Computer Applications

in

Hardware

Database

Charts

VBA

Word

Excel

Biological Systems

Dev Shrestha

2010

PREFACE

This book is a supplement to the course "ASM 240: Computer Applications in Biological Systems". The course is intended to provide the foundation that a college level student must have to work on their academic and professional problems using a computer. Computer has provided a tremendous opportunity to improve current agricultural practices for improved production and reduced environmental impact. The computer allows solving problems in record time, generate automated reports, and make the entire agricultural system sustainable both in economic and environmental sense. Therefore, the material covered in this course is geared towards the use of computer in solving agriculture related problems. The material covered in this class include

- ➢ Introduction to computer hardware,
- ➢ Professional use of word processing power,
- ➢ Harnessing the strength of spreadsheets techniques, graphics and charts
- ➢ Using database management techniques and
- ➢ Automation with Visual Basic for Application (a programming language)

Students are presented with range of agricultural problems they are likely to encounter in future. This class is intended for a sophomore level student. The students are expected to have high school level math and a basic computer skill.

This book contains information specific to the features and concepts used in the class. However, this book is not intended to be an exhaustive manual on any software package. Students are encouraged to consult further readings as suggested at the end of each chapter for additional knowledge.

This book also includes laboratory exercises. Each student is required to bring this book to laboratory every week. It is required that the specific sections covered in laboratory be studied prior to coming to the lab. Students are highly encouraged to report any error they find in this book for future corrections.

Dev Shrestha
Department of Biological and Agricultural Engineering
University of Idaho

© Jan 2010

TABLE OF CONTENTS

LABORATORY EXERCISES

Computer Hardware

The objective of this class is to make you familiar with the basic computer hardware and help understand different terminologies used to describe a modern computer. After completion of this class, you should be able to:

- ➢ Identify the different components of a personal computer (PC) to make a good buying or upgrading decision.
- ➢ Understand different types of processors and memory devices. You should be able to choose which processor is right for you.
- ➢ Understand monitor resolution and sizing specifications. You should be able to set right resolution for your monitor.

Introduction

Computers have become the most important communication and computational tool available to everyone in every walk of life. Once mastered, a readily available personal computer is an almost indispensable tool for everything from a letter writing to extensive computer modeling. Not only in academia, without a doubt, will you be using computers in future no matter what you do. Understanding hardware will not only help you

Some parts of a computer

decide to buy a computer you need but also you will feel more comfortable using it.

The essential parts of a modern microcomputer are a CPU, a main board, RAM, a hard drive, a monitor, a keyboard and a mouse. However, with advancement

in digital technology it is quite common to have more peripheral equipments attached to a computer. Following sections briefly discusses about essential computer components that affect the performance.

CPU (Central Processing Unit)

A central processing unit (CPU) is the heart of a computer. It is also commonly known as a microprocessor. It performs

A Pentium 4 processor

the actual data manipulation and calculations. How fast a CPU can process data is roughly determined by its clock speed. At this time of writing, you can buy a processor of clock speed up to 3.8 GHz (Giga Hertz). Where 1 GHz = 1 billion (10^9) hertz. This means, theoretically a 3.8 GHz computer is able to follow up to 3.8 billion instructions per second. Common CPUs manufacturers are Intel and AMD. As the speed of silicon based processors are approaching its limit, the manufacturers are putting more than one processor in a single chip in a dual or quad core processors.

Not only the clock speed, but other things also determine the actual processing speed, for instance,

Intel's Celeron processor is cheaper than a Pentium processor but, the Celeron processors have less cache memory (see cache memory description later) and hence are slower in performance even at the same clock speed.

A microprocessor executes a collection of machine instructions that tells a processor what to do. Based on the instructions, a microprocessor does three basic things:

1. Using its ALU (Arithmetic/Logic Unit), a microprocessor can perform mathematical operations like addition, subtraction, multiplication and division. Modern microprocessors contain complete floating point processors that can perform extremely sophisticated operations on large floating point numbers.

2. A microprocessor can move data from one memory location to another.

3. A microprocessor can make decisions and jump to a new set of instructions based on those decisions.

The data to and from the memory to ALU is carried over through the system bus. Usually the system bus works at a clock speed much lower than that of the microprocessors. With Pentium 4 processors, up to 400-800 MHz system bus are common.

Main Board (Mother board)

The mainboard provides connections to all other components that must attach to it. The mainboard determines the maximum number of expansion PCI cards and the amount of memory (RAM, random access memory) which can be installed. The mainboard will also determine the type of CPU that can be used because each mainboard is designed to seat a particular CPU. For example, a mainboard designed to seat a Pentium 4 CPU won't seat an AMD Athlon CPU.
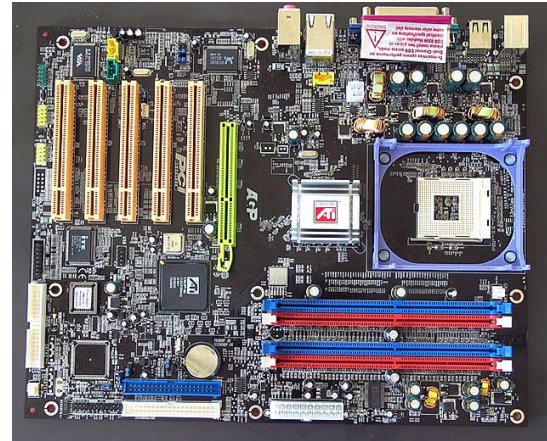
The main board

Chipset

The communication between CPU, RAM, and other components are linked by set of semiconductor chips called Chipsets. The speed at which these chipsets can transfer data back and forth is called **Bus Speed.** There are two main chipsets in a computer called **Northbridge** and **Southbridge.**

Northbridge connects CPU, RAM, Advanced Graphics Port (AGP) and Southbridge (See figure below). The bus that connects Northbridge and CPU is called **Front Side Bus (FSB)**. FSB is one of the major components that determine the computer speed. Even though processer can process information at extremely high speed, the FSB speed could be the limiting factor determining how fast the processor can get the information from RAM to process. Usually the FSB speed is much less than the processor speed. Therefore, it is wise to invest on higher FSB if you want to speed up the computer.

In the figure below, the data transfer between CPU and North Bridge occurs at every clock pulse.
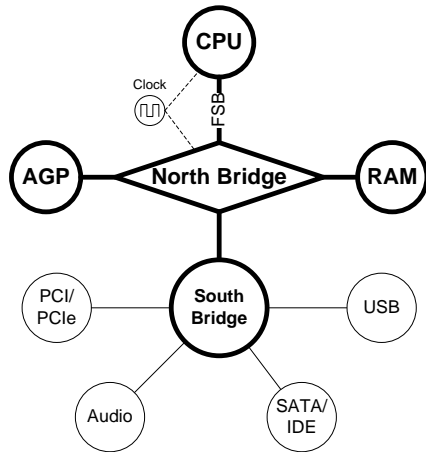
The Chipset connection

Memory devices

RAM (Random Access Memory):

RAM is the best-known form of computer memory.

Random Access Memory (RAM)

Random access means you can access any data in the memory directly if you know the memory address. RAM contains bytes of information and the microprocessor can read or write to those bytes at high speed. One problem with today's RAM chips is that they forget everything once the power goes off. That is why the computer needs ROM. If you are buying a new computer, 128MB is the minimum recommended amount of RAM for Windows XP operating systems. One of the effective ways to improve your computer speed is to install more memory if your system permits. The more RAM you have the more computer programs you can run simultaneously without noticing a slowdown in the computer.

There are several types of RAM with different data transfer speed. The latest one is called DDR3 RAM. The RAM type needed is determined by the mainboard. The predecessors of DDR3 ram are DDR2 ram and SDR ram, which you will find in older computers. Therefore, before you go buy more memory to upgrade your system, note down the type of memory being used in your computer.

BIOS or ROM: Read Only Memory

On a PC, the ROM is called the BIOS (Basic Input/Output System). Bios is kind of semiconductor that remember things even when the power is turned off. Normally BIOS used to be strictly read only

The BIOS

memory (that means no change allowed from factory setting) however newer BIOS can be rewritten for version upgrade. However, you should be very careful doing so as you may need to change several settings after you change the BIOS.

When the computer is turned on the microprocessor starts, executing instructions found on the BIOS. The BIOS instructions do things like

➢ *test the hardware in a machine, such as presence of keyboard and mouse and checks for their operability*
➢ *Recognizes and configures new hardware such as hard drives and floppy drives.*
➢ *Locates a valid OS and transfers the control of the system to that OS after boot functions have completed.*

Every motherboard has its own unique BIOS designed especially to handle the hardware it contains. The BIOS also performs the following tasks during the normal operation of the system:

➢ *Interacts with the OS to configure hardware behavior.*
➢ *Enables and disables integrated devices.*

A hard drive

> ➢ *Affects system power properties.*
> ➢ *Provides a level of system security.*

BIOS setting can usually be changed when system start up by pressing DELETE or the key specified on the screen.

Cache Memory

*A computer is a machine in which we measure time in very small increments. When the microprocessor accesses the main memory (RAM), it does it in about 60 nanoseconds (60 billionths of a second). That's pretty fast, but it is much slower than the typical microprocessor internal speed. Microprocessors can have cycle times as short as 0.2 nanoseconds, so to a microprocessor 60 nanoseconds seems like an eternity. What if we build a special memory bank, small but very fast (around 30 nanoseconds)? That's already two times faster than the main memory access. That's called a level 2 cache or an **L2** cache. What if we build an even smaller but faster memory system directly into the microprocessor's chip? That way, this memory will be accessed at the speed of the microprocessor and not at the FSB speed. That's an **L1** cache. A Pentium 4 processor has about 16KB L1 cache and up to 2 MB L2 cache. The Celeron processor has up to 256 KB of L2 cache.*

Hard Drive

The hard drive is the place where all of your data and programs are stored. 40-80 GB of memory is fairly common in modern computer. The amount of memory you need depends on amount and type of data you have. The way a hard drive is connected with the computer CPU makes a difference on data transfer rate. Hard drives (and other CD ROM drives) have standard electronic circuit built into it to communicate and control the drive. Hence they are also called IDE (Integrated Drive Electronics) or EIDE (Enhanced IDE) device, depending on their circuitry.

Advanced Technology Attachment (ATA) is a standard way for connecting storage devices such as hard disks and CD-ROM drives inside personal computers. Serial ATA or (SATA) is becoming more popular than traditional parallel ATA or (PATA).

ATA/100 and ATA/133 standards are commonly used. The ATA/X interface can theoretically transfer data up to X MB/s (mega bytes per second). Besides connection type, higher spin rate of the hard drive generally has higher data transfer rate. They are usually 5400 or 7200 RPM. Remember, a larger hard drive will not make your system any faster or slower unless you are low on available disk space but spin rate or data transfer rate certainly will. If you run low in memory you can always add one more hard drive. SATA (Serial ATA) is the newer way of attaching a hard drive with a faster data transfer rate.

Communication protocol and ports

Communication protocols (like languages) are the way computer (mainboard) communicates with external device such as hard drive, mouse, monitor, camera, and printers. All external devices are usually connected to main board. Each protocol uses different type of port (or interface). The common communication ports are:

PS/2 port: usually used for mouse and key board. Newer system connects mouse and keyboard via USB port and PS/2 port may be absent all together.

A PS/2 port

Serial port: Used for GPS and other peripheral connection. This port has 9 pins but may be absent in new computers. It is also referred as RS 232 port and mostly been replaced by USB port.

A Serial Port

Fire wire: This is a faster communication channel that can transfer data at up to 400 Mbits/s. This

protocol was developed by Sony. Fire wire is also referred as IEEE 1394 port.

A FireWire Port

VGA port is used to connect to monitors.

A VGA port

DVI is the newer standard to transfer the video digitally for higher quality.

A DVI Port

Universal Serial Bus (USB) is a serial bus standard to interface devices. USB 2 or Hi speed USB can theoretically communicate up to 480 Mbits/s. Because of its plug and play feature, high speed and multiple device connectivity, USB is replacing all other serial communication ports.

A USB Port

Bluetooth: is for wireless short distance communication. Bluetooth provides a way to connect and exchange information between devices using short-range radio frequency.

Peripheral Component Interconnect (PCI) slots

Desktop computers usually have 2-3 PCI slots. These slots are provided to add extra communication ports to the computer. This commutation may be any of the communication ports as described above and other communication such as **Data Acquisition** card to bring data from a sensor, Network cards, sound cards and Modems.

In newer computers after 2004 you may see a next generation of PCI slots called PCI Express or PCIe. There cards for PCI is NOT compatible with PCIe slots. PCIe cards comes at various speed designated as PCIeX1 to PCIeX16. Card size depends on bus speed and hence they cannot be interchanged with one another.

Monitor

A monitor is the universal output device for a computer. The cathode ray tube (CRT) monitors are widely being displaced by liquid crystal display (LCD) monitors primarily because of their light weight and low power consumption. When purchasing a display, you have a number of decisions to make. These decisions affect how well your display will perform for you, how much it will cost and how much information you will be able to view with it. Your decisions include:

- Display technology - Mainly between CRT and the newer LCD or flat screen,

- Viewable area (usually measured diagonally)

- Maximum resolution, and

- Amount of power consumption.
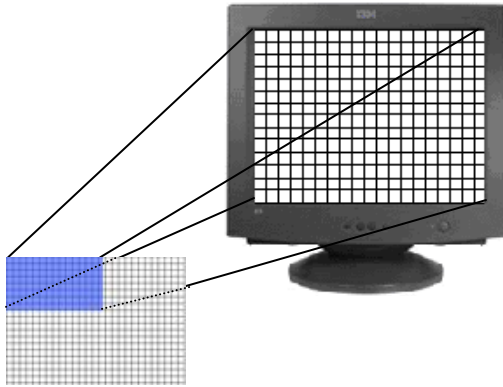
How much of video memory is displayed on a monitor depends on resolution

Most computer displays, like most televisions, have an aspect ratio of 4:3. This means that the ratio of the width of the display screen to the height is 4 to 3. Screen sizes are normally measured in inches from one corner to the corner diagonally across from it. Because the listed size is measured from inside beveled edges of display casing, viewable size is usually somewhat less than the stated screen size. There are also wide screen monitors available in the market with an aspect ratio of 16:9.

The image that is displayed on a monitor is made up of a grid work of horizontal and vertical dots called **pixels**. The number of pixels that can be displayed on the screen at one time is normally called the resolution of the image (or screen) and is expressed as a pair of numbers such as 640x480. A display normally can support resolutions that match the physical dot (pixel) size as well as several lesser resolutions. For example, a display with a physical grid of 1280 rows by 1024 columns can obviously support maximum resolution of 1280×1024 pixels. It usually supports lower resolutions such as 1024×768, 800×600, and 640×480. Size of a video image that can be transferred to a monitor depends on Screen resolution. High resolution settings in small monitors can make texts too small and hard to read. Lower resolution in bigger monitor can make things look bulky.

Compare the following two computer specifications from a manufacturer. Notice that the smaller the monitor the smaller the recommended resolution.

Diagonal Size:	21 inch	17 inch
Recommended Resolution:	1600×1200	1024×768
Maximum Resolution:	1920×1440	1280×1024

Power consumption varies greatly with different technologies. CRTs are somewhat power-hungry, at about 110 watts for a typical display, especially when compared to LCDs, which average between 30 and 40 watts.

Review questions:

1. What are the essential parts of a modern computer?

2. How many hertz makes one GHz?

3. What are the differences between RAM and ROM?

4. What does BIOS do?

5. What is FSB? Why it is an important factor that determines the computer speed?

6. What are the benefits of having a cache memory?

7. Why Celeron processor may be slower than Pentium Processor even at same the clock speed?

8. What is resolution of a monitor?

9. Look at the computer you have on hand and list the different communication ports it may have.

10. What is the difference between PCI and PCIe cards? Can they be interchanged?

11. If a monitor has an aspect ratio of 3:4 what is the height and width of 15" monitor screen?

12. What would be the screen area of a 15" monitor?

13. If you buy a19" wide screen monitor (16:9 aspect ratio) instead of 19" standard monitor (4:3 aspect ratio) how much less screen area would you get?

14. What happens if you set the resolution too low in a big monitor?

15. What happens if you set the resolution too high in a small monitor?

Multiple Choice questions

1. What happens if you set too low resolution in a big monitor?

   a. Pictures and texts will look too small
   b. Monitor screen will flicker
   c. Picture will look coarse and chunky
   d. Picture will be stretched vertically

2. Which of the following is a true statement about monitor resolution?

   a. The larger the monitor, the lower the recommended resolution
   b. The smaller the monitor, the lower the recommended resolution
   c. Resolution doesn't really matter
   d. Display resolution should be as high as possible

3. How many Hertz makes one GHz

   a. 1000
   b. 1,000,000
   c. 1,000,000,000
   d. 1,000,000,000,000

4. Which of the following is not an essential part of a modern microcomputer?

   a. Mouse
   b. Monitor
   c. Printer
   d. CPU
   e. Keyboard

5. What is one of the salient characteristics of a Random Access Memory (RAM)?

   a. New data cannot be stored on them.
   b. All memory stored on them disappears once the power goes off
   c. Their speed is dependent on their RPM
   d. None of the above

6. When a computer starts (boots), it identifies basic input and output components by executing from which of the following memories?

   a. BIOS/ROM
   b. RAM
   c. Hard Drive
   d. Cache Memory

7. Which is a true statement about Cache Memory in the processor?

   a. All processor must have some cache memory
   b. You can buy more cache memory and add just like RAM
   c. Level 2 cache (L2 cache) is faster than Level 1 cache (L1 cache)
   d. Cache memory is not useful in Work Processing

8. Which two factors influence the speed (data transfer rate) of a Hard Drive? Choose Two

   a. The way the Hard Drive is connected to the CPU
   b. The size of the Hard Drive
   c. The spin rate or RPM
   d. Number of hard drives in a computer

9. What is the universal output device for a computer

   a. Monitor

b. Printer
c. PCI card
d. USB port

10. *Which display technology is more energy efficient?*

a. LCD
b. CRT

11. *Usually the data from cache memory can be read much faster than RAM*
a. True
b. False

12. *For the same size of monitors (such as 19"), one with aspect ratio of 4:3 and another with aspect ratio of 16:9, both will have the same screen area.*
a. True
b. False

13. *When you buy a card such as a sound card for PCI slot, it will also fit into PCIe slot.*

a. True
b. False

14. *This computer component looks like a*

a. Hard drive
b. 3.5" Floppy drive
c. BIOS
d. CD ROM drive

Suggested further reading

Wikipedia Computer Hardware at:
http://en.wikipedia.org/wiki/Computer_hardware

Building a PC for Dummies, 5th Edition by Mark L. Chambers

The Operating System

The objective of this class is to make you familiar with operating system and its functions. You will learn particularly about Windows operating system. After this class, you should be able to
- ➢ Understand what is an operating system and why do you need it to run on your computer?
- ➢ Use different features of Windows operating system.
- ➢ Personalize your desktop.
- ➢ Backup your important files automatically at preset intervals.
- ➢ Create desktop shortcuts.
- ➢ Use keyboard shortcuts to speed up your work.

Introduction

Operating system (OS) is the central controller of computers that controls the hardware and makes them available to different software as needed. Operating system also keeps information about running software such as its position on the monitor screen, activation state and allocated shared resources such as memory. You can think of the operating system as a manger that manages all hardware and software installed into your computer.
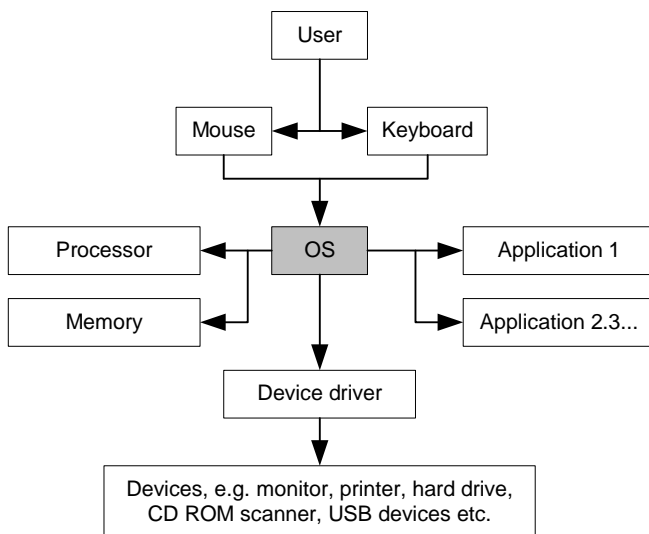
The Operating System (OS) manages the computer

While working on a computer, all the actions you do such as clicking the mouse or pressing a key on the keyboard is first detected by the operating system and then that information (an event) is passed to the program currently active. The information contains the type of event occurred along with other information such as in case of a mouse click, the location of the click. Some key combinations starting with a Windows logo or Alt keys are handled by OS itself. OS also manages processor, memories, and all other devices attached to the computer. However, OS would not know how to operate an external device attached to it. Therefore interface between hardware such as a printer and operating system is performed by yet another piece of software called a device driver that acts as an interpreter between the hardware and the OS.

Windows OS

Windows is a graphical user interface (GUI) operating system. Windows XP was released in 2001 Windows Vista in 2007 and Windows 7 in 2009. Because of the higher resource needed for Vista and Windows 7, Windows XP is still a popular operating system.

Windows operating system is not only used in personal computers but also being incorporated in many devices like GPS navigation system, smart agricultural sprayers, medical equipments, telephones, gaming devices etc. Inclusion of operating system allows equipment to integrate with other equipments and more logic can be built into the system without changing the hardware. In future, we will see more devices having incorporated OS.

The interface
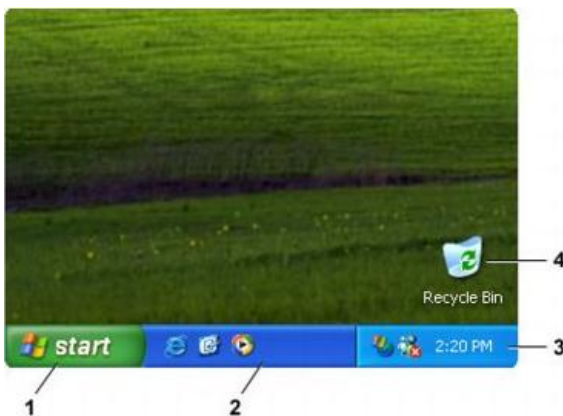
Windows desktop and start menu.

1. Start button

Depending on your setting, when you click the start button, either classic start menu or start menu is displayed. You can switch between these two options by right clicking on the start button and then choosing properties >> start menu. Some of the options in either view are:

- **Programs (or all programs)** list programs you can run from here.

- **Documents** provide quick access to recently opened files.

- **Settings** allow you to adjust computer settings.

- **Search** helps you locate files, folders, or computers to which you are connected.

- **Help and Support** opens the help and support window.

- **Run** displays a window for starting a program or opening a file with a command.

2. The task bar

Each time you open a program, a button for that program appears on taskbar. You can click buttons to move between open programs. You can use quick launch feature to quickly launch an application or show the desktop. No matter how many windows you have opened, you can always minimize all of them at once by clicking Show Desktop button in the Quick Launch part of the taskbar in Windows XP. If you change your mind and do not want to use the desktop, you can click the Show Desktop button again to restore all of your windows.

Note: If you do not see the Show Desktop button, right–click on an empty part of the taskbar, point to Toolbars, and make sure Quick Launch is checked. If it is not, then click it.

3. Notification area (or system tray)

The notification area contains icons that provide quick access to programs and computer functions, such as a computer clock and printer status. Windows XP hides notification area icons that are not frequently used. Click the caret, or chevron, icon to view hidden icons. To prevent Windows from hiding your notification area icons - Right-click on an empty spot on the taskbar and click Properties.>> Make sure that Hide inactive icons is not checked.

4. Recycle Bin

When you delete a file, it moves to the Recycle Bin, where it can later be retrieved. To permanently remove files, empty the Recycle Bin. (Shift –Delete will permanently delete your file without putting it to the recycle bin)

- Searching for Files

  [⊞] [F]

- Copying/Moving a File

  Select file(s) then [Ctrl][C] for copy or
  [Ctrl][X] to cut

- Renaming files

  Select file(s) then [F2]

- Deleting / Permanently deleting files   Select
  file(s) then [Shift⇧] [Delete]

- Emptying the recycle bin

  Right click on recycle bin, select empty
  recycle bin

- Retrieving files from recycle bin   Open
  recycle bin, select files, then File>>Restore

- Updating antivirus software

Right click on antivirus icon on notification area, then
select update now…

The Control Panel

Windows has conveniently places all the controls
under the control panel that you can use to tweak
how Window should behave. All of the settings you
can change to customize an operating system are
found under the control panel. There are two views
of the control panel, classic view and categorical
view. Categorical view is easier to work with if you
are not familiar with individual file names in classic
view.

Appearance and Themes

You can use this category to customize the
appearance of the user interface.

Control Panel >> Appearance and Themes >> Display

OR

Right click your mouse anywhere in an empty portion
of the desktop. Choose properties.

Choosing a Wallpaper

>> Select Desktop tab. You may choose a different
image of your choice using Browse and selecting an
image you like.

Choosing a Screen Saver

>> Select Screen Saver tab. Choose from the **Screen
Saver** pull-down menu, or click **(None)** if you prefer
not to activate a screen saver.

Choosing a Desktop Theme

It is used to change the appearance of your desktop
and add sound effects by using desktop themes:

>> Select Themes tab. Select one of the themes from
drop down list

Changing Display Resolution

>> Select Setting tab >> Use slide bar to set desired
screen resolution. Make sure you chose the right
resolution. If aspect ratio of the resolution you select
does not match with your physical aspect ratio of
your monitor the image will appear distorted.

Performance and Maintenance

You will find some critical performance options such
as backing up your data periodically, setting for
automatic updates, hardware and driver status,
system information under this topic.

Unintentional file deletion, corruption of files by
viruses, and hard drive failures can cause data loss. If
you lose the contents of your hard drive, you can
reinstall programs, but your data files are lost unless
you have a backup. CD-R and CD-RW drives are
convenient devices that can back up large amounts
of data (up to 700 MB) quickly and can often run
unattended.

To schedule a backup:

Control Panel >> Performance and Maintenance>> Scheduled Tasks >> select backup program from the dialog box that follows.

Creating and arranging shortcuts

A shortcut is an icon on the desktop that provides quick access to programs, files, folders, and drivers you might frequently use.

➢ *Open My Computer or Windows Explorer, and highlight the file or program for which you want to create a shortcut.*

➢ *Click and hold down the right mouse button, drag the highlighted item to the Windows desktop, and then release the right mouse button to display a pop-up menu.*

➢ *Click Create Shortcut(s) here.*

Alternative to step 2 and 3, hold Ctrl Shift *while dragging and dropping using left mouse button. An icon will appear on your desktop that you can double-click to activate the shortcut. You can drag and drop any desktop icon to quick launch bar to quickly access to a program or file.*

When your program stops responding…

- *Press <Ctrl><Shift><Esc> OR <Ctrl><Alt><Del> simultaneously. or*

- *Click Applications>> Click the program that is no longer responding >> Click End Task.*

When your computer stops responding…

If your computer locks up and you are unable to get a response by pressing any key on your keyboard or moving your mouse, press and hold the power button for at least 8 to 10 seconds until the computer turns off. Then press the power button again to turn on the computer. You might lose data if you are

*unable to turn off your computer through the **Start** menu.*

More Windows shortcuts

If you have a Windows Logo key[田] in your keyboard you can perform the following shortcuts

Key Combination	Function
田	*Displays or hides the Start menu*
田 F1	*Opens the Help and Support Center window*
田 M	*Minimizes all open windows*
田 Shift M	*Maximizes all windows*
田 E	*Runs Windows Explorer (My computer)*
田 R	*Opens the Run dialog box*
田 F	*Opens the Search Results window*
田 Pause Break	*Opens the System Properties dialog box*
田 Tab	*Cycle through buttons on taskbar*
田 L	*Lock the computer up*
田 U	*Utility window for narrator*

You can perform commonly used windows tasks using keyboard shortcuts instead of using menu from mouse. Keyboard shortcuts are generally a faster way to execute a window command.

Press	To
Ctrl c	Copy.
Ctrl x	Cut.
Ctrl v	Paste.
Ctrl z	Undo.
Delete	Delete.
Ctrl while dragging an item	Copy selected item.
Ctrl + Shift while dragging an item	Create shortcut to selected item.
F2	Rename selected file name.
F3	Search for a file or folder.
Alt + Enter	View properties for the selected item.
Alt +F4	Close the active item, or quit the active program.
Alt +SPACEBAR	Opens the shortcut menu for the active window.
Ctrl +F4	Close the active document in programs that allow you to have multiple documents open simultaneously.
Alt + Tab	Switch between open items.
Alt + Esc	Cycle through items in the

	order they were opened.
F4	Display the Address bar list in My Computer or Windows Explorer.
Shift +F10	Display the shortcut menu for the selected item (same as right click).
Shift when you insert a CD into the CD-ROM drive	Prevent the CD from automatically playing.

Windows 7

Windows 7 is the newest operating system from Microsoft. All of the features discussed above are also applicable for Windows 7.

Review Questions

1. What is an operating system?

2. Search internet to see how Windows OS is being used in smart agricultural and medical equipment.

3. What is a device driver? Do you need a driver to connect your digital camera to a computer?

4. What is a task bar? What is quick launch bar and how do you hide or unhide it?

5. What is the notification area?

6. Write down the steps to change the desktop wall paper.

7. How do you change the screen resolution? What setting will be most appropriate for a 17" monitor?

8. *Write down the steps to periodically backup your important files or folders.*

9. *What would you do to permanently delete a file without putting it in the recycle bin?*

10. *How do you create a program shortcut on your desktop?*

11. *How can you prevent a CD from automatically playing when you insert it into CD ROM drive?*

12. *Open System Properties dialog box using Windows shortcut (see windows shortcut table)and find out the following information about your computer:*

    a. *Operating System:*

    b. *Computer manufacturer:*

    c. *Processor type:*

    d. *Processor speed:*

    e. *Amount of RAM:*

13. *What is keyboard shortcut for a mouse right click?*

14. *What is the keyboard shortcut to quit an active program?*

Multiple choice questions

1. Normally when you delete a file from hard drive it goes to recycle bin and you can still restore your file later.

   a. True
   b. False
   Answer: _____

2. Smaller the Monitor screen size higher would be the recommended resolution.

   a. True
   b. False

Answer: _____

3. button_____ all open windows.

   a. Maximizes
   b. Minimizes
   c. Closes
   d. Tile

Answer: _____

4. Ctrl + letter_____ cuts the selected text.

   a. C
   b. V
   c. X
   d. Z

Answer:_____

5. Ctrl + letter_____ copies the selected text.

   a. C
   b. V
   c. X
   d. Z

Answer:_____

6. Ctrl + letter_____ pastes the selected text.

   a. C
   b. V
   c. X
   d. Z

Answer:_____

7. To make a shortcut on the desktop, you press _____ key while you drag a file or folder.

```
a. Ctrl
b. Ctrl + Alt
c. Ctrl + Shift
d. Alt + Shift
e. Shift
```

Answer: _____

Suggested further readings:

Windows XP For Dummies Chapter 14 - Customizing Windows XP (Fiddling with the Control Panel)

Microsoft Windows XP Inside Out Deluxe, Second Edition   Chapter 7 - Security Essentials

(These books are available online from Library)

Word Processing –The Interface

Objective of this section is to give you an overall view of Microsoft word application. It is expected that students are somewhat familiar with word processing software. If this is not true in your case, contact your instructor for some special sessions. In general, after this class you should be able to:

- ➢ Understand overall layout
- ➢ Understanding the ribbon
- ➢ Finding a needle in a hay stack
- ➢ Going shortcut

The Document object model

Microsoft Word is a powerful tool to create professional looking documents.
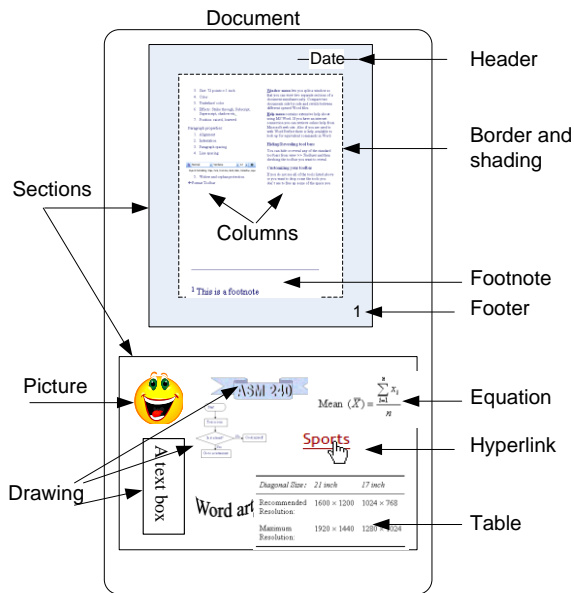
Figure: The document object model. A document may have more than one sections and each section may have paragraphs, pictures and tables.

A word document can be considered as a physical object. Objects usually have some **properties** (also called attributes) and **methods**. Properties or attributes of a "Human" object could be Height, Weight, Skin color etc. Method of the "Human" object could be step forward, jump etc. Similarly, for a word document, attributes could be page size, margin, header etc. and methods will be delete selected text, insert a table etc. You can think of attributes as adjective of an object and methods as action verbs.

An object may comprise some other objects such as a car object compromises engine and wheel objects. Similarly a word document comprises other objects like sections. Each section may have some other objects such as a paragraph and a table. There are two versions of Word commonly used Word 2003 and Word 2007. Even though we emphasize on using Word 2007, a brief description of Word 2003 is given at the end of this chapter.

If you are new to word 2007, I highly recommend you to watch some introductory video from Microsoft training web page found at:

http://office.microsoft.com/en-us/training

and click on Word 2007. Then view the following tutorials. (needs internet connection)

Up to speed with Word 2007 (40 min)

Get to know Word 2007 I: Create your first document (30min)

Word 2007

Word 2007 has replaced menu and tool bars with a ribbon. When you click one of the major tabs on the ribbon, the tools you need for specific tasks are

mostly be right where you need them. If you think of the object-oriented view of the Word, you will find the tools that are frequently used relevant to the object you are working at the most convenient location. This makes the work appear less cluttered with irrelevant tools and relevant tools easy to find.

The office menu
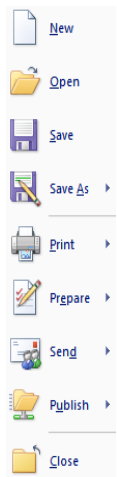
The only menu you will see in office 2007 is the office menu which is more like the file menu in 2003. If you click on this button you will see the following menus along with previously opened recent files list. The New, Open, and Save are self explanatory and same as in 2003. Use save as to save a document with a different name or to a different format such as Old Word file (1997-2003 format which will have **.doc** extension rather than Word 2007's **.docx** extension), document template or to create a **PDF file**. In order to create a PDF file you will need to download a free PDF add-on from www.microsoft.com/downloads and then search for PDF add-on. You will see a link to "2007 Microsoft Office Add-in: Microsoft Save as PDF". Click on this and it will walk you through the download process. Now when you want to create a PDF file from any office document, go to save as >> PDF.

The keyboard shortcuts to do these common tasks are:

Ctrl+
N → New;   O → Open;   P → Print;
S → Save;   W → Close

☑ On the right side of recently documents list there is a push pin icon. Click this icon to prevent the file name from scrolling out of the list as new files are opened.

Quick Access Toolbar

The only customizable toolbar you will see in Word 2007 is this quick access toolbar located next to office menu. You can keep any of your favorite tools for quick access. Click on the Customize button at the end to add or remove commands from this list.

The ribbon
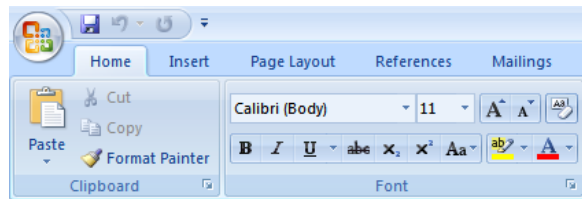
The ribbon (Ctrl+F1 to hide/ unhide the ribbon)

Instead of customizable menus in previous versions of Word, now first thing you will see in Word is a ribbon. The ribbon is designed in such a way that most of the tools you use is under Home tab (Instead of menu in 2003 version, there are tabs in 2007 version). Each of the remaining tabs is grouped in the task-oriented fashion. You will select a tab based on the task. The visible tabs when you first open the Word are:

Home

This tab has the most frequently used actions using Word they are:

Clip board: Clip board is a temporary memory space where copied items are placed to paste later. To collect multiple items, make the clipboard visible by clicking on   icon next to Word Clipboard.

To paste an item from visible clip board place your cursor where you want to paste and click on the clip board item to be pasted.

Cut → Ctrl+X   Copy → Ctrl+C   Paste → Ctrl + V
Paste Special → Alt+Ctrl+V

Format painter → *To copy paste just the formattings. Double click the icon for multiple pasting, ESC to cancel.*

Font: *Use to change the font properties of selected text. Click* icon *for more options.*

Paragraph: *Use to change the paragraph properties at the caret (Cursor) point. Click* icon *for more options.*

Style: *Style is the predefined set (Combination of paragraph and font properties) of different text items such as TITLE, Heading1, Heading2, paragraph text etc.*

Editing: *Allows finding, replacing and going to a specific location in Word.*

Find→*Ctrl +F   Replace*→ *Ctrl+H*

Goto→ *Ctrl + G*

Insert

Word document can hold several different objects other than just text. All other objects can be inserted from this tab. The objects you can insert are:

1. *Pictures*
2. *Tables*
3. *Breaks*
4. *Shapes*
5. *Hyperlinks*
6. *Bookmarks*
7. *Textboxes*
8. *Word arts*
9. *Headers and footers*

Page layout

Use this tab to change page properties such as margins, orientations, and paper size. More will be discussed in the following chapters.

Reference

This is really handy if you need to

1. *Insert table of contents*
2. *Insert endnotes/footnotes*
3. *Insert citation*
4. *Insert picture and table captions*
5. *Insert index words*

Mailing

Use this tabs to do mail merge, creating envelop, and address labels from existing mailing database.

Review

This tab features reviewing tools such as

1. *Proof reading*
2. *Commenting*
3. *Track change*
4. *Comparing documents*
5. *Protecting documents from reviewing*

View

This tab allows you to look at the document with

1. *Document views*
2. *Ruler*
3. *Document map*
4. *Zoom control*
5. *Split view*

Status bar

Unlike Word 2003, you can choose what information to display from list of items on status bar. Right click on the status bar to select/unselect the list of information displayed.

Equivalence from older Word

Because of the new interface in 2007, it is easy to get frustrated by not finding the button you are looking for. You can get help easily and interactively if you are connected to internet.

The help button is located at the upper right corner of Word just below the close button or press F1 button. On the help window type 2003 and search. Click on

Interactive: Word 2003 to Word 2007 command reference guide
Help > Getting help

On the next window that appears, click on
Start the guide ▶ . Then click on start and you will see an old Word 2003 interface. Click on the command or menu item and it will show where that command is located in Word 2007.

Some commonly used Word Shortcuts:

	Open a blank document	Ctrl +n
	Open an existing document	Ctrl +o
	Save the document	Ctrl + s
	Print the document	Ctrl + p
	Print preview	Ctrl + F2
	Cut	Ctrl + x
	Copy	Ctrl +c
	Paste	Ctrl + v
	Hide/Unhide Ribbon	Ctrl+F1
	Undo	Ctrl + z
	Redo	Ctrl+y

Review questions:

1. How a document can be considered as a physical object please explain.
2. Objects usually have some_____and _____.
3. What could the attributes of a word object like paragraph?
4. In a table object, categorize the following actions as attribute or method:
   Table Width:_____
   Font size:_____
   Insert Row:_____
   Add Numbers:_____
5. Download and Install a PDF and XPS writer from www.Microsoft.com and search for PDF.
6. Open a new word document and write your name. Print the document as PDF file.
7. How could you tell if a Word file was an older version of Word file (2003 or older) after you open in Word 2007?
8. Insert 🗔 New Comment tool in quick access toolbar if it is already not there.
9. Select your name on your new document and use the New Comment tool to insert a comment on your name.
10. Remove the 🗔 New Comment tool from quick access toolbar you have just added.
11. Is it possible to hide the ribbon, if so how can you hide and unhide the ribbon?
12. When you want to group the drawing objects it is a good idea to insert a drawing canvas and then populate your drawing objects into the drawing canvas. Explore and find the 🔷 New Drawing Canvas to insert a drawing canvas under Insert Tab.
13. use shortcut to:
    Open a blank document
    Copy, Cut and Paste
    Hide unhide the ribbon
    Undo and Redo
    Save a document
    Close a document
    Find a word
    Replace a word

Word Document – as an Object

> *The objective of this section is to make you familiar with basic Word features for document navigation and formatting. After this class you should be able to:*
> - *Set up a document page properly.*
> - *Rapidly navigate through a long document.*
> - *Find and replace special characters.*
> - *Insert a clipart, picture and a symbol.*
> - *Write mathematical equations, draw flowcharts and different objects.*
> - *Use keyboard shortcut to increase working speed.*

Working with objects

The first task you should consider doing even before you start typing the first word is setting up the page. Setting up your page margin in advance allows you to see how the document will look when printed. Your document structure may be chaotic if you change the page and margin setup at the end and may help avoid hours of frustration in a long document trying to fix shifted figures and broken tables when you change your page margin at the end.

The Page Object
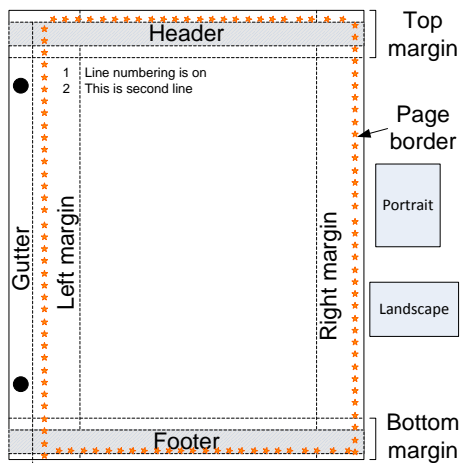
Figure 1: Basic page properties (attributes)

*The **Page Layout** tab conveniently provides all the commands to change the properties of a page such as:*

Margins	Orientation	Size
Columns	Breaks	Line #
Hyphenation	Watermark	Page Color
Border		

To change the property value for each of the properties select the corresponding tool under Page Setup or Page Background groups.
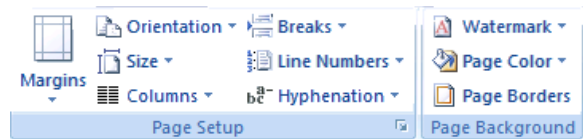
Each of the important properties of a page is briefly explained below.

Margins

By default, entire document will have the same page margin. However, you can create different margins for each section even if they are in a same page. Paragraph margins can also be viewed and modified using ruler. If rulers are not visible, then from View tab>> Show/Hide, make sure Ruler option box is checked.

Left
Margin = 0.5"

Top
Margin =1"

Drag to change the margin
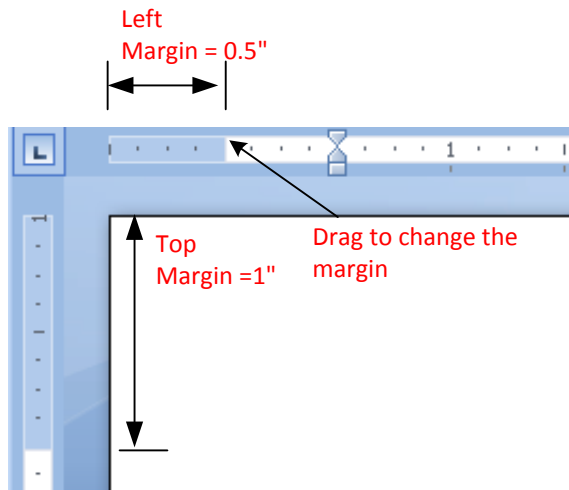
Figure 2: Margins can also be viewed and changed using ruler.

Orientation:

A different page orientation (portrait or Landscape) can be set to each section provided they are in a different page.

Size

You can chose from a standard pages size such as Letter, Legal, A4, Envelop or you can define your own page size.

Info on paper size: While letter, legal and executive are the standards used to specify the paper size in US, the international standard (ISO) paper size is measured in A, B or C series followed by a number. A4 is the closest size to US letter size. A0 has 1 m^2 area and each successive numbers would have half of that area. For instance A1 paper will have area of ½ m^2, A2 is ¼ m^2 and so on. The width to length ratio is always $1 : \sqrt{2}$. (Calculate length and width of an A4 size paper)

Column

A section can have more than one column and you can control individual column widths, spacing between columns from selecting the More Columns... *options under columns.*

Breaks

There are two types of breaks, breaks without creating sections like hard page break, column break etc and section breaks. Use section break to have different formatting within a document. When creating a section, you can decide whether the new section will start on the same page, a new page, new odd page or new even page.

Line

Displaying line numbers are useful when you send a document for editing, as editor can specify the line number to edit. Many professional documents such as journal paper require the authors to put the line numbers in their document when they submit for publication review.

Hyphenation

When you have narrow columns in your document, sometimes there may be too much space left because Word cannot fit a too long word. To make the lines more evenly spaced, turn the hyphenations on so that a long word at the end of a line automatically breaks at proper place.

Watermark

On occasions, you may want to place a watermark on a document such as the word "DRAFT" or "CONFINDENTIAL" or your corporate logo as a picture. Watermarks can easily be placed using watermark tool. From drop down menu, click on Custom watermark to create a different watermark.

The Paragraph Object

Everything you type in Word must be a part of a paragraph. *Titles, Headings, and subheadings are all paragraphs with a different formatting than normal text paragraphs. A paragraph object is a text block that ends with a paragraph marker (¶). To reveal this marking click on Home>> Paragraph>>* ¶ *(or Ctrl+*). The common properties of a paragraph are listed below.*

Alignment	Indentation	Spacing
Tabs	Border/Shading	Widow/Orphan
New page	Bullet/Numbering	

There are two places in Word 2007 from where you can change paragraph properties: Home tab >> Paragraph
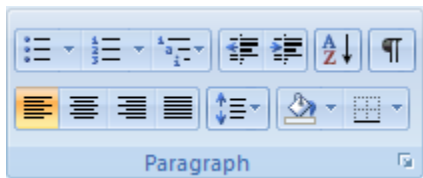
and Page Layout tab>> Paragraph.
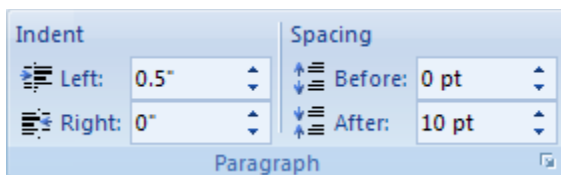
Alignment

Alignment is also called justification is the way that text aligns horizontally within its assigned area. Four choices for alignments are Left (Ctrl + L), Center (Ctrl + E), Right (Ctrl + R) and Justified (Ctrl + J).

Indentation

Indentation is the amount of horizontal space between the margin and the paragraph. There is also special indention for just the first line of the

*paragraph or for the rest of the paragraph but the first line. The latter is called **hanging style**. To create this special indentation, extend the paragraph group (by clicking ▫ next to paragraph) and specify the special indentation under special. Indentation can also be set using ruler.*

In the following ruler the indentation can be read as: First line: ¼", Remaining lines: ½", Right indentation: ¼".
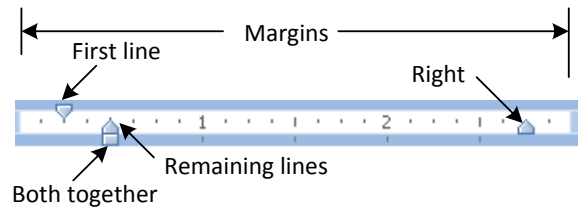
Figure 3: Indentations can be read and set using rulers. Drag the arrow points to set.

Spacing

- *Line spacing*
- *Paragraph spacing*

It is not a good idea to hit ENTER twice to separate paragraphs. *Instead change the paragraph spacing to adjust the spacing between paragraphs. The paragraph spacing is usually measured in points, for conversion, **1 inch = 72 points**.*

Tabs

Tab stops tell the insertion point where to stop when TAB key is pressed. By default, Word has tab stops every 1/2", starting from the left margin. You can change default tab setting or any special tab setting either using Paragraph >> Tabs... Tab keys are represented by non printing →marks if you reveal the markings.

Setting a tab:

1. *Choose the type of tab stop:*
   - └ *Left* : *Left aligned at tab stop*
   - ┴ *Center* : *Center aligned at tab stop*

⊡ Right :Right aligned at tab stop

⊡ Decimal :Decimal aligned at tab stop

⊡ Bar :Places a vertical line

You can use leftmost button of the ruler to choose the type of tab stop. Each time you click on it will cycle through the above tab stops (There are actually two other items in the cycle: First line and left indent, but they are for setting indents not tabs).

2. Choose a **leader**. Tab leader is a repeated character that extends from typed text to the next tab stop. Leaders are commonly used in table of Contents. (You cannot set leaders using ruler)

3. Click on the ruler where you want the tab stop if you are setting a tab using ruler or type in the value in "Tab stop position" box in tab dialogue box and click SET.

When you start a new paragraph by pressing enter at the end of paragraph, the tab stops carry over automatically.

