the measurement units. It helps in figuring out how two or more index numbers compare in various circumstances. Although, the % sign is never used.

3. It assesses the impact of changes with respect to time or location:

To compare changes over time, between places, and within categories, index numbers can be used. For example, the cost of living in two locations may differ at the same time, or the cost of living in one city can be compared over two time periods.

4. It measures the change that cannot be measured directly:

Its purpose is to examine changes in the effect of such factors that cannot be observed directly. For example, the cost of living cannot be measured directly. We can only study relative changes by examining variations in some related external factors.

5.4.2. Uses of Index Numbers

Practically, in all areas of economic activity, changes are measured using index numbers. It helps in recording changes in output, income, employment, business activities, productivity, etc.

1. Measurement and Comparison of Changes in the Price Level:

It is not possible to measure changes in the price level of two variables in absolute terms; therefore, index numbers provide a relative measure to the changes in the magnitude of a group of variables. It can be used to know the influence of changes in the value of money on different sections of society. It is possible to solve the problem of inflation or deflation in the system.

2. Helps in Policy Formulation:

An index number is an important tool for government or non-government organizations in the following ways: In policy formulation, there is a need for a base or trend. With the index numbers, the trends of different phenomena can be studied. It can also be utilized in the formulation and planning of government and business policies.

3. Acts as an Economic Barometer:

A barometer is an instrument that is used to measure atmospheric pressure. It indicates fluctuations in the general conditions of a country and measures the pulse of the economy.

4. Helps in Studying Trade:

Index numbers are useful in studying the trend of a series over a period of time. It helps in forecasting future trends which is crucial for any business or production activity's future operations. Besides, it also aids in determining patterns in exports, imports, prices, and several other occurrences. For example, if someone is planning on opening up a new business, then by studying the trend of price, wages, income, etc., in different industries will help the businessman in planning the future course of action for the business.

5. Measure Purchasing Power:

Money's worth is determined by purchasing power, and purchasing power is determined by commodity prices. Index numbers help find the intrinsic value of money as contrasted with its nominal value. It helps in establishing the nation's wage policy. Besides, a change in the price of the commodity adversely affects the value of money. When the price level of a commodity rises, the purchasing power or value of money falls.

6. Helps in Deflating Various Values:

With price index numbers, it becomes easy to adjust the monetary figures of the different periods for changes in the price. For example, a country's national income is calculated on the basis of the prices of the year mentioned in the question. However, the real change in the production level of goods and services cannot be revealed through the national income computed at the current year's price. To know the real change, first, we have to adjust the figures for the price changes in different years. Making adjustments is possible only by using price index numbers. Besides, in case of rise in prices, the process of adjustment is known as deflating.

5.4.3. Limitations of Index numbers

The limitations of Index Numbers are as follows:

1. Provides Relative Changes only:

Index Numbers estimate relative changes only and cannot speak the truth as they are only approximate indicators. Besides, they represent the generalized truth based on the overall average of the items. Therefore, it does not apply to specific units.

2. Lack of Perfect Accuracy:

Index numbers do not consider every item and are based on the sample items. Thus, in case of an inadequate sample or a sample selected through a faulty process, there will be inaccurate results.

3. Ignores Qualitative Changes:

Index numbers do not pay any attention to the qualitative changes in the product while constructing the price or production. An increase in the price possibly results from the improvement in the quality of the product. But it is neglected in the index numbers.

4. Possibility of Manipulations:

Index numbers can be created in a way that allows for manipulation. This manipulation can be made in a selection of a particular base year, a particular group of commodities, a specific set of prices, etc.

5. Difference between purpose and method of Construction:

When the index numbers are created for a specific purpose using a specific methodology, they are not suitable for all situations and uses. If they are employed for other reasons, they are bound to produce incorrect conclusions.

