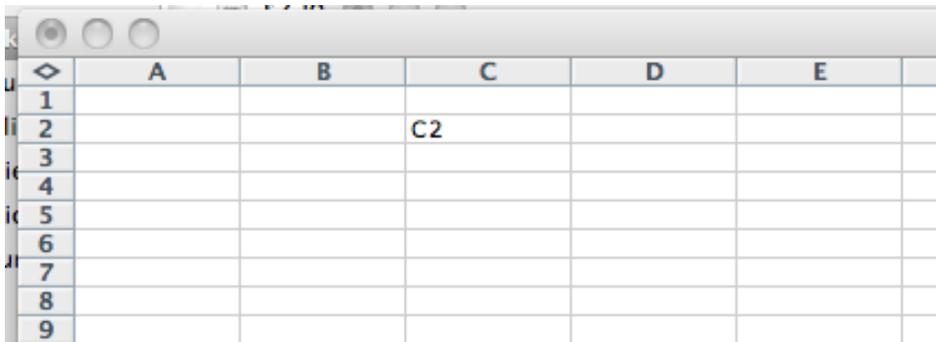


Assignment 1 supplement:  
**Using Microsoft Excel**

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 Linux box, things may look slightly different. Even different Macs produce different looking spreadsheets -- I don't know why.

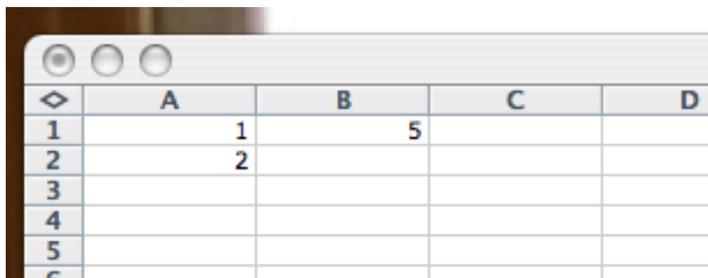
**Formulas and updating:** A spreadsheet is a way to express calculations and redo them as the data change. Open excel and get a blank spreadsheet. It should look something like this:



**Figure 1**

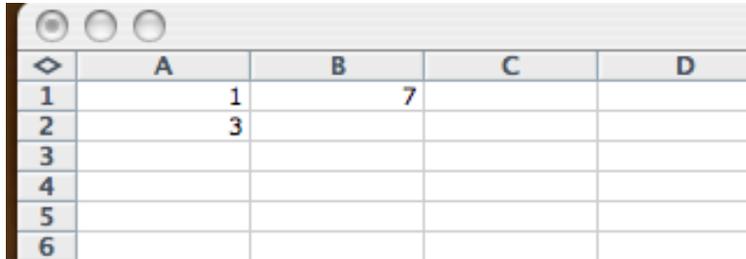
Letters label the columns and numbers label the rows, so that cell marked C2 is cell C2.

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. You must type the "equals sign" at the beginning, which indicates that the content of cell is a formula, not a number. The result should look like this:



**Figure 2**

The number in cell B2 is the result of the  $a_1 + 2 \cdot a_2$  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:

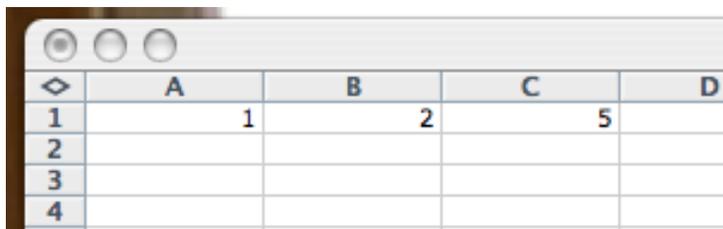


	A	B	C	D
1	1	7		
2	3			
3				
4				
5				
6				

**Figure 3**

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".) 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 " $= a_1 + 2 \cdot a_2$ " in cell C1. The result should be

