

EXCEL Tutorial: How to use EXCEL for Graphs and Calculations.

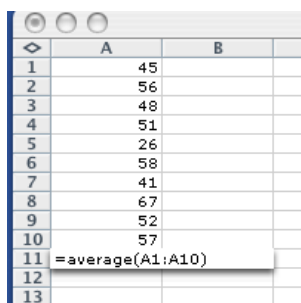
Excel is a powerful tool and can make your life easier if you are proficient in using it. You will need to use Excel to complete most of your experiments and are expected to know how to manipulate data, prepare plots and analyze error.

In Excel, the columns are labeled with letters, and rows are labeled by numbers. The individual boxes are called cells, which are designated by column and row. For example, the top left cell in the spreadsheet is A1. You can highlight an entire row or column by clicking on the letter or number, at the start of the row or top of the column, it is designated by. You can highlight specific cells by clicking INSIDE the cell and dragging the mouse. Pressing ENTER moves you down a column. Pressing TAB moves you across a row.

A new workbook contains three separate worksheets. Tabs at the bottom of the worksheets, labeled "Sheet 1" etc allow you to switch between the sheets. You can insert a new sheet by clicking INSERT, then WORKSHEET.

Part 1. Entering Formulas

Enter the following data in a column: 45, 56, 48, 51, 26, 58, 41, 67, 52, 57. Take the average. We can do this by entering a formula. All formulas must begin with an equal sign. Microsoft Excel has many common formulas "programmed" under key words. The average is one of these. Its keyword is 'average.' After typing '=average' it is necessary to specify the cells which have the numbers to be averaged. For example, where A1 is the beginning cell and A10 is the ending cell:



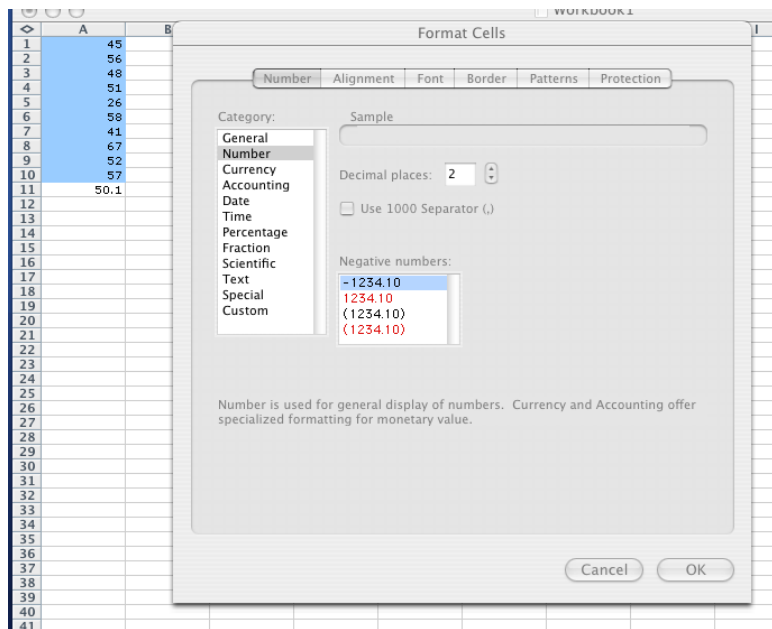
The screenshot shows a portion of an Excel spreadsheet. Column A contains the following values from row 1 to row 10: 45, 56, 48, 51, 26, 58, 41, 67, 52, 57. Row 11 contains the formula `=average(A1:A10)`. The spreadsheet interface includes a row and column header, a scroll bar on the left, and window control buttons at the top.

	A	B
1	45	
2	56	
3	48	
4	51	
5	26	
6	58	
7	41	
8	67	
9	52	
10	57	
11	=average(A1:A10)	
12		
13		

After you type the complete formula, and hit enter, the answer replaces your formula. Take the standard deviation, keyword is 'stdev', and the sum, keyword is 'sum'. You should determine that the standard deviation is 11.19 and the sum is 501. For a complete list of keywords click INSERT then FUNCTION. Use one of these keywords to find the median of the data set. Your answer should be 52.

If the data in column A was supposed to have more significant figures we could format our cells. To do this, highlight the appropriate cell and click FORMAT, then CELLS, then NUMBER. Under category, choose NUMBER and select correct number of

decimal places. You can also put numbers in scientific notation from this screen. Also under FORMAT, then CELLS you can change the font and colors of both the font and background. You should be able to use these features.