5.5. Demand Function

Demand refers to the quantity of a commodity the customer is willing and capable to purchase, at any given time and at each possible price. The above definition highlights essential components of demand: (i) Quantity of the commodity (ii) Willingness to buy (iii) Price of the commodity (iv) Period of time. Demand for a commodity can be expressed with respect to the individual (Individual Demand) or the entire market (Market Demand). The quantity of a good or service that a consumer is willing and capable to purchase at each possible price during a given time period is referred to as an Individual Demand. However, the quantity of goods or services that all

consumers are willing and capable to purchase at every possible price within a given time period is referred to as Market Demand.

5.5.1. Demand Function

The relationship between the quantity demanded of a particular commodity and the factors influencing it is expressed by the Demand Function. It can be with respect to an individual customer (Individual Demand Function) or all consumers in the market (Market Demand Function).

1. Individual Demand Function

The functional relationship between the individual quantity demanded of a particular commodity and the factors influencing it is defined as the Individual Demand Function.

It is expressed as:

$$D_x = f (P_x, P_r, Y, T, F)$$

Where,

D_x = Demand for Commodity x,

P_x = Price of the given Commodity x,

P_r = Prices of Related Goods,

Y = Income of the Consumer,

T = Tastes and Preferences, and

F = Expectation of Change in Price in the future.

2. Market Demand Function

The functional relationship between the market demand of a particular commodity and the factors influencing it is defined as the Market Demand Function. As earlier stated, market demand is influenced by all of the factors that influence individual demand. In addition to those factors, it is also influenced by population size and composition, season and weather, and income distribution. It is expressed as: $D_x = f (P_x, P_r, Y, T, F, P_o, S, D)$

Where,

D_x = Demand for Commodity x,

P_x = Price of the given Commodity x,

P_r = Prices of Related Goods,

Y = Income of the Consumer,

T = Tastes and Preferences, and

F = Expectation of Change in Price in the future.

P₀ = Size and Composition of the population,

S = Season and Weather, and

D = Distribution of Income.

Demand Schedule

A demand schedule is a tabular statement that shows different quantities of a commodity that are demanded at different prices, over the course of a particular time period. It shows the association between the quantity demanded and the price of the commodity. A demand schedule can be created for both individual buyers and the entire market.

Therefore there are two types of demand schedules:

1. Individual Demand Schedule
2. Market Demand Schedule

1. Individual Demand Schedule

The tabular statement that shows different quantities of a commodity that a consumer is willing and capable to purchase at different levels of prices during a given time period is referred to as the Individual Demand Schedule.

2. Market Demand Schedule

The tabular statement that shows different quantities of a commodity that all the consumers are willing and capable to purchase at different levels of prices during a given time period is referred to as the Market Demand Schedule. It is the aggregate of all individual demand schedules at all prices. The formula for the market demand schedule is:

$$D_m = D_A + D_B + \dots$$

Where,

D_m is the market demand, and

D_A+D_B are the individual demands of Household A, Household B, and so on.

5.5.2. Consumption Function

The functional relationship between consumption and national income is known as Consumption Function. It was introduced by John Maynard Keynes and represents the willingness of households to purchase goods and services

at a given income level during a given period of time. It is represented as $C = f(Y)$; where C = Consumption, Y = National Income and f = Functional Relationship. The consumption function is a psychological concept that shows consumption levels at different income levels in an economy. Besides, it is influenced by subjective factors like consumer habits, preferences, etc. Consumption Function is based on the Psychological Law of Consumption introduced by Keynes. The Psychological Law of Consumption states three main things:

Even at zero income level, there is minimum consumption, i.e., autonomous consumption which is required for the survival needs of people.

Consumption increases with the increase in income.

The rate at which income increases is more than the rate of increase in consumption.

5.5.3. Production Function

Production function is a concept in economics that explains the relationship between physical output and input. Output refers to the number of goods or services produced in a given time period. Input, on the other hand, is the number of resources or materials that are used to produce output. While production is simply the process of creating goods and services for consumption, production function is the concept explaining the quantitative relationship between input and output. There are four main components of the production function.

