For your lab report and some of your assignments, you will need to use Excel to analyze your data and/or generate graphs. This guide highlights specific features of Excel relevant to the work you’ll complete in this course. It was developed for the Mac version of Excel 2011. Guides specific for Excel 2010 and Excel 2013 are posted on BlackBoard. Many of the features described below can be accessed by right clicking (or holding down the control key and clicking) on a cell or graph rather than going through the tab menus. Even if you are familiar with Excel, please look through the guide. You never know, you might find some helpful tips.

### Formulas

It is often easier to perform calculations using Excel rather than your calculator. For all calculations, click on the cell (box) where you want the final answer to appear and type “=” (without the quotes). You can type in values and/or click to select cell(s) that have the values you wish to use in your calculations. Click and drag your mouse to select multiple cells. Be sure to use parentheses where appropriate as illustrated in the examples. Note that cells are indicated by their column letter and row number. The table below includes the functions that are most relevant for this course. There are LOTS more. You can find a complete list of Excel functions with descriptions by going to the Help option in Excel and searching for “list of functions.”

<table>
<thead>
<tr>
<th>Operation</th>
<th>Symbol</th>
<th>Example</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>addition</td>
<td>+</td>
<td>=5+C2</td>
<td>adds 5 to the value in cell C2</td>
</tr>
<tr>
<td>sum</td>
<td>SUM</td>
<td>=SUM(B4:C10)</td>
<td>gives the sum of the values present in columns B and C rows 4 through 10</td>
</tr>
<tr>
<td>subtraction</td>
<td>–</td>
<td>=D6-D5</td>
<td>subtracts the value in cell D5 from the value in cell D6</td>
</tr>
<tr>
<td>multiplication</td>
<td>*</td>
<td>=F6*0.12</td>
<td>multiplies the value in cell F6 by 0.12</td>
</tr>
<tr>
<td>division</td>
<td>/</td>
<td>=(D12/1000)/E12</td>
<td>divides the value in cell D12 by 1000, and then divides that result by the value in E12</td>
</tr>
<tr>
<td>average</td>
<td>AVERAGE</td>
<td>=AVERAGE(A3:A10)</td>
<td>gives the average of the values in cells A3 through A10</td>
</tr>
<tr>
<td>standard deviation</td>
<td>STDEV.P</td>
<td>=STDEV.P(G5:G12)</td>
<td>gives the standard deviation of the values in cells G5 through G12</td>
</tr>
<tr>
<td>t-test**</td>
<td>T.TEST</td>
<td>=T.TEST(B5:B8,C5:C8,1,3)</td>
<td>gives the p-value for a t-test comparing the average of the values in cells B5-B8 to the average of the values in cells C5-C8</td>
</tr>
</tbody>
</table>

**T-tests are statistical tests that compare two means (averages) and return a p-value indicating how likely it is that the difference between the two averages is due to random chance. If the p-value is very small, then there is a statistically significant difference between the two averages. The cutoff for “very small” depends on your analysis and the type of data collected. For this course, we will use 0.05. Therefore, any p-value less than or equal to 0.05 can be considered an indicator of a statistically significant difference. To perform a t-test you need two sets of data; you CANNOT perform a t-test if you only have two average values (i.e. you know the average, but you don’t know the numbers used to calculate the average). This is because t-tests take into consideration the variability of the data within each dataset. There are different types of t-tests that are used...
for different types of analyses and data. In Excel, the type of test is specified by the two numbers following your data ranges at the end of the formula. The different “flavors” of t-tests are beyond the scope of this course (if you’re interested in knowing more, ask your TA!). For your experiments, the first number should be “1” and the second number should be “3” unless otherwise indicated.

If you need to perform the same calculation for multiple values (e.g. all the numbers in column C, rows 4 through 13), you do NOT need to type in the formula multiple times. Instead, type the formula into one cell, hit enter, and then click on the cell where you typed the formula. Put your mouse over the black square in the bottom right corner of the cell. The “fat” cursor plus sign should change to a “skinny” one. Click and drag your mouse to copy the formula into the appropriate cells. The example below shows how to divide all the values in column C rows 4 through 13 by 1000.

Home Tab
This tab has functions useful for formatting data entered in your spreadsheet. Several particularly useful functions are highlighted in the image below.

