THE UNIVERSITY OF CHICAGO
Graduate School of Business
Business 41202, Spring Quarter 2008, Mr. Ruey S. Tsay

Homework Assignment #5

Due Date: Campus and evening: May 20, 2008

1. The file "d-ibmohlc0008.txt" contains daily open, high, low, closing prices and other variables for the IBM stock from January 2000 to May 9, 2008. The names of the variables are given in the first line of the file (i.e. header). The data are downloaded from Yahoo Finance. Use the data to construct the variance estimates $\sigma_{i,t}^2$ of Section 3.15.2 of the textbook for $i = 0$, 1, 2, 3, 5,and 6. Take the square root transformation to obtain volatility series. Obtain mean, median, maximum, and minimum of each of the six volatility series.

   Remark: The file has 2100 rows and 9 columns. Yahoo puts the most recent observations first. To reverse the order, you may do the following in R (or S-Plus).

   ```
   da=read.table(‘‘d-ibmohlc0008.txt’’, header=T)
   T=dim(da)[1]
   nc=dim(da)[2]
   x=matrix(0,T,nc)
   for (i in 1:2100){
   ii=2100-i+1
   x[i,]=da[ii,]
   }
   ```

2. Again, consider the data in "d-ibmohlc0008.txt". Use the data and $n = 63$ to compute the Yang and Zhang (2000) variance estimate $\hat{\sigma}_{yz}^2$ of Section 3.15.2 of the textbook. Obtain a time plot of the estimated volatility series (square-root of variance). Also, obtain the mean, median, maximum, and minimum of the volatility series.

3. Consider the monthly U.S. unemployment rates from January 1948 to February 2008. There are 722 observations. Divide the data into estimation and forecasting subsmples with the former consisting of the first 600 observations. Use the out-of-sample root mean squared forecast errors to compare the following forecasting models:

   (a) ARIMA$(2, 1, 1)(1, 0, 1)_{12}$, i.e. regular order c(2,1,1) and seasonal order c(1,0,1) with period 12.

   (b) Your own choice of an AR model.

(c) A neural network with $(x_{t-1}, x_{t-2}, x_{t-3}, x_{t-12}, x_{t-13}, x_{t-24})$ as input, a direct connection, and 2 nodes in the hidden layer, i.e. a 6-2-1 feedforward network.

4. Consider the daily log returns of the USUK exchange rate. The exchange rates are in the file "d-usuk0107.txt". (a) Build a proper GJR model for the log return series. (b) Is the leverage parameter significantly different from zero at the 5% level?

5. Again, consider the log returns of USUK exchange rates of Problem 4. (a) Use $r_{t-1}, r_{t-2}, r_{t-3}, r_{t-4}$ and r_{t-5} as input to build a 5-2-1 neural network for predicting the log return series. Compute the sum of squares of residuals for (a1)the network without a direct connection and (a2) the network with a direct connection from input to output. (b) Use the same input as part (a) to build a 5-2-1 neural network with direct connection for predicting the "direction" of the log returns of the exchange rate. If the fitted probability of being a positive return is greater than 0.5, then classify the prediction as "1"; otherwise, classify the prediction as "0". Compute the percentage of "hits" of the network, where a hit denotes a correct specification of the direction.

   In R and S-Plus, you may use the command

   $$\text{drtn} = \text{ifelse}(\text{rtn} > 0,1,0)$$

   to create a direction series for the return *rtn*. Similarly, you may use

   $$\text{fit} = \text{ifelse}(\text{fv} > 0.5,1,0)$$

   to code the fitted directions, where fv denotes the fitted values.

Reading assignments: Chapters 3 and 4 of the textbook.