THE KEY TO MICROSOFT EXCEL

A GUIDE TO USEFUL PRACTICAL SKILLS

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Topic 1: Spreadsheets

Definition

Spreadsheet: application package designed to store, organize and manipulate numerical data and charts.

- Also called electronic ledger.
- Examples : MS Excel, Lotus 1-2-3

Uses of Spreadsheets

1. **Accounting**
   - Prepare budgets
   - Calculate profits

2. **Statistical analysis**
   - Calculating statistical values e.g. mean, median etc.

3. **Data management**
   - Organizes data in tabular manner
   - Operations include sorting, filtering etc.

4. Tracking value of assets
   - Calculating appreciation and depreciation.

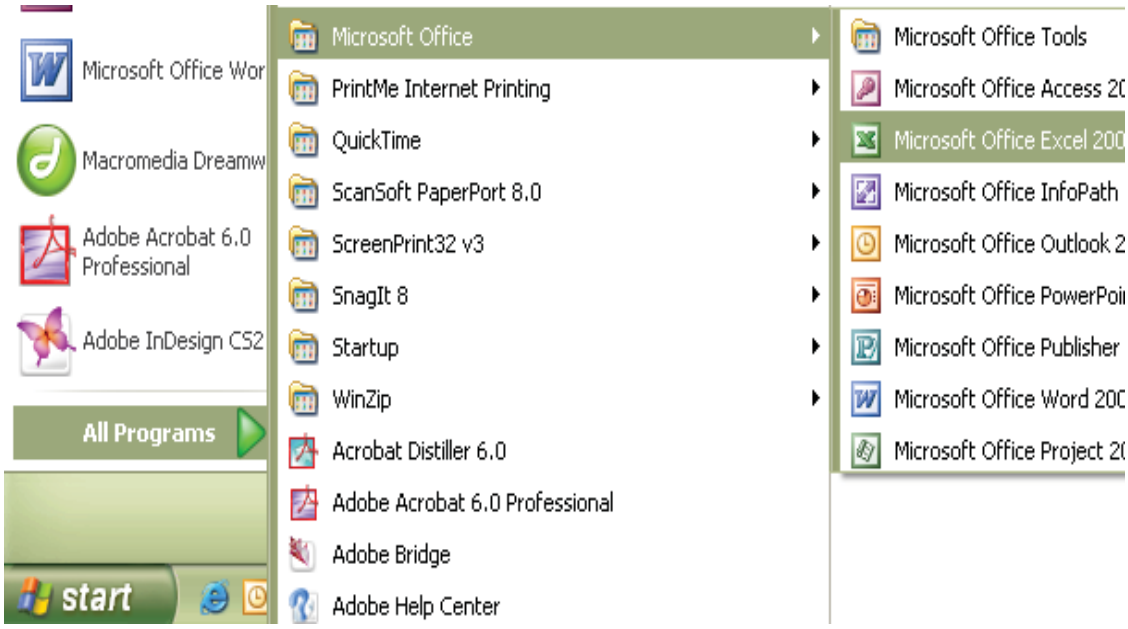
5. **Forecasting**
   - Its automatic recalculation feature enables 'what-if' analysis

Topic 2: Introduction to MS Excel

- A product of Microsoft Corporation.
- Versions: Excel 97, 2000, XP, 2003, 2007, 2010, 2013.

Starting Excel 2007

Step 1 Click the Start button on the taskbar
Step 2 Point to All Programs or Programs
Step 3 Point to Microsoft Office
Step 4 Click Microsoft Office Excel 2007



Excel Terminology

1. **Cell** – intersection of a row and a column.
2. **Cell Address** - consists of column letter and row number.
3. **Range** – a group of cells
4. **Active cell** – highlighted by thick borders.
    - Location for typing into a worksheet.
5. **Worksheet**- MS Excel working area.

- Consists of rows and columns
- Contains 1,048,576 horizontal rows (numbered 1 through 1048576) and 16,384 vertical columns from column A to column XFD.

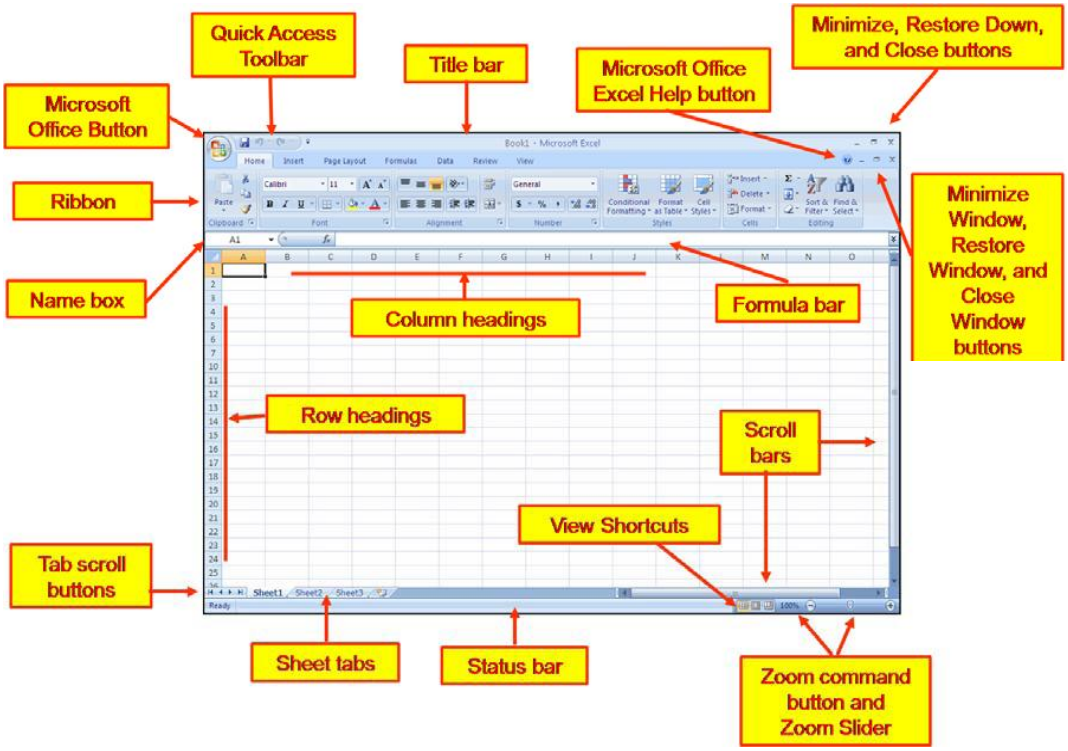
6. **Workbook** – refers to an MS Excel spreadsheet file.

- By default, consists of 3 worksheets.

The Excel Cell Referencing System

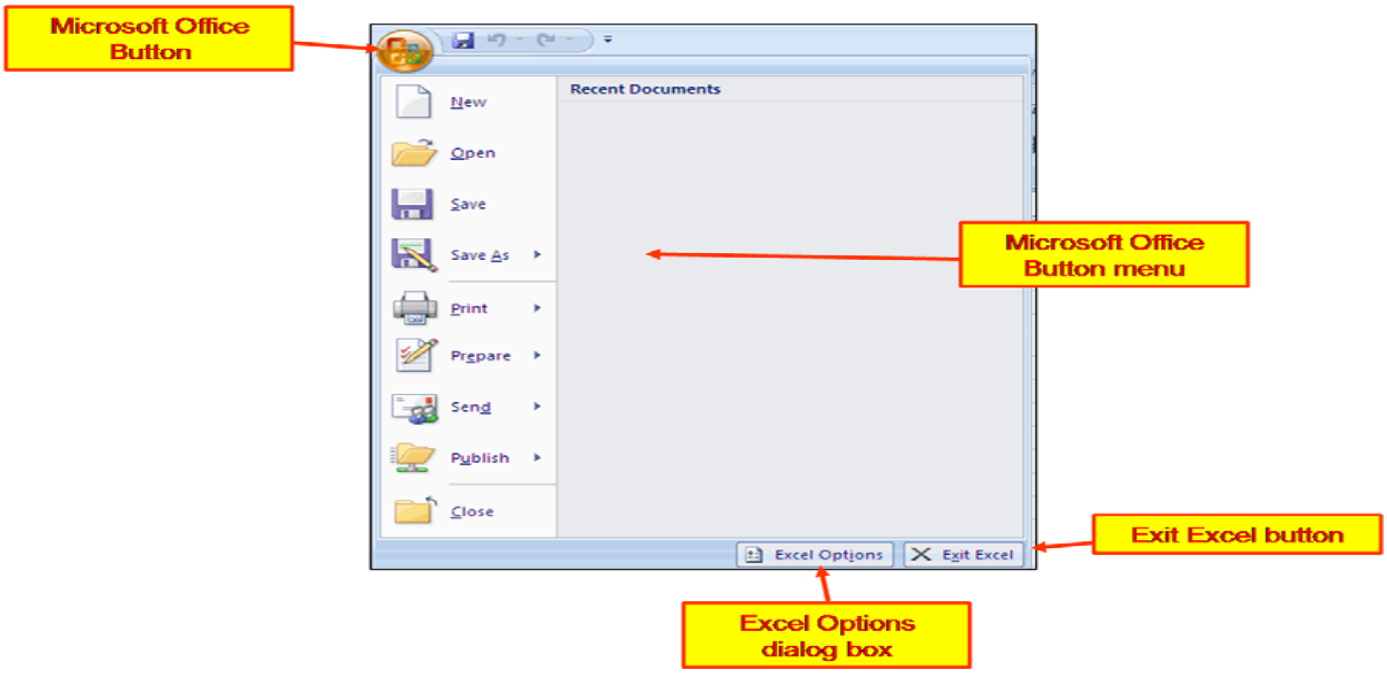
- Each cell has a unique address.
- An address consists of column letter and row number.
- There are two cell referencing styles, the:
  (i) A1 style - An address consists of column letter and row number e.g. B3, D2 etc.
  (ii) R1C1 style – both the row and the column are numbered e.g. R2C4 etc.

The Excel window

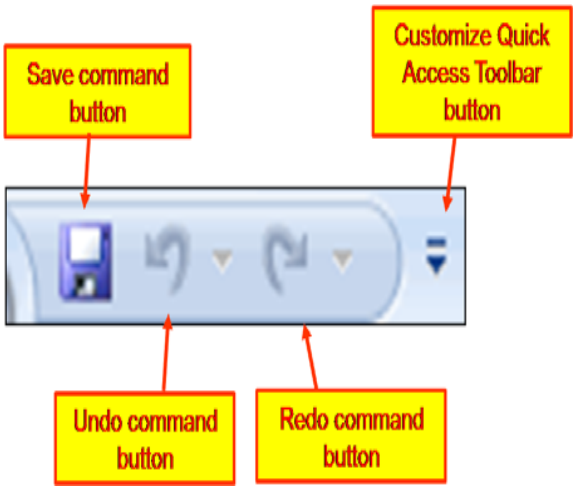


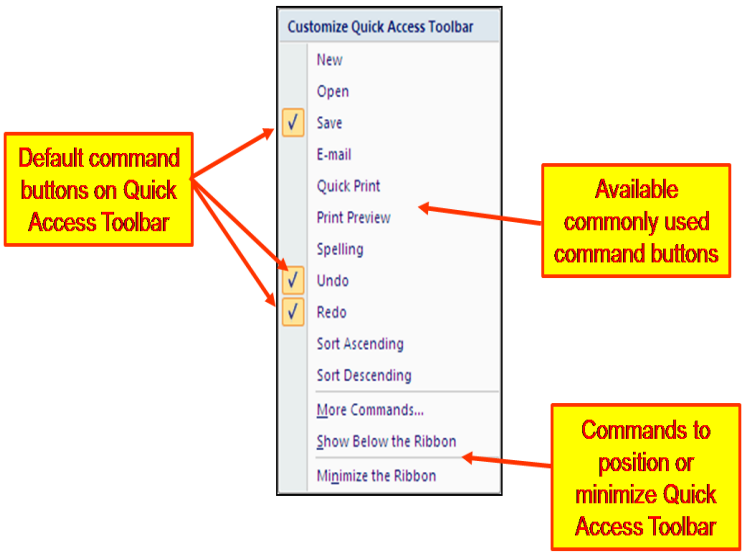
Excel Window Elements

1. **Microsoft Office Button** – contains a pull down menu with most frequently used commands e.g commands used to create, open and save workbooks, and print worksheets



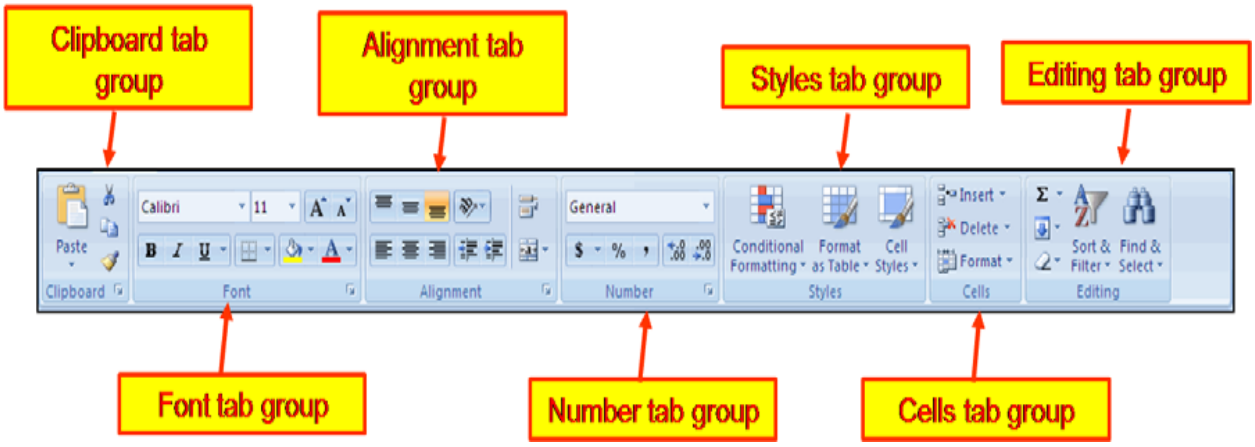
2. **Quick Access Toolbar** – a customizable toolbar





- The **Quick Access Toolbar (QAT) -** provides a faster access to commands.
- By default, the Quick Access Toolbar contains the Save, Undo, and Redo **command buttons** in addition to the Customize Quick Access Toolbar button.
- You can add or remove command buttons on the Quick Access Toolbar to help you quickly perform common tasks.

3. **Title bar** – contains the name of the workbook and the name of the software
4. **Microsoft Office Excel Help button** – used to access Excel Help.
5. **Minimize Window button** – minimizes the current workbook to a title bar icon inside the Excel window.
6. **Restore Window button** – restores the active workbook to a smaller window inside the Excel window.
7. **Close Window button** – closes the active workbook.
4. **Scroll bars** – vertical and horizontal scroll bars used to change the vertical or horizontal view of worksheet areas
5. **Status bar** – a customizable bar below the worksheet area that is used to display various messages, the View Toolbar, the Zoom button and the Zoom Slider.
6. **View Shortcuts** – contains view command buttons used to change the view of the active worksheet
7. **Zoom button** – a command button used to change the magnification or "zoom" of the worksheet view
8. **Zoom Slider** – a slide control used to change the magnification of "zoom" of the worksheet view
9. **The ribbon**

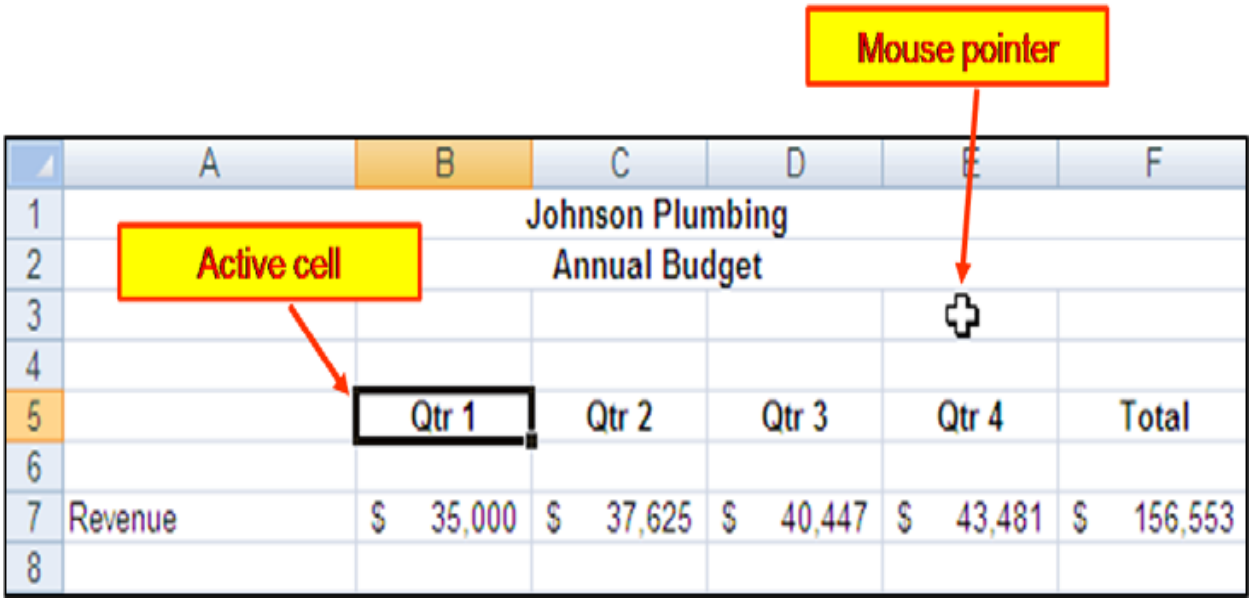


- The **Ribbon** contains a series of grouped command buttons organized around specific tasks.
- There are 3 parts to the ribbon – tabs, groups and commands.
  - (i) **Tab** – designed to be task oriented.
  - (ii) **Tab group** – divides a task into subtasks
  - (iii) **Command** – carries out a command operation or displays a command menu.