Types of Production Function

- ★ Short Run Production Function and Long Run Production Function are two types of production function.
- ★ Short run production function is the relationship between the specific variable input and quantity of output.
- ★ In the short run production function, only one factor is variable, while others remain fixed.
- ★ Long run production function explains the relationship between all inputs and the quantity of output.
- ★ In the long run production function, all factors of production, or inputs are variable.

Total Product, Marginal Product, Average Product

- ★ Total Product refers to the total amount of goods and services produced in a given period of time within a given input.
- ★ Marginal Product is the quantity of total goods and services when an additional unit of the variable factor is used.
- ★ Average Product refers to the total product per unit of variable factors or input.
- ★ The relationship between total product and marginal product is:
- ★ An increase in total product at an increasing rate results in an increase in marginal product.
- ★ The increase of total product at a diminishing rate causes the marginal product to decrease.
- ★ Finally, as the total product begins to decrease, the marginal product falls and becomes negative.
- ★ The relationship between average product and marginal product can be explained as:
- ★ When the average product is greater than the marginal product, the average product increases.
- ★ As the marginal product becomes more than the average product, the average product decreases.
- ★ As both marginal and average product fall, the marginal product falls at a greater rate and eventually becomes negative, while average product remains positive.

5.6. Demand for and supply of money

The law of supply and demand combines two fundamental economic principles describing how changes in the price of a resource, commodity, or product affect its supply and demand. As the price increases, supply rises while demand declines. Conversely, as the price drops supply constricts while demand grows. Levels of supply and demand for varying prices can be plotted on a graph as curves. The intersection of these curves marks the equilibrium, or market-clearing price at which demand equals supply, and represents the process of price discovery in the marketplace.

5.6.1. Law of Demand

The law of demand holds that demand for a product changes inversely to its price, all else being equal. In other words, the higher the price, the lower the level of demand.

Because buyers have finite resources, their spending on a given product or commodity is limited as well, so higher prices reduce the quantity demanded. Conversely, demand rises as the product becomes more affordable. As a result, demand curves slope downward from left to right, as in the chart below. Changes in demand levels as a function of a product's price relative to buyers' income or resources are known as the income effect.

Naturally, there are exceptions. One is Giffen goods, typically low-priced staples also known as inferior goods. Inferior goods are those that see a drop in demand when incomes rise because consumers trade up to higher-quality products. But when the price of an inferior good rises and demand goes up because consumers use more of it in place of costlier alternatives, the substitution effect turns the product into a Giffen good. At the opposite end of the income and wealth spectrum, Veblen goods are luxury goods that gain in value and consequently generate higher demand levels as they rise in price because the price of these luxury goods signals (and may even increase) the owner's status. Veblen goods are named for economist and sociologist Thorstein Veblen, who developed the concept and coined the term "conspicuous consumption" to describe it.

5.6.2. Law of Supply

The law of supply relates price changes for a product with the quantity supplied. In contrast with the law of demand the law of supply relationship is direct, not inverse. The higher the price, the higher the quantity supplied. Lower prices mean reduced supply, all else held equal. Higher prices give suppliers an incentive to supply more of the product or commodity, assuming their costs aren't increasing as much. Lower prices result in a cost squeeze that curbs supply. As a result, supply slopes are upwardly sloping from left to right. As with demand, supply constraints may limit the price elasticity of supply for a product, while supply shocks may cause a disproportionate price change for an essential commodity.

5.6.3. Equilibrium Price

Also called a market-clearing price, the equilibrium price is the price at which demand matches supply, producing a market equilibrium acceptable to buyers and sellers.

At the point where an upward-sloping supply curve and a downward-sloping demand curve intersect, supply and demand in terms of the quantity of the goods are balanced, leaving no surplus supply or unmet demand. The level of the market-clearing price depends on the shape and position of the respective supply and demand curves, which are influenced by numerous factors.

