Technical Support Services

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Workshop Training Materials:

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Course Description

This course is the geared towards gaining a better understanding of useful and advanced concepts in Microsoft Excel. As the introductory and intermediate workshops are prerequisites to this, it is assumed that attendees have a reasonable level of background in working with the basics of Excel. Concepts included in this handout will be explained and then applied in exercise scenarios. During this session, attendees will be exposed to the following areas:

Formatting & Appearance

- Background Colors
- Borders
- Commenting
- Conditional Formatting
- Hyperlinks
- Inserting Images
- Naming
- WordArt

Functions

- AVERAGE
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- IF
- MEDIAN
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- SUMIF

Tools & Techniques

- Absolute References
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Functions

Functions are predefined formulas that perform calculations. Excel has a vast array of built-in functions that can be used to simplify tasks where manual creation of formulas may take much longer and may not be as dynamic in nature.

To utilize a function:

1. Click to select a cell that will display the function results
2. Type an equal sign (=)
3. Type the function name followed by an opening parenthesis
4. Enter the required information for the chosen function
5. Type a closing parenthesis

As an example, the syntax to average values from cells A1 through C26 would be:

=AVERAGE(A1:C26)

Depending on what the function will do, a variety of possible parameters can be typed in the syntax. These can include cell references, specific values, mathematical operators (+, -, *, /), logical operators (=, >, <, =>, <=, <>), and text.

Function	Purpose	Syntax
AVERAGE	Adds collection of values and divides by the number of values	=AVERAGE(*values*)
COUNTIF	Counts the number of cells in a range meeting a specified condition	=COUNTIF(*range,criteria*)
IF	Evaluates cells against a specified condition, and takes a resulting action based on whether the condition is found to be true or false	=IF(*criteria, true action, false action*)
MEDIAN	Identifies the middle value in a set of numbers	=MEDIAN(*values*)
MAX	Identifies the highest value in a set of numbers	=MAX(*values*)
MIN	Identifies the lowest value in a set of numbers	=MIN(*values*)
PMT	Calculate loan payments based on amount borrowed, duration, and interest	=PMT(*Interest/12,# of payments,-financed)* Note: The interest rate is divided by 12 months and the amount financed is negative
SUM	Adds values	=SUM(*values*)
SUMIF	Evaluates for a specified condition in a first range of cells, and sums values in a second range when the condition is found	=SUMIF(*range, criteria, range to sum*)

Relative & Absolute Cell References

There are a variety of ways to express cell references. These dictate how they will be treated when used in a function or formula that is to be copied. It is important to understand them to be able to control the way you wish to have references behave. Relative addresses are dynamic in nature and allow things to change when copied. Absolute addresses utilize the $ (dollar sign) symbol, in one or more places, to limit which aspects of the cell reference may change when copied. Selecting which type to use depends on the circumstances and desired results:

1. Relative References require nothing to be changed to use them. In copying a function or formula using a relative reference upward or downward, the row number can change. In copying to the right or left, the column letter can change.

   Examples

   Original function: **=SUM(A1:C1)**

   - Copied downward 1 row becomes **=SUM(A2:C2)**
   - Copied to the right 1 column becomes **=SUM(B1:D1)**

2. Full Absolute References lock to a specific cell on the sheet. When a function or formula contains a reference of this kind and is copied, the copied version will still point to the exact cell that the original function or formula used. It does not matter if the original is copied to the left, right, up, or down:

   Examples

   Original function: **=SUM($A$1:$C$1)**

   - Copied up or down remains **=SUM($A$1:$C$1)**
   - Copied left or right remains **=SUM($A$1:$C$1)**

3. Column Absolute References lock the alphabetic column designator so that it will not change, but does not restrict the numeric row designator from changing:

   Examples

   Original function: **=SUM($A1:$C1)**

   - Copied to the right or left remains **=SUM($A1:$C1)**
   - Copied down 1 row becomes **=SUM($A2:$C2)**

4. Row Absolute References lock the numeric row designator so that is will not change, but does not restrict the alphabetic column designator from changing:

   Examples

   Original function: **=SUM(A$1:C$1)**

   - Copied up or down remains **=SUM(A$1:C$1)**
   - Copied right 1 column becomes **=SUM(B$1:D$1)**

Naming Cells

As your worksheet becomes larger with more columns, rows and data, it may become increasingly difficult to navigate quickly to relevant cells. This is where the convention of naming both individual cells and ranges works well.

You can use labels or text phrases that define the data in your worksheet to represent a cell or ranges of cells within formulas. For example, if the range **C5:C20** contains sales figures and is named **Sales**, you can calculate the total value for the range by using the formula **=SUM(Sales)** instead of **=SUM(C5:C20)**.

To create a named cell or range:

1. Select the cell(s) to name
2. **Formula** ribbon > **Defined Names** group > **Define Name**

   The name can now be used in functions and formulas as opposed an individual or group of cell references.