10. The **Name Box-** shows the cell reference of the active cell in the worksheet.
11. The **Formula Bar-** shows the contents of the active cell.
12. **Column Headers -** are the letters only at the top of the worksheet.
13. **Row Headers -** are the numbers on the left side of each row of the worksheet.
14. **Active Cell -** is the currently selected cell, displayed with a thick black border around the cell.
15. **Status bar-**provides a message area, for example the Caps Lock or Num Lock "on" warning message, in addition to displaying the View Shortcuts, the Zoom command button, and the Zoom Slider.
16. **Sheet Tabs –**

- Identify the **current** worksheet.
- Used to navigate from one worksheet to another.

Navigating in a Worksheet



- The **home cell – cell A1.**
- You can use the mouse pointer to navigate from one cell to another, thereby making the destination cell the active cell.

Keyboard shortcuts for navigating in a worksheet

To Navigate:	Press:
Up one cell	UP ARROW
Down one cell	DOWN ARROW
Right one cell	TAB or RIGHT ARROW
Left one cell	SHIFT + TAB or LEFT ARROW
To the first active cell in the current row	HOME
To the last active cell in the current row	END and then ENTER
Down one page	PAGE DOWN
Up one page	PAGE UP
To cell A1	CTRL + HOME
To the cell in the lower-right corner of the active area of the worksheet	CTRL + END or END and then HOME
To the last cell a blank column	END + DOWN ARROW
To the last cell in a blank row	END + RIGHT ARROW
To the first cell in blank column	END + UP ARROW
To the first cell in a blank row	END + LEFT ARROW

Excel Data Types

1. **Labels**
- Any text and alphanumeric data
- Used to make worksheet data more readable.
2. **Text**
- Any text and alphanumeric data
- Cannot be manipulated mathematically
3. **Numbers**
- Numerical values that can be manipulated mathematically
4. **Date**
- Calendar values
5. **Time**
- Time values
6. **Formula**
- User defined mathematical expression
7. **Function**
- Excel inbuilt mathematical/text operations

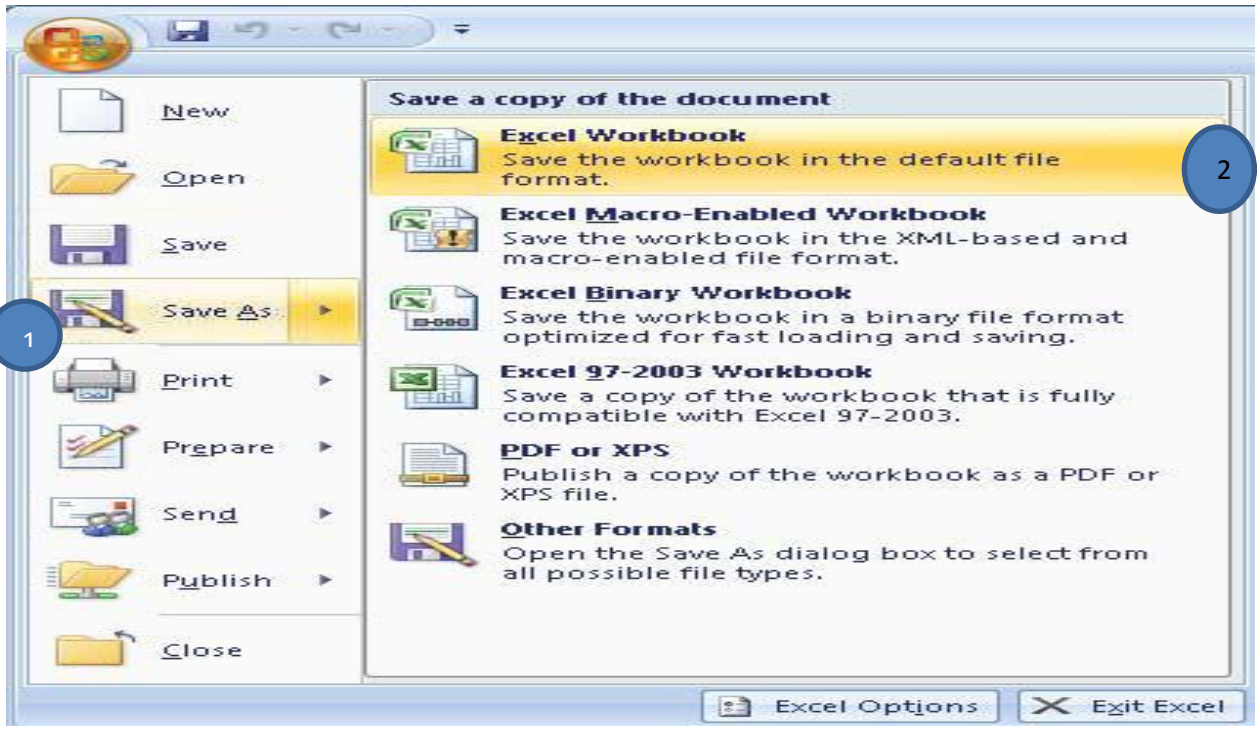
Entering Text and Numbers

- Make the appropriate cell the active cell and type in data e.g. B2 below and type the word **Region**

	A	B	C	D	E
1					
2		Region	Sales		
3		North	10488		
4		South	11973		
5		East	13841		
6		West	16284		
7		Total	=SUM(C3:C6)		

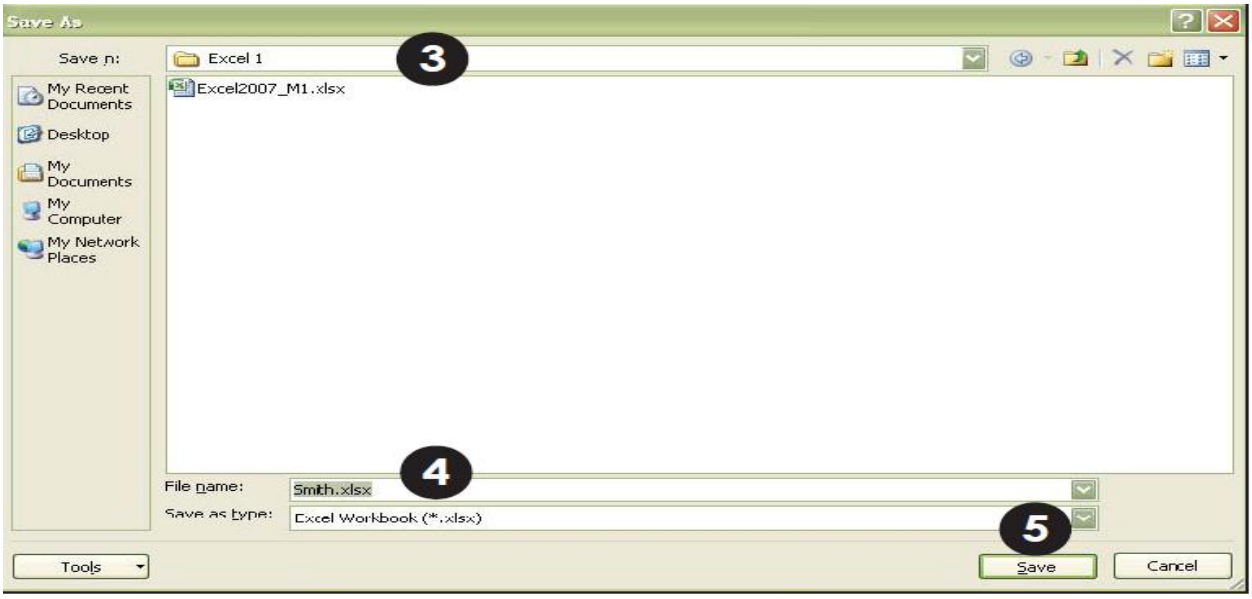
- By default, text is aligned to the left while numbers to the right.

Saving a Workbook



Steps

1. From the **Office Button,** select **Save As.**
2. Select the file type. (Excel Workbook)
3. Select the location/folder where you would like to save the workbook. e.g. **C :> SCS114 > Exceldemo >Sales**
4. Name the file. e.g. Use your last name as the file name.
5. Click **Save.**



Lab 1: Entering Text and Numbers

1. Start a new MS Excel session
2. Create the worksheet below

	A	B	C	D	E
1					
2		Region	Sales		
3		North	10488		
4		South	11973		
5		East	13841		
6		West	16284		

3. Save it as **SALES** in a folder in drive D:. (Create a folder by your own name now if it does not exist)

Entering numbers with fractions

- To enter a fractional value into a cell, leave a space between the whole number and the fraction.
- For example, to enter 67⁄8: enter 6, press spacebar then 7/8 and then press Enter.
- If you have a fraction only e.g. 1⁄8: you must enter a zero first, like this: **0 1/8**
- Otherwise, Excel will likely assume that you're entering a date.
- **N/B**: Excel automatically simplifies fractions e.g 4/8 = 1/2

Lab 2: Entering numbers with fractions

1. Start a new workbook
2. Create the worksheet below
3. Save it as **Fractions** in your folder

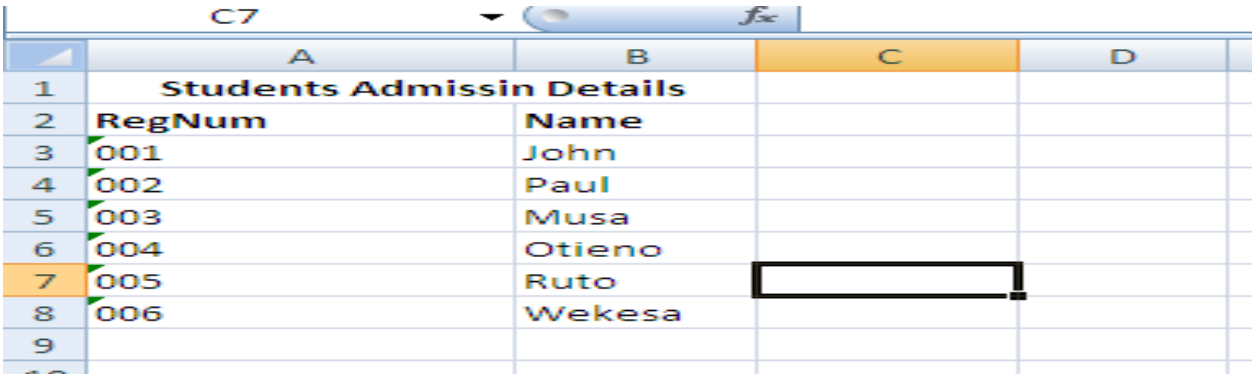
	A	B	C	D
1	Cake Recipe			
2		Ingredient	Amount	Metric Unit
3	1	Milk	1 1/3	litres
4	2	Sugar	1/4	KG
5	3	Salt	1/8	Grams
6	4	Flour	5 1/2	KG
7				

Entering Numbers as Text

- Precede the number with an apostrophe (‘) e.g ‘001, ‘002

Lab3

1. Start a new workbook session
2. Create the worksheet below
3. Save it as **text** in your folder



	A	B	C	D
1	Students Admissin Details			
2	RegNum	Name		
3	001	John		
4	002	Paul		
5	003	Musa		
6	004	Otieno		
7	005	Ruto		
8	006	Wekesa		
9				

Entering Date/Time Data

- Excel automatically recognizes valid date/time data type.
- Examples of valid date formats: 11/6/05, 6-Nov-05, 6-Nov, Nov 05
- Examples of valid time formats: 21:41, 21:41:35, 9:41 AM, 9:41:35 PM
- There must be a space before AM/PM

Lab 4: Entering date and time values

1. Start a new workbook session
2. Create the worksheet below
3. Save it as **date** in your folder

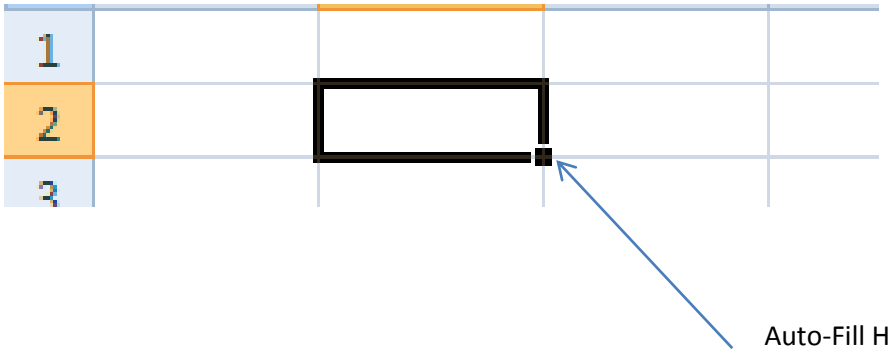
Clipboard | Font | Alignment | Number | Styles

C5 | fx 2:30:00 PM

	A	B	C	D	E
1	Exam Time Table				
2	Date	Subject	Start Time	Finish Time	
3	8/1/2012	SCS 112	8:30 AM	10:30 AM	
4	8/3/2012	SCS 114	2:00 PM	4:00 PM	
5	8/15/2012	SCS 214	14:30:00	16:00	
6					
7					

Using AutoFill to enter a series of values

- AutoFill- feature that inserts a series of values or text items in a range of cells.



Procedure

1. Enter the initial value e.g. 1
2. Place the mouse pointer over the auto fill handle
- It changes symbol from a white-plus-sign to a cross-hair
3. Drag the AutoFill handle using the right mouse button.

☐ Excel displays a shortcut menu with additional fill options.

4. Select Fill Series option from the shortcut menu

Lab 6: Using Auto-Fill Feature

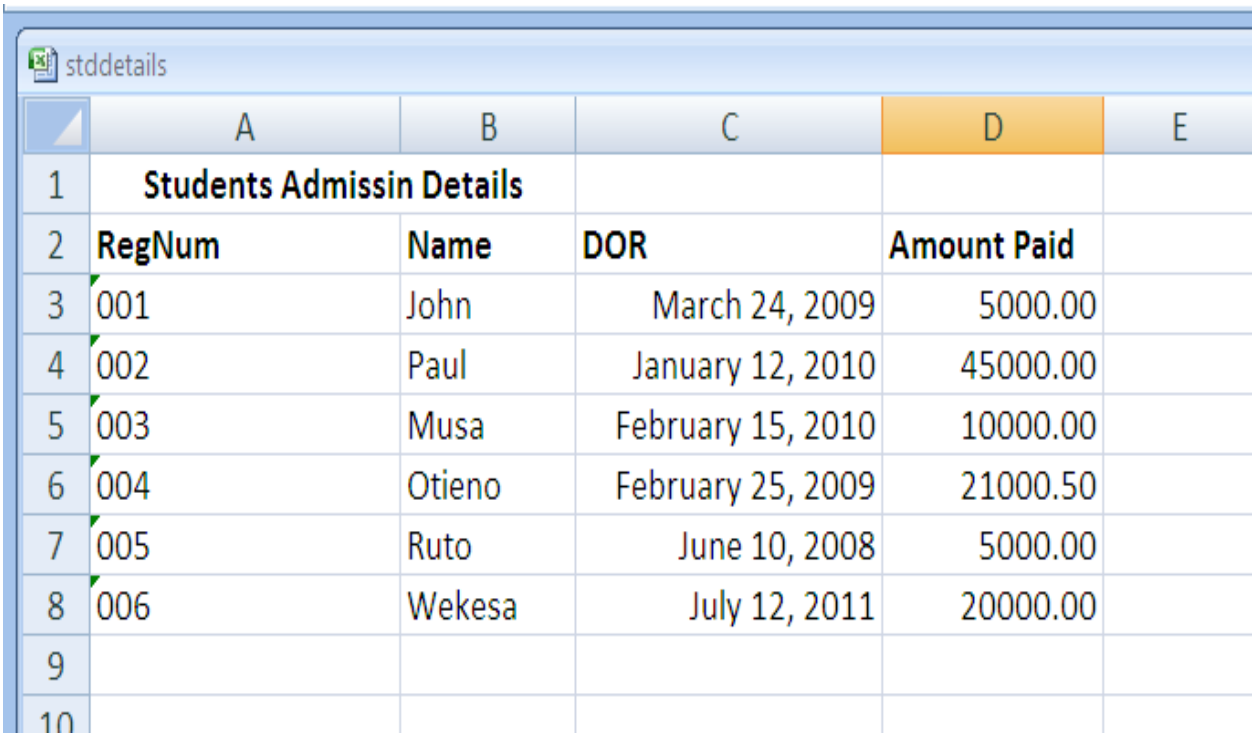
1. Start a new workbook session
2. Create the worksheet below by entering the initial value in each column and filling the rest of the values using auto-Fill Feature
3. Save it as **auto-fill** in your folder

E2 | fx

	A	B	C	D	E
1	Serial Nur	WeekDay	Months	Years	
2	1	Monday	Jan	2011	
3	2	Tuesday	Feb	2012	
4	3	Wednesd	Mar	2013	
5	4	Thursday	Apr	2014	
6	5	Friday	May	2015	
7	6	Saturday	Jun	2016	
8	7	Sunday	Jul	2017	
9	8	Monday	Aug	2018	
10	9	Tuesday	Sep	2019	
11	10	Wednesd	Oct	2020	
12	11	Thursday	Nov	2021	
13					
14					

Lab 6: Applying all the Skills

1. Start a new workbook session
2. Create the worksheet below
3. Save it as **Fee** in your folder


stddetails

	A	B	C	D	E
1	Students Admissin Details				
2	RegNum	Name	DOR	Amount Paid	
3	001	John	March 24, 2009	5000.00	
4	002	Paul	January 12, 2010	45000.00	
5	003	Musa	February 15, 2010	10000.00	
6	004	Otieno	February 25, 2009	21000.50	
7	005	Ruto	June 10, 2008	5000.00	
8	006	Wekesa	July 12, 2011	20000.00	
9					
10					

Topic 3: Formatting Numbers

- Values that you enter into cells normally are unformatted (General format).
- You format the numbers so that they're easier to read or are more consistent in terms of the number of decimal places shown.