5.7. Correlation

The previous statistical approaches (such as central tendency and dispersion) are limited to analysing a single variable or statistical analysis. This type of statistical analysis in which one variable is involved is known as Univariate Distribution. However, there are instances in real-world situations where distributions have two variables like data related to income and expenditure, prices and demand, height and weight, etc. The distribution with two variables is referred to as Bivariate Distribution. It is necessary to uncover relationships between two or more statistical series. Correlation is a statistical technique for determining the relationship between two variables. A statistical tool that helps in the study of the relationship between two variables is known as Correlation. It also helps in understanding the economic behaviour of the variables.

5.7.1. Significance of Correlation

- ❖ It helps determine the degree of correlation between the two variables in a single figure.
- ❖ It makes understanding of economic behaviour easier and identifies critical variables that are significant.
- ❖ When two variables are correlated, the value of one variable can be estimated using the value of the other. This is performed with the regression coefficients.
- ❖ In the business world, correlation helps in taking decisions. The correlation helps in making predictions which helps in reducing uncertainty. It is so because the predictions based on correlation are probably reliable and close to reality.

Based on the direction of change in the value of two variables, correlation can be classified as:

1. Positive Correlation:

When two variables move in the same direction; i.e., when one increases the other also increases and vice-versa, then such a relation is called a Positive Correlation. *For example*, Relationship between the price and supply, income and expenditure, height and weight, etc.

2. Negative Correlation:

When two variables move in opposite directions; i.e., when one increases the other decreases, and vice-versa, then such a relation is called a Negative Correlation. *For example*, the relationship between the price and demand, temperature and sale of woollen garments, etc.

Based on the ratio of variations between the variables, correlation can be classified as:

1. Linear Correlation:

When there is a constant change in the amount of one variable due to a change in another variable, it is known as Linear Correlation. This term is used when two variables change in the same ratio. If two variables that change in a fixed proportion are displayed on graph paper, a straight- line will be used to represent the relationship between them. As a result, it suggests a linear relationship.

2. Non-Linear (Curvilinear) Correlation:

When there is no constant change in the amount of one variable due to a change in another variable, it is known as a Non-Linear Correlation. This term is used when two variables do not change in the same ratio. This shows that it does not form a straight-line relationship. For example, the production of grains would not necessarily increase even if the use of fertilizers is doubled.

Based on the number of variables involved, correlation can be classified as:

1. Simple Correlation:

Simple correlation implies the study between the two variables only. For example, the relationship between price and demand, and the relationship between price and money supply.

2. Partial Correlation:

Partial correlation implies the study between the two variables keeping other variables constant. For example, the production of wheat depends upon various factors like rainfall, quality of manure, seeds, etc. But, if one studies the relationship between wheat and the quality of seeds, keeping rainfall and manure constant, then it is a partial correlation.

3. Multiple Correlation:

Multiple correlation implies the study between three or more three variables simultaneously. The entire set of independent and dependent variables is studied simultaneously. For example, the relationship between wheat output with the quality of seeds and rainfall.

5.7.2. Degree of Correlation

The degree of correlation is measured through the coefficient of correlation. The degree of correlation for the given variables can be expressed in the following ways:

1. Perfect Correlation:

If the relationship between the two variables is in such a way that it varies in equal proportion (increase or decrease) it is said to be perfectly correlated. This can be of two types:

Positive Correlation: When the proportional change in two variables is in the same direction, it is said to be positively correlated. In this case, the Coefficient of Correlation is shown as +1.

Negative Correlation: When the proportional change in two variables is in the opposite direction, it is said to be negatively correlated. In this case, the Coefficient of Correlation is shown as -1.

2. Zero Correlation:

If there is no relation between two series or variables, it is said to have zero or no correlation. It means that if one variable changes and it does not have any impact on the other variable, then there is a lack of correlation between them. In such cases, the Coefficient of Correlation will be 0.

