Problem Set 4: MAE 127

due Friday, May 6, 2005

For this problem set, you'll use data collected at three meteorological stations in San Diego County: San Miguel, Alpine, and Mt. Laguna. Download the data from the class website: http://www-pord.ucsd.edu/∼sgille/mae127/ps4.html or from the archived on-line data available on the UCSD server. The files contain daily minimum and maximum temperatures for the year 2004.

For all three problems, as always, please show your Matlab code.

1. Compute the correlation r for for all possible pairs of the three minimum temperature records and for all possible pairs of the three maximum temperature records. (The Matlab function "corrcoef" is an easy way to determine r, but check the help page to make sure you understand how to interpret its output.) Assuming that each observation is statistically independent, are these correlations statistically significant? Which pairs are most strongly correlated? Does this seem surprising?

2. Compute and plot the autocovariance of the Alpine minimum temperature record. (The Matlab function "xcov" is good for this.) Where does the first zero crossing occur? If you interpret the first zero crossing as a decorrelation scale and use this to adjust the number of effective degrees of freedom N_{eff}, how does the 95% significance level r_{sig} change compared with your results in question 1?

In this data, the first zero crossing occurs only after many months, because temperature data vary slowly over the course of the year. This slow time-scale may not be relevant for understanding our problem, so you could also try determining N_{eff} by using twice the time interval required for the autocorrelation to drop from 1 to 0.5. How would this change the results?

Finally, speculate a little: What seems like a relevant time-scale to you?

3. Since the temperature data have a significant annual cycle, we might want to remove the annual cycle before doing further analysis. Using the Alpine minimum temperature data, least-squares fit a function of the form:

$$T = a + b\cos(2\pi t/366) + c\sin(2\pi t/366), \tag{1}$$

where T is temperature, and t is time in days.