1. General

- The General format is Excel's standard number format;.
- Every cell starts out with the same number format: General.
- This format comes with a couple of basic rules:

1. If a number has any decimal places, Excel displays them, provided they fit in the column. If the number's got more decimal places than Excel can display, it leaves out the ones that don't fit. i.e. It rounds up the last displayed digit, when appropriate.
2. Excel removes leading and trailing zeros. Thus, 004.00 becomes 4.

2. Number

- The Number format is like the General format but with three refinements:

1. First, it uses a fixed number of decimal places (which you set).
2. It also allows you to use commas as a separator between groups of three digits.
3. Can display negative numbers displayed with the negative sign, in parentheses, or in red lettering.

3. Currency

- The Currency format displays the currency symbol before the number.
- Always includes commas.
- Also supports a fixed number of decimal places (chosen by you), and it allows you to customize how negative numbers are displayed.

4. Accounting

- The Accounting format is modeled on the Currency format.

- It also allows you to choose a currency symbol, uses commas, and has a fixed number of decimal places.
- The currency symbol's always at the far left of the cell (away from the number), and there's always an extra space that pads the right side of the cell.
- Also, the Accounting format always shows negative numbers in parentheses, which is an accounting standard.
- The number 0 is never shown when using the Accounting format. Instead, a dash (-) is displayed in its place.

5. Percentage

- The Percentage format displays fractional numbers as percentages. For example, if you enter 0.5, that translates to 50%.
- You can choose the number of decimal places to display.

6. Fraction

- The Fraction format displays your number as a fraction instead of a number with decimal places.
- The Fraction format doesn't mean you have to enter the number as a fraction

7. Scientific

- Scientific notation displays the first non-zero digit of a number, followed by a fixed number of digits, and then indicates what power of 10 that number needs to be multiplied by to generate the original number. For example, 0.0003 becomes 3.00×10^{-4} (displayed in Excel as 3.00E-04).
- The number 300, on the other hand, becomes 3.00×10^{2} (displayed in Excel as 3.00E02).

8. Text

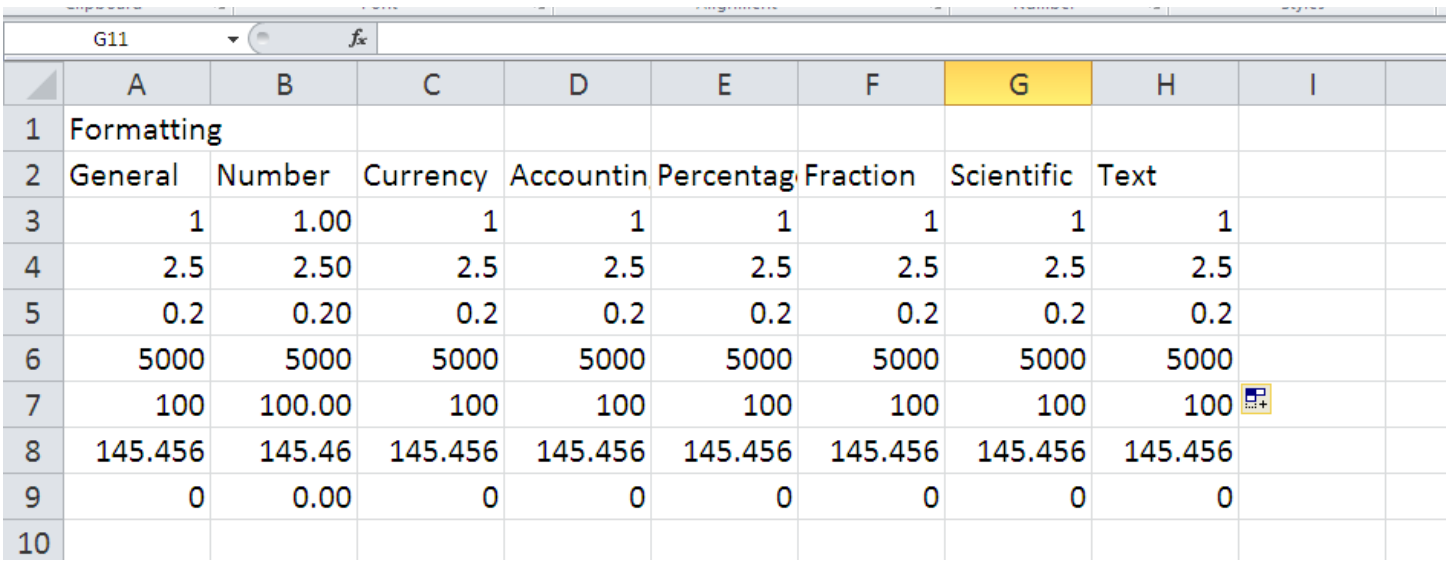
- The Text format simply displays a number as though it were text, although you can still perform calculations with it.
- Excel positions it against the left edge of the column.

Steps for Formatting a Number

1. Select the cell or range of cells
2. Right-click the selection
3. Choose Format Cells option from the context menu.
4. Choose a category
5. Choose a format similar to the one you desire

Lab 3.1

1. Start a new workbook
2. Create the work sheet below



	A	B	C	D	E	F	G	H	I
1	Formatting								
2	General	Number	Currency	Accountin	Percentag	Fraction	Scientific	Text	
3	1	1.00	1	1	1	1	1	1	
4	2.5	2.50	2.5	2.5	2.5	2.5	2.5	2.5	
5	0.2	0.20	0.2	0.2	0.2	0.2	0.2	0.2	
6	5000	5000	5000	5000	5000	5000	5000	5000	
7	100	100.00	100	100	100	100	100	100	
8	145.456	145.46	145.456	145.456	145.456	145.456	145.456	145.456	
9	0	0.00	0	0	0	0	0	0	
10									

3. Format it to appear as shown below
4. Save it as **Format**.

- If a cell displays a series of hash marks (such as #########), it usually means that the column isn't wide enough to display the value in the number format that you selected.
- Either make the column wider or change the number format.

	A	B	C	D	E	F	G	H
1	Formatting							
2	General	Number	Currency	Accounting	Percentage	Fraction	Scientific	Text
3	1	1.00	$1.00	$ 1.00	100%	1	1.0E+00	1
4	2.5	2.50	$2.50	$ 2.50	250%	2 1/2	2.5E+00	2.5
5	0.2	0.20	$0.20	$ 0.20	20%	1/5	2.0E-01	0.2
6	5000	5,000.00	$5,000.00	$ 5,000.00	500000%	5000	5.0E+03	5000
7	100	100.00	$100.00	$ 100.00	10000%	100	1.0E+02	100
8	145.456	145.46	$145.46	$ 145.46	14546%	145 31/68	1.5E+02	145.456
9	0	0.00	$0.00	$ -	0%	0	0.0E+00	0
10								

Topic 4: Creating Formula

- A **formula** is a mathematical expression that returns a value
- A formula is written using **operators** that combine different values, returning a single value that is then displayed in the cell.
- The most commonly used operators are **arithmetic operators.**

Excel Arithmetic Operators

Operator	Name	Example	Result
+	Addition	=1+1	2
-	Subtraction	=1-1	0
*	Multiplication	=2*2	4
/	Division	=4/2	2
^	Exponentiation	=2^3	8
%	Percent	=20%	0.20

Operator Precedence

Symbol	Operator	Precedence
^	Exponentiation	1
*	Multiplication	2
/	Division	2
+	Addition	3
–	Subtraction	3
&	Concatenation	4
=	Equal to	5
<	Less than	5
>	Greater than	5

- Excel reads a formula containing these operators from left to right and performs the calculations following these strict rules of precedence:

1. Parenthetical calculations first
2. Division or multiplication next *in the order in which the calculations appear from left to right*
3. Addition or subtraction next *in the order in which the calculations appear from left to right*

- For example, consider the following formula:
  =5 + 2 * 2 ^ 3 - 1
  To arrive at the answer of 20, Excel first performs the exponentiation (2 to the power of 3):
  =5 + 2 * 8 - 1
  and then the multiplication:
  =5 + 16 - 1
  and then the addition and subtraction:
  =20
- To control this order, you can add parentheses.
- 5 + (2 * (2 ^ 3)) - 1 = 20
- 5 + 2 * 2 ^ (3 - 1) = 13
- (5 + 2) * 2 ^ 3 - 1 = 55
- (5 + 2) * 2 ^ (3 - 1) = 28

Creating a Simple Formula

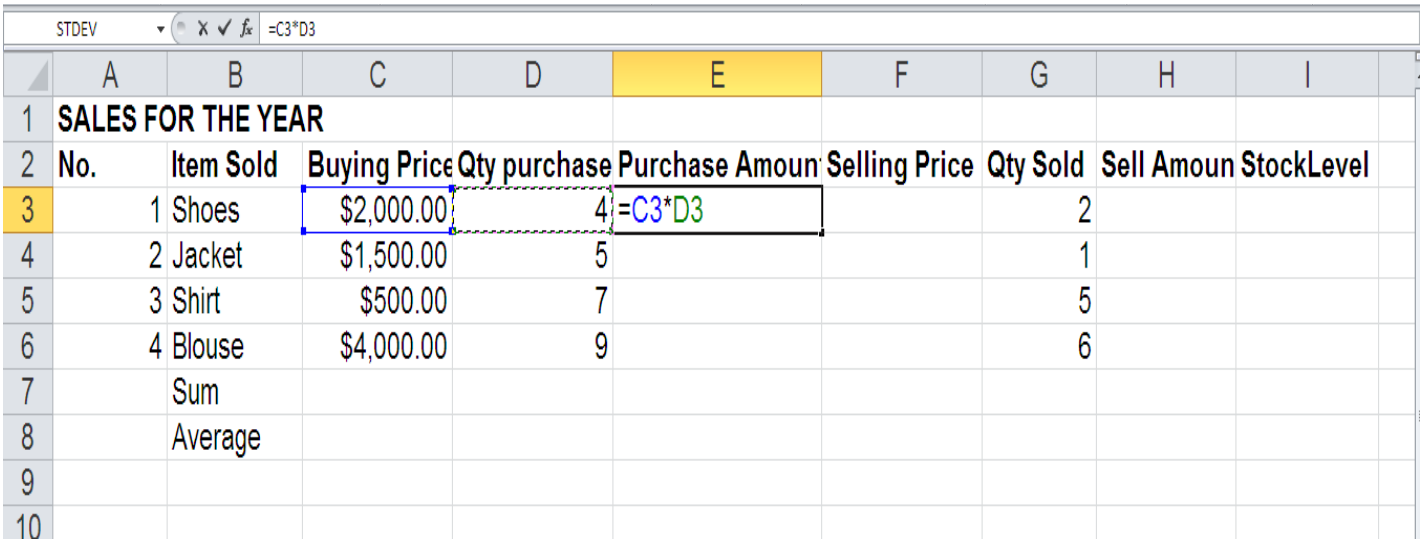
- A formula is expressed by reference to cell addresses e.g. = A1+ A2
- Must be preceded by an equal (=) sign.

Copying a Formula

- Drag the **Autofil**l handle through the cells that the formula is to be copied.
- **Alternatively**
  1. Right click on the cell that contains the formula
  2. Make cell where the formula is to be copied the active cell
  3. Right click on the active cell (cell where the formula is to be copied)
  4. Select Paste from the Shortcut Menu

Lab 3.1

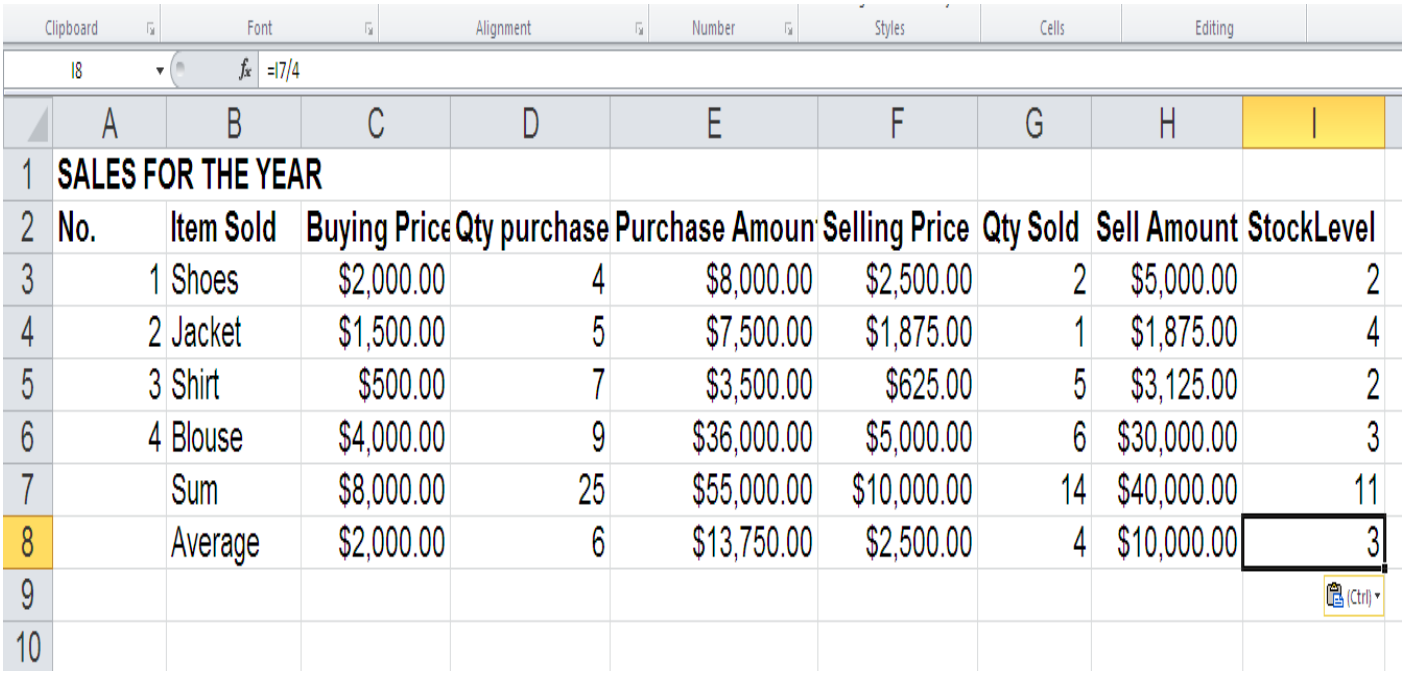
1. Start a new workbook
2. Create the work sheet below
3. Enter formula cell E3 as shown
4. Press enter to view the answer
5. Copy the formula to fill the Purchase Amount for the other items
6. Save it as **STOCK**



	A	B	C	D	E	F	G	H	I
1	SALES FOR THE YEAR								
2	No.	Item Sold	Buying Price	Qty purchase	Purchase Amoun	Selling Price	Qty Sold	Sell Amoun	StockLevel
3	1	Shoes	$2,000.00	4	=C3*D3		2		
4	2	Jacket	$1,500.00	5			1		
5	3	Shirt	$500.00	7			5		
6	4	Blouse	$4,000.00	9			6		
7		Sum							
8		Average							
9									
10									

7. Set the Selling Price such that a profit of 25% is realized. (In Cell F3 enter the formula: =C3*1.25)
8. Copy the formula to down to cell F6
9. Find the Sell amount for each Item (In Cell H3 enter the formula: =F3*G3)
10. Copy the formula down to H6
11. Find the Stock level for each Item (Qty Purchased – Qty Sold)
12. Copy the formula down to H6
13. Find the summation for all the values
14. Find the average for all the values. Format the values appropriately e.g. quantity must be a whole number while monetary values should be to 2 decimal places.
15. Resave the workbook.

- Your worksheet should look like the one below.