Border and Shading

You can choose a different paragraph background color (theme color or static color) and borders using border and shading tools. You can reveal border and shading dialogue box either by clicking down arrow next to border icon or from Page layout >> Page Background >> Page borders and click the Border Tab.

Widow/Orphan control

Paragraphs often flow to the next page. Sometimes a single line of a paragraph appears either at bottom or the top of the page. These stray lines are called widow (occurring at the top of the page) or orphan (occurring at the bottom of the page). To prevent widow and orphan, in paragraph dialogue box, click on "Line and page breaks" tab and check "Widow/Orphan control" box.

New page

Stating certain types of paragraphs such as CHAPTER TITLE may be desirable. To enable this, in paragraph dialogue box, click on "Line and page breaks" tab and check "Page break before" box.

Bullet and numbering

A paragraph may also be a list of things either bulleted or numbered. There are two ways to insert bullet or number.

- Select the adjacent paragraphs you want bulleted or numbered and click either bullet or number from Home>> Paragraph >> bullet/number
- Click one of the buttons first and then start typing. Each time you press enter a new bullet or number will follow. Press enter twice to turn off the list.

To change the bullet and numbering style use the drop down arrow next to "bullet" or "number" icon.

If you want the list to be started with a specific number other than 1, then right click on listed text and on the menu that appears, select "Set number value". There you can specify the starting numbering.

Multilevel list is used to create the numbering based on heading level. For instance, Heading 1s will be numbered 1,2,3.., Heading 2s will be numbered as 1.1, 1.2… or 2.1, 2.2 based on parent heading 1 numbering.

Styles and Themes

Since there are so many properties of a paragraph and text, making a document looks consistent could be hard if any of the paragraph property is changed manually. A **Style** is a defined set of attributes applied to a paragraph and or texts. Styles are extensively used in a longer document to create a professional document. Each Style has a name such as "**Normal**" or "**Heading 1**".

There are three main advantages of defining and applying the style to a paragraph:

1. The document will look consistent
2. Changing style will apply the change to all occurrences in entire document that eliminates having to edit each heading or paragraph individually.
3. Can be used to automate the process such as creating automated table of contents.

For a short document (about less than a page) it doesn't matter much whether you change fonts and paragraph idividually but for a longer document, it is always efficient and quicker to apply a style.

Home >> Styles have several quick styles that are frequently used. Although you can define and have as many styles in a document, limiting the styles used in a document to just a few is recommended.

Figure 4: Different styles available in quick style

There is also collection of styles called **Style set**. A Style set is nothing but the collection of styles. For example "Fancy" style set has different definition for Heading 1 style than "Elegant" Style set. For each style set, the font scheme and color scheme can be quickly changed from "Colors" and "Fonts" under dropdown menu for "Change styles". Combination of booth color and font is sub classified as **Theme**. The Theme can be changed from under Page Layout tab.

You can select a style set to apply in your document from Home>> Change Styles>>Style Set and then

hover your mouse on one of the list and park over a style set name to temporarily apply that style set to your document. Click if you want to apply that style set or navigate away to discard.

You change the theme of a style set from Page Layout >> Themes.

Changing a style

Any style can be redefined or a new style can be created according to your taste. Right click on any styles on the Quick Styles you want to modify and select . You will see a modify style dialogue box as shown below.
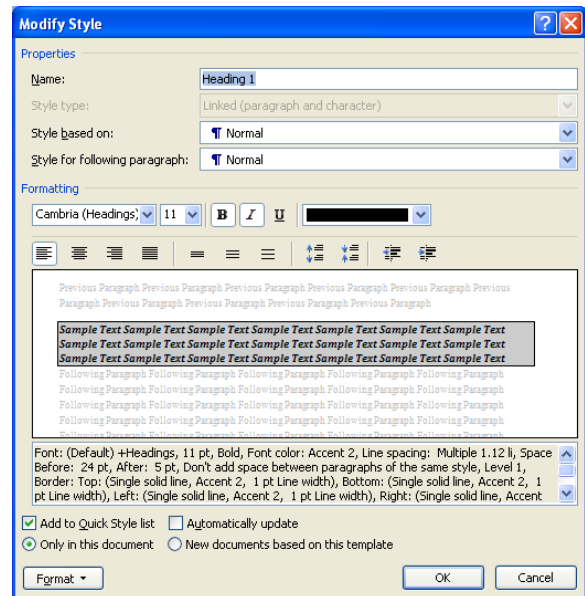
You change or add new style using this box. The entrees of the "Modify Style" dialogue box are:

Name: Name of the style

Style type: A style could be for a paragraph, text, or for both text and paragraph (called linked). A paragraph style **cannot** be applied only to a portion of a text inside a paragraph. Character style only applies to selected text. For the linked style, if nothing is selected when this style is applied, (just blinking cursor somewhere on the paragraph) the

style will be applied to entire paragraph. If only part of a single paragraph is selected, the style is applied to only to selected text.

Style <u>based</u> on: *This is the template used to start defining a new style.*

Style for following paragraph: *Style you want after you press 'Enter' that is the next paragraph. For instance you probably want normal style after "heading 1" style.*

Automatic update: *When this box is checked you need to be extremely careful making a one-instance formatting change. For instance if you select a part of heading 1 and change formatting, if automatic update is checked then it will also update the style definition. Consequently that will change all of the heading 1s to the new style. I suggest turning this feature off unless you understand the undesirable consequences it may have on your document.*

Two option buttons defines the scope of the new definition. ⊙ Only in this document *applies the changes to only the current document. If you want to make permanent change to all new documents, select* ○ New documents based on this template *. For more options on modifying paragraph styles click on the 'Format' command button and select from the list of items you want to change.*

▌*Quick Style set*

Style sets are collection of styles and themes. You would be working with only one style set for one document. You can change the style for any one single paragraph such as heading a style set or create your own style set. To create your own style set, first start with a basic available styles closest to you have in mind and from

Home>>Change Styles>> Save as Quick Style Set...
Name your style such as "my favorite". Then select

that style set and change whatever style you want in that style set as described in previous section.

▌*The style task pane*

The style pane can be used to view and change any style. To display style pane, click on dialogue box launcher of the styles group on Home tab. In addition to lists of all styles on style pane, it also displays style type on the right column.

	Normal is paragraph formatting *Heading1 is linked formatting* *Emphasis is character formatting*
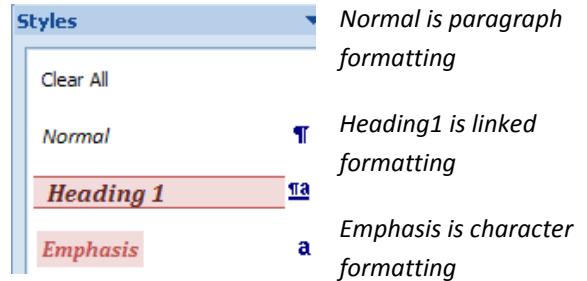
Right side making on styles pane tells about the type of formatting.

To limit the list of styles used on the current document, you can click on "Options…" at the bottom right corner of style task pane and from drop down menu under "Select styles to show" select the desired option.

KB Shortcuts

- *Shift+Enter will force the remaining of a line after caret to move to a next line without creating a new paragraph.*
- *Ctrl+Alt + 1 will apply heading 1 style*
- *Ctrl+Alt + 2will apply heading 2 style*
- *Ctrl+Alt + 3 will apply heading 3 style*

Formatting	
Delete previous word	*CTRL+Backspace*
Apply bulleted list	*CTRL+SHIFT+L*
Increase Indent	*CTRL+M*

Decrease Indent	CTRL+SHIFT+M
Page break	CTRL+Enter
Hide show markings	Ctrl + *

Review Questions

1. Which tab would you use to set up the page margin?
2. List some common attributes of a page in a document.
3. Explain what is a water mark and how would you insert one in a document?
4. How paragraph object is different than a character object?
5. Explain how you adjust the inter paragraph space without hitting Enter twice?
6. List some common attributes of a paragraph object.
7. What is a tab?
8. What is Widow/Orphan Control?
9. What is Hyphenation?
10. What is a style?
11. What is the difference between paragraph style and character style?
12. What is linked style and how does it behaves?

Multiple choice questions

1. Reveal formatting ¶ command is found on:

   a. Home >>paragraph group
   b. Insert >> symbols group
   c. Page Layout >> paragraph group
   d. View >> Show/Hide group

2. Applying built-in style like Heading 1 style helps

   a. Create automated table of contents
   b. Helps quick reformatting
   c. Makes the document consistent in style
   d. All of the above

3. One inch =

   a. 1 points
   b. 12 points
   c. 72 points
   d. 100 points

4. Closest ISO paper size for US letter size paper is

   a. A0
   b. A2
   c. A4
   d. A8

Non-alphabetic Objects in Word

The objective of this section is to make you familiar with basic word objects and their attributes:

➢ Table Object.
➢ Illustrations like picture, clipart and shapes.
➢ Equation.
➢ Understanding a symbol.
➢ Other objects such as PDF document.
➢ Use keyboard shortcut to increase working speed.

Table Object

A table is made up of rows and columns of cells that you can fill with text and graphics. Reveal formatting marks (Ctrl + *) to see the non printing marks.
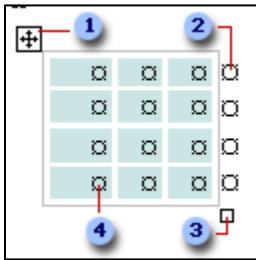
1. Table move handle becomes visible when you hover you mouse at this corner.

2. End-of-row mark. Click here and enter to insert a new row.

3. Table resize handle. Drag to resize.

4. End-of-cell mark.

Inserting a table and table menu

Use Insert >> table will insert a table of given rows and columns. Once you insert a table and click anywhere inside the table, you will see a "Table Tools" contextual tab at the end of tabs. Contextual tab is a tab which is visible only when corresponding object is selected.

This tab is visible only when a table is selected. You can think each cell inside a table as an individual paragraph. You can independently format those cells. The most frequently used table properties are:

Alignment	Text Wrapping	Size
Row height	Column width	Text direction
Cell margins	Border	

Alignment

There are two alignments when we are talking about a table; alignment of entire table in a page and alignment of test inside a cell. Both alignments can be controlled from table properties dialogue box
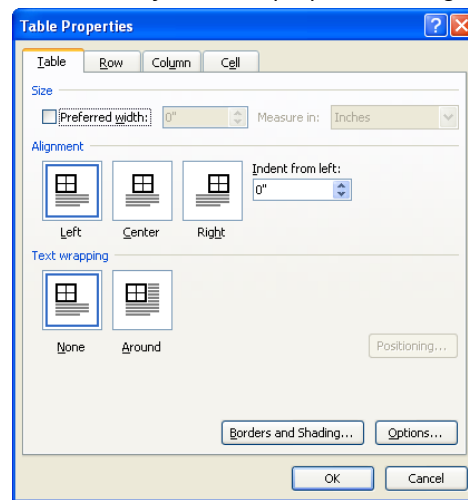
Figure: Table Properties dialogue box

To access the dialog box go to: **Layout >> Table >> Properties>> Table** *or*

R- click on table and select

*Click on the alignment you want. If you want more precise control of table position use **Indent from left:** scroll bar control to specify the table location.*

Text Wrapping

*By default table takes up the full width of a page. If your table is narrower than page width, you can allow the text to be on either side. This is called text wrapping (text wrapping outside of table). You can set this property from table property dialog box as well. **Layout >> Table >> Properties>> Table** or*

R- click on table and select

Table size

When a table is inserted, it by default takes up all the width of page or column. You can later specify the entire table width using table property dialogue box as before. Then check the preferred width option box and specify the table width.

Row height /Column width

This property can be changed directly from a table by dragging the border lines. If border lines are not visible then you can make them visible from Home>> Paragraph >> *>>*

Text direction

As name implies, text direction controls the direction of text flow. R- Click on cell to change the text direction and then select *.*

Cell margins

One of the most frequent troubles with table is to fit the content within a cell. Cell margin defines the space between the cell border and the text. If you run out of page, to fit your table nicely, try reducing cell margins from table properties dialogue box.

R-Click >> *>>Cell >> Options >> Cell margins*

Border

This property is used to define a line (or no line) around cells. Border is a frequently used feature and can be changed directly from Home >> Paragraph>> *.*

Table styles:

Table style is a collection of formatting that can be applied to a table. This is one of the easiest and quickest ways to make your table look professional. You can quickly give your table a professional design by using any of the built-in table styles.

To apply a table style, select a table and from Table Tools >> Design,

Select the option you wanted to apply from Table styles options
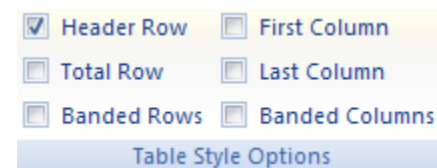
Select a style you want to apply.
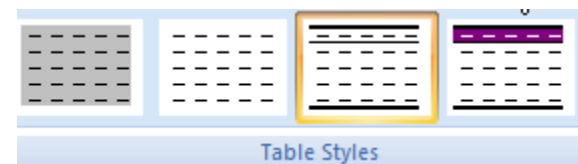
Similarly the methods (or actions) that are frequently applied to a table are:

Insert/Delete	Distribute	Merge/Split
Calculate		

Insert/Delete

Use to insert/delete row and columns or delete entire table (selecting entire table and delete rows).

Table Tools >> Layout >> Rows and column
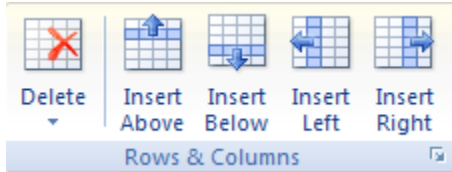
Distribute

This method is used to distribute row or columns equally. Select the rows or columns that you want to distribute equally and

Table Tools >> Layout >> Cell Size>>
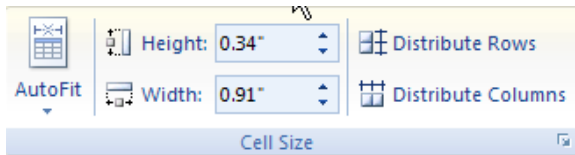
Merge/Split

Use to merge or split cells. Table Tools >> Layout >>
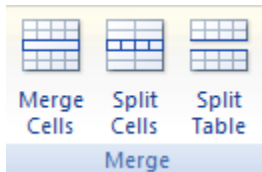
Calculate

You can perform simple calculation on table. If your calculations are complex I suggest to save that for Excel but for simple calculations such as subtotal and total, word can handle it well. For cell referencing you can use the following words:

LEFT   ABOVE   RIGHT   BELOW

Or direct cell reference like

A1   Column 1 Row 1

B1   Column 2 Row 1

A1:A3   A1 to A3

Use Formula dialogue box from Table Tools >>

Layout >> Data >> Formula to insert a formula.

Example of valid formula are:

=SUM(ABOVE)
=SUM(A1:A4)   SUM A1:A4
=SUM(A1:A4,A7)   SUM A1:A4 and A7
=A1+A2+A3
=A1*(A3+A4)
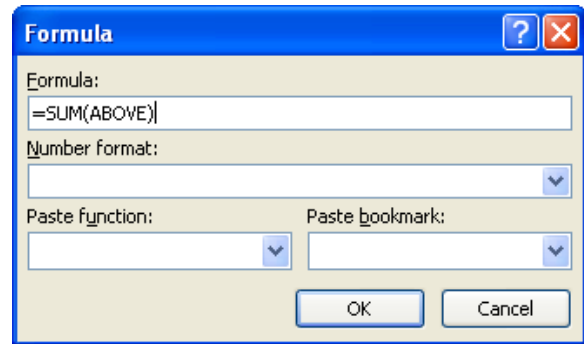
Illustrations

Illustrations are the pictures, clipart, diagrams and charts. They are grouped together because they share several attributes.

Picture/Clipart: Insert an image file /a clip art.

Shapes: Insert lines, Shapes, callouts and flow charts

Smart Art: To create dynamic diagrams like hierarchal diagram

Chart: Quickly create and insert an Excel chart.

When you select an object, you will see a contextual tab depending on object type that allows setting the illustration attributes. The commonly used attributes are briefly described:

1. Picture/Clipart		
Text wrapping	Size/Crop	Style

Text Wrapping

This defines how the text will be wrapped around a picture.

Picture tools >> Format >> Arrange >>
Text Wrapping ▾

Or,

Select a picture>> R-Click >> Text Wrapping ▾

Size/Crop

Resize using your mouse or select

Picture tools >> Format >> Size

Crop a picture just to select the area of interest using crop tool .

Style

Picture style is combined attribute for shape, border and effect. They can be individually set or selected from picture styles gallery. Style allows to give a picture an artistic touch such as:

If you do not find the preset style you were looking for, you can fine tune for Format Picture dialogue box. R-click then select Format Picture...

Shapes

Drawing a shape allows you to create special diagrams such as a flow chart or a callout.
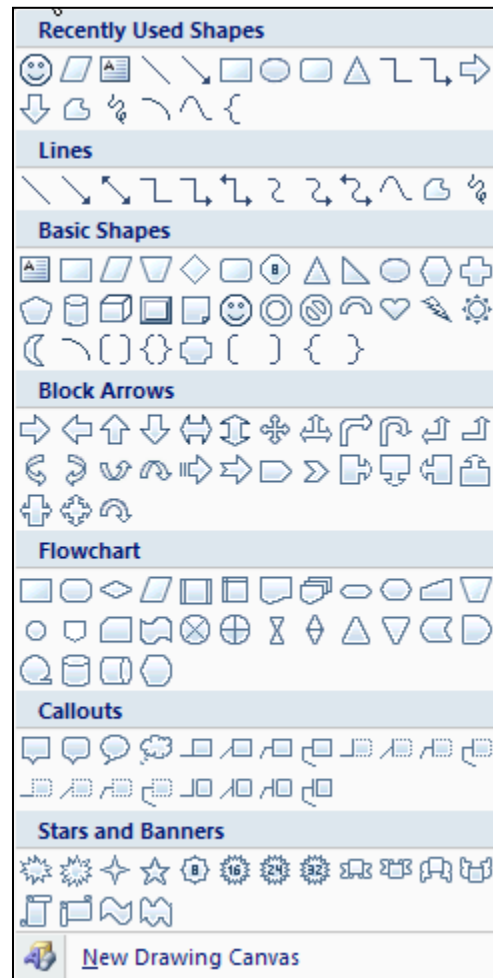
Creating a flow chart or a process diagram needs some understanding of standard shapes and their meaning. The basic ones are shown below.
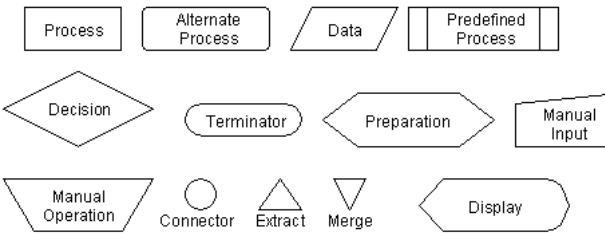
Components of a Block Diagram or Flow Chart

An example of a flow chart is given below:
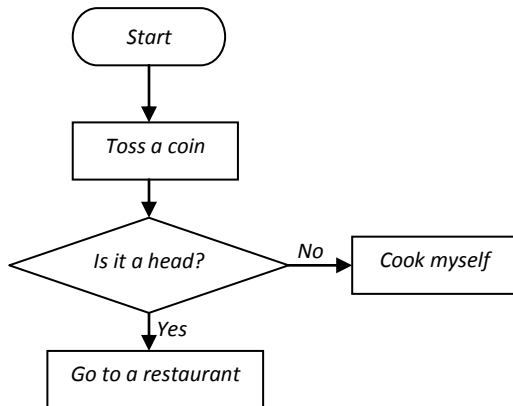
When it comes to creating a flow chart, it is easier to use a drawing canvas (Insert a drawing canvas selecting insert>>shapes>> [New Drawing Canvas] to organize your shapes. Once you insert your shapes, select a shape, R-Click and select [Add Text] to add text in that shape. Use connectors to connect different shapes. In order to align objects select the shapes you want to align (Select multiple items by holding Shift key while you select). Then from Drawing Tools>> Format>> Arrange>> select [Align ▾]. Text wrapping, size and style properties also applies to shapes and hence can be changed as described in the previous section.

Equation

Equation is an object used to place a mathematical equation or special character in a document. Use Insert>> Symbols >> Equation to create equations like shown below:

A letter with a bar like $\bar{x}$ is used to indicate the mean. In this sentence $\bar{x}$ was created using insert equation.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

An equation is similar to a graphic object in many ways. It's not a completely free-floating object like a picture, but it does have some independence from the surrounding text. An equation can interact with the text in the document in either of the two ways.

Inline: Runs with the rest of paragraph as any other character.

Display: The equation is its own separate object. It appears in a separate line from the surrounding text.

Once you create an equation, you can save it in equation gallery for later use and easy retrieval. To save a current equation in the gallery:

1. Select the equation $\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$ by clicking on the equating handle.
2. Equation Tools >> Design >> Tools >> Equation select
   [Save Selection to Equation Gallery...]
3. On the dialog box that appears, type in a meaningful name and description.
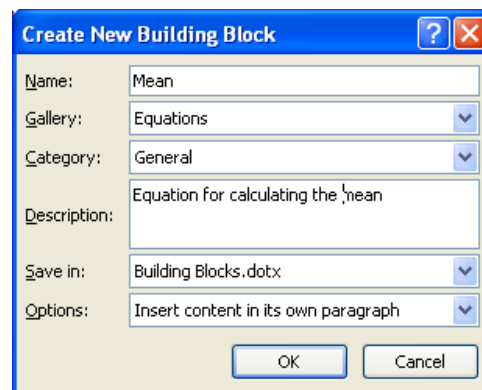
Understanding Symbols

Fundamentally, computers just deal with numbers. They store letters and other characters by assigning a number for each one. Symbol is nothing but a scheme on how a number is represented on either screen or a printed document. American Standard Code for Information Interchange (ASCII), generally pronounced ask-ee is a character encoding based on the English alphabet. Original ASCII used 7 bits of binary number (128 total representations) to represent English alphabets, mathematical operators, Greek characters and some other symbolic characters.

Because the number of written symbols used in common natural languages far exceeds the limited range of the ASCII code, many extensions to it have been used to facilitate handling of those languages. **Extended ASCII** uses eight-bits (256 total representations) that include the standard seven-bit ASCII characters as well as others. Note that not all ASCII characters are printing characters. Some of the numbers are reserved for special key strokes such as Backspace (8), Tab (9), ESC (27), and Space (32). The list of all characters can be found in Internet by googling for ASCII table.

The Unicode Standard is the universal character encoding standard used for representation of text for computer processing. The design of Unicode is based on the simplicity and consistency of ASCII, but goes far beyond ASCII's limited ability to encode only the Latin alphabet. The Unicode Standard provides the capacity to encode all of the characters used for the written languages of the world. Word processors commonly word (2 byte ≈65,000 characters) version of Unicode. Computer text handling involves processing and encoding. Consider, for example, a word processor user typing text at a keyboard. The computer's system software receives a message that the user pressed a key combination for "T", which it encodes as 0054. The word processor stores the number in memory, and also passes it on to the display software (FONT TYPE) responsible for putting the character on the screen. The font uses the number as an index to find an image (of a "T"), which it draws on the monitor screen.

You can look up a number associated with a character by placing the caret right after the character and pressing ALT+X. The character is converted into the corresponding Unicode number. Press Alt+X again to toggle.

If you know the ASCII or Unicode equivalent of a symbol, you can type that number using numeric keypad (You must use numeric keypad or it won't work) while you press ALT key and release the key when you finish entering the number. For example ASCII equivalent of a symbol ° is 248. To insert the symbol, just hold down the ALT key and type 248 from numeric keypad. Then release the ALT key. You should see the symbol. If you need to type insert this symbol as in °F it may worth memorizing the number 248 associated with this symbol. To insert a symbol using Unicode is little tricky. You have to convert the hexadecimal number associated with a symbol to decimal equivalent and use the decimal equivalent of hexadecimal instead. Also if the converted decimal number is less than 4 digits add 0's in front to make it 4 digits. Less than 4 digit numbers are interpreted as ASCII character. For instance Hexadecimal equivalent of ° is 00B0. You can convert it into decimal using windows scientific calculator or Excel. 00B0 in hexadecimal = 176 in decimal. So if you want to use Unicode you will have to type ALT + 0176 instead.

Commonly used symbols such as ° are included in normal fonts like 'Arial' and 'Times New Roman' but for some special symbols like ✈ which is in Wingding Font and has a decimal equivalent of 081, after you type ALT+0081 (Which is letter Q for normal fonts) you will also have to change the font to Wingding, in order to display ✈ instead of Q.

Word also has keyboard shortcut and/or auto correct for the most of the popular symbols through auto correct. Auto correct is a feature used most often for correcting common spelling error, but it is also useful for generating common symbol on the fly. To use the autocorrect type the shortcut and press spacebar once. Mostly used symbols and their shortcuts are:

Symbol	KB shortcut	Autocorrect
—	Ctrl+Alt+Num-	
©	Ctrl+Alt+C	(C)
®	Ctrl+Alt+R	(R)

To add an autocorrect for a symbol from symbol dialogue box, select a symbol and click auto correct. Type the autocorrect character to replace with the symbol.

Other objects

Besides the object discussed in this chapter, you can also insert other objects such as a part of a PDF document. From Inset >> Text, select .

Shortcuts

Tables	
Go to next cell	Tab
Go to previous cell	SHIFT + Tab
Tab inside a cell	Ctrl + Tab
Beginning of column	ALT + PageUp
Highlight to beginning of column	ALT +SHIFT+ PageUp
End of column	ALT + PageDown

Highlight to end of column	ALT+SHIFT+PageDown
Go to beginning of row	ALT+Home
Highlight to beginning of row	ALT+SHIFT+Home
Go to end of row	ALT+End
Highlight to end of row	ALT+SHIFT+End
Break a table	CTRL+SHIFT+Enter
Others	
Copyright symbol - ©	ALT+CTRL+C
Insert date	ALT+SHIFT+D
Change to "Symbol" font	Ctrl+ Shift+ Q
Change to "Normal" font	Ctrl+ Shift+ N

Questions

1. What is the different between object attribute and object method?
2. What is a contextual tab?
3. What are the common attributes of a table object?
4. What is cell margin and how would you change the cell margin inside a table?
5. What is table style? What are the advantages of table style?
6. What are the common methods of a table?
7. How would you insert an equation in word to add all cells above the formula row in the same column?
8. What is a flow chart?
9. Why is it recommended to use a drawing canvas to create a flow chart?
10. Can you add your new equation to the equation gallery? If yes how?

11. Find out what is the ASCII equivalent number of letter "A" searching in internet.
12. Try using that number to create a symbol "A" without actually typing A.
13. What is auto correct? Use autocorrect to create a symbol ¢ for c/.

Multiple-choice questions:

1. Which key moves your cursor from one cell to the next in a table?

    a. Tab
    b. Ctrl + Tab
    c. Enter
    d. Ctrl + Enter

2. To insert a tab inside a table cell, you hold down _____key while you press Tab key

    a. Shift
    b. Alt
    c. Ctrl
    d. Ctrl+Alt

Practice

1. Find the Unicode equivalent decimal number for the following symbols
± =_____   µ =_____
∞ =_____   ε =_____

2. Create a table like the one shown below

Cereals	Desired population		1000 ker. wt. (gm)	Seeds /lb (Average)
	Per sq. meter	Per sq. foot		
Wheat				
-Hard red	250	24 (16-30)	31-38	12,000-14,600
-Durum	210	20 (18-24)	41-45	10,000-11,000
-Soft white	210	20 (18-25)	34-36	12,600-14,200
Corn				
-Sweet	5	0.5	380	1,200
-Grain	6.1	0.6	380	1,200
-Silage	7.6	0.7	380	1,200

3. Make sure to have the following properties
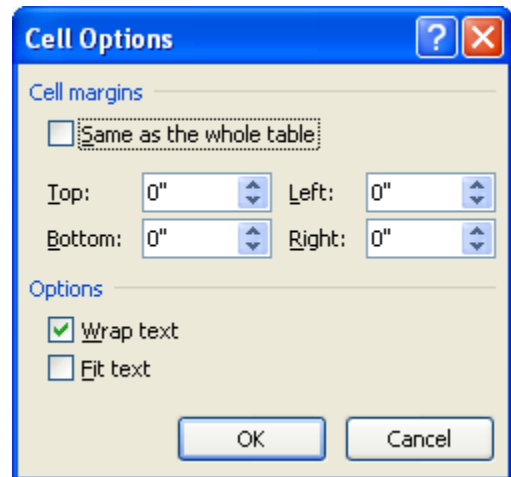
Font: Calibri
Font Size: 9
Table width: 3 inch

- Insert left tabs for the first column to align the wheat and Corn varieties.
- Insert decimal tabs in column 2 to align decimal points.
- Center justify column headings

- *Use Borders appropriately to hide some border outlines*
4. *create a flow chart line one below:*
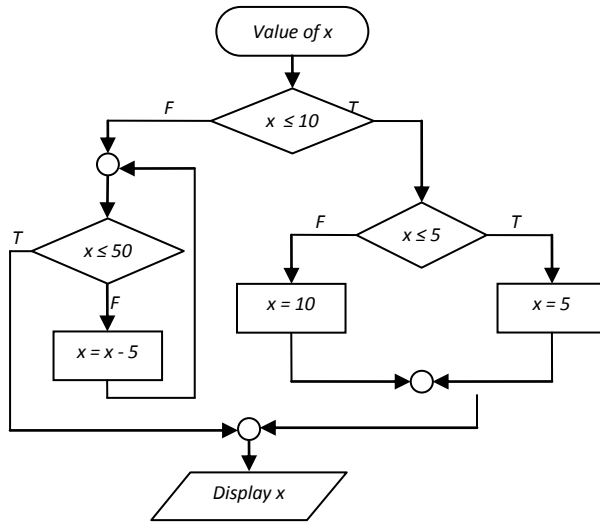
Dynamic Document

The objective of this section is to make you familiar with field codes and several common uses of field codes. Specifically after this chapter you should:

➢ Understand field codes and its utility in creating a dynamic documents
➢ Be able to insert an automated table of contents.
➢ Be able to insert citations.
➢ Be able to create a different headers and footers.
➢ Be able to mail merge.

Field Code

Fields are the placeholder that works behind the scene in a document. They help automate few important features in word such as inserting page number, creating table of contents, and much more. Field code allows the document contents to change dynamically such as updating page numbering in table of contents or updating figure numbering should you delete or insert a figure later in the document.

To insert a field, Use Insert>> text>> Quick Parts>> Field…

1. Select the field category
2. Select the field name and read the description to get more information about that field.
3. Select any options as needed then click OK.

For more advanced field code, and to view what code is written behind the scene, click on field code tab and then click on options to fine tune your field setting. Word normally displays the result of a field code rather than code itself. However, if you want to view the actual code, select a field and press Shift + F9. Some other KB shortcuts with field code are:

Alt + F9   Toggle field code display of entire document.

F9   Update the selected field

Alt+Shift_D Insert date field.

Alt+Shift+P Insert page number field.

Alt+Shift+T Insert time field.

Ctrl+3   Lock selected fields from updating.

Ctrl+4   Unlock selected fields from updating.

Ctrl+6   Convert selected fields to hard text.

This chapter discusses several commonly used features that word provide that use field codes.

Example

Create the following table

Purchase	Cost
Wheat	100
Barley	200
Total:	300

For the shaded cell for total insert Formula field from Table Layout menu >> Data >> fx and accept the default formula =SUM(ABOVE). Now press Alt + F9 that will switch the result to {=SUM(ABOVE)}. Press Alt + F9 again to show the result.

Now change the Wheat cost to 200. The result has not changed yet. Select the result and press F9 that will update the result. In case you have more than one field codes and you want to update all field

codes, then select all text by pressing Ctrl + A and then press F9.

Table of Contents (TOC)

A table of contents is a list of the specially formatted paragraphs (such as headings and titles) in a document. You can use a table of contents to get an overview of the topics discussed in a document. You can create a table of contents using the built-in heading styles and outline-level formats in Microsoft Word.

References >> Table of Contents >> Table of Contents

To fine tune what is placed in table of contents select 📄 Insert Table of Contents… . Or ,

Insert >> Text >> Quick Parts >> Field >> Index and tables >> TOC >> Table of Contents. The Table of Content dialogue box will appear.
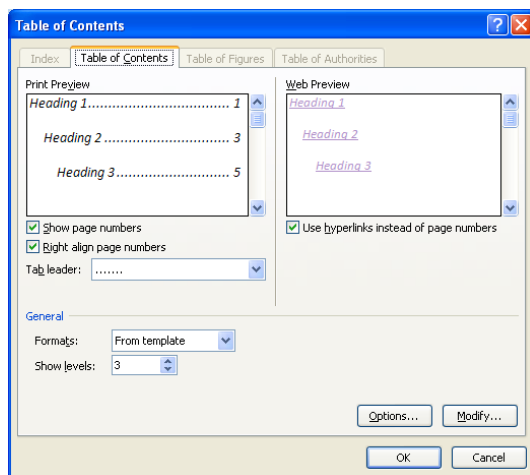
Show page numbers – ON/OFF page number display

Tab leader – By default (…) leader is used.

Formats – Chose the TOC template

Show levels – The levels of headings that will be included. If 3 is selected Heading styles 1,2, and 3 will be included in TOC.

To further specify which heading levels and text styles will be in TOC, Click on Options… and modify TOC level. To delete a style, delete TOC level box.

The entries in the TOC are formatted according to special built-in paragraph style named TOC1, TOC2 and so on. You can modify those styles as you would modify any other styles.

Example

Open the document "Biotechnology from biomass conversion.docx" from blackboard. Insert a table of content at the beginning of the document. Insert a section break to next page after the table of content.

Footnotes and endnotes

Footnotes and endnotes are used to illustrate an esoteric word or to explain in details without distracting the reader from the main contents. Footnotes are placed at the bottom of the page where as endnotes are placed at the end of the document. To insert a footnote use

Reference>> Footnotes >> AB^1 Insert Footnote (KB Shortcut Ctrl+Alt+F)

By default, word numbers footnotes with integers 1,2… to change the numbering scheme, click on dialogue box launcher ▫ in the Reference >> Footnotes group box.

Citation

Citations are used to credit the work someone else has done or to reference to other materials for further illustration. Technical papers and reports usually requires you to follow a specific citation style and it could be painful making sure each reference cited follows the specified citation style. Citing source in Word involves the following steps:

1. *Select a citation style (Reference >> Citation and bibliography >> Style)*

2. *Insert Citation*
3. *Generate bibliography*

Word stores the sources you inter in a database inside the document, so that the reference is available when needed. The reference is also by default is copied to master database located in root directory. Master database is maintained separately from the current document. Once built you can use the database or share the database with others to avoid retyping of the reference source.

Headers and footers

Headers and footers are used to display information such as page number and some static text that appear throughout a word section. To insert a header or footer in a document select

Insert>>Header & Footer

By default all section of the document are linked for header and footer and hence once inserted appears in all sections of a document. But you can break the link by selecting Design >> Navigation and then
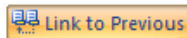
Mail Merge

Mail Merge in Word is used to create form letters, mailing labels, and data files to merge with external data sources such as Excel spreadsheet. Even though it is named mail merge, it can merge any data in a document.
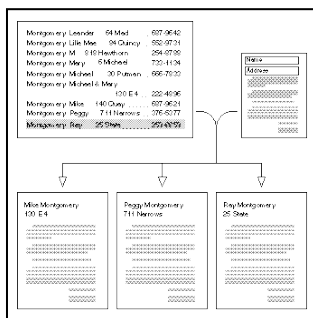
A mail merge uses two files:

✓ *The main document where mail merge fields are inserted*

✓ *The data file containing actual data. It can be another word document with a data table, Excel, Outlook contact list, or other data files.*

I recommend to use Mailing >> Start Mail Merge >>

 to start for all mail merge requirements. Using this wizard, you can create letters, email messages, envelopes, labels and directories. Follow the step by step directions to do the mail merge using an existing database.

Review Questions

1. *What is a field and how can you insert a filed in a document?*
2. *If you see a text like this:*
   {DATE \@ "M/d/yyyy}
   in a document, what happened? And how can you convert it to actual text?
3. *How do you control what goes into table of contents in a document?*
4. *How will you change footnote style from 1,2,3 to a,b,c list style?*
5. *What do you need to do to create a different header and footer in a document?*

Multiple choice questions

1. *To create a meaningful table of contents*
   a. *You don't have to define your headings*
   b. *You must define your headings*
   c. *You cannot have more than 3 levels of heading*
   d. *Document must be at least 3 pages long*
2. *By default text entered in the header and footer is printed*
   a. *On the first page of the document*
   b. *On the page where header or footer was entered*
   c. *On the pages where header or footer was entered and following pages after*

d. On every page of the document

3. Once you create an automated table of contents, if you alter your document, you must delete the table of contents and reinsert again to update the page numbers.
    a. True
    b. False

4. In order to have different schemes of page numbers within a document
    a. You must insert manual page breaks
    b. You must not insert manual page breaks
    c. You must divide the document into sections
    d. You must not divide the document into sections

5. Filed codes can be converted into static text by selecting the code and then pressing
    a. Ctrl+3
    b. Ctrl+4
    c. Ctrl+6
    d. Shift+F9

Forms and Templates

The objective of this section is to make you familiar with word features that allow you to become more productive. Specifically you will learn:

➢ *Document templates*
➢ *Creating forms*
➢ *Understanding and recording macro*
➢ *Viewing, Reviewing and Navigating a document*

Template

*Every Microsoft Word document is based on a template. A template determines the basic structure for a document and contains document settings such as Styles, fonts, Shortcut key assignments, macros, menus, page layout, special formatting, and styles. Office 2007 Word template has a file extension of **.dotx** for standard templates without macro and .**dotm** for macro enabled templates. Older versions of Word have .**dot** file extension for templates. In Windows XP the templates are saved in C:\Documents and Settings \username\Application Data\Microsoft\Templates.*

While opening a new document if you do not specify the template, the word will start with a Normal.dotm template. You can change the setting of the normal template to your taste of heading styles, fonts and page layout so that whenever you create a new document, your style will be the default style. Many built in templates are available in the Word for most frequently used documents such as memo, newsletter, invoice, forms and letters. Using them will greatly save your time and makes document look professional.

Word installs a limited set of templates in hard drive. There are 40+ of these ranging from memo to fax reports. To use an installed template from office menu select New and from templates, select an installed templates. Then select a template you want to use.

In addition to installed templates, Office online provides a hundreds of additional templates free to word users. You must be connected to internet to use them. These templates are professionally designed and may have various objects on them such as table and clipart. A snapshot of birthday card template is shown below.
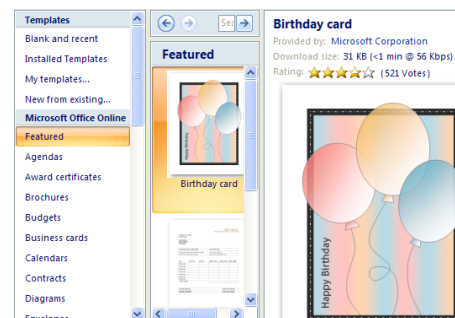
Changing the template

If you want to modify some template to your taste or need, open a document based on a built in template and make the change as you wish, like any other word document. Then from Office menu>> Save as >>choose word Template.

Forms

Forms are often used to gather information such as survey, job application, tax forms and list goes on and on. Hence in a form, document elements are combined with blank slots for entering the information.

Creating a form generally is a three step process:

1. *Combine text instructions and form fields.*
2. *Protect the document so that the users can only change the form filed.*
3. *Save the document as template.*

The third step is actually optional. If you save the form as template, you use the form template to create a new document. That document can then be sent out to be filled in, posted online, e-mailed, and so on.

Word's form tools and controls are located in the Developer tab. To enable the Developer tab, choose Office menu >> Word Options >> Under Popular category check the box:

☑ Show <u>D</u>eveloper tab in the Ribbon

The form usually uses control objects to fill in the information. There are seven controls in the controls group of developer tab. They are:

Aa *Rich text – Insert a space to enter formatted text.*

Aa *Text – Insert a space to enter plain text.*

🖻 *Picture –Allows the user to insert a picture.*

▦ *Combo box – A drop down box with preset and user entry.*

▤ *List box – A drop down box with preset list only.*

▦ *Date picker –Pops up a calendar to pick up a date.*

▥ *Building block gallery – Allows inserting a boilerplate text.*

▨ *Legacy tools – Allows to enter more controls.*

If the form is possibly be filled out by people using earlier version of Word, do not use regular form fields instead use legacy form fields only and make

sure to save the form template as Word 97-2003 template (.dot).

You need to protect a static text part of the form from being modified for the form to be fully active using legacy controls. To do so, in the Developer tab, first make sure that design mode (▨ Design Mode) is turned off (you cannot protect a form if Design mode is active). Then, click Protect Document >> Restrict Formatting and Editing, which displays the Restrict Formatting and Editing task pane, click to turn on the check box next to "Allow only this type of editing in the document," and set the drop-down selection to Filling in forms. When you're ready to begin enforcement, click Yes, Start Enforcing Protection.

Macro recording

If you perform a task repeatedly in Microsoft Word, you can automate the task by using a macro. A macro is a series of Word commands and instructions that you group together as a single command to accomplish a task automatically. Here are some typical uses for macros:

- *To speed up routine editing and formatting*
- *To combine multiple commands; for example, inserting a table with a specific size and borders, and with a specific number of rows and columns*
- *To make an option in a dialog box more accessible*

To automate a complex series of tasks Word offers two ways for you to create a macro: the macro recorder and the Visual Basic Editor. We will not discuss Visual basic Editor until we learn Excel. Here are the steps to record a macro:

1. *Developer >> Code >> Record Macro.*
2. *To assign the macro to shortcut keys, click Keyboard. In the Commands box, click the macro you are recording. In the Press new shortcut key box, type the key sequence, and then click Assign. Click Close to begin recording the macro.*

When the recording is in progress, your mouse options are restricted. You can select commands from ribbon, but cannot use the mouse to select text or perform other editing.

3. Perform the actions you want to include in your macro. (You can use the mouse to click commands and options, but the macro recorder cannot record mouse actions in a document window. To move the insertion point or select, copy, or move text, for example, you must use shortcut keys.)
4. To stop recording your macro, click Stop

It is easy to understand the macro once you actually do it. Record a macro to insert a chemical equation H_2SO_4 and assign this macro to Ctrl + Shift + H.

There are two common ways of saving a macro; in normal template and in the document itself. If the macro is saved in Normal.dotm template, the macro will be available to all other documents as well. If the macro is stored in current document, the macros will only be available to that document and the document must be saved as .docm (or .dotm for a template) format indicating that the document has a macro. This is for computer security purpose as macro can contain malicious code. We will learn more about macro in and VBA programming in later chapters.

Viewing/ Reviewing/Navigating

Once you create a draft of your document, you may want to view the document for its consistency, review for spell errors and readability and navigate through the document effectively.

View menu

This menu provides the tools to view the document in different ways. An optimal view for your need can make a tremendous difference in Word's usability.

Document views

Print Layout view: Shows how the document will be printed on paper. Most commonly used view. You can hide or unhide white spaces by double clicking between pages as shown below.
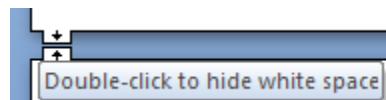
Full Screen reading view: Use to comfortably read the document using full screen. Press ESC to exit this view.

Show/Hide

Use this group under view tab to show hide different word tools such as Ruler, Gridlines, Document map and Thumbnails. Document map is useful in viewing the headings and sub headings in the document and quickly navigating around a long document. Thumbnail is useful to have a bird eye view of the document and to find any inconsistency in the document.

Review menu

When a document contains any spelling or grammar error, the status bar will show an ⌖ icon. Click on this icon to find the errors. When there is no spell or grammar error the icon turns to ⌖.

Readability evaluation

Readability refers to ease with which people can read what you have written. It is determined using some basic statistics of the document such as average words per sentence and average syllable per word. The statistics is then fed into an equation to get the following readability index:

- **Flesch Reading Ease**: A number between 0 and 100. Higher the number, easier it is to comprehend.

- **Flesch-Kincaid Grade Level**: An estimate of the approximate grade level of education to understand the content with ease.

To turn on the readability score do the following

1. Click the Microsoft Office Button , and then click Word Options.
2. Click Proofing.
3. Make sure Check grammar with spelling is selected.
4. Under when correcting grammar in Word, select the Show readability statistics check box.

Then complete Spelling and Grammar check or use the shortcut key F7.

Track change

Track change can be used when you are reviewing someone's document to keep track of your changes so that the author knows where and what changes have been made in the document. You can also insert comment to indicate your concerns or suggestions for improvement.

Navigating

So far you have been using scroll bars and arrow keys for navigation. However for a long document there is a better way than just scrolling.

Browsing by object: Click on the circle at the bottom of vertical scroll bar. A palette of objects appears. Move pointer over palette of objects. The name of each object appears at the top of the palette as you point to it. You can browse the document using this pallet much more efficiently than just by scrolling. Click on ▲ to go to previous object and ▼ to go to
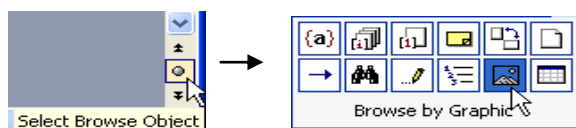
next object.

Other common shortcuts for moving the insertion point are listed below

Ctrl [→ OR ←]	Move caret to the beginning of the next OR previous word.
Ctrl [↓ OR ↑]	Move caret to the beginning of the next OR previous paragraph.
Shift ✛	Highlight a block of text.
Ctrl A	Select all.
Home / End	Move to the beginning/end of the current line
Ctrl + Home / End	Move to the beginning/end of the document
Page Up / Page Down	Up / down one screen
Ctrl + Page Up / Page Down	To the beginning of the previous/next page

Text selection tips

- Double click on a word to select the word and the space following the word.
- Triple click on a word to select the entire paragraph.
- Double click on left margin to select adjacent paragraph.
- Triple click on left page margin to select entire document (Equivalent to CTRL + A)
- CTRL + Click on a word to select an entire sentence and a space following that.
- Press ALT key while you drag your mouse to select a column of text.

1. Open Introduction to biology.doc from your webCT files. Navigate the document by figures and examine the consistency of figure caption style. Correct if necessary.
2. Create the following farm survey form

Date

    Click here to enter today's date.

Farmer's name:

    Click here to enter your name.

Farm location

    Select the farm location.

Pick the crop you grow

    Select the crop type.

Pick farm size

    Choose the farm size.

3. Use a memo template to write a memo to your instructor about what are the things you liked in Word that you learned in this class?
4. Create a template for data recording and reporting for one of your laboratories.

Review questions

1. What is the file extension of older Word versions for document template?
2. What is the file extension of Word 2007 document template?
3. Where can you find the Normal.dotm file in Windows XP?
4. How does template help you create a professional document?
5. When should you use the legacy form controls?
6. What is a macro?
7. Explain how can you hide/ unhide the ruler bar?

8. What is readability evaluation? How can you view the readability score for your document?
9. When should you turn on the track change?
10. How can you select a narrow column of text in Word?

Multiple choice questions

1. Which keystroke will take your cursor (caret) at the beginning or at the end of a line?
   a. Shift + Home and Shift + End
   b. Ctrl + Page Up and Ctrl + Page Down
   c. Ctrl + Home and Ctrl + End
   d. Home and End
2. Outline view is useful to see how your document would look like in webpage.
   a. True
   b. False
3. If you do not specify the name of the template while creating a new document, the document will be based on
   a. Last saved document style
   b. Teplate.dotm template
   c. Standard.dotm template
   d. Normal.dotm template
4. Which one of the followings are the typical uses of Macro?
   a. To speed up routine editing and formatting
   b. To combine multiple commands; for example, inserting a table with a specific size and borders, and with a specific number of rows and columns
   c. To insert a frequently used texts
   d. All of above
5. You cannot create your own template.
   a. True
   b. False

6. *In order to select narrow columns of text like this. You need to press _____ key before you make selection using your mouse.*

```
ns document setting
lt, special formattin
g the ▮Normal templ
 plates, such as the
ailable only to docu
late to your taste of
r document your sty
or most frequently u
king your document
```

a. *Shift*
b. *Ctrl*
c. *Alt*
d. *Tab*

Excel – The Interface

Objective of this class is to give you a brief introduction to Microsoft Excel spreadsheet program. After this class you should be able to:

➢ Understand Excel program interface and identify different items.
➢ Acquaint with Name box, Insert Function box and Formula Bar.
➢ Moving and navigating through the cell.
➢ Use status bar for quick calculation.
➢ Understand different tool bars and menu.
➢ Customize Excel.

Introduction to Microsoft Excel

You can think Excel as a general purpose number crunching tool. Excel can substitute even most powerful calculator and do much more than that. Most popular use of Excel is for

➢ Number crunching
➢ Creating charts
➢ Organizing lists and database

An Excel file is called a **workbook** that can hold many

rows (designated by numbers). The intersection of a column and a row is called a **cell**. Each cell on the worksheet has a **cell address** that is the column letter and the row number. A cell can contain texts, numbers, or mathematical formulas or also known as expressions.

