Grauer Chapter 2 – Formulae & Functions
Objectives

- Use semi-selection to create a formula
- Use relative, absolute, and mixed cell references in formulae
- Avoid circular references
- Insert a function
- Total values with the SUM function
- Insert basic statistical functions
- Use date functions
- Determine results with the IF function
- Use lookup functions
- Calculate payments with the PMT function
- Create and maintain range names
- Use range names in formulae

Cell References

- Excel offers three types of cell references for use when a formula is copied
    - **Absolute** A1
    - **Relative**   A1
    - **Mixed** $A1 or A$1
- $ indicates that the row number or column letter will not be modified during a copy operation

Absolute vs Relative Reference

A ***mixed reference*** uses a single **$** sign to make the column or the row absolute, leaving the other as relative. For example F$6 or $F6

Function Basics

- An Excel **function** is a predefined formula that performs a calculation, such as SUM(), AVERAGE().

Category	Description
Compatibility	Contains functions compatible with Excel 2007 and earlier.
Cube	Returns values based on data in a cube, such as validating membership or returning a member's ranking.
Database	Analyzes records stored in a database format in Excel and returns key values, such as the number of records or averages value in a field.
Date & Time	Provides methods for manipulating date and time values.

Function Basics (continued)

Category	Description
Engineering	Calculates values commonly used by engineers, such as conversions.
Financial	Performs financial calculations, such as payments, rates and present/future values.
Information	Provides information about the contents of a cell, typically displaying TRUE if the cell contains a particular data type, such as a value.
Logical	Performs logical tests and returns the value of the tests. Includes logical operators such as AND, OR, and NOT.
Lookup & Reference	Looks up values, creates links to cells, or provides references to cells in a worksheet.
Math & Trig	Performs standard math and trigonometry calculations.
Statistical	Performs statistical calculations, such as averages or standard deviation.
Text	Manipulates text strings, by combining words or converting cases.

Function Terminology

- **Syntax** is the set of rules that govern correct formation of a function. You have to follow the rules or Excel won't understand what you are trying to tell it.

- The rules for a function formula:
  - function formula ➔=functionName(argumentList)
  - argumentList ➔argument, …, argument

  Different functions need different sorts of arguments.

- A function begins with the equal sign (=) followed by the function name and arguments in parentheses

  Example: =SUM(A1:A3)

- An **argument** is an input, such as a cell or range

- Function arguments are sometimes single cells (like A3), but also sometimes *ranges*, like here (A1:A3)

Inserting a Function

- When a function is *typed*, **Formula AutoComplete** displays a list of functions matching the partial entry

Inserting a Function

- A **function ScreenTip** is a small pop-up description that displays the function arguments