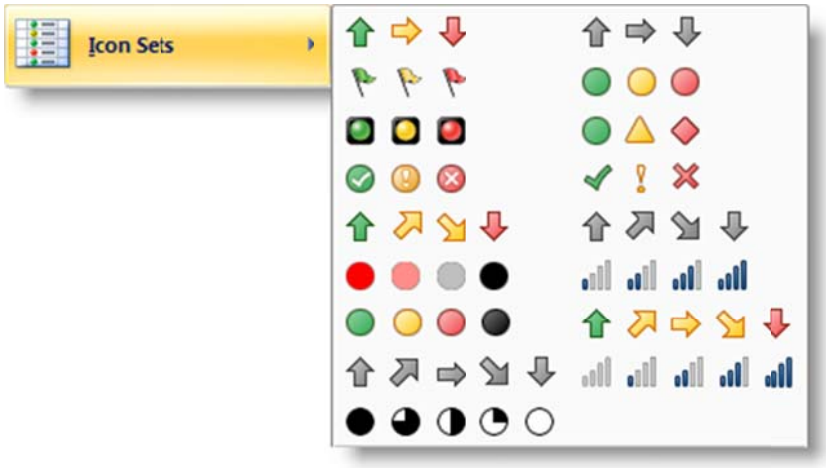
Click on any of the existing names to reveal the physical location of the cells relevant to the named area. Once you have names defined, if you simply want to navigate to a specific area on the worksheet, click the drop down arrow of the Name Box on the formula toolbar and select the location to which you wish to navigate.

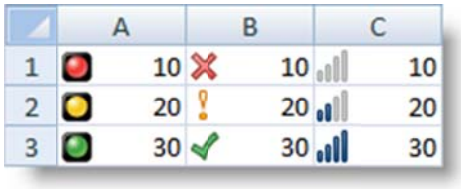
Conditional Formatting

Excel provides automated means to visually alter the appearance of cells based on analysis of their contents. This can involve changing background or font colors, or even displaying meaningful icons. Conditional formatting can be implemented in multiple ways, and we will examine a few of them. Additional ways to use this functionality can be found in Microsoft Office Excel Help, or by searching the Internet for methods that may suit your specific purposes. To access this area: **Home** ribbon > **Styles** group > **Conditional Formatting**

Icon Sets

These can be used to show pictorial representations in a range of associated cells to graphically show comparative levels among them. Simply select the range and an icon set.





Color Scales

These depict a gradient type of effect within a range of cells. To use this functionality, select a desired range and chose a color scale:

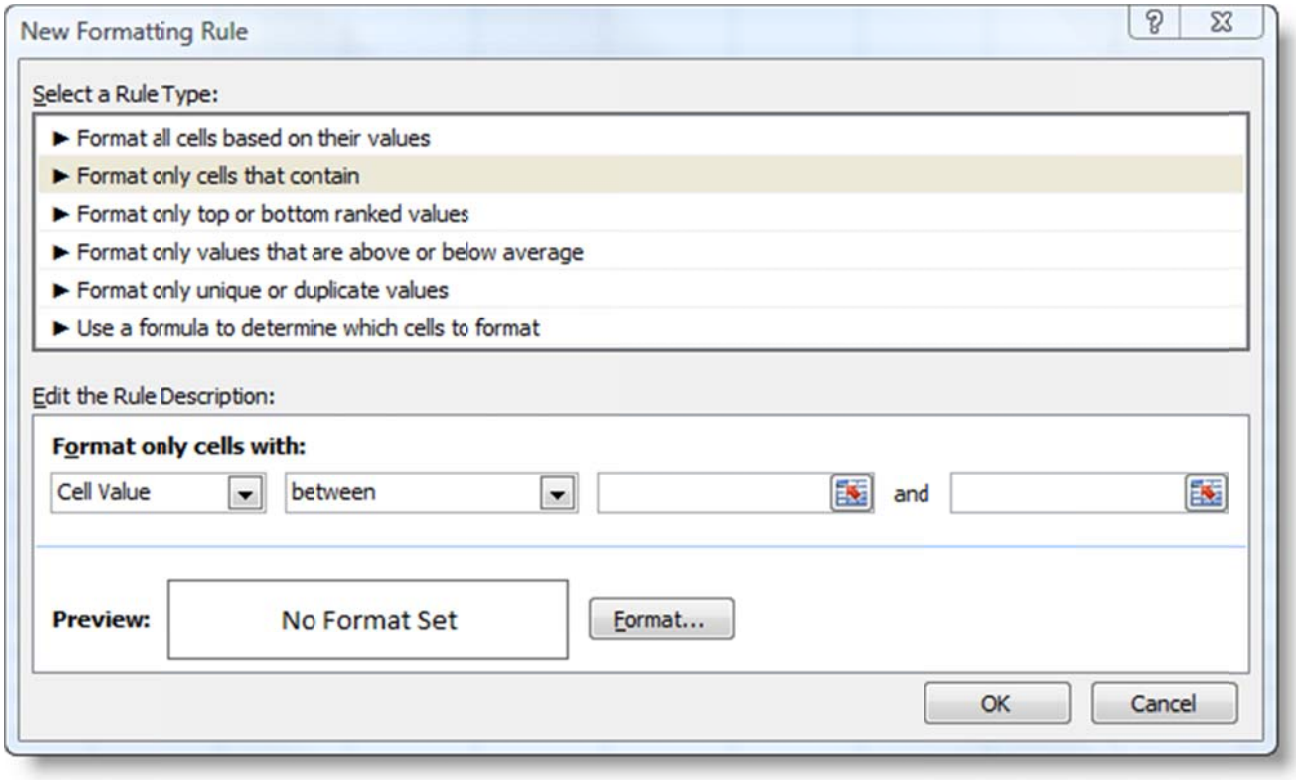
	A	B	C
1	10		100
2	20		90
3	30		80
4	40		70
5	50		60
6	60		50
7	70		40
8	80		30
9	90		20
10	100		10

Specifying Custom Colors for Conditions

In addition to preformatted schemes that can be assigned to worksheets, Excel allows for customized conditional formatting through user-defined rules. Selecting a range of cells and the following option will allow for creating a custom rule to specify background color and font:

Home ribbon > **Styles** group > **Conditional Formatting** > **Manage Rules** > **New Rule**

From there, a rule type may be selected and specifications set to achieve the desired behavior:



The Scientific Instrument Readings Analysis exercise includes the steps for this process.

