# *Lab 0:*
# How To Use Excel To Illustrate Data

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*The purpose of this activity is to:*

- *Guide you through an example of what this semester's lab activities will be like.*
- *Show you some of the features of Microsoft Excel that you will need to know about for future labs.*

*This lab will not be turned in for a grade, however, it is a good reference for future labs and a good review for lab practicals, so keep it handy.*

## WALKING TO SCHOOL

*Microsoft Excel is a spreadsheet program that can be used to tabulate, analyze, and illustrate information in a variety of different ways. You will use this program in every lab this semester to help understand your experiments and to communicate your results with others. Keep in mind that Microsoft Excel is available on almost every public computer in the university, in case you want to work with it outside of lab.*

Suppose you are asked the following question:

### How long does it take you to walk to school?

For the next ten days, you time how long it takes for you to walk from your apartment to school. You get the following times: 21 min, 25 min, 22 min, 22 min, 19 min, 26 min, 23 min, 24 min, 19 min, and 21 min.

In the next sections, you will learn how to illustrate your data using the Excel spreadsheet so that it conveys the right amount of information.

### Creating a Data Set

A. Double click the **Excel** icon. This will open the program

B. In cell **A1,** label the "A" column "Days". In cell **B1,** label the "B" column "Times".

**Under the "Days" column, you want to list the ten trials you took. Sometimes, when the number of trials is large, it can be a pain to have to fill in every number by hand. There is shortcut around this. In** A2, **type "1". In** A3, **type "2". Now select these two cells. Notice a small square on the lower right corner of the selected cells. This is the** fill handle.

C. Click the fill handle and drag it all the way down to 10, or however far you want. Excel will automatically fill in the rest.
D. Under the "Times" column, enter your data, the times recorded to get to school. Now you have a simple data set to work with.

## Graphing Data

At the top of the screen is a blue, yellow, and red icon, the **Chart Wizard** icon. Click this and a menu will pop up. Here are fourteen different ways in which your data can be graphically illustrated. You'll find during this semester that different kinds of data are best shown with different kinds of illustrations. Select **XY (Scatter)** and hit **Next.**

A. Here Excel asks you which data set you want to graph. Using the mouse, highlight the two columns of information you want to use. It will give you a preview of how this chart is going to look. This illustration is a basic point plot graph with the days on the x-axis and the times on the y-axis. Hit **Next.**

B. Excel now asks you to select what data you want to graph. Highlight the two columns (without the titles) and hit **Next.**

C. A graph needs to be detailed enough so that one can understand it without an explanation, yet concise enough to be understood at a glance. That's why you must always give your chart a title and label your axes. Title your chart "Time it Takes to Walk to School". Label your x-axis "Days" and your y-axis "Time". Hit **Next.**

D. Now Excel will give you the option to either place this chart next to your data, or on a separate sheet. For this chart, select **As new sheet,** and hit **Finish.** You now have a chart that displays your data!

## Certainty Bars

Very few things you can measure in the real world can be determined "exactly". Therefore, when referring to a scientific figure, it is important to specify how "certain" any figure is. For example, there is a big difference between saying that something costs "five dollars and six cents", and saying that something costs "around five dollars". Any time you take a measurement, it is important to determine how certain you know that calculation and to include that certainty with the calculation itself.

Let's say that after you finish timing your walks to school, you notice that there are discrepancies between the different timing devices you used. Some days you used a

wristwatch. Some days you looked at the clock in your apartment before you left, and checked the clock at school when you arrived. And some days you asked a friend for the time.

After comparing these different clocks, you determine that there is at most a 3 minute discrepancy between different devices. Since you're just doing this experiment for fun, it is not important to be more precise, but it is still necessary to determine how well you know your result. You're going to place a 3 minute **error bar** on each data point, so that you can see that any given point could be either 3 minutes too high or low.

A. On your chart, double-click one of the data points. Select **Y Error Bars.** Choose **Display Both.** Select **Fixed Value** and type in "3". Hit **Okay.** Now each of your data points has a certainty assigned to its time value. Keep in mind that you can also assign a certainty to the x-axis parameter, if necessary.