Insert Function Dialog Box

- Use the **Insert Function** dialog box to search for a function or select one from a list
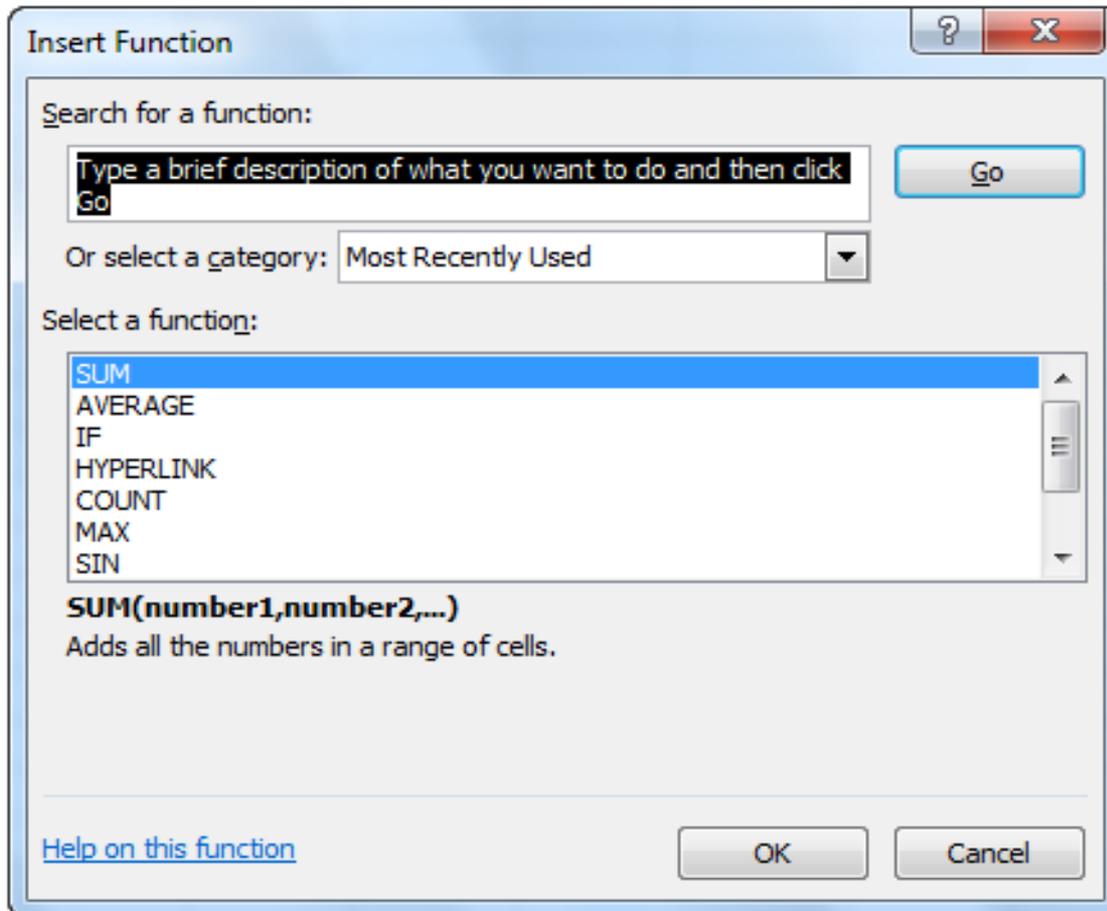