	A	B	C	D	E	F	G	H	I
1	SALES FOR THE YEAR								
2	No.	Item Sold	Buying Price	Qty purchase	Purchase Amoun	Selling Price	Qty Sold	Sell Amount	StockLevel
3	1	Shoes	$2,000.00	4	$8,000.00	$2,500.00	2	$5,000.00	2
4	2	Jacket	$1,500.00	5	$7,500.00	$1,875.00	1	$1,875.00	4
5	3	Shirt	$500.00	7	$3,500.00	$625.00	5	$3,125.00	2
6	4	Blouse	$4,000.00	9	$36,000.00	$5,000.00	6	$30,000.00	3
7		Sum	$8,000.00	25	$55,000.00	$10,000.00	14	$40,000.00	11
8		Average	$2,000.00	6	$13,750.00	$2,500.00	4	$10,000.00	3
9									
10									

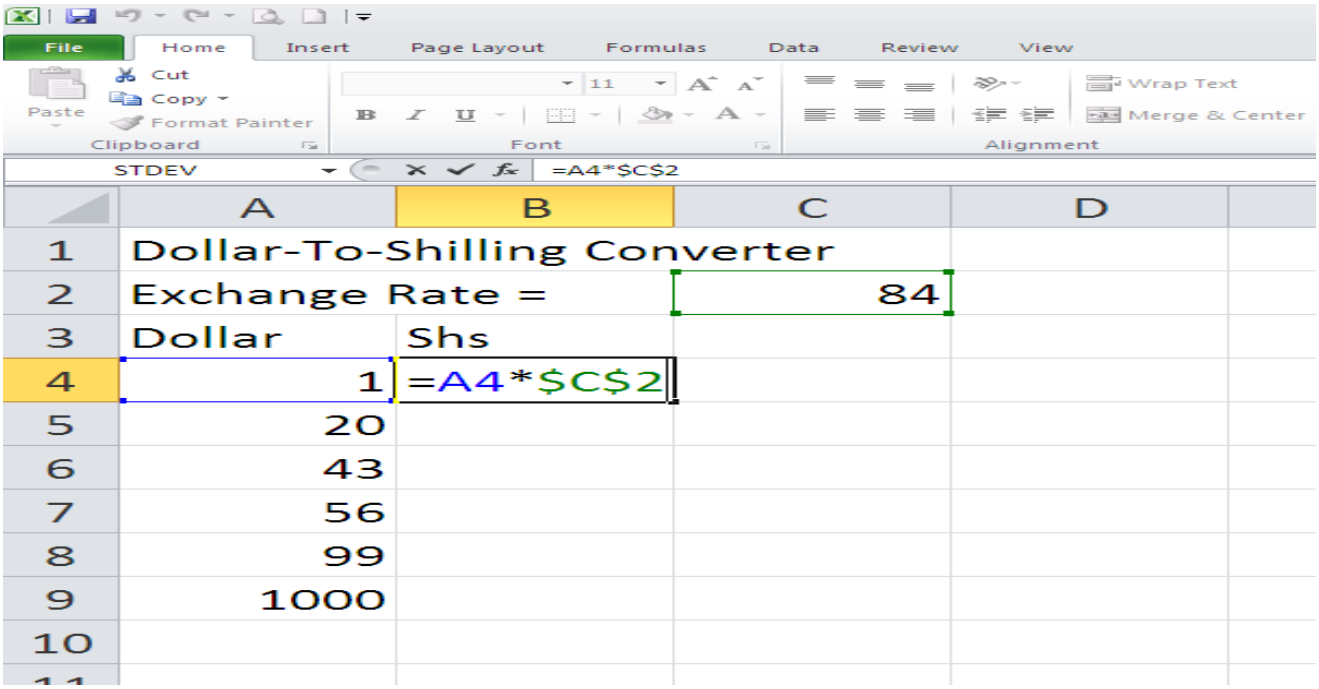
Types of Cell References

- There are three types of references:

1. **Relative**: The row and column references can change when you copy the formula to another cell.
- Is the default cell reference mode.
- Example: A2
2. **Absolute**: The row and column references do not change when you copy the formula.
- Necessary when there is a constant in a formula.
- Both the column letter and row number are preceded by the dollar ($) sign
- Example: $A$2
3. **Mixed**: Either the row or column reference is relative, and the other is absolute.
- Example: A$2, $A2

Lab 3.2

1. Start a new workbook
2. Create the work sheet below
3. Enter formula cell b4 as shown
4. Copy the formula downwards up to cell B9
5. Save the workbook as **Dollar**.



Common Formula Errors

1. **#VALUE!**
   - You used the wrong type of data. E.g. you might have used a function or created a simple arithmetic formula with a cell that contains text instead of numbers.
2. **#NAME?**
   - Excel can't find the name of the function you used.
   - This error code usually means you misspelled a function's name.
3. **NUM!**
   - This error code appears when a calculation produces a number that's too large or too small for Excel to deal with.
4. **#DIV/0**
   - You tried to divide by zero.
   - This error code also appears if you try to divide by a cell that's blank, because Excel treats a blank cell as though it contains the number 0 for the purpose of simple calculations with the arithmetic operators.
5. **#REF!**
   - Your cell reference is invalid.
   - This error most often occurs if you delete or paste over the cells you were using.

6. **#N/A**
   - The value isn't available.
   - This error can occur if you try to perform certain types of lookup or statistical functions that work with cell ranges.
7. **#NULL!**
   - You used the intersection operator incorrectly.
   - The intersection operator finds cells that two ranges share in common. This error results if there are no cells in common.
8. **########**

- Excel has successfully calculated your formula. However, the formula can't be displayed in the cell using the current number format.
- To solve this problem, you can widen the column, or possibly change the number format.

Topic 5: Functions

- Inbuilt MS Excel text or mathematical operation that returns a value given a range of values (arguments).
- Identified by its name e.g. SUM (), PRODUCT (), etc.

Function Categories

- Functions are grouped into broad categories by some common features among them.

1. ***Financial***
- Analyze investments including appreciation, depreciation, compound interest etc.

2. ***Date & Time***
- Manipulates date and time values.

3. ***Math & Trig***
- Includes general math and trigonometric functions.

4. ***Statistical***
- Performs calculations on list of values.

5. ***Lookup & reference***
- A *lookup formula essentially returns a value from a table by looking up another* related value.

6. ***Database***
- Performs statistical calculations and queries on databases.

7. ***Logical***
- Capable of making a decision based on the outcome of a Boolean expression.

8. ***Information***
- Returns information about a cell e.g. the formatting features applied to the cell.

9. ***Engineering***
- Includes common engineering calculations

10. ***Text***
- Manipulates text data

General Mathematical functions

1. SUM()
2. PRODUCT()

3. EXP()
4. POWER()
5. ROUND()
6. SQRT()

SUM ( )

- Adds up a group of cells.
- Format: =SUM(range)
- Range can be specified in 2 ways:
  (i) =SUM(A1,A2) -adds two cells.
  (ii) =SUM(A2:A12)- adds the range of 11 cells from A2 to A12.

PRODUCT ()

- The PRODUCT( ) function takes a list of numbers, multiplies them together, and gives the result.
  (i) =PRODUCT(A1,A2,A3)
  (ii) =PRODUCT(A1:A10)
- Takes a range of values as its argument

Rounding Numbers

1. ROUND( )

- Rounds a numeric value to a specified number of significant figures e.g. decimal places.
- **Format:** ROUND(value,d.p.)
- **For example**
- =ROUND(3.987, 2) The result is 3.99.
- If you specify 0 for the number of d.p., then Excel rounds to the nearest whole number.

2. ROUNDDOWN( )

- **Rounds numbers down, towards zero.**
- the result of ROUNDDOWN(1.9, 0) is 1,

3. ROUNDUP( ):

- Rounds numbers up, away from zero.
- the result of ROUNDUP(1.1, 0) is 2

POWER()

- POWER( ) works out exponents.
- =POWER(2,3) => 8
- Takes two arguments, the base and the index.

SQRT()

- SQRT() finds the square root of a number.
- =SQRT(9)=->3
- Takes a single argument

Statistical Functions

1. COUNT()
2. MAX()
3. MIN()
4. LARGE()
5. SMALL()
6. RANK()
7. AVERAGE()
8. MEDIAN()
9. MODE()

Counting Values

1. **COUNT ()**
   - Returns the number of cells that contain a numeric value or date value.
   - Format: = COUNT(Range)
   - Example: =COUNT(A1:A10)
   - Function ignores blank cells and cells with text data.

2. **COUNTA ()**

- Returns the number of cells with any data type.
- Used to determine the number of nonblank cells.
  - Format: = COUNT(Range)
  - Example: =COUNTA(A1:A10)
- Function ignores blank cells

3. **COUNTBLANK ()**
   - Returns the number of blank cells
   - Format: = COUNT(Range)
   - Example: =COUNTBLANK(A1:A10)

Maximum and Minimum Values

1. **The MAX( )**

- Pick the largest value out of a series of cells.
- Format: =Max(range)
- Example: =Max(A1:A10)

2. **MIN( )**

- Returns smallest value out of a series of cells.
- Format: =Min(range)
- Example: =Min(A1:A10)

Note:

1. The **MAX( )** and **MIN( )** functions ignore any non-numeric content, which includes text, empty cells, and Boolean (true or false) values.
2. Excel includes dates in MAX( ) and MIN( ) calculations because it stores them internally as the number of days that have passed since a particular date.

Ranking Your Numbers

1. **LARGE( )**

- Returns the k-th largest value in a list e.g. the 5^{th} largest value in a list.
- Example: =Large(A1:A10,5)

2. **SMALL()**

- Returns the k-th smallest value in a list e.g. the 5^{th} smallest value in a list.
- Example: =SMALL(A1:A10,5)
- Takes two arguments: range and position in the list (range).

3. **RANK( )**

- Function finds where a specific value falls in the list.
- Format : =RANK(number, range, [order_type])
- Example :

  =RANK(A1,A1:A10) – ascending order
  =RANK(A1,A1:A10,1) – descending order

Measuring Central Tendency

1. **AVERAGE( )**

- Finds the mean of a list of values

- Format: =AVERAGE(A1:A10)
- Takes one argument: the range of values.
- Function ignores all empty cells or text values.

2. MEDIAN( )

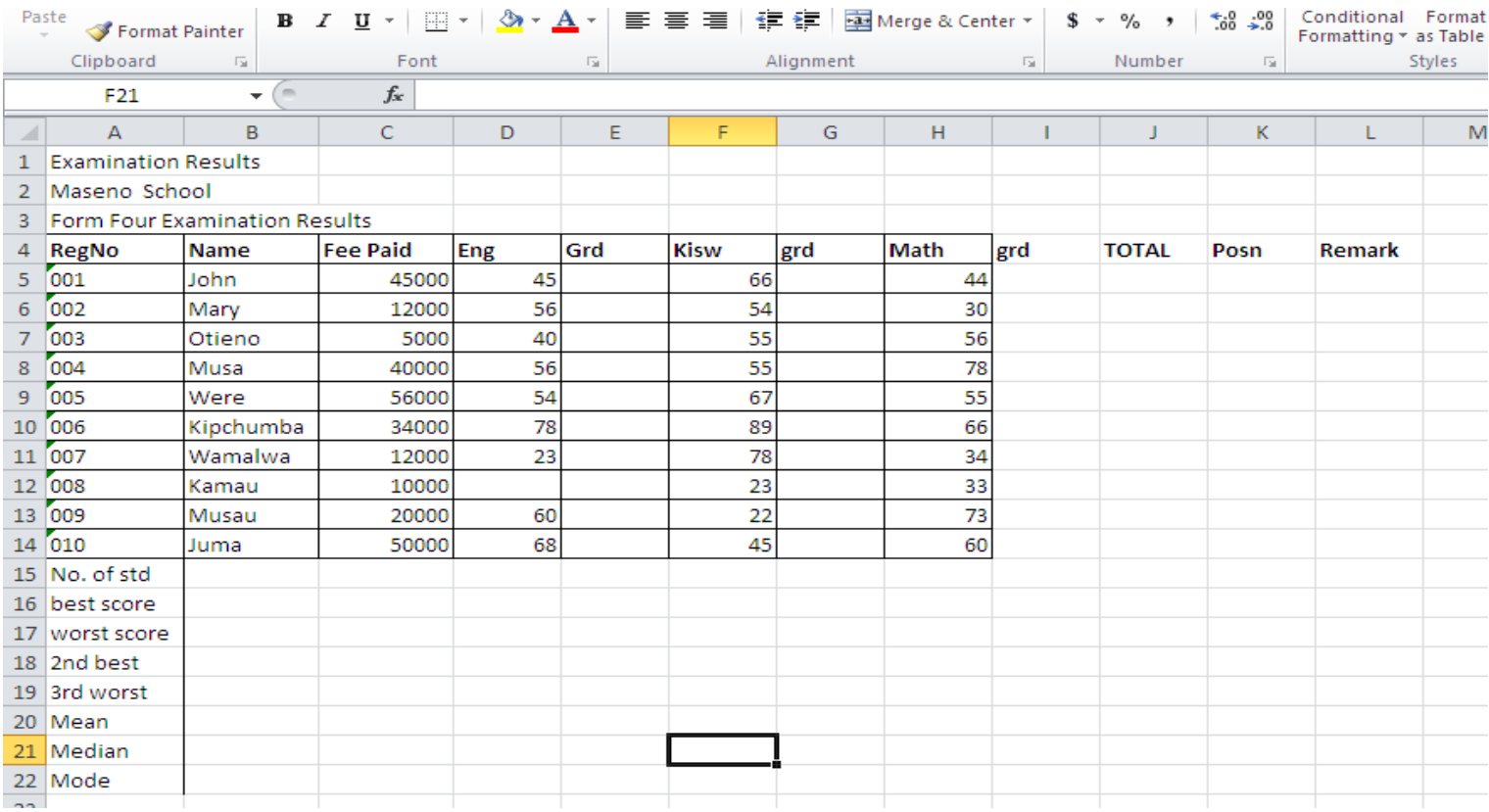
- Finds the median of a list of values.
- If the list is ordered in ascending order, the median is the value that lies in the middle position.
- Format: =MEDIAN(A2:A12)

3. MODE( )

- Returns the value that appears the highest number of times in a list (range) of values.
- Format: =MODE(A1:A10)
- Takes one argument: the range.
- It ignores text values and empty cells

Lab 5.1: Functions

1. Create the workbook below
2. Use functions to fill the gaps.
3. Save it as **Exam.**



	A	B	C	D	E	F	G	H	I	J	K	L
1	Examination Results											
2	Maseno School											
3	Form Four Examination Results											
4	**RegNo**	**Name**	**Fee Paid**	**Eng**	**Grd**	**Kisw**	**grd**	**Math**	**grd**	**TOTAL**	**Posn**	**Remark**
5	001	John	45000	45		66		44				
6	002	Mary	12000	56		54		30				
7	003	Otieno	5000	40		55		56				
8	004	Musa	40000	56		55		78				
9	005	Were	56000	54		67		55				
10	006	Kipchumba	34000	78		89		66				
11	007	Wamalwa	12000	23		78		34				
12	008	Kamau	10000			23		33				
13	009	Musau	20000	60		22		73				
14	010	Juma	50000	68		45		60				
15	No. of std											
16	best score											
17	worst score											
18	2nd best											
19	3rd worst											
20	Mean											
21	Median											
22	Mode											

Text Functions

CONCATENATE( ) function

- The CONCATENATE( ) function lets you join together text in exactly the same way the & operator does.

LEN( ) Function

- LEN( ) (short for LENgth) counts the number of characters in a string of text. For example, the result of the following formula is 5:

  =LEN("Hello")

Manipulating Text

The concatenation operator (&)

- Joins text together.

DATE/TIME Functions

1). TODAY() Function

- The function displays the current date in a cell:

=TODAY()

2). DAY()Function

- Function takes a date argument and returns a number representing the day (1 to 31).

3). MONTH()

- Function takes a date argument and returns a number representing the month (1 to 12).

4). YEAR()

- Function takes a date argument and returns a number representing the year (1900 to 9999).
- Example, if you place the date 1/1/2007 in cell A1, the following formula displays a result of 2007:

  =YEAR(A1)

5). The NETWORKDAYS() Function

- The NETWORKDAYS() function calculates the number of work days between two dates, excluding weekend days (Saturdays and Sundays).
- As an option, you can specify a range of cells that contain the dates of holidays, which are also excluded.
- Format:
  =NETWORKDAYS(StartDate,EndDate,[HolidayRange])
- Example:

=NETWORKDAYS(A15,16,B2:B11)

	A	B	C	D
1	Date	Holiday		
2	1/1/07	New Year's Day		
3	1/15/07	Martin Luther King Jr. Day		
4	2/19/07	Presidents' Day		
5	5/28/07	Memorial Day		
6	7/4/07	Independence Day		
7	9/3/07	Labor Day		
8	11/11/07	Veterans Day		
9	10/8/07	Columbus Day		
10	11/22/07	Thanksgiving Day		
11	12/25/07	Christmas Day		
12				
13				
14	First Day	Last Day	Working Days	
15	Monday 1/1/2007	Sunday 1/7/2007	4	
16	Monday 1/1/2007	Monday 12/31/2007	252	
17				
18				

Sheet1

6). WORKDAY() function

- The WORKDAY() function gives an offset work day.
- Example: function to determine the date that is ten working days from January 4, 2008: =WORKDAY(1/4/2008,10)

7). The WEEKDAY() function

- The WEEKDAY() function accepts a date argument and returns an integer between 1 and 7 that corresponds to the day of the week.
- Sunday -1,Monday-2……Saturday-7
- =WEEKDAY(11/1/2011)

Manipulating Dates and Times

- Date and Time values can be involved in calculations like addition, subtraction, and so on. For example, consider this formula:

  =A2-A1+1
- If A2 contains the value 10/30/2007, and A1 contains the value 3/20/2007, the result is 224, which is the number of days between these two dates.

