1 Problem set 3: Due 10-30-2017

Q1 Let y_1, y_2, y_3 be the growth rate of GDP, M_3, and the Fed-funds date. (Data can be downloaded from Quandl). Estimate a VAR(1) in y_t by least squares regression of y_{jt} on x_t, where $x_t = (1, y_{1t-1}, y_{2t-1}, y_{3t-1})'$, $j = 1, 2, 3$. Fill in the following values for μ and A:

$$\begin{pmatrix} y_{1t} \\ y_{2t} \\ y_{3t} \end{pmatrix} = \begin{pmatrix} \mu_1 \\ \mu_2 \\ \mu_3 \end{pmatrix} + \begin{pmatrix} A_{11}(1) & A_{12}(1) & A_{13}(1) \\ A_{21}(1) & A_{22}(1) & A_{23}(1) \\ A_{31}(1) & A_{32}(2) & A_{33}(1) \end{pmatrix} \begin{pmatrix} y_{1t-1} \\ y_{2t-1} \\ y_{3t-1} \end{pmatrix} + \begin{pmatrix} A_{11}(2) & A_{12}(2) & A_{13}(2) \\ A_{21}(2) & A_{22}(2) & A_{23}(2) \\ A_{31}(2) & A_{32}(2) & A_{33}(2) \end{pmatrix} \begin{pmatrix} y_{1t-2} \\ y_{2t-2} \\ y_{3t-2} \end{pmatrix} + \begin{pmatrix} e_{1t} \\ e_{2t} \\ e_{3t} \end{pmatrix}$$

with

$$E[e_t e_t'] = \begin{pmatrix} \Sigma_{11} & \Sigma_{12} & \Sigma_{13} \\ \Sigma_{21} & \Sigma_{22} & \Sigma_{23} \\ \Sigma_{31} & \Sigma_{32} & \Sigma_{33} \end{pmatrix} = PP'.$$

i Is $y_t = (y_{1t}, y_{2t}, y_{3t})'$ stable?

ii Estimate $E(y_t)$, $\Gamma(0)$ and $\Gamma(1)$.

iii Write a program to compute $\Phi(j)$, the moving average coefficient matrices of y_t.

iv Make 9 plots, one for the three impulse responses to a unit increase each of the three shocks.

v Use the AIC/BIC to determine the optimal lag length p.

vi Verify that your equation by equation estimates for a VAR(2) are the same as the systems estimates computed as (i) $\widehat{\Pi} = (YX'(XX')^{-1}$ and (v) $\widehat{\pi} = [(XX')^{-1}X \otimes I_n]\text{vec}(Y)$, where Y is $n \times T$ and X is $(np+1) \times T$.

iii Use the least squares residuals as shocks and the least squares estimates as true parameters. Simulate data using the companion matrix representation and verify that the simulated data equal the original data. (This is to help you verify that your companion matrix is setup properly before doing the bootstrap).

iv Based on the companion matrix representation, write a function to compute the h period forecast for y_t and decompose the forecast error variance. Construct 95% bootstrap confidence intervals for the impulse responses.

- Provide a decomposition of the mean-squared forecast error for horizons from 1 to 12.

ii Test H_0: the univariate and VAR forecast for industrial production have the same in-sample predictability.

Q2 Ramey, V. (2016). Macroeconomic Shocks and Their Propagation. Handbook of Macroeconomics. Data: `http://econweb.ucsd.edu/~vramey/research.html#data`. Replicate one of the following:

- Monetary policy shocks: Figure 3.1 and 3.2C.
- Fiscal policy shocks: Figure 4.2, 4.3A.
- News shocks: Figure 4.4, 4.5.