Assignment 1 supplement:

Using Microsoft Excel

There are many helpful web sites and books on the Excel program of Microsoft. Here are a few simple hints that will help you do Assignment 1. I don't assume you know anything about Excel. If in doubt, use the help feature on the top menu or ask someone else. Lots of the features are poorly documented and not intuitive, so don't feel bad not being able to figure it out quickly. I'm constantly asking. I use a Mac, so if you have a Windows box or a Unix box, things may look slightly different. Even different Macs produce different looking spreadsheets -- I don't know why.

Formulas and updating: A spreadsheet is a way to express calculations and redo them as the data change. Open excel and get a blank spreadsheet. It should look something like this[1]:
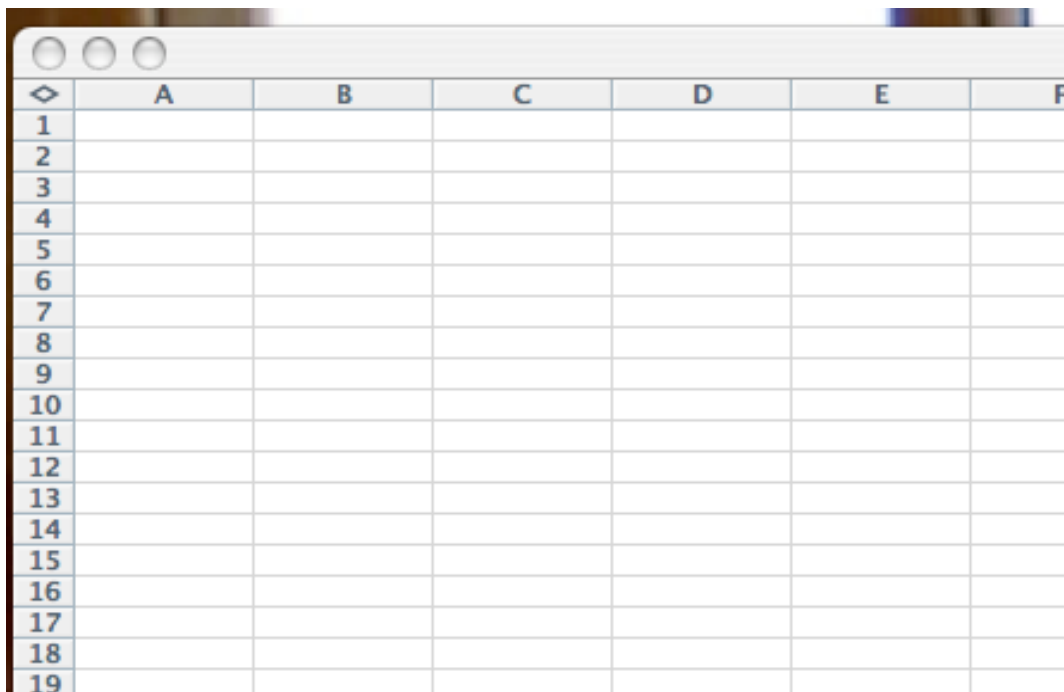
Now click in cell A1 and type the number 1, then return (enter). You should get a 1 in cell A1. Next, put a 2 in A2. Now click in cell B1 and type "= a1 + 2*a2" and return. The result should look like this:

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[1] This is a screen capture from my Mac. Unfortunately, the Grab program, which does the screen capture, must be running when I make the screen capture. This means that Excel is open but not running, which means that you never see the Excel toolbars. I don't know how to make screen caps that include the excel toolbars.

	A	B	C	D
1	1	5		
2	2			
3				
4				
5				

The number in cell B2 is the result of the a1+2*a2 computation, with the values currently in cells A1 and A2. Now go back to cell A2 and change the value from 2 to 3. The sheet now should look like this:

	A	B	C	D
1	1	7		
2	3			
3				
4				
5				
6				

The contents of cell B2 were updated automatically. (There is another Excel mode where updates are not automatic. This is for big spreadsheets that take a long time to update -- we don't want to update them with every edit.) You should (for this exercise) have the formula toolbar open (click on "View", then "formula bar"). When you click on a cell, you have a choice of typing directly into the cell or into the space in the formula bar. If you start with =, it assumes you're entering a formula rather than a number. That's why you had to start the B1 entry with =.