3. Limited Degree of Correlation:

- ❖ There is a situation with a limited degree of correlation between perfect and absence of correlation. In real life, it was found that there is a limited degree of correlation.
- ❖ The coefficient of correlation, in this case, lies between +1 and -1.
- ❖ Correlation is limited negative when there are unequal changes in the opposite direction.
- ❖ Correlation is limited and positive when there are unequal changes in the same direction.
- ❖ The degree of correlation can be low (when the coefficient of correlation lies between 0 and 0.25), moderate (when the coefficient of correlation lies between 0.25 and 0.75), or high (when the coefficient of correlation lies between 0.75 and 1).

5.8. Regression Analysis

Regression Analysis is a supervised learning analysis where supervised learning is the analyzing or predicting the data based on the previously available data or past data. For supervised learning, we have both train data and test data. Regression analysis is one of the statistical methods for the analysis and prediction of the data. Regression analysis is used for predictive data or quantitative or numerical data. In R Programming Language Regression Analysis is a statistical model which gives the relationship between the dependent variables and independent variables. Regression analysis is used in many fields like machine learning, artificial intelligence, data science, economics, finance, real estate, healthcare, marketing, business, science, education, psychology, sports analysis, agriculture, and many more. The main aim of the regression analysis is to give the relationship between the variables, nature, and strength among the variables, and make predictions based on the model.

5.8.1. Types of regression analysis

We know that the regression analysis is the statistical technique that gives the relationship between the dependent and independent variables. There are many types of regression analysis. Let us discuss the each type of regression analysis in detail.

1. Simple Linear Regression

It is one of the basic and linear regression analysis. In this simple linear regression there is only one dependent and one independent variable. This linear regression model only one predictor. This linear regression model gives the linear relationship between the dependent and independent variables. Simple linear regression is one of the most used regression analysis. This simple linear regression analysis is mostly used in weather forecasting, financial analysis, market analysis. It can be used for the predicting outcomes, increasing the efficiency of the models, make necessary measures to prevent the mistakes of the model.

The mathematical equation for the simple linear regression model is shown below.

$$y=ax+b$$

Where y is a dependent variable

x is a independent variable

a, b are the regression coefficients

2. Multiple Linear Regression

Multiple linear regression analysis gives the relationship between the two or more independent variables and a dependent variable. Multiple linear regression can be represented as the hyper plane in multidimensional space. It is also a linear type regression analysis. It is almost similar to the linear regression but the major difference is the number of independent variables are different. Multi linear regression analysis is used in the fields of real estate, finance, business, public healthcare etc.

The mathematical equation for the multiple linear regression is shown below.

$$y=a_0x_1+a_1x_2+a_2x_3+\dots+b$$

where y is a dependent variable

X₁, x₂, x₃ ...are the independent variables

a₀, a₁, a₂... are the constants /coefficients of independent variables / partial regression coefficients b is the intercept.

3. Polynomial Regression

Polynomial regression analysis is a non-linear regression analysis. Polynomial regression analysis helps for the flexible curve fitting of the data,

involves the fitting of polynomial equation of the data. Polynomial regression analysis is the extension of the simple linear regression analysis by adding the extra independent variables obtained by raising the power.

The mathematical expression for the polynomial regression analysis is shown below.

$$y=a_0+a_1x+a_2x^2+\dots\dots\dots+anx^n$$

where y is dependent variable

x is independent variable

a₀, a₁, a₂ are the coefficients of independent variable.

4. Exponential Regression

Exponential regression is a non-linear type of regression. Exponential regression can be expressed in two ways. Let us discuss the both type of exponential regression types in detail with example. Exponential regression can be used in finance, biology, physics etc. fields. Let us look the mathematical expression for the exponential regression with example.

$$y=ae^{(bx)}$$

where y is dependent variable

x is independent variable

a,b are the regression coefficients.
