

EC313-Fall 2011 Problem Set 2

(Updated 2 October 2011)

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When you write up your answers, your goals should be to (1) be correct, and (2) convince your reader that your answer is correct. It is always helpful if your work is legible and if all steps are presented, possibly with a line of explanation.

In the case of empirical exercises, your goal should be to provide enough information to allow a reader to replicate your answer. This requires a description of data and data sources as well as a description of your analysis of the data.

Answers which do not achieve these goals will not be awarded full credit.

Problems

1. Download download the Mauna Loa annual mean CO_2 data from

ftp://ftp.cmdl.noaa.gov/ccg/co2/trends/co2_annmean_mlo.txt

on the NOAA Mauna Loa page,

http://www.esrl.noaa.gov/gmd/ccgg/trends/#mlo_growth

Also download earth and ocean average annual temperature series from

ftp://ftp.ncdc.noaa.gov/pub/data/anomalies/annual.land_ocean.90S.90N.df_1901-2000mean.dat

- (a) Plot both series on the same graph. What does this graph show?
- (b) Let T denote temperature and CO_2 be CO_2 carbon ppm. Conduct the regression $T = A_0 + A_1CO_2$ Report the regression coefficients and estimated standard errors. What does this regression tell us about the relationship between CO_2 and climate?
- (c) download the land only average temperature series from

ftp://ftp.ncdc.noaa.gov/pub/data/anomalies/annual.land.90S.90N.df_1901-2000mean.dat

and replicate the first two parts of this problem.

2. Download data CO_2 and data for the Vostok Icecore from (use Petit et al 1999 data).

http://www.ncdc.noaa.gov/paleo/icecore/antarctica/vostok/vostok_co2.html

and also the oxygen isotope data

http://www.ncdc.noaa.gov/paleo/icecore/antarctica/vostok/vostok_isotope.html

be sure to also use the Petit et al data here, too,

<ftp://ftp.ncdc.noaa.gov/pub/data/paleo/icecore/antarctica/vostok/o18nat.txt>

- (a) Plot the two series on the same graph in order to see if they move together. If the raw data is too noisy to let you see anything, construct appropriate moving averages to smooth the data and plot these moving averages.
- (b) Let T denote oxygen isotope ratios and CO_2 be CO_2 carbon ppm. Conduct the regression $T = A_0 + A_1CO_2$. Report the regression coefficients and estimated standard errors.

That the years don't match up for the two data sets is a problem. Two possibilities for fixing it are: (1) matching each oxygen isotope year to its closest CO_2 year (if you don't know how to program this, you can do it by hand for the most recent 30 years), or a bit fancier, (2) matching each series to a complete series of years (from 1 to 414,603), for each year with no data (which be most of them) impute a weighted average of the two nearest observations, and then using these now complete series for your regression.

What does this regression tell us about the relationship between CO_2 and climate?

- 3. In the first problem you estimated two separate models relating climate to CO_2 , one based on whole world temperatures and one based just on land temperatures. Suppose that we don't have an opinion about which of the two models is right. This question suggest a mathematical solution to resolving this problem.

To make things easy, suppose that the parameters A_0 are estimated with certainty and that the x_1 and x_2 are the standard errors of both estimates of A_{1i} . Also to make things easy, suppose that the A_{1i} take the values $A_{1i} + x_i$ and $A_{1i} - x_i$ with equal probability (NB: This actually wrong – these variables are assumed normally distributed, but this is a lot harder to work with). That is, we're going to treat the parameters as random variables.

- (a) Suppose that CO_2 is 400 ppm. Calculate expected temperature from each model. Also calculate the standard error of each estimate.
- (b) Since we aren't sure of which model to use, the estimates above overstate the accuracy of our prediction. Suppose that we think each model is equally likely. What is the implied mean of predicted temperature for CO_2 at 400 ppm? What is the standard deviation of this estimate? You can assume the the standard errors for the two models are uncorrelated.
- (c) How does this problem suggest that our predictive ability responds to model uncertainty?