GLOBAL WARMING PROJECT—due Nov.29/01

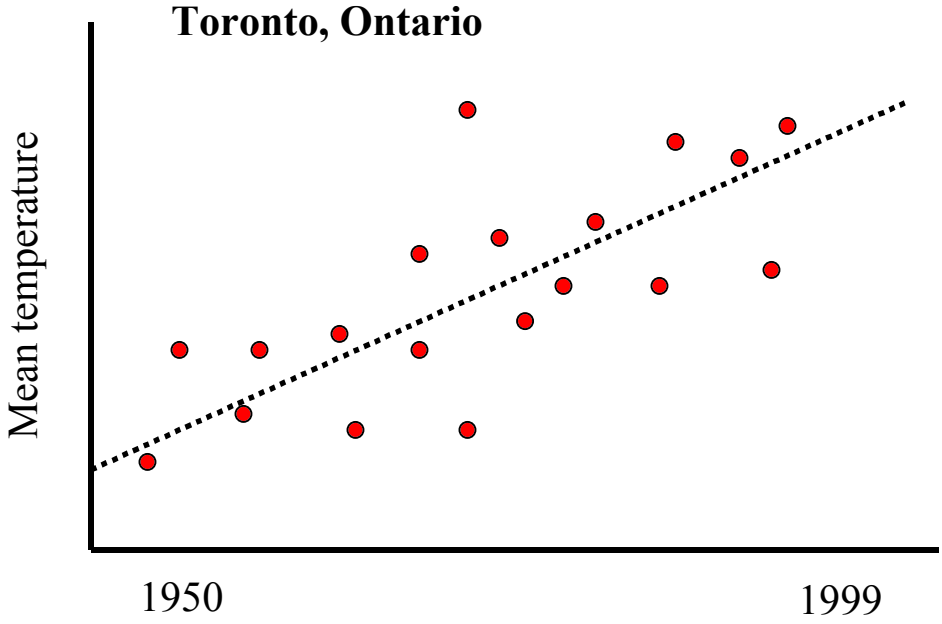
In this assignment, you are to choose three cities in the southwest, and evaluate whether or not global warming is occurring in this region. To accomplish this, Jim will provide you with data sets in Excel format which include the maximum and minimum temperatures for each month of the year from 1949 to 1999.

Before you begin, ask yourself which cities you will investigate and why. For example, you may want to choose your towns based on a latitudinal distribution, you may want to choose high elevation towns, Great Basin locations or a combination of any of the above. Justify your choice.

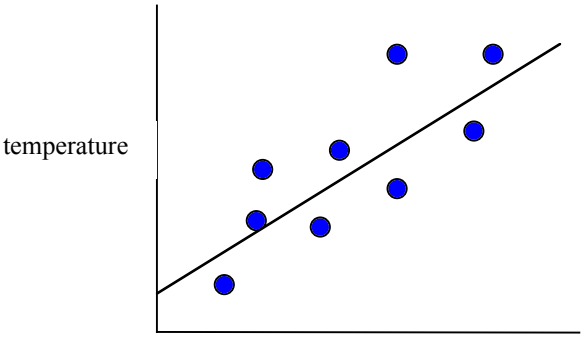
Now that you have chosen your cities, you can ask yourself a number of questions. To get you started, here are some ideas: 1) has the temperature changed significantly over the past 50 years? 2) has there been a temperature change that is only apparent during certain seasons? 3) are some cities experiencing rising temperatures at faster rate than others? Why do you think that may be so? 4) has the variation from mean temperature increased/decreased over the given time period? I'm sure you can think of many other interesting questions to evaluate. Understand that this is a question/hypothesis-driven paper: you are asking a question about the data set, and then analyzing the numbers to get an answer that you may or may not expect. Your conclusion about the issue will be based specifically on the results of your analysis.

What will your data look like? You may choose to plot and analyze the numbers in any way you please (as long as it makes sense!), but here are some examples to get you started.

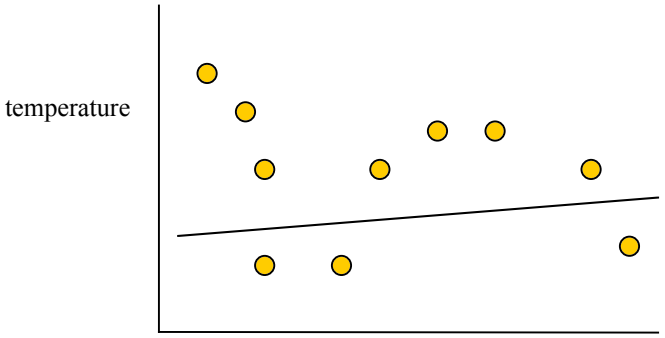
Example A: Regression analysis will answer a question such as: has the yearly average minimum temperature for Toronto, Ontario changed over the past 50 years? Mathematically, you are asking whether the slope of the regression line is significantly different from 0. Below is a graph of a regression analysis.