Copying. Excel is almost entirely manual. Programming is done using "plugins", but probably not in this class. That is both a strength (it's easy and visual) and a weakness (there is no automation). To understand copying, put a 1 in cell A1 and a 2 in cell B1, and the formula "= a1 + 2*a2" in cell C1. The result should be

	A	B	C	D
1	1	2	5	
2				
3				
4				

Now select the first three cells of the top row at the same time by clicking on A1, then with the, with the left button down, dragging trough B1 and C1. Not position the cursor very near the bottom corner of C1. The cursor should change to a +, which is a drag and copy symbol. Make sure you do this when all three top row cells are selected. With your finger on the left mouse button, drag to the bottom corner of C1, then release. This copies all the selected cells to the same locations in the B row. It will look identical to

the A row, but it isn't. If you then click on cell C2, in the formula bar you should see "= A2+2*B2". This is not what was in the C1 cell -- references to A1 and B1 have been changed to A2 and B2. (This is "relative addressing".   You can copy with absolute addressing by clicking in a slightly different way.) If you change the B2 cell value from 2 to 3, you should get this:
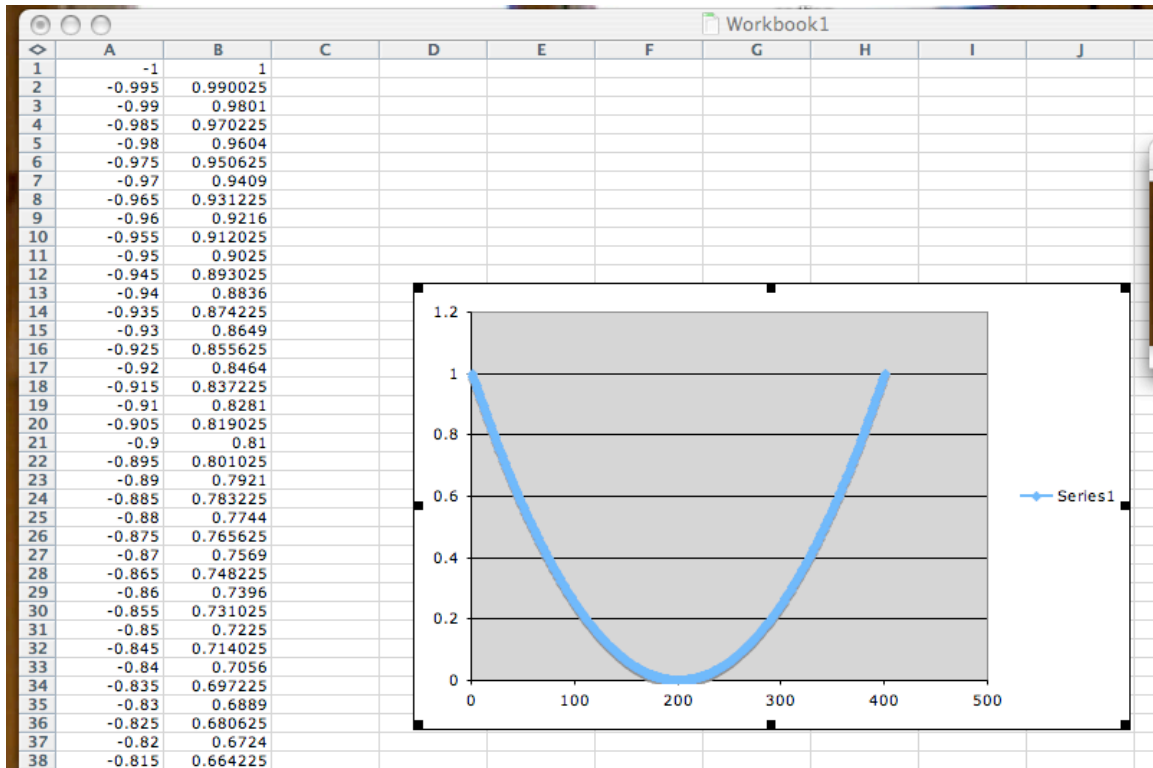
	A	B	C	D
1	1	2	5	
2	1	3	7	
3				
4				

There are variations on this theme. For example, delete row B and put the numbers 1, 2, 3, 4 . The use the copying procedure on column B to make it all 2 down to B4, then do it on column C. This should give:

	A	B	C	D	
1	1	2	5		
2	2	2	6		
3	3	2	7		
4	4	2	8		
5					
6					

Plotting: Let's make a plot of a parabola $y = x^2$. Start by putting -1 in A1 and -.995 in cell A2.   Now select these two cells and put the cursor near the bottom right of A2 and start copying down the A column. A little popup near the cursor will appear with a number in it. Keep moving down the column until that number is equal to 1. This should be cell A401. It might take a few tries to get the copying to stop exactly there. Fills in the numbers in an arithmetic progression, assuming that that's what you intended. Now go to cell B1 and type " = a1*a1". The answer should be 1. Copy this cell down the B column all the way to B401. This should give the x^2 values for all the x values in column A. Copying is a powerful form of automation, the only form easily available in Excel.