Function Arguments Dialog Box

- The **Function Arguments** dialog box offers help on each argument
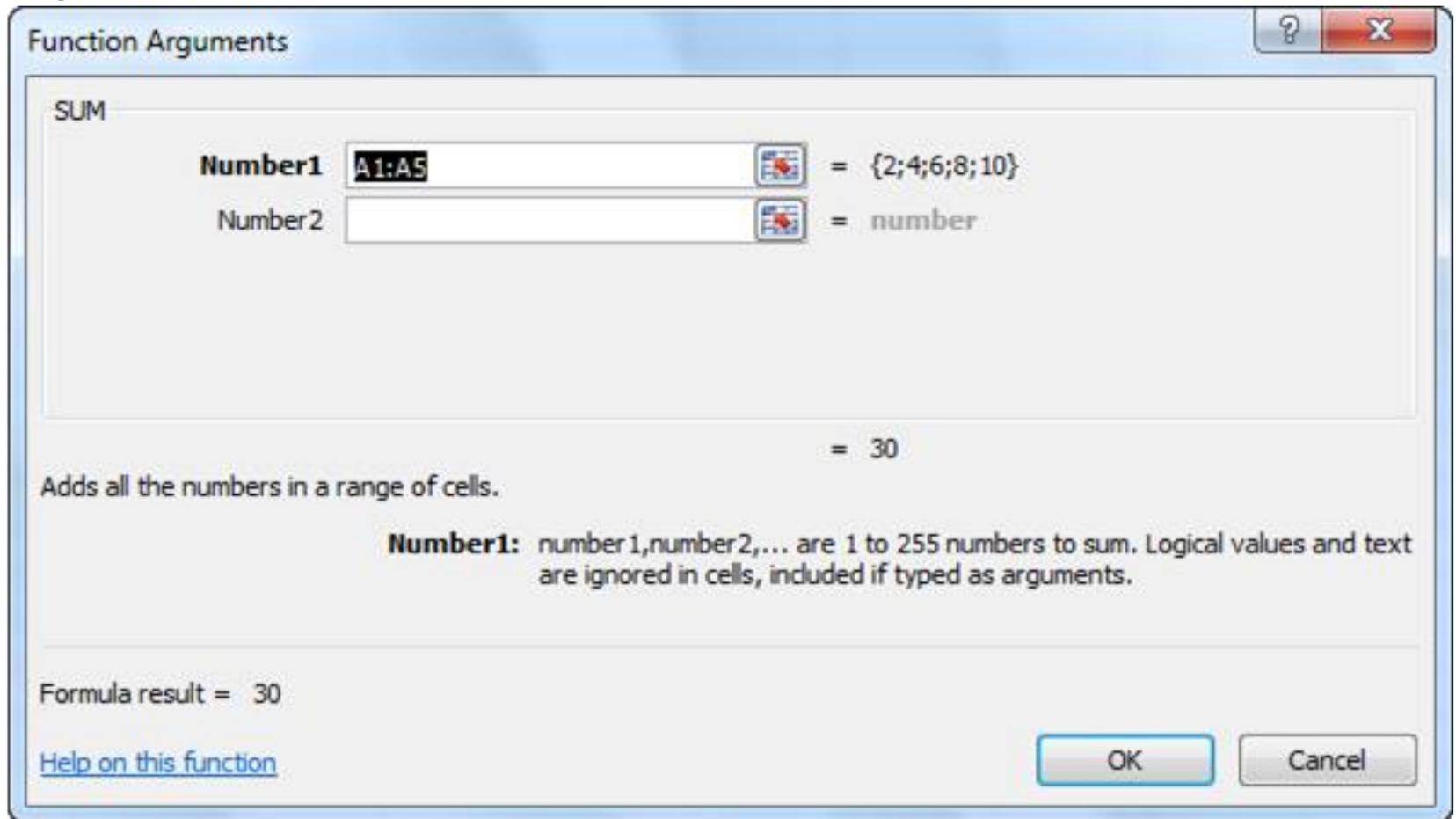
Totaling Values with SUM