It is possible to perform mathematical functions with the data we input. Again, formulas must begin with an equals sign. For example, if we want to multiply the values in Column A by 5, we would type in B1 '=A1*5'. A1 can be typed, or we can physically click on cell A1, after typing the equals sign and then continue typing the formula. Rather than typing this in the remaining nine cells, B2-B10, we can highlight B1 through B10, then click EDIT on the toolbar, and select FILL and DOWN. Try this for the formulas shown below. Notice, sometimes parenthesis need to be used.

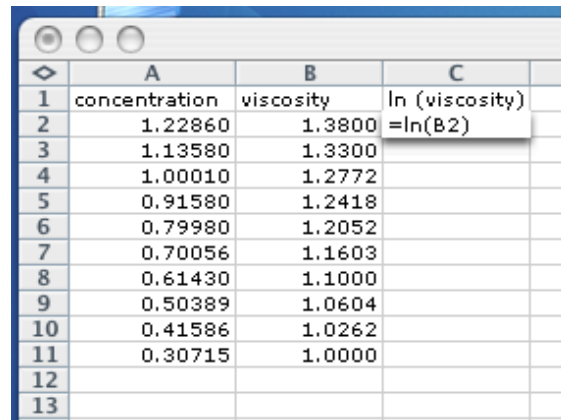
	A	B	C	D	E	F	G
1							
2	45	=A2*5	=B2*(A2/8)	=B2+A2/8	=(B2+A2)/8	=EXP(-E2)	=(B2+C2+D2)^2+E2
3	56	280	1960.00	287	42	5.7495E-19	6385771
4	48	240	1440.00	246	36	2.3195E-16	3709512
5	51	255	1625.63	261.375	38.25	2.4448E-17	4588202.25
6	26	130	422.50	133.25	19.5	3.3983E-09	470272.5625
7	58	290	2102.50	297.25	43.5	1.2829E-19	7234798.563
8	41	205	1050.63	210.125	30.75	4.4202E-14	2148453.813
9	67	335	2805.63	343.375	50.25	1.5021E-22	12138306.25
10	52	260	1690.00	266.5	39	1.1548E-17	4912911.25
11	57	285	2030.63	292.125	42.75	2.7159E-19	6800402.813
12							
13							

Part II. Making Graphs

The following is data from a viscosity experiment. Enter it in Worksheet 2.

Concentration	Viscosity
1.22860	1.3800
1.13580	1.3300
1.00010	1.2772
0.91580	1.2418
0.79980	1.2052
0.70056	1.1603
0.61430	1.1000
0.50389	1.0604
0.41586	1.0262
0.30715	1.0000

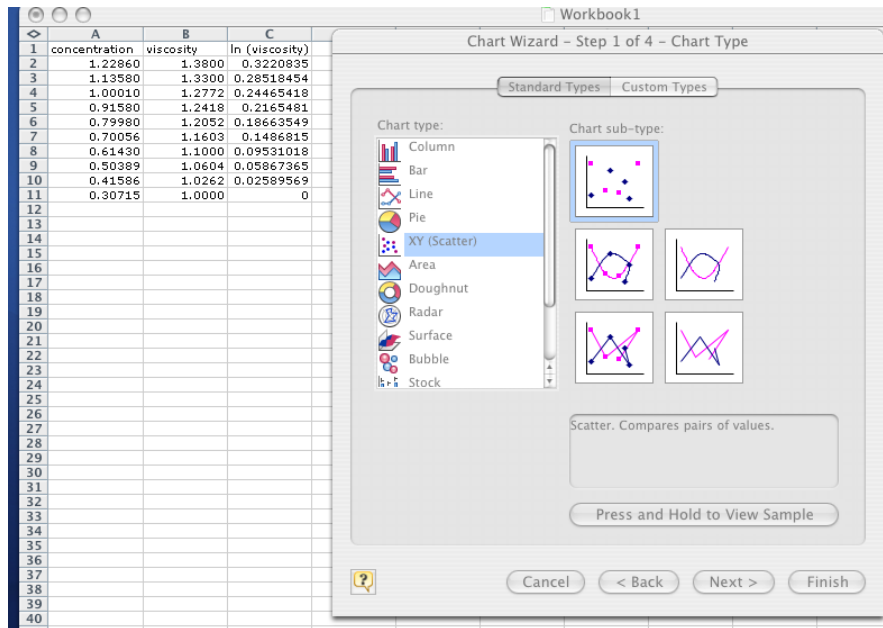
This data does not have a linear relationship. In order to produce a linear relationship, take the natural log of viscosity. Do this in column C. The formula is '=ln(B2)' for the first value.