To make a graph, select the first 401 entries in column and click on the "chart wizzard" in the toolbar. It's a little picture of a bar graph. Select, in the popup, XY(scatter), then the one with straight lines connecting dots. Click on "next" and "finish" and the chart will appear on the spreadsheet like this:

|	A	B	C	D	E	F	G	H	I	J
1	-1	1								
2	-0.995	0.990025								
3	-0.99	0.9801								
4	-0.985	0.970225								
5	-0.98	0.9604								
6	-0.975	0.950625								
7	-0.97	0.9409								
8	-0.965	0.931225								
9	-0.96	0.9216								
10	-0.955	0.912025								
11	-0.95	0.9025								
12	-0.945	0.893025								
13	-0.94	0.8836								
14	-0.935	0.874225								
15	-0.93	0.8649								
16	-0.925	0.855625								
17	-0.92	0.8464								
18	-0.915	0.837225								
19	-0.91	0.8281								
20	-0.905	0.819025								
21	-0.9	0.81								
22	-0.895	0.801025								
23	-0.89	0.7921								
24	-0.885	0.783225								
25	-0.88	0.7744								
26	-0.875	0.765625								
27	-0.87	0.7569								
28	-0.865	0.748225								
29	-0.86	0.7396								
30	-0.855	0.731025								
31	-0.85	0.7225								
32	-0.845	0.714025								
33	-0.84	0.7056								
34	-0.835	0.697225								
35	-0.83	0.6889								
36	-0.825	0.680625								
37	-0.82	0.6724								
38	-0.815	0.664225								

(Chart on the right showing a parabola, x-axis 0 to 500, y-axis 0 to 1.2, labeled "Series1")

Put the cursor inside the "chart area" but outside the "plot area" in the graph and right click. Then select "Source data" from the popup. Now click "Series" in the top of the "Source Data" dialog box and you will see a place for "X values". Make that =Sheet1!$A$1:$A$401 (change B to A in the "Y Values" box below). This will take the x values from column A. The result should be approximately

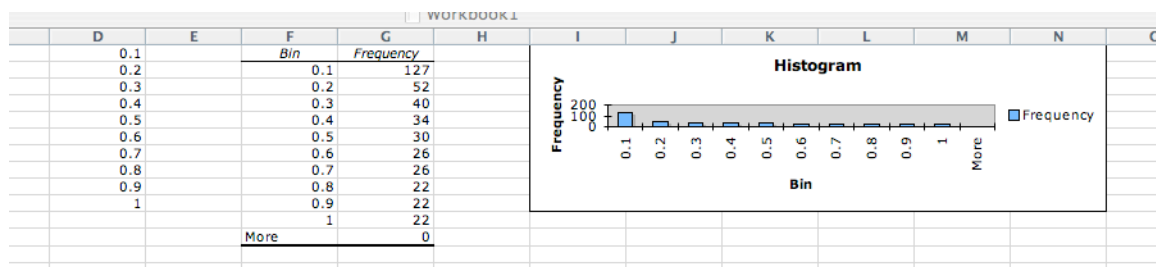|	A	B
1	-1	1
2	-0.995	0.990025
3	-0.99	0.9801
4	-0.985	0.970225
5	-0.98	0.9604
6	-0.975	0.950625
7	-0.97	0.9409
8	-0.965	0.931225
9	-0.96	0.9216
10	-0.955	0.912025
11	-0.95	0.9025
12	-0.945	0.893025
13	-0.94	0.8836
14	-0.935	0.874225
15	-0.93	0.8649
16	-0.925	0.855625
17	-0.92	0.8464
18	-0.915	0.837225
19	-0.91	0.8281
20	-0.905	0.819025
21	-0.9	0.81
22	-0.895	0.801025
23	-0.89	0.7921
24	-0.885	0.783225
25	-0.88	0.7744
26	-0.875	0.765625
27	-0.87	0.7569
28	-0.865	0.748225
29	-0.86	0.7396
30	-0.855	0.731025
31	-0.85	0.7225
32	-0.845	0.714025
33	-0.84	0.7056
34	-0.835	0.697225
35	-0.83	0.6889
36	-0.825	0.680625
37	-0.82	0.6724
38	-0.815	0.664225
39	-0.81	0.6561