- The SUM function returns the mathematical sum of some number of cells or ranges; for example:

    =SUM(A1:A3)

    =SUM(A1,B3,C5)

    =SUM(A1:B3,C5:E8)

Basic Statistical Functions

- Common statistical functions include:
    - AVERAGE   arithmetic mean
    - MEDIAN   midpoint value
    - MIN   minimum value
    - MAX   maximum value
    - COUNT   number of values in range
    - COUNTA   number of nonempty cells
    - COUNTBLANK   number of empty cells

Basic Statistical Functions
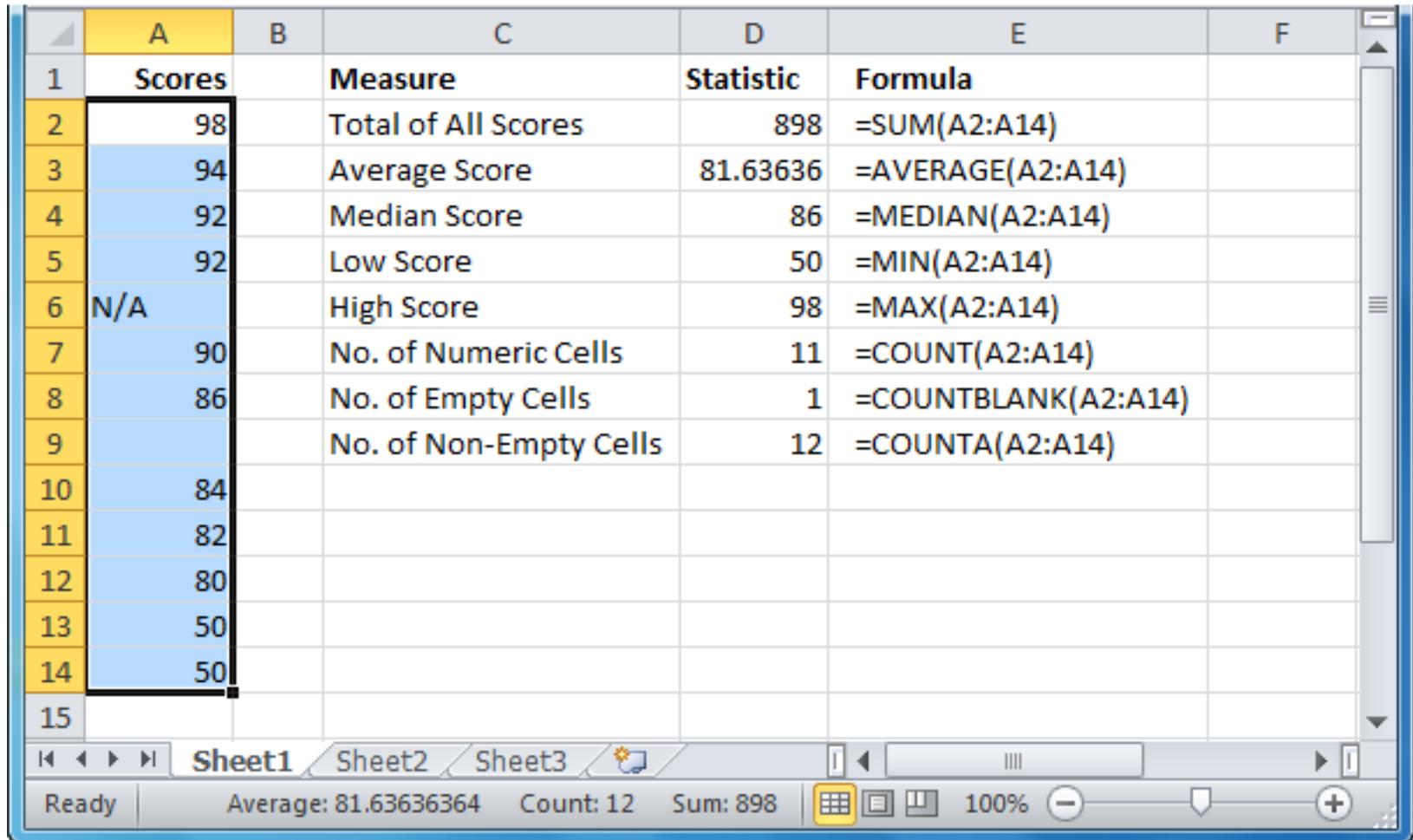
	A	B	C	D	E	F
1	**Scores**		**Measure**	**Statistic**	**Formula**	
2	98		Total of All Scores	898	=SUM(A2:A14)	
3	94		Average Score	81.63636	=AVERAGE(A2:A14)	
4	92		Median Score	86	=MEDIAN(A2:A14)	
5	92		Low Score	50	=MIN(A2:A14)	
6	N/A		High Score	98	=MAX(A2:A14)	
7	90		No. of Numeric Cells	11	=COUNT(A2:A14)	
8	86		No. of Empty Cells	1	=COUNTBLANK(A2:A14)	
9			No. of Non-Empty Cells	12	=COUNTA(A2:A14)	
10	84					
11	82					
12	80					
13	50					
14	50					
15						

Sheet1 / Sheet2 / Sheet3

Ready   Average: 81.63636364   Count: 12   Sum: 898   100%

Other Math & Trig Functions

Function Syntax	Description
=ABS(number)	Displays the positive value of a number.
=FREQUENCY(data_array, bins_array)	Counts how often values appear in a given range.
=INT(number)	Rounds a value down to the nearest whole number.
=MODE.SNGL(num1, [num2],…)	Displays the most frequently occurring value in a list.
=PI()	Returns the value of pi accurate to 15 digits.
=PRODUCT(num1, [num2],…)	Multiplies all values within the argument list.
=RANDBETWEEN(bottom, top)	Generates a random number between two values. Bottom and top are whole numbers.

Other Math & Trig Functions

Function Syntax	Description
=RANK.AVG(number,ref,[order])	Identifies a value's rank within a list; returns average rank for identical values.
=RANK.EQ(number,ref,[order])	Identifies a value's rank within a list; the top rank is identified for identical values.
=ROUND(number, num_digits)	Rounds a value to a specific number of digits.
=SUMPRODUCT(array1,[array2],…)	Finds the result of multiplying values in one range by related values in another column and adding products.
=TRIMMEAN(array,percent)	Returns the average of the internal values in a range by excluding a specified percentage at the upper and lower ends.
=TRUNC(number,num_digits)	Returns the integer equivalent of a number by truncating the fractional part.

