Graphing and Curve Analysis Using Microsoft Excel©2013
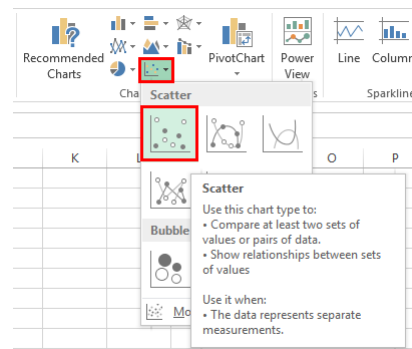## Fall 2015

The following instructions guide you through the process of creating a graph (called a "chart" in Excel) from a set of data, and using Excel to calculate and draw a line that best fits your data (called a "trendline" in Excel). The information determined from this best-fit line will be used to analyze your data. These graphing techniques will be used in most of the experiments performed this semester, so it is important that you understand them. You will also find that these graphing techniques are useful for analyzing data in other disciplines.

The graphs you create in this course will be simple x-y scatter plots. After creating the graph, you will apply a template that set the data point shape, gridlines, etc. You will use this procedure for every graph that you create in this course.

> **IMPORTANT**: The instructions below detail the steps required for you to enter data into a spreadsheet and create a graph. For the "Graphing and Curve Analysis…" exercise, you will be working with a file containing a set of sample data. Click on the **File** tab (upper left corner), and choose **Open**. Navigate to the T: drive, open the "PHYS103" folder, and then select *Excel Graphing Exercise*. If you wish to save a copy on your P: drive, choose **Save As...** from the **File** tab. After opening the file, you may then skip to step #2; you will start with step #1 when entering your own experimental data. Be sure to bring a copy of these instructions to lab each week until you have mastered the process.

Creating a Graph

1. Set up columns for data in the spreadsheet, *making sure that the first column contains the values to be plotted along the 'X' axis*. **Include a title for each column, including the units!** Generally, you will only need to include the data that will actually be plotted, not your raw measurements – unless you wish to check your calculations. Be sure to save your spreadsheet on your P: drive; if your instructor wishes to check your graph during an experiment, you will have to re-enter all of your data if it has not been saved!

2. Click the left mouse button and drag the mouse over the data to be plotted. In general, you will not need to include the column title in your selection (*shortcut: if the data to be plotted is in adjacent columns, simply click one cell that contains data and Excel will automatically plot all the data in the adjacent cells!*).

3. Click the **Insert** tab. In the **Charts** group, click the **Insert Scatter (X, Y)** button, then choose "Scatter" (this is the 1st choice that appears in the upper left of the menu, as shown highlighted at right).

    A graph will appear in your worksheet. Now you will apply the custom chart template to this graph:

4. Make sure that the graph you've just created is selected. You will see that you are on the "Design" tab of the "Chart Tools" section. Click the **Change Chart Type** button (second from right).

5. Click the **Templates** icon at the top left side of the window that appears. There is only one choice inside this folder: "SLUPhysics"; click **OK** to select. Your graph has now changed so that light gridlines are displayed, there is a space for a graph title and axis labels, and the symbol for data points is an open circle.

6. Enter a title for your graph, and label the axes in the appropriate locations (double-click these areas to change their contents). Your title should be descriptive; "Distance cart travels vs. elapsed time" is better than "D vs. t". You will want to include units with the axis labels; it is *not* necessary to include units in the title.

7. The default location for your graph is that it is inserted as a new object on the worksheet, which allows you to see the data and the graph at the same time. Many times it is advantageous to have the graph appear on its own, separate worksheet. The graph will print nicer, and it will be easier to spot bad measurements or interesting trends when the graph appears full screen. To move the graph to its own page, first make sure the graph is selected. In the **Design** section of the **Chart Tools** tab you'll see a button (on the far right)

labeled **Move Chart**. Click this button, and choose **New Sheet;** the graph will be placed on a new worksheet in front of the sheet that contained your data. If you wish to return the graph to its original location, click the **Move Chart** button, select **Object In**: and the name of the worksheet and the graph will be inserted on the same page as the data used to create it. Check with your instructor to find out which position they would prefer that you use.

Analyzing the Graph

8. Now that your graph is created, you'll need to analyze it. The first step is to add a best-fit line, called a *trendline* in Excel. Click *once* on any one of your data points, then in the **Design** tab click **Add Chart Element** (on the far left), then **Trendline**, and then **More Trendline Options** *(much faster shortcut: **Right-click** on any data point, and choose "Add Trendline...").*

    There are 6 possible best-fit "trendlines", also known as regressions; Excel will determine which of the six can be used for your data *(but it doesn't pick the correct regression for you!)*. In this course we will only use four of these regressions: "Linear" for straight-line data (in the form of $y = mx + b$), and "Power" ($y = ax^b$), "Exponential" ($y = ae^{bx}$), or "Polynomial" (of 2nd order: $y = ax^2 + bx + c$) for curvilinear data.

9. Select the regression that best fits your data (your instructor can offer suggestions if necessary). Note that when performing an actual experiment you will generally know the function that fits your data. You will be guessing at the best fit when doing the "Graphing and Curve Analysis…" exercise. If you pick the wrong regression, select the trendline, and the Format Trendline window will appear to the right of your graph where you can make another selection *(shortcut: Right-click on the trendline and choose **Format Trendline**).*

    Important note: If you pick a function which cannot be applied to the selected data set, Excel will remove the trendline, and the dialog box will switch from "Format Trendline" to "Format Chart Area"! Close this window, and add the trendline again.

10. Next you will ALWAYS put a check in the box next to **Display Equation on Chart**. This will display the appropriate equation for the line chosen. Excel calculates the values of the appropriate coefficients *a, b, c,* and *m*. You should note that more significant figures might be presented than are dictated by the accuracy of your measurements. It is from these coefficient values that you will be performing your analysis.

11. At this point your graph is complete. Your instructor can show you how to edit portions of the graph if they need to be changed. If you find that a data point is incorrect, simply change the number, or delete the point, and the graph will update automatically.

Add Your Names, and Print the Graph

Since all the groups in your lab section will collect similar data for a particular experiment, it's important to add your names to the graph to distinguish it from the others in the printer. An elegant way of adding your names, the date and the experiment title to your graph is to put them in the header of the page that prints.

13. Click the graph once to select it. Click the **File** tab, then **Print**. It is not necessary to print your data, since your lab report contains a data table. If you need to make a change, click the **File** tab, and make your modifications.

14. You can add your name – and your lab partners' – to the header as follows: in the **Print** window, click the **Page Setup...** link (near the center of the window), and then the **Header/Footer** tab. Next click the **Custom Header...** button, and type your names in the "Left Section" box. You can put the experiment title in the "Center Section" box.

15. Insert the current date in the "Right Section" box by clicking the "Date" button (the little calendar – see sample at right). This will add *&[Date]* to the right section of the header, and will print the current date on the graph.

16. Click **OK** twice to return to the print window. If the graph is to your liking, set the number of copies and click the **Print** button. In general, you will print one copy for each member of your group, unless otherwise instructed, so that each person can include a copy with their own lab report.