Math 474 HW 11 Fall 2013, due Monday, Dec. 2.

Quiz 10 Wed. Dec. 4. Cumulative Final: Tuesday, Dec 10, 12:50-02:50PM.
Exam 3, Wed. Nov. 20

Download `tspack`. You can copy and paste some *R* commands for some homework problems from `TSRhw.txt` into *R*. See (http://lagrange.math.siu.edu/Olive/TSRhw.txt).

**A)** Find a good time series model for the nhtemp data which gives the mean annual temperature in degrees Fahrenheit in New Haven, Connecticut, from 1912 to 1971. Give the output table and AIC matrix. Support your model with 5 to 7 figures.

**B)** This problem modifies 13.5, and simulates a signal plus noise time series with frequencies at 1/96 and 2/96.

a) These commands plot the time series. Include the plot in *Word*.

b) These commands make the periodogram of the time series using Fourier frequencies. Include the plot in *Word*. Note that there are 2 spikes at 1/96 and 2/96.

**C)** This problem analyzes `notemp` time series, which contains the average monthly air temperatures at Nottingham Castle in degrees Fahrenheit for 20 years.

a) This part makes the periodogram of the time series $Y_t$. There is one spike at $f = 0.083333333 = 17/204$. Include the plot in *Word*.

b) This part gets least squares output for the model $Y_t = A_0 + A_1 \cos(2\pi(17/204)t) + B_1 \sin(2\pi(17/204)t) + e_t$. Include the output table in *Word*.

c) This part plots $Y_t$ and includes $\hat{Y}_t$ from b) as circles. Include the plot in *Word*. Do the circles track the time series fairly well?

d) This part makes the response and residual plots. There will be an error message but the plots are make. Include the plots in *Word*. Note that the fitted values only take on 12 values, but the plotted points do track the identity line fairly well in the response plot.

e) This part makes the ACF and PACF of the residuals from the b) model. There is a sinusoidal pattern in the ACF, but the spikes are barely significant. Include the plots in *Word*.

f) This part does the McLeod Li test for whether the residuals resemble a white noise. They do since the plotted points are above the 0.05 horizontal line. Include the plot in *Word*.

**D)** Consider the lynx time series data and let the response $Y_t = \log_{10}(lynx)$. Moran (1953) suggested the autoregressive AR(2) model $\hat{Y}_t = 1.05 + 1.41Y_{t-1} - 0.77Y_{t-2}$. Tong (1977) suggested the AR(11) model $\hat{Y}_t = 1.13Y_{t-1} - .51Y_{t-2} + .23Y_{t-3} - 0.29Y_{t-4} + .14Y_{t-5} - 0.14Y_{t-6} + .08Y_{t-7} - .04Y_{t-8} + .13Y_{t-9} + 0.19Y_{t-10} - .31Y_{t-11}$. Brockwell and Davis (1991, p. 550) suggested the AR(12) model $\hat{Y}_t = 1.123 + 1.084Y_{t-1} - .477Y_{t-2} + .265Y_{t-3} - 0.218Y_{t-4} + .180Y_{t-9} - 0.224Y_{t-12}$. Tong (1983) suggested the following two self–exciting autoregressive models. The SETAR(2,7,2) model uses $\hat{Y}_t = .546 + 1.032Y_{t-1} - .173Y_{t-2} + .171Y_{t-3} - 0.431Y_{t-4} + .332Y_{t-5} - 0.284Y_{t-6} + .210Y_{t-7}$ if $Y_{t-2} \leq 3.116$ and $\hat{Y}_t = 2.632 + 1.492Y_{t-1} - 1.324Y_{t-2}$, otherwise. The SETAR(2,5,2) model uses $\hat{Y}_t = .768 + 1.064Y_{t-1} - .200Y_{t-2} + .164Y_{t-3} - 0.428Y_{t-4} + .181Y_{t-5}$ if $Y_{t-2} \leq 3.05$ and $\hat{Y}_t = 2.254 + 1.474Y_{t-1} - 1.202Y_{t-2}$, otherwise. The FF plot of the fitted values and the response can be used to compare the models.

a) Use the command for this part and include the resulting plot and correlation matrix in *Word*.

b) Which model seems to be best? Explain briefly.

c) Which two pairs of models gave very similar fitted values?

**E)** Let's see if *R* output gives similar models for those in D). Include the output tables for the models in *Word*. The coefficients are similar but not identical to those in D). Do not include any plots in *Word*.

a) The commands for this part make the output table for the AR(2) model.

b) The commands for this part make the output table for the AR(11) model.

c) The commands for this part make the output table for the AR(12) model.

d) The commands for this part make the output table for the SETAR(2,7,2) model.

e) The commands for this part make the output table for the SETAR(2,5,2) model.