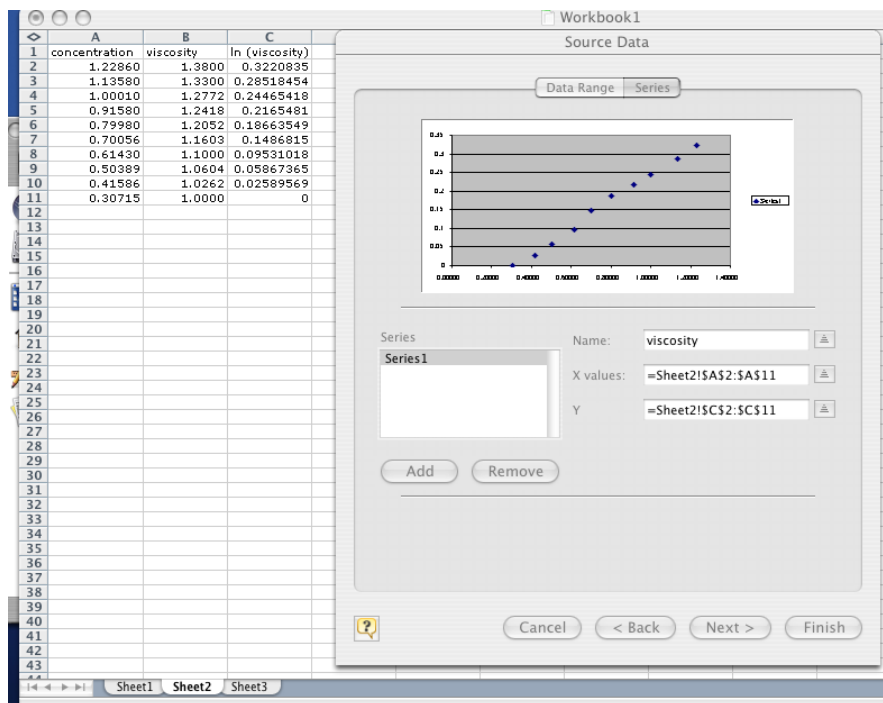
The screenshot shows a spreadsheet window with three columns: A, B, and C. Column A is labeled 'concentration' and contains the same values as the table above. Column B is labeled 'viscosity' and also contains the same values. Column C is labeled 'ln (viscosity)' and contains the formula '=ln(B2)' in the first row, with the rest of the cells in the column being empty. The rows are numbered 1 through 13.

	A	B	C
1	concentration	viscosity	ln (viscosity)
2	1.22860	1.3800	=ln(B2)
3	1.13580	1.3300	
4	1.00010	1.2772	
5	0.91580	1.2418	
6	0.79980	1.2052	
7	0.70056	1.1603	
8	0.61430	1.1000	
9	0.50389	1.0604	
10	0.41586	1.0262	
11	0.30715	1.0000	
12			
13			

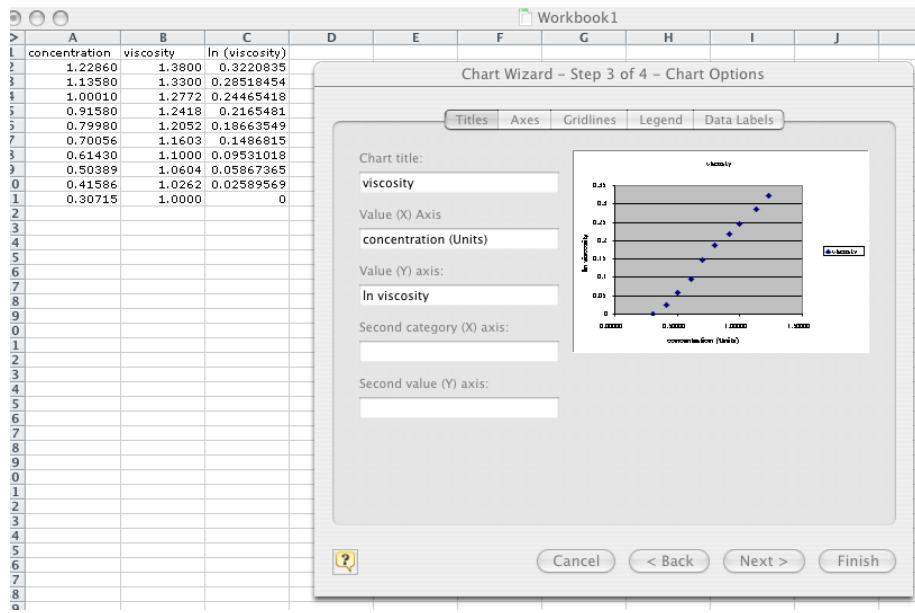
After calculating the natural log for all values of viscosity, the data can be graphed. Click on INSERT then CHART. We want to represent this data in an XY scatter plot.