Exercise: Scientific Instrument Readings Analysis

Using a variety of Excel features we will examine field readings taken from a scientific instrument over the course of ten days. We will compare the readings to a predetermined hazardous threshold level and have the sheet automatically display the words “Yes” or “No”, with corresponding red background color when reading is at a hazardous level.

Additionally, we will use a number of functions to examine the data and provide us with a summary. Lastly, we will embed a hyperlink to a web site where we could go to view current published hazard levels to be able to update the hazardous threshold level on our worksheet.

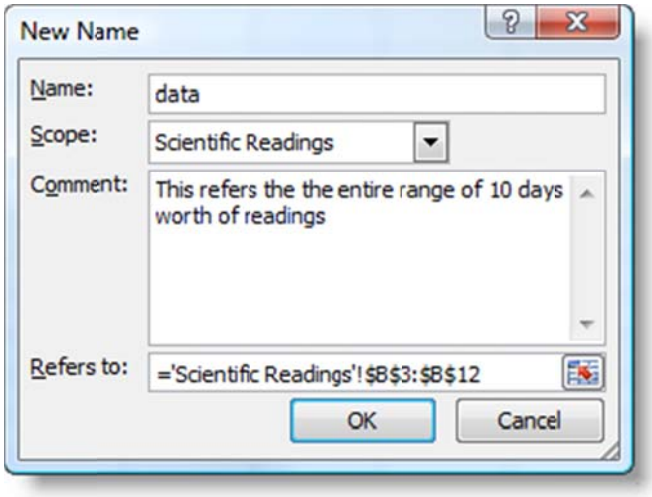
1. Go to the **Scientific Readings** sheet in the “Advanced_Examples” workbook
2. Enter the following number in cell B21 to establish an initial warning level: **90**
3. Enter the following IF function in cell C3 to display the word “Yes” if the warning level has been met or exceeded, and the word “No” if it is within tolerance:

   =IF(B3>=B21,"Yes","No")
4. Using the fill handle, attempt to copy this function down through cells C4:C12

   Notice that the answers are incorrect! Look in cell C4 and look at how the references in the copied function changed. While we did wanted this evaluate cell B4, it is now comparing it to the value in cell B22. B21 contains the warning level and we needed to tell Excel always reference this cell and not move past it.
5. Using the formula bar, modify the function in C3 to include a $ (dollar sign) to lock this reference to row 21 this way so that the first reference can change freely and the second one will not change as the function is copied down:

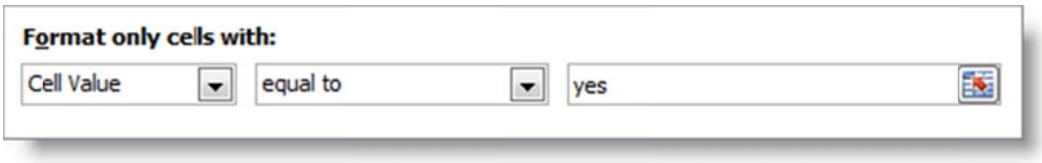
   =IF(B3>=**B$21**,"Yes","No")
6. Using the fill handle, recopy the function from C3 through C12

   Success!
7. Fill in the appropriate function for cell B14 using the range B3:B12
8. To simplify entering the remaining functions, give the range B3:B12 the name “data”:
   a. Select **B3:B12**
   b. **Formulas** ribbon > **Defined Names** group > **Define Name**
   c. Provide the name **data**
   d. Select scope to be **Scientific Readings** worksheet
   e. Click **OK**



9. Complete the remaining functions in B15:B18 using the format **=*function*(data)**
10. Type the following in cell B19 to add up the number of readings that are hazardous:

    =COUNTIF(C3:C12,"Yes")
11. Add conditional formatting data bars in the readings column for some visual depiction:
    a. Select **B3:B12**
    b. **Home** ribbon > **Styles** group > **Conditional Formatting** > **Data Bars**
    c. Select the first option (shown as "Blue Data Bars" when mousing over)
12. Add conditional formatting so that the cells displaying the word "Yes" are given a bright red background color
    a. Select **C3:C12**
    b. **Home** ribbon > **Styles** group > **Conditional Formatting** > **New Rule**
    c. Select "**Format only cells that contain**" and In the "Format only cells with" area, set the following:



    d. Select **Format** > **Fill** tab and choose the bright red color
    e. Click **OK** twice
13. Create a hyperlink to the OSHA web site:
    a. Click in cell **B23**
    b. **Insert** ribbon > **Links** group > **Hyperlink**
    c. Enter the following in "Text to display" area: **OSHA**
    d. Enter the following in "Address" area:

       http://osha.gov
    e. Click **OK** and click to test your link

The resulting sheet should look as shown:

	A	B	C
1	Scientific Readings		
2	Day	Reading	Hazardous
3	1	14	No
4	2	27	No
5	3	139	Yes
6	4	152	Yes
7	5	27	No
8	6	43	No
9	7	90	Yes
10	8	2	No
11	9	191	Yes
12	10	7	No
13			
14	Sum	692	
15	Average	69.2	
16	Median	35	
17	Minimum	2	
18	Maximum	191	
19	#Hazardous	4	
20			
21	Warning Level	90	
22			
23	Web Site	OSHA	

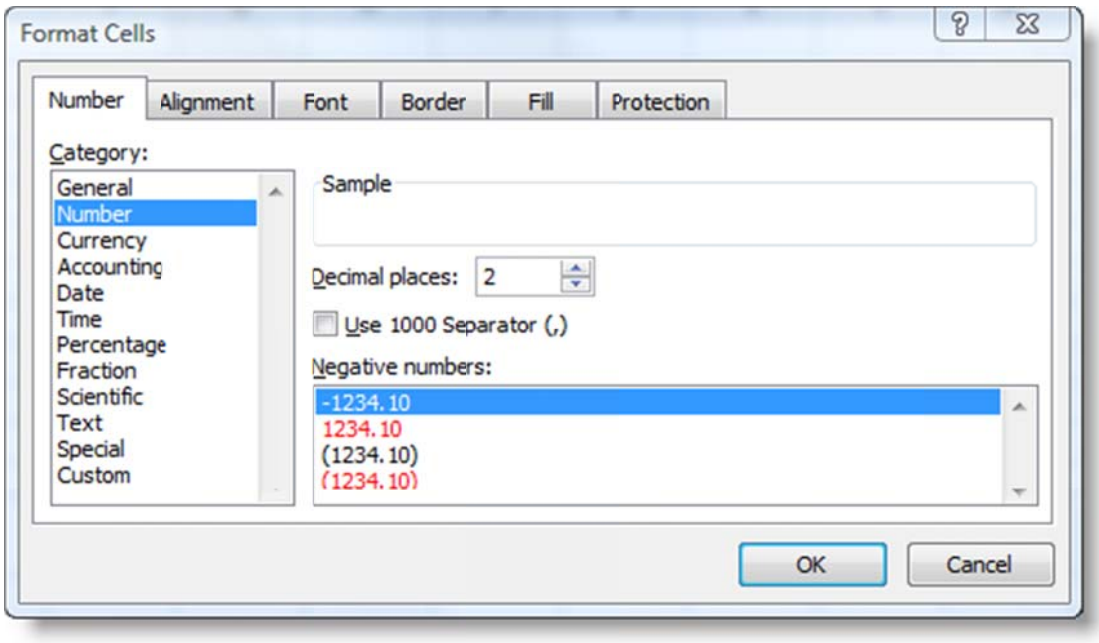
Formatting & Appearance

Excel includes controls to fine tune aspects of worksheets look and behavior. Basic aspects of these controls can be accessed from the Font, Alignment, and Number groups under the Home ribbon. A more comprehensive set of controls can be found by clicking one of the small buttons in the bottom-right area of each of these groups:

The buttons each open the Format Cells dialog box, and the initial tab displayed will be determined by which button was selected. To use this functionality, begin by selecting a range of cells you wish to enact a change on. Next select the appropriate area to access the needed controls:

Numbers

The Number tab of the Format Cells dialog allows for specifying how content of a cell will be formatted. This can control things such as number of decimal places, and if other symbols are used such as a thousand separator or currency symbol.



Alignment

The Alignment tab offers enhanced controls such as:

- Vertically center text (when space allows)
- Wrap text, so that longer entries will stay within the column width and increase row height as needed
- Orientation, which allows placing text at an angle as opposed to the horizontal default

Fonts

The Font tab offers the following beyond what the Font group in the Home ribbon has:

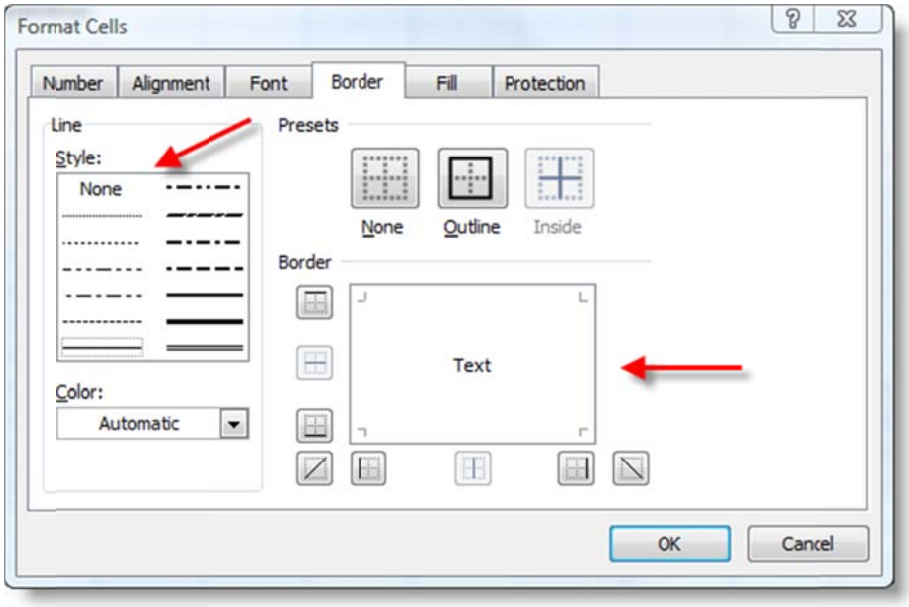
- Preview area that provides an example of what the results will look like
- Additional underline types
- Strikethrough, Superscript and Subscript