At the top of the Excel workspace is the title bar, which displays the application name along with the name of the workbook in which you are currently working. If the window is floating, as shown in above
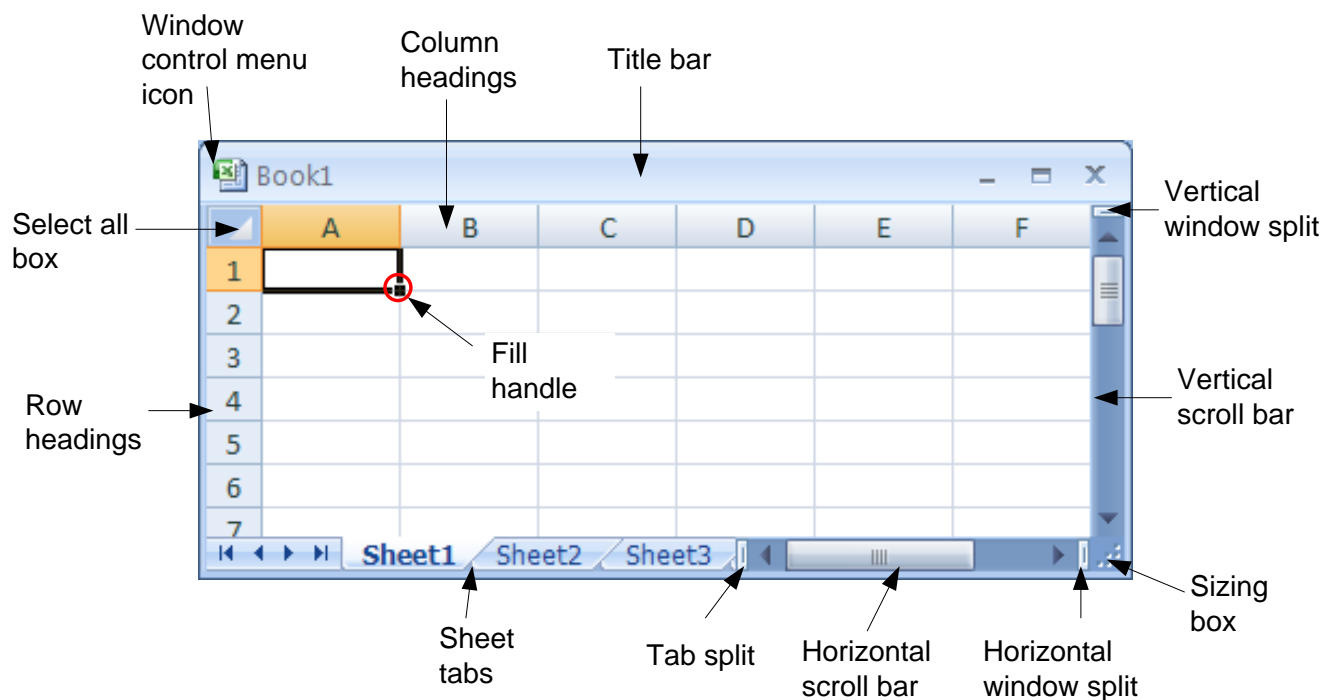
worksheets. A worksheet is a grid of **columns** and

figure, the workbook name appears at the top of the window instead of at the top of the Excel workspace.

Worksheet cells are Excel's building blocks. They store and display the information you enter in an Excel worksheet and allow you to perform worksheet calculations. You can enter information directly in a cell, or you can enter information through the Formula Bar. The contents of the active cell appear in the Formula Bar, and the active cell address is displayed in the Name box at the left end of the Formula Bar.
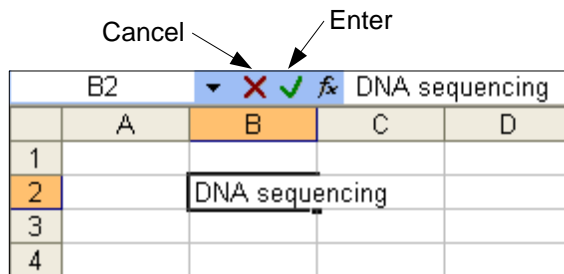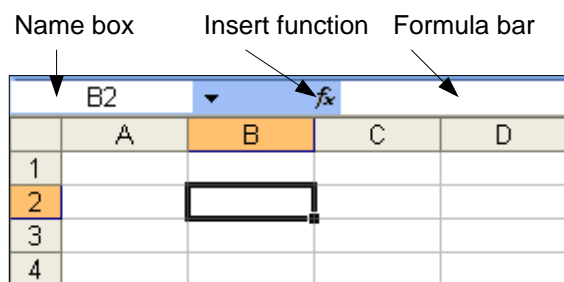
The Insert Function button is always available, but the other two formula-editing buttons appear only while you are entering or editing data in a cell. Clicking the Cancel button cancels the current action in the cell and is the same as pressing the Esc key. Clicking the Enter button enters the current action into the cell and is the same as pressing the Enter key (except that pressing the Enter key also normally activates the cell directly below the active cell).

Clicking the Insert Function button displays a dialog box that helps you construct formulas. We learn more about that in following chapters.

Moving Through Cells

Use the mouse to select a cell you want to begin adding data to and use the keyboard strokes listed in the table below to move through the cells of a worksheet.

Key stroke	Movement
Up / down arrow key	One cell up/down
Left / Right arrow key	One cell left/Right
CTRL + HOME	Top of the worksheet (cell A1)
CTRL + END	Last cell containing data
CTRL + Right arrow	End of the row
CTRL + Down arrow	End of the column

When you have a huge amount of data on a worksheet, the fastest way to scroll is drag the scroll bar. Alternatively you can use the wheel on your IntelliMouse to scroll through your worksheet. Turn the wheel toward you to scroll down or away from you to scroll up. To scroll left to right, press the wheel button down and drag the mouse in the direction you want to move. (This is alternatively referred to as panning.) When you press the wheel button, a gray directional device appears which is anchored to the spot where you first pressed the wheel button. The speed of panning depends on how far you drag away from the anchored directional device. As you hold the button down and drag, a black arrow appears, pointing in the direction you drag.
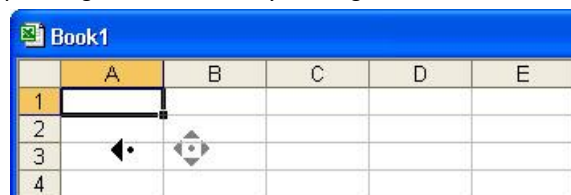
At the bottom of the workbook window are controls you can use to move from sheet to sheet in a workbook. The tab scrolling buttons shown below are needed only when your workbook contains more

sheet tabs than can be displayed at once.
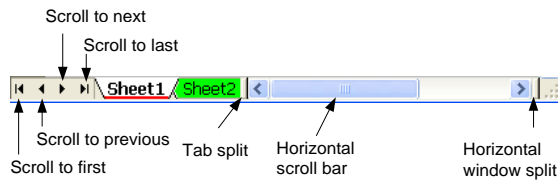
Status Bar

*The status bar displays information about what's happening in your workspace. For example, most of the time, Excel displays the word "*Ready*" at the left end of the status bar excel is done with calculations and ready to respond to your command. When you type, the status bar displays the word* Enter; *when you double-click a cell that contains data, the status bar displays the word* Edit.

Unlike previous version of Excel the status bar is customizable. Right click on the status bar to select or unselect various information you want to be displayed such as various keyboard modes such as, Caps Lock *appears in this area of the status bar when you press the Caps Lock key. When you press the Num Lock key to activate the numeric keypad (to use it for numeric entry rather than navigation),* Num Lock *appears in this area of the status bar.*

When two or more cells are selected and at least one of them contains a value, Excel displays the one or more calculations such as sum and average of the values in the status bar, as shown in the following graphic. The displayed result depends on your settings.
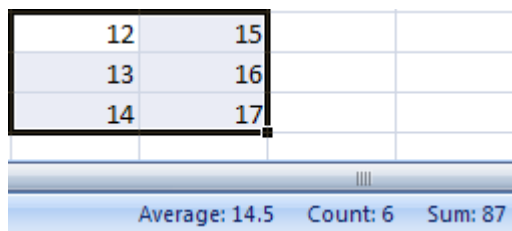
This is called the AutoCalculate feature. The AutoCalculate area of the status bar can be

configured to displays the several results by right-clicking the area, and checking the results you want to be displayed.

The entire list of options that you can be displayed on the status bar is shown below. However, for efficiency you may want to turn on only the information you care about.

The office menu and quick access toolbar

Once you learn about the office menu and quick access toolbar in Word, you do not have to re-learn it in Excel as they have similar look and feel. They behave in a similar way and common shortcuts hold true for both. For a refresher in office menu and quick access toolbar please refer to Word I notes.

The ribbon

As in Word, excel has seven default tabs and more may be visible depending on your settings and selection. The seven basic tabs are:

Home: You'll probably spend most of your time with the Home tab selected. This tab contains the basic Clipboard commands, formatting commands, style commands, commands to insert and delete rows or columns, plus an assortment of worksheet editing commands.

Insert: Select this tab when you need to insert something in a worksheet—a table, a diagram, a chart, a symbol, and so on.

Page Layout: This tab contains commands that affect the overall appearance of your worksheet, including settings that deal with printing.

Formulas: Use this tab to insert a formula, name a range, access the formula auditing tools, or control how Excel performs calculations.

Data: Excel's data-related commands are on this tab.

Review: This tab contains tools to check spelling, translate words, add comments, or protect sheets.

View: The View tab contains commands that control various aspects of how a sheet is viewed. Some commands on this tab are also available in the status bar.

The Shortcut Menus

Shortcut menus contain only those commands that apply to the item indicated by the position of the mouse pointer when you activate the menu. Shortcut menus provide a handy way to access the commands most likely to be useful at the pointer's current location and to help minimize mouse movements. To activate a shortcut menu, right click on the selection.

How big is Excel?

Excel keeps track of cell addresses internally using binary numbers (bits). Like telephone numbers are always designated by 10 digits, certain numbers of bits are used to represent row and column. Earlier versions of excel until Excel 2003 used 1 byte (= 8 bits) to represent columns. Using 8 bits you could count only from 0 to 255 or 1 to 256 (= 2^8) numbers. Similarly 2 bytes (16 bits) were used to represent rows. Therefore a worksheet had 65536 (2^{16}) rows. All together there were 256x65536 = 16,777,216 cells in a single worksheet. A workbook could contain maximum of 256 worksheets. Excel 2007 uses 20 bits to indicate row and 14 bits to indicate columns. Therefore the new version of excel has 2^{20}=1,048,576 rows and 16,384 columns. More bits stand for bigger capacity but also indicate more memory required to store those extra cells.

In older version of Excel, the number of worksheets you can have was limited to 256 but in 2007 version, it is only limited by the available memory. Therefore an Excel 2007 can hold a tremendous amount of numbers. The extra capacity may be useful for holding some large database system.

Writing into a cell

You can point and click any cell and start typing. If the cell entry is a numeric value (Date is a numeric value for Excel), it will be right aligned, and if it is non numeric then the content will be treated as text entry and is right aligned.

In a spreadsheet there are three basic types of data that can be entered.

➤ labels - (text with no numerical value, left aligned by default)

➤ constants or numbers (Used in calculation, right aligned by default; a date is also a number)

➤ formulas - (a mathematical expression or function, formula must be started with an = sign)

To enter a mathematical expression (or formula) and view the result start the expression with an = sign for example to add 2 and 3 and to view the result type

= 2 + 3

A mathematical expression is evaluated in the order according to standard rule as follows:

1. **Parentheses** First. Example:
   $6 \times (5 + 3) = 6 \times 8 = 48$
   $6 \times (5 + 3) = 30 + 3 = 33$ (wrong)
2. **Exponents** (Powers, Roots) before Multiply, Divide, Add or Subtract. Example:
   $5 \times 2^2 = 5 \times 4 = 20$
   $5 \times 2^2 = 10^2 = 100$ (wrong)
3. **Multiplication or Division** before you Add or Subtract. Example:
   $2 + 5 \times 3 = 2 + 15 = 17$
   $2 + 5 \times 3 = 7 \times 3 = 21$ (wrong)
4. **Addition or Subtraction from left to right**
   $2+5-6 = 1$
5. **Otherwise just go left to right. Example:**
   $30 \div 5 \times 3 = 6 \times 3 = 18$
   $30 \div 5 \times 3 = 30 \div 15 = 2$ (wrong)
   $30 \times 5 \div 3 = 50$

Mnemonics: PEMDAS

P   **P**arentheses
E   **E**xponents (ie Powers and Square Roots)
MD   **M**ultiplication and **D**ivision (left-to-right)
AS   **A**ddition and **S**ubtraction (left-to-right)

At times you may want to enter numerical expressions or numbers as text such as a telephone number. To treat a cell content as text precede the content with a single quote. Like:

'2   will display 2 as text

'=2+3   will display =2+3 instead of 5

'1-5   will display 1-5 instead of 5-Jan

'2:3   will display 2:3 instead of 2:03 AM

Regular addition, subtraction, multiplication and division notation   +,-, *, /

Exponent other than e (2^3= 2^3)   ^

Exponent with e (e^x)   EXP(x)

Where 'e' is a constant with a value of 2.7182. The symbol has a special meaning in mathematics like π. When you encounter an expression like 2.2 x 10^3 you can enter the expression as 2.2e3. The 'e' is used to indicate the power of 10. To write $x \times 10^y$ where x and y are any numbers, just write x**e**y or X**E**Y.

Do not confuse excel's 'e' with mathematical notation e for exponent. In Excel e means $\times$ 10^. This could potentially be confusing if you do not remember the difference.

Example:

To enter 3×10^{-4} as expression Enter =3e-4 which is a shorter way of writing =3*10^-4

To enter the exponential growth of bacterial like bacterial count = $50e^5$ enter in Excel as =50*EXP(5) which equals 7,421 . Never type as 50e5 which means 5,000,000; a huge difference!

Entering a fraction

To enter a fraction like $2\frac{3}{4}$ you type 2 (space) 3/4. You could also enter as 2+3/4 which is what $2\frac{3}{4}$ stands for.

Examples of entering an expression:

4 percent of 20   =4%*20

$4\frac{1}{2}$ percent of 20   = 4 (space) ½%*20

30 is what percentage of 80?

                    =30/80%

11. What are the common uses of a spreadsheet program?

12. How many different combinations can you make with 1 byte (= 8 bits) of binary numbers?

13. What is the largest number that can be represented by 1 byte of binary numbers counting from 0?

14. What is name box? What does this display?

15. One Excel Worksheet can have maximum of how many columns?

16. One Excel Worksheet can have maximum of how many rows?

17. When you have a huge amount of data, what are the faster ways of scrolling?

18. What happens if you click on the "select all" box (Intersecting box of row and column headings)?

19. What would be the cell address of second row second column?

20. How you can display the maximum value of selected cells in the status bar?

21. Discuss the similarities in Office menu between Word and Excel.

Practice questions

1. Type 2:20 in an empty cell and type enter. Now select that cell again and read from the formula bar how the entry has been modified. What would you do to enter the text 2:20 in a cell?

2. Type = 12+ 34 in a cell and display this expression as text.

3. Evaluate following mathematical expressions in Excel:

   a. 3+11-6

   b. -3 * 4 + 3

   c. $2 + \frac{4}{5}$

   d. $\frac{2\frac{3}{4}+4\frac{1}{4}}{7}$

   e. $\frac{3\times10^{-4}+7\times10^{-4}}{10^{-5}}$

   f. $\frac{1}{2}+\frac{2}{3}+\frac{3}{4}$

   g. $1 + 3 \times 4 - 3(3 - 1)^2$

   h. $4e^2/10$

4. Denis planted 300 acres of potato this year in his 1200-acre farm. What percentage of his field planted with potato?

5. If next year Denis wants to plant 30% of his field with potatoes how many more (or less) acres he will have to plant with potatoes than this year?

Excel Objects

Excel object model

As Microsoft word, Excel can also be viewed as an object. An Excel file is an object called a workbook. As each object has a name, the filename itself is the name of the workbook. Therefore, if you save a file with a name mybook.xlsx, the workbook is said to have name mybook.xlsx. Other common objects that comprise a workbook are:

1. Worksheet(s), Chart sheet (s)
2. Cells and List
3. Images, Drawings, Textboxes
4. Chart
5. Pivot table
6. ActiveX and other form controls

Each workbook is comprised of one or more worksheets, and each worksheet is made up of individual cells. Each cell contains a value, a formula, or text. A range of cell can be defined as a list. A worksheet also has an invisible draw layer, which holds charts, images, and diagrams.

Worksheet

An Excel workbook can hold unlimited number of worksheets as memory permits. The limit was up to 256 sheets for earlier version of Excel. A worksheet may contain cells or a chart. A worksheet that contains no cells but a single chart is called a chart sheet. Each worksheet in a workbook is accessible by clicking the tab at the bottom of the workbook window.

The common properties (attributes) of a Worksheet objects are:

Name	Tab color	Visible
Protection	Gridlines	

Name: Each worksheet must have a name. The default names are sheet1, sheet2…. It may be more desirable to give a sheet more meaningful name such as "January sales" or "Quarter 1 report". No two worksheets in a workbook can have the same name.

Tab color: This property allows you to change tab color for visually differentiating between worksheets for quick switching.

Visible: You can hide some worksheet to prevent some data from involuntary modification or to keep your workbook neat and clean. Usually the worksheet with sensitive and static data is hidden.

Protection: You may want to protect a worksheet for a variety of reasons. One reason is to prevent yourself or others from accidentally deleting formulas or other critical data. To protect a worksheet from editing, Review >> Changes >> Protect Sheet or right click on sheet tab and select "protect sheet…".

In many cases, you will want to allow some cells to be changed when the worksheet is protected. For example, your worksheet may have some input cells that are used by formula cells. In such a case, you would want the user to be able to change the input cells, but not the formula cells. Every cell has a Locked attribute, and that attribute determines whether the cell can be changed when the sheet is protected. See cells object in the following section to understand how the cells can be unprotected.

Gridlines: You can turn on or off the gridlines using this property. Use View >> Show/Hide >> Gridlines to turn on and off the gridlines.

Intersection of rows and columns makes a cell. Some of the properties of columns are:

Hidden	Height	Width

Hidden: You can hide column(s) or row(s) by selecting entire rows or columns by clicking on header which turns the curser into ⬇ for columns or ➡ for rows. Then dragging the cursor to select. Once selected, right click and then select Hide from quick menu Or, you can use the commands on the Home >> Cells >> Format drop-down list

To unhide the hidden rows, columns, select across the hidden columns/rows. For example, if column C is hidden, select columns B and D. Then right click and select unhide or from use the commands on the Home >> Cells >> Format drop-down list.

Height: Select the row and Home>> Cells >> Format drop-down list >> Row height.

Remember 1 inch = 72 points

You can also set the row height directly by dragging the row border when your cursor turns to ✛.

Width: Select the column and Home>> Cells >> Format drop-down list >> Column width.

Unlike row height, column width is measured in number of digits in default font and size you can fit in a column. Therefore, column width of 10 will fit 10 digits.

You can also set the column width directly by dragging the row border when your cursor turns to ✛. Double clicking this cursor automatically adjusts the left column width to fit the content.

Cell(s)

Cells object has the following properties. Some of the properties of an object could be read only. That means you cannot change the property of that cell. A perfect example of such a property is cell address.

Address	Alignment	Font
Border	Fill Color	Number Format
Text Wrap	Locked	Merged

Some other properties of a cell are:

Address: Every cell has an address called cell reference. A cell reference consists of the column letter and row number that intersect at the cell's location. Note that when listing a cell reference, the column letter is always listed first.

Cell references are used in formulas, functions, charts, and other Excel commands. While references often refer to individual cells such as A1, B38, or Z345, they can also refer to a group or range of cells. Ranges are identified by the cell references of the cells in the upper left and lower right corners of the range. Examples of the cell references are given in the following table.

To refer to	Use
The range of cells in column A and rows 10 through 20	A10:A20
The range of cells in columns A through E and rows 10 through 20	A10:E20
All cells in row 5	5:5
All cells in rows 5 through 10	5:10
All cells in column H	H:H
All cells in columns H through J	H:J

When you use the cell reference in a formula, actually you are referring to the value contained in

that cell address. For Example if you have value 2 in cell A1 and value 3 in cell B1, you add 2 and 3 in another cell by typing:

= 2 + 3   or   =A1+B1

Although the final result will be same in either case, the difference (very important one) between two cases are that when you change the value in cell A1 or B1 the sum value is automatically updated in latter case, whereas, in the first style the formula itself must be edited. Therefore, cell referencing is always preferred in equations than using hard numbers.

Alignment: By default, the texts are left aligned and numbers are right aligned. However, you can change the alignment of the cells at your wish from under home tab >> Alignment.

Font: Change the font and other text properties as in Word from Home>>Font. You can also change the default font for entire worksheet. To change the default font, From Office Button >> Excel Options >> under 'Popular' tab and under "When creating new workbooks", change the default font for all future new Excel workbooks.

Border: By default, the gridlines in Excel is not printed when you print the worksheet. Add border to make them print. A cell border can be changed from Home >> Font >>

Fill Color: This property allows you to fill a cell with colors to distinguish it from other cells. Change the fill color from Home >> Font >>

Number format: Number format is the scheme how a number will be displayed on the cell. The actual number that a cell holds may be different from what is displayed in the cell. For example, enter 0.5 in a cell then format as percentage, it will show 50%. The actual number the cell holds is still 0.5. Now format

the cell as time and it will display 12:00:00 PM. Again the cell still holds 0.5. Format the number back to as a Number and reduce the number of decimal places displayed to 0, now the cell will display 1. In all cases the cell holds the value of 0.5. You can verify this by multiplying this cell with 100 and looking at the result.

Text Wrap: Changing this property will prevent the text from flowing into adjacent column.

Locked: You can change this property to make a certain cells editable when a worksheet is protected. To unprotect a cell:

- *Home >> Font >> Dialogue box launcher* or Right click on selected cells and then from quick menu select Format Cells... .
- *Click on protection tab and uncheck locked* Locked

When a sheet is protected, you have an option to make unlocked cell editable.

Merged: To merge more than one cell together, select the cell and from Home >> Alignment >> Merge and Center. The merged cell acts as a single cell with cell address of upper left cell. All other cell will be empty.

Editing

You can use the formula bar to edit the contents of a selected cell, or you can perform your editing "on location" in the cell itself. However, copy and paste in Excel works little differently than in Word. When you copy or cut cells, a marquee (marching ants) appears around the cell, which indicates the area, is copied or cut. When you copy an item, Excel saves it in memory, using a temporary storage area called the Clipboard. However, if you do not paste immediately after copying and start editing a cell or press ESC key, the marquee will disappear and clipboard is cleared.

Moving Vs copying a formula

When you move (cut and paste) a formula, the cell references within the formula do not change. When you copy a formula, the cell references may change based on the type of reference used. When you move some content of a sheet, the formula and functions reference to that cell will adjust automatically to adjust for the new location of the data. Copying the original data, however, will the affect the formulas referencing the copied item.

Absolute Vs relative reference

When you copy a formula to a different location, the cells references may automatically change depending on the type of your reference. There are two types of cell referencing in Excel, relative and absolute. Relative cell referencing maintains the relative position between formula cell and the cell being referenced when copied to another location, whereas absolute reference goes by cell address. Relative or absolute referencing only matters if you copy the content to another location. Else it has no effect on how the cell value is used.

In the following example, we are looking at an invoice to calculate the total amount for each line item. Amount is calculated by multiplying quantity and rate. Therefore, the following equation was entered in cell D2:

= B2*C2

After entering the equation, the cell is copied down to cell D3 and D4. The formula will automatically change in cell D3 and D4 as:

=B3 * C3   in cell D3
=B4 * C4   in cell D4

	A	B	C	D
1	Item	Quantity	Rate	Amount
2	Sprayer	5	19.99	99.95
3	Hose	2	1.59	3.18
4	Fertilizer	3	16.99	50.97

Even though the cell reference is changed, it does not introduce any error. In fact this is what you wanted as amount is always quantity * rate for a line item. Now let's look at the above example with tax situation. Let's assume that the tax must be added to the amount at the rate defined in cell E1 and column E should display the tax amount.

	A	B	C	D	E
1				Tax rate:	6%
2	Item	Quantity	Rate	Amount	Tax
3	Sprayer	5	19.99	99.95	6.00
4	Hose	2	1.59	3.18	0.19
5	Fertilizer	3	16.99	50.97	3.06

 Now if you enter this equation in cell E3

=D3 * E1 and copy the formula to cell E4, the cell E4 would read =D4 * E2. While D4 is the cell reference you want E2 is not the cell reference you want and hence cell E2 does not have any numerical value to multiply, the formula will return #VALUE! error.

The key here is to use the absolute cell reference for cell E1 to calculate the tax amount so that when the formula is copied, the reference does not change. Put a $ sign in front of row and column reference to make an absolute cell reference. Therefore, to be able to copy the formula and still display the right result you will have to enter in cell E3:

= D3 * E1   (Hint: press the key F4 after you type E1 to change it to E1)

At times, you may have to use absolute row and relative column or relative row, absolute column. In such cases you put a $ sign just before a row or a column reference to make it absolute.

Following table shows an example of the farm profit over operating cost for different scenarios of soft white spring wheat for northern Idaho.

	A	B	C	D
1	Operating cost ($/ac):		148.80	
2		$/bushel		
3	Yield (bu/ac)	3.00	4.00	5.00
4	50	1.20	51.20	101.20
5	60	31.20	91.20	151.20
6	70	61.20	131.20	201.20

The profit is Yield * $/bushel – Operating cost. The formula in cell B4 is entered as:

= $A4 * B$3 - C1

and copied to the fill the rest of the cells in table. Note the absolute row, absolute column and absolute cell reference.

Naming a cell or a range of cells

You can create descriptive names to represent a cell, ranges of cells. Naming can help you add clarity in your formula and ease addressing a range of cell. To name a range of cell, select cells and from name box, type in the name and enter. Keep in mind the followings:

➢ The first character of a name must be a letter or an underscore character.

➢ No space allowed and names cannot be the same as a cell reference, such as A1 or R1C1.

➢ A name can contain up to 255 characters.

➢ Names are NOT case sensitive.

Example:

You could name the cell C1 in above example as Operating_Cost and use it in the formula as:

= $A4 * B$3 - Operating_Cost

The names defined in this fashion are visible from entire workbook. If you want to restrict the scope of the name to a sheet go to Formulas >> Define names >> Define Name. You can also use this dialogue box to redefine or delete the names.

Review questions

1. What are the important objects that make up a workbook?
2. What may be the reasons you want to protect your worksheet?
3. How do you protect a worksheet and still allow the users to change some of the cells?
4. What is relative referencing? Come up with your own example when you use a relative referencing.
5. What is absolute referencing? Come up with your own example when you use an absolute referencing.
6. Can you make only row or column absolute, if sow how?
7. What are the advantages in using cell reference in a mathematical expression instead of a hard number?
8. How copy operation in Excel is different from Word?
9. How moving (or cut-paste) is different that copy paste for the pated item?
10. Is AB12 is a valid name to name a range of cell? Explain why or why not.
11. Is **tax rate** a valid name for a cell?
12. How do you merge several cells together?
13. How do you unmerge a merged cell?
14. How can you wrap text inside a cell?
15. How can you make Excel to display thousand separators for a big number?

Multiple choice questions

1. What do you type into an empty cell to start a formula?
   a. #
   b. *
   c. (
   d. =
2. A range of cells may be entered in a formula by typing the first cell reference followed by a _____ and then the last cell reference

a. Comma (,)

b. Colon (:)

c. Semicolon (;)

d. Dash (-)

3. A formula result is in cell C6. You wonder how you got the result. To see the formula, you:

    a. Click in cell C6, and then press CTRL+SHIFT.

    b. Click in cell C6, and then press F5.

    c. Click in cell C6.

4. You cannot hide gridlines in an Excel sheet.

    a. True

    b. False

5. You can customize Excel to display column headings as 1,2,3 instead of A,B,C.

    a. True

    b. False

6. If the content of cell B2 in figure below is **copied** to cell B3, B3 will display____

    a. 1

    b. 2

    c. 1.5

    d. #DIV/0!

7. If the content of cell B2 in figure above is **moved** to cell B3, B3 will display____

    a. 1

    b. 2

    c. 1.5

    d. #DIV/0

8. Which cell reference refers to a range of cells in column B, rows 3 through 6?

    a. (B3:6)

    b. (B3-6)

    c. (B3:B6)

    d. (B3,B6)

9. What is an absolute cell reference?

    a. The cell reference automatically changes when the formula is copied down a column or across a row.

    b. The cell reference is fixed.

    c. The cell reference uses the A1 reference style.

10. Difference between absolute and relative cell reference is that

    a. Absolute cell reference automatically changes when copied to another cell

    b. Relative cell reference automatically changes when copied to another cell

    c. Absolute cell reference is better way to write a formula

    d. Relative cell reference is better way to write a formula

11. Which of these is an absolute row and relative column reference?

    a. B4:B12

    b. A1

    c. A1

    d. A$1

12. If you copy the formula =C3*D9 from cell C4 to cell C5, what will the formula be in cell C5?

    a. =C4*D9

    b. =C3*D9

    c. =D4*D9

    d. =C4*E10

13. Area of rectangle is Side1 * Side2. If the formula from cell C4 is copied to cell D4 the value displayed in Cell D4 would be

    a. 4

    b. 8

    c. 16

    d. #DIV/0!

Using Excel Functions

Objective of this class is to introduce Microsoft Excel spreadsheet function. After this class, you should understand the rules in using a function especially functions of the following category:

➢ *Math and trigonometry function*
➢ *Date and time function*
➢ *Financial function*
➢ *Lookup and reference function*

Functions

Functions are predefined formulas that perform calculations. The power of Excel mostly lies in the collection of functions it provides to perform various calculations. A function usually takes some known values, called arguments, in a particular order, or structure and after calculation returns the answer. Functions can be used to perform simple or complex calculations. There are well over three hundred functions to carryout everyday calculation. All regular functions must return one and only one number or text. There are small numbers of special formulas called array formula that can return an array instead of a single number.

Understanding a function syntax

There are two essential parts of every function; the function name and a pair of opening and closing parenthesis. The parenthesis separates a function from cell or range names.

Most functions also take some kind of known values called arguments to calculate unknown quantities. The arguments are separated by a comma. The argument could be a hard number such as 5 or a cell reference such as D2, expression such as 2+3 or a value returned from some other functions. In essence, a function has the following structure:

FunctionName(*a1,a2,…,an***)**

FunctionName: Each function has a name. The function name is always a single word and not case sensitive.

( ): A pair of opening and closing parenthesis immediately following the function name (no space between function name and parenthesis). Even if a function does not take any argument, you cannot omit this parenthesis.

a1,a2,…an: – known values called arguments. If a function requires argument they must be provide in the order specified in function help. Some argument could be optional. All arguments goes between the pair of parenthesis.

Remember: Even if there is no argument, a set of parenthesis must be included e.g. PI(), RAND()

Example:

Suppose you want to calculate the remainder part of a division operation. This operation is called modulus operator and uses a function called MOD. If you use help to look for MOD function, you will find this:

> **Syntax:**
>
> **MOD(number,divisor)**
>
> **Number** is the number for which you want to find the remainder.
>
> **Divisor** is the number by which you want to divide number.
>
> **Remarks**
>
> If divisor is 0, MOD returns the #DIV/0! error value

Syntax is the acceptable structure for the function to

work. As shown the function MOD takes two arguments, the arguments are defined below the function. In addition, users are cautioned that the devisor cannot be 0 or the function will produce an error.

Inserting a function

It is almost impossible to remember all the function names and their argument list. Excel has insert function dialogue box to help you insert a function correctly with proper syntax. You can activate insert function dialogue box by clicking on insert function

 or Formulas >> or keyboard shortcut SHIFT + F3. The following insert function dialog box is displayed:
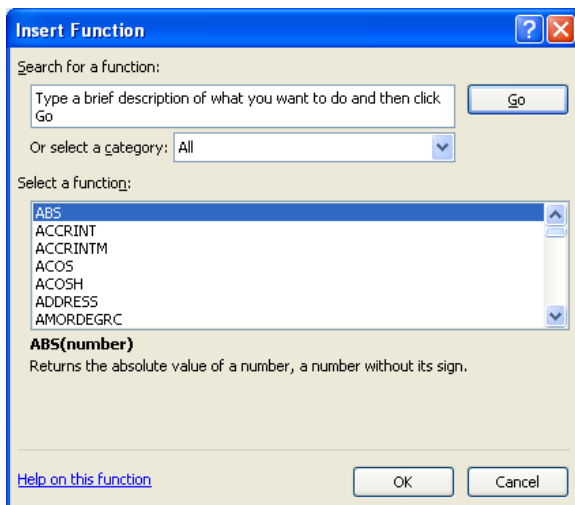
If you are looking for a function that does a specific task, type the description of a function to help you find the right function. Excel also has categorized the functions according to what it does, select a category from category dropdown list for the function you are looking for. Once you select a function, a short description about that function is displayed and you can click on **Help on this function** to learn more about that function.

After you press OK, a Function arguments dialogue box will open to help you explain about each of the

arguments, their type and help you select from worksheet.

Example:

You want to calculate a mortgage payment for a $15,000 car loan you borrowed. To search for a right function type "Mortgage payment" in search for a function box. Then you click on suggested functions to get help about that function. You will figure out that **PMT** is the right function. Click OK and then you will see Function Arguments dialogue box.
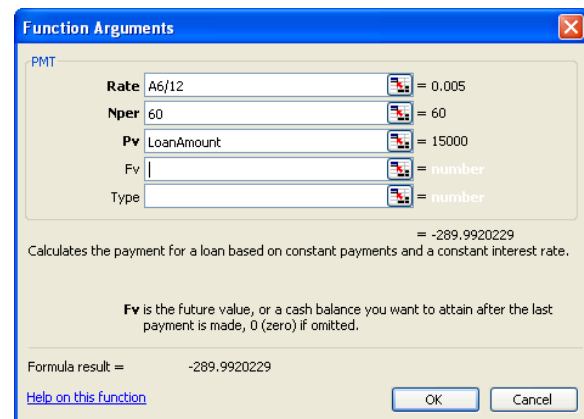
Click on each boxes to get help about that argument. Note that the arguments that you must provide such as **Rate, Nper** and **Pv** are Bolded. Optional arguments Fv and Type are not bolded. You can leave the optional argument blank.

You can provide the argument values using cell reference like A6, cell reference and an expression (Like A6/12), a value (like 60) or a cell name (like LoanAmount). The resulting values are displayed on right side. Optionally you can click on on right side of the box to pick a value from worksheet. When all the required arguments are filled out, the formula result is shown at the bottom of the dialogue box.

To quickly insert a SUM function, click on Home >> Editing >> . For other available functions select a function from drop down list .

Typing function manually

If you know the function name and arguments, you can just type the function into a cell. Excel 2007 provides formula auto complete feature providing the list of function names. To use the formula auto complete double click on the function in the list or scroll to the list using arrow keys and press TAB key. Excel enters the function name and adds the opening parenthesis. Like if you have tabbed the PMT function it would display the list of arguments.

=PMT(

PMT(rate, nper, pv, [fv], [type])
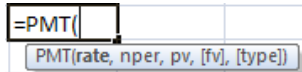
The bolded argument as shown in this figure is the one that is currently being entered. After you enter the first argument for rate, enter a "**,**" to enter the second argument. The arguments with a bracket [ ] are the optional arguments. To enter a cell address or a range, you can either type the address like A1 or point or click on the cell. Drag the mouse to enter a range of cells)

If you want help at any point during manual entering a function press F1 and on the help box that appears type the function name to search.

Error types

If a function is used incorrectly, it displays and error message depending on error type. Excel puts a brief error message in the cell to let you know that something went wrong. Some of the most common error messages, their meanings and most probable remedy are listed below. If this does not solve the problem please refer to Excel help (F1).

Message	Meaning and troubleshoot
#DIV/0	Attempted to divide by zero such as =AVERAGE(A1:A10) where range A1:10 is empty ⇨ Make sure you don't have 0 in denominator

#N/A	Function returns value not available. Such as =LOOKUP(2,A1:A5,B1:B5) where range A1:A5 does not have any value smaller than 2. Make sure you are not using the function improperly
#NAME?	Excel could not recognize the function name or variable name you have typed. Such as =ADD(2,3). There is no function with name ADD ⇨ Check function and cell or range name spelling
#NUM!	A function or math operation returned an invalid numeric value such as =DAY(-1) ⇨ Check your argument numbers.
#REF!	An invalid cell reference was encountered. ⇨ You have deleted the reference cell (or range) used in a formula.
#VALUE	Wrong type of argument was passed to a function such as SUM(A1:A5-A2). ⇨ Check your argument values

Using function as an argument

You can use a function as an argument to another function. If you use a function as an argument, the argument function is evaluated first and the return value is used as an argument for outer function. Such as =SUM(MOD(4,3),5). In this example, MOD(4,3) is evaluated first which returns a value of 1. This value used as an argument for SUM function which returns 6 (because 1+5 = 6). When you have one function used as an argument for another function, it is best to type function manually. This is the only time insert

function is not convenient, as you cannot invoke another "insert function" dialogue box when one is open.

Function categories

The functions in Excel are divided into 11 categories.

1. *Math and trigonometry functions*
2. *Date and time functions*
3. *Financial functions*
4. *Lookup and reference functions*
5. *Logical functions*
6. *Text functions*
7. *Statistical functions*
8. *Database functions*
9. *Engineering functions*
10. *Information functions*
11. *Cube functions (Only available in Excel 2007)*

Most frequently used functions are briefly explained below.

Math and trigonometry functions

ABS	Returns the absolute value of a number
CEILING	Rounds a number to the nearest integer or to the nearest multiple of significance
COS	Returns the cosine of a number
DEGREES	Converts radians to degrees
EVEN	Rounds a number up to the nearest even integer
EXP	Returns *e* raised to the power of a given number
FLOOR	Rounds a number down, toward 0
GCD	Returns the greatest common divisor
INT	Rounds a number down to the nearest integer
LCM	Returns the least common multiple
LN	Returns the natural logarithm of a number
LOG10	Returns the base-10 logarithm of a number
MOD	Returns the remainder from division
ODD	Rounds a number up to the nearest odd integer

PI	Returns the value of pi = 3.1415…
QUOTIENT	Returns the integer portion of a division
RADIANS	Converts degrees to radians
RANDBETWEEN	Returns a random number between the numbers that you specify
ROUND	Rounds a number to a specified number of digits
ROUNDDOWN	Rounds a number down, toward 0
ROUNDUP	Rounds a number up, away from 0
SIGN	Returns the sign of a number
SIN	Returns the sine of the given angle
SQRT	Returns a positive square root
SUM	Adds its arguments
SUMIF	Adds the cells specified by a given criteria
SUMPRODUCT	Returns the sum of the products of corresponding array components
TAN	Returns the tangent of a number

What most of the functions do can be guessed from their name; such as ABS to calculate absolute value, QUOTIENT to calculate quotient of a division. Few examples of using a mathematical functions are given below:

Examples:

1. *Mr. Ben's field is 2686 feet long. If he has to plant peach trees every 14 feet apart, and he wants to leave equal space on both sides of the field, how many trees will he plant on each row and how much space he should leave from the field border?*
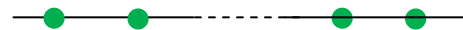
   ANSWER:
   Number of trees on each row
   =QUOTIENT(2686,14)+1   (192)
   Space on each side =MOD(2686,14)/2   (3)

2. *Find the area of a circular pond with radius of 20 feet? Round down the area to nearest multiple of 5.*
   ANSWER:
   Area of a circle (A) = πr^2 ; Enter in excel
   *=PI() * 20 ^2   (1256.6)*

Since we need to round down the answer, use floor function:

=FLOOR(PI() * 20 ^2,5)   (1255)

3. *How long fencing wire would be required to fence around a circular pond of 1256 sq. ft.?*

   ANSWER:

   Here we need perimeter of the pond. We know the relation perimeter (P) = 2πr. There is no direct conversion formula from area to perimeter. Therefore we need to calculate the radius from given area and then calculate perimeter from that radius. We know A = πr^2. Therefore we can write

   $$r = \sqrt{\frac{A}{\pi}} \text{ or in Excel =SQRT(1256/PI())}$$

   Perimeter $P = 2\pi \times r$. Therefore enter in excel

   =2*PI()*SQRT(1256/PI())

Date and time functions

Date and times are just a number for Excel. The date is represented by the integer part of a number. The day counting starts from January 1, 1900. When you format a cell as date it translates a number into corresponding date. For instance if you enter 1 in cell A1 and format the cell as a number, the cell will display January 1, 1900. In the eyes of Excel, the world began on January 1, 1900. Excel is not capable of working with dates earlier than that.

Even though you could enter a date as a number and format it as date, you enter a date using any of several recognized date formats. Excel automatically converts your entry into the corresponding date serial number (which it uses for calculations), and it also applies the default date format to the cell so that it displays as an actual date rather than as a serial number.

For example, to enter Jan 1, 2008, you can enter the date by typing any of the following:

Jan 1, 2008	*1 Jan 2008*	*1/1/08*
1/1/2008	*1-1-08*	*2008/1/1*
1-1/08	*1-1*	*1/1*

If you enter 2 digit years, Excel interprets 00 to 29 and 21st century years and 30 to 99 and 20th century year. If you do not specify the year for a valid date format, it will assume the current year. Some countries specify their date in the format day/month/year rather than month/day/year as in the United States. You can change the default Excel date interpretation by changing the regional setting from control panel.

Once you enter a date or time in a cell and later type in some number in that cell, you will see a strange date displayed instead. Don't be puzzled, change the cell formatting back to number and you should be fine.

As Excel use the fractional part of a number to represent time, and the fractional part can be from 0 to almost 1 (it can be very close to 1, like 0.999999999) and therefore, the range can be considered as 1 for all practical purposes. Since 1 day has 24 hours,

1 hour = 1/24 = 1 AM therefore if you enter =1+1/24 in a cell and format as date and time it will display 1-Jan-1900, 1:00 AM. Similarly to increment by 1 minute you will have to add:

1 minute = 1/(24*60) and for 1 second it will be =1/(24*60*60)

Since date and time is a single number in Excel it allows you to do all sorts of calculation with dates and times. For example if you want to count the number of days from your birthday to today's date, just subtract your birthday from today's date. However, you need to remember that one excel cell cannot hold two dates, and hence they needs to be entered in separate cells.

	A	B	C
1	Today's date	2/21/2008	
2	My Birthday	8/21/1990	
3	Cell B1 - B2 =	6393	

When you perform calculations with date in earlier versions of Excel, the result cell is automatically formatted as date and you may have to change the cell formatting to number to actually see the number of days.

Frequently used date and time functions are listed below. See help for the complete list of functions

DATE	Returns the serial number of a particular date
DAY	Converts a serial number to a day of the month
EDATE	Returns the serial number of the date that is the indicated number of months before or after the start date
EOMONTH	Returns the serial number of the last day of the month before or after a specified number of months
HOUR	Converts a serial number to an hour
MONTH	Converts a serial number to a month
NOW	Returns the serial number of the current date and time
TODAY	Returns the serial number of today's date
WEEKDAY	Converts a serial number to a day of the week
WEEKNUM	Returns the week number in the year
WORKDAY	Returns the serial number of the date before or after a specified number of workdays
YEAR	Converts a serial number to a year

Examples:

1. Use TODAY function to insert a dynamic date that changes its value to display current date.
   Answer:
   =TODAY()

2. Invoice are payable by the end of next month. Which function will you use to find what date is the end of next month from today?
   Answer:
   =EOMONTH(TODAY(),1)
   Format cell as date if necessary

3. Which function will you use to find which day of the week was your birthday?
   Answer:
   =WEEKDAY(DATE(1990,10,20)) assuming you were born on Oct 20, 1990.

4. Winter wheat was planted on September 12 of last year. It takes about 300 days to reach the maturity. What is the date after 300 days from September 12 last year?
   Answer:
   =DATE(YEAR(TODAY())-1,9,12)+300
   YEAR(TODAY()) returns this year, subtract 1 to get the last year.

5. Ben started harvesting with his 4 row combine at 7:25 AM and finished combining his 12 acre patch at 12:10 PM. How many hours did he work? How many acres did he combined an hour?
   Answer: To get total hours, subtract two times and multiply by 24

	A	B	C
1	Start time:	7:25 AM	
2	End time	12:10 PM	
3	Hours worked	4.75	'=(B2-B1)*24
4	Acre/hour	2.53	'=12/B3

Financial functions

Excel comes with many built-in financial functions. You need to understand some basic terms before you use financial functions. Key terms used in financial calculations are:

➢ Present Value (PV): This is the principal amount. If you deposit $1,000 in a bank, this amount represents the principal or present value, of the money you invested.

➤ *Future Value (FV): This is the principal plus interest. If you invest $1,000 for 1 year and earn 5 percent annual interest, you receive $1,050 at the end of the five-year term. This amount is the future value of your $1,000 investment.*

➤ *Payment (PMT): This is the deposit or amortization per period of time. If you deposit $100 per month into a savings account, $100 is the payment.*

➤ *Interest Rate (Rate): Interest is a percentage of the principal, expressed per period. For example, you may earn 5.5 percent annual interest on a bank account. Your annual payment rate (APR) is 5.5% but, if your interest is compounded every month your periodic rate is 5.5%/12. Always use periodic rate in calculations.*

➤ *Number of Period (Nper): This represents the number of equal payments. For example you can get a car loan for 4 years paid every month. Then your Nper is 4*12 = 48.*
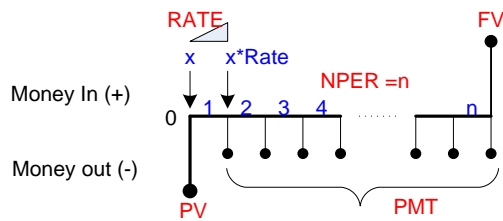
Frequently used financial functions are:

SIGN convention: Financial functions uses negative and positive sign to indicate the direction of cash flow. You think the cash going out of your pocket or the amount you owe is a negative number and the cash coming to your pocket or the amount other owe you as positive amount.

Examples:

1. *Joe purchased 300 acres of farmland at $2600 per acre. They paid 20% down and were able to get a fixed rate loan 7.6% over 15-year*

period. They are to repay the loan at equal monthly payments. How much would be the payment?

Answer: Use PMT function to calculate periodic payment on a loan.

	A	B	C
1	Loan calculator for land purchase		
2		Formula	Result
3	Land price	=300*2600	780,000
4	Down	=B1*20%	156,000
5	Loan amount (PV)	=B1-B2	624,000
6	Annual rate	7.60%	7.60%
7	Monthly rate (Rate)	=B4/12	0.63%
8	Balance at end (FV)	0	0
9	Loan period in years	15	15
10	Number of payments (Nper)	=B7*12	180

Monthly payment (PMT)
=PMT(B5,B8,B3,0)   -5,820
Notice the negative sign for payment.

2. *You have $1500 now to start an account in a bank that pays annual interest rate of 5% but interests are calculated every month. You are planning to contribute a fixed amount of $100 every month, how much you will withdraw after 40 years when you retire?*

	A	B	C
1	Future valueof money		
2		Formula	Result
3	Today's deposite (PV)	-1500	-1500
4	Annual interest rate	5.00%	5.00%
5	Monthly rate (Rate)	=B4/12	0.42%
6	Period in years	40	40
7	Number of payments (Nper)	=B6*12	480
8	Monthly deposit	-100	-100

NPER	Returns the number of periods for an investment
PV	Returns the present value of an investment
RATE	Returns the interest rate per period of an annuity
FV	Returns the future value of an investment
PMT	Returns the periodic payment for an annuity

Future value of money (FV)

=FV(C5,C7,C8,C3)   =163,340

Lookup and reference functions

Lookup and reference are collections of lookup functions and reference functions. Lookup function looks up a value from a table or a list with a given criteria. Reference functions are useful in referring the cell addresses in a flexible way.

Lookup functions

The most commonly used lookup functions are:

LOOKUP	Returns a value either from a one-row or one-column range or from an array, _For the LOOKUP function to work correctly, the data being looked up must be sorted in ascending order_.
MATCH	Returns the relative position of an item in an array
INDEX	Uses an index to choose a value from a reference or array
VLOOKUP	Searches for a value in the leftmost column of a table and then returns a value in the same row from a column you specify in the table

Example:

1. WEEKDAY function returns a number indicating 1 for Sunday, 2 for Monday and so on. If you want to display the actual name of the day instead of cryptic number you can create the following table and translate a number into days of the week using LOOKUP function.

	A	B
1	1	Sunday
2	2	Monday
3	3	Tuesday
4	4	Wednesday
5	5	Thursday
6	6	Friday
7	7	Saturday

=LOOKUP(1,A1:A7,B1:B7) will return Sunday

LOOKUP function looks for the first argument

value (1 in this case) and searches in list A1:A7. If it finds a match then LOOKUP function returns an item from a list of items at index number (In this case, the value in same row from B1:B7).

= LOOKUP(6.5,A1:A7,B1:B7) will return Friday

If LOOKUP function can't find the exact match, the function matches the largest value in lookup vector that is less than or equal to lookup value. For this reason the 1st column must be sorted to always get correct results.
To use LOOKUP function to display the spelled out day of a week from WEEKDAY function, we use:
=LOOKUP(WEEKDAY(DATE(1990,2,3)), A1:A7,B1:B7) will return Saturday for February 3, 1990.

The first argument is a return value from WEEKDAY function which can be a number between 1 and 7. This number is then used by LLOK function to return Sunday for 1 and so on.

2. Sometimes you want the index itself where an item was matched instead of a valued looked for that index from some other list. For instance if user types in a weekday in a form, you may want to check if the spelling is right by trying to match with list of weekdays. You can use MATCH function that returns the index in the list where a match was found. This index can be used to find out which day of the week it was. You can specify the match type in 3 different ways:

In above example, we want an exact match for the spelling; so we specify match type as 0.