There are many ways one can determine the precision of a measurement. Some lab devices actually state a "tolerance level", or, how close it can determine that it is measuring. Things like reaction time can be measured by you. And other things, like the reading on a scale, one can make a rough estimate of how well one can read the needle.

But however you do it, it is absolutely important that you assign a level of certainty to <u>any</u> calculation.

☆ Check with your TA before proceeding.

# BURNING OUT LIGHT BULBS

***Now that you know the basics of compiling and plotting data, you will now perform an actual experiment and produce illustrated data for a grade.***

## How much voltage does it take to burn out a light bulb?

*Normally it will be up to you and your group to design your <u>own</u> experiment to accomplish this task. Today you'll be guided through it.*

## Collecting and Analyzing Data

A. You have been given an **electrical power source**. This box can supply a current of electricity to an electrical circuit. Notice the **voltage dial.** You can

change the amount of electricity this box produces by raising or lowering the voltage.

B. You have been given six **Christmas lights**. Notice that there are two wires leading out of the bulb. Using an **alligator clip** and a **cable,** connect one of these wires to the red plug on the power source marked with a "+". Connect the other wire to the black plug marked with a "-".

C. Find out how much voltage is required to burn a bulb out! Do this with all six bulbs. Keep track of your data on a new Excel spreadsheet and create an appropriate graph of your data.

D. How well were you able to determine the maximum voltage of each bulb? Create the appropriate error bars on your graph.

## The Test

### What's the highest voltage at which *most* of a collection of bulbs will stay lit without burning out?

Your group will be asked by the TA to submit a value answering this question. At the end of the class, the TA will light a bulb up until it burns out. The group that submits the highest voltage *without* going over the burning-out voltage will receive extra credit.

## Class Discussion

## To Hand In

Make sure your groups' names are on your two spreadsheets. Save your data to your group diskette for a grade.

### Optional

*You'll be using Microsoft Excel all throughout this course, so you'll need to get used to it. If you have time at the end of lab, or in your spare time, try experimenting with different charts. There are many different ways you can display your data. Remember that neatness counts and creativity is rewarded.*

# Excel Hints

## Graphing Equations

Let's say you want to make a graph of a function. In the "A" column, fill in a list of x-values you want to use as your range (1 through 10, for example). Next, click on the cell B1. In here, fill in the function you want to use, preceded by an equal sign, for example: "=3*x" to make a linear plot with a slope of 3, or "=x^2" for a parabolic function. In B1, the y-value corresponding to A1 will automatically appear. Drag the fill handle down to fill in the rest. Finally, plot the data.

Remember, you can work with several sets of data at once, as well as refer to different sets when tabulating a new set. For example, if you have data in columns A, B, and C, you can make a sum of this data in the D column by filling in cell D1 with "=A1+B1+C1".

## Multiple Plots

When plotting your data, you can select several different columns and plot them simultaneously on the same graph. This is useful for comparing data. **Highlight** several columns of data and hit the **plot** icon. It will automatically use the first column as your x-values and each other column as a y-plot.

## Error Bars

There are a few different ways you can put error bars on your data. On the graph, double click one of the data points and a menu will pop up. Under **X Error Bars** or **Y Error Bars,** you can select the **Error Amount.**

- Selecting **Fixed Value** will put the same size error bar on all your data points.
- Selecting **Percentage** will create error bars whose size is proportional to the value of the data point.
- You can also enter in manually the error bars for each data point by selecting **Custom** and specifying both a column that contains "upper limit" values and a column that contains "lower limit" values for the error bars.

Which method you use depends on how you determined the uncertainty in your measurement. You must be able to justify *why* you chose particular error bars.

## Other Tools

Click on the "Σ" at the top of the screen. Here is a list of useful tools that can be used with data sets:

- To **Sum** data**,** first highlight a cell you want the sum to appear in, then select **Sum** under the Σ icon. Next, highlight the data you want to sum and hit enter. The sum will appear in the cell.
- To **Average** data**,** first highlight a cell you want the average to appear in, then select **Average** under the Σ icon. Next, highlight the data you want to average and hit enter. The average will appear in the cell.