

## Using Excel

### Tables

How you lay out your data tables is up to you, but it should be clear (to me) what the quantities within the table are (both in terms of what they are physically and what part of the experiment they go with) and what their units are. Here are some general things to keep in mind (see example table on page 9 of lab manual):

1. Label your data tables with a number and a title. For example “Table 1: The Simple Pendulum”
2. Format your data tables with borders
  - Highlight the cells you want to format (i.e. your data table)
  - Click on “Format” at top of Excel window
  - Click on “Cell”
  - Click the “Border” Tab
  - Choose how you want to format the cells and click “OK”
3. Include units along with the quantity labels. For example “Mass (grams)”
4. Format the data table cells so that they display the proper number of significant figures (decimal places).
  - Highlight the cells you want to format
  - Click on “Format” at top of Excel window
  - Click on “Cell”
  - Click the “Number” Tab
  - Click on “Number” from the list on the left
  - Choose the number of “Decimal places” you want and click “OK”

### Calculations

You can perform calculations on the numbers you have placed within the cells of your spreadsheet. The first thing to do is pick an empty cell where you want the result of the calculation to appear:

- Click on empty cell
- Hit the “=” key (this tells Excel you are going to enter a formula). Notice that an “=” appears in the window labeled “fx” near the top of the Excel window. Your formula will appear in this window as you enter it.
- Start entering your formula. You can click on the cells of the numbers that will appear in your formula to place their values into the formula.
- When you are done, hit “Enter”

For example, let’s put the number 1 in cell A1 (click on cell A1, type in “1” and hit “Enter”) and the number 2 in the cell. Now click on the empty cell B1 and type “=”.

Let's say we want to add the two numbers in cells A1 and A2. Click on cell A1, type "+", click on cell A2 and hit "Enter". The result "3" should appear.

Click on the cell where you put your formula and look at the "fx" window. Notice that when you clicked on a cell with a number, Excel didn't put the actual number into the formula. Instead, it put the address of that number's cell (like A2, for example). This way, you can go back and change the number in, say A1, and the formula will still add together whatever is in cell A1 and A2.

**IMPORTANT:** When you copy and past your Excel work into Word, I can't see what formulas are in your cells (and even if I could, I wouldn't be able to tell what cells correspond to what numbers), so you have to indicate (type out) what formula was used to get the result of some particular calculation.

Write the formula in regular math notation (don't write "A1 + A2" since, again, I won't be able to tell what these cells are once you Copy/Paste your results into Word). If, for example, A1 and A2 are two time values, and if you label them as such (like t1 and t2) in your data table, I will be able to tell what you mean by "t1+t2".

### Cell References

The cell references in your formula are called "relative" cell reference. To see what this means, lets first do some manipulations.

Highlight cell A2 (the number "2" should still be there). Notice the little black square in the lower right-hand corner of the cell. If you click, hold and drag that down a few cells, Excel will copy whatever was in cell A2 into those cells.

Now highlight both cells A1 and A2 (the numbers "1" and "2" should still be in these). Now drag that little black square down a few cells (over the "2"s you copied). Notice that Excel continues the "sequence" that you started with the "1" in A1 and the "2" in A2, giving "3" in A3, "4" in A4 and so on.

Now erase (delete) all the numbers in the A column and place a "2" in A1 and a "4" in A2, highlight both these cells and drag that down (go up to 20), Excel will continue the sequence of even numbers.

Now notice that the cell with your formula reads "6". It's still looking at the values in cells A1 and A2. If you highlight the cell with your formula, and drag the little black square down, you will make copies of the formula. However, the values are no longer "6". To see why, click on the first copied formula below the original (the one in cell B2) and look at the cell references in the formula. Instead of reading "A1+A2" now it reads "A2+A3".

The reason why is because the original formula actually read something like “look to the left one cell, get its value, now look to the left one cell and down one cell and get its value and add these two together”. When you copied the formula down to B2, it still had the same kind of instruction. Now, however, the cell to the left is A2 and the cell to the left and down one is A3, so it’s adding those two values.

If you want to copy a formula but do not want one or more of the cells you are referencing change in this relative way, you can either write (or copy/paste) the actual number in the formula or you can use an “absolute reference”.

Let’s say we want to add the number 2 to all of our number in column A. To do this, go back to cell B1 and put in the formula “A1 + A1” by clicking on A1 then “+” then A1 again. Now click within the “fx” box and put a “\$” in front of the A and one in front of the 1 of the first cell reference so it looks like: “\$A\$1 + A1”.

Now if you copy your formula (do this for 10 values, from B1 to B10), you will notice that the second cell reference changes but the first one doesn’t – your formula is looking at the A1 for that first value.

As an aside, in this case, it probably would have just been easier to write our formula as “2 + A1” instead of putting in the dollar signs.

### **Built in Functions**

Excel has a large number of built in functions that you can use in your formulas. To use them:

- Click on “Insert” at top of Excel window
- Click “Function”
- Find the function you are looking for (Note: there is an “Or select a category” pull down window) and highlight it and click “OK”

Most built in functions expect you to tell it what number or numbers it should use.

As an example, let’s find the sum of the 10 values in column B. Click on C1 and insert the “Average” function. When you click “OK” a window opens called “Function Arguments”. Make sure the “Number 1” box is highlighted (it should be already) and highlight the cells in your spreadsheet that you want to average over (B1 through B10 in this case). Then click “OK”. The sum should appear in C1.

### **Charts and Histograms**

The analysis for most of our labs will involve creating graphs (charts) to give a visual representation of our results. This will typically involve graphing one set of values versus another set (Excel calls these “XY (Scatter)” charts). To do this

- Click on the “Chart Wizard” icon near the top of the Excel window (it looks like a miniature bar graph).
- Select “XY (Scatter)” and make sure the graph type without lines or curves connecting the data points is selected. Click “Next”
- Highlight the cells that contain the data for your chart and click “Next”
  - If your x and y axis data isn’t right next to each then just select one set of data.
  - Then click the “Series” tab near the top of the “Chart Wizard” window.
  - Now you can specify which data is to be along the x axis and which is to be along the y axis by clicking on the appropriate windows and highlighting the appropriate data in your spreadsheet.
- Label your axes (with units) and give the graph a label.
- Make sure the “As object in Sheet 1” button is lit and click “Finish”

Once your graph is created, you can right click on its different parts (axes, legend, etc...) and format them.

A histogram keeps track of how often some particular range of values occurs in some collection of data. For example, give a list of grades for a class, I might want to make a histogram that tells me how many cadets have a grades with the ranges 100-90, 90-80, 80-70, 70-60 and so on. These ranges are called “bin” values. The number of grades within a certain bin range is called the “frequency”.

For a Histogram, use the following procedure

- First, before we make the histogram, we have to create a column of numbers to represent the “bin” values (the value ranges we are tracking). So create that somewhere within your spreadsheet. In the above grade example, my bin values would be 100, 90, 80, 70, 60, ...
- Click on “Tools” at the top of the Excel window
- Click “Data Analysis”
- Click Histogram and click “OK”
- Within the “Histogram” window
  - Put in the “Input Range” by highlighting the appropriate cells.
  - Put in the “Bin Range” by highlighting the bin values you created.
  - Click “Output Range”, click on the box that appears next to it and click on any empty cell in your spreadsheet. This is where the histogram will appear within your spreadsheet.
  - Put a check next to “Chart Output” and click “OK”.

You can format your chart, as you did with the XY (Scatter) chart. You can also alter the Bin and Frequency chart that was created. For example, you should get into the habit of deleting the “More” entry.