=MATCH("Friday",B1:B7,0) will return 6
=MATCH("Friday",B1:B7) will return #N/A error because the list is not sorted

3. *INDEX function returns a value at an index from one or two dimensional array.*

	A	B
1	Product	Count
2	Bananas	25
3	Oranges	38
4	Apples	40
5	Pears	41

=INDEX(A2:B5,2,1) will return Oranges
=INDEX(A2:B5,2,2) will return 38
=INDEX(A2:A5,3) will return Apples

4. *Following table gives the postal service charges for different weights and zones.*

	A	B	C	D	E	F
1				Zone		
2	Weight	1	2	3	4	5
3	1	$0.29	$0.33	$0.37	$0.45	$0.50
4	2	$0.51	$0.55	$0.61	$0.70	$0.75
5	5	$1.05	$1.10	$1.15	$1.25	$1.35
6	10	$2.00	$2.20	$2.30	$2.40	$2.50
7	15	$2.78	$2.95	$3.15	$3.25	$3.50

We want the users to choose the weight and zone they are shipping to calculate their postal charges. In an Excel sheet as

	G	H	I
1	Weight of Package		5
2	Postal Zone		1
3	Cost of shipping		1.05

The actual table may be hidden from the user. In order to look up for the postal charge we'll use VLOOKUP function as:

Match_ type	Behavior
1 or omitted	MATCH finds the largest value that is less than or equal to *lookup_value*. The values in the *lookup_array* argument must be placed in ascending order, for example: ...-2, -1, 0, 1, 2, ..., A-Z, FALSE, TRUE.
0	MATCH finds the first value that is exactly equal to *lookup_value*. The values in the *lookup_array* argument can be in any order.
-1	MATCH finds the smallest value that is greater than or equal to *lookup_value*. The values in the *lookup_array* argument must be placed in descending order, for example: TRUE, FALSE, Z-A, ...2, 1, 0, -1, -2, ..., and so on.

=VLOOKUP(I1,A3:F7,I2+1)
VLOOKUP has the following syntax:
VLOOKUP(lookup_value, table_array, col_index_num, [range_lookup])

If range_lookup is either TRUE or is omitted and exact match is not found, the next largest value that is less than lookup_value is returned. For this reason the 1st column must be sorted to return a proper value when an exact match is not found.

Reference functions

Reference functions are often used to reference a cell in an indirect way. Address of the range as passed as an argument instead of absolute reference.

ADDRESS	*Returns a reference as text to a single cell in a worksheet*
COLUMN	*Returns the column number of a reference*
INDIRECT	*Returns a reference indicated by a text value*
ROW	*Returns the row number of a reference*

Example

Imagine you had a table like this:

	A	B
1	Item	Cost
2	Bread	2.30
3	Butter	1.78
4	Total cost	4.08

You entered the formula =SUM(B2:B3) in cell B4. This is all good until someone inserts a row to enter more items like:

	A	B
1	Item	Cost
2	Bread	2.30
3	Butter	1.78
4	Jam	2.49
5	Total cost	4.08

The result stayed the same. You could definitely change the formula to include cell B4 as =SUM(B2:B3) but if this pattern repeats, you might want to change how the cell is referenced so that Total cost row automatically add up to one row above. In order to do that we need:

1. *The address of current row where the total cost is located. =ROW() will return current row number.*
2. *The address of current column where the total cost is located. In this case we could have used 2 but to be more flexible in copying the formula to other columns, we use =COLUMN() function.*
3. *Convert row number and column numbers thus obtained to create a cell address as: = ADDRESS(ROW()-1,COLUMN()) function creates address as text for one row above and same column. Address function takes row and column number as numeric value and returns the cell address as text.*

4. *Convert that text into actual cell address. INDIRECT function uses cell address as text and creates a valid cell address. =INDIRECT(ADDRESS(ROW()-1,COLUMN()))*
5. *Now use SUM function to add from cell B2 to one cell above the total cost row as: =SUM(B2:INDIRECT(ADDRESS(ROW()-1,COLUMN())))*

Review questions

1. What is a function?
2. What are some of the advantages of using a function?
3. What is syntax of a function?
4. What is function argument? Does every function take an argument? If not give some function examples that don't take an argument.
5. Summarize different ways you can insert a function.
6. What are three different ways you can invoke insert function dialogue box?
7. How does insert function dialog box help you find the right function?
8. When you are typing a function manually, how do you know if an argument is optional?
9. When you are typing a function manually how do you know which argument value you are entering?
10. If you see #NAME when you use a function, what might be the probable cause and how would you fix it?
11. What is the most probable cause if your see a #REF! error message? How do you fix it?
12. Can you use a function to calculate an argument value for another function, if yes how does this work? Which function is evaluated first?

Multiple choice questions

1. What is a function?
   a. A prewritten formula.
   b. A math operator.
2. Function name cannot have a space i.e. function name must be a single word.
   a. True
   b. False
3. What does ##### most probably mean?
   a. The column is not wide enough to display the content.
   b. The cell reference is not valid.
   c. You have misspelled a function name or used a name that Excel doesn't recognize.
4. In the practice, you learned that if you misspell SUM in this formula =SUME(B4:B7), you'll get an error value of #NAME? To fix the formula, you must delete it and start over again.
   a. True.
   b. False.
5. Which function would you use to roundup a number to multiple of 5?
   a. CEILING
   b. ROUND
   c. ROUNDUP
6. If you want to get the quotient of a division operation, which of the following function would you use?
   a. DIVIDE
   b. QUOTIENT
   c. MOD
   d. REM

Practice problems

Use Excel to perform the calculations

1. Evaluate $1/\sqrt{2}$
2. Evaluate $\sqrt{(3^2 + 4^2)}$

3. Find the least common multiple of 3, 6 and 9.
4. pH is defined as –ve logarithm (base 10) of hydrogen ion concentration. Or,
   pH = -Log10(H+)
   If a chemical compound has hydrogen ion concentration of 0.00002 what would be its pH value?
5. Convert 60° angle to radians using RADIANS function.
6. Calculate the value of SIN(60°). (Hint: First you need to convert the angle to radians, Use both RADIANS and SIN functions.)
7. Round your answer in above question using ROUND function to 2 decimal places.
8. If 139 cookies were packed in boxes each holds 12 cookies, how many boxes of cookies will you have? How many cookies will be left after the last full box?
9. What is the remainder if you divide 4321 by 1234?
10. π is actually the ratio of perimeter to diameter of a perfect circle. If you measure the circumference of a round tree as 8 feet, what is the tree diameter?
11. In many scientific applications, angles are measured in radians. How many radians in a complete circle. (Hint: A complete circle has 360 degrees).
12. How many radians in a half circle? Compare this value to the value of π. If so can you explain why they are equal?
13. Generate a random number between 1 and 6 in cell A1 to simulate rolling of a dice. Copy this function to cell B1. Do you get the same number? Press F9 key to recalculate Excel sheet and see if you get different number each time?
14. Fine amount in overdue payment is calculated as: 1% per day of the payment amount for first 15 days, 2% per day after that. A payment of $220 was due on February 23, 2008 which was paid only on

March 15.Calculate the amount in fine? Use Excel to do all calculations. (ANS: $59.40).

15. You are paid hourly at the rate of $18.50/hour. You had the following time sheet:

	A	B	C
1	Day	Start Time	Stop time
2	Monday	8:40 AM	11:35 AM
3	Monday	12:05 PM	5:30 PM
4	Tuesday	8:05 AM	12:00 PM
5	Tuesday	12:20 PM	4:35 PM
6	Wednesday	9:15 AM	1:35 PM
7	Wednesday	2:00 PM	5:15 PM

How many hours did you work in three days? How much would be your pay? (ANS 24.08 hours, $445.55).

16. Calculate how many days has been past from Jan 1st of this year to today?

17. A calf was born 78 lbs on March 13. The calf weighted 498 lbs on September 12. What was the average weight gain per day to the tenth of a pound?

18. Interest rate on 15 year home mortgage is based on credit score as follows:

	A	B
1	Credit score	Interest rate
2	0	7.50%
3	3	6.70%
4	5	6.20%
5	7	5.80%
6	8	5.40%

How much would be the monthly payment on $150,000 loan for someone with credit score 6.5? (Use credit score value that is next lower or equal to someone's credit score). Use LOOKUP function to look for the interest rate.

19. You want to simulate drawing of a card from a deck of cards. The colors can be represented by a number between 1 and 4 and value from 1 to 13.
You have the following lookup table:

	A	B	C	D
1	1	Spade	1	Ace
2	2	Heart	2	Two
3	3	Diamond	3	Three
4	4	Club	4	Four
5			5	Five
6			6	Six
7			7	Seven
8			8	Eight
9			9	Nine
10			10	Ten
11			11	Jack
12			12	Queen
13			13	King

Using RANDBETWEEN function and LOOKUP function write a function that simulates drawing a card from a deck with replacement and write like:

F	G	H

Queen of Diamond

20. Use COLUMN function to find the column number of cell AF14.

21. Use COLUMN function to 1, 2, 3 as column headings.

22. Use ROW function to generate list number 1,2,3…What happens if you delete an entire row in a middle of these generated numbers?

More Useful Functions

Logical operations

There would be many situations where calculation is based on some criteria. These are the IF situations of life. If your credit score is excellent you get lower interest rate, else you pay higher interest rate. In these situations, your calculations are based on some condition and if one set of condition is true, that triggers one set of calculation else, it does something else. Unlike other functions, a logical function always returns TRUE or FALSE. There are also logical operators used to compare two values and returns either TRUE if statement is true otherwise returns FALSE.

Examples of logical operators:

Test whether the statement "2 is greater than 3" is true or false, enter into Excel,
=2>3 and it will return FALSE.

The word "TRUE" and "FALSE" standing alone is interpreted as 1 and 0 respectively by Excel. Therefore you can use the word "True" for 1 and "False" for zero if you wish in calculation like,

=True * 10   will result in 10
=False * 10   will result in 0
=True + True   will result in 2
=True – True   will result in FALSE

There are total of 6 comparison operations that produce one of the logical values (TRUE or FALSE). Example of comparison operators:

Cell A1 has value of 2 and cell A2 has value of 2 as well

=A1 > A2	FALSE	=A1<A2	FALSE
=A1>=A2	TRUE	=A1<=A2	TRUE
=A1=A2	TRUE	=A1<>A2	FALSE

The last one with <> (both less than greater than together) means not equal to.

Logical functions

Logical functions are used to test if certain criteria meet before performing a calculation.

AND	**Returns TRUE if all its arguments are TRUE**
OR	**Returns TRUE if any argument is TRUE**
NOT	**Reverses the logic of its argument**
IF	**Specifies a logical test to perform**

You can combine more than one criterion with AND or OR function. AND function returns TRUE only if **all** of the arguments are true. Otherwise it returns false. OR function returns TRUE if **any** of the arguments are true.

Example:

	A	B	C
1	2	Expression	Result
2	2	=AND(A1<=A2,A2<=A3)	TRUE
3	3	=AND(A1<A2,A2<A3)	FALSE
4		=OR(A1<=A2,A2<=A3)	TRUE
5		=OR(A1<A2,A2<A3)	TRUE
6		=NOT(A1>A2)	TRUE

IF function takes its first argument as logical value and returns the second argument if first argument is true else it returns the third argument or FALSE if third argument is not provided.

Example:

A growing degree day (GDD) is an index used to express crop maturity. The index is computed by

subtracting a base temperature of 50°F from the average of the maximum and minimum temperatures for the day. Minimum temperatures less than 50°F are set to 50, and maximum temperatures greater than 86°F are set to 86. These substitutions indicate that no appreciable growth is detected with temperatures lower than 50 or greater than 86 does not grow a crop any faster.

Therefore, minimum temperature can be set to 50 by =IF(A1<50,50,A1) will return 50 if temperature in cell A1 is <50 else it will return the temperature in cell A1. Note that if A1<50 is false then A1 must be greater than or equal to 50, so we will use just use that temperature as it is.

Similarly we can use IF function to cap the maximum temperature as,

=IF(B1>86,86,B1) and combine these two to calculate the average temperature as:

=(IF(A1<50,50,A1) + IF(B1>86,86,B1))/2

The growing degree day for that day will be then

=(IF(A1<50,50,A1) + IF(B1>86,86,B1))/2 – 50

Nested IF function

The above approach for GDD calculation works well for the situations where maximum temperature is not below 50°F or the minimum temperature is not above 86°F. Therefore to set the proper minimum temperature, following flowchart can be used:
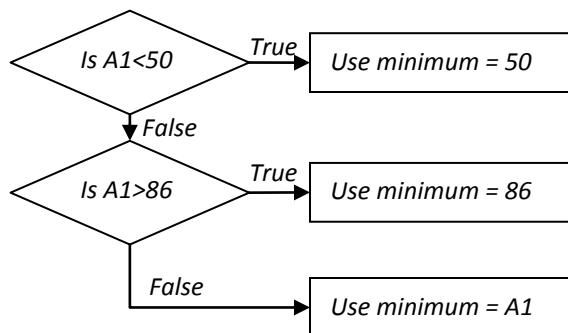
So the temperature has to be tested twice. You can implement this by

=IF(A1<50,50,IF(A1>86,86,A1))

This formula testes whether the temperature is <50, the second IF statement is carried out only if the first argument returns FALSE. The same equation can be used for maximum temperatures as well.

Text function

Text function does not do calculation with text but extracts information about a text, find a character or word inside a sentence, extract a part of sentence or combine one or more pieces of text together.

CHAR	**Returns the character specified by the ASCII code number**
CODE	**Returns a numeric code for the first character in a text string**
CONCATENATE	**Joins several text items into one text item**
DOLLAR	**Converts a number to text, using currency format**
FIXED	**Formats a number as text with a fixed number of decimals**
LEFT	**Returns the leftmost characters from a text value**
LEN	**Returns the number of characters in a text string**
LOWER	**Converts text to lowercase**
MID	**Returns a specific number of characters from a text string, starting at the position you specify**
PROPER	**Capitalizes the first letter in each**

	word of a text value
REPLACE	**Replaces characters within text**
REPT	**Repeats text a given number of times**
RIGHT	**Returns the rightmost characters from a text value**
TEXT	**Formats a number and converts it to text**
TRIM	**Removes excess spaces from text**
UPPER	**Converts text to uppercase**
VALUE	**Converts a text argument to a number**
FIND	**Finds one text value within another (case sensitive)**

Example:

Cell A1 has "wheat harvest" and cell B1 has 35. As shown in the following table. Carefully study the expression and result of different text functions.

	A	B
1	wheat harvest	35
2	Expression	Result
3	=LEN(A1)	13
4	=LEFT(A1,5)	wheat
5	=RIGHT(A1,4)	vest
6	=PROPER(A1)	Wheat Harvest
7	=UPPER(A1)	WHEAT HARVEST
8	=CHAR(B1)	#
9	=DOLLAR(B1)	$35.00
10	=FIND("v",A1)	10
11	=CONCATENATE("Cost of ", A1, " per hour =", DOLLAR(B1))	Cost of wheat harvest per hour =$35.00
12	=REPT("-",10)	----------

Statistical functions

AVERAGE	**Returns the average or mean**
AVERAGEIF	**Counts the number of cells that meet multiple criteria**
COUNT	**Counts how many numbers are in the list of arguments**
FORECAST	**Returns a value along a linear trend**
GEOMEAN	**Returns the geometric mean**
HARMEAN	**Returns the harmonic mean**
INTERCEPT	**Returns the intercept of the linear regression line**
MAX	**Returns the maximum value in a list of arguments, ignoring logical values and text**
MEDIAN	**Returns the median of the given numbers**
MIN	**Returns the minimum value in a list of arguments, ignoring logical values and text**
MODE	**Returns the most common value in a data set**
PERCENTILE	**Returns the kth percentile of values in a range**
QUARTILE	**Returns the quartile of a data set**
RSQ	**Returns the square of the Pearson product moment correlation coefficient**
SLOPE	**Returns the slope of the linear regression line**
STDEV	**Estimates standard deviation based on a sample, ignoring text and**

	logical values
STDEVP	Calculates standard deviation based on the entire population, ignoring text and logical values
VAR	Estimates variance based on a sample, ignoring logical values and text
VARP	Calculates variance based on the entire population, ignoring logical values and text

Statistical function as name implies is useful to conduct statistical calculations. Understanding of basic statistics is essential to make sense of most of the statistical functions. A brief review is provided in the following sections:

Statistics Review

A first step in data analysis is often to produce useful summaries of data characteristics. Middle value of data or average (also called mean) is often used to describe the central tendency; standard deviation is used to quantify the dispersion of other data from that central value.

Five different ways to specify the central tendency are:

1. Arithmetic mean (AVERAGE function)
2. Geometric mean (GEOMEAN function)
3. Harmonic mean (HARMEAN function)
4. Median (MEDIAN function)
5. Mode (MODE function)

Arithmetic mean is defined as:

$$\bar{x} = \frac{Sum\ of\ terms}{Number\ of\ terms} = \frac{\sum_1^n x_i}{n}$$

Arithmetic mean in Excel is calculated using AVERAGE function. There is also the function called AVERAGEIF (in word 2007 only) that calculates the average of numbers that meets certain criteria.

If you rather calculate numerator and denominator separately use SUM function to calculate sum of terms and COUNT function to count number of terms and calculate the fraction to calculate the arithmetic mean.

Example:

Calculate the average of data 1, 1, 2, 2, 2, 4.

=AVERAGE(1,1,2,2,2,4)   (Result is 2)

More often than not, the data like above is presented in a tabular format with values and their frequencies like:

	A	B	C	D
1	x=	1	2	4
2	Frequency=	2	3	1

In this case there is no straight forward way to calculate the average. We need to apply the definition of average and calculate sum of terms and number of terms separately.

Sum of terms = B1*B2 + C1*C2 + D1*D2. This calculation can be easily carried out using SUMPRODUCT function as =SUMPRODUCT(B1:D1,B2:D2)

Number of terms can be calculated using the sum of frequencies. In above case there are total of 7 terms which is = SUM(B2:D2). Therefore the average is

= SUMPRODUCT(B1:D1,B2:D2)/SUM(B2:D2)

Geometric mean is defined as:

$$\bar{x}_G = \sqrt[n]{\prod_1^n x_i}$$

The notation indicates the nth root of the product of the terms. The geometric mean is a useful summary when we expect that changes in the data occur in a

relative fashion such as bacteria growth. Future Bacteria count dependent on previous bacteria concentration. Let's take an example:

Bacteria count every hour from a dairy sample was found to be: 10, 13, 32, 82, 198, 218, 261, and 235. What is the average growth factor per hour?

Answer:

Growth factor is the ratio of previous hour bacteria to current bacteria count. Therefore the growth factors are

13/10 = 1.3   32/13 = 2.45   82/32 = 2.55 similarly the rest can be calculated as 2.4, 1.1, 1.2, and 0.9. If you now calculate the arithmetic mean it would be 1.70. If this were the average growth factor, the bacteria count after seventh hour should have been,

10 * 1.70 = 17 after first hour,
10* 1.70^2 = 29 after second hour and similarly…
10*1.70^7 = 415 after 7th hour. This is way different than actual count 235.

Now if we have used the geometric mean, (Use Excel GEOMEAN function) the average geometric mean is 1.57. Bacteria count after 7th hour = 10*1.57^7 = 235, and this is what the count was.

Use geometric mean to express the average growth rate that increases or decreases as a fraction of previous value.

Harmonic mean is defined as:

$$\bar{x}_H = \frac{n}{\sum_1^n \frac{1}{x_i}}$$

The harmonic mean is a better "average" when the numbers you are taking the average of have a unit for both numerator and the denominator and all numbers are the same in terms of their unit in numerator.

Example: Jack climbed up 1 mile of hilly road at 2 miles per hour speed and returned down at 4 miles per hour of speed. What was his average speed?

Speed is defined as the ratio of distance traveled by time taken. Speed has the unit of Distance/Time. The numerator is the same that is 1 mile of climbing up and 1 mile of climbing down. Therefore, for this case, harmonic mean is the better average.

You may be tempted to calculate average speed of 2 and 4 as 3 miles per hour, but doing so would be wrong. Jack travelled total distance of 2 miles and spent 0.5 hour going up and only 0.25 hour in coming down. Therefore, he travelled 2 miles in 0.75 hour. Therefore his average speed is 2/0.75 = 2.67 miles/hour.

Now calculate the harmonic mean of 2 and 3 using excel function HARMEAN(2,4) = 2.67 miles per hour.

Median does not have a mathematical equation like means. However it is frequently used in statistics to measure the central tendency. Unlike means Median is not affected by extreme data values and this makes it a better measure than the mean for highly skewed distributions. The median income is usually more informative than the mean income, for example (Remember Pareto principle or commonly known as 80-20 rule? 80% of income goes to 20% of people?). Use MEDIAN function to calculate the median.

Mode is the value that occurs the most frequently in a data set or a probability distribution. The mode is not necessarily unique, since the same maximum frequency may be attained at different values. Use MODE function to calculate the mode.

Measure of dispersion

The purpose of measures of dispersion is to find out how spread out the data values is on the number line.

The standard deviation and the variance are popular measures of spread that are optimal for normally distributed samples. The equation to calculate standard deviation of entire population is slightly different than for sample population. Sample standard deviation is the most frequently used one as statistics more often than not deals with samples than the entire population. Sample standard deviation is given by:

$$S = \sqrt{\frac{\sum_1^n (x_i - \bar{x})^2}{n-1}}$$

Population standard deviation uses n instead of n-1 in denominator and that is the only difference. Use the function STDEV to calculate sample standard deviation and STDEVP to calculate population sample deviation.

Variance is the squared value of standard deviation can be calculated using VAR for sample and VARP for population variance.

The range (the difference between the maximum and minimum values) is the simplest measure of spread. Range is not frequently used because its susceptibility to outliers. There is no special function is Excel to calculate range. However, range can be easily calculated using MAX and MIN functions. =MAX(data)-MIN(data) will return the range of data.

Interquartile range is more robust than range because it calculates range by ignoring top $1/4^{th}$ of data (Above 3rd quartile or 75th percentile) and bottom $1/4^{th}$ of data (Below 1st quartile or 25th percentile). The Interquartile range can be calculated in Excel using:
=QUARTILE(data,3)-Quartile(data,1)   or
= PERCENTILE(data,0.75)-PERCENTILE(data,0.25)

Linear regression

Linear models represent the relationship between a response variable and one or more predictor variables. The most basic form of regression analysis produces an equation like:
y = a.x+b
Where, y is response variable, x is control variable. Regression analysis estimates the constant coefficient a (called slope) and b (called intercept).

	A	B
1	Nitrogen(lbs/acre)	Yield (Bu/ac)
2	0	30
3	10	35
4	20	42
5	30	40
6	40	50
7	50	55

If Y is yield and x is applied nitrogen in above equation, what is the estimated value of a nd b? Excel's SLOPE function gives the value for a and INTERCEPT function provides the value for b.
=SLOPE(B2:B7,A2:A7)   (value of a = 0.48)
=INTERCEPT(B2:B7,A2:A7) (Value of b=30)

Intercept is the value of y when x = 0, in our case yield without any nitrogen input and that is 30 bu/ac. Slope is the average response. There is average yield increase of 0.48bu/ac for every pound increase in nitrogen application.

R^2 is the fraction of the total squared error that is explained by the model. Thus values approaching one are desirable. Above model does not exactly represent data, for instance yield for 20 lbs of nitrogen as predicted by model is =0.48*20+30 = 39.6. But actual yield was only 42 bushels/acre. For a perfect fit model, R^2 would be 1. R^2 in this case determines what fraction of yield variation is due to nitrogen variation. R^2 can be calculated using RSQ function as
=RSQ(B2:B7,A2:A7) (=0.94). Therefore 94% of yield variability is attributed to nitrogen. R^2 is also sometimes used as how good the model fits the data.

If you want to predict the yield for any value of nitrogen application you can use the equation above, but there is a shortcut function called FORECAST that evaluate Y value for any given x. For example if you want to know the expected yield if you apply 90 lbs of nitrogen use FORECAST function like:
=FORECAST(90,B2:B7,A2:A7)   =73.2 bu/ac.
You can also use FORECAST function to do the reverse calculation. For example what amount of nitrogen application gives you yield of 60 bu/ac?
=FORECAST(60,A2:A7, B2:B7)   =60.16. Notice the switching the argument for known x's and known y's.

Analysis Toolpak

More advanced statistical analysis tools is available under Analysis Toolpak. The Analysis Toolpak is an Excel add-in program that is available when you install Microsoft Office or Excel. Add-in is a supplemental program that adds custom commands or custom features to Excel. To use it in Excel, however, you need to load it first.

1. Click the Microsoft Office Button 	, and then click Excel Options.
2. Click Add-Ins, and then in the Manage box, select Excel Add-ins.
3. Click Go.
4. In the Add-Ins available box, select the Analysis ToolPak check box, and then click OK.
5. If you get prompted that the Analysis ToolPak is not currently installed on your computer, click Yes to install it.
6. After you load the Analysis ToolPak, the Data Analysis command is available in the Analysis group on the Data tab.

Try running the regression analysis for above data. From data analysis dialog box select regression and click OK.
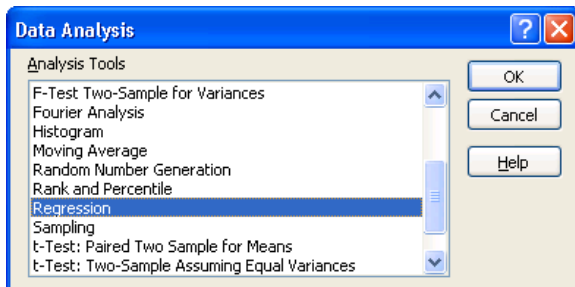
From regression dialogue box, select the input range

and output cell for Excel to dump the results.
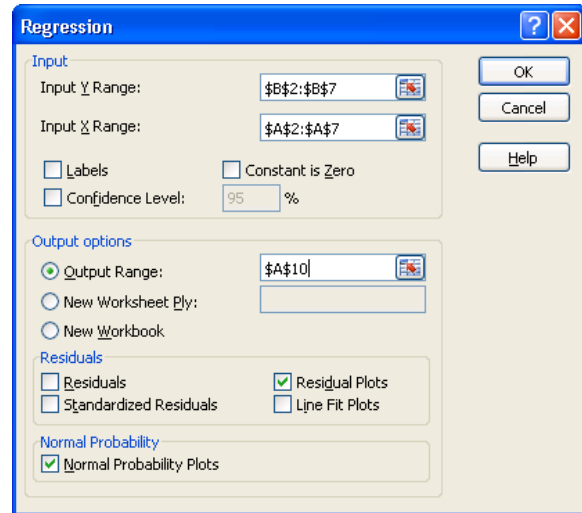
Look at the results and see which ones you can make sense of?

Histogram

Histogram creates the frequency table for given set of data. To create a histogram, you must have data and the bin range.

	A	B	C	D	E
1		Data			Bin range
2	2.3	7.4	2.7	4.3	3
3	7.5	6.4	-1.6	5.2	5
4	1.1	4.3	3.2	4.3	7
5	5.8	5.4	-3.4	9.6	

Provide the following information in Histogram dialogue box
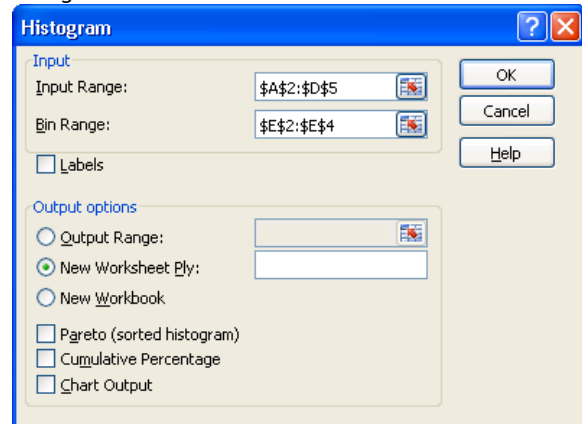
Input data: This is the data that you want to analyze by using the Histogram tool.

Bin numbers: These numbers represent the intervals that you want the Histogram tool to use for measuring the input data in the data analysis. When you use the Histogram tool, Excel counts the number of data points in each data bin. In this example it will create 4 bins with

Bin 1:   <=3
Bin 2:   >3   to   <=5
Bin 3:   >5   to   <=7
Bin 4:   >7

If you omit the bin range, Excel creates a set of evenly distributed bins between the minimum and maximum values of the input data. The output would look like this:

	A	B
	Bin	Frequency
1		
2	3	5
3	5	4
4	7	4
5	More	3

A column of text contains first and last name entered together separated by a space. However, you are asked to separate their name

Review questions

1. What logical operators are available in Excel?
2. How logical operators are different than mathematical operators?
3. What are the possible two outcomes from any logical operation?
4. What would be the outcome of the following logical expressions
   =AND(True,True,False)
   =AND(1,1,1)
   =OR(True,True,False)
   =OR(0,0,0)
5. Explain how the following IF function always returns the bigger of two numbers in cell A1 and B1
   =IF(A1>B1,A1,B1)

6. Does LEN function include space in character counting? Verify our answer by counting characters in your name.
7. Sometimes a name contains leading or trailing spaces. Leading space mess the sort operation and trailing space may mess with name matching operation. Which function would you use to ditch leading or trailing spaces in a text?
8. When names are sorted they are sorted according to their ASCII value. Which function do you use to find out the ASCII number associated with a character?
9. In what situations the geometric mean is more meaningful than arithmetic mean? What function calculate the geometric mean?
10. Do you expect to find SUMPRODUCT function under statistical function category? If not where would you find this function?

Multiple choice questions

1. =(3>1)*10 will produce a
   a. 20
   b. 10
   c. 0
   d. Error!
2. Internally Excel treat TRUE as 1 and FALSE as 0
   a. True
   b. False
3. =IF(3>2,3,2) will always return
   a. 2
   b. 3
   c. Either 3 or 2
   d. Smaller of 2 and 3
4. =NOT(AND(4>=2*2,5>4)) will return
   a. TRUE
   b. FALSE
5. =TRUE*FALSE-FALSE*TRUE will return
   a. 1
   b. 2
   c. TRUE
   d. 0

1. You want to generate a text sequence as Image001, Image002, and Image003. Where the word image is in column 1 and number 1, 2, 3 are in column B. Use TEXT function along with "000" formatting option to pad extra zeros before number and CONCATENATE function to add the information in column A and B.

2. Enter value 10 in cell A1 and 20 in cell B1. Type =A1>B1 in cell C1, what result did you get? Change the value in cell B1 to 5, what happened to cell C1?

3. If you type = "A"<"B" in a cell it will return TRUE. In Excel, texts are compared according to their ASCII value. Find the ASCII value of letter A, a, b and B using CODE function. The expression = "B"< "a" is true or false? Why?

4. A student works 2 part time jobs 10 hours per week each. In one job, he is paid $10/hr and in another job, he is paid $9/hr. What is his average earning per hour?

5. If the student got 15 hours to work on his $10/hr job and cut back 5 hours on his $9/hr job, how much is his average income per hour now?

6. The daily temperatures, in degrees, Fahrenheit for 10 days in May were 61, 62, 65, 65, 65, 68, 74, 75, 77, and 78. Calculate the mean temperature and standard deviation of the data. If each day had been 7 degrees warmer, what would have been the mean temperature and standard deviation?

7. Figures below have same number of data points. Each data point is a pair of value in X and Y-axis. Which dataset seems to have higher standard deviation?

Dataset 1

Dataset 2
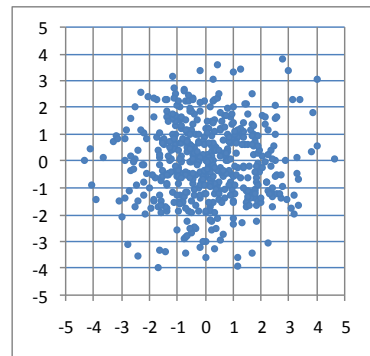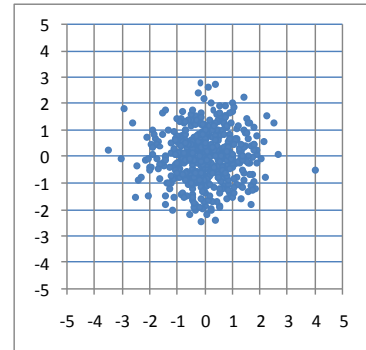
8. A group of 20 values has mean of 85. A different group of 30 values has mean 75. What is the combined mean?

9. Jack climbed up 4 mile of hilly road at 2 miles per hour speed and returned down at 4 miles per hour of speed. What was his average speed?

10. A grower spent $1,000 to buy nitrogen fertilizer at $1/lb. Later he found a better deal and spent another $1000 to buy nitrogen fertilizer at $0.60/lb. How much on average the grower paid per lb of Nitrogen?

11. If a student's average score of 3 exams is 80% and he has one more exam to take. If he wants to raise his percent average to 83%. Assuming that all exams have an equal weight, how much he would require securing in the final exam to raise his score to 83%? Use Goal Seek to answer this question.

12. A study was conducted to determine urine flow of sheep (in milliliters/minute) when

infused intravenously with the antidiuretic hormone ADH. The urine flows of 10 sheep are recorded as:

0.7, 0.5, 0.5, 0.6, 0.5, 0.4, 0.3, 0.9, 1.2, 0.9

Determine the mean and the standard deviation of the sample data

13. Find the average of x from following table:

X =	3	6	8	9	11
Frequency	2	30	36	67	18

14. Age at death of the Capuchin monkeys around a drug factory were found as follows:

Age	1	4	7	9	11	14
Frequency	3	5	14	15	6	2

   Calculate the average life expectancy of the monkeys around that drug factory.

15. Weight in kilogram and elongation of a metal wire in mm/m is given in the following table

Weight=	1	5	10	15	20
Elongation=	0.1	0.4	1.1	1.3	1.8

   Elongation and weight can be modeled as: Y=a.x+b where Y is elongation in mm/m and weight in kilogram. Find the value of constants a nd b in the equation:

16. In above question, what percentage of change in elongation is explained by change in weight? (Use RSQ function)

17. How much the wire will elongated by 6 kg load?

18. How much weight will cause the wire to elongate 1.0 mm/m?

19. Create a histogram of the following data. The bin range should be from 10 to 50 at an interval of 10, (Total of 6 bins, <=10,>10-<=20....,>50)

```
50 32 20 29 30 22 33 34 26 24
28 31 34 33 29 33 22 32 35 28
31 34 31 29 27 28 43 31 27 30
33 28 36 34 29 31 39 28 36 35
28 28 29 31 23 29 33 28 32 32
39 29 30 31 32 42 24 23 26 27
23 32 31 23 31 41 31 30 28 37
18 33 27 37 34 32 22 30 36 38
30 24 27 32 28 25 29 24 35 32
26 24 30 23 41 32 33 31 25 30
```

20. What is the arithmetic mean of above data?

21. What is the sample standard deviation of above data?

Using Solver and Goal Seek

Controlling Views

Normally you can view only one worksheet at a time, however you can open a new window to view the additional worksheets from View >> Window >> New Window. Once a new window is opened arrange them from view >> window >> arrange all and select different sheets in two different views. This feature is very useful to refer to other worksheets while you are working in a different worksheet in the same workbook.
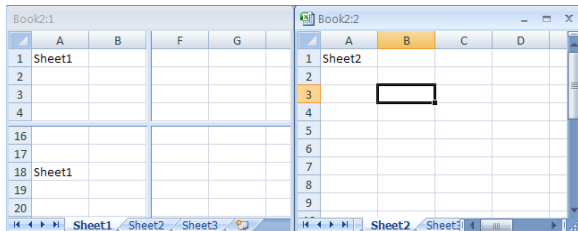
Another handy way of splitting windows is to use the split bar. Split bars are located above and right of the vertical and horizontal scroll bars. Just drag the splitter to place where you want the split to appear.

When you are scrolling down a long table that does not fit within a screen, it is hard to remember which column had what column title. By suing freeze pane feature certain rows and columns can be prevented from going out of view when you scroll. To freeze part of window click on the cell from which left and above portion will be frozen. Then select view>> Window >> Freeze pane. You will see a vertical and horizontal line partitioning frozen area. Portion of window left and above of this partition line will not scroll out of view.

Figure: Selecting cell C2 and freezing pane will keep Column A and B and row 1 always in view.

Page break view

Just looking at a sheet it may not be obvious how much of the area will be printed on a page. To view page breaks and adjust the columns so that the area you want to print comes within a page, from View tab, select Workbook views and click on page layout preview. This preview also allows you to add page headers and footers. Page break preview is useful to adjust the relative sizes to fit desired contents inside a page.

Managing Page Layout

Page layout in Excel is similar to page layout in Word. Refer to Word II notes to set up the page properties.

Formulas Tab

Formulas tab allows you to enter functions from different categories quickly. **Define names** under this tab allows you to define or mange the names used in workbook. In addition to these formula auditing and calculation allows you to change how Excel recalculates and handles circular reference.

Auto calculation and circular reference

Calculation is the process of computing formulas and then displaying the results as values in the cells that contain the formulas. To avoid unnecessary calculations, Excel automatically recalculates formulas only when the cells that the formula depends on have changed. This is the default behavior when you first open a workbook and when you are editing a workbook. However, you can control when Excel recalculates formulas.

To manually recalculate, change the option to manual from Formulas >> Calculation options >> ⊙ Manual.
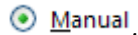
To manually recalculate all open worksheets, including data tables, and update all open chart sheets, on the Formulas tab, in the Calculation group, click the Calculate Now button (Keyboard shortcut F9). You can also change the calculation option from Formulas >> Calculation >> Calculation Options dialogue box.

Iteration is the repeated recalculation of a worksheet until a specific numeric condition is met. Excel cannot by default calculate a formula that refers to the cell — either directly or indirectly — that contains the formula. This is called a circular reference and normally it is an error.

Example: In the following worksheet, Profit is calculated as Income(B2)-Expense(B1)-Charity(B4)

Charity is calculated as Profit * 5%.

Therefore cell B3 is depending on cell B4 to evaluate its calculation and cell B4 calculation depends on cell B3. Usually this is an error and excel will complain showing blue dots and arrows indicating circular references.

	A	B	C
1	Expense	100	
2	Income	150	
3	Profit	50	'=B2-B1-B4
4	Charity=	0	'=B3*5%

In some other cases allowing circular references may be something you want. If a formula refers back to one of its own cells, you must determine how many times the formula should recalculate by turning on iterations. You can control the maximum number of iterations and the amount of acceptable change.

For instance, Cell A1 is a continuously changing value. You want to keep track of the highest value that A1 ever got in cell A2. We will do it by typing in cell A2,

=IF(A1>A2,A1,A2)

Since formula in cell A2 is referring to itself the Excel will complain about circular reference. And formula is not updated when value is changed. Now from Excel option >> Formulas >> Calculation options select Enable iterative calculation and click OK.

Now every time you change the value in cell A1, Cell A2 will display the maximum value that cell A1 ever gotten up to.

GOAL seek

Functions we have been using so far takes arguments and returns a value based on those argument values. However, at times you know what the function should return (goal) but do not what value of one single input will make the function to return desired result.

For example, imagine that you are going to buy a car. You know that you can make up to $300 monthly payments. With 3% of annual interest (APR), how much of a car you can afford to buy with 0 down and 60 months of payment terms?

If you recall, we used PMT function to calculate the mortgage payment for a given amount of loan. PMT function takes periodic rate, number of payments and present value of money or loan amount and returns the periodic payment amount. If you have loaned $10,000 for the car you would prepare your Excel sheet as:

	A	B
1	APR	3%
2	Terms	60
3	Present Value	10000
4	Payment	=PMT(B1/12,B2,B3)

The function would return -$179.69 as payment amount. But you know you could afford up -$300.00. That is you know what the function should return. What you don't know is what loan amount will make your payment -$300.00? That is we want to back calculate for the amount of loan for a given monthly payment.

Goal seek feature in Excel allows you to do the back calculation. In above example, click on cell B4. From Data >> Data Tools >> What-If analysis >> Goal Seek…A goal seek dialogue box will appear with B4 selected in Set cell.

Set Cell: This is the target cell. We want cell B4 to be set to desired value. Type B4 in set cell if it is not already so.

To value: This is the desired result. In this case set "To value" to -300 (you don't need a dollar sign).

By changing cell: This is the value you want to find. In our case it would be the value in cell B3, so point and select cell B3 or just type B3.
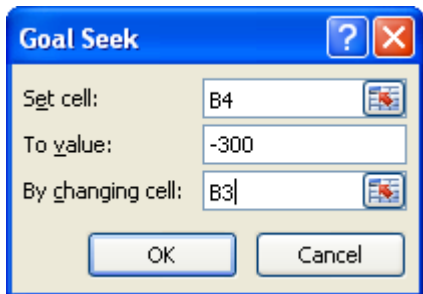
Click OK and you will see the present value adjusted to make your payment of -$300.00.

In some cases there may be no solution. If there is no solution, goal seek will most probably warn you so (Goal seek cannot work with complex numbers). Some problems have more than one solution. For example if x^2=16, x could be +4 or -4. Goals seek returns only one value nearest to the initial guess.

Solver

Goal seek can solve for only one variable. Excel's solver extends the Goal seek limitation to include solve:

➢ Maximization or minimization problem
➢ Multiple variables
➢ Solution with constraints

Solver is part of Excel Ad-ins and must be activated before you use it. Activate solver like Analysis Toolpak from Excel options >> Add-ins >> from the bottom of the dialogue box select Add-ins form the manage drop-down box and click GO. In the add-ins dialogue box, select Solver Add-ins.

Close the dialogue box and you should see in data tab Analysis >> Solver. Following examples will demonstrate the use of solver.

Maximization problem:

A farmer had 100 meter of fencing material. He wanted to make a fence to keep his cattle inside. He can use wall of his barn on one side and use fence in remaining 3 sides (picture below). If he wants to make his fence of rectangular shape, how much should be the length of each side of his fence so that he gets the maximum area?
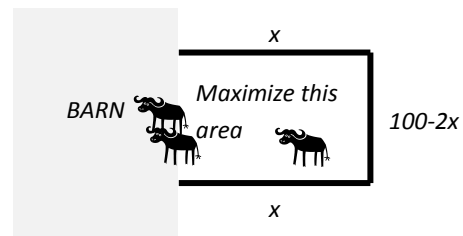
	A	B	C	D
1	Total	X	100-2X	Area
2	100	10	=A2-2*B2	=C2*B2

Select cell D2 and from Data>> Analysis >> Solver
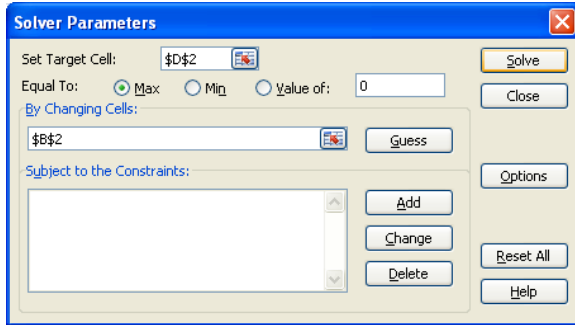
Set target cell to D2. By changing cell B2. Then click on solve. Excel given an option to keep or discard the solver solution. If you keep than the cell value will change as:

	A	B	C	D
1	Total	X	100-2X	Area
2	100	25	50	1250

Multiple variable

Economic law says that supply of a commodity increases as price increase while demand decreases. Price of a commodity is determined at the intersection of supply and demand curve.
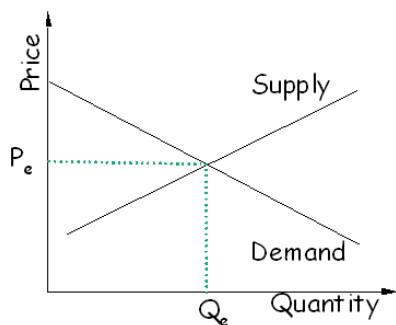
Let's assume that supply is given by the equation: 2Q - P = 150 Where Q is supply units and P is price in dollars. Demand is given by the equation: Q + 2.P = 200

What is the price and quantity at equilibrium?
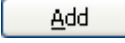
Solution:

Set the work sheet like below

	A	B	C	D
1	Equations	Constants		
2	=2*D2-D3	150	Q=	
3	=D2+2*D3	200	P=	

Cell A2 and A3 holds the left side of the above equations. We are assuming that the value of Q is in cell D2 and value of P is in cell D3. The objective of this problem is to make cell A2 = B2 and cell A3 = B3 by changing cell D2 and D3 which are the values of Q and P.

To solve the equation select Data >> Analysis>> Solver

In the solver dialogue box that appears, under "By changing cell:" select the cell range D2:D3. Then under "Subject to the Constraints" click Add .
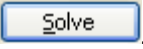
In the Add constraint dialogue box make cell reference A2:A3 = B2:B3 as shown below
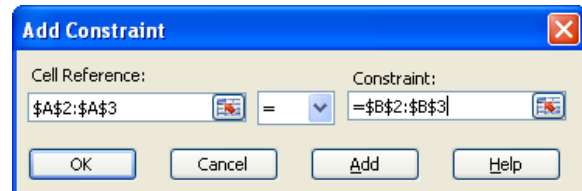
Click OK .

Your Solver parameter dialogue box would look like this:
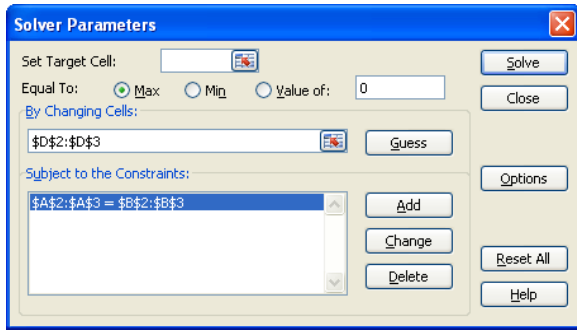
Click .

You will see the value of Q and P as:

	A	B	C	D
1	Equations	Constants		
2	150	150	Q=	100
3	200	200	P=	50

Solution with constraints

You have a dairy farm and want to develop a balance ration at minimum possible cost. To make a problem simple let's assume that you have only two choices of feed mix; corn and soybean meal. Protein and carbohydrate contents are crucial in the ration. Following information is available for feed choices:

	Protein	Carbohydrate	Cost/lb
Soybean	65%	10%	0.35
Corn	8%	70%	0.25

The recommended minimum protein and carbohydrates intakes are 4 and 7 lbs respectively. What amount of Corn and soybean meal would you mix to meet the recommended protein and carbohydrate yet keep your cost as low as possible? Neither soy meal nor corn can be a negative amount.

Answer:

Set your work sheet as:

	A	B	C	D	E
1		Amount	Cost	Constraints	Constants
2	Soy=		=B2*0.35+B3*0.25	=B2*65%+B3*8%	4
3	Corn=			=B2*10%+B3*70%	7
4				=B2	0
5				=B3	0

Set the solver as:
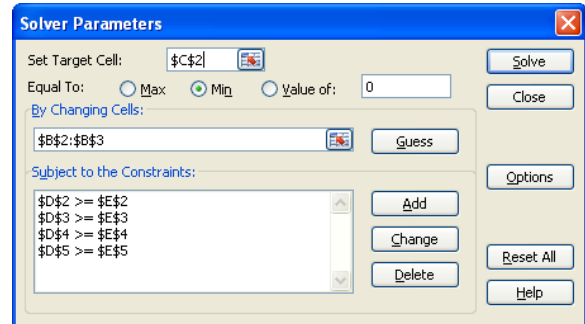
In other words, minimize cost = Soy*0.35+Corn*0.25 by changing feed amount subject to constraints.

Protein (= Soy*65% + Corn*8%) >= 4
Carbohydrate (=Soy*10% + Corn*70%) >= 7
Soy >= 0
Corn >= 0

After you click solve, you should see the solution:

	A	B	C	D	E
1		Amount	Cost	Constraints	Constants
2	Soy=	5.0	4.07	4	4
3	Corn=	9.3		7	7
4				5.0	0
5				9.3	0

Fill handle

When it comes to copying formula to adjacent cells, it is quicker to use fill handle than copying and pasting. When you select a cell or a range of cells you will see a small black square at the lower right corner of the selection

Fill handle
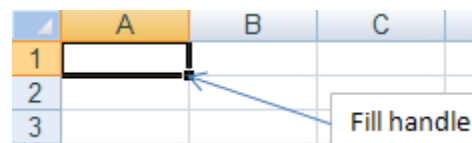
When you hover your mouse over that square it turns to a black ✚ sign like:
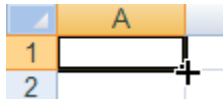
If you drag your mouse when your mouse pointer is still like ✚, the content of that cell is copied to adjacent cells. If you want to copy over several rows and columns, you have to fill one row or column first and drag again to fill entire selection of rows and columns. In the following example formula in cell B3 is to be copied to fill the entire table.

Fill a column or row first and then drag the entire selection of column to fill the entire table.

Fill handle can also to used to fill a series like 1, 2, 3; 1, 3, 5...; 2, 4, 6... January, February, March etc. To fill a series with constant difference, enter the first two entries in the series, then select both cells and drag. For example to fill a series 2, 3, 4 with difference 1, enter first two numbers and select both cells like:
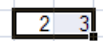
Now drag the fill handle to fill the series like:
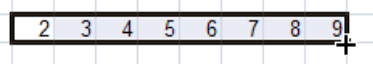
To fill a series like days of the week and month name you do not have to enter two entries. Just one entry is sufficient for excel to understand that you want to fill the months or days like:

As you may have noticed the list does not have to start from January or Sunday.