If you right click in the white space "chart area" then choose "chart options", you can add labels and grid lines -- all of which a professional chart should have:
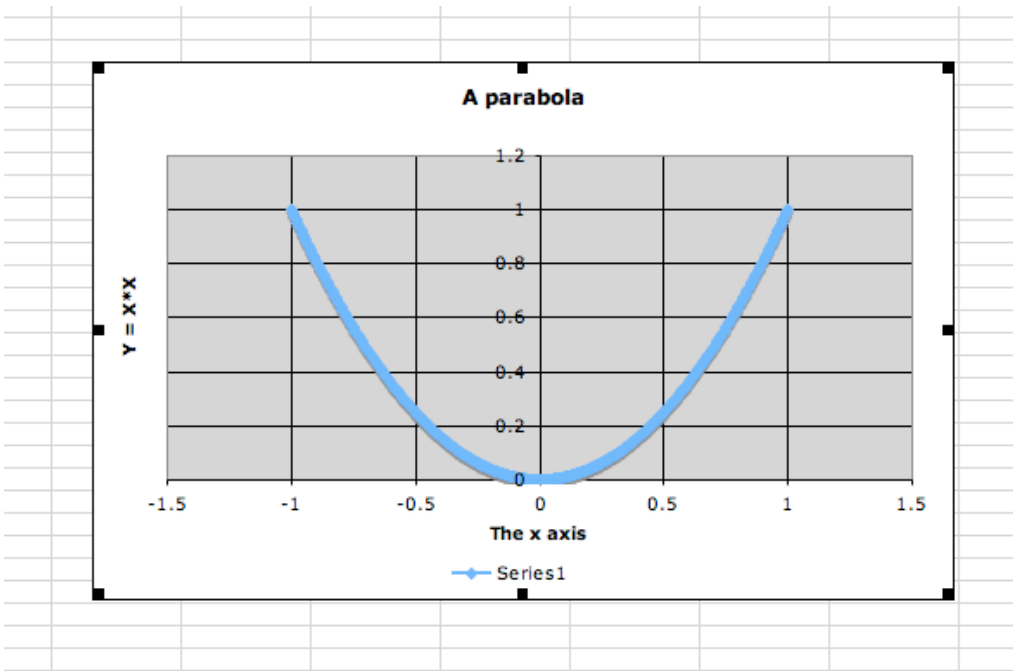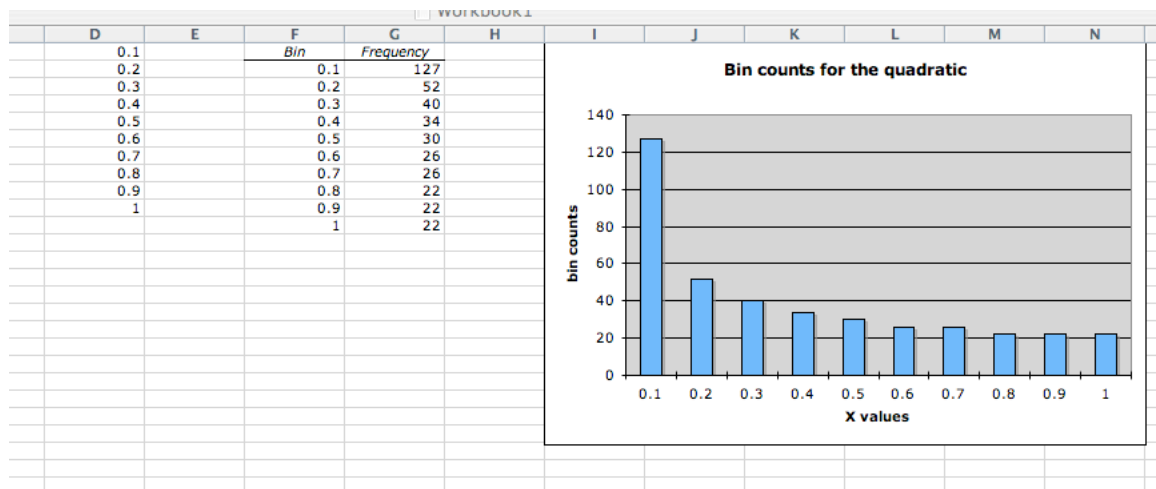

This seems quick and convenient, but you will get tired of it very quickly when you find yourself doing it over and over for one graph after another. Better computing environments like Matlab automate graph making too.

Histogram: You can make a histogram of the y values by first creating the bins by specifying their right boundaries. If you give "Bin ranges" (a,b,c,d,...), then Excel will calculate bin counts: how many data points less than a, then how many between a and b, then how many between b and c, and so on. I created, in column D, the bin ranges .1, .2, ..., 1. I did this by entering .1 and .2 in D1 and D2, then copying down to D10, as before. To make the histogram, select "Tools" from the top menu, and "Data Analysis" from the Tools popup menu. You might have to install the data analysis toolkit, but it comes with the Excel package, at least mine did. A box labeled "Data Analysis" pops up and you select "Histogram", then "OK". For the "Input range", specify b1:b401. For "Bin range", specify d1:d10, if that's where you put the numbers. Click the "Output range" button than make the output range f1:f10. Click the "Chart output" box near the bottom and then "OK". Excel goes to work and produces this:

| D	E	F	G	H	I	J	K	L	M	N	O
0.1		Bin	Frequency					Histogram			
0.2		0.1	127								
0.3		0.2	52								
0.4		0.3	40								
0.5		0.4	34							Frequency	
0.6		0.5	30								
0.7		0.6	26								
0.8		0.7	26								
0.9		0.8	22					Bin			
1		0.9	22								
		1	22								
		More	0								

We can remove the last (pointless) row of histogram data by deleting cells F12 and G12: select the cell, right click to get a popup menu, then click on "Delete..." and select "Move cells up". Note that the Histogram chart automatically adjusts accordingly. You then can resize the plot and adjust labels to get something like this:

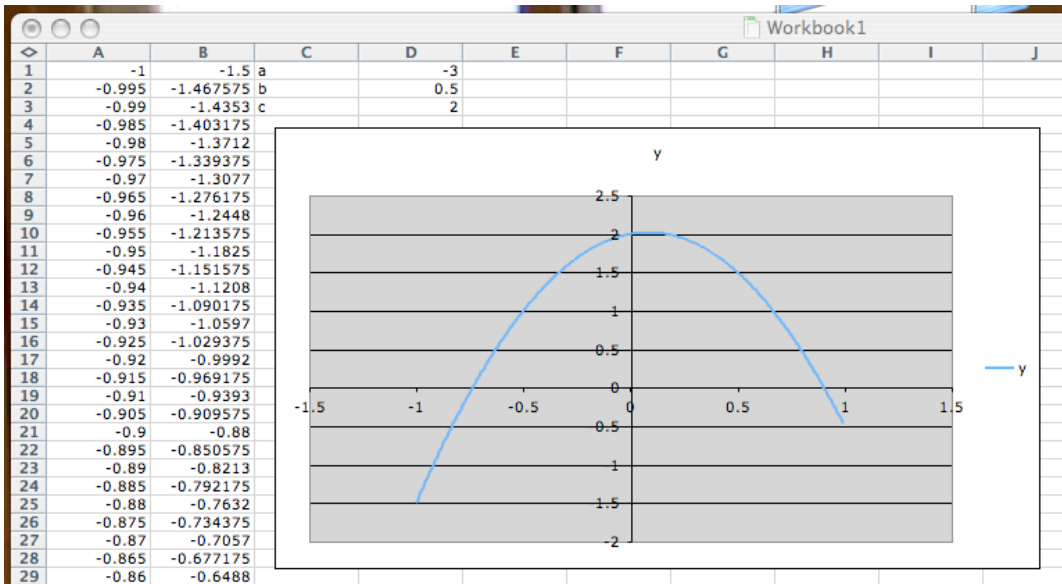| D	E	F	G	H	I	J	K	L	M	N
0.1		Bin	Frequency							
0.2		0.1	127			Bin counts for the quadratic				
0.3		0.2	52							
0.4		0.3	40							
0.5		0.4	34							
0.6		0.5	30							
0.7		0.6	26							
0.8		0.7	26							
0.9		0.8	22							
1		0.9	22							
		1	22							