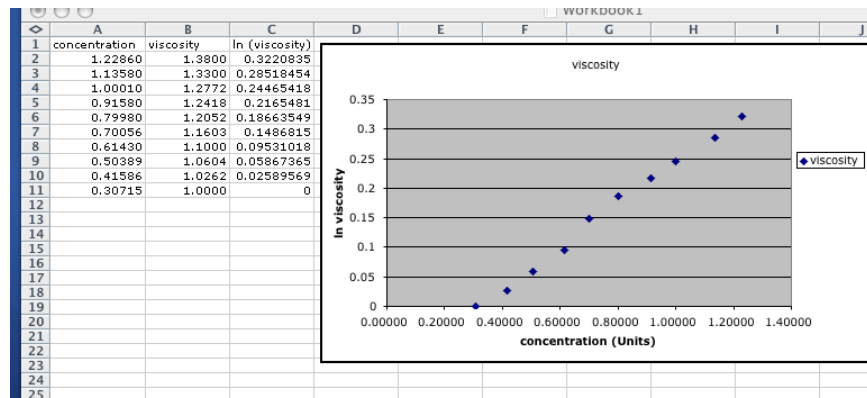
Click NEXT. Now, we need to tell the program what to graph. To do this, click on the SERIES tab. The 'Series' box should be empty. If it contains anything, highlight it and click remove. Now we need to add the correct series. Click ADD. In the 'name' box, label the series. Click in the 'X-values' box; then highlight the concentration column, A2-A11. Click in the 'Y' box; then highlight the values you calculated for the natural log of viscosity, C2-C11.



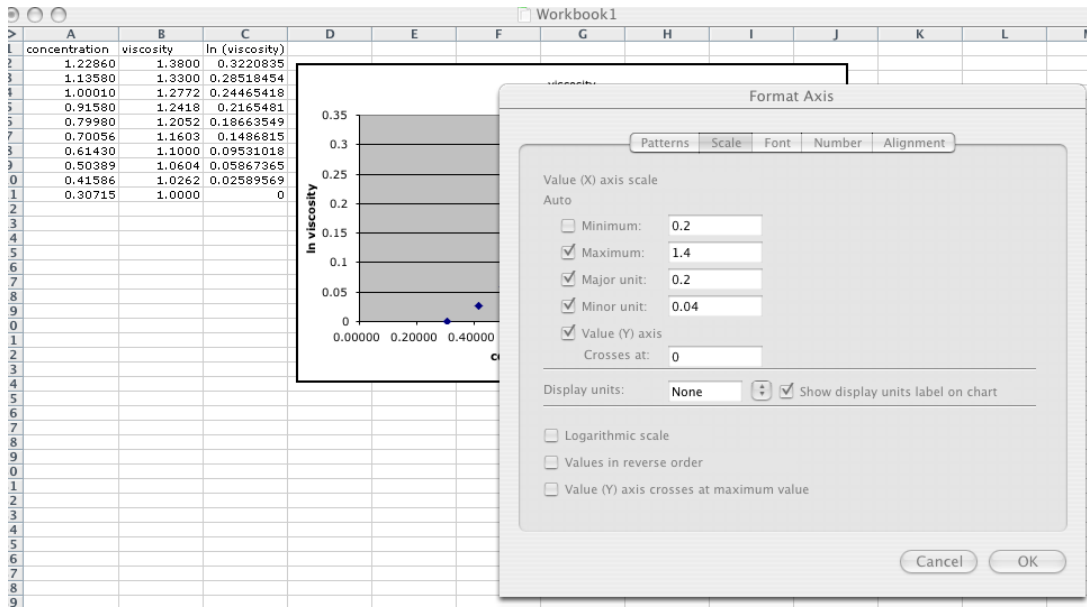
Then, click NEXT. Now, we can label the axis and the title of the graph as shown below.