In addition, Excel is smart enough to keep the original formatting such as if you drag the day of the week with only three letter it will create a list like this:
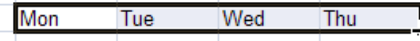
If you type all capital, it will keep all capital as:
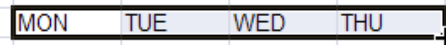
You can also create a custom numbering with preceding text such as Item 1, Item 2...and so one. To do that , just type static text followed by a number. Some of the example list are:

Notice that Excel keeps the original formatting and style of copied numbers. The last column needs first two entries as numbering distance is not 1.

In addition to built-in list like weekdays, you can create your own custom list from Excel options. Office menu >> Excel options. Under popular tab select Edit Custom Lists... .

Example a list of your xyz club members as: Alice Sepal, Barbara Henderson, Joe Cooper, Judy Nelson, and Karen Stevenson.

Once you create the list, you type any name in the list on any cell and use fill handle to fill the series. Try using all UPPERCASE or lowercase to verify that it keeps the original formatting.

Viewing page properties

Since worksheet in an object it has associated properties. To view the page properties you need to make developer tab visible from office menu >> Excel

Options >> Popular and under Top options for working with Excel, check Show developer tab in the ribbon. ☑ Show <u>D</u>eveloper tab in the Ribbon

Click Ok, then under Developer tab that appears, Click Controls>> Properties.
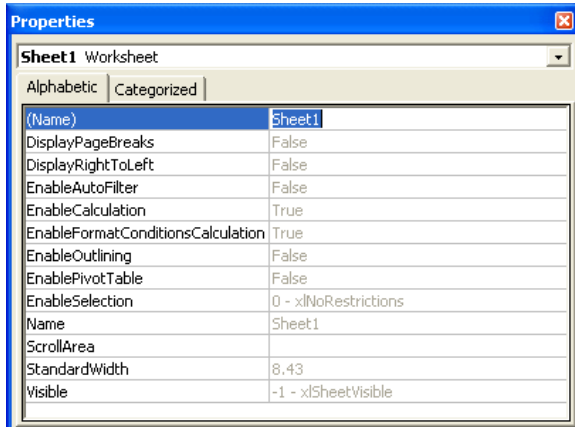
Among several other, the important one you should know about are:

Scroll area: *Scroll area defines the scrollable area in a sheet. When putting together a worksheet for others to use, you may want to limit the cells that the user can access.*

- *Place the insertion point in the box to the right of the ScrollArea property.*
- *Enter the range in which you want navigation possible. For instance, if you want the user to only be able to access the cells in the range A1:Z100, then enter that range.*

EnableCalculation: *This property must be true or else Excel worksheet will not calculate at all. Try turning this property to False.*

Review Questions

1. *How can you view two worksheets simultaneously?*
2. *How can you prevent a row 1 and column 1 from scrolling out of the view?*

3. *If you want to see how a page would look before printing which view would be the best?*
4. *If you want to adjust some columns or rows to fit within a page, which view would be helpful?*
5. *How can you limit the scroll area in Excel?*
6. *What is circular reference?*
7. *Could you do iterative calculation in Excel? If so how?*
8. *What is Goal Seek? When do you use goal seek in Excel?*
9. *What is Solver, how do you activate solver Ad-in in Excel?*

Practice problems

1. *Use fill handle to generate a sequence 1, 3, 5, 7, 9, ..., 15.*
2. *Use fill handle to generate a sequence Sun, Mon, Tue,...Sat.*
3. *Create a custom list with your friends' name. Use fill handle to fill in the names. Try using upper case and lower case letters.*
4. *Create a custom list of some common crops grown in Idaho.*
5. *Generate a sequence of numbers 1, 2, 3, ..., 10 in the range A1:A10. Use SUM function to add cells A1 to A10 in cell 11.*
6. *Use AVERAGE function to average cells A1 to A5 and cell A8 with above numbers.*
7. *Jack want to get an average of 80% to get at least "B" grade. He has 75, 76, and 81 in previous 3 tests. One final test is left and the final grade is going to be the average of four tests. How much he should secure in final to get average of 80%? Use goal seek to answer this question.*
8. *In previous question, the first test worth 10%, second test worth 20%, the third test worth 30% and final worth 40%. Now how much he has to score in final to get 80%?*

9. Using goal seek, solve the following equation for x

$$\frac{2-x}{x} \times 100 = 20$$

10. Using goal seek, solve the following equation for x

$$20 = 100 \times \frac{x}{2+x}$$

11. Cost of a owning a farm equipment consists of fixed cost and variable cost. For example owning a field sprayer cost $2000/year in mortgage payment plus $10/acre for field operation. Hiring costs $500 flat rate for overhead plus $13/acre of operation. As a farm manager, you are interested in knowing the acreage of farm to have a break even. Use goal seek or solver to find the answer.

12. At what temperature both Celsius and Fahrenheit will have equal reading? Use goal seek or solver to answer this question. (Hint, $C = \frac{5}{9}(F-32)$, when C and F are equal you can assign C = F = X and use the equation $X = \frac{5}{9}(X-32)$, then solve for X)

13. Wheat yield is given by the function $Y = 50 + 0.7x - 0.004x^2$ where, Y is yield in bushels and x is the pounds of nitrogen per acre. Using solver find out what amount of nitrogen gives you the highest yield. (Ans: Maximum yield of 87.5 bu/ac at 80.6 lbs of N/acre)

14. Using Excel Solver, Solve the system of following linear equations for x and y:
$$y - x = 2$$
$$5x - y = 6$$
(Ans: x=2, y = 4)

15. Using Excel Solver, Solve the system of following linear equations for x, y and z:

$$x + 2y + 3z = 14$$
$$x + 3y + 3z = 16$$
$$x + 2y + 4z = 17$$
(Ans: x=1, y = 2, z=3)

16. Using Excel Solver, Solve the following problem:
Maximize: 5x+4y with constraints,
$$x + y \le 6$$
$$-2x + y \le 4$$
$$5x + 3y \le 15$$
$$x \ge 0 \; and \; y \ge 0$$

17. A dairy farm produces four types of cheese: Cheese1, cheese2 cheese3 and cheese4. The producer has three machines A, B and C to produce the cheese. The production rate in lbs/hr of each cheese in each machine is given in the following table. Assume that each machine can be used only up to 50 hours per week and the hourly operating cost of machines A, B and C are $3.20, $6.00, and $9.00 respectively. Suppose the farm can sell 1000, 800, 600 and 600 lbs of cheese1, 2, 3 and 4 per week.

Machine	Cheese (lbs/hr)			
	1	2	3	4
A	30	25	20	10
B	60	40	35	20
C	80	70	60	30

Using solver, figure out which machine should be operated how many hours making which cheese to produce enough to meet the demand yet keep the machine cost to a minimum.

Answer:

Machine	Cheese			
	1	2	3	4
A	0.0	32.0	0.0	0.0
B	16.7	0.0	0.0	30.0
C	0.0	0.0	10.0	0.0

Hours each machine should be used to
producing cheese
Total machine cost = $ 472.40

Chart -Fundamentals

Objective of this class is to understand different chart types and the way the data is presented. Particularly after this class you should be able to understand:

> ➢ *when to use which kind of chart*
> ➢ *The difference between a line diagram and a scatter plot.*
> ➢ *The difference between 2-D and 3-D charts.*
> ➢ *Understand the essentials of a good chart.*

One of the most frequent uses of Excel is to create a chart. A good chart is indispensable in presenting your data, data trend and making your point convincing. A chart is important because people remember a picture more than a bunch of numbers. Chart makes data comparison easier and makes the data trend obvious. Microsoft Excel supports many kinds of charts to help you display data in ways that are meaningful to your audience.

> The main objective of a chart is to convey information effectively. Do not put anything in a chart that does not add to its clarity. For example: By default Excel inserts a legend box. Never put a legend in a single data series plot.

Most frequently used chart types and their uses are discussed in the following sections.

Column/Bar charts

A column/Bar chart shows data changes over a period of time or illustrates comparisons among items. Bar chart is same as column chart except that bars are horizontal. Column or bar charts have the following chart sub-types:

- **Clustered**   This type of chart compares values across categories. It is also available with a 3-D visual effect. As shown in the following chart, categories are organized horizontally, and values vertically, to emphasize variation over time.
- **Stacked**   This type of chart shows the relationship of individual items to the whole, comparing the contribution of each value to a total across

categories. It is also available with a 3-D visual effect.

- **100% Stacked**   This type of chart compares the percentage each value contributes to a total across categories. It is also available with a 3-D visual effect.
- **3-D** This type of chart compares data points (data points: Individual values plotted in a chart and represented by bars, columns, lines, pie or doughnut slices, dots, and various other shapes called data markers.) Data markers of the same color constitute a data series. 3D type is only available in column chart and not in bar chart.
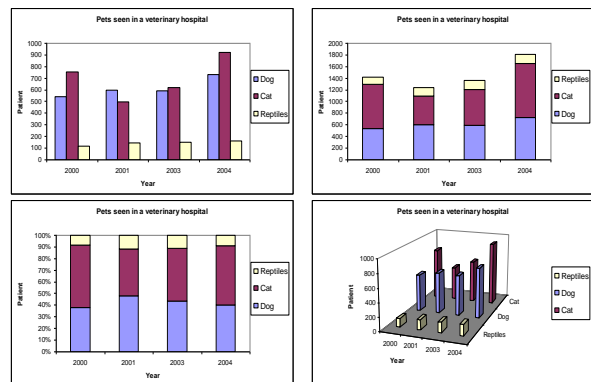
Besides only flat looking rectangles (2D columns) for column chart, you have an option to change the rectangles to appear as 3D columns, Cylinder, Cone or Pyramid. However bear in mind that selecting different shapes for columns does not add any more information to your chart. It may be even not acceptable in many formal graphs. So stick to simple 2-D column unless there to a strong need to go for other.

Line /Area charts

*Line chart is same as column chart except it connects the actual data points instead of making a column. Area chart is also similar to line chart in terms of the information content in the chart. L*ine chart is used to show the ***trends*** *in data. Area chart is same as line chart except it fills the area with some color underneath the line. Line or area charts have the following chart sub-types:*

- ***Line / Area*** *This type of chart displays trends over time or categories. The line chart is also available with markers displayed at each data value.*
- ***Stacked Line / Stacked area*** *This type of chart displays the trend of the contribution of each value over time or categories. When you want to show the stacked graph, stacked area is more common than stacked line as it resembles building wall.*
- ***100% Stacked Line / 100% Stacked area*** *This type of chart displays the trend of the percentage each value contributes over time or categories. This type of chart is used in occasions when relative change in the component is more important than its absolute value.*

For the line type there is an option to show the lines as 3D line. However this is not frequently used.

Pie charts

A pie chart shows the size of items that make up a data series. It always shows only one data series and is useful when you want to show the relative proportion and emphasize a significant element in the data. Pie charts have the following chart sub-types:

- ***Pie*** *This type of chart displays the contribution of each value to a total. It is also available with a 3-D visual effect, as shown in the following chart (Commonly used).*
- ***Exploded Pie*** *This type of chart displays the contribution of each value to a total while emphasizing individual values. It is also available with a 3-D visual effect (Commonly used).*
- ***Pie of Pie*** *This is a pie chart with user-defined values extracted and combined into a second pie. For example, to make small slices easier to see, you can group them together as one item in a pie chart and then break down that item in a smaller pie or bar chart next to the main chart (Not frequently used).*
- ***Bar of Pie*** *This is a pie chart with user-defined values extracted and combined into a stacked bar.*

2-D Pie

3-D Pie
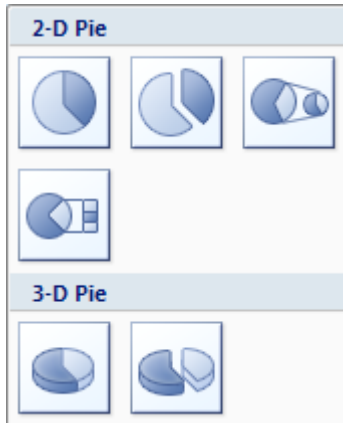
Scatter chart

An XY (scatter) chart shows the relationships among the numeric values in several data series, or
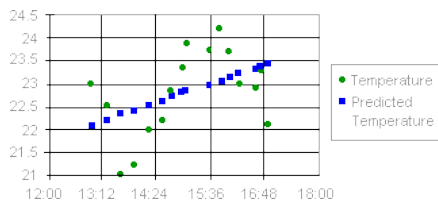
plots two groups of numbers as one series of XY coordinates. Do not confuse Scatter chart with line chart as they both may look similar; remember that line for trend, Scatter for relationship; Line can take non numerical values in x axis, scatter must have a numeric values in both axes. Scatter charts are commonly used for scientific data and have the following chart sub-types:

- *Scatter   This type of chart compares pairs of values. When you arrange your data for a scatter chart, place x values in one row or column, and then enter corresponding y values in the adjacent rows or columns. If you are intending to show a data-trend instead of merely connecting the data points, this is the chart type you want to select. Once the chart is created, a trend line can be added later.*
- *Scatter with Data Points Connected by Lines   This type of chart can be displayed with or without straight or smoothed connecting lines between data points. This chart looks much like a line chart but unlike line chart, a mathematical relation or trend line can be placed in scatter plot connected by line.*

Other charts

Besides standard chart types, Excel also provide some special charts stock chart, surface chart, doughnut chart, bubble chart and .
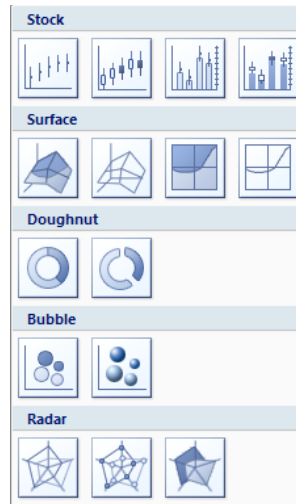
Stock chart

As its name implies, a Stock chart is most often used to illustrate the fluctuation of stock prices. However, this chart may also be used for scientific data. For example, you could use a Stock chart to indicate the fluctuation of daily or annual temperatures.

The way Stock chart data is organized in your worksheet is very important. For example, to create a simple high-low-close Stock chart, your data should be arranged with the stock names entered as row headings, and High, Low, and Close entered as column headings, as shown in the following picture.

	A	B	C	D
1		High	Low	Close
2	Fund 1	27.2	23.49	25.45
3	Fund 2	25.03	19.55	23.05
4	Fund 3	19.05	15.12	17.32
5	Fund 4	20.5	15.5	17.5

The high-low-close Stock chart below displays the price fluctuation for each stock.
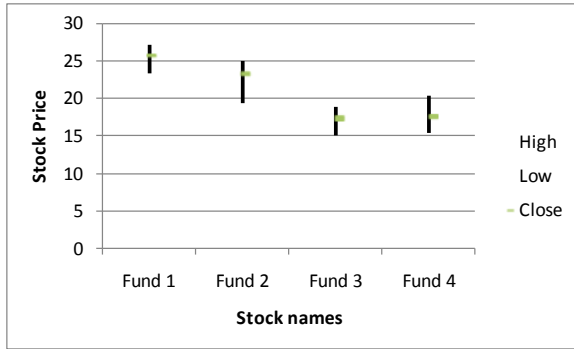
Surface chart

A surface chart is useful when you want to show the response of one variable depending on other two variable values. As in a topographic map, colors and patterns indicate areas that are in the same range of values. Surface charts have the following chart sub-types:

- **3-D Surface**   This type of chart shows trends in values across two dimensions in a continuous curve. For example, the following surface chart shows the various combinations of temperature and time that result in

the same measure of tensile strength. The colors in this chart represent specific ranges of values. Displayed without color, a 3-D surface chart is called a wireframe 3-D surface chart.
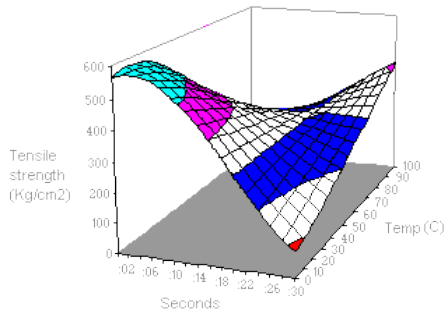
Doughnut chart

A doughnut chart is similar to a pie chart, with two exceptions: It has a hole in the middle, and it can display more than one series of data.

Data that is arranged in columns or rows only on a worksheet can be plotted in a doughnut chart. Just like a pie chart, a doughnut chart shows the relationship of parts to a whole, but a doughnut

chart can contain more than one data series. Each data series that you plot in a doughnut chart adds a ring to the chart. The first data series is displayed in the center of the chart.
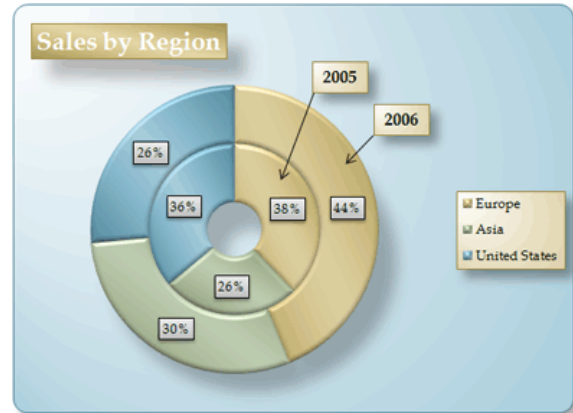
Because of their circular nature, doughnut charts are not easy to read, especially when they display multiple data series. The proportions of outer rings and inner rings do not represent the size of the data accurately — data points on outer rings may appear larger than data points on inner rings while their actual values may be smaller. Displaying values or percentages in data labels is very useful in a doughnut chart, but if you want to compare the data points side by side, you should use a stacked column or stacked bar chart instead.

Bubble chart

A bubble chart is a variation of a scatter chart in which the data points are replaced with bubbles, and an additional dimension of the data is represented in the size of the bubbles. Just like a scatter chart, a bubble chart does not use a category axis — both horizontal and vertical axes are value axes. In addition to the x values and y values that are plotted in a scatter chart, a bubble chart plots x values, y values, and z (size) values. Different bubble sizes are useful to visually emphasize specific values.

To create a bubble chart, arrange your data in rows or columns on a worksheet so that x values are listed in the first row or column and corresponding y values

and bubble size (z) values are listed in adjacent rows or columns. For example, organize your worksheet data as shown in the following picture.

Nitrogen	Yield (bu/ac)	# cases
5	30	1
5	40	4
25	45	2
25	50	3
50	60	2
50	70	3
75	75	4
75	85	1
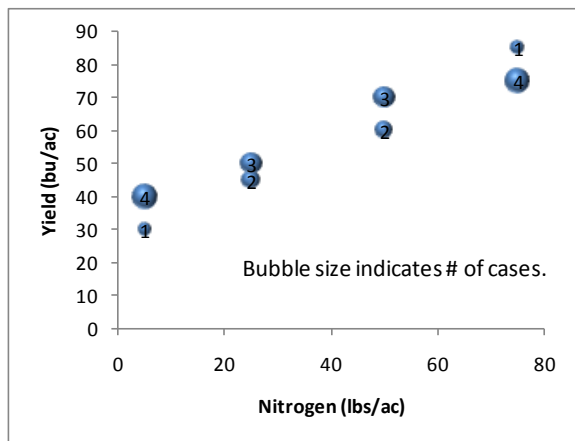
In this bubble chart, the number of nitrogen application is displayed along the horizontal axis, the yields are displayed along the vertical axis, and the number of cases is represented by the size of the bubbles. The marker labels are displayed to exclusively specify the # of cases.

Radar chart

In a radar chart, each category of values has its own axis radiating from a center point. Lines connect all the values in the same category series. Radar chart is used to show the cyclic data pattern. Another common use of radar chart is when you have the angle in x axis. Rather chart can be more intuitive

and easy to understand than regular charts. Following two examples demonstrate the use.

Natural gas consumption in MCFT (Source: www.eia.doe.gov)

Month	Year			
	1990	1995	2000	2005
January	1445	2375	3331	3792
February	1419	1760	2716	3278
March	1078	1503	2298	2365
April	630	1274	1695	2118
May	475	915	909	1155
June	360	539	633	752
July	173	338	438	503
August	160	254	349	379
September	186	304	484	537
October	349	628	859	923
November	896	1364	2147	1919
December	1397	1748	3272	3881

Idaho residential natural gas consumption (million cft)
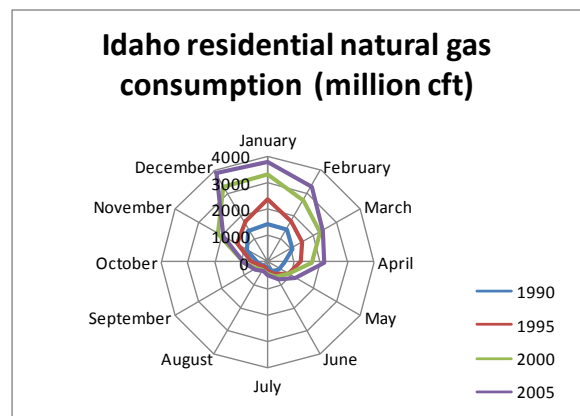
Internet links:

Link to tutorial: http://office.microsoft.com/training then search for

- How to create a chart in Excel 2007
- Choose the right chart type
- Charts for the scientist

Review Questions

10. Why chart is preferred for presenting data?
11. What is the difference between a bar chart and column chart?
12. What is the difference between line chart and area chart?
13. When do you use a pie chart?
14. When do you use a pie of pie or bar of pie chart?
15. What is the difference between a line chart and a scatter chart?
16. When do you use scatter chart over a line chart?
17. When do you use line chart over a scatter chart?
18. When do you use a stock chart? Give an example.
19. When do you use a surface chart? Give an example.
20. When do you use a doughnut chart? Give an example.
21. When do you use a bubble chart? Give an example.
22. When do you use a radar chart? Give an example.

Multiple choice questions

1. A chart is important because
   a. People remember a picture more than a bunch numbers.
   b. Chart makes the data comparison easier.
   c. Makes the data trend obvious.
   d. All of the above
2. Bar chart and column chart carries the similar information.
   a. True
   b. False
3. Line chart is better choice over column chart to show the data trend.
   a. True
   b. False
4. Pie chart can represent only one series of data.
   a. True
   b. False
5. Pie chart is useful to show the date trend.
   a. True
   b. False
6. Scatter chart can have non numeric x axis like in line chart.
   a. True
   b. False
7. Scatter chart is preferred when relationship between x and Y axes are important.
   a. True
   b. False
8. If you need to vary the size of the data points in scatter plot according to its importance, you would use
   a. Line chart
   b. Surface plot
   c. 3-D line chart
   d. Bubble chart
9. If you need to show the maximum, minimum and average value of data points, you would probably use
   a. Stock chart
   b. Surface plot
   c. 3-D line chart
   d. Bubble chart
10. When you want to present a cyclic data, you would consider using
   a. Bubble chart
   b. Surface chart
   c. Radar chart
   d. Scatter chart

Chart-Objects

Objective of this class is to understand chart objects. After this class you should be able to:
- ➢ *Use a right kind of chart for your data in hand.*
- ➢ *Modify Excel default chart to create a professional chart.*
- ➢ *Use and modify chart objects effectively*

Excel includes a powerful and versatile charting engine to create professional charts. However, default chart you from excel is seldom looks professional. The easiest way to create a chart is to select some data-or a single cell within a data block- and from Insert >> Chart >> Select a chart to create. You can create a chart within few seconds using this feature. However, producing a good chart may take some practice and understanding.

Example: Create a chart with following data.

Average production of three farm locations:

Crop	Ada	Payette	Owyhee
Wheat	100	125	150
Corn	130	180	150
Russet	550	500	450

Wheat and corn are in bu/ac, Russet potatoes are in cwt/ac

1. Select entire table or just click on a single cell
2. Select Insert >> Chart >> 2D clustered column.

You will see the following chart.
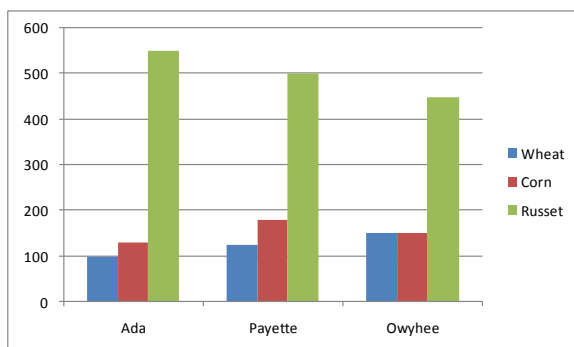
This is the default chart that Excel has created from the data. Once you have a default chart you can change the chart as you like. The next section discuss about the chart objects to understand how a chart can be viewed and edited as an object.

The chart object

A chart in essence can be viewed as an object that comprises several sub objects. A chart as a whole is called chart area which is in essence is empty area placed on top invisible layer of an Excel worksheet.

All other chart objects are placed on top of chart area that makes up an entire chart, such as:

1. Plat area: is the part of your chart that displays data.
2. Chart title
3. Axis titles
4. Legend
5. Data labels
6. Data table
7. X-axis (or horizontal or category axis).
8. Y- axis (or vertical or value axis).
9. Data series: is actual plotting of a series of data points.
10. Gridlines

Not all charts will have all the objects listed above. For example a pie chart will not have x and y axis. While some chart may have additional objects such as a trend line and equation.

Settings of an object property or attribute are called formatting. A chart can be modified at two different levels. The higher level of designing a chart is called a design and lower level of controlling an object is called layout.

Design is a set of objects (Layouts) and their predefined formatting for a chart. It is a handy and quick way to change which object will and will not be included in a chart. With layout, you can control the properties of an individual object.

Caution: If you change the chart design after you fine tune your charts with Layouts, the objects that are not in selected design will be discarded.

To change a chart in design level, select a chart and you will see a context sensitive "Chart Tools" namely **Design, Layout and Format**.

Design

Design can be used to control the overall appearance of chart in a higher level.

Type and data
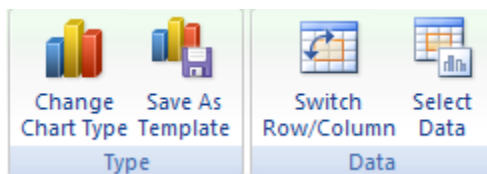
Under design tab, Type and Data are same for all kinds of chart. From type you can either change the chart type for a selected data, or save the current chart as template so that all future charts can be formatted as the current chart.

Exercise: Change the chart type to column stacked, 3D clustered and cylinder clustered see which one is easier to read.

Use "Switch Row/Column" to swap a column as a data series to row as a data series. Try switching row and column to decide which one you make data series and which one in category? In above example, if you want to compare the productivity of each county you would put county in x axis. If you want to compare which crop is better in which county, you would you crop in x-axis.

"Select Data" can be used to change the series name in legend or cluster name in x-axis. For instance if you want to change the legend to Wheat, Corn and Potato, click on Select data and then select Russet. Click on edit and change the series name to Potato as
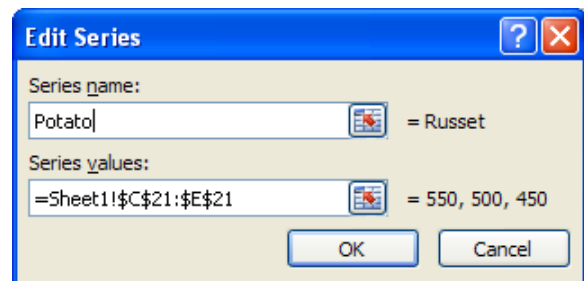
Click OK. You should see the legend has been changed to Wheat, corn and Potato.

Chart Layout

Overall layout of the chart can be controlled from this group. The choice depends on the chart type you have selected. On each layout options available you will see a bird eye view of chart layout. Click on drop down box to see more options.

If you do not see the layout options you are looking for select the one that has more or closest to the one

you are looking. It is not difficult to change the existing objects or add more objects on a chart.

Chart styles

A chart style is a collection of color and fonts predefined for a chart. The style options depend on chart type you select but in all cases it is helpful to give your chart a professional look and feel by changing the color coordination and font style.

Move chart

You have an option to plot a chart as an object on a particular worksheet or create its own sheet called chart sheet. Use this group to move a chart to its own sheet or as an object on a sheet.

Layout

Layout allows you to insert an object one at a time. Or view and select the objects on the chart. Selecting an object off of a list could be very useful when the objects are too close or the object is obscured because of overlay.

Current selection
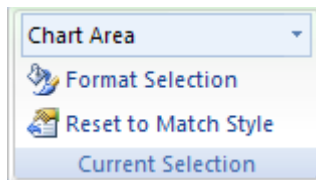
Current selection allows you to select an object from a list and change the formatting of the selection. Practice using this selection method to select a series of corn data.

Once an object is selected, you can click on format selection to change the formatting. In case you do not like the formatting you've changed click on "Reset to Match Style" and the default properties for that type will be applied. Any changes you've made will be discarded for selected object.

This current selection group is visible from both Layout and Format tabs.

Insert
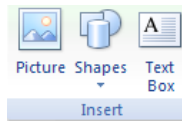
You can insert objects like picture, textbox and shapes. When you insert a shape or any drawing object, the chart area acts as the drawing canvas. When you select a shape to format context sensitive "Format drawing" tab papers. This tab is equivalent the format tab for drawing in Microsoft Word.

Labels
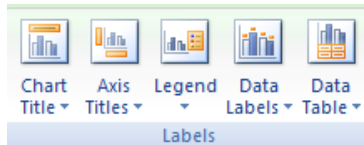
Labels are placed on a chart to describe what is what such as chart title, axis title, legend, data labels and data table. It is strongly recommended to put axis titles and units if applicable to all charts. Too often units are omitted from the chart making the chart incomplete in information it carries.

Once you add an object onto a chart, the object is listed under current selection group. The data label for a series could be value, series name or category name. Once you insert data labels you can edit the labels by selecting and changing the text except Legend and data table entries. To change the legend entry you must change the series name from Design tab >> Select data. Data table entry can only be changed by changing the actual data.

Axes
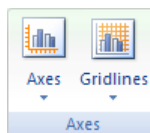
From axes group you can turn on or off any vertical or horizontal display. In addition depending on axis type (Numerical or text) you can adjust the minimum and maximum value, number formatting, change the scale (such as log scale) and define the units. You can also decide where the other axis will cross on the selected axis. More formatting option will be discussed under format menus discussion.

As name indicates Gridlines button allows you to hide and unhide chart gridlines.

Background
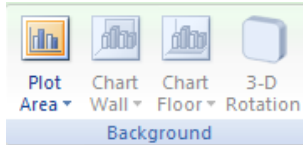
By default plot area (Part of your chart that displays data) is transparent. You can add a different color only to plot area. Chart wall, chart floor and 3-D rotations are not applicable for 2-D chart and are grayed.

Analysis
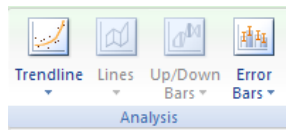
Analysis allows you to add trend lines and error bars on your data plot.

A trend line is a line that describes the general tendency of a data series. It can be a moving average, a linear-regression line, or a line generated by one of various kinds of nonlinear curve-fitting methods.

With a trend line you have an option to display equation and R^2 value on chart. When a trend line is inserted for a column chart or line chart, the horizontal category is always taken as value 1, 2, 3 regardless of what is displayed. Therefore displaying equation on a chart for a line chart does not make much sense and could rise to confusion.

Format

As described earlier, format is the properties of chart object. Properties can be changed from current selection group from any of Layout or Format tabs by selecting an object and then clicking on Format selection. However, Format tab provides some additional quick formatting options such as Shape styles, WordArt styles, shape arrangement and size. These features are obvious once you try them and intuitive to use. Special formats that are frequently used in a technical chart are discussed below:

Assigning a Series to a Secondary Value Axis

A secondary value axis makes it possible to plot series that fall within widely divergent value ranges. The secondary axis, usually positioned on the right side of the chart, can have a completely different scale from the primary axis. You can assign as many series as you like to the secondary axis. To switch a series from the primary axis to a secondary axis (creating the secondary axis in the process if you don't already have one): select the series, then from "Format Selection" under Layout or Format tab (or right click >> [icon] Format Data Series...

Under "Series Options" select Secondary axis option button.

Example:

Following table shows the yield and profit as a function of applied nitrogen level in lb/ac.

Nitrogen	Yield (bu/ac)	Profit($/ac)
0	40	-0.2
25	60	0
50	70	0.7
75	75	0.9
100	77	0.4

Plot a scatter plot with smooth lines.

Without a secondary axis the chart will look like this.
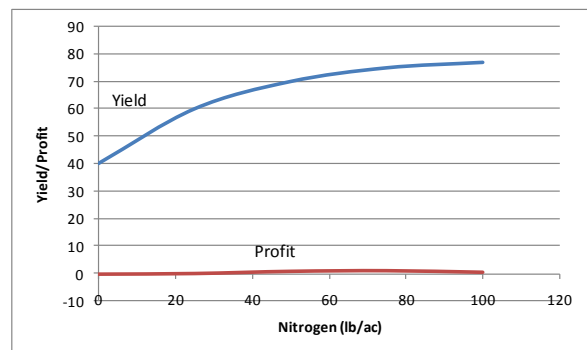
To create profit in the secondary axis:

1. *Select the series by clicking on it or from Layout >> Current selection, select "Series Profit ($/ac)"*
2. *Under same group click Format Selection*
3. *Select Series options >> Secondary axis*

When profit is plotted in secondary axis, the profit values are easily readable and the trend of the profit line is obvious.
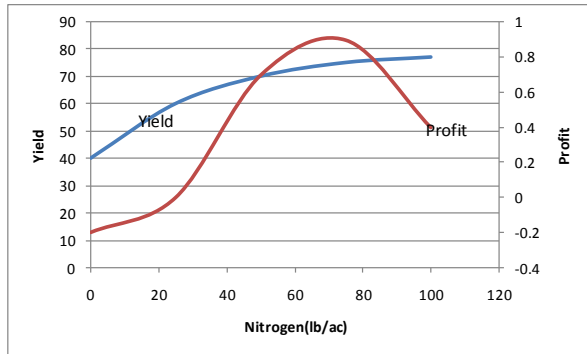
Using Two or More Chart Types in the Same Chart

You can create many different kinds of overlay charts in which you have plotted one or more data series in a chart type that contrasts with the remaining data series.

To change the chart type that you have assigned to a series, select the series, choose Chart, Chart Type, and select from Excel's chart-type gallery. Be aware that Excel cannot overlay certain subtypes over other subtypes. For example, you can't combine a three-dimensional area chart with a two-dimensional column chart. You should also realize that certain permitted overlays don't work aesthetically.

Example: Following table shows the expected and actual profit of a farm in thousands. Create a mixed plot as shown below.

Quarter	Projected	Actual
Jan-Mar	2	1.8
Apr-Jun	3	2.5
Jul-sep	1	1.5
Oct-Dec	3	3

Steps:

1. *Create a column chart*
2. *Select the series projected*
3. *From Design>>Current Selection >> Change chart type to line*
4. *Add axis titles from Layout>> Labels*
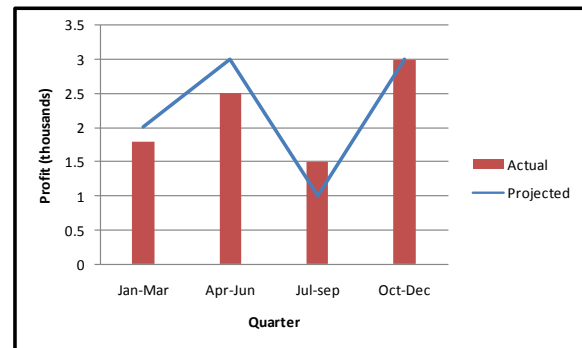
1. *Land Use of selected big countries of the world is given in the following table:*

Country	Area (km^2)
Russia	17,075,400
Canada	9,970,610
USA	9,629,090
China	9,598,050
Brazil	8,547,400
India	3,287,260

Create the following chart from above data.

Area comparison of selected big countries in the world

Russia	17.1
Canada	10.0
USA	9.6
China	9.6
Brazil	8.5
India	3.3

Area in million sq. km

Countries
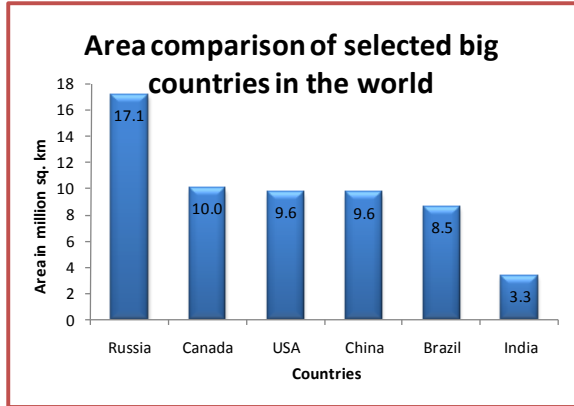
2. Comparative size of seven continents is given in the following table. Create a chart as shown below.

Continent	Billion acre
Africa	7.5
Asia	7.9
Europe	5.7
North America	5.6
South America	4.4
Australia	1.9
Antarctica	0.2

Size of North America compared to other continents

- Antarctica 1%
- Australia 6%
- South America 13%
- North America 17%
- Europe 17%
- Asia 24%
- Africa 22%

Total area of the world = 33 billion acre
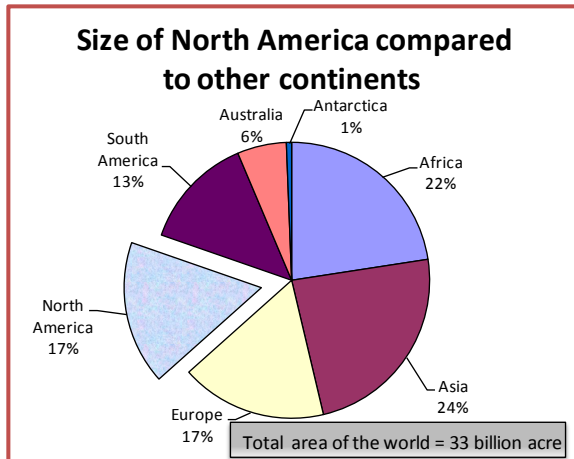
3. Temperature data for Ames Iowa in January 2000 is given in the following table. Create a chart as shown below.

Day	TMAX	TMIN
1	-8.9	-20.0
2	-2.2	-17.8
3	-3.9	-11.7
4	-8.3	-21.1
5	-18.9	-25.0
6	-18.9	-26.7
7	-10.6	-22.2
8	-12.2	-18.3
9	-14.4	-23.3
10	-6.1	-22.2
11	-1.1	-7.8
12	1.1	-13.3
13	-10.0	-22.2
14	-0.6	-17.2
15	3.9	-9.4
16	4.4	0.6
17	2.8	-2.8
18	-0.6	-2.2
19	1.1	-1.7
20	0.6	-8.3
21	-5.6	-10.0
22	-2.2	-11.7
23	0.6	-12.8
24	0.6	-16.1
25	0.0	-21.1
26	-11.1	-23.3
27	-1.1	-14.4
28	1.7	-9.4
29	9.4	-3.9
30	11.1	3.9
31	7.8	-9.4
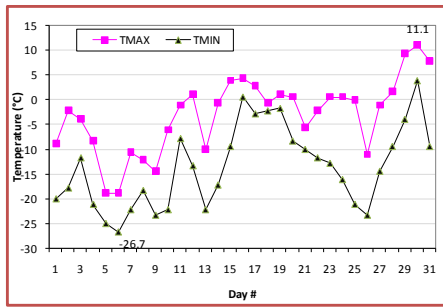
4. *Produce a chart as follows (specified in highlighted boxes) from the following data.*

Engine RPM	Torque (lbs-ft)	Engine Power (hp)
1190	158.9	36.0
1375	183.3	48.0
1500	199.6	57.0
1750	204.1	68.0
1875	200.3	71.5
2000	189.1	72.0
2125	187.8	76.0
2250	180.7	77.4
2375	174.7	79.0
2500	159.7	76.0
2625	148.1	74.0
2690	140.6	72.0
2700	132.0	67.9
2900	121.2	66.9
2946	110.2	61.8
3051	100.5	58.4
3147	90.4	54.2
3244	80.2	49.5
3354	70.9	45.3
3456	61.0	40.1
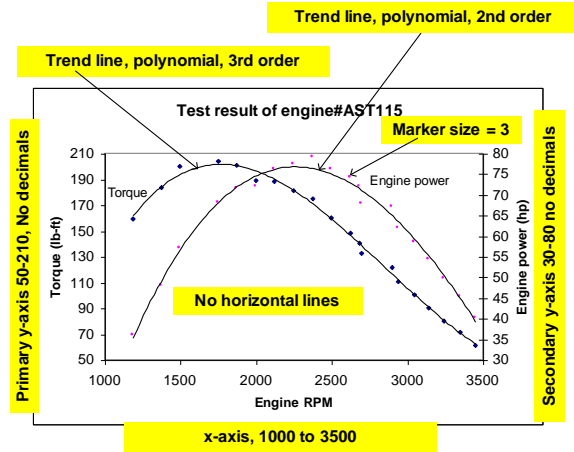
5. *Microbial count from a carcass sample was determined as follows. Create a chart as shown below.*

Time (hrs)	Microbial Count
0.0	125
0.5	267
1.0	508
1.5	1,357
2.0	1,989
2.5	5,165
3.0	3,122
3.5	11,279
4.0	21,066
4.5	20,433
5.0	103,648
5.5	107,475
6.0	739,680
6.5	487,479
7.0	1,899,437
7.5	3,254,354
8.0	3,678,591

Microbial Count

$y = 127.8e^{1.310x}$

6. Farm Income data is given below. Use picture of a dollar (Use clipart to find a picture of a dollar) as the image inside columns. Change the background color and line color to your taste.

Year	Actual	Projected
2000	23000	24000
2001	24600	25000
2002	22900	22000
2003	24500	26000
2004	26000	25000

7. The equation of the standard normal distribution is given by the equation:

$$y = \frac{1}{2\pi} e^{-\left(\frac{1}{2}x^2\right)}$$

Create a column for value of X from -3 to +3 at 0.1 intervals. Calculate the value of X using above equation. Plot the value of y for x. Your final chart should look somewhat like this. Feel free to modify the chart to make it more professional looking.

8. Following data is the past and projected crude oil price in $/barrel. Produce a chart like shown below to have two different types of line for projected and actual prices.
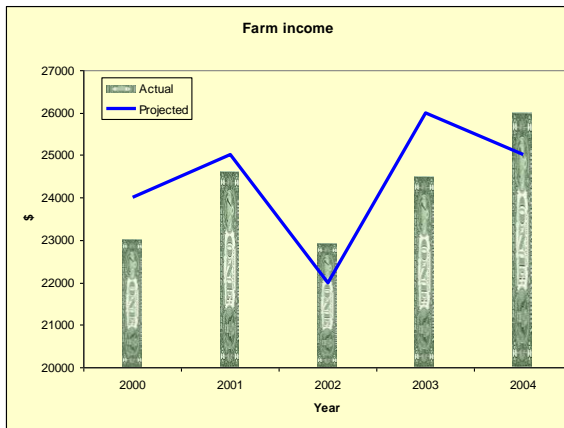
Year	Actual	Projected
1996	22.13	
1997	20.6	
1998	14.41	
1999	19.25	
2000	30.31	
2001	25.86	
2002	26.05	
2003	31.1	
2004	36	36
2005		40
2006		48
2007		53
2008		48
2009		60
2010		68

US Crude oil price

RPM	Diesel		Biodiesel	
1900	59	302	55	295
2000	57	307	53	301
2100	55	312	51	307
2200	52	314	49	309
2300	48	317	46	313
2400	45	315	43	312
2500	40	312	39	311

Power and Torque for Biodiesel Vs. Diesel Fuel

(Note: Two lines are two different series, so you can change their appearance independently)

9. *Following table shows the power (kW) and torque (Nm) an engine produced with biodiesel and diesel fuel. Create a chart as shown below from the data provided.*

RPM	Diesel		Biodiesel	
	Power	Torque	Power	Torque
1300	56	230	55	229
1400	59	250	57	248
1500	61	265	59	262
1600	62	277	59	275
1700	62	287	58	284
1800	62	295	57	290

(Note: your legend may be showing 4 entries, squeeze the legend box so that only two are showing for diesel and biodiesel)

Data Analysis -Fundamentals

Objective of this class is to understand how Excel can be used to visualize and analyze tabular database:

- ➤ Understand the basic elements of a database.
- ➤ Use Excel as a database program.
- ➤ Importing text data from external source.
- ➤ Validating data entry.
- ➤ Sorting and filtering data.

The field of information technology is suffering from information explosion. Development of faster computer and automation made it possible to collect hundreds of thousands of data every day. Think of the database that records each transaction of credit cards. An example from production agriculture is a dairy farm with automated milking system, the amount of milk produced by a cow, milk composition and other relevant data are measured and recorded automatically. Precision agriculture is a branch of agriculture which deals with the production optimization in the sub field level. Spatial information like soil texture, moisture content, and yield data are collected as small as every single inch of the field to build billions of records from a single agricultural field.

Database management system (DBMS) software such as MS Access and dBase is designed to simplify the storage and retrieval of large amount of data. It is a computer software tool that manages bulk data and helps extract useful information. Database managers provide a quick and efficient way to enter, sort, query data, and produce printed copies if desired.

Excel vs. Access

Strictly speaking Excel is not a database application. However, Excel is very powerful in analyzing data. Both Excel and Access, dedicated database program has many striking similarities.

But there are some limitations using Excel as a database that you should be aware of.

- Only one person at a time can enter data into the database although many users can access simultaneously in "read only" mode.

- An Excel workbook comprises sheets each having 16384 columns (256 in older versions) and 1,048,576 rows (65536 in older versions). If your database is bigger than that then Excel is not convenient to use.

- Excel cannot work with relational database. Relational database is a collection of data tables (more than one table) linked together with a common identifier field.

However if your database is simple and consists of a single table, excel can be more effective because of its pivot table capabilities discussed in the next chapter. Even if you have data stored in some other database program, you may prefer to import the data you are interested into Excel (using query) and use familiar tools such as formulas and pivot table for analysis.

Database Elements

We will discuss only about the tabular database in this discussion. All databases programs comprise four basic elements: TABLE, QUERY, FORM and the REPORT.

- ➤ **TABLE:** The TABLE is the basic element of all databases. Tables contain the data organized in FIELDS (data columns) and RECORDS (data rows).

To make managing and analyzing a group of related data easier, you can turn a range of cells into a defined Table (previously known as a List). There are several advantages defining data as table which are discussed later.

➢ **FORM**: The FORM (also called GUI or Graphical User Interface) is usually created to help users enter data in the tables of a database.

➢ **QUERY**: The query allows the user to extract specific data from a table or other database program. The result of a QUERY is a sub-database (sales for January, sales by product etc.). Using Microsoft Query, you can connect to external data sources, select data from those external sources, import that data into your worksheet, and refresh the data as needed to keep your worksheet data synchronized with the data in the external sources.

➢ **REPORT**: The report is the written presentation of an analysis of the data. It can be as simple as a list of records with sub-totals but it can also be a complex presentation of ratios and other calculated relations between the elements of the data. Excel provides very powerful tools to generate report from a database

Representing data (TABLE)

In Excel, a database is a set of columns and rows in your spreadsheets _without_ any empty rows and empty columns. Many cells can be empty but never an entire row or an entire column. Instead of row and column, each column is called a 'FIELD' and each row is called a 'RECORD". The first row in a database is called the title row.

<-----------------FIELDS-------------------->

V number	Student Name	CGPA
1024858	Mark Stinger	3.9
1057892	Jake Gano	2.8
1024589	Jim Faber	2.6
1025897	Tim Kinked	1.5
1025698	Brian Steward	4.0

RECORDS

You can also explicitly define your data as a Table. Defining as a Table is preferable as it provides you more functionality and easy operation.

Defining data as a Table

You can use table to manage your data. Defining your database as a table has few advantages they are:

1. By using the table features, you can manage the data in the table rows and columns independently from the data in other rows and columns on the worksheet.
2. The table range grows automatically as you add more records. If you have a report table linked to a table, the report will include new records.
3. If you have a chart based on a table, the chart will automatically update to include new records.
4. Formatting and removing duplicates are easier.
5. Creating calculated column is easier, as you have to enter only the first entry and the rest of the rows are automatically updated.

FORM

You can enter new data directly in the Excel sheet or use data input form. The form is not visible directly under and tabs as in previous versions of Excel but it can be placed on quick access toolbar.

From dropdown list of quick access bar select More Commands…. Select All Commands under category Choose commands from: then scroll down until you see Form… (Form...). Select the item and click Add >> .
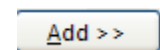
Now if you click anywhere on database and click on form you will see a form which can be used to enter or view any single record in the database.
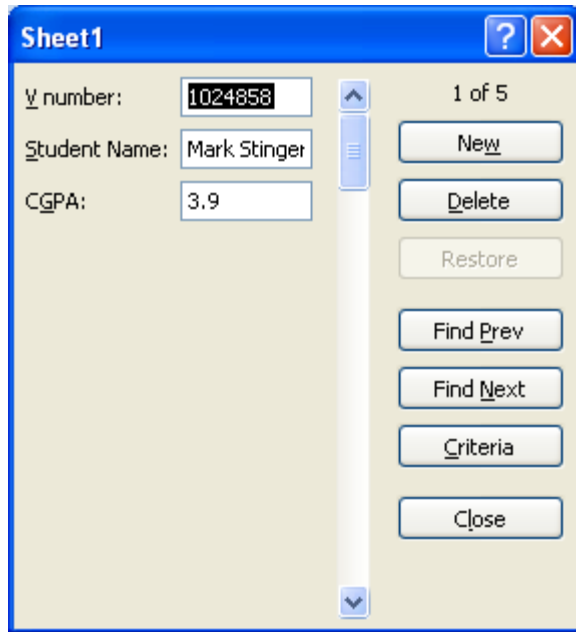
To enter data using a form, click new and enter new record in the corresponding fields. Press enter to add the record to the end of the database. You can also scroll to any record and then modify the entries using this form.