Useful Functions and Features

- **COUNTIF**: Counts the number of cells within a range that meet the given criteria
    - Example: **COUNTIF**(C2:C8, "<10") equals 2

- **SUMIF**: Adds the cells specified by a given criteria.
    - Example: **SUMIF**(B2:B8,"Absent", C2:C8) equals 29

	A	B	C
1	Name	Labs Total	Assignments
2	Linda	75	19
3	Sue	Absent	17
4	Paul	40	8
5	Rob		5
6	John	66	15
7	Jesse	Absent	12
8	Rita	78	18

Date Functions

- Since dates are numeric, calculations can be performed, such as subtraction
- The **TODAY()** function displays the current date
- The **NOW()** function displays the current date and time

TODAY()	27/02/2017	
NOW()	27/02/2017 13:21	

Making Decisions with the IF Function

- =IF(logical_test, value_if_true,value_if_false)
- The IF function has three arguments:
  - A logical test or condition that is true or false
  - The resulting value if the condition is true
  - The resulting value if the condition is false

  For example:

  =IF(A1>A2,true,false)

Using the IF Function

	A	B	C
1	Input Values		
2	$1,000		
3	$2,000		
4	10%		
5	5%		
6	$250		
7			
8			
9	IF Function	Evaluation	Result
10	=IF(A2=A3,A4,A5)	1000 is equal to 2000: FALSE	5%
11	=IF(A2<A3,A4,A5)	1000 is less than 2000: TRUE	10%
12	=IF(A2<A3,A5*A2,MAX(A3*A4,A6))	1000 is less than 2000: TRUE	$50
13	=IF(A2<>A3,"Not Equal","Equal")	1000 and 2000 are not equal: TRUE	Not Equal
14	=IF(A2*A4=A3*A5,A6,0)	100 (A2*A4) is equal to 100 (A3*A5): TRUE	$250

Designing the Logical Test

- The **logical test** is built from the logical operators

Operator	Description
=	Equal to
<>	Not equal to
<	Less than
>	Greater than
<=	Less than or equal to
>=	Greater than or equal to

- =IF(A2=A3,true,false)
- =IF(A2<A3,true,false)

Using Functions as Arguments

- A **nested function** occurs when one function is embedded as an argument to another function; for example:

=IF(A1<A2,MIN(B1:B5),MAX(B1:B5))

  - The MIN(…) and MAX(…) are nested function evaluations

  - Compute the MIN function if A1 is less than A2

  - Compute the MAX function if A1 is not less than A2

Useful Functions and Features

Conditional Functions:

- **AND**: Returns TRUE if all its arguments are TRUE; returns FALSE if one or more arguments is FALSE. Example:

  IF(**AND**(B2>75, C2>15), "Very Good", "Not Good!")

- **OR**: Returns TRUE if any argument is TRUE; returns FALSE if all arguments are FALSE. Example:

  IF(**OR**(B2>75, C2>15), "Good", "Not Good!")

- **NOT**: Reverses the value of its argument, a logical expression. Example:

-
  IF(**NOT(C5<50),** "PS", "FL")
- NOT(true)=false
- NOT(false)=true

Using Lookup Functions

- **Lookup functions** are used to look up values in a table to perform calculations or display results
  - For example, a teacher may want to look up a score in order to assign a grade

Range	Grade
90-100	A
80-89	B
70-79	C
60-69	D
Below 60	F

Score	Grade
88	?
91	?
65	?
57	?
66	?

Creating a Lookup Table

- When searching a range, the **breakpoint** is the lowest value

- A **lookup table** typically lists breakpoints in one column and return values in a second column

Range	Grade
0	FL
50	PS
65	CR
75	DN
85	HD

VLOOKUP Function

- The **VLOOKUP** function searches a lookup table for a value and returns the result from the related column

- VLOOKUP has three required arguments:
  - Lookup value – e.g. the student's mark
  - Table array (range of lookup table)
  - Column index of return value – e.g. 2 for grade (PS, etc.)