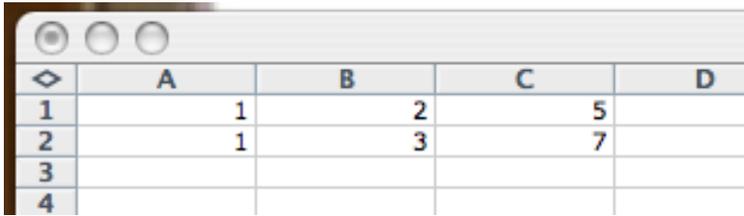


	A	B	C	D
1	1	2	5	
2				
3				
4				

**Figure 4**

Now select the first three cells of the top row at the same time by clicking on A1, then with the left button down, dragging through B1 and C1. Next 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 " $= A_2 + 2 \cdot B_2$ ". 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

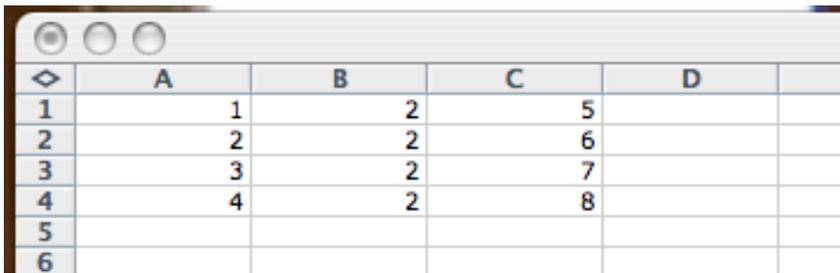
addressing by clicking in a slightly different way.) If you change the B2 cell value from 2 to 3, you should get this:



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

**Figure 5**

There are variations on this theme. For example, delete row 2 (right click on the 2 labeling row 2 and select "delete"), put the numbers 1, 2, 3, 4 in cells A1, A2, A3, A4, select cells B1 and C1 (but not A1) and drag down to row 4. This should give:



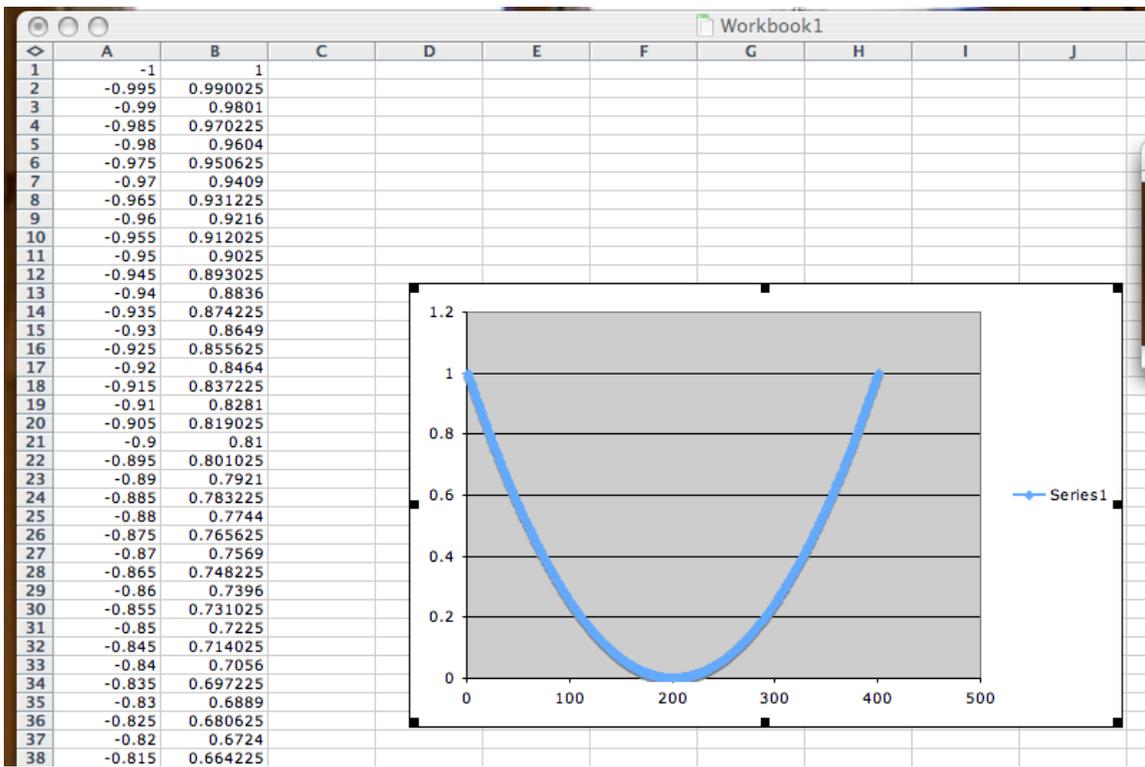
	A	B	C	D
1	1	2	5	
2	2	2	6	
3	3	2	7	
4	4	2	8	
5				
6				