Borders

The Border tab provides an interface to select desired line types and specify which part of the cell structure they should be applied to. The following steps can be used to do this:

1. Chose a line type in the **Style** section
2. Specify a color other than the default if desired
3. In the **Border** area either choose buttons depicting where the line(s) should go, or simply click the area(s) inside the **Text** box that you wish to have the line appear

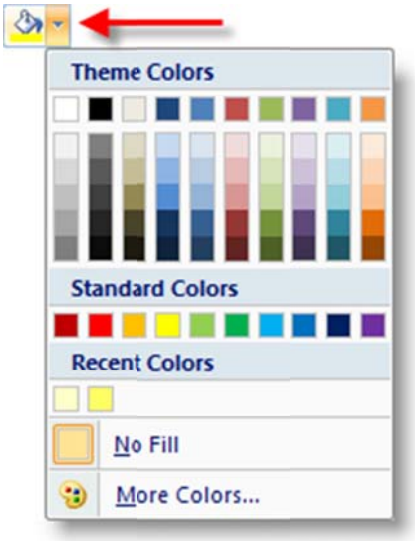
   It is possible to repeat this process to have multiple line styles if desired



Background Colors

The background of a cell can appear in a designated color. The Fill tab offers some additional features, but most things can be accessed by clicking the down arrow by the paint can in the Font group of the Home ribbon.

1. Highlight the desired cell(s)
2. Click on the down triangle of the **Fill Color** (paint can) drop down
3. Choose a color from the window that appears. The selected cells will be filled with that color.



Clearing Cell Formatting

You might decide that you no longer want certain formatting features to apply to your worksheet. There is an easy way to remove formatting features:

1. Highlight the range(s) from which you want to remove the formatting
2. Choose the **Home** ribbon > **Editing** group > **Clear** > **Clear Formats**

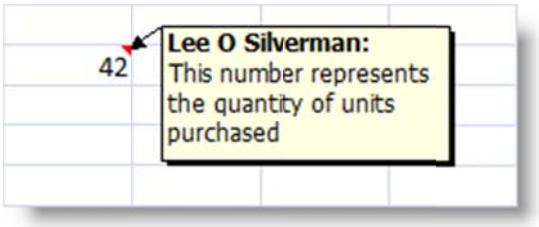
   The cell will revert to the normal style

Adding Comments to Cells

When working on large or complex worksheets, it can be helpful to document how the worksheet has been designed. This can assist others who are less familiar with a worksheet, or help the designer recall specific information in the future.

This can be done by inserting comments to specific cells in the worksheet. Commented areas are characterized by small red triangles in their upper-right corner. Performing a mouse-over of a commented cell will reveal a popup window with the comment inside.

Inserting Comments



1. Right click the cell you wish comment
2. Select **Insert Comment**
3. Type the desired text in the comment box

   A name associated with the computer will display at the top to show who added the comment. This can be deleted.
4. When you finish typing, click outside the comment box

Editing Comments

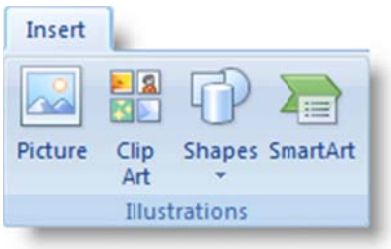
1. Right click the cell with the comment to be edited
2. Select **Edit Comment** in the resulting menu

   Comment boxes can be resized by clicking the selection handles and dragging them to change the size of the box. It can also be repositioned by clicking and dragging one of the sides while the pointer is a 4-headed arrow.
3. Click outside the comment box when you have finished editing

Graphics & WordArt

Images such as photos, logos, and clipart can be inserted into worksheets.

Insert ribbon > **Illustrations** group:



- **Picture** can be selected for GIF, JPG, and other format files you possess
- **Clip Art** can be used to search collections for clip art, photos, movies, and even sound files
- **Shapes** offers a variety of premade items such as common shapes, flow chart symbols, and callouts

- **SmartArt** offers the ability to chart processes and relationships

To easily create graphical representations of words in a variety of styles, use WordArt.

To do so:

1. **Insert** ribbon > **Text** group > **WordArt**
2. Chose a style from the gallery
3. Type the desired text
4. Use the fill handles to manipulate the orientation and position
5. Text may be highlighted and changed using conventional font tools on the Home ribbon
6. Click away from the WordArt when finished

Advanced Analysis Tools

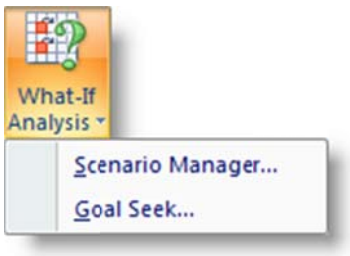
One of the most powerful uses for Excel is to have it provide answers to "What-If" questions. We are able to enter known information and look at it in different ways, attempt to find target values, or manipulate aspects to see what the results would be. Two powerful tools that Excel makes available are Goal Seek and Scenario Manger. Basic explanations follow, and our "Buying a House" example will illustrate using each of these tools.