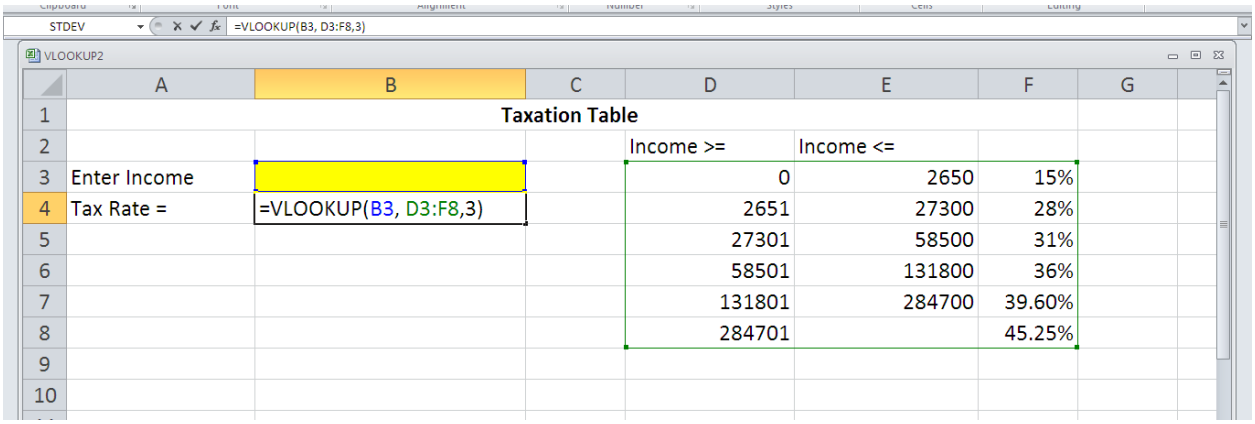
Lookup Functions

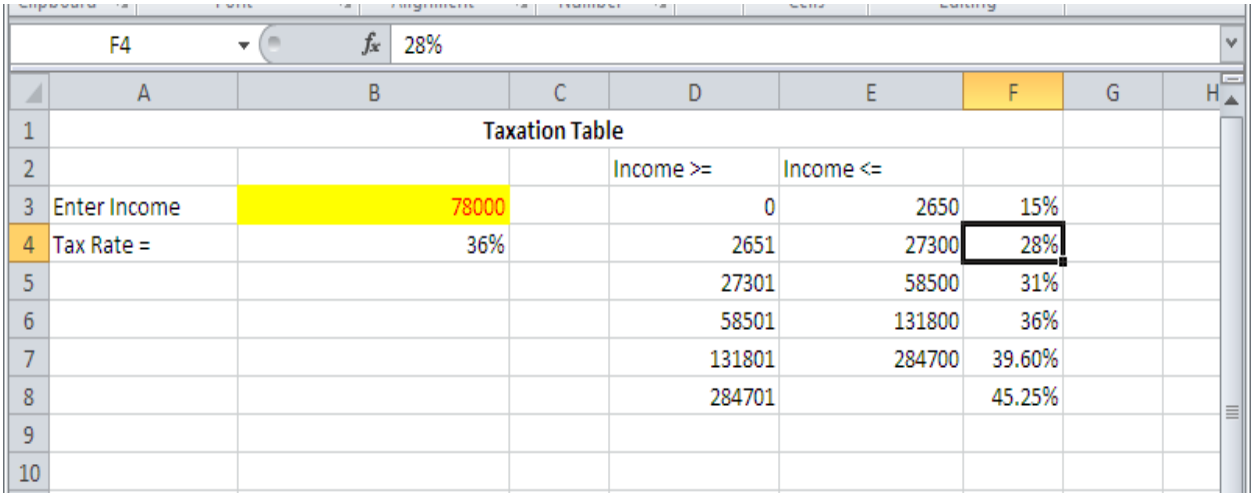
1. HLOOKUP()

- is the horizontal lookup function.
- HLOOKUP( ) works by scanning the values in a single row from left to right. Once it finds the entry you're looking for, it can then retrieve other information from the same column.
- Format:
  =HLOOKUP(SearchValue, TableRange, rowNumber, [rangeLookup])
- Example:

2. VLOOKUP()

- Is the vertical lookup function.
- VLOOKUP( ) works by scanning the values in a single column from top to bottom.
- Once it finds the entry you're looking for, it can then retrieve other information from the same row.
- Format:
- VLOOKUP(search_for value, table_range, column_number)





F4 | 28%

	A	B	C	D	E	F	G	H
1	Taxation Table							
2				Income >=	Income <=			
3	Enter Income	78000		0	2650	15%		
4	Tax Rate =	36%		2651	27300	28%		
5				27301	58500	31%		
6				58501	131800	36%		
7				131801	284700	39.60%		
8				284701		45.25%		
9								
10								

Financial Functions

Financial Concepts

1. **Present Value (PV).** - The value of an investment or loan at the very beginning of its life. This number's also called the principal.
2. **Rate** - The rate at which an investment or loan will increase or decrease.
3. **Future Value (FV)** - The value of an investment or loan at some point in the future.
4. **Payment** -An amount of money that's being contributed to an investment or loan. It's a ***regular*** contribution that's usually made at the same time the interest is calculated.
5. **Number of Payment Periods** (NPER)-The total number of payment periods between the present value and the future value of an investment or loan.
6. If you've got a three-year car loan (with payments due monthly), then the NPER equals 36. In other words, there are 12 payment periods each year, for three years.

1). FV( ): Future Value Function

- The FV( ) function lets you calculate the future value of an investment, assuming a fixed interest rate.
- It lets you factor in regular payments, which makes it perfect for calculating how money's accumulating in a retirement or savings account.
- Format:
  =FV(rate, nper, payment, [pv], [type])

1. *Rate* -the interest rate your investment's earning.
2. *nper* -the number of interest payments.

- If your account receives interest once a year and you invest your money over a two-year period, then the nper will be 2.
- If you're making regular contributions, this value also specifies the number of contributions you're making. FV( ) assumes that every contribution's made on the same day as the interest's generated.

3. *payment* -the amount of the contribution you want to make regularly.

- Set this to 0 if you don't want to add anything.

4. *pv* -the present value, or the initial balance of your account.

- If you omit this value, then Excel assumes you start with nothing. As a result, you'll need to include something other than 0 for the payment.

5. *type* - indicates the timing of the payment. If you specify 0 (or omit this value), then the payment's made at the end of the period.

- If you specify 1, then the payment's made at the beginning, giving your interest just a little bit more time to compound.
- N/B:- make sure both the payment and the initial balance (pv) are negative numbers (or zero values). In Excel's thinking, the initial balance and the regular contributions are money you're handing over, so these numbers, consequently, need to be negative. The final value is positive because that's the total you're getting back.

- the formula that calculates the return on a $10,000 investment after one year earning 5 percent annual interest:
- =FV(5%, 1, 0, -10000,0)
- what happens if you switch to an account that pays monthly interest?
- You now have 12 interest payment periods per year, and each one pays a twelfth of the total 5 percent interest
- =FV(5%/12, 12, 0, -10000)
  The new total earned is a slightly improved $10,511.62.

Loan Repayment

- FV( ) works just as well on loan payments.
- Example -you take out a $10,000 loan and decide to repay $200 monthly. Interest is set at 7 percent and calculated monthly.
- FV() can tells you your outstanding balance that is, the amount that you still owe, after three years as follows:
- =FV(7%/12, 3*12, -200, 10000)

2). PV( ): Present Value Function

- The PV( ) function calculates the initial value of an investment or a loan (which is also called the present value).
- Format:
- =PV(rate, nper, payment, [fv], [type])
- the real purpose of PV( ) is to answer hypothetical questions.
- Consider this formula:
- =PV(10%/12, 25*12, 0, 1000000)
  The question Excel answers here is: In order to end up with $1,000,000, how much money do I need to invest initially, assuming a 10 percent annual interest rate (compounded monthly) and a maturation period of 25 years? The PV( ) function returns a modest result of $82,939.75.
- You can supplement your principal with a regular investment. The following formula assumes a monthly payment of $200, paid at the beginning of each month. Note that you should type in a negative number, because it's money you're giving up:
- =PV(10%/12, 25*12, -200, 1000000)

3). PMT( ) Function

- The PMT( ) function calculates the amount of the regular payments you need to make, either to pay off a loan or to achieve a desired investment target.
- You specify the present value and future value of the investment and the rate of interest over its lifetime, and the function returns the payment you'd need to make in each time period. Here's how the function breaks down:
- Format:
  =PMT(rate, nper, pv, [fv], [type])
- If you don't specify a future value, then Excel assumes it's 0 (which is correct if you're performing the calculation to see how long it'll take to pay off a loan).
- Once again, the type argument indicates whether you make payments at the beginning of the payment period (1) or at the end (0).
- Example :- If you have a 7 percent interest rate (compounded monthly) and a starting balance of $10,000, how much do you need to pay monthly to top it up to $1,000,000 in 30 years? The PMT( ) function provides your answer:
- =PMT(7%/12, 12*30, -10000, 1000000)
  The result$753.16is a negative number because this is money that you're giving up each month.
- A loan calculation is just as easy, although, in this case, the present value becomes positive, since it represents money you received when you took out the loan. To determine the payments needed to

pay back a $10,000 loan (that comes with a 10 percent annual interest rate) over five years, you need this formula:

- =PMT(10%/12, 12*5, 10000, 0)
  Assuming you make payments at the end of each month, the monthly payment is $212.47. If you add a type argument of 1 to pay at the beginning of the month, then this amount decreases to $210.71.

4). NPER( ): Number of payment Periods Function

- The NPER( ) function calculates the amount of time it will take you to pay off a loan or meet an investment target, provided you already know the initial balance, the interest rate, and the amount you're prepared to contribute for each payment.
- Format :

=NPER(rate, pmt, pv, [fv], [type])

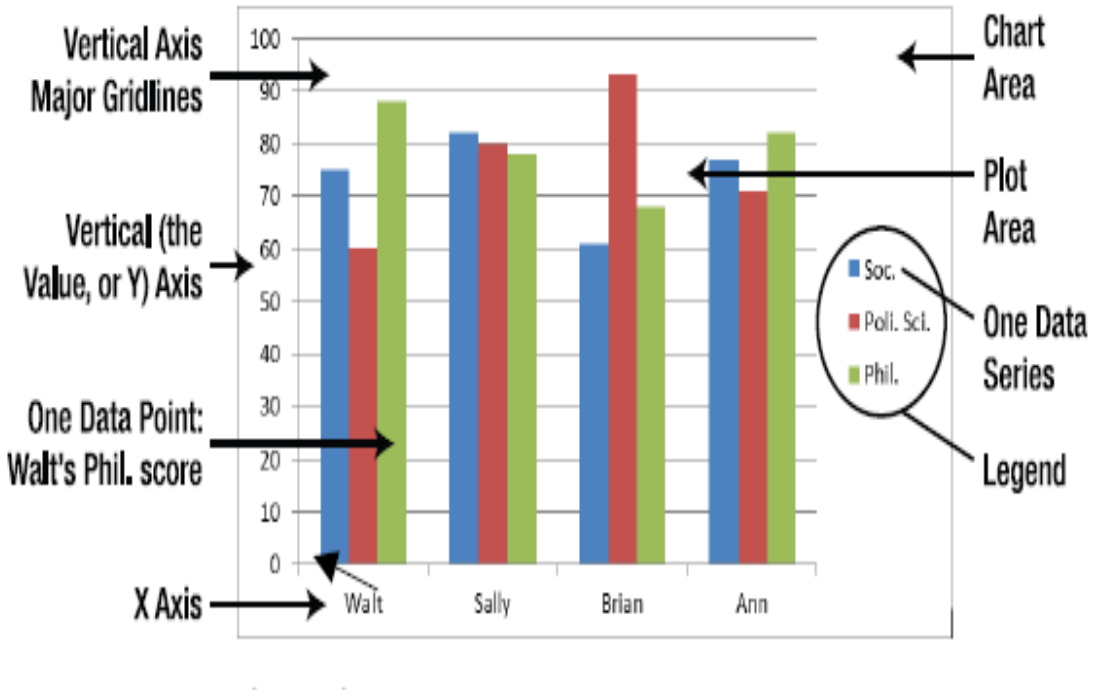
- Example : If you're ready to contribute $150 a month into a savings account that pays 3.5 percent interest, you can use the following formula to determine how long it'll take to afford a new $4500 plasma television, assuming you start off with an initial balance of $500:
- =NPER(3.5%/12, -150, -500, 4500)
  The answer is 25.48 payment periods. Remember, a payment period in this example is one month, so you need to save for over two years.
- A similar calculation can tell you how long it'll take to pay off a line of credit. Assuming the line of credit's $10,000 at 6 percent, and you pay $500 monthly, here's the formula you would use:
- =NPER(6%/12, -500, 10000, 0)
  In this case, the news isn't so good: It'll take 21 months before you're rid of your debt.

Charts

Definition

- A *chart* is a visual (graphical) representation of numeric values.

Chart elements



Types of Charts

	Chart Type	Use
1.	Column	Compares categories of data in vertical format.
2.	Bar	Compares multiple values in horizontal format.
3.	Line	Displays trends in data over time.
4.	Pie	Compares data as part of a contribution to a whole.
5.	Scatter	Plot Compares pairs of values in a dot format.
6.	Area	Compares the trend of values over time or categories.
7.	Doughnut	Compares multiple series of data in a percent format.
8.	Radar	Displays changes in values relative to a center point.
9.	Surface	Displays trends in values across two dimensions.
10.	Bubble	Compares sets of three values.
11.	Stock	Displays a chart to compare stock prices.
12.	Cylinder	Same as a column or bar chart, but a cylinder is used instead.
13.	Cone	Same as a column or bar chart, but a cone is used instead.
14.	Pyramid	Same as a column or bar chart, but a pyramid is used instead.

Choosing a chart Type

Chart Type	What It Does	When to Use It
Column	Depicts data as vertical bars; perhaps the most commonly used type	When you need to present individual sets of data (e.g., sales totals by different departments)
Line	Depicts data as a series of lines	When you want to present data that varies over time (e.g., a student's test scores)
Pie	Characterizes only *one* data series as a series of slices, each contributing to a whole	If, for example, you need to portray different departments' percentages of an overall company budget
Bar	Basically depicts a column chart whose data series are presented horizontally instead of vertically	As per a column chart, but here the data bars extend sideways
Area	Depicts a line chart whose data fills in the areas between the lines and the x-axis (take a look at the Area button)	When you want to convey the relative depth of data (e.g., a test score of 90 will cover more area than a score of 75)
Scatter	Portrays data along *two* value axes (that term will be defined shortly), thus treating data as paired values.,	When you want to look at data organized by two quantitative variables at the same time, e.g., plotting marathon times by age of the runners.
Other	Encompasses a collection of less commonly used charts.	When you need a specialized chart, such as for a stock market comparison

Inserting a chart

1 Click a cell in the data list you want to summarize.
2 Click the Insert tab.
3 Click the type of chart you want to create.
4 Click the chart subtype you want to use.

Adding chart elements

Show or Hide a Chart Legend

1 Click the chart you want to format.
2 Click the Layout tab.
3 Click Legend.
4 Click a legend display option.

Add Titles

1 Click the chart you want to format.
2 Click the Layout tab.
3 Click Chart Title.
4 Click the title display option you want.
5 Click the title, and then type the new title for the chart.

Add and Remove Data Labels

1 Click the chart you want to format.
2 Click the Layout tab.
3 Click Data Labels.
4 Click a data label option.

Show or Hide Chart Gridlines

1 Click the chart you want to format.
2 Click the Layout tab.
3 Click Gridlines.
4 Click the set of gridlines you want to change.
5 Click a gridline display option.

Add a New Series

1 Click the chart you want to change.
2 Click the Design tab.
3 Click Select Data.
4 Click Add.
5 Type the name you want to assign to the series.
6 Click in the Series Values field.
7 Select the cells you want to add.
8 Click OK.
9 Click OK.

What-If Analysis

- One of the most appealing aspects of Excel is its ability to create dynamic models.
- A *dynamic model* uses formulas that instantly recalculate when you change values in cells that are used by the formulas.
- When you change values in cells in a systematic manner and observe the effects on specific formula cells, you're performing a type of *what-if* analysis.

Types of What-If Analyses

1. **Manual what-if analysis:** Plug in new values and observe the effects on formula cells.
2. **Data tables:** Create a special type of table that displays the results of selected formula cell as you systematically change one or two input cells.
3. **Scenario Manager:** Create named scenarios and generate reports that use outlines or pivot tables.

Manual what-if analysis

- Manual what-if analysis is based on the idea that you have one or more input cells that affect one or more key formula cells. You change the value in the input cells and see what happens to the formula cells.

Example:

C7 fx 6.5%

mortgage loan

	A	B	C	D
1		**Mortgage Loan Worksheet**		
2				
3		**Input Cells**		
4		Purchase Price:	$325,000	
5		Down Payment:	10%	
6		Loan Term (Months):	360	
7		Interest Rate (APR):	6.50%	
8				
9		**Result Cells**		
10		Loan Amount:	$292,500	
11		Monthly Payment:	$2,054	
12		Total Payments:	$739,520	
13		Total Interest:	$447,020	
14				

FORMULA
C10 =C4*(1-C5)
C11 =PMT(C7/12,C6,-C4)
C12 =C11*C6
C13 =C12-C10

With this worksheet, you can easily answer the following what-if questions:

i). What if I can negotiate a lower purchase price on the property?
ii). What if the lender requires a 20-percent down payment?
iii). What if I can get a 40-year mortgage?
iv). What if the interest rate increases to 7.0 percent?

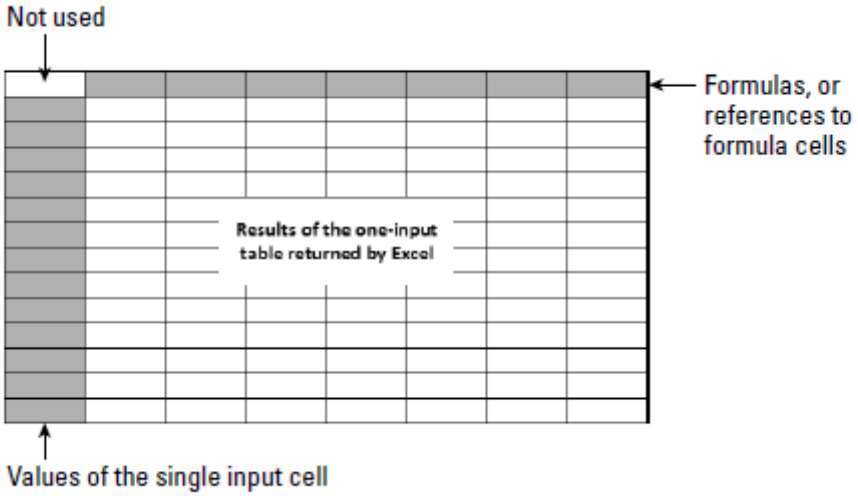
- You can answer these questions by simply changing the values in the cells in range C4:C7 and observing the effects in the dependent cells (C10:C13).

Data Tables

- A *data table* is a dynamic range that summarizes formula cells for varying input cells.
- You can create a data table fairly easily, but data tables have some limitations. In particular, a data table can deal with only one or two input cells at a time.

Creating a one-input data table

- A *one-input data table* displays the results of one or more formulas for various values of a single input cell.
- The Figure below shows the general layout for a one-input data table.