The regression analysis deals with the investigation of the relationship between two (or more) variables, such as time and temperature. This can be easily done in most spreadsheet, graphing or statistics packages including Excel. In Excel choose 'insert' in the main menu, then 'function' then 'statistical', then RSQ. Enter the x and y values of your data. This will give you're the 'r-square' value which is a measure of how much of the variation in the data is explained by the regression line. So the higher the r^2, the greater the proportion of variation that is explained by your model, or specifically, the regression line. If your r^2 is low, then there may not be a trend, or another analysis may better fit your data. Anything above 0.75 is considered pretty good. Most statistical packages will tell you via a P-value whether your slope is significantly different from 0 or not. Since statistical tests operate within a 5% level of certainty, constraining your P-value by 5% means that there is only a 5% likelihood that the results are due to chance. This is expressed as P=0.05. For example, if our analysis yields a P-value of 0.0001, then there is only a 0.01% probability that the data trend is due to chance, and thus the slope of the regression line is significantly different from 0.



Here, the r^2 is 0.92, and the P-value is 0.001. This tells us that the regression line explains 92% of the variation in the data, while the P-value indicates that the slope is significantly different from 0.

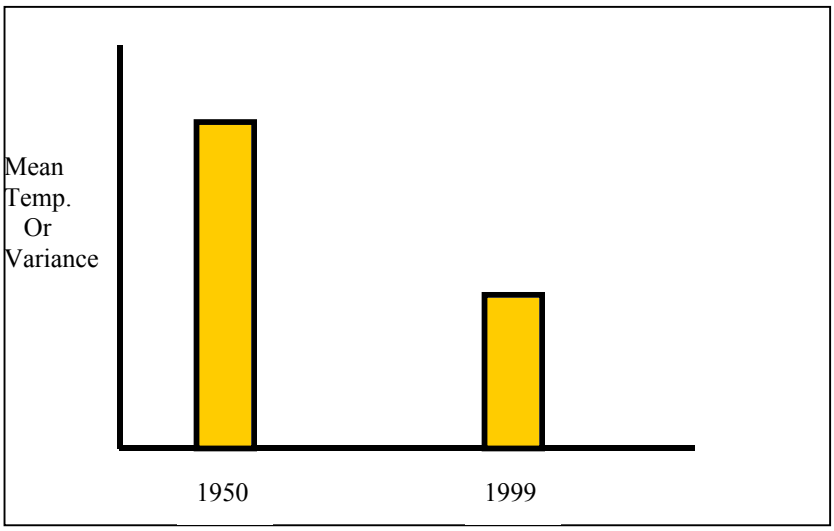


Here, the r^2 value may be a pitiful 0.13, and the P-value 0.06. What does that mean?

You can perform basic statistics using most spreadsheet and statistics packages such as Excel, SigmaStat, SAS or InStat, and you are highly encouraged to work as a group on this! Not only will you all benefit, but it'll be easier to solve any problems that may arise during the statistical analysis. The websites listed below give very detailed information on how to perform statistics in Excel, or will allow you to download a stats package for free. Statistical software is also available on the Mac's in the South Biology computer lab.

Example B: You may wish to simply compare mean annual (or seasonal or whatever) temperatures in two different time periods, or between the different cities. So you may ask yourself: are temperatures in 1999 significantly different from those in 1950? A

simple statistical analysis here would involve a **T-test**. A t-test is good for comparing two group (sample) means. Alternatively, the y-axis on the graph below could represent the magnitude of the variance in the temperature ie: the deviation from the mean. Recall that one of the predictions of global climate change models is an increase in climate (temperature??) variation.



Calculating a t-test in Excel is very straightforward. In the main menu, click 'insert', then 'function' then 'statistical', then T-test. Make sure your data is in columns. Follow the instructions, enter 2 for Tails, and 1 for type, and note the formula result. This analysis will again yield a P-value, and depending on your level of significance (0.01 or 0.05 is customary), evaluate your P-value. For example, if you decide to set your level of significance to be 0.05, then your P-value should be less than 0.05. A low P-value indicates that the differences between the two sample means is significant. A P-value greater than 0.05 indicates no differences between the sample means.

Calculating a t-value and comparing it to a critical t-value listed in a table, is another way of performing a t-test, and is the procedure usually explained in introductory statistics tests. This is a more 'hands on' method of dealing with your data, and will provide you with a better mechanistic understanding of the analysis.

Some useful statistics websites:

www.graphpad.com --- download free demo stats packages! Both InStat and Prism are very user friendly; on-line advice about performing and analysing statistical results

http://www.stat.sc.edu/webstat --another useful demo

http://www.stata.com/support/links/stat_software.html --displays many links to statistical software providers, many of whom offer demos

A word on format, figures, analyses and style

Generally speaking, follow the 5:3:15 rule as in the previous essay. Again, do not overuse internet info, but websites such as those of the Intergovernmental Panel on Climate Change (http://www.ipcc.ch/) may be useful. The figures should take the form of original graphs, but if you wish to add other diagrams, that will be alright. Describe your methods (choice of cities, type of analysis), interpret the data, discuss the results and reasons for why they may be as they are. Be critical and analytical. You will be evaluated on your analyses and interpretation but not on the outcome of your data. I simply want you to evalulate your results logically, and come to a reasonable conclusion about the (lack of) trends.

For examples of previous year's essays, see the Plant Ecology website.