**Figure 6**

Here is another way to get Figure 6 from Figure 5. Put 2 in cell A2 and 2 in cell B2, then select all six cells A1 through C2 and drag the bottom right corner of C2 to C4. Excel automatically extrapolates the sequence 1, 2 in column A to 1, 2, 3, 4. The result should be the same as Figure 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. Excel 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 wizard" 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:



**Figure 7**

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

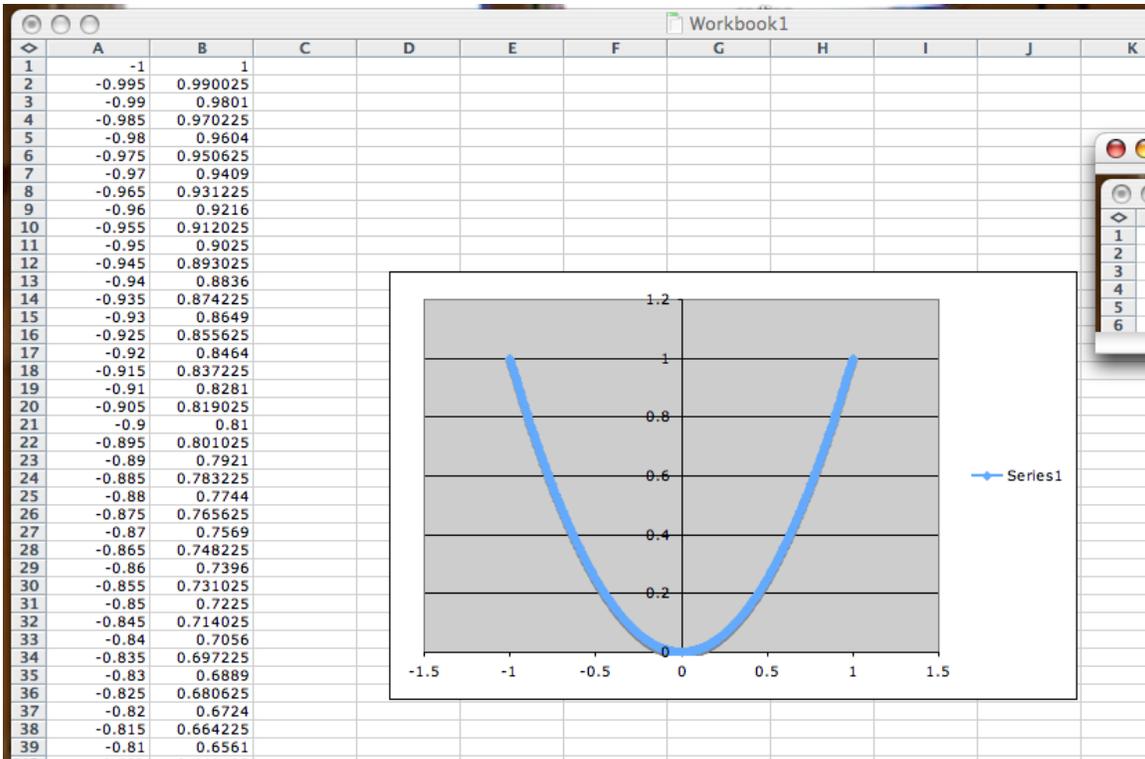


Figure 8

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:

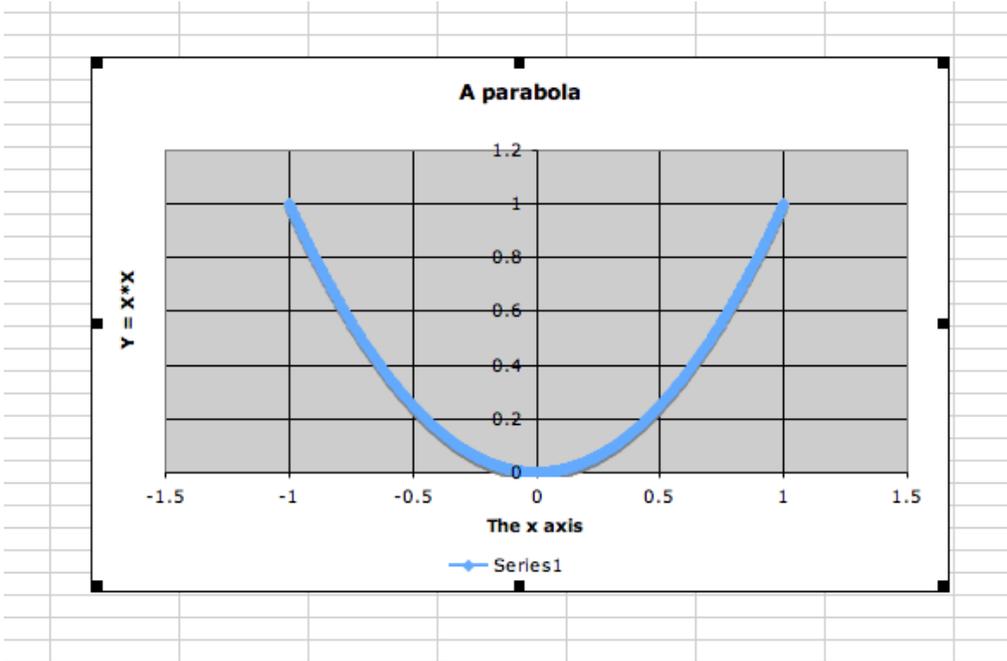
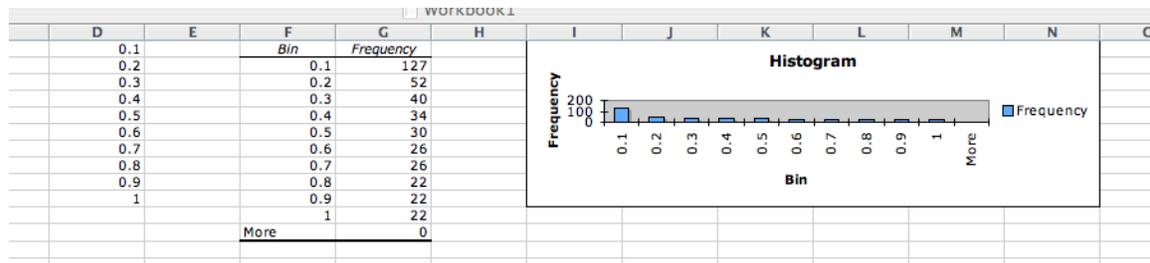


Figure 9

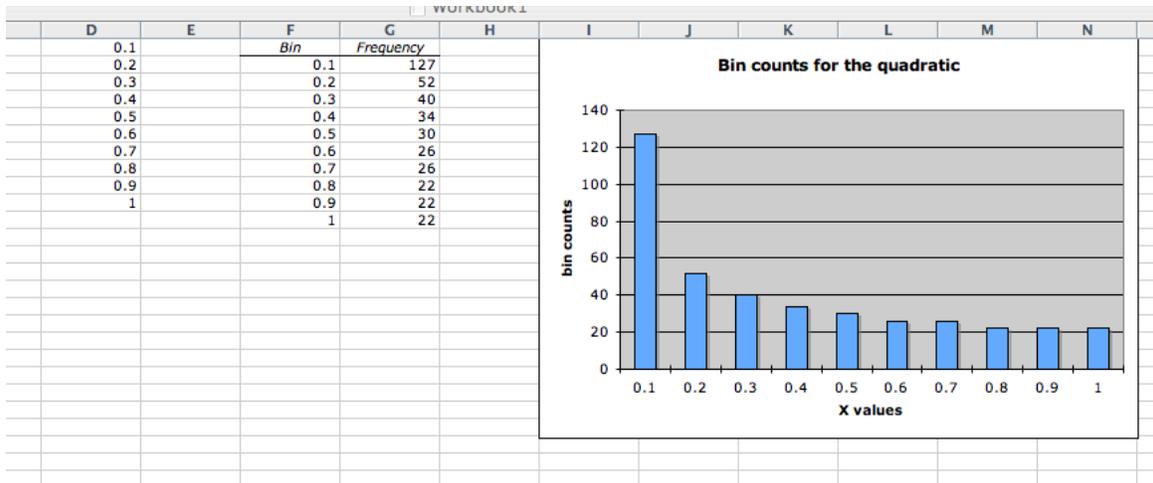
This seems quick and convenient, but you will get tired of it very quickly when you find yourself doing it over and over for one graph after another. Better computing environments like Matlab automate graph making too.