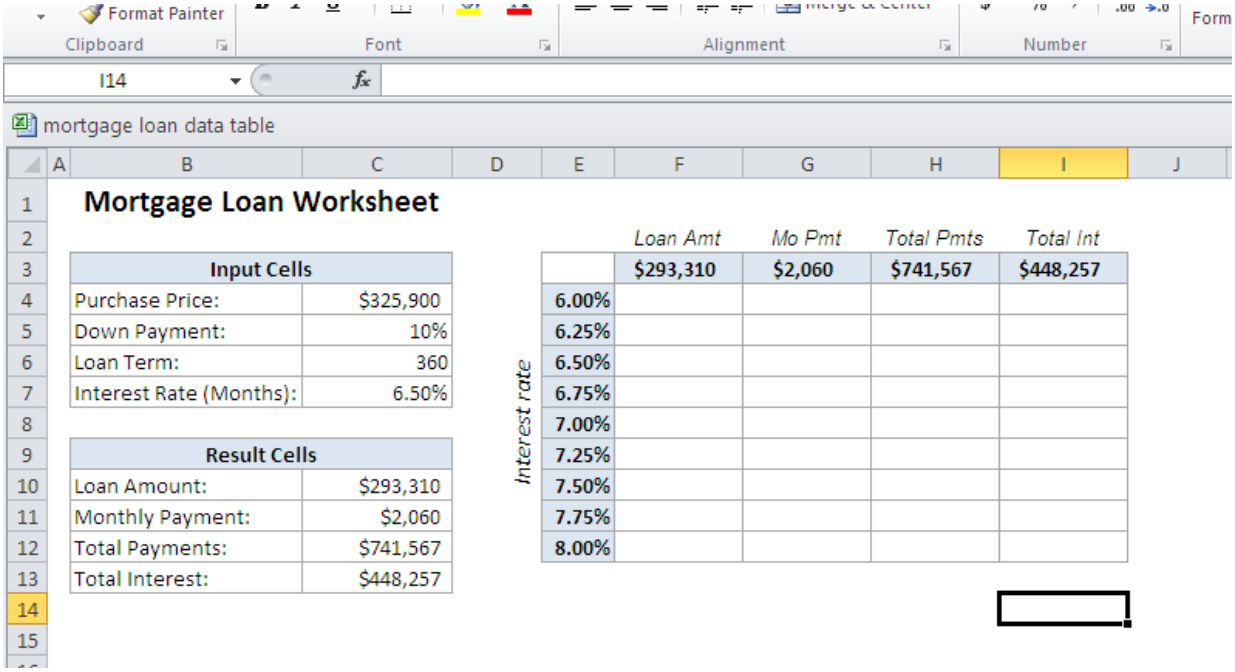
- You can place the data table anywhere in a worksheet. The left column contains various values for the single input cell.
- The top row contains references to formulas located elsewhere in the worksheet. You can use a single formula reference or any number of formula references. The upper-left cell of the table remains empty.
- Excel calculates the values that result from each value of the input cell and places them under each formula reference.

Example:

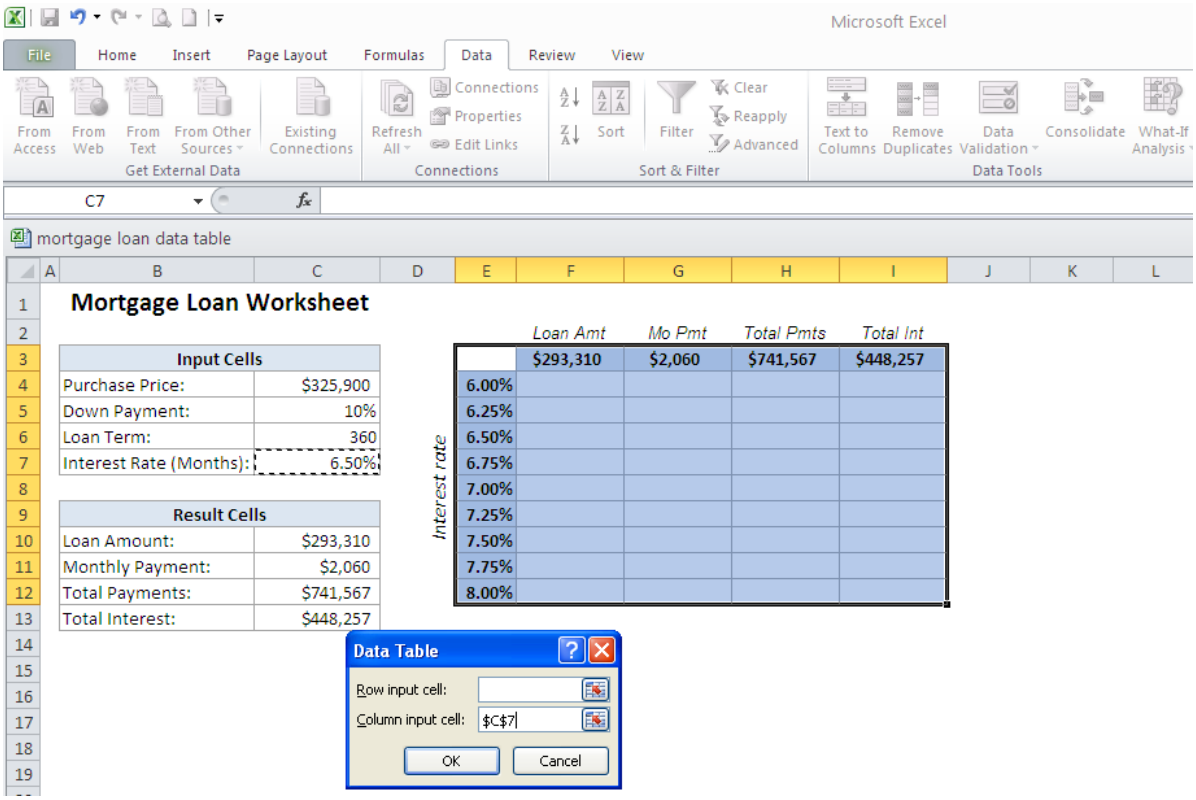
- This example uses the mortgage loan worksheet from earlier in the chapter (see “A What-If Example”). The goal of this exercise is to create a data table that shows the values of the four formula cells (loan amount, monthly payment, total payments, and total interest) for various interest rates ranging from 6 to 8 percent, in 0.25-percent increments.

Solution

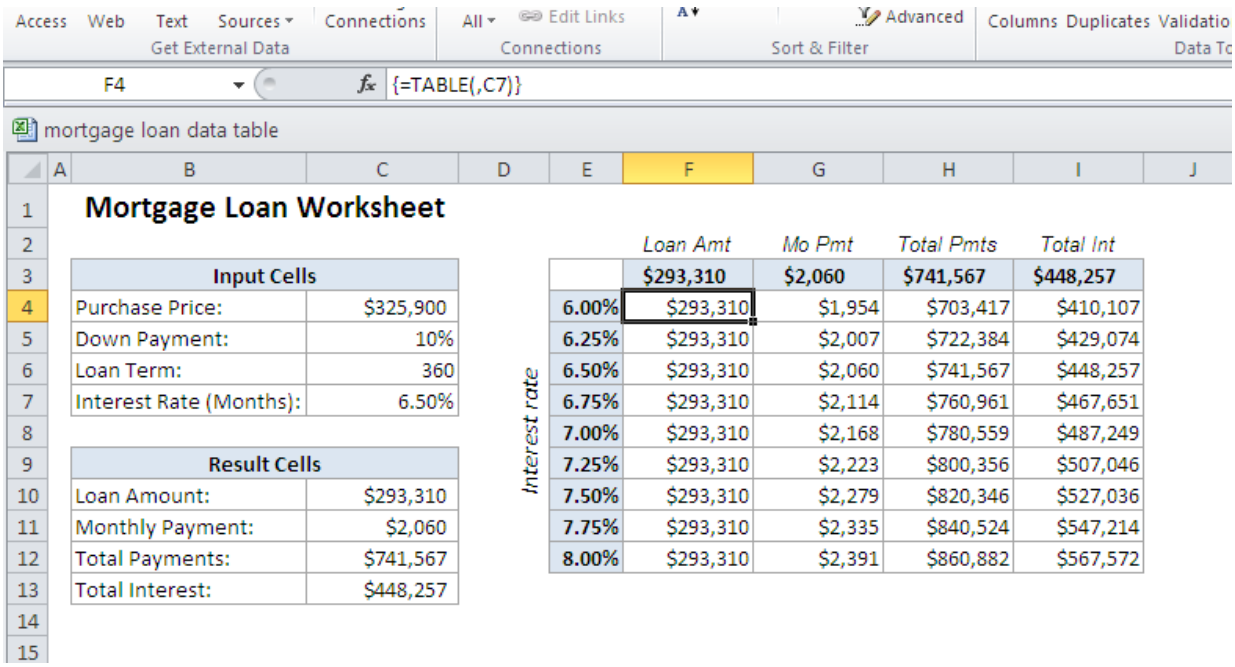
- Figure 2 below shows the setup for the data table area.
- Row 3 consists of references to the formulas in the worksheet. For example, cell F3 contains the formula =C10, and cell G3 contains the formula =C11.
- Column E contains the values of the single input cell (interest rate) that Excel will use in the table.



- To create the table, select the data table range (in this case, E3:I12) and then choose :
  Data ➪ Data Tools ➪ What-If Analysis ➪ Data Table.
  Excel displays the Data Table dialog box, shown in Figure below.
- You must specify the worksheet cell that contains the input value. Because variables for the input cell appear in the left column in the data table, you place this cell reference in the Column Input Cell field. Enter **C7** or point to the cell in the worksheet. Leave the Row Input Cell field blank. Click OK, and Excel fills in the table with the calculated results .
-



- Using this table, you can now see the calculated loan values for varying interest rates. If you examine the contents of the cells that Excel entered as a result of this command, you'll see that the data is generated with a multicell array formula: {=TABLE(,C7)}



Using Scenario Manager

- Data tables are useful, but they have a few limitations:

i). You can vary only one or two input cells at a time.

ii). Setting up a data table is not very intuitive.

iii). A two-input table shows the results of only one formula cell although you can create additional tables for more formulas.

- In many situations, you're interested in a few select combinations, not an entire table that shows all possible combinations of two input cells.
- The Scenario Manager feature makes automating your what-if models easy. You can store different sets of input values (called *changing cells* in the terminology of Scenario Manager) for any number of variables and give a name to each set.
- You can then select a set of values by name, and Excel displays the worksheet by using those values.
- You can also generate a summary report that shows the effect of various combinations of values on any number of result cells. These summary reports can be an outline or a pivot table.
- For example, your annual sales forecast may depend upon several factors. Consequently, you can define three scenarios: best case, worst case, and most likely case. You then can switch to any of these scenarios by selecting the named scenario from a list. Excel substitutes the appropriate input values in your worksheet and recalculates the formulas.

Defining scenarios

- The figure below is an example that uses a simplified production model.

production model

	A	B	C	D	E
1	**Resource Cost Variables**				
2	Hourly labor cost	30			
3	Material cost	57			
4					
5					
6		**Product A**	**Product B**	**Product C**	
7	Hours per unit	12	14	24	
8	Material per unit	6	9	14	
9	Cost to produce	$702	$933	$1,518	
10	Sales price	$795	$1,295	$2,195	
11	Unit profit	$93	$362	$677	
12	Units produced	36	18	12	
13	**Total profit per product**	**$3,348**	**$6,516**	**$8,124**	
14					
15	**Total Profit**	**$17,988**			

B9:
=(Hourly_labor_cost*B7)+(Material_cost*B8)

B11:
=B10-B9

B13
=B11*B12

B15:
=SUM(B13:D13)

- This worksheet contains two input cells: the hourly labor cost (cell B2) and the unit cost for materials (cell B3).
- The company produces three products, and each product requires a different number of hours and a different amount of materials to produce.
- Formulas calculate the total profit per product (row 13) and the total combined profit (cell B15).
- Management — trying to predict the total profit, but uncertain what the hourly labor cost and material costs will be — has identified three scenarios, listed in Table below

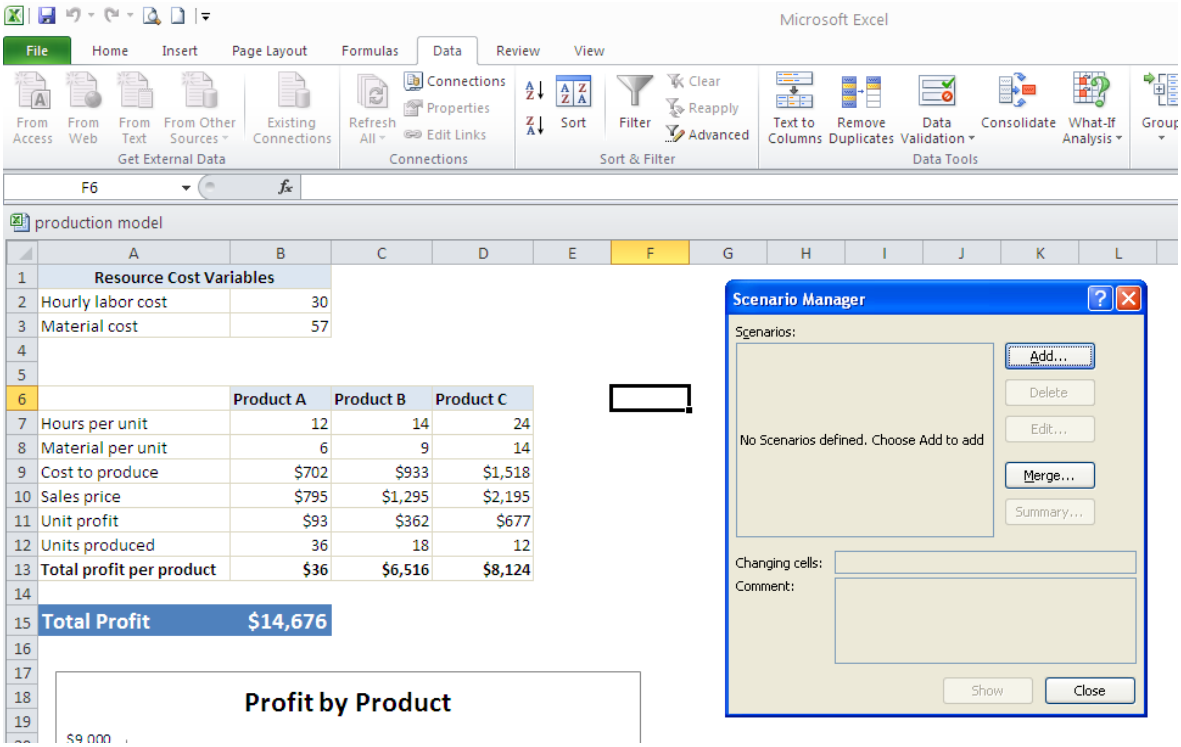
Three Scenarios for the Production Model

Scenario	Hourly Cost	Materials Cost
Best Case	30	57
Worst Case	38	62
Most Likely	34	59

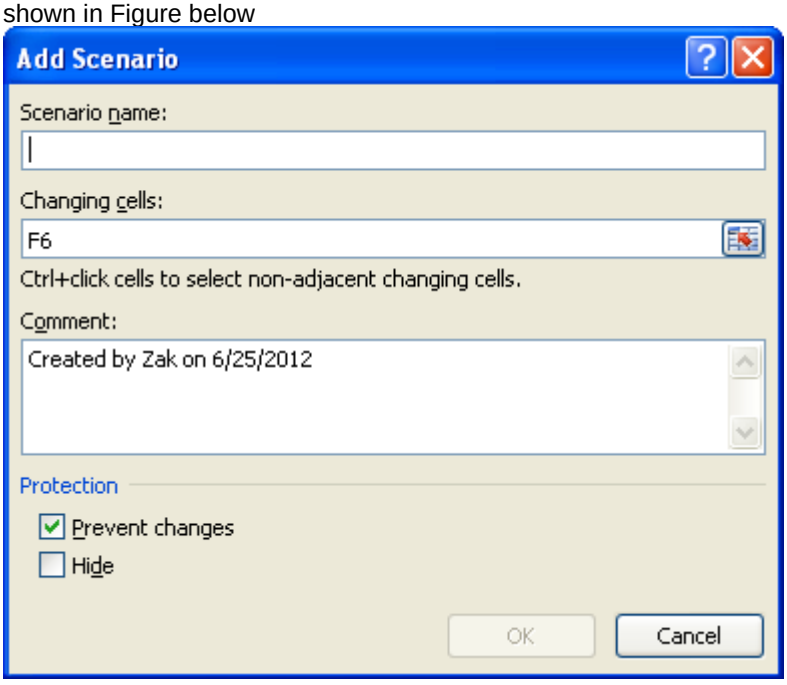
- The Best Case scenario has the lowest hourly cost and lowest materials cost.
- The Worst Case scenario has high values for both the hourly cost and the materials cost.
- The third scenario, Most Likely Case, has intermediate values for both of these input cells.
- The managers need to be prepared for the worst case, however, and they're interested in what would happen under the Best Case scenario.

Solution

- Choose Data ➪ Data Tools ➪ What-If Analysis ➪ Scenario Manger to display the Scenario Manager dialog box.
- When you first open this dialog box, it tells you that no scenarios are defined — which is not too surprising because you're just starting.
- As you add named scenarios, they appear in the Scenarios list in this dialog box.



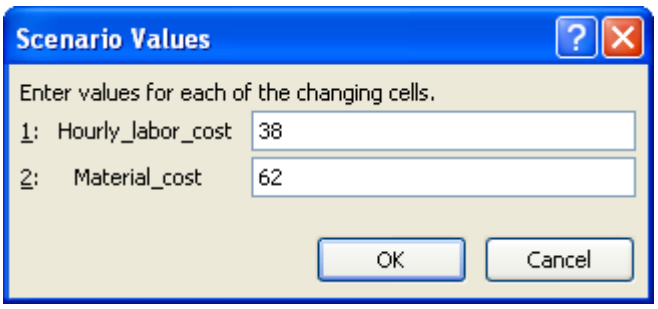
To add a scenario, click the Add button in the Scenario Manager dialog box. Excel displays its Add Scenario dialog box, shown in Figure below



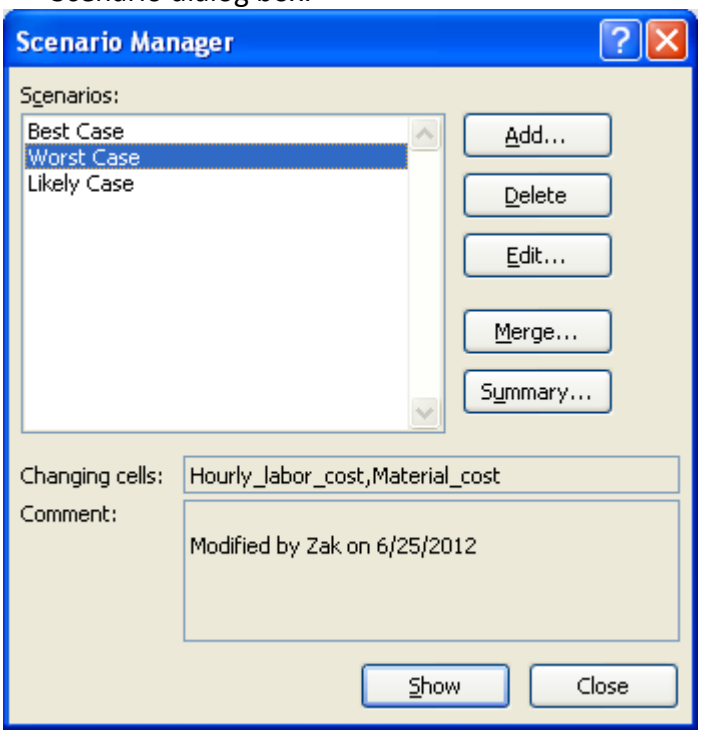
- This dialog box consists of four parts:

1. **Scenario Name:** You can give the scenario any name that you like — preferably something meaningful.
2. **Changing Cells:** The input cells for the scenario. You can enter the cell addresses directly or point to them. If you've created a name for the cells, type the name.
    - The number of changing cells for a scenario is limited to 32.
3. **Comment:** By default, Excel displays the name of the person who created the scenario and the date when it was created. You can change this text, add new text to it, or delete it.
4. **Protection:** The two Protection options (preventing changes and hiding a scenario) are in effect only when you protect the worksheet and choose the Scenario option in the Protect Sheet dialog box. Protecting a scenario prevents anyone from modifying it; a hidden scenario doesn't appear in the Scenario Manager dialog box.

- In this example, define the three scenarios that are listed in Table above. The changing cells are Hourly_Cost (B2) and Materials_Cost (B3).
- After you enter the information in the Add Scenario dialog box, click OK. Excel then displays the Scenario Values dialog box, shown in Figure 36.12. This dialog box displays one field for each changing cell that you specified in the previous dialog box. Enter the values for each cell in the scenario.

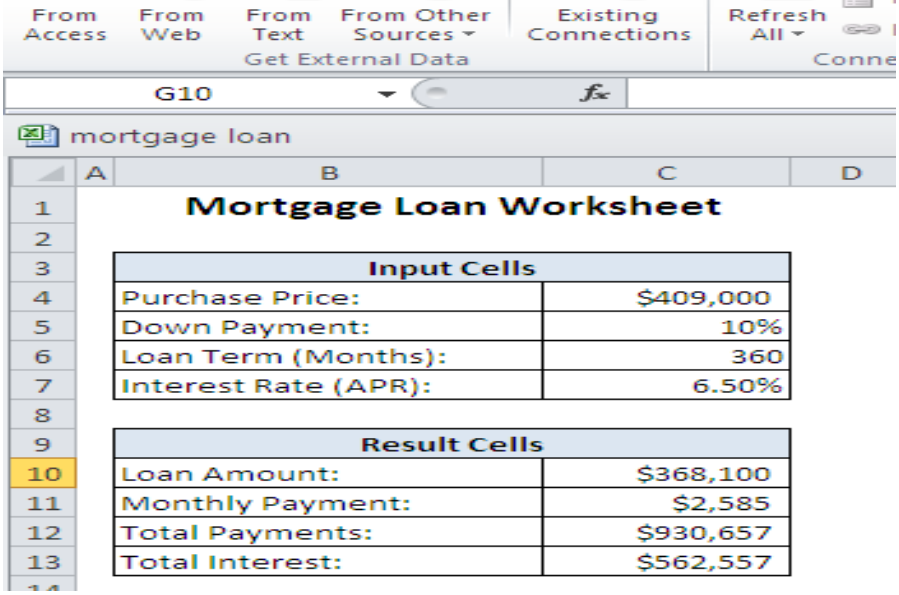


- If you click OK, you return to the Scenario Manager dialog box, which then displays your named scenario in its list. If you have more scenarios to create, click the Add button to return to the Add Scenario dialog box.



Displaying scenarios

- After you define all the scenarios and return to the Scenario Manager dialog box, the dialog box displays the names of your defined scenarios.
- Select one of the scenarios and then click the Show button. Excel inserts the corresponding values into the changing cells and calculates the worksheet to show the results for that scenario. Figure below shows an example of selecting worst case scenario.



Reverse What-If Analysis

- If you know what a formula result *should* be, Excel can tell you the values that you need to enter in one or more input cells to produce that result. In other words, you can ask a question such as "How much do sales need to increase to produce a profit of $1.2 million?".
- Excel provides two tools that are relevant:

1. **Goal Seek:** Determines the value that you need to enter in a single input cell to produce a result that you want in a dependent (formula) cell.
2. **Solver:** Determines the values that you need to enter in multiple input cells to produce a result that you want. Moreover, because you can specify certain constraints to the problem, you gain significant problem-solving ability.

Single-Cell Goal Seeking

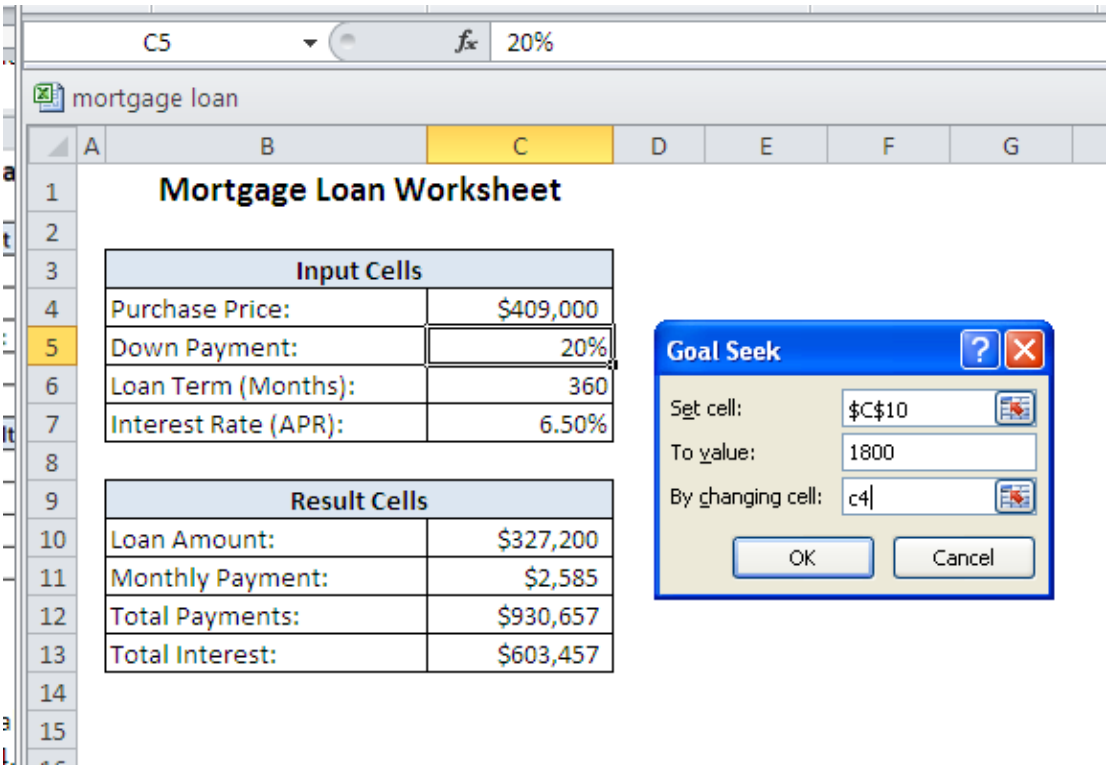
- In Single-cell goal seeking, Excel determines what value in an input cell produces a desired result in a formula cell.

A goal-seeking example

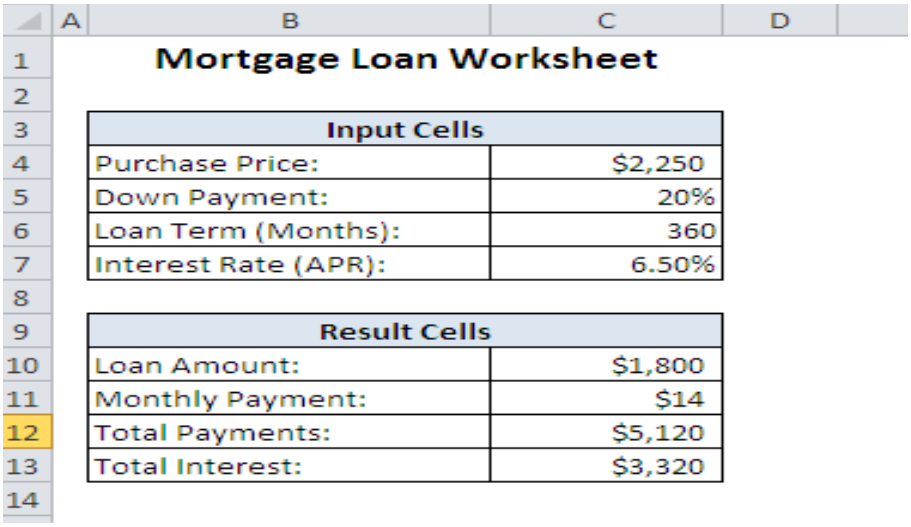
- Figure below shows the mortgage loan worksheet used in the preceding chapter. This worksheet has four input cells (C4:C7) and four formula cells (C10:C13).
- This example demonstrates the opposite approach. Rather than supply different input cell values to look at the calculated formulas, this example lets Excel determine one of the input values that will produce the desired result.
- Assume that you're in the market for a new home and you know that you can afford an $1,800 monthly mortgage payment. You also know that a lender can issue a 30-year fixed-rate mortgage loan for 6.50%, based on an 80% loan-to-value (that is, a 20% down payment). The question is "What is the maximum purchase price I can handle?" In other words, what value in cell C4 causes the formula in cell C11 to result in $1,800?
- In this simple example, you could plug values into cell C4 until C11 displays $1,800. With more complex models, Excel can usually determine the answer much more efficiently.
- To answer the question posed in the preceding paragraph, first set up the input cells to match what you already know. Specifically:
    i). Enter **20%** in cell C5 (the down payment percent)
    ii). Enter **360** in cell C6 (the loan term, in months)

iii). Enter **6.5%** in cell C7 (the annual interest rate)

- Next, choose Data ➪ Data Tools ➪ What-If Analysis ➪ Goal Seek. Excel displays the Goal Seek dialog box, shown in Figure below.



- Completing this dialog box is similar to forming a sentence. You want to set cell C11 to 1800 by changing cell C4. Enter this information in the dialog box either by typing the cell references or by pointing with the mouse. Click OK to begin the goal-seeking process.
- In less than a second, Excel displays the Goal Seek Status box, which shows the target value and the value that Excel calculated. In this case, Excel found an exact value. The worksheet now displays the found value in cell C4 ($355,974). As a result of this value, the monthly payment amount is $1,800. At this point, you have two options:
  i). Click OK to replace the original value with the found value.
  ii). Click Cancel to restore your worksheet to the form that it had before you chose Goal Seek.



More about goal seeking

- Excel can't always find a value that produces the result that you're seeking. Sometimes, a solution simply doesn't exist. In such a case, the Goal Seek Status box informs you of that fact.
- Other times, however, Excel may report that it can't find a solution, but you're pretty sure that one exists. If that's the case, you can try the following options:

i). Change the current value of the By Changing Cell field in the Goal Seek dialog to a value that is closer to the solution and then reissue the command.

ii). Adjust the Maximum iterations setting on the Formulas tab of the Excel Options dialog box (choose File ➪ Excel Options). Increasing the number of iterations (or calculations) makes Excel try more possible solutions.

iii). Double-check your logic and make sure that the formula cell does, indeed, depend upon the specified changing cell.

Introducing Solver

- The Excel Goal Seek feature is a useful tool, but it clearly has limitations. It can solve for only one adjustable cell, and it returns only a single solution.
- Excel's powerful Solver tool extends this concept by enabling you to do the following:
  i). Specify multiple adjustable cells.
  ii). Specify constraints on the values that the adjustable cells can have.
  iii). Generate a solution that maximizes or minimizes a particular worksheet cell.
  iv). Generate multiple solutions to a problem.
- Although goal seeking is a relatively simple operation, using Solver can be much more complicated.

No Solver Command?

You access Solver by choosing Data ➪ Analysis ➪ Solver. If this command isn't available, you need to install the Solver add-in. It's a simple process:

1. **Choose File ➪ Options.**
2. **In the Excel Options dialog box, click the Add-Ins tab.**
3. **At the bottom of the dialog box, select Excel Add-Ins from the Manage drop-down list and then click Go.** Excel displays its Add-Ins dialog box.
4. **In the Add-Ins dialog box, place a check mark next to Solver Add-In and then click OK.**

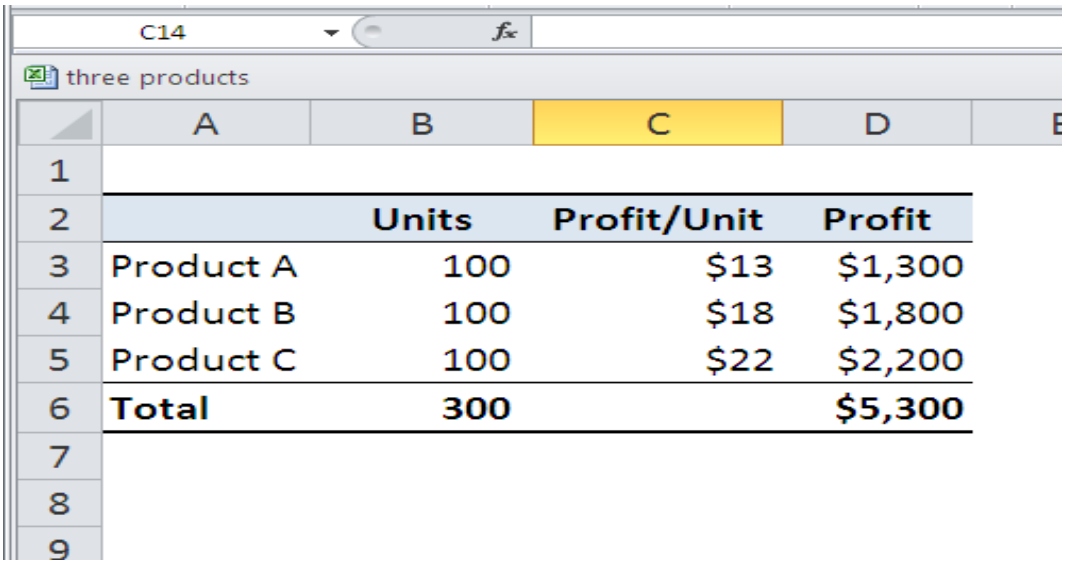
After performing these steps, the Solver add-in loads whenever you start Excel.

Appropriate problems for Solver

- Problems that are appropriate for Solver fall into a relatively narrow range. They typically involve situations that meet the following criteria:
  i). A target cell depends upon other cells and formulas. Typically, you want to maximize or minimize this target cell or set it equal to some value.
  ii). The target cell depends on a group of cells (called *changing cells*) that Solver can adjust to affect the target cell.
  iii). The solution must adhere to certain limitations, or *constraints.*
- After you set up your worksheet appropriately, you can use Solver to adjust the changing cells and produce the result that you want in your target cell — and simultaneously meet all the constraints that you defined.

A simple Solver example

- Figure below shows a worksheet that is set up to calculate the profit for three products.
- Column B shows the number of units of each product, Column C shows the profit per unit for each product, and Column D contains formulas that calculate the total profit for each product by multiplying the units by the profit per unit.



	A	B	C	D
1				
2		Units	Profit/Unit	Profit
3	Product A	100	$13	$1,300
4	Product B	100	$18	$1,800
5	Product C	100	$22	$2,200
6	**Total**	**300**		**$5,300**
7				
8				
9				

- You don't need an MBA degree to realize that the greatest profit comes from Product C. Therefore, to maximize total profit, the logical solution is to produce only Product C. If things were really this simple, you wouldn't need tools such as Solver.
- As in most situations, this company has some constraints that must be met:

i). The combined production capacity is 300 total units per day.
ii). The company needs 50 units of Product A to fill an existing order.
iii). The company needs 40 units of Product B to fill an anticipated order.
iv). Because the market for Product C is relatively limited, the company doesn't want to produce more than 40 units of this product.