Importing data

Excel allows you to import data from different sources. One of the most frequently encountered one is the text file. In the text file usually each line make up one record and fields are separated by tab, comma, other special characters or it may be a fixed width fields.

Example:

Download **Milking cow data.txt** from the WebCt to your local drive. This file has data from a dairy production farm. Fields are separated by a comma (,) and records are separated by lines.

```
COW ID,Breed,TEST DATE,MILK(lbs/d) ,FAT %,PROTEIN %
A001,Ayrshire,5/20/2001,50.7,4.27,3.42
A002,Ayrshire,5/20/2001,49.1,4.11,3.18
A003,Ayrshire,5/20/2001,52.4,4.13,3.54
A004,Ayrshire,5/20/2001,55.9,4.48,3.34
```

To import data in Excel, from Data tab >> Get external data >> From Text. From the dialog box that appears, select the file.

Use the following settings in the Text Import Wizard for steps:

1. Check Delimited ; Start Import Row: 1
2. Delimiters: Comma
3. Leave column data format as General

Then select the upper left cell where you want the imported data to appear.

In Excel, from Data >> select Import External Data >> Import Data. In the Select Data Source dialogue box, Select Text Files from Files of Type: dropdown list. Point to your downloaded "milking cow data.txt". Follow instructions and when opened, Save it as Milking cow data.xls.

Entry Validation

When you enter data, it is possible to make a mistake. Excel provides with entry validation feature to check for some obvious errors. For instance, you can make sure that any entries in a Social Security number field have nine digits before the computer will accept them.

Not only the table but, you can use entry validation to any cell even if it is not a part of database. This may be desirable sometime. For example if you want the users of your Excel sheet to choose the payment plan for their loan amount (In terms of payback period). You can make a dropdown list for the users to choose from available options.

Example:

We would want the users to be able to select cow breed from a drop down list. That is, whenever someone clicks on any cell in column B, a drop down list should pop out to help select one of the breeds. To do that:

1. Select entire column B by clicking on column B when your cursor turns to downward arrow like .
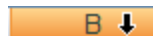
2. *From Data >> Data Tools >> Data Validation Under Setting tab Set Allow to List. On Source box type **Aryshire, Brown Swiss, Jersey.***
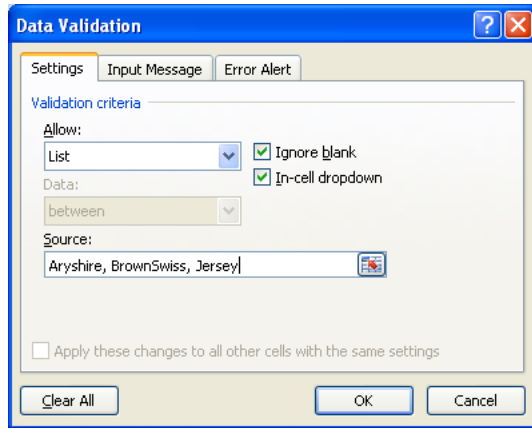
3.   *Input Message Tab can be used to inform the user about what is expected when they click on a cell. To display a message click on Input Message. In this box, "Title" is the title of the message like : "Breed selection". Input message could be like "Select a breed from dropdown list." If you have typed those in proper boxes, the following message appears when you select a relevant cell on the worksheet.*
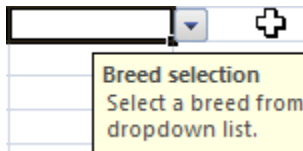
4. *Use "Error Alert" tab to set the level of restriction and warning message if the value entered is not within the specified range. For this example, we will set the "Style" to Stop. Set "Title" to **Incorrect Breed** Set "Error Message" to **You must select one of the breeds from dropdown list.** Then click OK*

After Error Alert setting, if the user enters a value that does not match with allowed value, an error message like this will pop up:
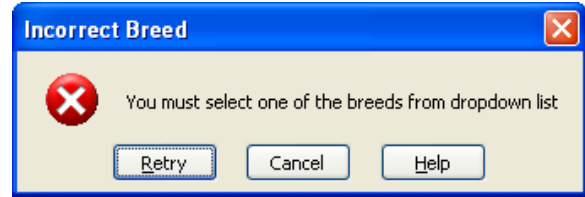
Similarly, make column C to accept a date entry not older than 30 days and not a future date. (Under "Setting" tab, select "Date"; Data to "between", Start Date to =TODAY()-30 and End Date to =TODAY() . You can use Excel functions in data validation box). Then in "Input message" tab, display a message as soon as column C is selected as shown below. If invalid data is entered it should display a

Warning (Not STOP) message telling the user the range of acceptable dates (come up with your own message).
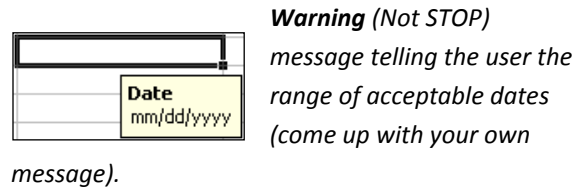
Similarly make column D accept a numeric value between 0 and 100 and display message like shown on right whenever column D is selected and display a warning message if the entered values is out of range. User can still enter the date that is outside of acceptable range

but it will display an information message telling the user that Milk production is usually within 100 lbs/day.

Also practice setting the appropriate range for Fat% (from 2 to 7%) and Protein % (2 to 4%).

Sorting and filtering

Sorting:

By rearranging data in a particular order, you can add up clarity and make some data like highest and lowest values obvious. Sorting is rearranging the rows in a particular order. You can sort text, numbers, or data in ascending order (A to Z, zero to 9, or earliest to latest date) in lists or tables. Or, you can sort in descending order (Z to A, 9 to zero, or latest to earliest date).

In order to sort records by any column, select the table column you want to sort and from Data tab, click on ![A-Z sort icon] *to sort from small to large,* ![Z-A sort icon] *to sort from large to small and* ![Sort icon] *to specify optional sorting criteria and multiple columns in case of tie between two entries.*

▊ *Filtering*

Filtering is a quick and easy way to extract records from a database that meet certain criteria, making it possible to manipulate the records as a group of their own - separate from the rest of the database. An example is extracting only the records from an address database where the Zip code is equal to 12345. This group of records could then be printed, sorted, copied, deleted, etc. Unlike sorting, filtering does not rearrange the list; instead it hides the rows containing the records that do not meet the criteria.

Auto Filter

When you define a data range as table by default, Excel inserts AutoFilter arrows ![dropdown arrow] *to the right of the column labels in the filtered range. You can turn off or back on this arrow by clicking on* ![filter funnel icon] *icon on Data tab >> Sort and filter.*

To auto filter a column, click on the drop down arrow and check off the categories you don't want to see. For example if you want to see only Jersey cows data, click on Breed drop down box and uncheck Aryshire and Brown Swiss. This will make only rows with Jersey breed visible and the drop down arrow will change to ![filtered dropdown icon] *indicating that the column has been filtered.*

	A	B	C
1	COW ▼	Breed ▼	TEST DAT ▼
2	J033	Jersey	7/25/2001
3	J047	Jersey	7/25/2001
4	J029	Jersey	7/25/2001
6	J023	Jersey	7/10/2001

You can also use custom AutoFilter to display rows that meet more than one condition for a column; for example, you might display rows that contain values within a specific range using Number Filter or date filter from drop down list.

When a database is filtered or "queried" essentially what happens is a statement is sent to the computer instructing it to "hide the records where the data in this field does not match the set criteria". Although this can be very handy, only basic queries can be performed. To display all data again click Clear (![Clear icon] *) under the Sort and Filter group.*

Advanced Filter

You can set a complex criteria[1] table to filter the data. A criteria range allows for more complex data filtering. All 6 standard Comparison Operators (=, >, <,<=,>= and, <>) and wild cards[2] can be used to set the criteria table. To set the criteria table, Spell out exactly the field heading for which you are specifying the criteria (To avoid typing error, use cell reference instead). Each column is combined with AND operator, each row is combined with OR operator. The Advanced Filter command (![Advanced icon] *) can filter a range in place like the AutoFilter command, or it can copy the filtered data to somewhere else.*

Example: Filter the milking cow that that satisfy the following criteria

---

[1] *Conditions you specify to limit which records are included in the result set of a query or filter.*

[2] **t = cat, at, hat, format etc; ?t = at, it but not cat, hat.; ~oil = phrase that does not contain the word oil. The characters such as *, ~ and ? are called wild cards.*

Breed is Jersey and milk production is either greater than 65 lbs or less than 45 lbs.

To specify this criteria, create the criteria table somewhere in worksheet (outside the database) as follows

=B1	=D1
Jersey	>65
Jersey	<45

And your criteria table will look like:

Breed	MILK (lbs/d)
Jersey	>65
Jersey	<45

This criteria table should be read as:

Breed = "Jersey" **AND** *MILK (lbs/d) > 65*
OR
Breed = "Jersey" **AND** *MILK (lbs/d) < 45*

If you omit the word Jersey in the second row, the criteria will read as:

Breed = "Jersey" **AND** *MILK (lbs/d) > 65*
OR
Any Breeds **AND** *MILK (lbs/d) < 45*

That means any breeds of cow with milk production less than 45 lbs will be displayed as well.

When you need to compare the values in two columns or value in a column to some number, you can use the relative cell reference of the first record to represent the entire column. Place an = sign to indicate that it is an expression and omit the field heading. For instance to display the records that has greater Fat% than Protein % for Jersey Breed in Milking Cow data you can use the criteria as.

=B1	=D1	
Jersey	>65	=E2>F2

The table will show

Breed	MILK (lbs/d)	
Jersey	>65	TRUE

Once you set up your criteria table, select any cell on your data table and click on Advanced (

Advanced). This way your List range (or data range) will be already filled out for you in the Advanced dialogue box. Now select the criteria table under criteria range box:
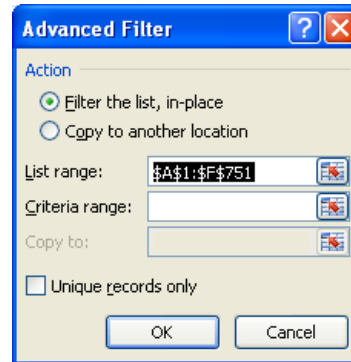
If you may want to copy the filtered records to a separate place, check Copy to another location radio button in Advanced filter dialogue box and entering in the cell address in Copy to box. If you want to display the filtered records in a different place, make sure you select that sheet before you do the advance filtering. Or else you will get an error message:
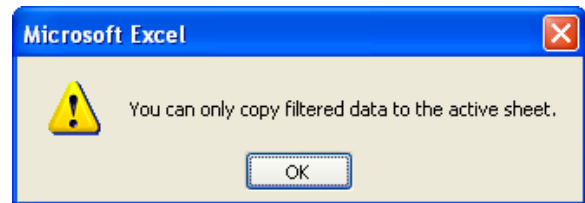
In this case you will have select data range (or type in name of data range) and criteria table yourself.

Review Questions

1. When Excel is a better choice over access to handle your database?
2. What are the four essential elements of a database program?

3. *Can you import external data into Excel such as from Access or Text File? If so how?*
4. *What is data validation? Can you use data validation to a single cell?*
5. *What happens when user enter an invalid data into a cell after you enable data validation?*
6. *How Sort is different from Filtering?*
7. *What is the difference between a auto filter and advanced filter?*
8. *What is criteria table when do you use it?*
9. *How do you set up a criterion in a criteria table that depends on two fields?*
10. *How can you copy the filtered data to a different worksheet? How it is different from copying data to same worksheet?*

Data Analysis –Pivot Table

> Objective of this class is to understand how Excel can be used to generate a report from a database suing pivot table and pivot chart:
> - ➤ Use Pivot table and pivot chart for dynamic data analysis.
> - ➤ Use database functions.

Report generation

PivotTable is the handiest form of report generation scheme in Excel. A PivotTable creates an interactive summary from a table. For our Milking Cow Data, we can generate a pivot table for average milk, fat and protein percentages for each cow breeds and test dates.

Example: Use Data >> PivotTable and Pivot Chart report to generate a tabular report for Milk average milk production from each breed of cow. Your table should look like this:

Breed	Average of MILK (lbs/d)
Ayrshire	56.48
Brown Swiss	56.40
Jersey	51.87

To create a report, select from "Insert" tab >> Tables >> PivotTable. You will see the "Create PivotTable" dialogue box as below:
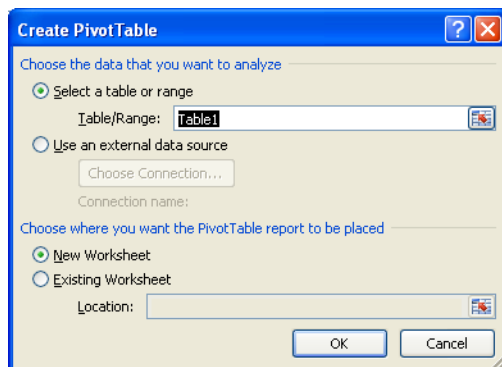
If you have selected one of the table cells before you start creating PivotTable you will see the name or the range of the table is already selected under "select a table or range" option button.

Click OK to create a PivotTable in a new worksheet. Creating a PivotTable in a new worksheet is a good idea because it does not messes up with data. By default you will see an empty table and a PivotTable field list (click somewhere inside PivotTable if you don't see the field list) as below.
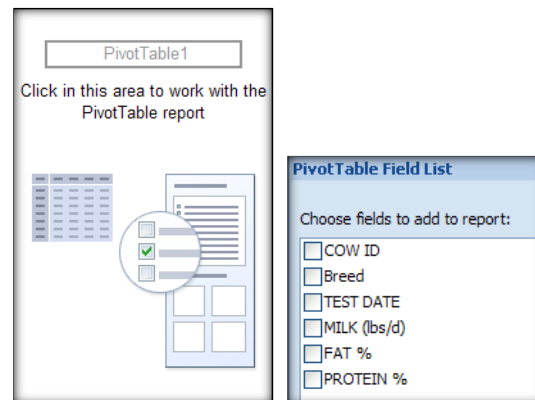
The fields (or column headings) are listed in task pane. Therefore, make sure that you have names for each column across the first row of the worksheet in the source data.

First thing in report generation is to ask yourself which fields are needed to generate the report. In this case you need Breed and Milk production column to calculate the average milk production for all breeds. So, select the Breed and MILK (lbs/d) fields by clicking on the check box next to the field name on the list. This will change your pivot table to:

Breed	Sum of MILK (lbs/d)
Ayrshire	14120.6
Brown Swiss	14101.1
Jersey	12966.5
Grand Total	41188.2

The order of checking the field list does not matter. Excel automatically puts text on lest side of table and calculates by default, the sum of the numbers under each category. The column heading SUM of Milk (lbs/d) is reflection the fact that SUM function has been used.

Changing from SUM to AVERAGE

To change from sum of milk production to average of milk production, select the pivot table by clicking anywhere inside the table and from Options tab under context sensitive Pivot Table Tools that appear, click on "Field Settings" (🔢 Field Settings) under "Active Filed" group. Then from the" Value Field Setting" dialogue box that appears, select "Average" as shown below and click OK.
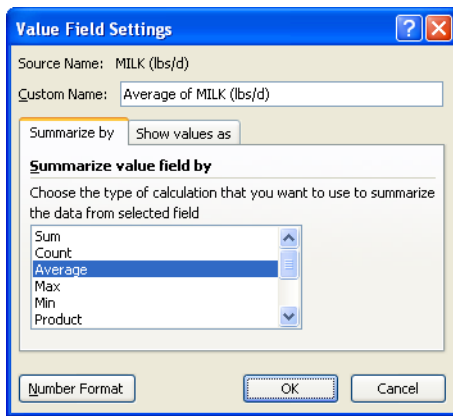
Alternatively right click on pivot table and from the quick menu that appears select "Summarize Data By" and select "Average".
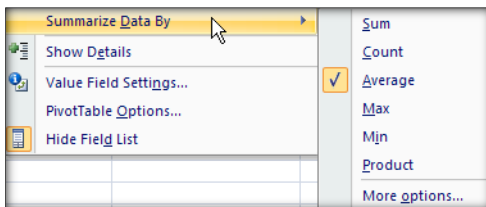
Notice that Filed setting is also available from right click menu as Value Filed Settings….

Removing Grand Total

You can turn grand total on or off using Pivot from "Pivot table options" dialogue box. This dialogue box can be invoked from Options tab >> PivotTable >> Options (🖳 Options ▾) or Right click on pivot table and select PivotTable Options (PivotTable Options…).

Then Click on "Totals & Filters" Tab and uncheck "Show grand totals for columns".
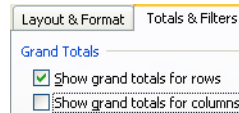
Calculating for sub category

Above example is perfectly useful in itself. Pivot table does not have to be complex to be useful. However if you need further analysis, such as breakdown of average milk production by date then you can add sub categories as easily too.

Breed	TEST DATE	Average of MILK (lbs/d)
⊟Ayrshire	5/20/2001	54.9
	6/5/2001	56.5
	6/25/2001	58.7
	7/10/2001	57.7
	7/25/2001	54.7
Ayrshire Total		56.5
⊟Brown Swiss	5/20/2001	54.5
	6/5/2001	56.4
	6/25/2001	59.0
	7/10/2001	58.3
	7/25/2001	53.8
Brown Swiss Total		56.4
⊟Jersey	5/20/2001	50.1
	6/5/2001	53.1
	6/25/2001	54.2
	7/10/2001	52.7
	7/25/2001	49.2
Jersey Total		51.9

To breakdown the average milk production by date, check the "TEST DATE" filed from field list pane and test milk production average has been sub categorized by date for each breed. PivotTable also adds subtotal rows for each breed. Notice that the sub totals are not the sum of averages, but the average of all each breed same as in the previous table we created.

If you don't need to display subtotals, select any cell under Breed Column and then from field settings set

"Sub totals" to "none". Or right click on breed column and uncheck "Subtotal Breed". Right click provides a context sensitive menu items.

Order of selection

When you have a subcategory, the order of selection does matter. The field you select first will be the main category and the field you select later will be the subcategory. However, you can change the hierarchy either by changing the order of selection or right click on field you want to move. From the menu that appears click on "Move…" and select "Move to Right" or left for that purpose.

TEST DATE ▾	Breed ▾	Average of MILK (lbs/d)
⊟5/20/2001	Ayrshire	54.9
	Brown Swiss	54.5
	Jersey	50.1
⊟6/5/2001	Ayrshire	56.5
	Brown Swiss	56.4
	Jersey	53.1
⊟6/25/2001	Ayrshire	58.7
	Brown Swiss	59.0
	Jersey	54.2
⊟7/10/2001	Ayrshire	57.7
	Brown Swiss	58.3
	Jersey	52.7
⊟7/25/2001	Ayrshire	54.7
	Brown Swiss	53.8
	Jersey	49.2

Using the same option you can also change the order of breed or data by moving up or down.

Row Vs Column selection

By default, when you add a field into table they are placed in columns. It may be desirable to add some sub categories in row like this:

Average of MILK (lbs/d)	Breed ▾		
TEST DATE ▾	Ayrshire	Brown Swiss	Jersey
6/5/2001	56.5	56.4	53.1
5/20/2001	54.9	54.5	50.1
6/25/2001	58.7	59.0	54.2
7/10/2001	57.7	58.3	52.7
7/25/2001	54.7	53.8	49.2

This table is easier to read than previous table to see how the milk production is varying with time or which breed had better production at what date. In order to switch a category between column and row select the category you want to switch. Then Right click >> Move... and from the last option in the list, change to Row or column.

Adding more values

You can easily include more information into your pivot table as you go along. If the field you are adding to is a numeric, Excel automatically adds as values. For instance, in addition to average milk production you could also display the average of fat% in the table as:

		Breed ▾		
TEST DATE ▾	Data	Ayrshire	Brown Swiss	Jersey
6/5/2001	Average of MILK (lbs/d)	56.5	56.4	53.1
	Average of FAT %	4.0	4.9	5.1
5/20/2001	Average of MILK (lbs/d)	54.9	54.5	50.1
	Average of FAT %	4.2	5.2	5.3
6/25/2001	Average of MILK (lbs/d)	58.7	59.0	54.2
	Average of FAT %	3.7	4.6	4.9
7/10/2001	Average of MILK (lbs/d)	57.7	58.3	52.7
	Average of FAT %	3.3	4.4	4.5
7/25/2001	Average of MILK (lbs/d)	54.7	53.8	49.2
	Average of FAT %	3.3	4.3	4.2

To do that check the Fat% field, and change "summarize data by" to "Average".

Using drag and drop

If you are familiar with old versions of Excel you may remember the ease of dragging and dropping of a field onto a pivot table. Well, you can get the same interface in Excel 2007 by changing from pivot table options dialogue box (Click on "Display" group and check on "Classic pivot table layout"). Dragging and draping also works in 2007 version as easily or even better, but you have to drag and drop NOT on the table itself but on the drag and drop area. For the table discussed in previous section the drag and drop area would look like below.
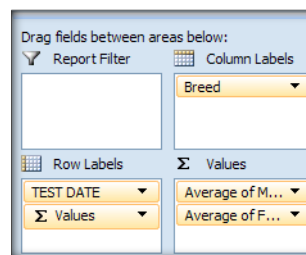
You can drag fields from row to column and vice versa. You can also change the category hierarchy by dragging lower field to move higher on stack.

Report Filter

Instead of creating a pivot table from entire data, you can hide or filter out some of the categories. For instance if you want to look at the data only for three dates about a month apart like this:

Average of MILK (lbs/d)	Breed		
TEST DATE	Ayrshire	Brown Swiss	Jersey
5/20/2001	54.9	54.5	50.1
6/25/2001	58.7	59.0	54.2
7/25/2001	54.7	53.8	49.2

You click on drop down box next to "TEST DATE" on the table and uncheck the dates you don't want. This makes drop down arrow to change to 🔽 indicating the field is filtered. You will also see a 🔽 icon next to the filed name in Pivot table field list.

Grouping data

One of the most useful features of a pivot table is the ability to combine items into groups. You can group items that appear as Row Labels or Column Labels. You can group items either manually or automatically. For example to group the average milk production by month, select "TEST DATE" field and from Options tab >> Group >> Group Field. From the dialogue box that appears, select "Months".
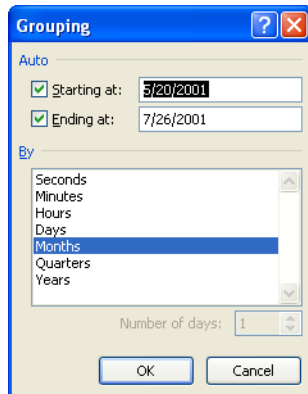
Click OK, the TEST DATE will be grouped by months as follows:

Average of MILK (lbs/d)	Breed		
TEST DATE	Ayrshire	Brown Swiss	Jersey
May	54.9	54.5	50.1
Jun	57.6	57.7	53.7
Jul	56.2	56.1	51.0

To create a manual group, select the items you want to put in a group and right click. From the menu that appears, select Group...(➡ Group...).

Pivot chart

In addition to pivot table, you can also create a pivot from a pivot table. Pivot chart and pivot table are always linked and hence to change pivot chart you will need to change the pivot table (In older version of excel you could either change table or chart). To create a pivot chart from above pivot table, select the pivot table by clicking anywhere inside the table; then from "Options" tab >> Tools >> click on pivot chart. Select the chart type and click OK. Once you insert a chart you can format chart as you format a regular chart.
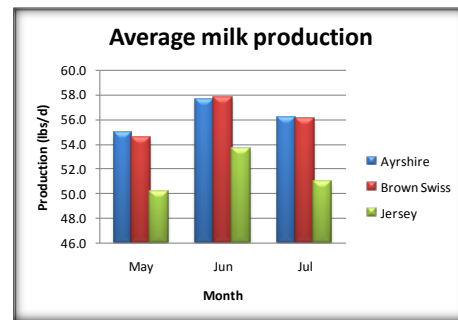
Database Functions

There are some database specific functions in Excel to calculate from the data table with some specific criteria defined in criteria table. All database functions have following three arguments

FunctionName(database, field, criteria)

The first argument, "database" is the address of the range (or name of the range) that makes up the database. The second argument "field" indicates which column is used in the function for calculation. Field can be given as text with the column label enclosed between double quotation marks, such as "FAT%" or "PROTEIN%," or as a number that represents the position of the column within the list: 1 for the first column, 2 for the second column, and

so on. The third argument "criteria" is the range of cells that contains the criteria table. To create the criteria table, see advanced filter. Following database functions are available in Excel:

DAVERAGE	Averages a field
DCOUNT	Counts the cells that contain numbers
DCOUNTA	Counts the nonblank cells
DGET	Extracts a single value from a field
DMAX	Returns the largest number in a field
DMIN	Returns the smallest number in a field
DPRODUCT	Multiplies the values in a column
DSTDEV	Sample standard deviation
DSTDEVP	Population standard deviation
DSUM	Adds the numbers
DVAR	Variance of sample
DVARP	Variance of a population

Example: Calculate the average milk production of Ayrshire breed that have fat % less than 3%.

Create the criteria table as:

	H	I
1	Breed	FAT%
2	Ayrshire	>3

Use DAVERAGE function as:
=DAVERAGE(A1:A751,4,H1:I2)

A1:A751 is range of database table
4 is 4th column on table (i.e. MILK (lbs/d))

4 is 4th column on table (i.e. MILK (lbs/d))
H1:I2 is range of criteria table

1. What kind of record keeping you may encounter in the area of your interest? Give a specific example.
2. What do you do to change the sum of a field to average of a field?
3. How do you remove a grand total row or column?
4. How do you remove a sub total row?
5. Does order of selection matters while creating a pivot table is so when?
6. How do you switch a category from row to column and vice versa?
7. What is a report filter?
8. How do you group data into months?
9. What are database functions?
10. What are the three arguments all database functions take?

Introduction to Macros and VBA

> *After this class you should be able to:*
> *Record a macro.*
> - ➢ *Call a macro.*
> - ➢ *Use VBA editor to modify your macro.*
> - ➢ *Write a custom function.*

Macro

A macro is a saved sequence of commands or keyboard strokes that can be stored and then recalled with a single command or keyboard stroke. *Recordings are done as a series of instruction. Since it is a series of instructions, a language is needed to make those instructions understandable both to human and to the computer. All office applications use Visual Basic for Applications (VBA) as a language to store these instructions. Macros are saved with corresponding office file when they are saved.*

Why Macro and VBA?

VBA is a programming language which is a subset of general programming language called VISUAL BASIC. General Word and Excel users don't need to know about VBA but learning VBA makes you a power user of those programs. VBA is common languages that can be used from any office application to do several things that would otherwise be not possible. Some of the frequent uses of VBA are:

1. *Automation: Several kinds of analyses need a routine steps which can be standardized in a flow chat like format. VBA is can translate your flow chart into series of command that computer understands.*
2. *Add functionality: You can add some user defined functions that are not available otherwise. For example, a function that calculates area of a triangle or body mass index of a person.*
3. *Make program more interactive and user friendly: With VBA, you can add custom controls*

to make it user friendly. One student made a commercial software using VBA to help manage dietary requirement for a dairy cattle, horse and pet animals. The software would help mix best ration with minimum cost and keep track of animal development.

4. *Integrate functionality of several programs: VBA is a common programming language for all office programs and other programs like AutoCAD. You can use the functionality of one program into another program. For example, Excel is great for number crunching; Word is great for typing up your report. You can use VBA to combine features from Excel and Word to create a dynamic report.*
5. *Do things that you could not have done otherwise. Some tasks are impossible to do without VBA. For instance if you want to get your GPS data from a GPS receiver into EXCEL for analysis, you must use VBA to read serial bus to acquire GPS data.*

Macro Recorder

Excel's macro recorder operates very much like the recorder that stores the greeting on your telephone answering machine. Instead of voice, a macro records series of key strokes and commands.

To start a new macro recording, simply turn on the recorder found under Developer tab >> Code >> Record Macro. *Macro recording is Excel is similar to macro recording in Word which we have practiced to record frequently typed words and chemical equations like H_2SO_4.*

Example: Record a macro that inserts an equation to convert the temperature in °F on left cell to °C. *The conversion equation is* $C = \frac{5}{9}(F - 32)\cdot$

This is a simple process and you could have done it just by simple copy and paste. However, this illustrates the process of recording and playing a macro.

6. *Under Developer tab >> Code >> Record Macro. If developer tab is not visible, from Excel Options dialog box, under popular category, check the box "Show Developer tab in the ribbon".*
7. *Provide a name for your Macro. Macro name has to be a single word. No special symbols are allowed except for underscore (_) and first character cannot be a number. Give a macro a meaningful name so that you can guess what that macro does just by looking at the name.*
8. *Assign a shortcut key that will play the recorded macro. Be careful not to use the exiting shortcut such as Ctrl+C used for copy. If you do, the macro will override the default shortcut.*
9. *Fill in the description: Converts from °F to °C. Press OK. (Alt + 248 from Numeric keypad will insert ° symbol).*
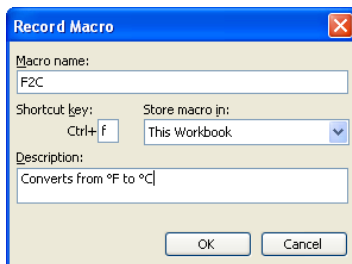
10.
11. *Click OK, and you are now in Macro Record mode. When the Macro recorder is on, everything you do except for mouse movements and some meaningless clicks are recorded. The Record macro tool will be replaced by Stop Recording (**). If you have*

macro recording icon displayed on status bar, the icon will change from to . You can also use these buttons to start and stop recording.

12. *Click on "Use Relative Reference" under Developer >> Code to make your cell selection relative to the active cell (The cell where you started your macro from). Even if you do not use relative cell reference, the cell reference inside an equation will still follow '$' sign convention relative vs. absolute reference.*
     Not activated
    Activated (Golden background)
13. *Enter the formula =5/9*(A3-32) as you would have entered normally in cell B3 (I'm assuming that your active cell was B3, If it wasn't the case, just select the cell left to your active cell instead of A3). After you finish typing, press enter and stop recording.*
14. *To run the macro to convert the temperature from °F to °C, place your cell cursor to the right of the cell containing the temperature in °F and then press the shortcut key you've assigned to it. The second method of running a macro is from Developer >> Code >> Macros>> Select the name of the macro and click Run.*
15. *Test the macro with some known temperatures to make sure it works.*
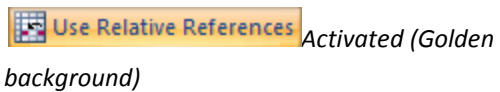
Viewing the Macro instructions

As mentioned earlier, macro are series of instructions written in the language called VBA (Visual Basic for Application).In other words it is a laundry list of things to do which is accomplished in a press of a button.

Since VBA is a language, it has its own vocabulary (called keywords*) that has a special meaning and grammar (called* Syntax*) that must be followed to make your instructions unambiguous to computer. Learning VBA means learning these keywords and*

syntax so that you can tell a computer to do exactly what you intent to do. The codes are viewed and modified using VBA editor.

VBA Editor

You can open a VBA editor window either from Developer>> Code >> Visual Basic *or simply using shortcut key (Alt + F11). In either case you will see a visual basic editor window. Alt + F11 acts as toggle key between active excel application and Visual Basic Editor (VBE).*
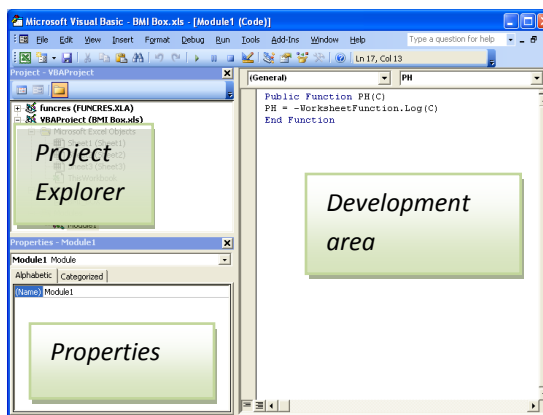
You write or modify the VBA code within the visual basic editor. The editor is a multi paneled environment. The three standard panels; project explorer, properties and development area are shown in figure above.

Project Explorer

The project explorer window shows the active project you are working on and let you quickly navigate between projects. If Project explorer window is not showing from View menu select Project Explorer (Ctrl + R) Project Explorer   Ctrl+R *or press* ▨ *from tool. This window shows the Excel file you are working on such as "My Project", the Name of the sheets such as Sheet1 (Sheet1). The first sheet1 is the Name properties of the sheet and the Sheet1 inside the parenthesis is coming from sheet tab. You can independently change Sheet name and what is displayed on sheet tab.*

ThisWorkbook object is the Current workbook object that you are working on.

Properties window

Properties window shows the properties of the object you select. For example if you click on Sheet1 object in project explorer window, you will see the properties of Sheet1. You can change some properties right from this properties window. Changes made in this panel affect the default properties of the object.

If properties window is not visible, then from View menu select Project Properties window (Shortcut F4) or from tools menu click on ▦ *command.*

Exercise*: Set the scroll area of sheet1 to A1 to Z200.*

Development area

Development area (right window) is the place to write the VBA code for the object you select from project explorer. This window is like a text editor where you write instructions to a computer.

There are two types of development area, one specific to an object and another is general module. For instance, you may double click on Sheet1 object to write VBA code for objects in Sheet1 or to handle events (we will discuss event handling functions later) related to objects in sheet1. The SUB or FUNCTION procedures (we will learn about them shortly) inside Sheet1 development area are private meaning the code is not usable as macro or function from excel worksheet. Therefore do not write your user defined function or macro code inside any of the object development area.

Modules are development area which is public means the code is accessible from Excel (can be called from a worksheet) or any other object specific code. In general all functions and procedures that are called (used) from within Excel worksheets must be written in a module development area.

When you record a macro, Excel automatically creates a new module and places the macro code inside that module development area. You can insert more modules as needed to keep your codes uncluttered.

Inserting a module

To insert a module from Insert menu select module (![Module]) or from ![tool icon] ▼ tool's dropdown list select module. A new module is inserted and you will see a blank development area for that module. **Make sure you write user defined functions and macros you intend to use from Excel are inside a module but not under any Microsoft Excel objects.**

For small programs usually only one module is sufficient; more modules are used for bigger programs to separate related collection of procedures.

A procedure

In a nut shell a procedure is a set of list of commands that does a specified unit task. Once you have a module in your project you have a place to write your code. You can insert a Sub (sub procedure) or a Function (function procedure). The biggest difference between a sub procedure and a function procedure is that function procedure is used to so some calculation and returns the result. Function procedure is similar to Excel built in functions you have been using. On contrary, SUB procedure is used to write something into or modify an Excel sheet.

Function Example

Body Mass Index (BMI) can be used to indicate if you are overweight, obese, underweight or normal. Women tend to believe they look their best at values from 20 to 22 and men are usually satisfied with a BMI of 23 to 25. If your BMI is between 17 and 22, your life expectancy is longer than average.

In this example we are going to create a user defined function that calculates the BMI of a person given weight in kg and height in meter.

Step1. Insert a function (Insert >> Procedure >> Name your function as BMI and check the radio button Function and Scope as Public. Click OK).
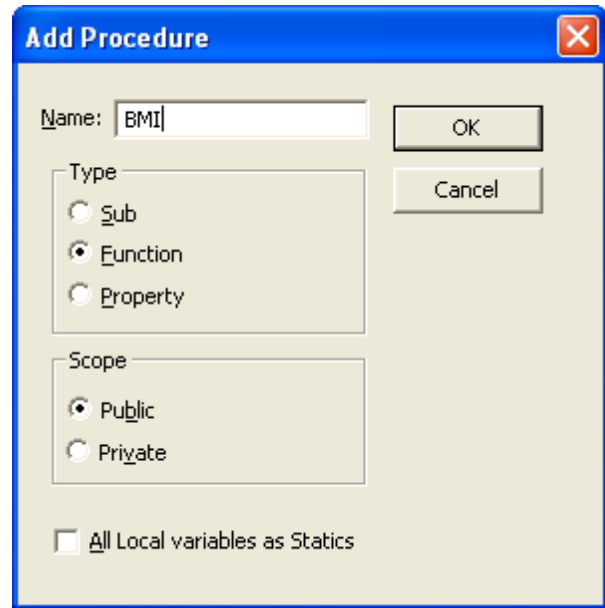
Step 2. BMI is defined as Weight of a person in kg divided by square of the height of a person in meter or,

$$\text{BMI} = \frac{\text{Weight in ki} \log \text{ram}}{(\text{Height in meter})^2}$$

Now, in order to calculate BMI we need two arguments, i.e. weight in kg and height in m. Include the parameter list as follows and complete the function.

```
Public Function BMI(Wt, Ht)

BMI = Wt / Ht ^ 2

End Function
```

Step 3. Now you can use BMI function from any worksheet as you would use a built in functions. Notice that the units of the arguments are in kg and

meter; you will get an erroneous result if you pass argument values in lbs and feet.

Anatomy of the BMI function

When you inserted a function from insert >> procedure, it inserted two lines of code

```
Public Function BMI()

End Function
```

Each word used above have some meaning to the computer. The first word in this function **Public** has a meaning that this function can be called from outside of this module such as an Excel worksheet. If you do not want this procedure accessible from other modules replace the **Public** keyword with **Private**. **By default all modules are public and hence you can omit this word if you wanted to, but having the word Public makes it less confusing**.

BMI is the name of the procedure you gave it to and also the name of the variable whose value is returned to the calling function.

The word **Function** tells that it is a function procedure. The line **End Function** is like a flag that tells the computer that it is the end of Function that is the end of the bock of instruction.

All the commands (except comments right to an apostrophe (')) that you write in between these two lines will be carried out every time you call this function. You can have as many instructions as you want in a function. You could have typed these two lines of code yourself without using insert procedure dialogue box but using a dialog box makes it less prone to mistyping keywords and making a syntax error.

Arguments and function return

A function can accept arguments and return a single value (**a function never returns more than one value**). When the function was first created it had no arguments. For BMI function, it takes two pieces of

information; weight and height to calculate BMI of a person. This information is brought into the function as an argument lists. The values are given a name called Wt and Ht. Each argument is separated by a comma. Doing so, we have introduced two variables Wt and Ht. You could have named them anything you liked such except for some reserved keywords, such as SUB and END.

Understanding variables

It is helpful to think a variable like a named container that holds a single value and you can use these names in place of the value itself (see figure below).
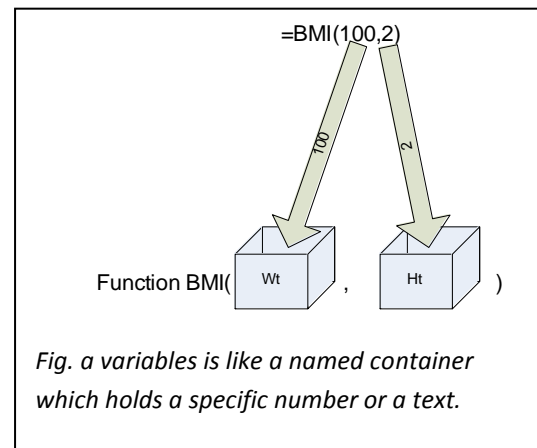
Fig. a variables is like a named container which holds a specific number or a text.

What value these variables Wt and Ht holds depends on how the function was called. For instance, if the function was called like =BMI(100,2) then the first argument Wt is assigned a value of 100 and second argument Ht will hold a value of 2.
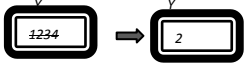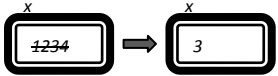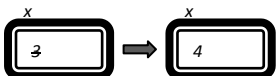
The line $BMI = Wt / Ht \char`^ 2$

is asking the computer to divide the value in Wt box by the value in Ht box squared and then put the result in BMI box. **As a rule, the value of variable that has the name of the function itself is returned to the calling function**. Since BMI is also the name of the function the final value contained in the BMI box (which will be $100/2^2 = 25$ in this case) will be returned to the calling function.

VBA expressions

Each line in VBA is a single instruction. You can have as many blank lines as you want between two instructions and VBA ignores those blank lines. However, you cannot break single instructions into two lines. If an instruction is too long to fit comfortably in a line, then you must put an underscore (_) to indicate continuation of instruction to the next line.

Most of the VBA instructions are called expression. VBA expressions are a single line that performs some calculation and assigns a result to some variable. Consider the following expressions:

Expression	Action
`Y = 2`	*Discards any value stored in Y and assigns value of 2 to variable Y.*
`X = Y + 1`	1. *Calculates the right side of '=' sign* *Y+1 → 2+1 → 3* 2. *Assign the final value to variable on left*
`X = X + 1`	1. *Calculates the right side of '=' sign* *X+1 → 3+1 → 4* 2. *Assign the final value to variable on left*
`Z = Rnd()*5`	*Evaluates the function Rnd(), multiplies the return value by 5 and assigns to variable Z.*

VBA's operators are similar to those of Excel. The mathematical operators in Excel have same meaning and order of operation in VBA. You can use either arithmetic or logical operators where appropriate. Order of calculation is also same as in Excel, for example, if $x=4$ and $y=2$, the following expression:

`Z = x + y * 3`

Will assign a value of 10 (not 18) to the variable Z.

VBA Vs Excel functions

VBA, being a common programming language, has its own built-in functions that are independent to Excel functions. Most of the function in VBA has the same name and argument list as Excel.

VBA function works the same way as any other functions you have used so far in Excel. Since Excel and VBA are independent, be cautioned that there are some functions that have different name for the same work they do or have a different meaning for the same function name. The most common Excel function and different in VBA are compared in table below.

Excel	VBA	Operation
Sqrt	*Sqr*	*Carryout square root operation*
Ln	*Log*	*Natural logarithm*
Log	*Not Available*	*Log with base 10*
Rand	*Rnd*	*Generates a random number between 0 and 1*
Mod (a,b)	*a Mod b*	*Remainder (modulus) operator. Note the different way in using Mod.*

Some frequently used functions that are available both in Excel and VBA are:

Abs	Atn	Sin	Cos	Tan	Exp
Pmt	Pv	Fv	Nper	Int	

Not all functions available in Excel are available in VBA. However, if you want to call (use) an Excel function that is not available in VBA, precede Excel function name with the word **Worksheetfunction** (notice that this is a single word) followed by an a dot(.) like this.

```
X = WorksheetFunction.Choose(Y, "Zeroth", "First")
```

Writing Comments

When you look at code that someone else has written or your own code from past, understanding the logic behind the code can be a challenging task. A good section of program code should contains enough comments to describe the process in plain English so that when you look at the program in future, you know what you did, or if someone looks at your program then they know why you did what you did.

To add comments in your program start with apostrophe (')sign. Anything followed by this sign will be ignored when the code is executed.

Example:

' Following line of code generates a random number between 1 and 6 and assigns it to variable X.

' Int(x) functions get rids of fractional part of x and Rnd() function returns a random number between 0 and 1.

```
X = Int(Rnd() * 6) + 1
```

Saving Excel with Macro code

Because VBA is a programming language, it provides an opportunity for inclined people to create a malicious program that may harm a computer. Even though older version of Excel has the same file extension .xls for both macro enabled and macro free workbooks, office 2007 has added a layer of security by changing the file extension for macro free workbooks to .xlsx file extension and macro enabled workbook to .xlsm file extension. Therefore when you write a macro you must save as .xlsm (at time of saving choose from save as type dropdown box to "Excel Macro-Enabled Workbook (*.xlsm)".

 You should be careful in running a macro obtained from a source that is unknown or doubtful. You should take the macro virus very seriously. To select a level of protection choose an option from Developer >> Macro Security to open **Trust Center** dialogue box.

is most appropriate most of the time but that means if you are the writer of macro you need to digitally sign and attach the signature to macro you write. Then you need to write yourself as a trusted publisher from "Trusted Publishers" category on trust center dialogue box. Or you save all your macro enabled files to "Trusted location" so that macro security is not checked.

Signing your own macro

From Start >> Microsoft Office >> Microsoft Office Tools >> run . In the box that appears, provide your name.

If the program is not available from start menu, navigate from file explorer to folder:
C:\Program Files\Microsoft Office\OFFICE12
and run the program selfcert.exe.

Once you have a certificate, you may digitally sign a visual basic project. From Visual Basic editor under Tools >> Digital Signature. Choose to select the digital signature you have just created.

Next time you open the Excel, you will see a warning message as:
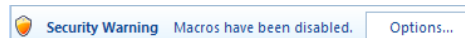
Click Options and select

⊙ Trust all documents from this publisher

to add the publisher to trusted publisher list.

Exercise:

1. Create a macro that converts the temperature from Celsius to Fahrenheit.

2. Study the following function and find out what value will be returned by this function if the function was called as = HypotenuseLength(3,4)

   ```
   Function HypotenuseLength(x, y)
   ' Calculates the length of a
   ' right angle triangle's hypotenuse
   ' given the other two sides: x and y

   HypotenuseLength = Sqr(x ^ 2 + y ^ 2)

   End Function
   ```

3. Create a function named "lbs2kg" that converts from pounds to kilograms.

4. Create a function that converts from feet and inches to meter.

5. Create a function named 'volume' which returns the volume of a sphere given a radius of sphere r. The equation to calculate volume from radius is $V = 4/3 * \pi * r^3$. (Hint, there is no Pi() function in VBA, so use Excel's PI() function)

6. Create a function named 'perimeter' which returns the perimeter of a circle given a radius of circle r. ($P = 2 * \pi * r$)

7. The logistic growth model

$$P(t) = \frac{1000}{1 + 32.33e^{-0.439t}}$$

Represents the population of bacteria after time t in hours. Write a function named bacteria that returns bacteria population P at any given time t in hours. (Hint, EXP function is available in VBA as well, so you don't need to borrow this function from Excel)

8. Create a function that returns temperature in Fahrenheit given a temperature in Celsius. Compare the macro you have created in exercise 1 to this function.

9. Modify BMI function so that you can enter your weight in pounds and height in inches.

10. Add these three lines of comment on your BMI function after the line

    ```
    BMI = Wt / Ht ^ 2

    'BMI of a person is weight in kg
    'divided by height in meter squared.

    'Guess what happens if someone calls
    ' the function with Ht = 0?

    'How would I prevent the user from
    'calling the function with Ht = 0?
    ```

11. pH is the negative logarithm (with base 10) of hydrogen ion concentration. i.e.
    $pH = -LOG_{10} (H^+)$
    Log function in VBA calculates logarithm with base e where e is a constant number = 2.71. We will borrow the Excel function Log which is the logarithm with base 10. Write a function named PH that uses worksheet function Log and returns the PH for a given hydrogen ion concentration.

12. Write a function that converts a given pH into corresponding hydrogen ion concentration. Name this function H_ion_conc. (Hint: this is the reverse of previous problem. Therefore from pH equation, $H^+ = 10^{-pH}$)

13. Since pH is in logarithmic scale, an acid with pH 3 is actually 10 times stronger than acid of pH 4 because the acid with pH 3 have 10 times more hydrogen ion concentration. Write a function that calculates the ratio of hydrogen ion concentrations to tell you how strong an acid with pH value x to the acid with pH value y. Name the function Acid_ratio. Find out How stronger the acid with pH = 2 then acid with pH 2.1?

14. Use GOALSEEK to find what value of pH is twice as stronger than acid of pH 3?

15. In human genetics probability of having a boy is equal to probability of having a girl =

½. With that assumption, in a family of N children, probability of having n boys (or n girls) is given by:

$$p = \frac{N!}{n!\,(N-n)!}\left(\frac{1}{2}\right)^N$$

Where x! is called factorial x and is calculated as = x . (x-1). (x-2)…..1. For instance 3! = 3*2*1 = 6

Write a function to return the probability value p for given N and n. Use worksheet function FACT() to calculate the factorial. (Hint: In VBA, you cannot use N and n as two separate variable names because VBA function names are case insensitive, Use something else for variable names such as n1 and n2).

16. In a family of 4 children, find the probability of having 2 boys and 2 girls. (If you though it would be 0.5, you were wrong)

17. Using above formula find the probability of having 5 boys and 2 girls in family of 7 children.

18. Area of any triangle with side lengths a, b and c is given by
$A = \sqrt{S(S-a)(S-b)(S-c)}$ where,
S = (a+b+c)/2.
Write a function that calculates the area of a triangle given a, b and c.

19. Why should you be aware of macro virus and what are the precautions you can take to prevent infected with micro virus?

