Excel--An Introduction to Its Use, and Some Useful Uses
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The purpose of this assignment is to prepare you for a numerical lab that uses Excel to solve two coupled differential equations. It doesn't matter at this point whether you have any idea what that means, but it might matter to you that the goal is to show you that, with a little patience, you can calculate just about anything with a computer. The use of the spreadsheet program Excel is one way to do it, one that is widely available. If you already prefer using some other programming scheme, you might later adapt what you learn here to that scheme, if that would make you more likely to use it when needed.

A List of Useful Excel Skills--assuming you have started it up

1. select a cell (click on it)
2. naming a cell (click on it, then click on the box in the upper left part of the page where you see the initial name of the cell, then enter the name you want for it in that box, and hit "return"--Example: suppose you have clicked on cell B2, in column B and row 2. "B2" will appear in the name box. Change the name to Karen. Hit "return". Anything you now put into cell B2 will be known as Karen. Type 27 into cell B2. Click on cell D5 and type "=Karen" without the quotes. Voila, when you hit return, cell D5 will say "27".)
3. entering a number in a cell (see example of entering 27 in B2 above.)
4. entering an equation in a cell (see example of entering "=Karen" in D5 above)
5. entering a column of sequentially increasing numbers--learning to "fill down" (click on cell D6 and type "=D5+Karen/10", again-and always-without the quotes. Hit return. If cell D6 does not remain selected, select it again (depends on how preferences are set up, I think). Notice that there is a box around the selected cell and a spot of some sort on the lower right corner of that box. Click on that spot and drag down in column D by about 10 cells. You should find that the cells show a sequence of numbers starting with 27 in B5 and increasing by 2.7 in each step. Now go back to cell B2 [Karen] and change it to 10. Your sequence should now start with 10 and increase by one each as you go down.
6. getting a fresh start (close this workbook and if the computer asks if you want to save it, reply "no" or "don't save". Then go to the upper left menu item "File" and ask it for a "New Workbook". You are ready to start fresh without erasing a bunch of things (cell names are a bit tricky to get rid of).
7. getting a functional relationship (in cell A1 of your new worksheet, type "apple =", hit return. Select cell B1 and change its name to "apple". Then type 2 into cell B1. This makes apple=2, while the typing in cell A1 just reminds you that "Apple" is found in B1. Repeat this process with "pear =" in A2 and naming B2 "pear". Then type 4 into B2, making pear=4.

Now, select C5 and type in "x". Similarly, type "y" in D5. We are going to have a look at some function y(x) in columns C and D below these headers. In C6 type "=0". In C7 we are going to arrange to have "=C6+0.1" but there is an easier way to do this once you get used to it. Select C7, type ":", then click on the cell right above--your equation has inserted the name of the clicked cell, then type "+0.1" and hit return. Fill this down for 10 cells, that is, grab the lower right corner of C7 [selected first if necessary] and pull it down until the x values run from 0 to 1.
Now we are ready to enter the equation we want in column D. Select D6, right next to the zero value of x, below the name y. We are going to enter "=apple + pear*C6^2". So, type "=apple + pear*", then poke C6, then type "A2". Hit return. The symbol "^" means "raise to the power". So our equation for y is 
\[ y = \text{apple} + \text{pear} \times (x \text{ squared}) \]. Is it obvious what to do next? You might think, "Ahh, I just have to grab the corner of D6 and drag it down to fill the other cells next to the values of x." But then you might lose your courage, thinking it will always fill down "=apple + pear*C6^2", when what you really need is for the "C6" name to change as you fill down. Try that first idea to see what happens! The "fill down" procedure somehow chose the value of x next to each y! Click on one of those y cells. You will see that if you selected D10, its equation will read "=apple + pear*C10^2". This is the true magic of a spreadsheet program. The equation "=apple + pear*C6^2" is really in the machine as "=apple + pear*(the value of the cell just to your left)^2". It is what is called a "relative reference".

There are ways to prevent this, in part or in whole. [In D6, if you were to have typed "=apple + pear*$C6^2", it would be interpreted as "=apple + pear*(the value of the cell in column C on this row)^2". If you were to have typed "=apple + pear*C$6^2", it would be interpreted as "=apple + pear*(the value of the cell in the column just to the left but always in row 6 )^2". And finally, if you put $ before both column and row, it is a fully absolute reference, always meaning the value of cell C6.]

**8. getting a graph of the function.** (Select the cells C6 through D16 by clicking on C6 and then dragging down and over to D16. These contain the data you wish to graph. Then click on the Chart Wizard symbol in the row of tools above the worksheet. [It looks a little like a vertical bar chart on a Mac.] A Dialog Box will come up asking what sort of graph you want. Click first on the "XY(scatter)" choice in the left column, and then on the choice on the right that shows a smooth set of curves with symbols on the data points. Then poke "next" for further choices about your graph. There are 5 areas of choice, Titles, Axes, Gridlines, Legend, and Data Labels. Choose "Titles" if you aren't already there. In chart title, type "My Graph"; in Value x axis, type "x (meters)"; in value y axis type "y (mmHg)". Then poke "Axes" and make sure both primary axes are chosen. Then poke Gridlines and poke x axis "Major gridlines". Then poke Legend and poke "Show Legend" to turn it off. Skip Data Labels. Then hit Finish (if you hit "Next" instead, it will ask you where to put the chart). You should now have your graph of y(x). If you want to move your graph, just poke on it near an edge and drag it to where you want it. Your spreadsheet should now look about like:

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apple = 2
pear = 4
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Don Cox, March 2007
Unfortunately, the copy and paste did not show the row and column names or the cell lines.