Labeled values: A spreadsheet often has a few numbers that appear so commonly that it is useful to name them. To illustrate this, we make plots of more general quadratics $y = ax^2 + bx + c$. I first enter a, b, and c in cells C1, C2, and C3. Then I enter the intended

values a = -1, b = .5 and c = .5 into the neighboring cells D1, D2, and D3. Next, select cell D1 and look at the left most box in the formula toolbar. It should say D1. Click on this and replace it with a. Continue by setting D2 to b and D3 to co in the same way (for some reason, it did not let me use c instead of co.). You can check that it worked by selecting again cell D1 and seeing that a appears instead of D1. Now delete column B and enter the formula =a*A1*A1 + b*A1 + co into the formula bar for cell A1. Copy this formula down the column to B401 and graph as before. The result should be (after moving the plot):
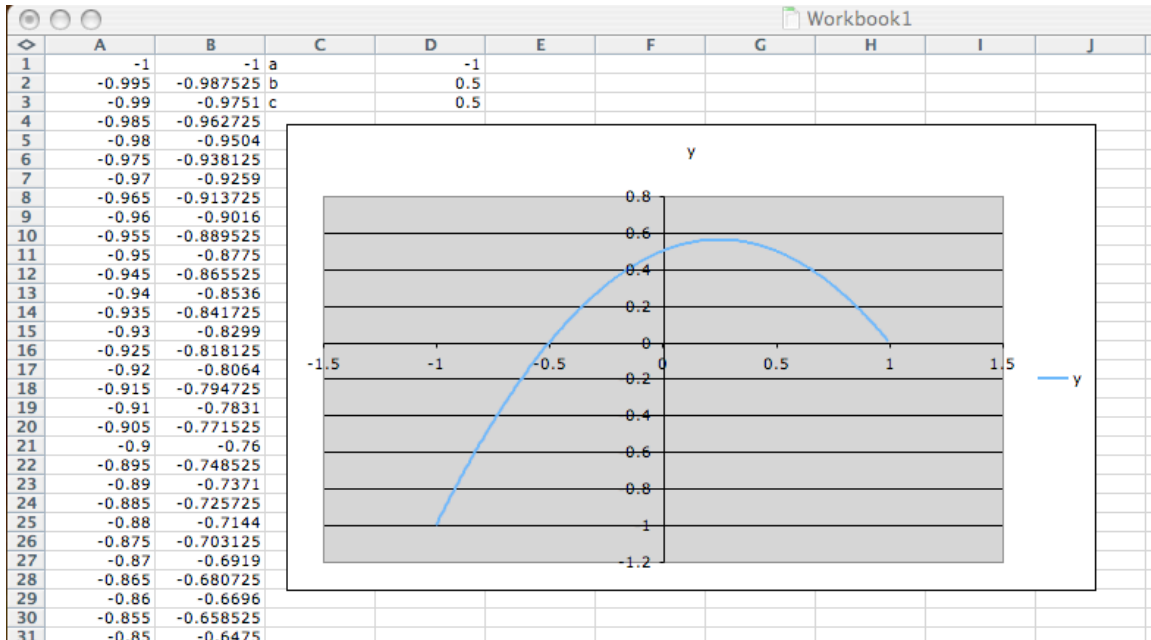
You can see what you've accomplished by changing the value of a to -3 and the value of c to 2. For me, Excel recomputes all the function values and redraws the graph:

	A	B	C	D	E	F	G	H	I	J
1	-1	-1.5 a		-3						
2	-0.995	-1.467575 b		0.5						
3	-0.99	-1.4353 c		2						
4	-0.985	-1.403175								
5	-0.98	-1.3712								
6	-0.975	-1.339375								
7	-0.97	-1.3077								
8	-0.965	-1.276175								
9	-0.96	-1.2448								
10	-0.955	-1.213575								
11	-0.95	-1.1825								
12	-0.945	-1.151575								
13	-0.94	-1.1208								
14	-0.935	-1.090175								
15	-0.93	-1.0597								
16	-0.925	-1.029375								
17	-0.92	-0.9992								
18	-0.915	-0.969175								
19	-0.91	-0.9393								
20	-0.905	-0.909575								
21	-0.9	-0.88								
22	-0.895	-0.850575								
23	-0.89	-0.8213								
24	-0.885	-0.792175								
25	-0.88	-0.7632								
26	-0.875	-0.734375								
27	-0.87	-0.7057								
28	-0.865	-0.677175								
29	-0.86	-0.6488								

