## Calculating averages and standard error in a Open Office spreadsheet

1. You will first need to input your data into the spreadsheet. I've entered some madeup data below for radiation measurements taken with a pyranometer from incandescent and fluorescent bulbs.
2. Whenever you are going to use one of the package formulas in Open Office (or Excel) you start out by typing an equal sign (=). The command to for Open Office to calculate average is =AVERAGE( ). You type this into the cell you want the average to appear and, with the cursor between the parentheses, select the cells containing the values you wish to average. Once the cells are selected, hit ENTER and your average will appear.

3. There is no package function for calculating the standard error in Open Office (or Excel), but we can do it in two steps. We know that standard error is the standard deviation divided by the square root of the sample size, and there is a package function for calculating the standard deviation. This function is =STDEV(). Again, you will select the cells containing the values for which you wish to calculate the standard deviation and hit enter. You're almost there.

4. To get the standard error, type " $=$ " and select the cell containing the standard deviation value, then finish the formula as seen in the following screen shot and hit enter. SQRT is the function for taking the square root of a number.


5．Your finished product should look something like the screen shot below．Now you have all the calculations you need to make your graphs．

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|  | A | B | C |  |
| 1 |  | Incandescent | Fluorescent |  |
| 2 |  | 286.2 | 100.3 |  |
| 3 |  | 290.7 | 110.6 |  |
| 4 |  | 287.3 | 108.1 |  |
| 5 |  | 287.6 | 109.4 |  |
| 6 |  | 290.1 | 111.2 |  |
| 7 | Average | 288.38 | 107.92 |  |
| 8 | Standard deviation | 1.927952282 | 4.422329703 |  |
| 9 | Standard error | 0.862206472 | 1.977725967 |  |
| 10 |  |  |  |  |
| 11 |  |  |  |  |

## Making a bar graph with error bars

1. Since we are only graphing averages and the standard error, I find it easier to copy and paste my relevant values in a condensed area. Graphing is so much easier when you arrange your data neatly. See below.

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| E10 |  |  |  |  |
|  | A | B | C | D |
| 1 |  | Incandescent | Fluorescent |  |
| 2 |  | 286.2 | 100.3 |  |
| 3 |  | 290.7 | 110.6 |  |
| 4 |  | 287.3 | 108.1 |  |
| 5 |  | 287.6 | 109.4 |  |
| 6 |  | 290.1 | 111.2 |  |
| 7 | Average | 288.38 | 107.92 |  |
| 8 | Standard deviation | 1.927952282 | 4.422329703 |  |
| 9 | Standard error | 0.862206472 | 1.977725967 |  |
| 10 |  |  |  |  |
| 11 |  | Incandescent Fluorescent |  |  |
| 12 | Average | 288.38 | 107.92 |  |
| 13 | Standard deviation | 1.927952282 | 4.422329703 |  |
| 14 | Standard error | 0.862206472 | 1.977725967 |  |
| 15 |  |  |  |  |
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2. To insert a chart, you will select the cells containing the data you want to represent graphically (and their labels). Then go to Insert on the menu and select Chart.

3. The following screen will pop up. Select the type of graph you want to make (we are using column) and click Next.

4. The chart elements tab can be seen below. This is where you can label your axes. Make sure the box to display a legend isn't checked. This gets rid of the series legend, which is redundant in this example. You now have a chart, but no error bars.

5. Making sure your graph is selected, go to Insert on the menu again. You will notice the options are different when the graph is selected. Select Y Error Bars from this menu.

6. The following box should pop up. Select Cell Range and then place your cursor in the Positive (+) box then click the cell icon next to the box.

7. This screen will appear. Once it appears, select the two cells containing your standard error values.

8.This box will appear once you select your values. You should then place your cursor in the Negative (-) box and do exactly the same thing you did for positive (select the same standard error boxes). You could also check the Same value for both box. Then click OK.

8. You have a graph with error bars!! The standard error is really small in this example compared to the $y$-values, so they look like little tiny tick marks.