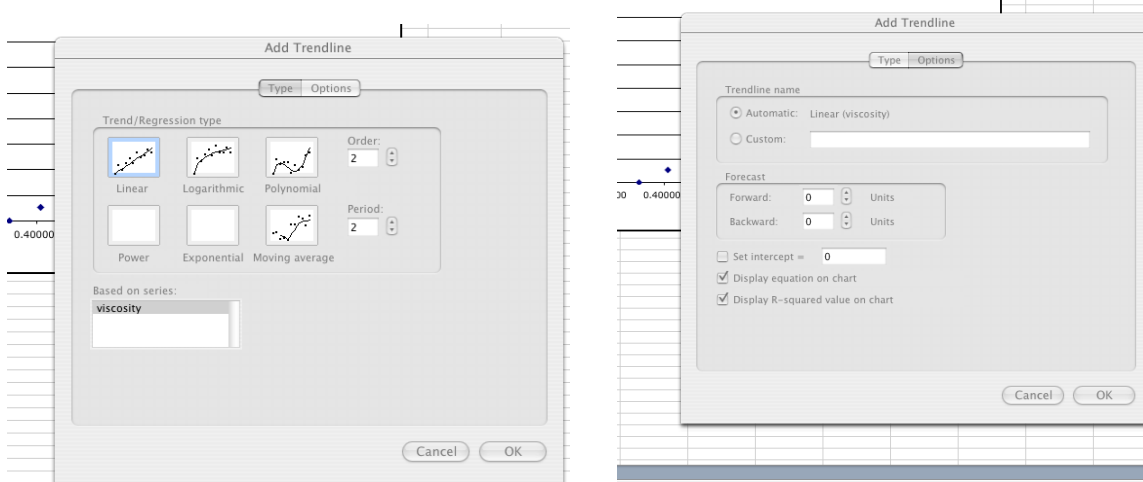
Then, click FINISH.

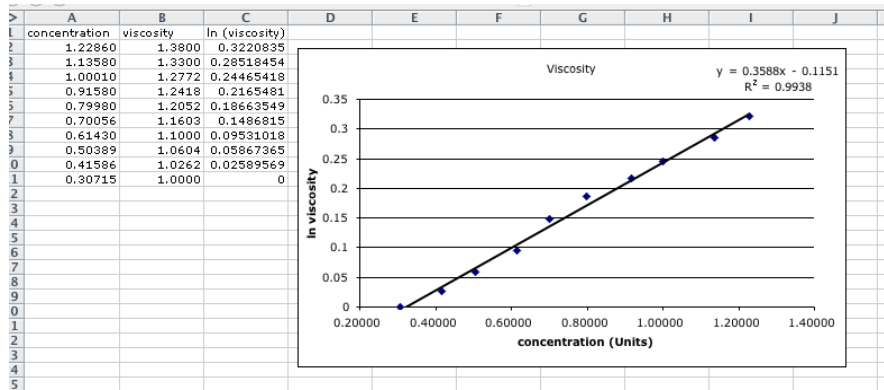


To delete the grey background, click on the background. A rectangle will outline the background. Press delete. To change the scale of your axis to make it more appropriate, so your data fills the graph, double click the axis you want to change. Click on the scale tab. For this case, it is more appropriate for the minimum value of the x-axis to be 0.2, rather than 0. There are other interesting features within this menu you may want to try.