Charts Tab
Use the options in this tab to make graphs. For this course, you will generate both Column and Scatter graphs. To facilitate making graphs, enter your data in a table format that includes appropriate headings. Put the numbers/text that you want plotted on the horizontal axis (x-axis) in the left hand column, and the vertical axis (y-axis) values numbers in the right hand column(s). Be sure to select the data you wish to graph BEFORE you try to make a graph. To select a non-contiguous dataset (e.g. the values in columns A and D, but NOT the values in columns B or C), select one group of values, hold down the command key, and select the next group of values. Specific details for each type of graph are provided below.
**Marked Scatter Graph:** Plots individual points of a line graph. A trendline (see section below) or line connecting the points can be added after the graph is made. If you have multiple datasets (e.g. initial velocity values for three different enzyme assay conditions), make sure that you label the columns clearly in your data table and select the labels when making the graph. That will ensure that your graph has the appropriate legend.

**Clustered Column Graph:** Makes a graph with vertical bars. Use this type of graph when your x-axis values are categories (words). For example, average sales for three different stores – the x-axis values would be the store names. See section below for how to add error bars representing standard deviations. Do NOT select standard deviation values when making your graph!

**Charts – Chart Layout Tab**
This tab appears ONLY when you select a graph. Useful features are shown below. Once you have added text to your graph (e.g. a title), you can use the formatting options under the Home Tab to modify selected text. It’s easiest to format your graph if you move it to a separate sheet. To do this, right click (or hold down the control key and click) on your graph. Choose Move Chart and select New sheet.

**Chart Title:** Choose the Title Above Chart option to add a title to your graph. When a title box appears, select the text and type in the title that you want.

**Axis Titles:** Select Horizontal Axis Title to label your x-axis. Choose the Title Below Axis option, select the text in the title box, and type in the appropriate label. Use Vertical Axis Title and the Rotated Title option to label your y-axis.

**Error Bars:** To add error bars representing standard deviation, click on your graph to select the data series (set of bars/points) you want, click on Error Bars, and choose Error Bar Options. Select Custom and click Specify Values. For BOTH the Positive Error Values and Negative Error Values, click on the spreadsheet icon next to the box and select the cells that have the standard deviations for the data shown on the graph. (For the datasets in this course, the positive and negative standard deviations are the same.)
**Trendlines** (applies to Scatter graphs ONLY): Trendlines are lines specified by mathematical formulas that represent a best fit for your data. For this course, we will only use linear trendlines — lines that have the formula \( y = mx + b \) where \( m \) is the slope and \( b \) is the x-intercept. To add a trendline, click on your graph to select the data series (set of points) you want, click the Trendline option, and go to Trendline Options. Make sure that the type selected is “Linear.” Select “Display equation on chart” and “Display R-squared value.” The R-squared value indicates how well your data fit the line (1.0 is a perfect fit, above 0.95 is acceptable). If relevant, select “Set Intercept = 0” to make the line go through the point 0,0. If you have a legend on your graph, Excel adds a legend entry titled Linear when you generate a trendline. This does NOT belong in your legend. To remove it, click once to select the legend, and again to select the Linear entry. Hit delete.

![Trendline Options](image)

**Other Useful Tips**

- Change the size of your columns in a sheet by putting your mouse over the dividing line where the column labels are (the gray part with A, B, C, etc.). Click and drag right or left to make bigger or smaller. Double clicking instead of dragging will automatically change the column size to fit the data in the column.

- Modify the labels in the legend on a graph by changing the column headings in the appropriate sheet. There are other ways to change them, but this is the easiest way.

- To select a non-contiguous dataset (e.g. the values in columns A and D, but NOT the values in columns B or C), select one group of values, hold down the command key on a Mac, and select the next group of values.

- Click and drag on graph text (e.g. title, trendline equation) to move them.

- To check the spelling on a graph or spreadsheet, go to the Review tab and look for the “ABC” option. Note that this ONLY checks the sheet or graph that is visible to you, not the whole file. If you have multiple graphs, check each one individually.

- To paste a graph into a Word document, select the graph, and use the “Copy” option under the Home Tab to copy it. When you paste it into Word, chose the “Paste as Picture” option. This makes it easier to resize and move the graph. If you change your graph, delete the old picture and paste in your modified graph.

- If you can’t figure out how to do something, use the Help feature to search for information.