Using other sheets. An Excel *Workbook* consists of some number of *Worksheets*. You can move from one sheet to another using tabs on the bottom. You can click in those tabs to rename sheets. You can use Insert on the top menu to add more sheets.   This can make spreadsheets easier to use by hiding stuff you don't need to see. Select columns A and B and click on "cut". Then go to sheet2 and paste them into columns A and B there. They should appear on sheet2 and disappear from sheet1. The only things on sheet1 will be the parameter values and the plot. To check that things still work, change b to -.5. Finally, give the sheets more appropriate names. The result is:

	A	B	C	D	E	F	G
1		Parameter values for a general quadratic	a	-3			
2			b	-0.5			
3			c	2			

params | data
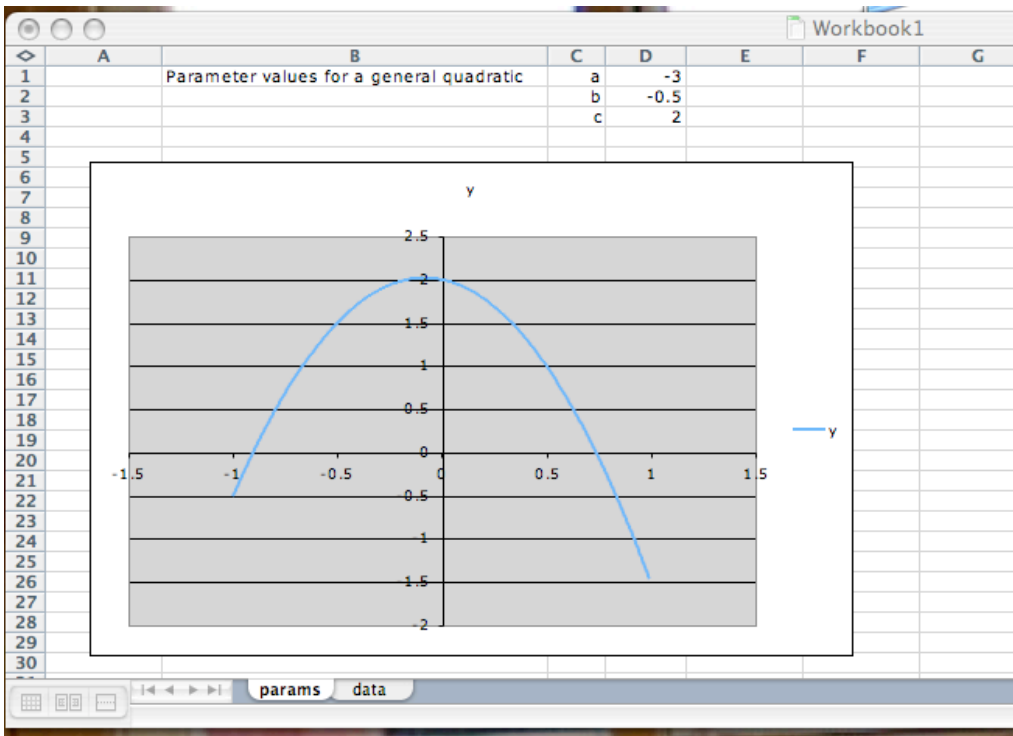
	A	B	C	D	E	F	G	H
1	-1	-0.5						
2	-0.995	-0.472575						
3	-0.99	-0.4453						
4	-0.985	-0.418175						
5	-0.98	-0.3912						
6	-0.975	-0.364375						
7	-0.97	-0.3377						
8	-0.965	-0.311175						
9	-0.96	-0.2848						
10	-0.955	-0.258575						
11	-0.95	-0.2325						
12	-0.945	-0.206575						
13	-0.94	-0.1808						
14	-0.935	-0.155175						
15	-0.93	-0.1297						
16	-0.925	-0.104375						
17	-0.92	-0.0792						
18	-0.915	-0.054175						
19	-0.91	-0.0293						
20	-0.905	-0.004575						
21	-0.9	0.02						
22	-0.895	0.044425						
23	-0.89	0.0687						
24	-0.885	0.092825						
25	-0.88	0.1168						
26	-0.875	0.140625						
27	-0.87	0.1643						
28	-0.865	0.187825						
29	-0.86	0.2112						
30	-0.855	0.234425						

params   data

A professional spreadsheet should be easy to read and use by others. This means intelligent labels and placement of data and use of worksheets.