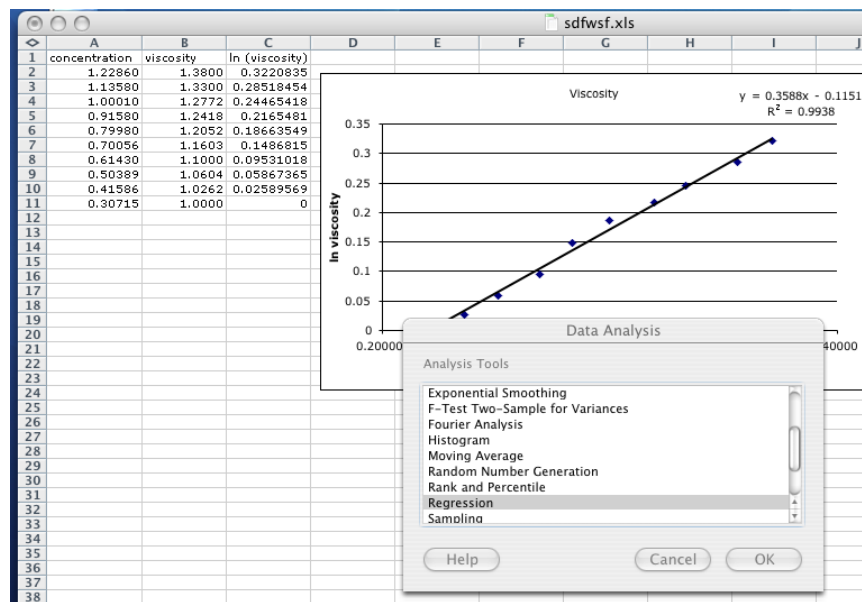


Excel can be used to find a best fit line for data. In this case, the data looks linear so we will fit it with a linear trend line. To do this, click on a data point on the graph. Then click CHART, then ADD TRENDLINE. Under the type tab, select linear. On the OPTIONS tab, make sure the boxes are checked to 'display equation on chart' and 'display R-squared value on chart.'

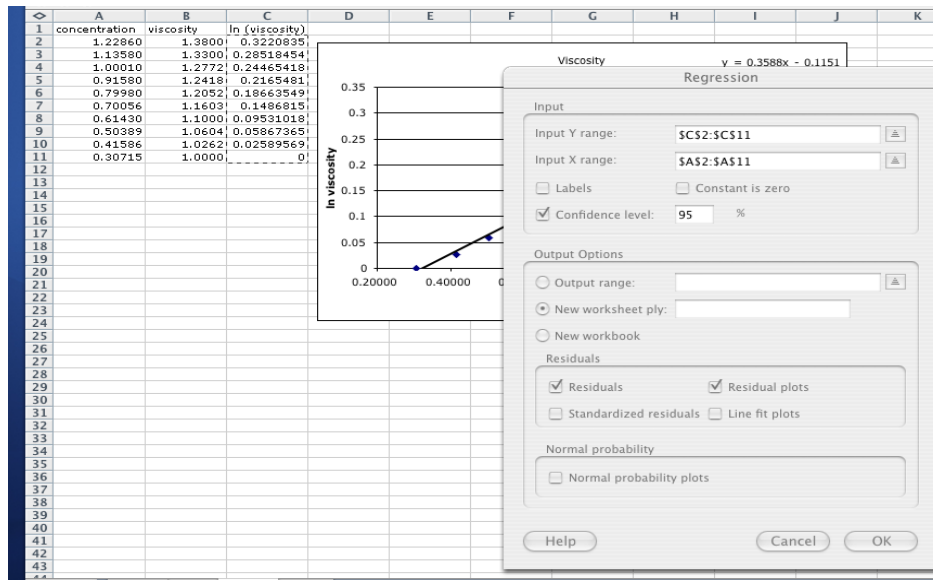




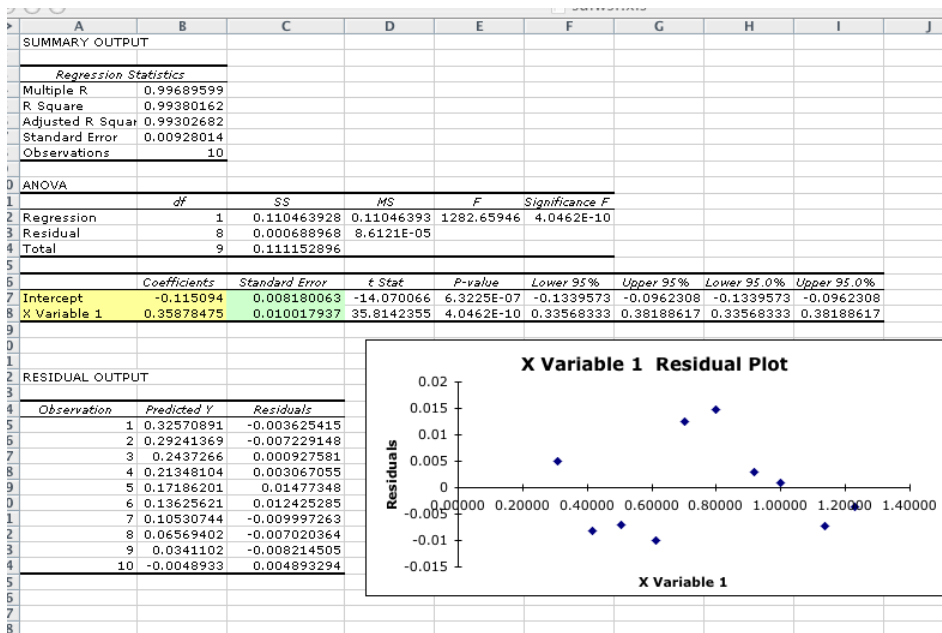
As you can see, the data points do not fall exactly on the line. We need to know the error in the slope and intercept of the trendline, as well as the distribution of the data points around the line, known as residuals. To do this, you need to use the data analysis toolpak. To do this, click TOOLS then DATA ANALYSIS. (If you do not see DATA ANALYSIS as an option, please see the paragraph about it's installation at the end of this tutorial, Part III.) Scroll down and select 'Regression.'



