Homework Assignment 2

Note:

• You may discuss problems with other students, but must hand in your OWN solutions.

• You may use any software to do the empirical analysis even though I use R in the demonstration, especially the MTS package.

• The assignment is due in one week once assigned.

• Due on April 20, 2017 (before class).

1. Consider the monthly unemployment rates of Michigan, Illinois, and Indiana from 1976.1 to 2017.2. Build a VAR model for this 3-dimensional time series. Simplify (or refine) the model by removing insignificant parameters with threshold of $t$-ratio 1.645, and perform model checking.
   • Write down the final fitted model.
   • Comments on the residual plot of the fitted model.
   • Obtain the Cholesky decomposition of the residual covariance matrix.
   • Obtain the plots of impulse response function of the fitted model (both with original innovations and orthogonal innovations).

2. Consider the daily exchange rates between U.S. dollar and Japanese Yen and Euro from April 20, 2005 to March 31, 2017 for 3001 observations. The data are available from FRED and are also in the file `d-exjpuseu.txt`. The first column denotes Japanese Yens of one U.S. dollar whereas the second column denotes U.S. dollars per Euro.
   • Obtain the time series plots of the log series of the exchange rates.
   • Build a VAR model for the bivariate exchange rate series, including model checking.
   • Based fitted model, is there any cross-dynamic dependence between the two exchange rate series? Why?

3. Consider the monthly growth rate of M1 money supply of China and the growth rate of monthly crude oil price. The original data are from FRED. The crude oil prices are `MCOILWTICO`, Western Texas Intermediate. The data are in `m-m1cnwti.txt` with first column containing M1 series.
   • Obtain the time series plots of the bivariate time series, say $z_t$.
   • Build a VAR model for $z_t$, including simplification and model checking. Write down the fitted model.
• Perform a chi-square test to confirm that one can remove the insignificant parameters in the previous question. You may use 5% significant level.
• Is there a transfer function structure between the two series? Why?
• Obtain the impulse response functions of the fitted model. What is the relationship between the M1 money supply of China and crude oil price, which represents commodity prices.
• Obtain 1-step to 6-step ahead predictions of \( z_t \) at the forecast origin 2015.2.
• Obtain the forecast error variance decomposition.

4. Consider, again, the monthly growth series \( z_t \) of Problem 3. Obtain Bayesian estimation of a VAR(3) model. Write down the fitted model.

5. Consider four components of U.S. monthly industrial production index from January 1947 February 2017 for 842 data points. The four components are durable consumer goods (IPD-CONGD), nondurable consumer goods (IPNCONGD), business equivalent (IPBUSEQ), and materials (IPMAT). The original data are available from the Federal Reserve Bank of St. Louis and are seasonally adjusted. Note that IPMAT starts at January 1939.

• Construct the growth rate series \( z_t \) of the four industrial production index, i.e. take the first difference of the log data. Obtain time plots of \( z_t \). Comment on the time plot.
• Build a VAR model for \( z_t \), including simplification and model checking. Write down the fitted model.
• Compute 1-step to 6-step ahead predictions of \( z_t \) at the forecast origin \( h = 841 \) (February 2017). Obtain 95% interval forecasts for each component series.

**Reading assignment**: Chapter 2 of the textbook.