Access them here: **Data** ribbon > **Data Tools** group > **What-If Analysis**

Goal Seek

This tool allows specifying a target value that you wish to have a cell, which is displaying the results of a function of formula, become. To do so:

1. Open Goal Seek
2. Indicate the cell that will be changed
3. Specify the value you wish it to become
4. Specify the cell that will be manipulated to make this change happen



Scenario Manager

With this tool it is possible to set up a worksheet so that some or all of the values can be made to interchange. It allows storing of multiple sets of numbers, or "scenarios", so they can be loaded, analyzed, and interchanged as needed. To add scenarios, follow these steps:

1. Open Scenario Manager
2. Add a new scenario & provide a name for it
3. Specify a range of cells
4. Select values for the range of cells to use

Adding subsequent scenarios in the same sheet will default to using the same range of cells.

Exercise: Buying a House

The following example will demonstrate using a number of techniques for data analysis in the context of seeking to buy a house and comparing options in doing so. We will use the PMT function to plug in various loan parameters, Scenario Manager to allow us to swap between data for multiple homes, and Goal Seek to further explore possibilities.

1. Go to the **Buying a House** worksheet
2. Enter a formula **B4** to subtract the down payment from the price of the house
3. Enter a formula in B7 to multiply the number of years by 12 months
4. Use the PMT function to calculate what our monthly payment will be by entering the following in B8: **=PMT(B5/12,B7,-B4)**

   Note: it is normal for an error to initially displayed for this
5. Enter a formula in B10 to multiply the number of payments by the monthly bill
6. Format these cells **B2**, **B3**, **B4**, **B8** and **B10** as Currency:

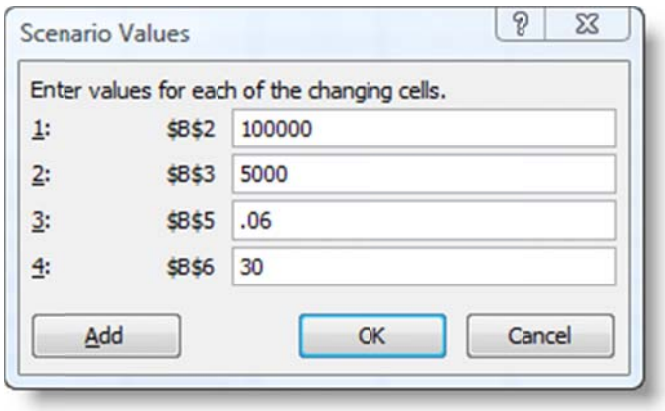
   Home ribbon > **Number** group > **$**
7. Now it is time to put in the two possible scenarios representing the homes we are considering. Open Scenario Manager :

   Data ribbon > **Data Tools** group > **What-If Analysis** > **Scenario Manager**
8. Click **Add…**
9. Enter the following for Scenario name: **First House**
10. Click the button to the right of the **Changing Cells** space 
11. Begin by clicking and dragging to select **B2** and **B3**
12. Hold the [Ctrl] key down on your keyboard and click and drag **B5** and **B6**

    The resulting **Add Scenario** space should look like this:

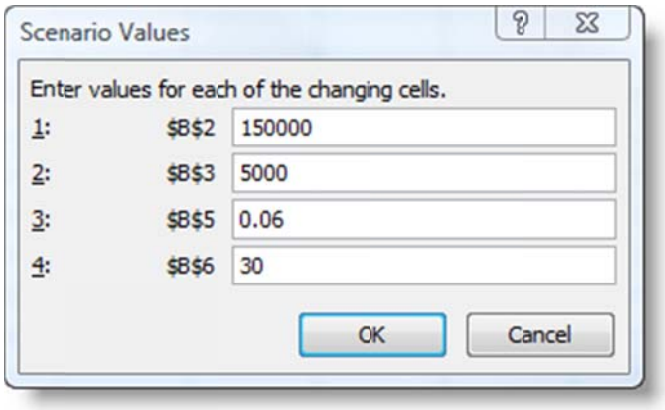
13. Press [Enter] on your keyboard to accept this group of cells
14. Click **OK**

15. Enter the following in the **Scenario Values** window to represent the first house:



16. Click **OK** and **Show** to view the first set of numbers
17. Click **Add** to create a scenario for a second house we are considering
18. Type the following in the Scenario name space: **Second House**

    Notice that the cells which are variables are already filled in the Changing cells space
19. Click **OK** and fill in the following values for this house:



20. Click **OK** and **Show** to review the numbers for this scenario

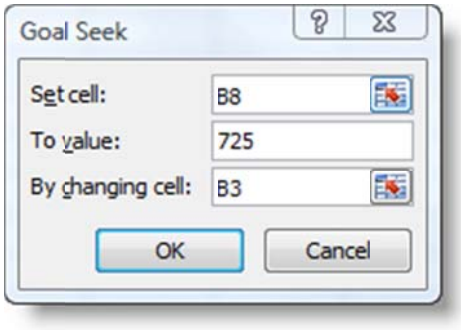
    Note: you can select the “First House” scenario and click **Show** to toggle the numbers back and forth

Analyzing and Manipulating the Data

We decide that we can afford as much as $725 a month, so the second house is ruled out.

1. Return to the first scenario and click the **Close** button to keep it in place
2. To see if we can afford to do better than paying $205,046.28 over the life of the loan change cells B5 and B6 to reflect 0.05 (5% interest) and 15 years respectively.

   $751.25 a month for $135,225.71 is much better, but still $26.24 a month more than we can afford. Let’s use Goal Seek to figure out how much more we need to put down…
3. Select **B8** and choose **Data** ribbon > **Data Tools** > **What-If Analysis** > **Goal Seek**
4. Enter the following values and click **OK**:



The end result is that we can pay $725 per month on our mortgage if we put down an additional $3319.95. This also reduces the total amount we will pay for the loan to $130,500, which means an additional savings of $1405.76.

Regression Analysis with Trendlines

When working with certain types of charts, trendlines can be added to help identify potential future, unknown values. These predictions can be useful indicators of where things will be when certain points are reached, assuming all surrounding circumstances remain similar. This approach can be useful for a wide variety of applications ranging from business and finance through scientific applications.

Based on existing plotted information, a “line of best fit” can be applied to model it as closely as possible, and can be extended forward to predict future, unknown values. It is important for Excel to have an accurate picture of the known information to be able to model it. Once it is modeled as accurately as possible, the best chance of an accurate prediction based on existing data can be found.

Working with trendlines requires examining things visually to determine which line type is best to use in a given instance:

Line Type	Characteristics	Sample
Exponential	**Curved line used with exponential increases or decreases**	
Linear	**Straight line**	
Logarithmic	**Curved line depicting rapid change followed by a leveling effect**	
Polynomial	**Curved line that depicts fluctuating data**	
Power	**Used for positive value curves**	
Moving Average	***Cannot be extended forward!** **Visually isolates a general pattern among wide-spread points**	

Exercise: Finding Unknown Alligator Weights

In this example, we will attempt to use known shorter alligator lengths, and their known corresponding weights, to determine the unknown weights of longer ones. We will create a scatter chart to plot the known information, add an appropriate trendline to model it, and extend it forward to depict an estimate for the unknown weights. We will also have excel display the equation it used to calculate the line so we can plug it back into the sheet.

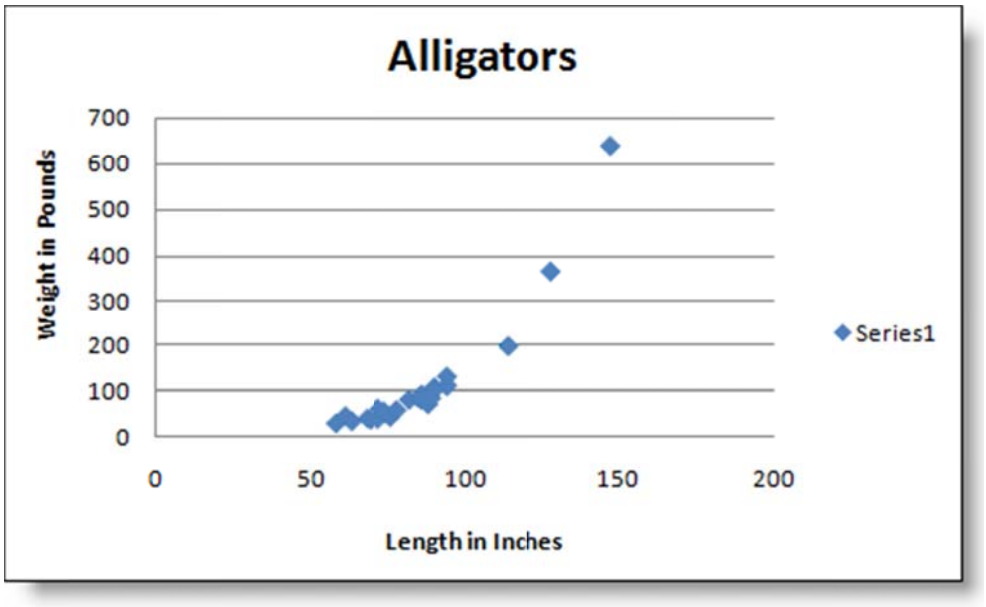
1. Go to the **Alligators** worksheet

   In this file are known lengths and corresponding weights of Florida alligators ranging from 58” to 147”. We will be attempting to find estimated weights for 148” through 150” alligators.

2. Begin creating a Scatter chart by selecting the range containing the known values in A3:B27

3. Select **Insert** ribbon > **Charts** group > **Scatter** > **Scatter with only Markers** (top left chart type)

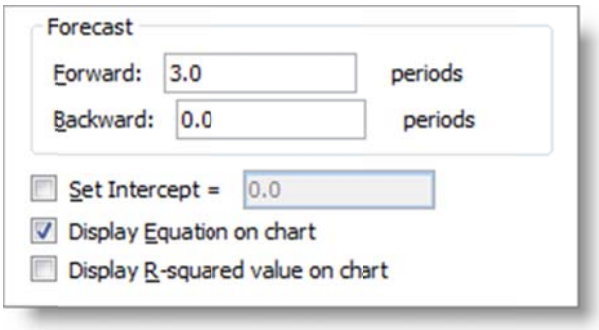
4. Add a title and axis labels to your chart by choosing **Layout 1** under the **Design** ribbon > **Chart Layouts** group while the chart is selected.