In the 'Input Y range' and 'Input X range' fields, select the same data you used to make your graph. Make sure the boxes are checked next to 'Confidence Level:95%', 'Residuals' and 'Residual plots.'



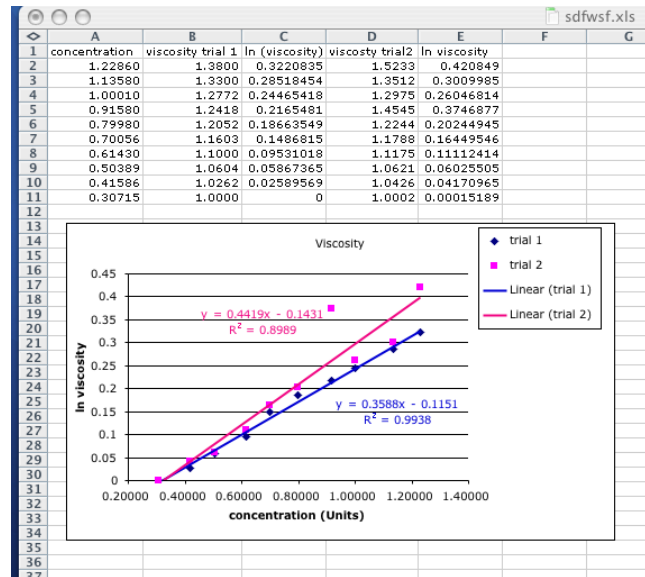
Click OK. This will output in a new worksheet unless you specify and output range.



You will notice that not only have you plotted your residuals, but Excel has calculated many other statistics for you. Most importantly, you will see the slope, labeled here as 'X Variable 1', and the intercept of the trendline in yellow. The standard deviation of the mean for the slope and intercept are highlighted in green. The value under "lower 95%" contains the lower limit of the 95% confidence interval and the value under "upper 95%" contains the upper limit. The difference between these numbers, divided by 2, gives you your Δ as described in detail on the error analysis handout.

Sometimes, it is useful to put more than one data set on the same graph. For example, if you did two trials of the above viscosity experiment, both could be displayed on the same

graph by adding a series. For trial 2, the viscosities are: 1.5233, 1.3512, 1.2975, 1.4545, 1.2244, 1.1788, 1.1175, 1.0621, 1.0426, and 1.0002. Again, you will have to take the natural log of this data to make it linear. To add this data to your graph, click on the graph, click CHART from the toolbar, then ADD SOURCE DATA. Click the series tab. Then click ADD. Name this data set something different than the first, then input the appropriate x and y data. Add a trend line to this data.



As you can see in the figure above, we have changed the colors of our lines and trendline equations so that they can be distinguished between. To do this, double click on the item you want to change.

Part III. Installing Data Analysis Toolpak

To install the data analysis toolpak, you need to click TOOLS, then ADD-INS. Check the box for 'Analysis ToolPak' and 'Analysis Toolpak VBA'. Then click OK. You may be prompted to insert your Microsoft Office Disk. If you don't see the appropriate boxes to check, you'll have to rerun the Excel installation routine from the CD and make sure you install the ATP. After the installation you will be able to click TOOLS then DATA ANALYSIS. Sometimes it may be necessary to restart Excel before being able to run the data analysis.

*This is just a brief introduction to Excel. This program has many more useful features that could be very beneficial for you to learn. You should try to spend some time becoming proficient in Excel because it will save you time while trying to do homework and lab reports and is a good skill to have upon entering the workforce.