**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. The expression b1:b401 means all cells between b1 and b401, including the ends. Also, B1 and b1 refer to the same cell; Excel is not case sensitive for cell labeling, though it is for other things. For "Bin range", specify d1:d10, if that's where you put the numbers. Click the "Output range" button then make the output range f1:f10. Click the "Chart output" box near the bottom and then "OK". Excel goes to work and produces this:



**Figure 10**

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:



**Figure 11**

**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  $y = ax^2 + bx + c$ . First enter **a**, **b**, and **c** in cells C1, C2, and C3. These are not used in any computation. They are just visual labels, as you will see. Then 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 **c0** in the same way (for some reason, it did not let me use **c** instead of **c0**). 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 + c0` 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):

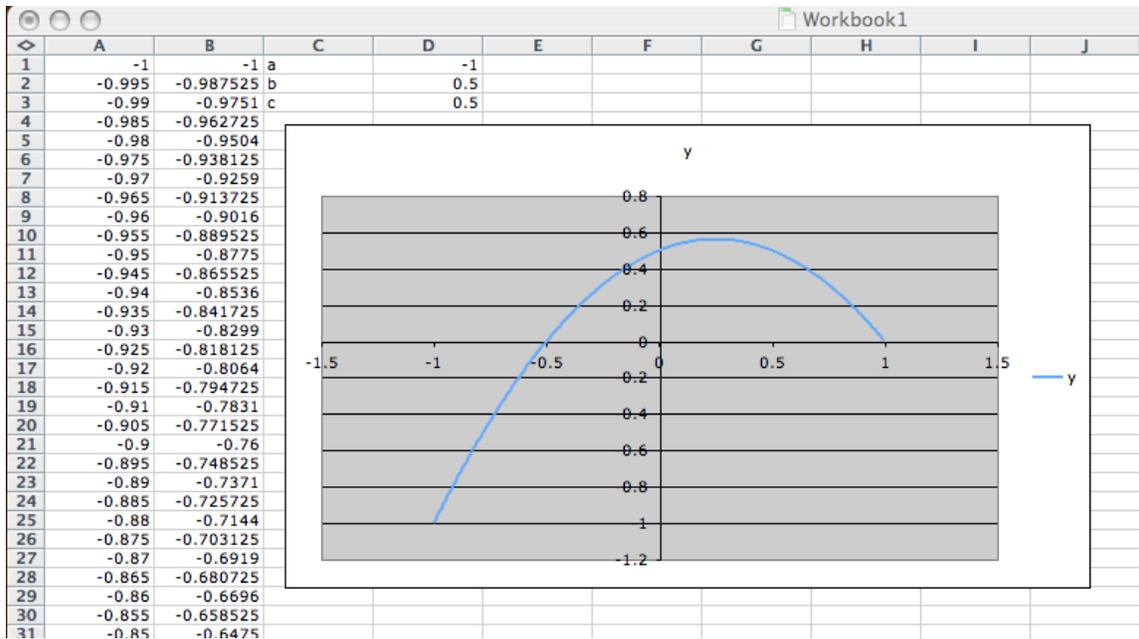


Figure 12

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:

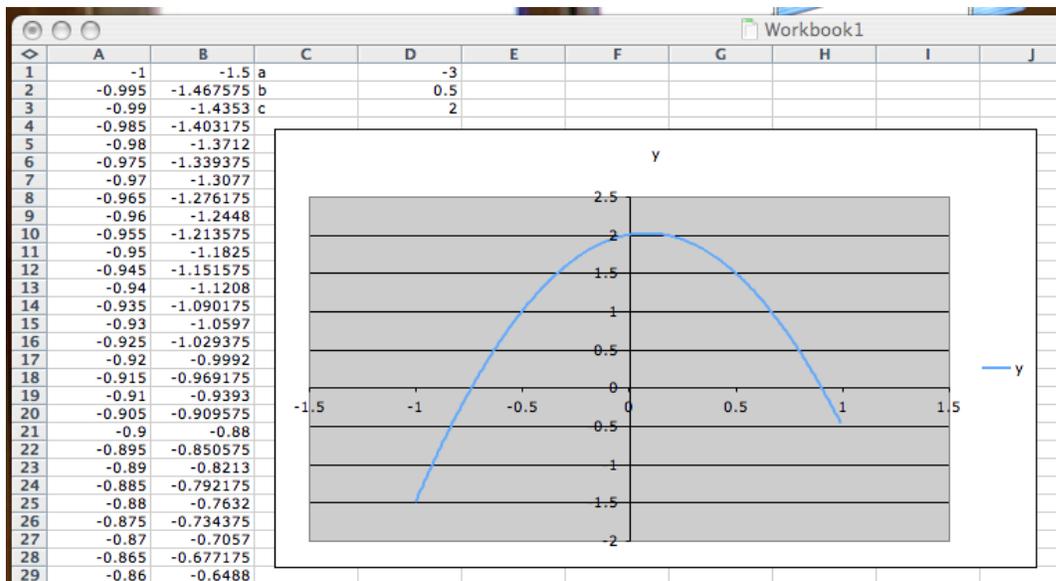
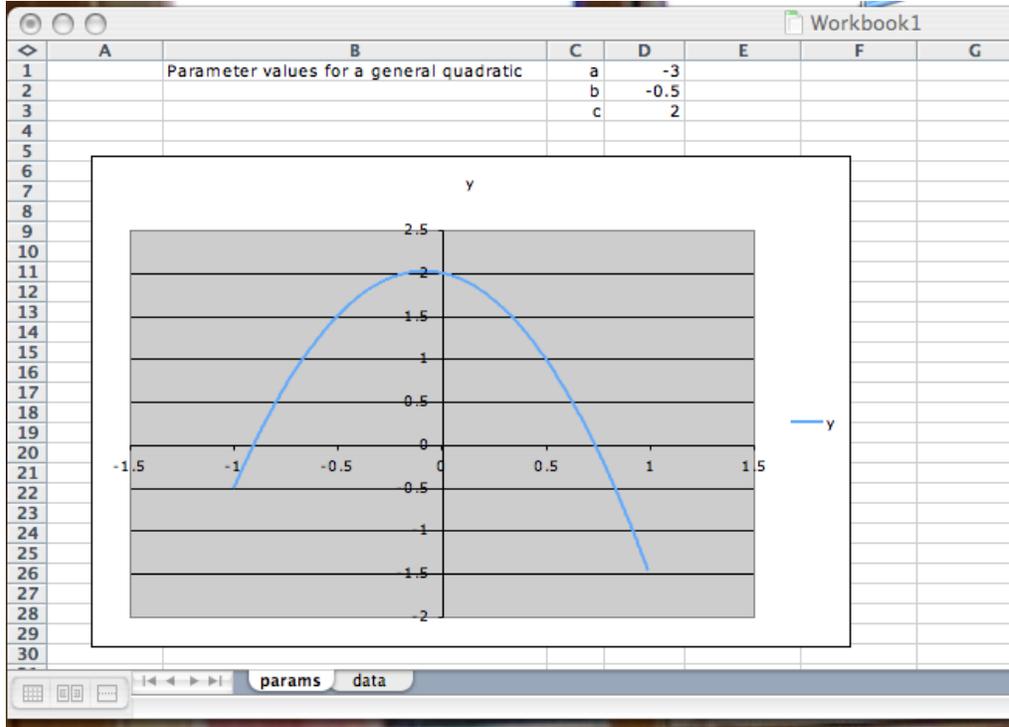


Figure 13

**Using other worksheets.** 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 -0.5. Put some information in cell B1. Finally, give the sheets more appropriate names, **params** and **data**. The result is:



**Figure 14**

	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							

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