20. What is signing your micro? How can you digitally sign your macro project?

Multiple Choice Questions

1. When we say programming in VBA, VBA stands for

   a. Very Basic Application
   b. Visual Basic for Applications
   c. Visual Basic for Analysts

   d. Very Broad Applications

2. All office applications such as Word, Excel and PowerPoint use VBA as its MACRO language.

   a. True
   b. False

3. A FUNCTION subroutine can return

   a. As many values as you desire
   b. Up to three values
   c. Up to two values
   d. Only one value

4. Identify the correct answer: When you name a variable

   a. It cannot be longer than 1 character long
   b. It must be a single word with no space in between
   c. It can be any word, even key word used by VBA such as "FOR"
   d. It should be at least 5 characters long

5. When you write a FUNCTION procedure to be called from Excel worksheets

   a. You need to write it under Sheet1 Object
   b. You need to write it under ThisWorkBook object
   c. You need to insert a new module and write your function there or write on the existing modules.
   d. Where you write your function procedure does not matter.

6. Read this FUNCTION procedure carefully:

   PUBLIC FUNCTION BodyMassIndex(w,h)

   BodyMassIndex = Weight / height ^ 2
   'BodyMassIndex = Body mass index
   END FUNCTION
   Above function will not calculate the body mass index correctly because

   a. There is a blank line between function name and the first line
   b. There is no space between 2nd and the 3rd line
   c. You cannot have a comment in a function

d. Variable names used in the argument list (w and h) are not the same variables used in function body (Weight and height).

7. The difference between a SUB and a FUNCTION procedure is that

   a. A FUNCTION procedure is more powerful
   b. A SUB procedure can modify values in a worksheet but FUNCTION procedure can not
   c. A FUNCTION procedure must take an argument whereas SUB procedure may not take an argument
   d. SUB procedure is preferred when all you want to do some simple calculation and return the calculation result.

8. What will be value stored on variable M after execution of this code

   M = 1

   M = 2

   M = M + 1

   M = M * 2

   a. 2
   b. 4
   c. 6
   d. Will generate an error

9. A module is a

   a. Programming language
   b. Sub procedure
   c. Space where you usually wite your subroutine and functions
   d. Function procedure

10. From VBA

   a. You cannot use Excel built-in functions
   b. You can use Excel built-in function normally as you would from any excel sheet
   c. You can use Excel built-in functions but you have to put a word EXCEL and a dot before function name like EXCEL.Sum(A1:A7)
   d. You can use Excel built-in function but you have to put a word WorksheetFunction and a dot before function name like WorksheetFunction.Sum(A1:A7)

11. Macro and Visual Basic Editor is under which of the following tab?

   a. Home

b. Review
c. Developer
d .Insert

12. You will need to buy VBA editor separate from office application like Excel.

   a.True
   b.False

13. You write your codes in which part of VBA Editor Window?

   a. Project Explorer
   b. Properties
   c. Development Area

14. Each Function Procedure must have an Ending line of:

   a. END
   b. END FUNCTION
   c. END SUB
   d. EXIT

15. What will be the value of X after executing the following lines of code

   Y = 2

   X = Y + 1

   X = X + 2

   a. Null
   b. 3
   c. 5
   d. Error

16. What is the name of the function used in VBA to calculate the square root of a number?

   a. SQRT
   b. SQR
   c. ROOT
   d.LOG

17. To Write a comment in VBA you start with an

   a. '
   b. //
   c. *
   d. %

18. What is the file extension for macro enabled Excel file in Office 2007?

   a. XLS

b. XLA
c. XLSX
d.XLSM

19. A program code like

```
Range("A1") = 20
```

in a SUB procedure inside a module will write 20 on

a. Cell A1 of Sheet1 Object
b. Cell A1 of Sheet2 Object
c. Cell A1 of ActiveSheet Object
d. None of the Above

20. The lines

X = Range("A1")

and

Range("A1") = X

a. Are interpreted the same in VBA
b. X = Range("A1") copies the value of variable X to cell A1 and Range("A1") = X reads the value from cell A1 and assigns to the variable X.
c. X = Range("A1") reads the value from cell A1 and assigns to the variable X and Range("A1") = X copies the value of variable X to cell A1.
d . The computer may be confused by such ambiguous lines.

21. The Event handling procedures are

a. The procedures you write yourself
b. Special procedures that are called when certain event happens such as a mouse click.
c. All the build in Excel Functions
d. all macros in a workbook.

22. Form Controls are simple to use than ActiveX control but they are not as flexible as ActiveX control.

a. True
b. False

23. What will be the value of variable X after these lines of code has been executed

Y = 5

X = Y /2

Y = Y-2

X = IIF(X>Y,X,Y)

a. 5
b. 2.5
c. 3
d.2

24. What value the following function in Excel will return?

=StrangeRatio(3,6)

Where StrangeRatio function code is as given below:

Function StrangeRatio(x,y)

IF x>y then
    StrangeRatio = x/y
Else
    StrangeRatio = y/x
End If
End Function

a. 2
b. 0.5

25. What value the following function in Excel will return?

=NaturalSum(2)

Where NaturalSum function code is as given below:

Function NaturalSum (x)
  NaturalSum =0
    For Counter = 1 to x
      NaturalSum = NaturalSum + Counter
    Next
End Function

a. 0
b. 1
c. 2
d. 3

Excel Object Model

SUB Procedure

Unlike function procedure, SUB procedures can change the Excel object properties such as worksheet cell contents. Therefore a SUB procedure is not restricted to returning one single value to calling function. In fact, sub procedure does not return any value like a function does. As always, the power comes with responsibility, you have to be careful in changing cell values as it may not be undone.

Just like function, SUB procedure can also have arguments passed to it. A SUB procedure without any argument is called a MACRO. A module can have several SUB and FUNCTION procedures.

Since SUB procedures are used to change the object properties, it is necessary to understand the basic excel object model.

Excel Object Model

In one common analogy, objects are equated to nouns in the English language (a book, a table). Objects usually have some properties, and are capable of performing some actions (methods), and could be built out of smaller objects. For example, a car is an object, with properties like color, make and model. It can perform some action like drive, burn fuel, accelerate, steer etc. Car is made of other smaller objects like wheels, chassis and engine.

Similarly Word and Excel are application objects (similar to a car). Word application can hold many word documents (similar to passengers riding a car); Excel application can hold more than one workbook. Each workbook consists of many worksheets, and worksheet consists of many cells. You can perform certain tasks such add or delete a sheet, select a range of cells and copy selected cells. To view all the objects available in Excel and VBA including function and constants, from the visual basic editor go to

View>>Object Browser or click on toolbar ![icon] icon (or F2).
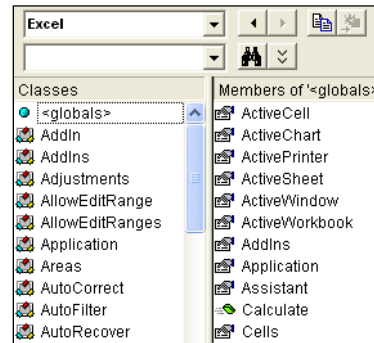
Figure. View of an object browser (left), frequently used objects (right)

From the library chooser choose Excel or VBA to view the objects and functions available in Excel or VBA. When you browse object properties, you will see three distinct icons: ![icon] means property, ![icon] means method, ![icon] is a named constant and ![icon] is the name of event handling function. They are explained in the following sections.

Working with objects

Every object has a unique name. You address an object by its name. The names are case insensitive. Name is the most important property of an object and hence it is listed on the top of properties box indicated by (Name). There may be other properties of an object called "Name" but you will use the one inside the parenthesis to address that object. For example select the Sheet1 object from VBA and look at the property box. You will see a property (Name) listed on top and Name property, which is in fact, is same as name of the sheet on the tab. As you may guess, changing what is written on sheet tab does not change the (Name) property.

Even though there are zillion objects, fortunately there are only a few objects that you need to learn to

make Excel do most of the things. Default names of some common Excel objects are:

Object Name	Refers to
Application	Entire Excel application
Sheet1, Sheet2…	Worksheets 1, 2…
Selection	Range of selected cells
ActiveSheet	Currently active worksheet
ActiveCell	Currently selected cell

In addition to regular objects like Sheet1, Sheet2 there is also a collection object which is a container for all related objects like "Sheets". Each individual object in the collection is indexed. If an object is a part of collection you can refer to that object using index. For example, since "Sheets" is a container objects that holds all worksheets, instead of referring as Sheet1, you could also have referred to this sheet as Sheets(1) which refers to the sheet to farthest left.

Sheets(1) always refers to left most sheet, if you change the sheet order, Sheets(1) may be referring to different worksheet . In addition to using index, you could also use the tab name such as Sheets("Profit") to refer to "Profit" worksheet. But this may produce an error is someone changes the name in sheet tab. Therefore Sheet1, Sheet2… may still be a better way to address to a cell.

Some collection objects are:

Collection Name	Objects
Sheets or Worksheets	Collection of all Worksheets
Cells	Collection of all cells in a worksheet
Range	Range of cells

Object.SubObject

Since VBA can refer to any object including Word object and other excel workbooks (open files), it could be confusing when you say Sheet1 without referring to which workbook's sheet1 is being

referred. Excel resolves the ambiguity assuming that the currently active workbook is being referred. This may be a source of error is that is not the case. This is also true with other objects such as cells and range. The best way to avoid ambiguity is by specifying the object where sub-object belongs to by following the syntax:

Object.SubObject.Sub-Subobject.Property

Name	Values
☑ Visible	True (default), False
☑ Caption	"Microsoft Excel"(default)
☑ StatusBar	To display message in Status bar. "Ready" (default)
☑ Cursor	• xlDefault (default) • xl$\mathcal{I}$Beam • xlNorthwestArrow • xlWait
☑ Sheets	Sheets collection sub object
• Calculate	Method that invokes calculation
• Evaluate	Evaluates an expression

Example:

1. Change Excel title bar so that it displays today's date instead of "Microsoft Excel."
   Date returns today's date in VBA, so the command:
   Application.Caption= Date will write date in caption. To restore default, set caption to nothing
   Application.Caption= ""

2. Change Statusbar to display "University of Idaho"
   Application.Statusbar= "University of Idaho"
   To restore default
   Application.Statusbar= ""

3. Make the Application invisible and visible again
   Application.visible = False (Hide Excel application, it stills runs in background)
   Application.visible = True (Reveals again)

4. *Application.Cursor = xlWait will make the cursor appear ⧗. Even if excel is not doing anything.*

5. *Find out the number of worksheets in current excel file and assign the value to variable "Sheet_count"*
   Sheet_Count = Application.Sheets.Count

6. *Evaluate the function, $=\pi*2^2$.*
   Application.Evaluate("Expression") evaluates any excel expression. It uses Excel function rather than VBA function.
   *x = Application.Evaluate("=pi()*2^2") will assign x = 12.57*

Following are some interesting application property:

Property name

Visible = True or False   default is True
Caption = "My Caption"   "Microsoft Excel"

It is said to have Caption property having a value = "Microsoft Excel" in this case. You can address the property value using following syntax

```
Object.Property
```

For example the following expression will set the value of caption property of the application object to "ASM 240"

```
Application.Caption = "ASM 240"
```

To get the value of the caption property and to store into variable x you will write:

```
x = Application.Caption

Application.StatusBar =
Application.Path 'Set Status bar
display to Excel program path
```

Some of he most frequently used Excel objects are as follows:

Application	Workbooks	Range
Selection	ActiveCell	Cells
Sheets	ActiveSheet	

Application object

Application object stands for whole Excel application.

```
Application.Statusbar = "World is
beautiful" 'Will set the status bar
display

Application.StatusBar = False 'Will
hide status bar

Application.Workbooks(1).Worksheets(1).
Cells(1,1) = 100
'Changes the 1st opened Excel file's,
first worksheet's cell A1 to value of
100.
```

Range object

As name implies Range object is a range of cells. How it could be as small as a single cell.

```
Range("A1").Select

'Selects cell A1 in active WorkBook and
WorkSheet. Active means currently
selected.

Range(Cells(5, 1), Cells(8,
2)).Font.Bold = True

Range("A1:C10").Value = 15

'will change the value of range A1:C10
in active WorkSheet to 15
```

Workbooks object

Workbooks is a collection of Workbooks that is Excel files.

```
x = Workbooks.Count       ' count how
many WorkBooks i.e. Excel files are
open and 'assigns the value to variable
x.

Workbooks(1).Sheets(1).cells(1,1) = 100
```

```
Workbooks("farm
income.xls").Sheets("Sheet1").Cells(1,
1) = 100      'Applies to farm 'income
excel file. If farm income.xls is not
open it will return an error.
```

Sheets object

Sheets is a collection of Worksheets.

```
Sheets.Add   ' This command will add a
new Worksheet
```

```
Sheets(1).Cells(2,4).Value = 25 '
refers to first worksheet's cell B4.
```

```
Sheets("Temperature").cells(2,4) = 25
'Refers to Temperature WorkSheet's cell
B4.
```

Selection object

Selection is the object that represents the range of selected cells.

```
Selection.Font.Strikethrough = True
      'Strikethrough the current
selection
```

```
Selection.Font.Size = 72   'Change font
size to 72
```

```
Selection.Delete     'Delete the content
of the selection
```

Cells object

Cells is the object that is a collections of individual cell. You can refer to cell's column in two ways - either providing the column number as 1, 2 (A = 1; B = 2) or actually providing the column heading letter as "A", "B".

```
X = cells(1,2)              'Cells(1,2)
is cell B1 i.e. Row 1, Column 2
```

```
                           'Sets the
                     value of variable X
                     to content of cell
                     B1
```

```
Y = cells(15,"C")           'Sets the
value of variable Y to content of Cell
C15
```

```
Cells (2,4) = "Biology"    'Sets cell B4
to Biology
```

ActiveCell and Activesheet object

Activecell object refers the cell that is currently selected or the upper left cell if a range of cells are selected.

Activesheet object refers to the WorkSheet that is currently active.

```
ActiveSheet.DisplayPageBreaks = True
      'Display page breaks
```

```
ActiveCell.Formula = "=5/9*(RC[-1]-32)"
'Inserts the formula to active cell
```

Event Handling Procedure

Event handling procedures

Whenever you do something in computer like press a key, move your mouse or make a mouse click, the operating system will detect the event and notify to the active program. While Excel is the active program (If Excel respond to your keyboard stocks then Excel is the active program), which means Excel is the one who handles these events sent by the operating system.

For example, if your active cell is A1 and you press right arrow, the operating system, notifies Excel that right arrow key had been pressed and Excel respond to the event by changing the active cell to B1. Excel does that by calling a special procedure associated with that event. **Collection of all these procedures which are called by an event is called "Event Handling Procedures"**

Objects like **Worksheet** and **Workbook** provides a special event handling procedure for common event like selection change or right click that you can modify. Your code is carried out first before carrying out Excel's default event handling procedure. For example, you may automatically save changes when Users click ✕ to close the program before Excel closes the file.

For instance whenever you change cell selection by clicking on a new cell or pressing an arrow key, it calls an event handling procedure named "SelectionChange" which is a event associated with a worksheet object. To place the procedure in Sheet1 object code areas, follow these steps:

1. Double click on Sheet1 object from object explorer. This will open the workspace associated with this Sheet1 object.
2. From left (Object list) dropdown box, select worksheet

3. From right (Procedure list) dropdown box select event "SelectionChange"

Object List   Procedure List
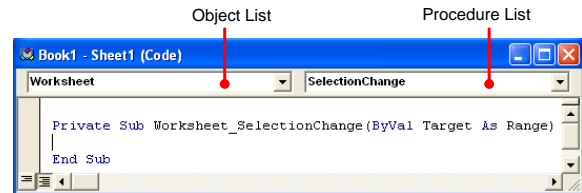
VBA will automatically enter the procedure that will be called every time you change the cell selection in Sheet1.

This sub procedure also has an argument named Target which is a **Range** object. This object is a copy of Range that was selected. **ByVal** keyword specify that the object is only copy of properties values. Write the following code in this procedure:

```
Range("A1") = Range("A1") + 1
```

Now back in Excel Sheet1, change the cell selections by clicking at random cells or using arrow keys and see how it accounts for number of selection changes. Add one more line like below:

```
Range("B1") = Target.Address
```

Test the code again by changing selection. Also try selecting a range instead just clicking on a cell. Notice how the address changes. Other common procedures and associated events are listed below:

Worksheet events:

Procedure	Called when
Activate	Every time the sheet is activated by selecting the sheet
Change	Every time a value or equation is changed

Workbook events

Procedure	Called when
Activate	*When the Workbook is activated*
Open	*When a workbook is opened*
SheetChange	*When a value or equation is changed in any sheet*
SheetSelection Change	*When different sheet is activated*
BeforeClose	*When you try to close the file.*

Working with Forms and controls objects
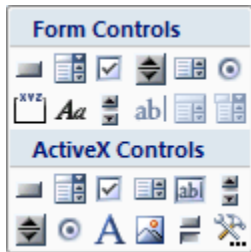
We have seen how Excel comprised of workbooks, worksheets and Range objects. Excel can have more objects such as a chart object or special control objects to create a user interface. Control objects are used to allow the user to have easy control over the entire process.

Excel has two different sets of controls that can be embedded in worksheets. One set is called the Form Controls are quite easy to use for simple task like calling a macro but has a very limited flexibility. The Forms toolbar has been inherited from Excel 95 programs for back compatibility. Another set of controls introduced after Excel 97 called, ActiveX controls has more flexibility in use but not as simple to use as Form Object.

The choice between Form and ActiveX lies on your need. Forms are simpler to use whereas ActiveX gives you more features. Form Controls and ActiveX controls are discussed briefly in the following sections.

Form Controls
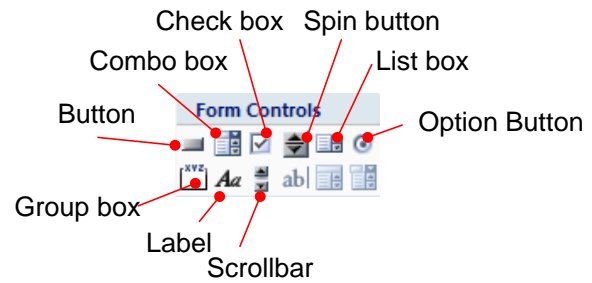
Form Controls will be illustrated by the following example:

Following form is being used to calculate the vehicle insurance premium.

Insurance premiums are calculated per following rules:

Regular price: $700

Credits are given according to the following rule:

		Credit
Sex	*Male*	*0*
	Female	*25*

Education	High School	25
	College	50
	Grad School	100
Accidents		150 – 30*#Accidents
		Or 0 whichever higher
Age		30 if >25 else 0

Quote price = Regular price - Credit

The results should be visible only after Calculate button is pressed

Reset button resets the form

Step1: Create the form controls

1. Insert a Group box and name is Sex.
2. Place two option buttons and label them as Male and Female.
3. Insert another Group box and label it Education.
4. Place three check boxes and label as in the form.
5. Insert a group box for other information.
6. Insert a combo box for #of accidents
7. Insert a list box for Birth year

Step2: Create the list

1. Somewhere in Excel Sheet where it is not easily visible, create a list like this:
   No Accident
   1 Accident
   2 Accidents
   3 Accidents
   > 3 Accidents
2. Also create a list of Years starting from 15 years before today's year to 65 years before today's year. Use =Year(Today())-15 get the year 15 years ago.

Step 3: Create a table to calculate the credit

		Linked	Credit
Sex	Male (=1)		
	Female (=2)		=IF(K8=2,-25,0)
Edu	Highschool		=25*K9
	College		=50*K10
	Grad		=100*K11
Other	Acc (No accident = 1)		=MAX(150-40*(J12-1),0)
	Birth year		=IF(K13>10,30,0)
	Total Credit		=SUM(L7:L13)
	Regular Price		700
	Quote		=L15-L14

Step 4: Make Links to Control and corresponding cells

Right Click on Controls and from the menu that appears, select Format Control. Under "Control" tab, select the Cell Link.

1. Link both option buttons to the same cell.
2. Link each Check box to corresponding cells.
3. For Combo box provide the Input Range to appear in the list and Cell Link
4. For List range, provide Input range, Cell link and make sure you choose Single for Selection type.

Step5: Write needed macros

When the user clicks Calculate, the credit information should appear in the lower left box. Write a macro that copies the calculated cell values to form area. Your Macro will somewhat look like this if your display area were from D10:E12 and you had to copy from E100:E102.

```
Public Sub Calculate_Quote()
'Write Text
Range("D10") = "Regular price"
Range("D11") = "Total credits"
Range("D12") = "Your quote"

'Copy Cells
Range("E10") = Range("E101")
Range("E11") = -Range("E100")
Range("E12") = Range("E102")
End Sub
```

Reset button should reset all controls. To do that clear all linked cells using range object's clear method. Do not forget to clear the cells that display the message.

```
Public Sub Clear_Quote()

'Clear the Quote
Range("D10:E12").ClearContent

'Clear the Form assuming the linked
cells are in E94:E99

Range("E94:E99").ClearContent

End Sub
```

Step 6: Assign the button to Macro

Assign the macros to the Buttons by Right clicking on the button and from the menu select **Assign Macro**. Pick the Macro that you want to be called when the button is clicked.

AxtiveX Control

There was not much you needed to learn once you are familiar with using Form Controls. The controls did not have any properties or methods. On the other hand, ActiveX controls which acts and feels like form controls are the objects with several properties and methods. The controls have event handling procedure such as double_click, right_click, change etc. These properties can be changed from code.

A commonly used properties and events associated with most of the controls are shown is table below

Properties

(Name)	Name of the control.
Caption	The text displayed on the control.
Value	The value/text held by a control. (Except for Command button control).
Enabled	When False the control is inactive.
Visible	When False, the control is hidden.

Events

Click	Called when the user clicks on control.
Change	Called when the Value is changes.

These objects behave like any other Excel objects and can be changes from code.

Review Questions

Exercise:

1. What do you understand by the word "Event" in computer?

2. What is an Event handling procedure? What kind of events you can handle?

3. What is the difference between a Form control and an ActiveX Control?

4. Can you change Caption (what is displayed on a button) of a button in form control using code? Why or Why not?

5. Can you change the caption of an ActiveX control command button using code? If yes how?

Practice questions

1. Use an even handling procedure that is called every time a cell is double clicked to make interior color of the cell to Yellow.

2. Using event handling procedure SheetSelectionChange make the interior of a selected cell to yellow. You can use the property like this:
   `ActiveCell.Interior.Color = vbYellow`

3. Write a command that will change the content of cell A1 to worksheet Name every time to change the worksheet selection.

4. Create a Form to calculate body mass index of a person like shown below.

BMI CALCULATOR

Weight [ ]

Unit
○ Kilo grams
◉ Pounds

| Feet | Inch |

Height [|]

Unit
○ Meter / Centimeter
◉ Feet / Inches

[Calculate]　[Reset]

Your BMI = [ ]

5. Crate the following calculation table somewhere in the sheet (Preferably outside of visible area):

	Unit	In SI Units
Weight=	2	78.18
Height=	2	1.75
	BMI=	25.5

Where grayed cells are linked cell. Use IF function to account for the Unit selection.

6. Also change the Height Unit guides in form using IF function. For Example if Feet / Inches are chosen the form should display:

| Feet | Inch |
Height [5 | 9]

Unit
○ Meter / Centimeter
◉ Feet / Inches

Calculate　Reset

and if Meter/Centimeter is selected then the form should look like:

| Meter | Centimeter |
Height [5 | 9]

Unit
◉ Meter / Centimeter
○ Feet / Inches

Calculate　Reset

7. Write a Macro to copy the BMI calculation when calculate command is pressed

8. Write another macro to reset the form. Default selection should be Weight Unit to Pound (Selection 2) and Height unit to Feet / Inches (Selection 2). Clear the Weight and Height and BMI display boxes.

9. Assign the macros to corresponding button.

10. Test your form.

11. Create a form control as shown below to mix varying amount of red, green and blue to produce a color. The numbers on right are linked to slider control.

COLOR mixer (Slide to Vary)

Red	◄ [►]	249
Green	◄ [►]	116
Blue	◄ [►]	47

Write a macro that reads the linked cells and change the color property the range interior to the color mix. Your code would look somewhat like this:

```
Public Sub Color_mixer()

'Read Red Green Blue values
Red = Cells(2, "F")
Green = Cells(4, "F")
Blue = Cells(6, "F")

'Paint cell interior
Range("H2:H6").Interior.Color = _
RGB(Red, Green, Blue)

End Sub
```

12. Assign the same macro to all three slide bars.

13. Test your sliders.

14. Use a ActiveX command Button Control to toggle the Caption property of the Command Button from ON and OFF.

Click

[On]　[Off]

Click
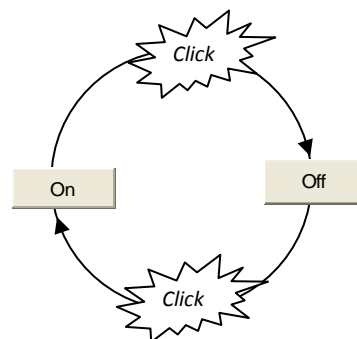
Program Flow Controls

Making Decisions

When there is a need of some conditional calculation, VBA provides three different ways to do the calculation.

The IIF function

The simplest form is IIF function which is like Excel's IF function. Like IF function IIF function also takes three arguments.

```
=IIF(Condtion, TrueResult, FalseResult)
```

Example:

```
MyVar = IIF(x>y, x, y)
```

Will assign MyVar to greater of x or y

If...Then...Else ...

This is similar to IIF function but in addition to just returning a value it can perform some other action. This is a structured statement and structure must be followed.

If *Condition* **Then** *Action1* **Else** *Action2*

All in one line (do not break the line)

Example:
If *Temp >32* **Then** *Range("A1") = "Above _ Freezing"* **Else** *Range("A1") = "Below _ Freezing"*

Block IF Statement

When the tasks are numerous or there are more than just two conditions, a Block IF structure must be used. The Block IF statement has the following structure:

If *Condition* **Then**
[Statement or several lines of statements]
*[***ElseIf*** Condition* **Then***]*

[Statement or several lines of statements]
⋮
*[***Else***]*
[Statement or several lines of statements]
End If

This block of code starts with the word **If** followed by a test condition followed by the word **Then.** You must break the line after the word **Then**. The statements inside [ ] are optional but you can insert one or several commands to carry out if the test condition is true. If the first test condition is False then it tests next condition starting by the word **ElseIf**. The following commands will be carried out if the test condition is true. You can have as many **ElseIf** conditions as you need. Once the code finds a true condition, it does not test for the rest of the conditions. If no condition is true, then you can optionally have a default action flagged by the Word **Else**. Since this is the default action, it does not need a test condition. The Line **End If** terminates the If block.

Example:
Write a function that returns the following message based on Temperature argument:
If T < 0 return "Too cold to go out"
If (T >= 0 and T< 32) "Watch for Ice"
If (T >= 32 and < 60) "Chilly weather"
Else "Warm Weather"

```
Function Weather(T)
'T is temperature in °F
If T < 0 Then
    Weather = "Too cold to go out"
ElseIf (T >= 0 And T < 32) Then
    Weather = "Watch for ice"
ElseIf (T >= 32 And T < 60) Then
    Weather = "Chilly weather"
Else
```

```
      Weather = "Warm weather"
End If

End Function
```

Program Looping

Program looping is the repetition of a specific block of command lines. This can make the code easy to read and uncluttered. For example let's say you needed to write 1,2,3…5 diagonally starting from Cells(1,1). You could write your code like this:

```
Cells(1,1) = 1
Cells(2,2) = 2
Cells(3,3) = 3
Cells(4,4) = 4
Cells(5,5) = 5
```

```
While above code is perfectly valid
you can imagine how unwieldy it
will grow if you had to write for
100 rows. A Looping controls comes
to rescue these situations.
```

FOR….NEXT

When you know exactly how many times a block of code has to be executed, For…Next is the best loop option. FOR….NEXT loop has the following structure.

```
For CountVar = StartVal To EndVal
[Step value]

[Statement or several lines of
statements]

Next [variable]
```

Bolded words are key words; words inside square brackets are optional.

When the loop is first executed, the value of CountVar is assigned equal to "StartVal". As the code sees the work **Next**, the execution returns to the line beginning of loop and increment the CounterVar by Step value (default = 1). The loop continues until CounterVar is greater than "EndVal".

Example:

1. Implement the above task of writing diagonally,

```
For Count = 1 To 5
Cells(Count, Count) = Count
Next
```

2. Factorial of x, where x is a positive integer is defined as x * (x-1) * (x-2)*….*2* 1. Factorial of 4 would be 4*3*2*1=24. Write a function that takes x as an argument and return the factorial of x.

```
Public Function factorial(x)

x = Int(x) 'Discard fraction in x
'Initialize the factorial to 1
factorial = 1
For Count = x To 1 Step -1
 factorial = factorial * Count
Next

End Function
```

3. Write a function to add all integer numbers from 1 up to a given number. For instance, if the given number is 4, the function should return the value, 1+2+3+4

```
Public Function sumto(n)
For i = 1 To n
     sumto = sumto + i
Next
End Function
```

DO….Loop

DO…Loop is useful when you do not know how many times to loop. Whether to continue or not to continue next loop is based on some test condition. Condition can be tagged before or after the loop has been executed as:

```
Do [While condition]
[Statements if true]
Loop

Or,
```

```
Do
[Statements if true]
Loop [While condition]
```

If the condition is at the end Do…Loop will execute at least once. The execution will return to Do if the condition is true otherwise the line after the Loop will be executed.

Example: In a worksheet, all the numbers needed to be add starting from row 1 until the word "Flag1" is found. Like:

	A
1	1
2	3
3	4
4	Flag1

```
'Set Current row to 1 and Myvar to 0
CurrentRow = 1
MyVar = 0 'Optional line
'Set Do…Loop to check for flag row
Do While Cells(CurrentRow, "A") <> _
"Flag1"
MyVar = MyVar + Cells(CurrentRow, "A")
CurrentRow = CurrentRow + 1
Loop
```

Be careful using Do loop. Check carefully if the condition turns falls when you want to terminate the loop. Otherwise the loop may never terminate (called infinite loop) and your computer will appear hanged. Press **Ctrl + Break** key to force terminate the execution.

4. Example: When you sum positive integers as **sum** =1+2+3+…+n, suppose you are interested in knowing what would be the maximum value of **n** so that the sum is still <= a given number. For instance if the given number is 5, then, 1+2 (= 3) is still <= 5 but 1+2+3 (=6) exceeds 5, so n = 2. Write a function that will get you **n** for any given positive number **SumTo**.

Solution: You do not know how many times you need to keep adding so For…Next is not choice here. Keep adding a higher integer while the sum is still <= give number.

```
Public Function CalculateN(SumTo)

'Initialize variables
Sum = 0 'Sum of integers
Count = 0 'Integers
Do
    Count = Count + 1
    Sum = Sum + Count
Loop While Sum <= SumTo
'Subtract 1 from Count as SumAll has
already exceeded SumTo
CalculateN = Count - 1

End Function
```

Review Questions

15. How IIF function in VBA and IF function is Excel are similar? Compare their structure.

16. What is the structure of a block IF statement?

17. When do you used a block IF Statement?

18. What is looping?

19. How For…Next is different than Do…Loop?

Practice questions

20. Give an example of IIF function that you might think of.

21. Implement your example using IF…THEN…ELSE and block IF statement.

22. Magic square is a square grid of integers whose sums are equal for each row, column and diagonal. For Example for a grid of 3x3, the magic square would look like:

8	1	6
3	5	7
4	9	2

Sum in all direction = 15.

The algorithm for creating a magic square for n×n grid where n is an odd number > 1 is as follows.

i.   Make a n×n grid.

ii.   *Begin by placing a first number in the middle column of the top row.*

	1	

iii.   *Then write successive integers in an upward-right diagonal path, with the following special cases:*

- *When this upward-right movement would result in a location outside the boundaries, place the new number at the opposite end of the row or column that went out of the boundary.*

	1	
3		
	2	

- *If the upward-right square is already occupied, or out of grid for both row and column, place the new number directly below the current one.*

	1	6
3	5	7
4		2

	8	1	6
3	5	7	
4	9	2	

Write a SUB procedure to create a magic square of size given is A1 following above procedure. Make your upper-left square of grid to cell B2.

Lab Exercises
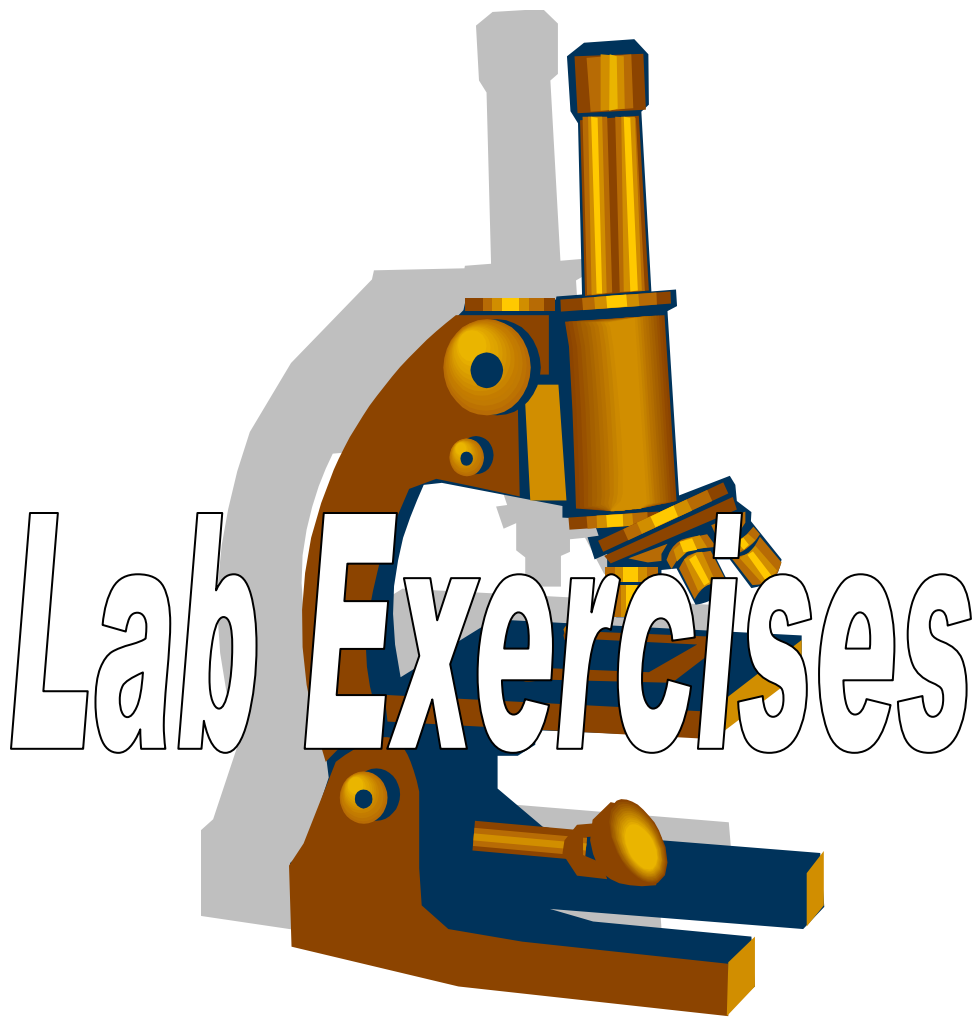
Computer Hardware

1. Turn off the computer and disconnect the power to the computer
2. Open the outer cover for chassis
3. Identify the following components inside the computer:
   a. Power Supply unit
   b. Motherboard
   c. CPU
   d. Ram
   e. PCI slots
   f. Hard drive

Assembling a computer

4. Touch to a metal surface to discharge any static electricity on you.
5. Get an empty ATX chassis and open the side panels.
6. Lay down chassis and install the motherboard (ATX or micro-ATX).
7. Install the CD ROM drive.
8. Install Hard drive
9. Install Power Supply Unit (PSU).
10. Install Processor and fan.
11. Install memory
12. Connect wires according to motherboard manual.
13. Install the Operating System.
14. Use internet to search for two desktop PCs in the price range below $ 500 and above $500. Read some of their specifications. Make sure you understand the important specifications that have implication to processing speed. Fill out the following information:

	Computer 1	Computer 2
Processor type/speed		
Amount of L1/L2 cache		
Amount of RAM		
FSB speed		
Price		

Search component vendor and compare the price if you had assembled your own computer.

Word Processing 1

This exercise provides an overview of Microsoft Word interface and help Identify the different Word features of the by exploring a document. At the end of the laboratory the students are expected to:

1. Understand the logical grouping of various tabs.
2. Understand page margins, paragraph indentation and using ruler to change and view the same.
3. Understand and use header and footer in a document.
4. Identify and correct the misspelled word.
5. Apply Heading, paragraph, bullet and numbering style.
6. Use find and replace feature of the word to subscript a chemical equation like CO_2.
7. View document at different zoom level.
8. Use word count in word.
9. Practice with revealing and hiding formatting mark.
10. Hide and unhide ribbon, add more command to quick access bar.

Instructions

Create a new folder named ASM240 on your H drive (Network drive) or USB flash memory. Download **Bioenergy.doc** from the course content section of Blackboard and save in the folder you just created.

15. Open Microsoft Word 2007. From office menu 🔲 open the file "Bioenergy.doc". Notice the "compatibility mode" displayed next to document name. That means the document is in older version of word which may not support some new features of Word 2007.
16. From Page Layout tab >> Page setup >> Margins >> Custom margins, set margin to 0.75 inches in all sides.
17. Correct the underlined misspelled words by right clicking over them with the mouse. Alternatively under Review tab >> Proofing >> Spelling and grammar to do the spell check.
18. Display the line numbers in the document through Page Layout >> Page Setup >> Line Numbers >> Continuous.
19. Select the block of text starting from Line 10 to 13. Hover your mouse on top of quick menu that appears (if menu does not appear automatically then right click) and select bullet and numbering. Alternatively select bullet and numbering from Home >> Paragraph group.
20. Apply **Title** style to "Agriculture and the World Energy" and **Heading 1** style to "Introduction", "Heat and temperature" and "Bioenergy". Apply style by placing your caret where you want to apply the style and then from Home >> Styles >> select the style you want to apply.
21. Find all instances of 2 as in CO2 and H2O using find feature of word. (Home >> editing >> find or KB shortcut: **Ctrl + f** for find dialogue box)
22. Replace the 2 that is associated with chemical equation with subscript 2 like H2O. (Home >> editing >> replace or KB shortcut: **Ctrl + h** for replace dialogue box). To replace with special formatting (subscript in this case) Click on "More" command button at the bottom of find and replace dialogue box. Then from under Format command button >> Font >> Effect >> Subscript. Press OK. Now you should see "Subscript" under replace with indicated the replaced text will be subscripted.
23. From Insert tab >> Header & Footer, put your name as header.
24. Save your document as Lab2_your last name and save as **.docx** (word document) format. Notice the compatibility mode disappears.

25. *Zoom your document to view at 50% and 200% using zooming slider bar located at the bottom right corner of Word or from View >> Zoom (KB Shortcut: Scroll the mouse roller while you hold Ctrl Key)*

26. *Read the word count in the document. Either from Review >> Proofing >> Word Count or from status bar. If word count is not displayed on the status bar, right click the status bar and make sure* ☑ Word Count *is checked.*

27. *Practice with revealing and hiding formatting marks. (Home >> Paragraph >> ¶ or KB shortcut: Ctrl + *). Identify the formatting markings for*
    a. *Spacing*
    b. *Paragraph marking*
    c. **Hard line break** *(If you do not have one, insert a hard line break by typing SHIFT + ENTER).* **Hard line break** *breaks the line without inserting a new paragraph.*
    d. *Tab character*

28. *Change the heading to upper case using Home>> Font >> Aa command.*

29. *Hide and unhide the ribbon using quick access bar and Kb shortcut: Ctrl + F1 key*

30. *Add more command to quick access bar and afterwards delete them before you leave.*
    a. *For existing command: Right click on the command and select "Add to Quick Access Toolbar"*
    b. *For other command right click on quick access toolbar and select "Customize quick access toolbar…"*

31. *Practice with customizing the status bar. Right click the status bar and check and uncheck various options you would like to display or hide.*

32. *Invoke Word help by pressing ⓘ on the upper right corner of Word (KB shortcut: F1) and search for the word "2003". Spend some time to locate your favorite features from word 2003 and make yourself comfortable with Word 2007.*

Word Processing 2

This exercise provides inserting and working with objects, especially you will work with

1. *Paragraph object*
2. *Table object*
3. *Flow chart*
4. *Equation object*
5. *Word Art*
6. *Building blocks*
7. *Text box*

Instructions

1. *Open a new document and set margins to 1" in all direction (Set gutter to 0).*
2. *Apply Fancy style set.*

The economic return over operating cost for some selected crops in Northern Idaho is shown below. Reproduce this table using appropriate tabs without using table feature.

3. *Set the tab for the header as follows (you may use the ruler to set the tab. If you ruler is not visible make sure to check Ruler option* ☑ Ruler *under view tab. You can also use the Paragraph Properties Dialogue box from Home>> Paragraph >>* ⬛ *>> Tabs. To activate the 'Tabs' dialogue box you could also double click on top ruler. Your ruler should look like this after you finish setting the tabs*

4. *Type the following line:*

   Operating cost ($/ac)   Yield   Unit   Price/unit   Return ($/ac)
5. *Press Enter and set the tab for the rest of the table as:*

Winter wheat	152.85	75	bu	3.55	113.40
Chickpea	198.19	1200	lb	0.21	53.81
Lentils	128.22	13	cwt	13.60	48.58

6. *Save your document*
7. *Following table shows the costs and returns per acre to produce soft white winter wheat. Create the table with automated summation. Apply a formatting style from one of the available table styles.*
   Make sure to set the following properties:
   1. *Table width = 5 inches from table properties*
   2. *Column 2 to 5 = 0.7 inch each*
   3. *Row height = 0.1 inch*

	Quantity Per Acre	Unit	Price or Cost/Unit	Value or Cost/Acre
Gross Returns				
Wheat	75.00	bu	3.55	266.25
Total Gross Returns for Wheat				266.25
Operating Costs Fertilizer:				
Nitrogen	120	lb.	0.40	48.00
P_2O_5	45	lb.	0.25	11.25
Sulfur	20	lb.	0.17	3.40
Seed:				
Wheat seed	80	lb.	0.16	12.80
Custom:				
Sprayer	1.0	acre	1.50	1.50
Pesticide:				
Bronate 4lb. Ai	0.5	qt	11.20	5.60
Harmony Extra	0.33	oz	14.60	4.82
Other:				
Crop Insurance	1.0	acre	2.60	2.60
Labor (machine)	1.38	hrs	13.15	18.13
Labor (non-machine)	0.31	hrs	7.70	2.39
Fuel – Gas	2.23	gal	2.66	5.94
Fuel – Diesel	7.09	gal	2.45	17.38
Lube				3.50
Machinery Repair				7.28
Interest on Operating Capital @ 7.50%				7.28
Total Operating Costs per Acre				152.85
Net Returns Above Operating Costs				113.40

8. Draw a reasonable and neat copy of the flowchart shown below that accounts for life cycle energy input in biodiesel production.
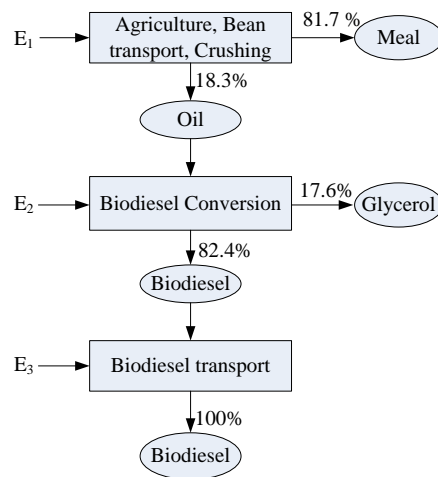
9. Insert your name using Word art
10. Save the document.

Word Processing 3

1. Searching for a template
2. Using a template from web
3. Viewing the formatting marks
4. Understanding the template
5. Using and linking text boxes
6. Drawing a flow chart
7. Changing object properties
8. Changing predefined formatting
9. Inserting special text in header and footer

Instructions:

1. Open a new word document form file >> new and from task pane under templates click on templates on office online.
2. In the Microsoft office webpage, search for a template with theme family newsletter. Select "Family newsletter" from the list displayed.
3. Download the template.
4. We are going to create a newsletter for ASM 240 from this template as shown in the example.
5. Save template as Lab3_yourlastname and also remember to save your work periodically as you work on it.
6. Reveal formatting (Ctrl + *) and see how the template is laid out. Take time to understand this template. Especially note that all the texts are over an image.
7. Change title "Our family" to "ASM 240".
8. Select Newsletter data and insert today's date (Month and year only) from Insert >> Date and time.
9. Change "COLLEGE APPROACHING FOR JEFF AND DENISE" to Golf Decision"
10. Delete all texts inside text boxes and copy paste (text only no formatting) from the text shown below.

    This summer ASM 240 team is planning on a golf game. However, whether the team will be able to go out and play depends on the weather. Following flow-chart will help the team to decide whether to go out and play or do housework.

11. Replace the text "BEN GRADUATES FROM 6TH GRADE!" to "ASM project report!"
12. Replace the text inside the text box after the heading with following text.

    For our final project we decided to make a excel workbook for Gooding County Choppers (GCC), a corn chopping company. More to the point we are making a workbook that will allow ease and convenience of record keeping and billing. Currently GCC is manually writing all the weight sheets by hand and transferring the weights into excel where the final billing is done.

    Because GCC offers a 25 cent per ton discount if bills are paid within 10 days of receiving the bill it is costly to take a long time with the billing. Because weights are handled by hand billing takes up to a week and a half. Having the data inputted directly into the computer will save this lost time, having billing done within one day. This reduces our chance of people paying late and us losing money.

With this new workbook weights will inputted into the computer directly, formulas will automatically be copied and conversions made. All this will be done with an easy to use form so all the record keeper has to do is type in the numbers and hit enter, and all the information will be put into the proper record.

This new workbook will have several forms, the first being the weight form (Fig. 1), and the second being the moisture form (Fig. 2, next page). Five moisture tests are taken per day and for ease of entry we have created a separate form just for that. This form places each moisture test in the proper order in which it was taken. When this is done the workbook automatically averages all the moistures for the day. This number is then copied to every other sheet and calculated into the conversions.

This new workbook, when put into effect, will save time, energy and money. To accomplish all this we used a combination of Excel formulas, macros, and Visual Basics Editor. To present this project to our classmates, we also made a PowerPoint presentation that explained our problem, our goals, what we did and our results.

In conclusion, the final project helped us to put all of the skills we have learned in this class to a useful purpose. We now have a greater understanding for computers, how they work and how they apply to real life problems.

13. *Watch how the text flows into following textbox. It is because two text boxes are linked. Text will not flow to unlinked text boxes. Do not worry if text box does not fit all texts.*
14. *Delete previous contents of the text box and everything on page 2.*
15. *Replace the picture with figure 1.gif from your Blackboard*
16. *Format picture to make it floating over text. Resize as necessary and place inside square box. Resize square box to fit.*
17. *Drag text box beneath the figure to above the figure and resize not to overflow into the figure.*
18. *Create a new textbox either dragging an existing textbox while holding the Control key or from insert text box.*
19. *Link this new textbox to previous textbox so that texts that did not fit into previous textbox will flow into the new textbox.*
20. *Replace "Caption about your family photo." to "Figure: A form to enter weight data"*
21. *Open a new Word program and draw the flowchart as shown in the figure. Format and fill the flow chart to your favorite colors. Use connectors not a line with an arrow*
22. *Select four boxes on the left sides and align at the center from Draw >> Align or distribute. Also distribute them to have equal spacing in between shapes.*
23. *Change the order of text boxes to behind the lines so that it does not cover up a portion of line*
24. *Format layout of the drawing canvas to In front of text (Other).*
25. *Copy paste your drawing canvas to your newsletter and re-position to fit nicely.*
26. *Change color of heading 2 styles to orange color from style and formatting.*
27. *Change the paragraph setting of "body text" so that the first line is indented by 0.5".*
28. *Insert Author, Page#, Date using insert auto text in footer section. If author name is not displayed correctly, under file menu go to properties and under summary tab change the author to your name.*
29. *Compare your document to sample document shown on the next page*

GOLF DECISION

This summer ASM 240 team is planning on a golf game. However, whether the team will be able to go out and play depends on the weather. Following flow chart will help the team to decide whether to go out and play or do the housework.
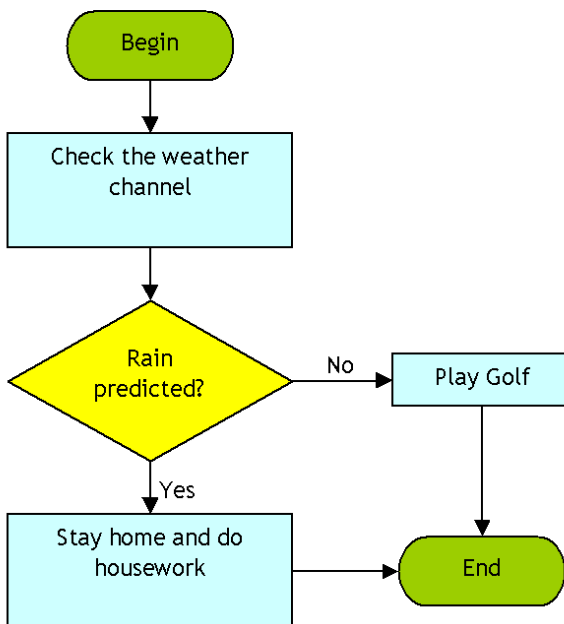
ASM PROJECT REPORT!

For our final project we decided to make a excel workbook for Gooding County Choppers (GCC), a corn chopping company. More to the point we are making a workbook that will allow ease and convenience of record keeping and billing. Currently GCC is manually writing all the weight sheets by hand and transferring the weights into excel where the final billing is done.