HLOOKUP Function

- The **HLOOKUP** function is used when the breakpoints and return data are placed in rows

- The third argument now lists the *row* index of the return value

0	60	70	80	90
F	D	C	B	A

- VLOOKUP: Vertical Lookup
- HLOOKUP: Horizontal Lookup

Calculating Payments with the PMT Function

- The **PMT** financial function calculates the periodic payment for a loan with a fixed interest rate and term length

- PMT has three required arguments:
  - Interest rate (in years/months)
  - Number of periods (in years/months)
  - Present value (amount of loan) (aka Principal)

- =PMT(interest rate, number of periods, present value)

  Make sure they are in same unit (years/months/weeks)

- The result is a negative value because it represents your debt. You can display the result as a positive value by typing a minus sign =-PMT(,,,)

Using the PMT Function

	B9	▼	○	f_x	=PMT(B6,B8,-B3)

	A	B	C	D
1	Purchase Price	$25,999.00		
2	Down Payment	$ 5,000.00		
3	Amount to Finance	$20,999.00		
4	Payments per Year	12		
5	Interest Rate (APR)	5.250%		
6	Periodic Rate (Monthly)	0.438%		
7	Term (Years)	5		
8	No. of Payment Periods	60		
9	Monthly Payment	$ 398.69		
10				

Range Names

- A **range name** is a word or phrase used to identify a cell or cell range

- Range names make formulae easier to read
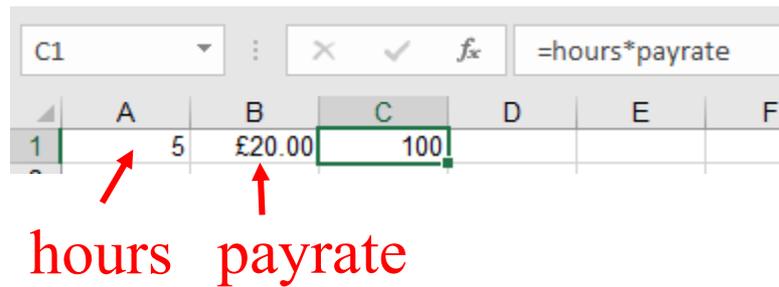
hours   payrate

C1=A1*B1 $\longrightarrow$ C1=hours*payrate

Range Name Rules

- Range names use the following rules:
    - 1 to 255 characters
    - Begin with a letter or underscore (_)
    - Contain letters, digits, period, underscore
- Valid names include Rate, Tax_Rate, Rate_2012

Creating a Range Name

- Excel offers a variety of methods to enter a range name after selecting the cells:
  - Type the range name in the **Name Box** area
  - Enter the name using **New Name** dialog box (Formulas tab / Defined Names group / Define Name)
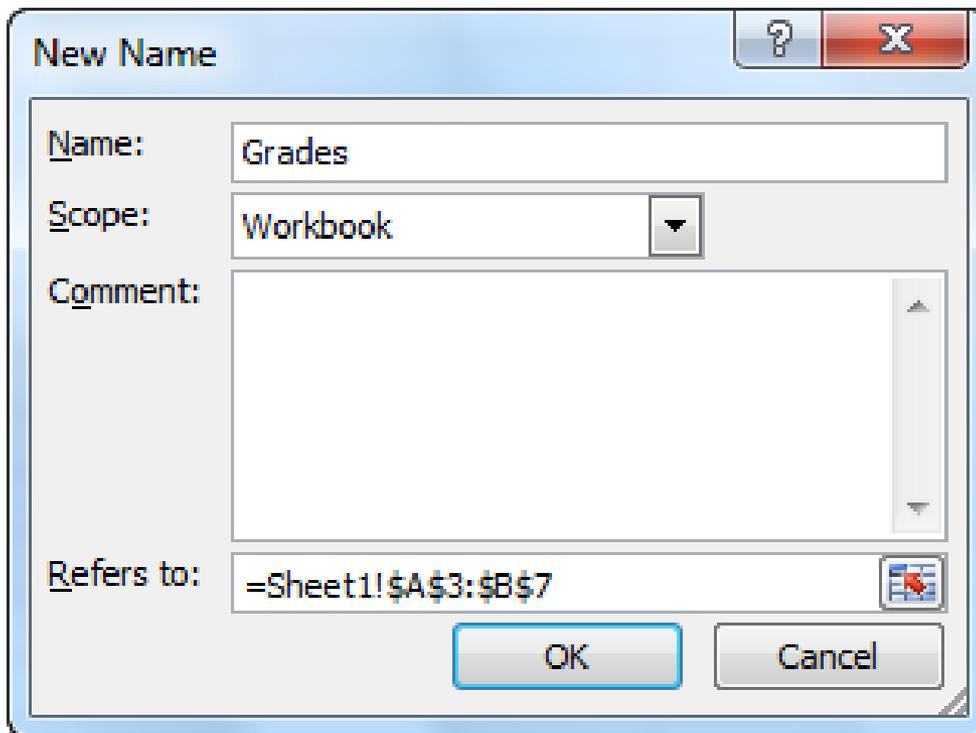
Maintaining Range Names