5. Open the Format Trendline menu by right-clicking one of the plotted points on the chart and selecting **Add Trendline**.

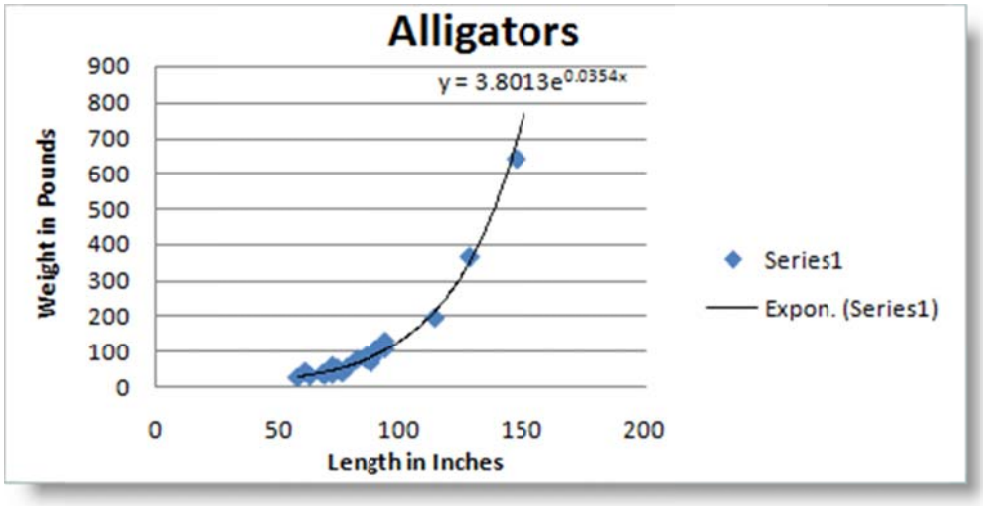
6. Try each of the Trendline types in the **Trendline Options** area by selecting the corresponding radio buttons. Visually compare each line type to the plotted data on the chart and identify the one that matches the closest to give the line of best fit.

7. With the line of best fit selected, enter **3.0** in the **Forward** box of the **Forecast** area.



8. Select the **Display Equation on chart** option and click the **Close** button to leave the Format Trendline menu.

   You should see the following which provides a visual reference with the extended trendline showing roughly 770 pounds for a 150 pound alligator:



   To get more concise numbers, we reformat the displayed equation and plug it back into the sheet. As our chart depicts, the Y axis is weight, and the X axis is length. Our known values are the lengths depicted in column A of the sheet. These are the X in the equation. As the equation indicates, we are solving for Y, which is the unknown weight. We will plug our equation into cells in column B, as these represent the Y value we are solving for.

   We must reformat a few things about the equation to be able to plug it in as a formula:

   - Since formulas must begin with an = (equal sign), we remove the initial “Y”
   - The letter “e” is a mathematical constant that translates to 2.718
   - We need to express the exponent portion using a ^ (carrot symbol)
   - We will use parenthesis around the exponent and use the actual cell reference for the X value from column A in place of the letter “x”

9. Enter the following in cell B28: **=3.8013*2.718^(0.0354*A28)**

10. Using the fill handle, copy the formula down to B29 and B30.

    In comparing the resulting value in cell B30 of 768.771 to the tip of the extended trendline in the chart, we can see they are the same. Plugging the equation back into the sheet does afford the ability to see a concise range of numbers though.

Exercise: Billing Example

For this example, we will pretend that we are in charge of accounts receivable in a business. We will use the COUNTIF function to total the number of bills that are due, and also how many have been collected. We will use the SUMIF function total the amount of money due, and the amount of money collected.

1. Open the **Billing** worksheet in the Advanced_Excel.xlsx workbook.
2. In the C column, create 3 bills that have not been paid:
    - Mark them “No” in cells C3:C5
    - Associate names to each account
    - Give them the values of: 100, 200, and 300 respectively
3. Type the following function in cell B2 to reflect the number of unpaid bills:

    =COUNTIF(C3:C5,"No")
4. Type the following function in cell B5 to reflect the number of paid bills:

    =COUNTIF(C3:C5,"yes")
5. Type the following function in cell B3 to total the amount of all unpaid bills:

    =SUMIF(C3:C5, "No",E3:E5)
6. Type the following function in cell B6 to total the amount of all paid bills:

    =SUMIF(C3:C5,"Yes",E3:E5)
7. Change the Paid status on each of the bills from **No** to **Yes** and watch the numbers in the B column change!

	A	B	C	D	E
1	Billing				
2	Unpaid Bills	0	Paid	Name	Amount
3	Amount Due	0	Yes	joe	100
4			Yes	jill	200
5	Paid Bills	3	Yes	lee	300
6	Amount Collected	600			

Workshop Evaluation

The Office of Information Technology is dedicated to providing the best possible learning opportunities. As such, your feedback is very important to us. Please take a few moments to visit the following web site and complete our online survey:

1. Go to the following URL: **http://oit.wvu.edu/training/eval/**
2. Click the workshop evaluation form link
3. Enter the date, chose **Excel** for the topic, and select the appropriate instructor name.