Because GCC offers a 25 cent per ton discount if bills are paid within 10 days of receiving the bill it is costly to take a long time with the billing. Because weights are handled by hand billing takes up to a week and a half. Having the data inputted directly into the computer will save this lost time, having billing done within one day. This reduces our chance of people paying early and us losing money.

With this new workbook weights will inputted into the computer directly, formulas will automatically be copied and conversions made. All this will be done with an easy to use form so all the record keeper has to do is type in the numbers and hit enter, and all the information will be put into the proper record.

This new workbook will have several forms, the first being the weight form (Fig. 1), and the second being
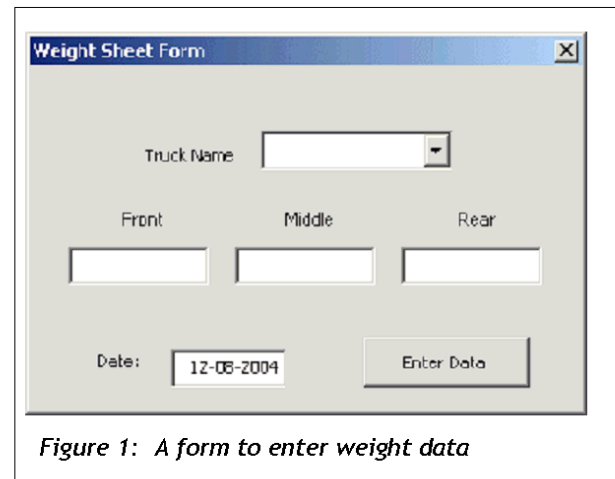
Figure 1: A form to enter weight data

the moisture form (Fig. 2, next page). Five moisture tests are taken per day and for ease of entry we have created a separate form just for that. This form places each moisture test in the proper order in which it was taken. When this is done the workbook automatically averages all the moistures for the day. This number is then copied to every other sheet and calculated into the conversions.

This new workbook, when put into effect, will save time, energy and money. To accomplish all this we used a combination of Excel formulas, macros, and Visual Basics Editor. To present this project to our classmates, we also made a PowerPoint presentation that explained our problem, our goals, what we did and our results.

In conclusion, the final project helped us to put all of the skills we have learned in this class to a useful purpose. We now have a greater understanding for computers, how they work and how they apply to real life

Word Processing 4

When I type (c) word automatically makes it ©. When I type adn word automatically makes it and. It is because Word has autocorrect feature.

- ☑ I used picture like this for my bullets.
- ☑ I changed the indenting so that it aligns with paragraph.
- ☑ I added my name to the Auto Text List. I used auto text to complete my name here: <Insert your name from auto text>
- ☑ Formatted this section as two columns
- ☑ General Text is formatted as Normal style which is in Times New Roman 12 pt.
- ☑ Used Styles and Formatting to modify Title styles. Title is center aligned with 16 pt., bold, Verdana font. I have used copy formatting to copy title style to the line "Table of contents" below.

Table of Contents

The following table of content was inserted automatically after completing rest of the document in this page.

Heading 1

Heading 1 has following format properties:

Font: Arial, 16, Bold, Blue, and Engrave

Paragraph: Left aligned, Outline level-1, indentation=0, special= hanging by 0.3". After and before spacing = 0, Line spacing = 1.5.

Border: Box, Shading Gray-5%.

Numbering: Outline numbered

Heading 2

Heading 2 is Bold Italic 14 pt Arial with no indent. Same outline numbered, Spacing before 3 pt, Spacing after = 3 pt.

Numbering: Outline numbered

Heading 2

Heading 3

Heading 3 is Bold 13 pt Arial with no indentation. Spacing before 12 pt, Spacing after = 3 pt.

Numbering: Outline numbered

Format pasted H3

Use format copy to format above line as heading 3.

Heading 1

Heading 2

After you press Enter after heading 2 styles it should start typing in Normal style.

Heading 2

A picture also has a formatting style. See what happens if you apply Heading 1 style to this figure. Finally I drew an orange 3pt thick line between section 1 and 2.

A text box can have a vertical aligned text and no borders.

Word Processing 5

Table of content

1. Open "How did life originate.doc" from your Blackboard. (You might have already downloaded and saved on your thumb drive).
2. Try inserting table of content at the beginning of this document? You may not see any table of content inserted because the document does not have clearly defined headings.
3. Apply different heading styles as you find appropriate.
4. Re insert the table of content at the beginning of the document.
5. Insert a section break next page after the table of content.
6. Start the page numbering from 1 for the main document (table of content page should not have any numbering on it.).
7. Update the page number field.
8. Print your table of content page.

Mail Merge/ Mailing Labels

9. Download the Addresses.xls to your H drive.
10. Open Excel file and add your Name and address (could be made up) at the end of records.
11. Open Word
12. From Mailings> Start Mail Merge >> Step by step mail merge Wizard
13. Select label options: 5660 type labels
14. Use Addresses.xls, Sheet 1 as the data source
15. Layout labels as you wish
16. Preview
17. Print out the single sheet and hand in for credit

Using template / Creating a form

18. In word from Office menu select New and form and from Microsoft office on line template select Forms >> Academic . Then download "Substitute Feedback Form".
19. From Word Options, make the Developer tab visible.
20. Unprotect this document by selecting Developer>>Protect Document >> Restrict Formatting and editing. Then from the task pane that appears click on Stop Protection
21. Imagine that you are creating a survey of land use in Palouse agriculture. Modify the language or the survey form to reflect your questionnaire (Be imaginative to make up your own). Add the following fields for questions using legacy field or form fields.
    a. Date: Use date picker for users to allow selecting a date.
    b. Farm size: Drop down list with three choices (Small (<100 ac), Medium (100-500 ac) and large (>500 ac).
    c. Primary crop: Combo box with preset list (Wheat, Peas and Lentil).
    Add more questions if you wish and then protect the document.

Excel 1

Instructions:

1. Open Excel and open a new file.
2. Locate the following items on Excel:
    1. Select all box
    2. Sheet tabs
    3. Tab split
    4. Horizontal window split
    5. Vertical window split
    6. Name box
    7. Formula bar
3. Click each tab on the ribbon and spend few minutes exploring what command buttons are under each tab. Hover and rest your mouse under each command to read that that command does.
4. Use help (F1 key) to search for 2003. Use interactive guide to find the stuffs from Excel 2003.
5. Type your Name on Cell A1.
6. Type following mathematical expressions to use Excel as a calculator.

    a. 3+11-6

    b. -3 * 4 + 3

    c. 2+3*2 (First guess your answer)

    d. 8/2*2 (First guess your answer)

    e. 8*2/2(First guess your answer)

    f. $2 + \dfrac{4}{5}$

    g. 2 ¼+3 ½ (Hint: to enter 2 ¼ type 2 space 1/4)

    h. $\dfrac{2\frac{3}{4} + 4\frac{1}{4}}{7}$

    i. $\dfrac{3 \times 10^{-4} + 7 \times 10^{-4}}{10^{-5}}$ (Use the letter format aeb to write a x10^{b})

    j. $\dfrac{1}{2} + \dfrac{2}{3} + \dfrac{3}{4}$

    k. $1 + 3 \times 4 - 3(-1)^2 + (-4)^2$ (Do not forget to put x for multiplication)

    l. e^2 (e here represents exponent. Do not confuse mathematical exponent with Excel's e shorthand notation e). Use EXP(a) to represent exponent of a that is e^a

    m. e^{-2}

    n. Using 8 bits you could count only from 1 to 256. Verify that 2^8 = 256.

    o. Using the same pattern find out how big you can count using 20 bits?

7. Answer following questions. Indicate question number you are answering on column A.

  a. Convert -15°C to °F using the conversion equation $F = \dfrac{9}{5}C + 32$

  b. The number N of bacteria present in a culture at time t (in hours) obeys the equation N = 100e^{0.01t}. How many bacteria do you expect in 10 hours?

  c. Often environmentalists will capture an endangered species and transport the species to a controlled environment where the species can reproduce off springs and regenerate its population. Suppose that six bald eagles were captured and transported to Montana and set free. Based on experience, the environmentalists expect the population to grow according to the model.

$$P(t) = \frac{500}{1 + 83.33e^{-0.162t}}$$ where t is time in years.

   i. What is the predicted population of the bald eagles in 10 years?
   ii. What is the carrying capacity of the environment? (Carrying capacity is the maximum population that the eagles will ever get up to. Put a large value for t say 100 years and note down the population. Now put t = 500 years and see if the eagle population changes.)

  d. If you deposit $500 in a bank CD and it gives you an interest of 5% per year. How much its value will be at the end of 1st year? The following year? After 5 years? Create the following table. Hint, adding 5% is equivalent to multiplying a number by 1.05.

End of Year	Value
1	=500*1.05
2	...
3	...
4	...
5	...

8. Create the following tables in Excel:

Box #	Produce
1	Apple
2-5	Cherry
6-10	Peach

Ratio	Fraction	Decimal
2:4	2/4	0.5
3:4	3/4	0.75

Hint: preceding cell content with ' would tell Excel to keep the content as text.

9. Scroll the sheet using arrows, home, and end key. What is the difference between Ctrl end and Ctrl + ↓?
10. Read the very last row number in sheet 1 and verify that it matches with your answer from #6 (o).
11. Save your excel file.

Excel 2

In this Exercise you will practice to:

1. Adding worksheets
2. Renaming a worksheet
3. Inserting columns
4. Formatting text and numbers.
5. Using Paste special
6. Copying formula using a fill handle.

7. Using mathematical operators
8. Using various functions
9. Referencing a range of cells
10. Auto formatting table
11. Viewing page break marks
12. Printing just what you want

Instructions:

Download Exercise VII Start.xls from Blackboard, save it to your H drive and rename it to LastName.xls. Next download and open the file Exercise VII Demo1.pdf. The demo file is to be used as a reference to show you what your finished Excel file should look like. Please note that the demo file has no equations or functions in the cells, your Excel file will because you will be calculating many of the values.

1. Add a worksheet and name it as "Temperature" and place in after SnoTel worksheet.
2. First on the SnoTEL worksheet, select and copy the range of cells A3:AF16 (**Not F16**). You can select cells by dragging your mouse pointer or by selecting a corner cell and clicking on opposite corner cell while pressing shift key. Try both ways for this example.
3. Then on Temperature worksheet select A4 and then from the context menu select Paste Special…>>Transpose.
4. Arrange the month of February to its proper place in the table. (You can insert a column after January and copy paste February. You can move using cursor by selecting a range of cell and then dragging selection border.)
5. This table is of daily temperatures at Moscow Mountain in °C. But we want to convert this to °F. Begin this by copying table heading from cell A4 to M4 and pasting to A40 to M40, then add the day of the month column to the left using fill handle (do not copy paste).
6. In cell B41 enter the equation =9/5*B5+32 and press enter. B41 should now equal 37.4 which is that day's temperature in °F. Copy this equation throughout the table to complete it. Use fill handle to copy the formula. Important: Make sure to delete the copied formula that refers to the blank cells.
7. Calculate the average monthly temperatures below the new table (See demo). Use the Average() function. For example B73 =Average(B41:B71). Compare these values to the demo. (Hint: Average() will <u>not</u> count blank cells in the calculated average for short months such as February, but <u>will</u> count cells with a value of 0)
8. Add table title as shown in the demo for your new table.
9. Change number format of the table to have only one decimal place.
10. Apply the same table format as the demo by selecting each table and going to Format>>AutoFormat…>>List 1>>Options and unselecting the Width/Height option.
11. Change view to page break preview and change the page setup to landscape if needed.
12. From file>> page setup, change header to display your name.
13. Print the table for temperature in °F along with table heading. Select the area you want to print and before it goes out to printing make sure you select selection radio button under print what. Consider previewing before actual printing by clicking on preview.
14. Insert a new worksheet and name it to Number crunch.
15. This is a simple calculating sheet to help practice entering an equation and using Excel functions. You will answer following questions on this sheet. Indicate question number you are answering on column A.

1. Area of a circle with radius r is given by $A = \pi r^2$. Find the area of a circle with radius of 1' 3" in square feet. Display your value up to 1 decimal place.

2. Convert -15°C to °F using the conversion equation $F = \frac{9}{5}C + 32$

3. Evaluate the expression $1 + 3 \times 10^4 - 3(3-1)^2$

4. Evaluate the expression $3^2(2-4)^{10}$

5. Enter your last name in cell A1, first name in cell B1 (Insert Rows if necessary to make space). Enter this expression combine to a single name **= B1 & " " & A1**.

6. The number N of bacteria present in a culture at time t (in hours) obeys the equation N = 100e^{0.01t}. How many bacteria do you expect in 10 hours? Round you value to nearest integer.

7. Often environmentalists will capture an endangered species and transport the species to a controlled environment where the species can reproduce off springs and regenerate its population. Suppose that six bald eagles were captured and transported to Montana and set free. Based on experience, the environmentalists expect the population to grow according to the model. Round the number to nearest integer.

$$P(t) = \frac{500}{1 + 83.33e^{-0.162t}} \qquad \text{where, 't' is time in years.}$$

   a) What is the predicted population of the bald eagles in 10 years?

   b) What is the carrying capacity of the environment? (Carrying capacity is the maximum population that the eagles will ever get up to. Put a large value for t say 100 years and note down the population. Now put t = 500 years and see if the eagle population changes.)

8. A study was conducted to determine urine flow of sheep (in milliliters/minute) when infused intravenously with the antidiuretic hormone ADH. The urine flows of 10 sheep are recorded as: 0.7, 0.5, 0.5, 0.6, 0.5, 0.4, 0.3, 0.9, 1.2, 0.9. Determine the mean and the standard deviation of the sample data.

9. If you deposit $1000 in a bank and it gives you an interest of 5% per year. Interests are calculated every month. How much will be its value after 30 years? (Hint search for an appropriate function)

10. In addition to initial deposit of $1000 in above case you also start saving $100 every month. Assuming same amount of interest rate, how much value your money will grow up to after same 30 years? Use ABS function to convert negative number into positive.

16. Under Tools>>Options>>View >> Page breaks and make sure all of your answers fit in a page. Make adjustments as needed to make it fit in a page.

17. Print the page and also email your spreadsheet when you are done.

Excel 3

Instructions:

In an agribusiness farm you are assigned to select a grain bin that can hold at least 100,000 bushel of grain within company's budget of $20,000. Available bin diameters are at 5 ft diameter increment from 20 to 50 ft. Available bin heights are 40 ft to 80 ft in 10 ft interval. You objective is to pick the best bin diameter and height combination so that the volume of storage per unit price is maximized (Biggest bang for buck).

You start your calculation by sorting out which of the available bins can hold at least 100,000 bushels. For that you want to calculate the storage capacity of each bin diameter and height combination. The grain volume is measured in bushels (1 bushel = 1.24 cubic feet). Follow these steps:

1. *Write you name in cell A1*
2. *Create a table outline like this*

	A	B	C	D	E	F	G
1	Name						
2							
3	Bin volume in bushel for different bin height and diamtere combination						
4		Bin height					
5	Bin diameter	30	40	50	60	70	80
6	20						
7	25						
8	30						
9	35						
10	40						
11	45						
12	50						

3. *Volume of a bin is calculated using this formula: $V = \pi d^2 h/4$ where V is volume in cubic feet, d is diameter in feet and h is height in feet. To calculate the volume in bushel you will have to divide the result from this equation by 1.24. Enter the equation in cell B6. Use PI function to substitute for π and appropriate cell address in the equation.*
4. *Now put the $signs at appropriate places so that when you copy the formula to fill the table, it will display the correct result. Double click on several cells with formula pasted and verify that it refers to correct cell address for bin diameter and height combination.*

   (Alternatively and also more elegantly, you can name the range A6:A12 as diameter and range B5:G5 as Height and used name in your equation. Also to create a named constant like Cubic_feet_to_bushel for 1.24, from Formulas >> Defined Names >> Define Name type in like shown on right →
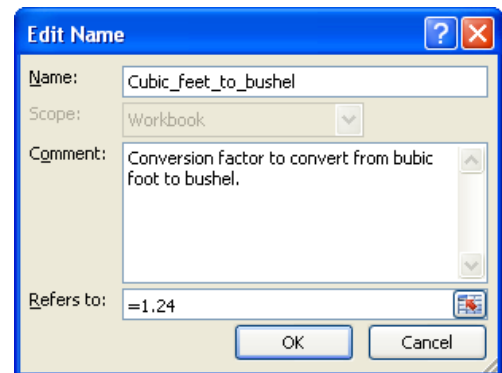
   Then your equation would look like

=PI()*diamater^2*height/4/Cubic_feet_to_bushel
which is much easier to understand what is going on and what did you do when review the same sheet next year than if you have written your formula like:
=PI()*$A14^2*B$14/4/1.24

5. Use conditional formatting of cells to make the background of cells green that can hold at least 100,000 bushel of grain. (Hint conditional formatting is under Home>>Style>> under dropdown menu for conditional formatting select New rule then select "Format only cells that contain" . Then set the appropriate rule at the bottom portion of dialogue box.
6. The price of the bin is basically proportional to amount of the sheet metal used and can be calculated suing the following equation:
Bin price = Total sheet metal work in square feet * 1.36
Sheet metal work includes the metal for wall and roof. Metal for wall is given by the equation:
Metal for wall = πdh
Metal for roof = $\frac{\pi d^2}{2\sqrt{2}}$ (Hint: Use SQRT function for $\sqrt{2}$)
7. Calculate the price for each bin that meets the volume criteria and tabulate the result like this (Fill in cells with "?" signs):

Bin diameter	Bin height	Bin Volume	Bin cost	Volume/$
?	?	?	?	?
?	?	?	?	?
?	?	?	?	?

8. Now recommend the bin diameter and height combination that gives you the highest storage volume per $ and still within the company's $20,000 budget for bin purchase.
9. Your company borrows the money to buy the bin you recommended from a bank with following criteria,
Loan term: 10 years
payback: biannual (every 6 months)
Total payments: 20
Interest rate: 5.75% (annual rate)

Find the amount of each payment using appropriate function. (Hint search for a function that calculates "payment")
10. Neatly organize your worksheet so that it is easy to read for your supervisor (Instructor in this case).

Excel 4

1. If 12889 cookies were packed in boxes each holds 144 cookies, how many full boxes of cookies will you have? How many cookies will be left after the last full box? (Hint: use QUOTIENT and MODE functions)

2. Generate a random number between 1 and 6 in cell A1 to simulate rolling of a dice. Copy this function to cell B1. (Hint: Use RANDBETWEEN function). Press F9 key to recalculate Excel sheet and see if you get different number each time? (Note: RANDBETWEEN returns a new number every time it is recalculated and hence it is called a volatile function. Means its value is changed every time you recalculated.

3. The odd of getting any number in rolling of a dice is 1/6. Therefore if you roll a dice 60 times you should get each number about 10 times. Copy your function that generates a random number to fill 60 cells (10 rows * 6 columns) and count how many you got for each number using COUNTIF function. Did you get all numbers = 10? Repeat rolling of dice by pressing F9 to see if you ever get all counting = 10.

4. Fine amount in overdue payment is calculated as: 1% per day of the payment amount for first 15 days, 2% per day after that. A payment of $220 was due on February 23, 2008 which was paid only on March 15.Calculate the amount in fine? Use Excel to do all calculations.

   Hint: The calculation can be summarized as follows

   Payment = 220

   Overdue = Given date – Due date

   IF Overdue > 15 Then   Fine = Payment * 15 * 1% + Payment * (Overdue -15) * 2%

   ELSE   Fine = Payment * Overdue * 1%

5. Calculate how many days has been past from Jan 1st of this year to today?

6. A person's age at a given date can be calculated by subtracting birth year from the year part of given date if birthday for that year has already past otherwise, the age will be one less than the result you get by year subtraction.

To check if a birthday has passed, both month and day of year is question has to be greater or equal to birth month and day. The flow chart can be like this:
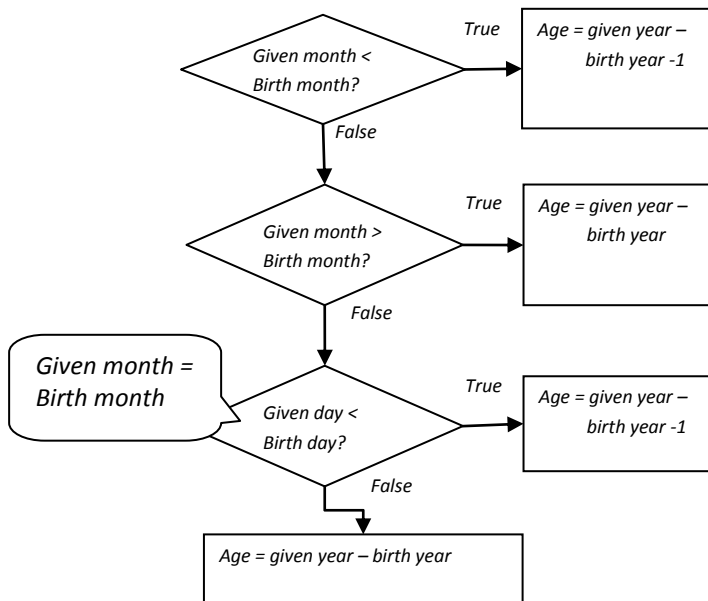
Sample calculation

Birth_Month = MONTH(Birth_date)

Birth_Day = DAY(Birth_date)

Given_Month = MONTH(Given_date)

Given_Day = DAY(Given_date)

Years = YEAR (Given_date) - YEAR(Birth_date)

IF Given_Month < Birth_Month THEN

ELSE IF Given_Month > Birth_Month THEN

Flow chart:
- Given month < Birth month? — True → Age = given year – birth year -1
- False ↓
- Given month > Birth month? — True → Age = given year – birth year
- False ↓
- Given month = Birth month
- Given day < Birth day? — True → Age = given year – birth year -1
- False ↓
- Age = given year – birth year

ELSEIF Given_Day < Birth_Day THEN

Age = Years – 1

ELSE

Age = Years

END

This can be implemented in Excel using IF function as:

= IF(Given_Month < Birth_Month,Years-1,IF(Given_Month > Birth_Month, Years, IF (Given_Day < Birth_Day,Years-1,Years)))

Assume that Birthday is entered in cell A1 and given date is entered in cell A2. Implement above calculation to find the person's age at date in cell A2.

7. Interest rate on 15 year home mortgage is based on credit score as follows:

	A	B	C	D	E
1	Loan amount	$ 150,000.00		Credit score	Interest rate
2	Loan years	15		0	7.50%
3	Credit score	8		3	6.70%
4	Interest rate	5.40%		5	6.20%
5	Monthly payment	($1,217.68)		7	5.80%
6				8	5.40%

Insert a new worksheet and create it like shown above. The Excel should look up for the interest rate from given table from credit score in cell B3. (Use credit score value that is next lower or equal to someone's credit score). So interest rate and all other grayed cells are not editable by user.

Use LOOKUP function to look for the interest rate. Calculate Monthly payment using PMT function. Once you all formulas in place and working, unlock the cells B1:B3 (Select B1:B3, right click >>

[icon] Format Cells... . Under protection tab unselect locked ☐ Locked . Then From Review tab select Protect Sheet. With following property

☐ Select locked cells
☑ Select unlocked cells

Use the form to answer this question

How much would be the monthly payment on $250,000 loan for someone with credit score 6.5?

8. You want to generate a text sequence as Image001, Image002, and Image003. Where the word "image" is in column 1 and number 1, 2, 3 are in column B. Use TEXT function along with "000" formatting option to pad extra zeros before number and CONCATENATE function to add the information in column A and B.

9. If you type ="A"<"B" in a cell it will return TRUE. In Excel texts are compared according to their ASCII value. Find the ASCII value of letter A, a, B, @, and # using CODE function. The expression ="*">"$" is true or false? Why?

10. Save your Excel file.

Excel 5

1. USDA grades beef primarily on its inter-muscular fat content. A random sample of USDA prime beef from two farms had the following fat percentages

    Farm 1   2.64   2.96   2.31   2.66   3.14   2.62   2.80   2.50   2.64   2.83
   Farm 2   2.89   2.82   2.93   2.90   2.93   2.87   2.99   2.92   2.95   2.91

    Answer the following questions:
    a. What are the mean fat percentages for farm 1 and farm 2 beef?
    b. What is the standard deviation of fat percentages for two farms?
    c. Which farm produces more consistent meat quality?
    d. If you were the buyer, from which farm would you buy your meat? Discuss about your answer choice.

2. Beef quality can be monitored using infrared reflectance from carcasses. Following table shows the relationship between reflectance and inter-muscular fat content.

Reflectance	Fat%
20.7	2.67
20.1	2.30
20.8	2.50
22.4	3.23
22.6	3.45
22.7	2.91
24.7	3.28
24.1	3.63
24.6	3.65
26.8	4.72
26.7	4.54
26.4	4.38
28.0	4.18
28.6	4.27
28.7	4.53
30.3	4.28
30.3	4.66
30.2	4.85
32.0	6.08
32.1	5.82
32.5	5.47
35.0	5.66
34.4	6.50
35.0	6.03

The relation between reflectance and fat% can be modeled as **Y = a.X+b** where, **Y** is reflectance, **X** is fat%, **a** is slope and **b** is intercept.

a. Find the value of **a** and **b** (Hint: use SLOPE and INTERCEPT functions)

b. US prime beef should not have more than 3% of fat (**X = 3**). From the model (**Y = a.X+b**), estimate the value of reflectance corresponding to 3% of fat.

c. What percentage of reflectance variation is explained by fat%? (Hint: Use R^2 value (RSQ function) to answer this questions)

d. if a beef had reflectance of 25, what would be the corresponding fat%? (Hint: X = (Y-b)/a)
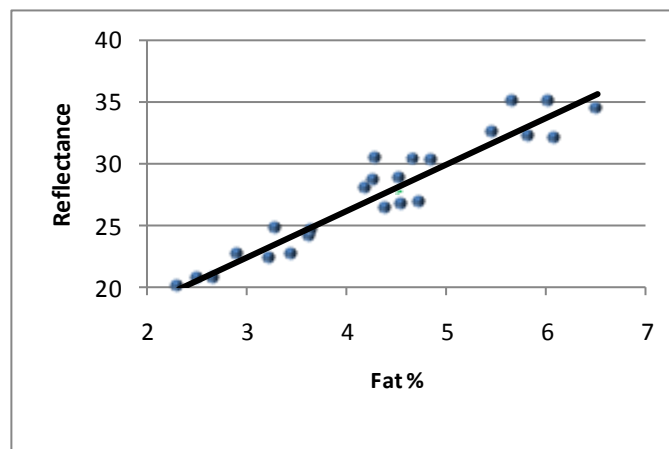
3. Using above data, create a histogram for following ranges of fat% using Analysis Toolpak
<= 3, >3→4, 4→5, 5→6 and >6

(Hint: you need to create bin ranges as

3	4	5	6

)

4. Age at death of Capuchin monkeys around a drug factory were found as follows:

Age	1	4	7	9	11	14
Frequency	3	5	14	15	6	2

Calculate the average life expectancy of the monkeys. (Hint: look at your note for help)

5. Jack wants to get an average of 80% to get at least "B" grade. He has 75, 76, and 81 in previous 3 tests. One final test is left and the final grade is going to be the average of four tests. How much he should secure in final to get average of 80%? Use goal seek to answer this question.

6. Using goal seek, solve the following equation for x

$$\frac{2-x}{x} \times 100 = 20$$

(Hint: Assume some cell as x, let's say A1. Start with a guess (say 1) in cell A1. Enter the left side of the above equation =(2-A1)/A1*100 in some other cell (say A2).

If A1 has the correct answer, then cell A2 would 20. But A2 does not have 20 so x=1 is not the corrent answer. Now goal seek for cell A2 to value 20 bu changing cell A1 as:
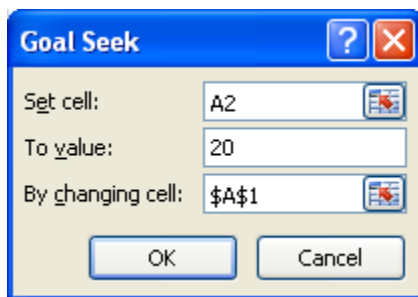
The value in cell A1 is the value of x you are looking for.

7. Using goal seek, solve the following equation for x
15+x = 5(x-1)

8. At what temperature both Celsius and Fahrenheit have equal reading? Use goal seek to answer this question. (Hint, $C = \frac{5}{9}(F - 32)$, when C and F are equal you can assign C = F = X and use the equation $X = \frac{5}{9}(X - 32)$, then solve for X)
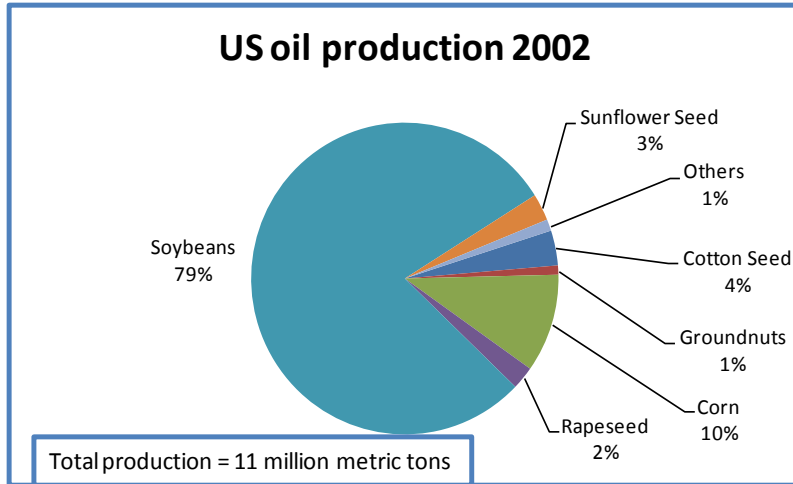
9. Save your Excel file.

Graph and Chart

Instructions:

Download and save Graphit.xls from Blackboard under course contents. Produce the following charts from the data provided.

1. *Produce a chart as follows from the data given on "Oil" worksheet. (Rotate data series to 70°)*

2. *Produce a chart as follows (specified in grayed boxes) from the data in "Engine" worksheet.*
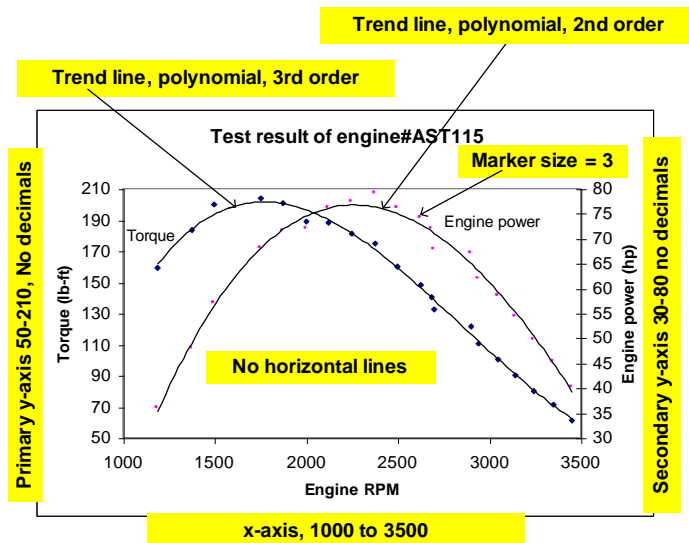
3. *Produce the following chart (as specified in grayed boxes) from "Dice" worksheet. Your observed # may look different.*

This sheet uses RANDBETWEEN function to generate a random number between 1 and 6 to simulate rolling of a dice and add up two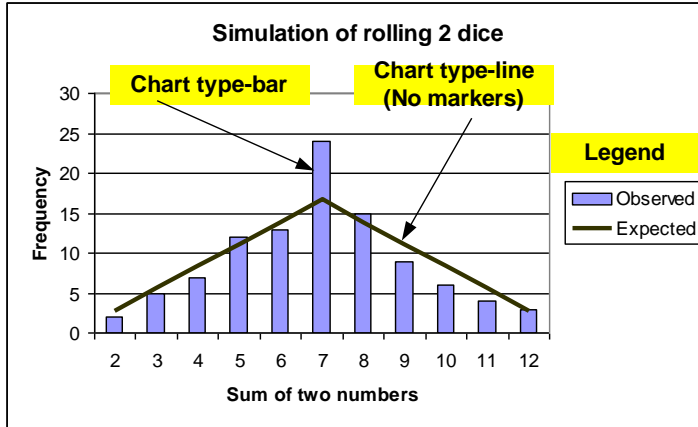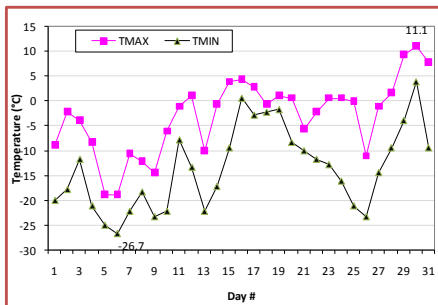 numbers from random rolling. The process is repeated 100 times and frequency is calculated. Since RANDBETWEN is a volatile function expect to get the different observed frequency every the sheet is recalculated.

4. *Temperature data for Ames Iowa in January 2000 is given in the Temperature worksheet. Create a chart as shown below.*

5. *Microbial count from a carcass sample was determined and recorded in microb worksheet. Create a chart as shown below.*
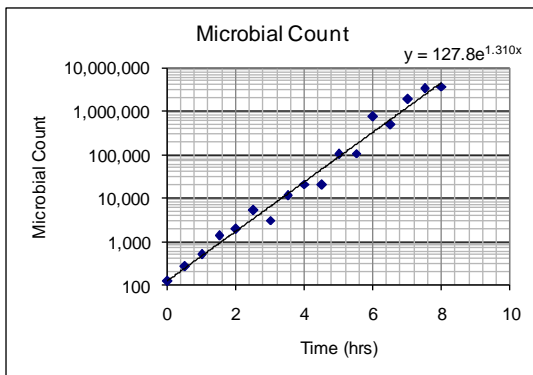
6. *Add a worksheet and name it "wolf". The logistic growth model* $P(t) = \dfrac{1000}{1 + 32.33e^{-0.439t}}$ *represents the population of wolf after time t years. Growth rate of wolves are restricted by food availability and hence cannot grow unbound. Plot the number of wolves from t = 0 to 20. What was the initial count of wolves?*

Do you think if enough time is allowed to grow the wolves, it will exceed 1000 population with this growth model? Use ROUND function to round your number to the nearest integer.

7. *Save your Excel file.*

Database

1. *Download Expenditure data.txt from course contents*

2. *Import into Excel (comma delimited) and save as Expenditure.xlsx*

3. *Apply data validation to date from Jan 1, 2007 to Dec 31, 2007.*

4. *The cells should display "Enter a date in year 2007"*

5. *The cell should display a warning message outside of this range.*

6. *Name Sheet2 as "Category List"*

7. *Create a list of expenditure categories here as:*

   Grocery
   Clothing
   Medical
   Entertainment
   Eating out
   Miscellaneous

8. *Name the range of categories as "Expenditure_Category"*

9. *Apply data validation to Categories to List and on the source box type = Expenditure_Category.*

10. *A cell in category filed, should display "Select a category from drop down list" when selected.*

11. *Set Error Alert to "STOP" with appropriate message.*

12. *Apply Expenditure data validation to a positive number (>0).*

13. *Set Error alert to information, as returned of purchased item could be a negative cost.*

14. *Add the following new records:*

Date	Category	Expenditure
12/31/07	Entertainment	59.99
12/20/07	Clothing	83.58
12/31/07	Eating Out	22.58

15. Use Pivot Table to make the following table:

Sum of Expenditure	Column Labels						
Row Labels	Clothing	Eating Out	Grocery	Intertainment	Medical	Miscellaneous	Grand Total
Jan	222.92	51.17	225.2	68.4		38.44	606.13
Feb	81.84	66.46	227.56	71.29	87	53.4	587.55
Mar	161.14	50.43	210.58	78.57	60	62.4	623.12
Apr	175.51	50.3	207.73	73.65		47.72	554.91
May	121.24	72.13	266.32	53.94	90	33.18	636.81
Jun	212.79	60.34	171.55	78.74		46.46	569.88
Jul	197.45	67.72	196.75	67.35	350	103.62	982.89
Aug	312.49	66.48	181.37	59.97		75.45	695.76
Sep	129.87	74.66	216.25	106.8	25	41.18	593.76
Oct	130.7	53.19	200.6	76.36		57.24	518.09
Nov	98.36	42.34	181.14	73.81		59.79	455.44
Dec	178.16	56.79	248.71	73.55		37.94	595.15
Grand Total	2022.47	712.01	2533.76	882.43	612	656.82	7419.49

16. Answer the following question regarding data:

   a.   Which month the spending was the most?

   b.   Which category spending was the highest for year 2007?

   c.   How much does the person spent on average per Grocery shopping?

   d.   How many times the person did go to Grocery in Month of May?
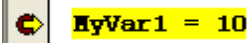
17. Save your Excel file.

MACRO and VBA

Instructions

1. Open a New Excel File and open visual basic editor (VBE). (Alt+F11) or Developer>> Visual basic
2. Explore the VBE environment and make yourself comfortable working on this environment.
3. Hide and unhide "project explorer" window.
4. Hide and unhide "properties" window.
5. Arrange your "project explorer" and "properties" windows neatly.
6. Insert a module in Book1.xls to write your function.
7. Insert a function called TEST.
8. Inside the function block type the following expressions:

   MyVar1 = 10
   MyVar1 = 20
   MyVar1 = MyVar1 + 1
   MyVar2 = MyVar1 + MyNewVar1
   MyNewVar1 = MyNewVar1+1
   MyVar2 = 2+3*4
   MyVar2 = 4*exp(-3*MyVar2)
   MyVar2 = WorksheetFunction.pi() * MyVar1^2
   Test = 100

9. Call this test function from Excel, What does it returns?
10. Explore what functions are available in VBA from View >> Object Browser. Under All Libraries, select VBA from the drop down list. Locate $\rightarrow$ DateSerial function and press F1 to get help about that function.

Using debug menu

VBA allows you to go through each command line one at a time and examine the variable values. For that, you need to set a break point at the line where you want to start examining. We will stop the execution at the first line and examine what each command line does to understand what is going on:

11. Set a breakpoint at the first line (MyVar1 = 10). To do this click anywhere on that command and from Debug >> Toggle Break Point. (Shortcut F9).
12. From Run>> Click on ▶ Run Sub/UserForm F5 (Shortcut F5)
13. The function is going to RUN that is start to execute and will stop at the break point. Like
    ⟳ MyVar1 = 10
14. Hover your cursor over MyVar1 to see its value.
15. From Debug >> StepInto (Shortcut F8) to execute that line.
16. Now hover your cursor again over MyVar1, what does it show?
17. The variable values can also be examined without hovering the cursor over variable. From Debug >> Quick Watch to open a quick watch window.

18. *Drag and drop the variables to quick watch window to display its values like:*
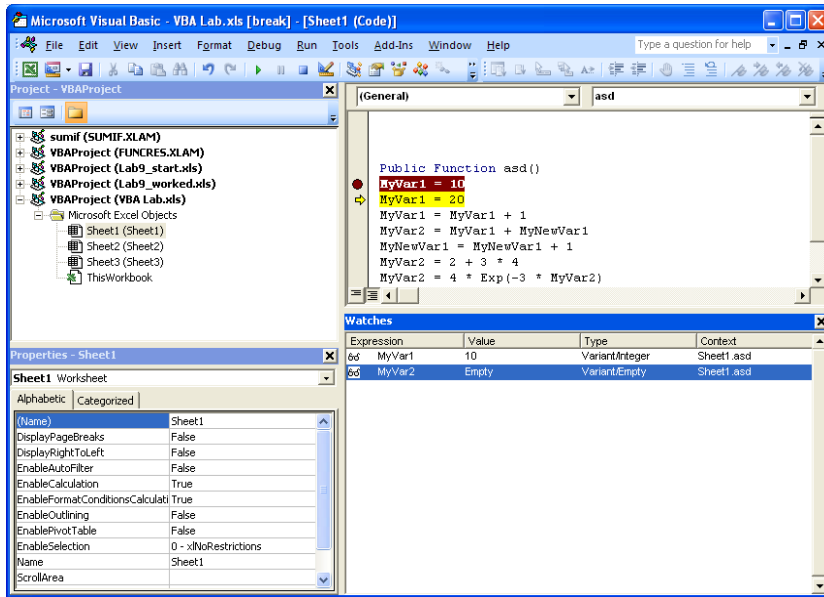
19. *Step over the remaining lines of code by pressing F8 (or Step into from Debug menu)*
20. *Watch how the values of variables change after every line executes.*
21. *Write a comment after each line or above the line to explain yourself what that command line is doing, for example add a comment of the line as:*

    MyNewVar1 = MyNewVar1+1 'Increments the value of MyNewVar1 by 1

22. *If you want to run the rest of the lines at any point press F5 or Run >>*

Inserting more functions

23. *Create a function that converts from feet and inches to meter.*
24. *Create a function named 'volume' which returns the volume of a sphere given a radius of sphere r. The equation to calculate volume from radius is V = 4/3*π*r3. (Hint, there is no Pi() function in VBA, so use Excel's PI() function)*
25. *Create a function named 'perimeter' which returns the perimeter of a circle given a radius of circle r. (P = 2*π*r)*
26. *The logistic growth model*

$$P(t) = \frac{1000}{1 + 32.33 e^{-0.439t}}$$

27. *Represents the population of bacteria after time t in hours. Write a function named bacteria that returns bacteria population P at any given time t in hours. (Hint, EXP function is available in VBA as well, so you don't need to borrow this function from Excel)*
28. *Area of any triangle with side lengths a, b and c is given by*

    A = $\sqrt{S(S-a)(S-b)(S-c)}$ where,

    S = (a+b+c)/2.

    Write a function that calculates the area of a triangle given a, b and c.
29. *Write a BMI function so that you can enter your weight in pounds and height in feet and inches.*

Working with Excel Objects

Application object

7. Change Excel title bar so that it displays today's date instead of "Microsoft Excel."
   Date returns today's date in VBA, so the command:

   `Application.Caption= Date`

   will write date in caption. To restore default, set caption to nothing

   `Application.Caption= ""`

8. Change Statusbar to display "University of Idaho"

   `Application.Statusbar= "University of Idaho"`

   To restore default

   `Application.Statusbar= ""`

9. Make the Application invisible and visible again

   `Application.visible = False` *'(Hide Excel application, (it stills runs in the background)*

   `Application.visible = True` *'(Reveals again)*

10. `Application.Cursor = xlWait` *'will make the cursor appear ⧖, Even if excel is not doing anything. Try other cursor types from the table and when done trying restore the cursor to default type.*

Object Name	Refers to
Application	*Entire Excel application*
Sheets	*Collection of all worksheets*
Sheet1, Sheet2…	*Worksheets 1, 2…*
Selection	*Range of selected cells*
ActiveSheet	*Currently active worksheet*
ActiveCell	*Currently selected cell*
Cells(Row,Col)	*Particular cell in active worksheet*
Range("Address")	*Range of cells*

Name	Values
☑ *Visible*	*True (default), False*
☑ *Caption*	*"Microsoft Excel"(default)*
☑ *StatusBar*	*To display message in Status bar. "Ready" (default)*
Cursor	• *xlDefault (default)*
	• *xlIBeam*
	• *xlNorthwestArrow*
	• *xlWait*
Sheets	*Sheets collection sub object also a global object*
• *Calculate*	*Method that invokes calculation*
• *Evaluate*	*Evaluates an expression*

11. `Application.Statusbar = Application.Sheets.Count` *or* `Application.Statusbar = Sheets.Count` *will write the number of open sheets on status bar.*

12. `Application.Calculate` *will recalculate and update cells. It is equivalent to pressing F9 button in Excel.*

13. *Application.evaluate evaluates an excel expression.*

   `Cells(2, 1) = Application.Evaluate("=pi()*12^2")` *'Should write 452.4 on cell A2*

Sheets object

`Sheets.Add` *'will add a new worksheet before the activeworksheet*

`Sheets.Add  After:=Sheet1` *will add a new worksheet after Sheet1*

`Sheets.Add After:=Sheets(Sheets.Count)` *will add a new worksheet at the end*

`Sheets(1).name = "January"` *will rename the sheet1 as January*

Sheets("January").Cells(1,1) = 25 *will write 25 on cell A1 of the sheet January*

Range object

Range("A1") = 100 *will write 100 in Cell "A1" of the active cell*

Range("A1:A100").copy *will copy to clipboard*

Range("A1:A100").copy Cells(1,3) *or*

Range("A1:A100").copy Range("C1") *will copy and paste the range A1:100 to C1:C100*

Range("A1").Font.Size = 72 *will make font size = 72*

Range("A1").RowHeight = 100 *'will set the row height to 100*

Range("A1").Font.Color = RGB(255, 0, 0) *'Red color*

Range("A1").Interior.Color = RGB(127, 127, 127) *'Gray color*

Range("B1:B100").Formula = "=5/9*(RC[-1]-32)" *'Write 100 formulas at once*

Cells object

Cells is a collection object like sheets and can be used to refer to any cell

Cells(1,1) is the same as Range("A1")

Range("A1:B5") is same as Range(cells(1,1),cells(5,2))

Reading cell values

Range("A1")=Range("A1").RowHeight *will read row height and write to cell A1*

X = Activecell.Row *will read the row number of the active cell*

Y = Activecell.Column *will read the column number of the active cell*

Cells(X+1,Y)=8 *will write the value 8 in one row below activecell*

Exercise:

1. *Write a macro that reads the value in cell A1 then add 1 to it and writes it back to cell A1. Then insert a Form controls ➔ Button to call the macro. Test the button to make sure it works.*

2. ***3/3 magic square***. *Write a macro that create the following magic square with upper left corner of the magic square at the ActiveCell*
3. *Insert a Form controls* ➔ *Button to call the macro*
4. *Label your button to "Magic"*
5. *Make sure your macro works*
6. *Print your macro code and submit*

8	1	6
3	5	7
4	9	2

Excel Objects and Controls

In this Exercise you will practice:

1. *Understanding Excel objects*
2. *Using a command button control to call a sub procedure*
3. *Using Textbox control*
4. *Using Label Control*
5. *Using Combo Box control*
6. *Using Stats bar to display the information*

Instructions

Using Excel Objects

1. *Download and open Lab9_start.xls*
2. *Open visual basic editor.*
3. *Insert a sub procedure and write VBA code that reads the value from Sheet1 cell A1 and writes the same value to Sheet2 cell A1.*
4. *Add a line to read the value from Sheet1 cell A2 and write to Sheet2 cell B1*
5. *Run the Sub procedure.*
6. *Switch to Excel and see if the values were written properly in Sheet2.*
7. *If you look at Population Worksheet (Which is the Name of Sheet1 object), it contains the population count of US by states listed alphabetically. Unfortunately, instead of state names in one column and population in adjacent column, population is reported below each state making it difficult for you to rank the states according to its population. To sort the list according to population you need to separate state name and population into two columns as shown below.*

	A	B
1	Alabama	4599030
2	Alaska	670053
3	Arizona	6166318

    One way to achieve this is to cut and paste population yourself for each state but that is a cumbersome way to do. To simplify the task you will use VBA code. Since you already know how to read and write data (from exercise 3 and 4), reuse the code using FOR loop to repeat the action for all states (Of course with some modification for row numbers). After you run the code you should have two columns with state and population as shown above.
8. *Sort the columns find out the 26th state (the middle state) ranked by population.*

Using Control Objects

9. *Insert a command button control and change its caption properties to "CALCULATE". (Make controls toolbox visible. Click on command button control and draw the control over Sheet 1.)*
10. *Insert a textbox to enter height of a person in meter. Change the TextAlign property fmTextAlighRight (*

    TextAlign   3 - fmTextAlignRight *)*
11. *Insert another textbox to enter the weight of a person in kg.*
12. *Hide the grid lines of the Sheet1 (Form Tools>>Options menu).*
13. *Insert a label to display the calculated BMI value. Your user interface should look like:*

Write the necessary codes so that when a user clicks "CALCULATE" button the label should show the BMI result as "YOUR BMI = XX.X". Use ROUND function to round up the number to 1 decimal place. Your code would probably look similar to:

```
Wt = Textbox1.Value
Ht = Textbox2.Value

Label1.Caption = "Your BMI = " & Round(Wt / Ht ^ 2, 1)
```

Working with a Spin Button

Spin buttons are used to change the values of a textbox or cell in a specific sequence. You need to set Max, Min and Small Change property to fine tune the upper limit, lower limit and increment of the spin button. To get or set the current value of a spin button, use, value property.

Insert a spin button. Change its max value to 7, min value to 1 and small change value to 1. Handle the Spin button Change event to write the day of a week depending current value of spin button(1 = Sunday..7 = Saturday) in cell A1. Your code should look like this.

```
Private Sub SpinButton1_Change()

Cells(1,"A") = WorksheetFunction.Choose…

(SpinButton1.Value,"Sun","Mon","Tue","wed","Thu","Fri","Sat")

End Sub
```

> *… means continuation of the line.*

Working with a Combo Box

Combobox is a combination of a textbox and dropdown arrow showing a list of items form where a textbox entry can be selected from. Usually the list displayed in drop down box come form a cell range in Excel.

14. Write January to December in cell a range of cells.
15. Insert a combo box and change its ListFillRange property to the range of cells that have month names.
16. Come out of design mode and test your combo box.
17. Write an event handling procedure so that whenever you change the value of the combo box the selected month name will be displayed on the status bar.