- Use the **Name Manager** dialog box to edit or delete a range name (Formulas tab / Defined Names group / Name Manager)
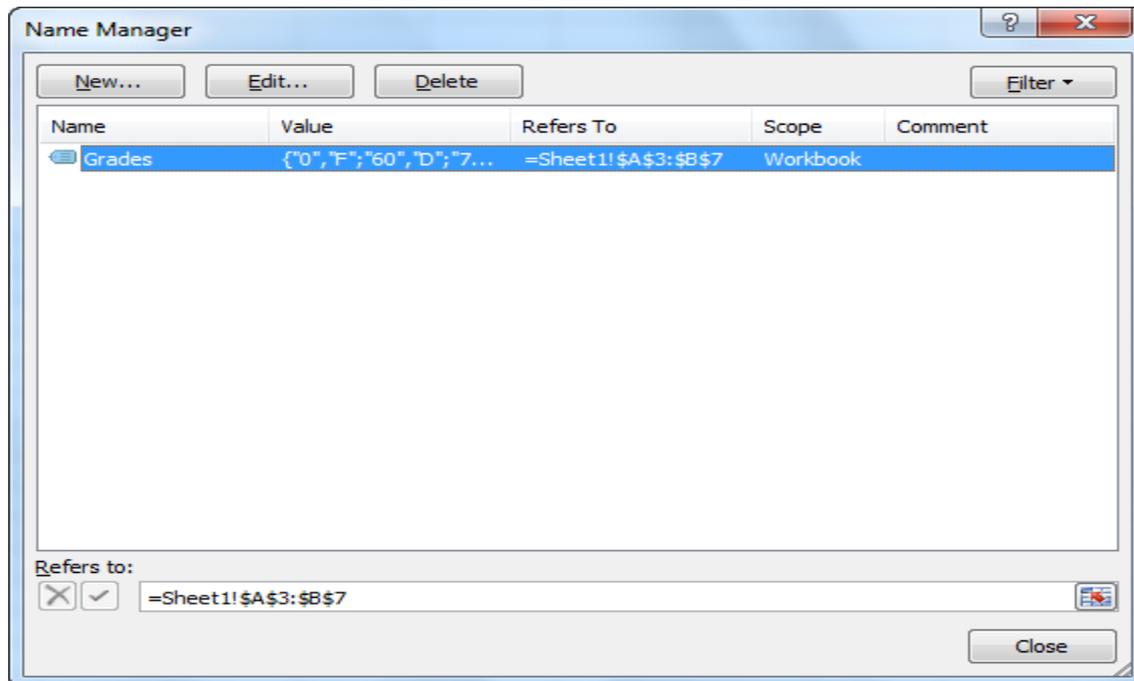
Testing/Debugging/Auditing Spreadsheets

- **Test, Test, Test**, …….. your solutions ……!!

- Test your solution for **obvious mistakes**, like:

  - invalid or missing data in a cell
  - formula is replaced a constant in a cell
  - incorrect cell references in a formula (due to incorrect usage of relative/mixed/absolute addressing while copy and past actions)
  - Etc .. Etc ..

Testing/Debugging/Auditing Spreadsheets

- Debugging by **Using Tracing**

  - Select Formula/Trace Precedence and Formula/Trace Dependents

Summary

- In this chapter, you have learned to write formulate using relative, absolute, and mixed cell references.

- You have learned about statistical and date functions, such as SUM, AVERAGE, and TODAY.

- You have explored the IF, VLOOKUP, and PMT functions.

- You learned to create and use range names.

- Practical exercise