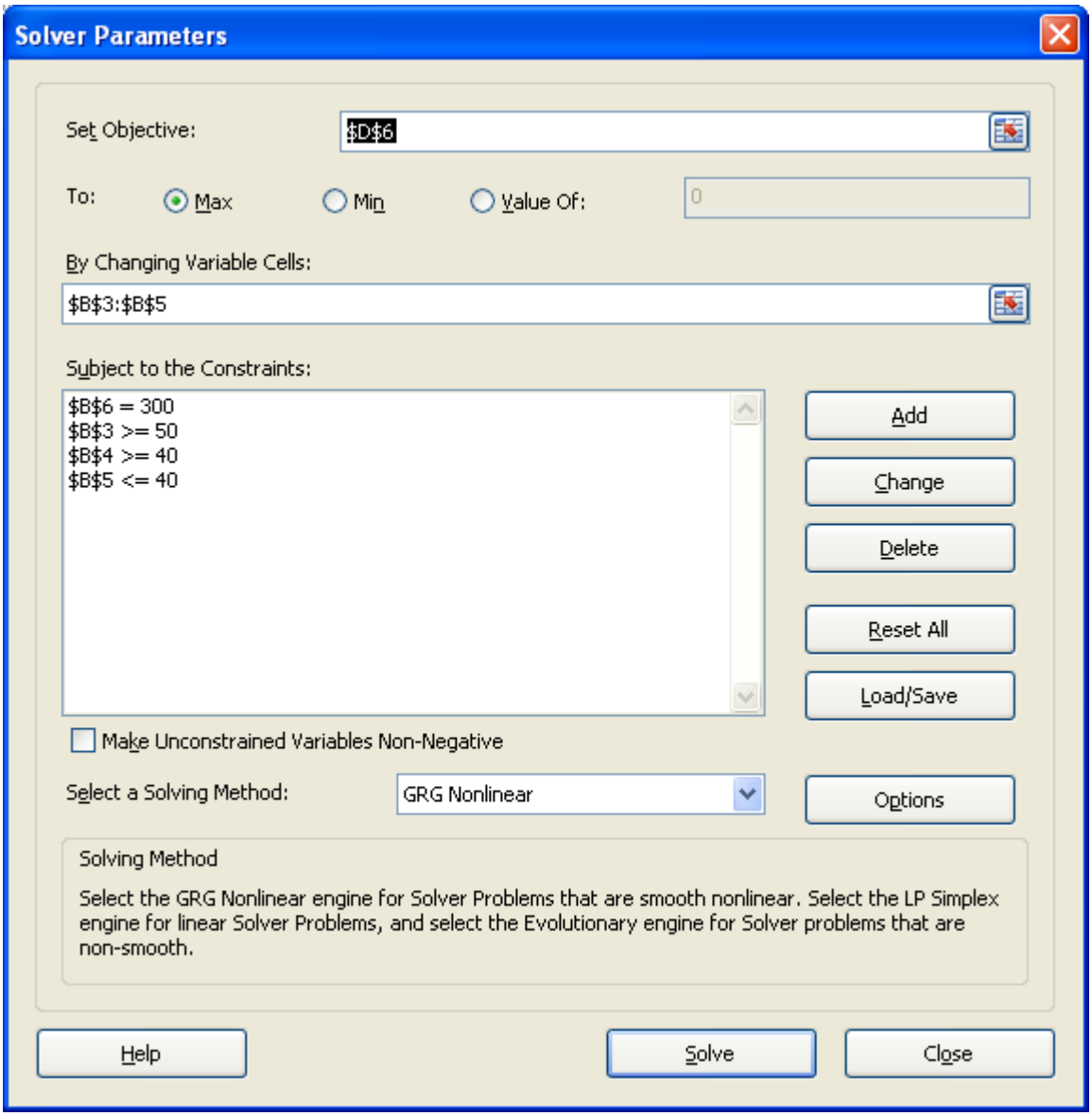
- These four constraints make the problem more realistic and a bit more challenging. In fact, it's a perfect problem for Solver.

Steps

1. **Set up the worksheet with values and formulas.** Make sure that you format cells logically; for example, if you can't produce partial units of your products, format those cells to contain numbers with no decimal values.
2. **Choose Data ➪ Analysis ➪ Solver to bring up the Solver Parameters dialog box.**
3. **Specify the target cell.**
4. **Specify the range that contains the changing cells.**
5. **Specify the constraints.**
6. **Change the Solver options, if necessary.**
7. **Let Solver solve the problem.**

Solution

- To start Solver to tackle this example, choose Data ➪ Analysis ➪ Solver. Excel displays its Solver Parameters dialog box, shown in Figure below.



- In this example, the target cell is D6 — the cell that calculates the total profit for three products.

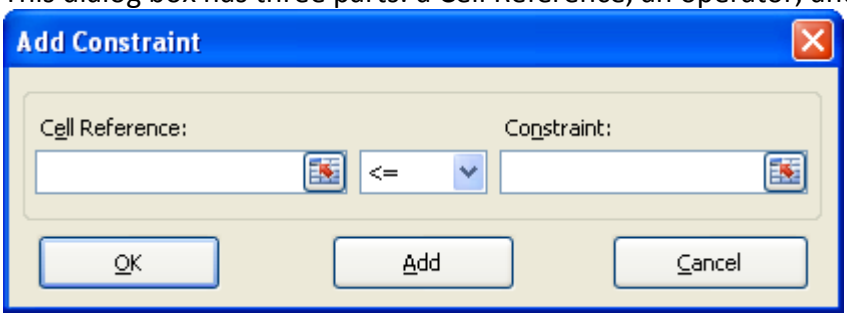
1. Enter D6 **in the Set Objective field of the Solver Parameters dialog box.**

2. Because the objective is to maximize this cell, select the Max option button.

3. Specify the changing cells (which are in the range B3:B5) in the By Changing Variable Cells field.

- The next step is to specify the constraints on the problem. The constraints are added one at a time and appear in the Subject to the Constraints list.

4. To add a constraint, click the Add button. Excel displays the Add Constraint dialog box, shown in below. This dialog box has three parts: a Cell Reference, an operator, and a Constraint value.

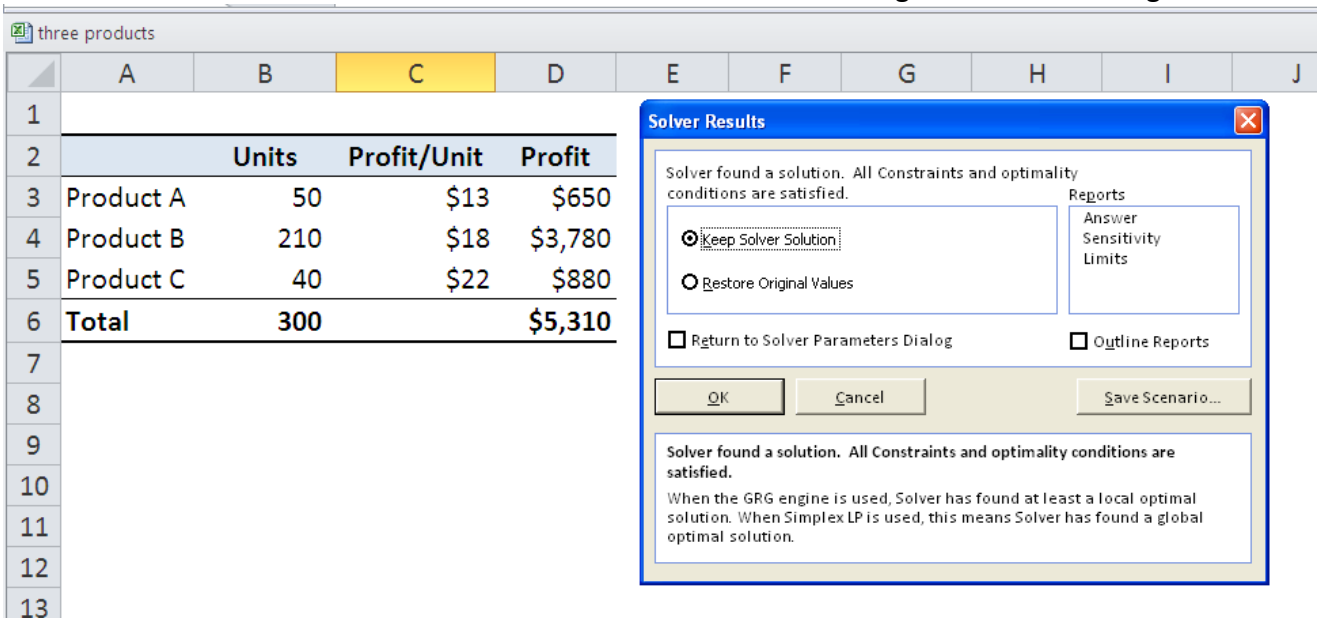


5. To set the first constraint (that the total production capacity is 300 units), enter B6 **as the Cell Reference, choose equal (=) from the drop-down list of operators, and enter** 300 **as the Constraint value.**
6. Click Add, and enter the remaining constraints. Table below summarizes the constraints for this problem.

Constraints Summary

Constraint	Expressed As
Capacity is 300 units	B6=300
At least 50 units of Product A	B3>=50
At least 40 units of Product B	B4>=40
No more than 40 units of Product C	B5<=40

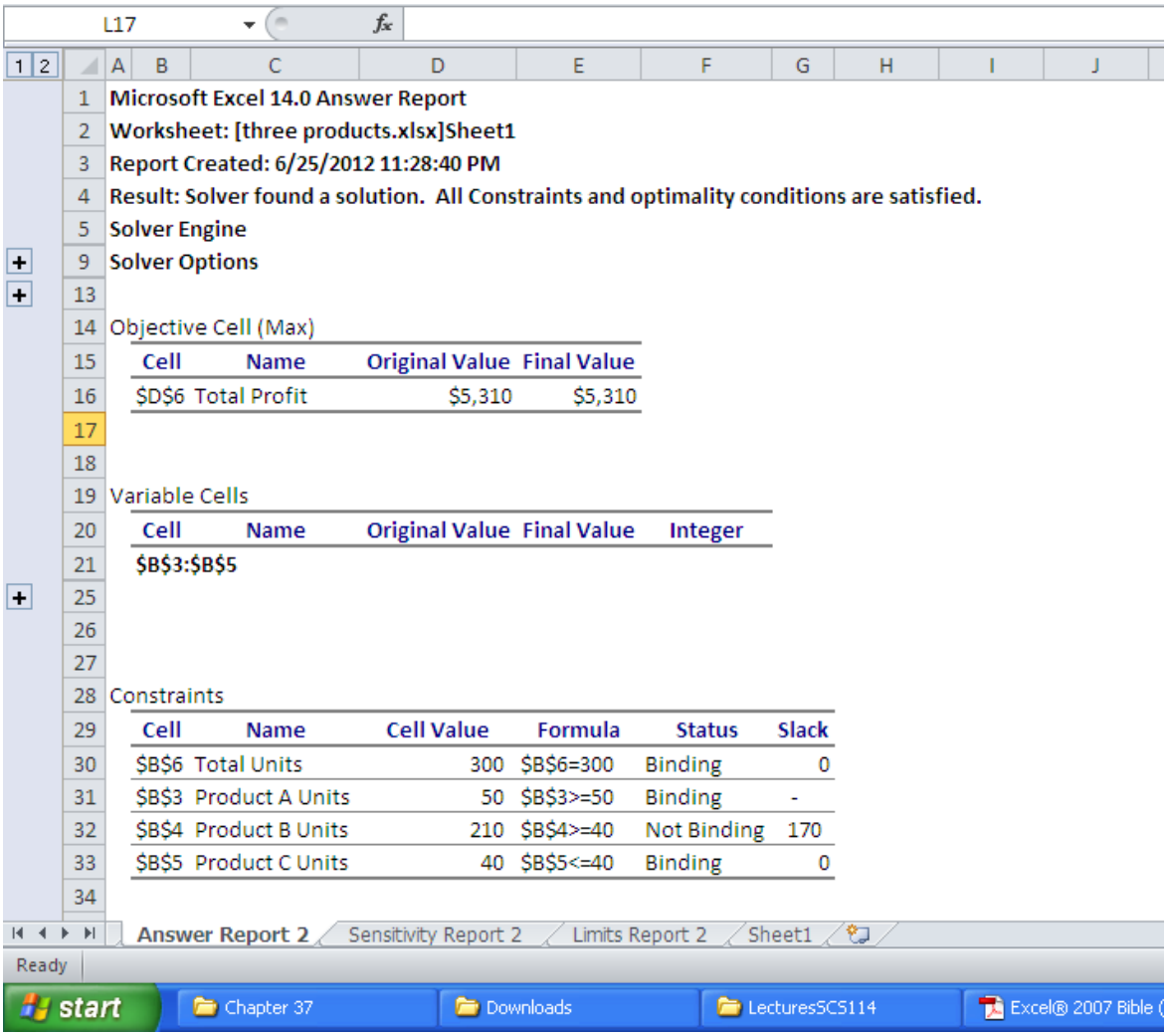
7. After you enter the last constraint, click OK to return to the Solver Parameters dialog box, which now lists the four constraints.
8. For the Solving Method, use the default, GRG Nonlinear.
9. Click the Solve button to start the solution process. You can watch the progress onscreen, and Excel soon announces that it has found a solution. The Solver Results dialog box is shown in Figure below.



- At this point, you have the following options:

i). Keep the solution that Solver found.
ii). Restore the original changing cell values.
iii). Create any or all three reports that describe what Solver did.
iv). Click the Save Scenario button to save the solution as a scenario so that Scenario Manager can use.

- The Reports section of the Solver Results dialog box lets you select any or all of three optional reports.
- If you specify any report options, Excel creates each report on a new worksheet, with an appropriate name.
- Figure below shows an Answer Report, in the form of a collapsible outline (I chose the Outline Reports check box in the Solver Results dialog box). In the Constraints section of the report, three of the four constraints are *binding,* which means that these constraints were satisfied at their limit with no more room to change.



Microsoft Excel 14.0 Answer Report
Worksheet: [three products.xlsx]Sheet1
Report Created: 6/25/2012 11:28:40 PM
Result: Solver found a solution. All Constraints and optimality conditions are satisfied.
Solver Engine
Solver Options

Objective Cell (Max)

Cell	Name	Original Value	Final Value
$D$6	Total Profit	$5,310	$5,310

Variable Cells

Cell	Name	Original Value	Final Value	Integer
$B$3:$B$5				

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$B$6	Total Units	300	$B$6=300	Binding	0
$B$3	Product A Units	50	$B$3>=50	Binding	-
$B$4	Product B Units	210	$B$4>=40	Not Binding	170
$B$5	Product C Units	40	$B$5<=40	Binding	0

Answer Report 2 | Sensitivity Report 2 | Limits Report 2 | Sheet1

Ready

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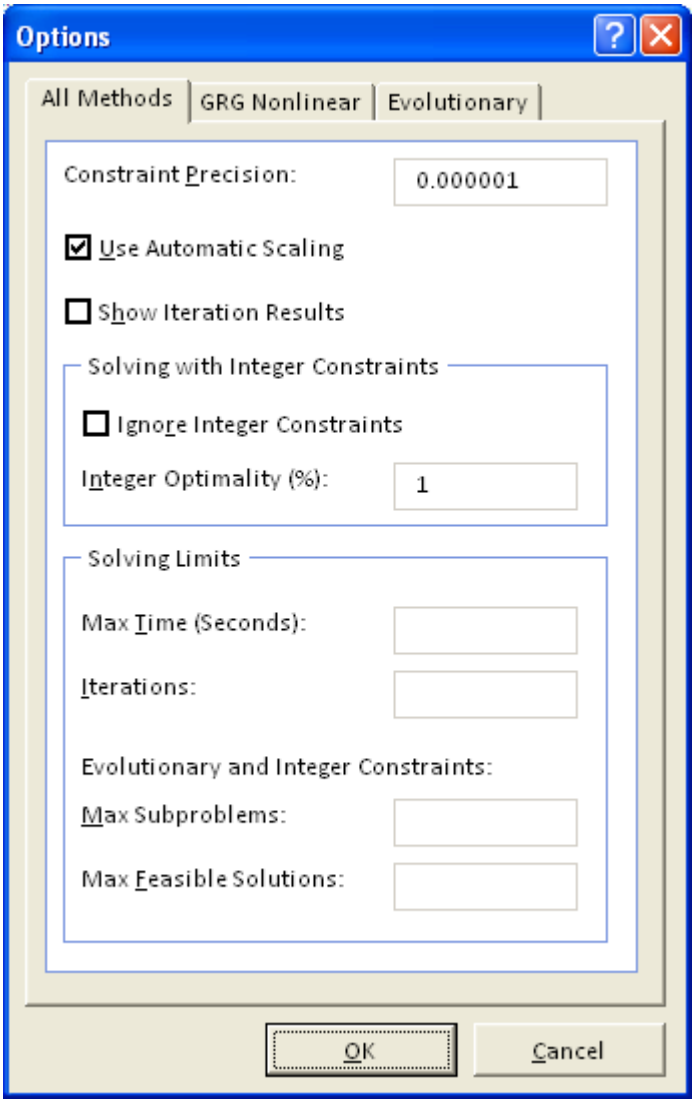
- This simple example illustrates how Solver works. The fact is, you could probably solve this particular problem manually just as quickly. That, of course, isn't always the case.
- At this point, you have the following options:
  i). Keep the solution that Solver found.
  ii). Restore the original changing cell values.
  iii). Create any or all three reports that describe what Solver did.
  iv). Click the Save Scenario button to save the solution as a scenario so that Scenario Manager can use it.

More about Solver

- It's not unusual for Solver to report that it can't find a solution, even when you know that one should exist. Often, you can change one or more of the Solver options and try again.
- When you click the Options button in the Solver Parameters dialog box, Excel displays the Solver Options dialog box, shown in Figure below



This list describes Solver's options:

1. **Constraint Precision:** Specify how close the Cell Reference and Constraint formulas must be to satisfy a constraint. Excel may solve the problem more quickly if you specify less precision.
2. **Use Automatic Scaling:** Use when the problem involves large differences in magnitude — when you attempt to maximize a percentage, for example, by varying cells that are very large.
3. **Show Iteration Results:** Instruct Solver to pause and display the results after each iteration by selecting this check box.
4. **Ignore Integer Constraints:** When this check box is selected, Solver ignores constraints that specify that a particular cell must be an integer. Using this option may allow Solver to find a solution that cannot be found otherwise.
5. **Max Time:** Specify the maximum amount of time (in seconds) that you want Solver to spend on a problem. If Solver reports that it exceeded the time limit, you can increase the amount of time that it spends searching for a solution.
6. **Iterations:** Enter the maximum number of trial solutions that you want Solver to perform.
7. **Max Subproblems:** For complex problems. Specify the maximum number of subproblems that may be explored by the Evolutionary algorithm.
8. **Max Feasible Solutions:** For complex problems. Specify the maximum number of feasible solutions that may be explored by the Evolutionary algorithm.