Problem Set 3

Econ 211C

Question 1 ..... *70 points*

Recall the $ARMA(2,5)$ process in Problem Set 1:

$$Y_t = 1.3Y_{t-1} - 0.4Y_{t-2} + \varepsilon_t + 0.7\varepsilon_{t-1} + 0.1\varepsilon_{t-3} - 0.5\varepsilon_{t-4} - 0.2\varepsilon_{t-5},$$

where $\varepsilon_t \sim WN(0,1)$.

(a) (5 points) What are the exact, finite-sample, one-step forecast coefficients?

(b) (8 points) Simulate $N = 105$ observations for this process. Starting with Y_{100}, compute and report one-step forecasts for $Y_{101}, \ldots, Y_{105}$. When computing the forecasts for $t \geq 102$, use your previously computed forecasts as data, rather than the actual values that you originally simulated.

(c) (8 points) Repeat part (b) 1000 times. What is the mean squared error of your forecast for Y_{105}?

(d) (5 points) What are the exact, finite-sample, five-step forecast coefficients?

(e) (6 points) Compute and report a five-step forecast for Y_{105}.

(f) (6 points) Repeat part (e) 1000 times. What is the mean squared error of your forecast for Y_{105}?

For the remainder of the problem, assume that you do not know the true coefficients of the process, but that you do know that it is an $ARMA(2,5)$.

(g) (5 points) Use the first 100 observations, $\{y_t\}_{t=1}^{100}$ to estimate the $ARMA(2,5)$. What are the parameter estimates?

(h) (5 points) Repeat part (a), using your estimates.

(i) (5 points) Repeat parts (b) and (c), using the same estimates (without updating) for each one-step forecast.

(j) (7 points) Repeat parts (b) and (c), updating your estimates with each forecast. That is, compute the forecast for Y_{101}, using estimates obtained from $\{y_t\}_{t=1}^{100}$, compute the forecast for Y_{102} using estimates obtained from $\{y_t\}_{t=2}^{100}$ and your forecast $\hat{Y}_{101}$, etc.

(k) (5 points) Repeat part (d), using your estimates.

(l) (5 points) Repeat parts (e) and (f), using the your estimates.

Question 2 ..... *30 points*

The file `ps3Dat.csv` contains data on 1 minute returns and order flow for the EUR/USD exchange rate on 13 Nov 2013. The first column of the dataset contains a date/time stamp, the second column reports returns over each minute between 9:30 am and 4:00 pm EST, and the last column reports order flow for the same minutes. Order flow can be thought of as signed volume – trades occurring at the lowest offer prices are counted as a positive number of traded contracts during the time interval, and trades occurring at the highest bid prices are counted as a negative number of traded contracts. Volume, on the other hand, counts all traded contracts positively, regardless of which side of the order book the transactions take place.

(a) (10 points) Estimate a $VAR(2)$ model for EUR/USD returns and order flow. Write the equations of the full model, substituting estimated values for the parameters. (Hint: the estimation can be done equation by equation).

(b) (10 points) Rewrite the $VAR(2)$ as a $VAR(1)$, again substituting estimates for parameters.

(c) (10 points) What is the matrix that will orthogonalize the error vector of the $VAR(2)$?