

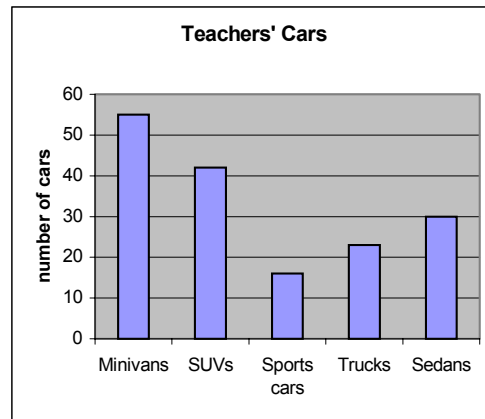
Physics Data and Graphs

Much of our time in this class will be used in collecting and analyzing lab data. Almost all of the time, we will use a graph to analyze the data. Different types of graphs are appropriate for different situations; below is a brief summary of the graphs we will use in physics (and in most sciences).

Histogram

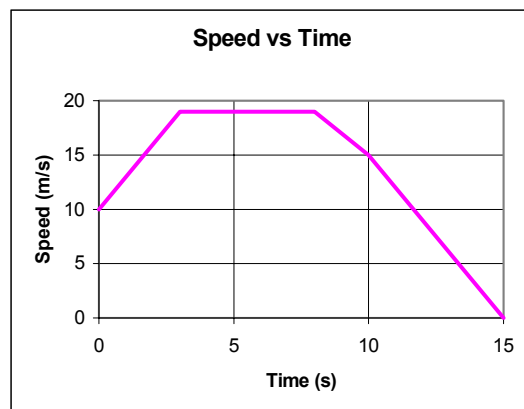
This type of graph is very unusual in a physics class. It is usually used to compare amounts in various categories *that do not make a sequence*. For example, the histogram here shows the types of cars driven by various types of teachers. There is no way you could make a sequence out of the categories, so we use a histogram.

I only put this graph here because some of you will want to draw one. I cannot think of a time in our class when we will use a histogram. Don't do it.



Line Graph

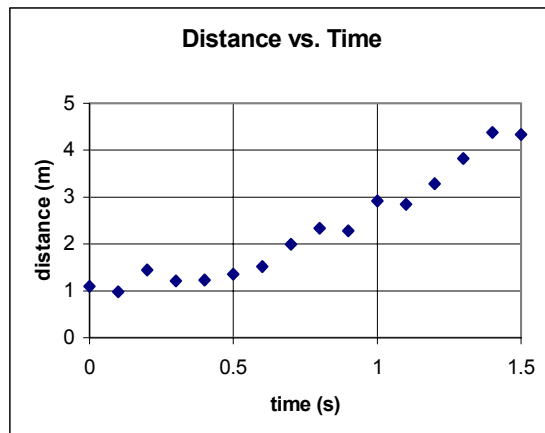
While common in economics classes, line graphs are unusual in physics, except during the first month of the course. We will use these graphs to show idealized distances, speeds, and accelerations when doing kinematics problems. Draw this type of graph when you have a simple kinematics problem that gives idealized data. You will not draw this type of graph to analyze data taken from an experiment.



Scatter Plot

This is the most common type of graph used. 99% of the time, when I say to draw a graph, this is the type of graph I mean. Physicists and other scientists use these graphs as a *tool* to analyze their data, not just as a display method for their results. This type of graph has data points individually marked on the graph, without any connecting lines. This way you only show the actual data points you took during the experiment.

Notice that the points do not all line up on a simple line. Whenever you do an experiment, there is some amount of uncertainty. But we always assume that there is a simple relationship underlying the complex data. To get at that simple relationship, we use the graph to determine a best-fit curve. The equation of the best-fit curve then gives us what we take to be our simple relationship.



There are many ways of determining a best-fit curve for a collection of data. There are mathematical formulas that you could use to figure it out. But if you do that, why did you pay so much money for your graphing calculator? A program called BESTFIT is available for TI-83 and TI-86 graphing calculators; see me to get it. It will allow you to try various curves and pick the best one. If your

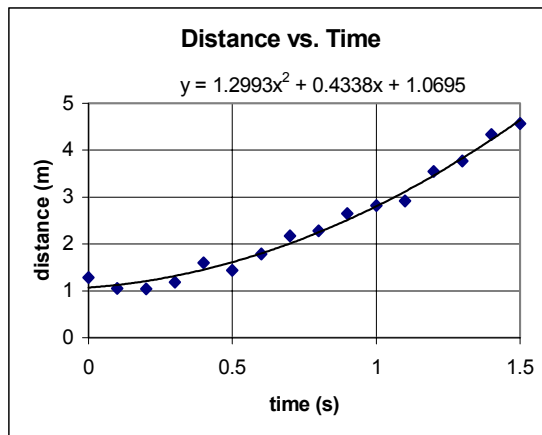
data is in a computer file, there are many programs that can do best-fit curves, including Microsoft Excel. (Excel calls it a trendline.) Here is the same graph as above, with a trendline added to it.

Notice that the best-fit curve doesn't go through all the data points exactly. That's to be expected. It would be a miracle if your data came out perfectly. Also notice that the equation of the best fit line is displayed on the graph. This gives us the mathematical relationship between the two quantities we graphed. Now we can substitute distance for y in the equation and time for x :

$$y = 1.58x^2 - 0.16x + 1.30$$

$$d = 1.58t^2 - 0.16t + 1.30$$

Voila! There's our simple relationship. The graph was only a step along the way to our final goal of finding a relationship between distance and time.



P.S. In physics, time is *never* on the vertical axis of a graph. Time is the ultimate independent variable because we have no control over it. So when time is one of the values you are graphing, it always goes on the x -axis.