9. **changing your graph to suit your tastes** (You can change many things. If you change the values of apple and/or pear, the numbers and the graph will respond immediately. If you want to change the size of the graph, click on it near the edge and "drag points" will appear around the boundary. Click on and drag any of these points, to change the size of the graph. If you would like to get rid of the gray background, double click on it and a dialog box will appear; by selecting "none" under "area", the gray will disappear (or you can change it to any other color). If you would like to change the range of an axis, for example having x run from 0 to 1 rather than whatever Excel chose (1.5 in the graph above), double click on the numbers next to the axis and then choose the "scale" tab to set the minimum, maximum, and major unit. If you don't like the font or size of any of the text, click on it and change it to what you want. You can do this at the same time as changing the scale by choosing the font tab. (If you want the font size to stay the same when you rescale the graph, deselect "auto scale" on the font page of the Format axis dialog box.) Under "Number" in this same dialog box, you can choose how the numbers are displayed. With several such changes, your graph might end up looking like:

![My Graph](image)

You can also double click on the line in the graph and change it in color, form (e.g. dashed), thickness, show or not show the data points, plot it directly from one point to the next, or smoothed as above. (Note: if you want to copy your graph and paste it into a text file like this one, choose paste special and paste it as a picture.)

10. **fitting your graph with a trendline** (suppose that you did not actually graph an equation you know but got your curve from a more complicated procedure, or from data, and would like to see what sort of functional form it has. If you single click on the curve, then go up to the Chart menu and select "Add Trendline", a dialog box comes up asking you what sort of form you would like to try. If you choose a bad form, the trendline will not resemble your curve. In our case, we know that a second order polynomial will fit exactly, so we would choose polynomial fit, order 2. Before hitting "OK", though, you might want to poke the options tab and select "Display Equation on Chart". Then hit "OK". The result will be a black line following the data, and an equation that is hard to read because it sits on top of the graph. But you can click on and drag the equation to wherever it is convenient to read. An example appears on the next page. Notice that it tried to include a linear term in x, but the coefficient was negligible. It basically
says \( y = 2 + 4x^2 \), the correct answer. Usually, the numbers in this equation do not have enough decimal places, but if you double click on it, you can have as many decimal places as you like. If you increase it to 2 decimal places, it will read \( y = 4.00x^2 + 0.00x + 2.00 \). (You have to change from "General" to "Number" in the dialog box before you can change the number of decimal places.)

![My Graph](image)

**11. using other functions** (Excel has many built in functions that you can use, trig functions, and many others. If you know their names, you can just type them in. For example, suppose you wanted to plot \( y = 2 \sin(2\pi x) \). In cell D6, you would type "=2*sin(2*pi()*C6)". Then fill it down to D16. If you do it now, you will get a nice graph of the function with no extra trouble. (You will want to click on your now useless trendline to get rid of it.) The formula above illustrates three things: you must put an asterisk in between things that are multiplied; the function pi() with nothing in the brackets provides the value of pi; and sin(stuff) is the form of the sine function with the stuff in units of radians. (You can use sin(pi()*stuff/180) if stuff is in degrees.) My graph now looks like: (Sorry I left out a 2 in the \( y = 2 \sin(2\pi x) \) vertical axis label.)

![My Graph](image)

This example involved clicking on and editing the axis labels, typing pi as p and then using the formatting palette to change its font to "symbol" and double clicking on the horizontal axis.
numbers to get the axis formatting dialog box, choosing "pattern" and then "low" for the placement of the tick mark labels.

This completes the initial exposure to Excel, except to tell you that, to see all the functions available to you, you poke on the "paste function" tool that looks sort of like $fx$. It will offer you a host of function types and functions in those categories. When you choose one, it will offer you help in using it. (You should click a cell first, then "=" then hit the function tool, then choose one. Oh yes, you can also "fill" equations to cells to the right or left by dragging the cell corner right or left rather than down or up.) \textbf{But don't get rid of the spreadsheet you have been working on just yet, as it will simplify doing the example that comes next.}

\textbf{A New Excel Skill--Adding another line to a graph.} It is easiest to compare results if you see them both graphed together. Poke your graph. Then from the Chart menu, choose Source Data. The poke the Series tab. Then hit the Add button to add a series. Then insert the cursor in the x values box and select cells D6 through D16. Then put the cursor in the y values box, and delete whatever you find already there (e.g. "=1"). Then select cells F6 through F16. You can put a name in the name boxes for each series if you like, like $Q(\text{true})$ and $Q(\text{calc})$, and if you then reactivate the legend (via Chart Options in the Chart menu), the legend will show the names of the lines and which is which. You might also update the axis labels. Doing all this, My Graph looks like: