Assignment 6
Due on 05/12/19

1 Analytical Exercise

1. Consider the bivariate cointegrated VECM

$$\Delta y_t = c + \alpha\beta' y_{t-1} + \varepsilon_t, \varepsilon_t \tilde{} iid(0, \Sigma)$$

where $\alpha = (\alpha_1, 0)'$ and $\beta = (1, -\beta_2)'$. Equation by equation, the system is given by

$$\Delta y_{1t} = c_1 + \alpha_1(y_{1t-1} - \beta_2 y_{2t-1}) + \varepsilon_{1t}$$

$$\Delta y_{2t} = c_2 + \varepsilon_{2t}$$

(a) From the cointegrated VECM representation above, derive the VECM representation

$$\Delta y_t = c + \Pi y_{t-1} + \varepsilon_t$$

and the VAR(1) representation

$$y_t = c + A y_{t-1} + \varepsilon_t$$

That is, determine the elements of the matrices Π and A.

(b) Show that $\beta' y_t$ follows an AR(1) process. Show that the AR(1) process is stable provided that -2 $< \alpha_1 <$ 0. What can you say about the system when $\alpha_1 = 0$?

2 Empirical Exercise

1. (GARCH Modeling)

   (a) Data file dsp.txt contains monthly data on S&P 500 returns from 1960:M2 to 2014:M9. Plot the data.

   (b) Look at the ACF and the PACF. What process describes the dynamics of the stock returns?

   (c) Now estimate the following GARCH(1,1) model:

   $$y_t = c + \varepsilon_t, \varepsilon_t \tilde{} N(0, \sigma_t^2)$$

   $$\sigma_t^2 = a_0 + a_1 \varepsilon_{t-1}^2 + b_1 \sigma_{t-1}^2$$

   Comment on the results. Calculate the unconditional variance of this GARCH model. Plot the conditional variance.

   (d) Test whether asymmetric leverage effect is present in stock returns or not. To test the asymmetric leverage effect, perform sign bias test.

   (e) Run an EGARCH(1,1) regression for the stock returns. Comment on your results.

   (f) Run a TGARCH(1,1) regression for the stock returns. Comment on your results.

   (g) Plot the News Impact Curve for different models.

2. (Cointegration) The theory of term structure of interest rates suggest that the yield on government securities of different maturity moves together in the long-run. We can test a part of this theory by testing for cointegration between 3-month T-bill and 1-year T-bond yields. This exercise exploits this idea to get a better understanding of the dynamics of term structure of interest rates. The file TERM.txt has monthly data on yield on 3-month T-bill (TB) and 1-year Treasury bond (GS). The sample period is 1994:01-2008:06.

   (a) The theory suggests that the spread between 1-year T-bond yield and 3-month T-bill yield should be stationary, implying that the cointegration vector is $(1,-1)'$. Test this hypothesis.

(b) Conduct the Engle-Granger test of the null that 3-month T-bill yield is not cointegrated with yield on 1-year T-bond yield.

(c) Conduct the Stock-Watson DOLS test of the null that TB is not cointegrated with GS. Plot the cointegrating residuals. Comment on your results.

(d) Do the estimated cointegrating vectors differ substantially in (a), (b) and (c)?

(e) Estimate the VECM model using the cointegrating residual from the DOLS method. Which variable does adjust if there is a short-run disequilibrium from the long-run relationship? Comment on your results.

(f) Do the error-correction coefficients have correct signs?

(g) Let Y_t = (TB, GS)$'$. Use the AIC model selection criteria to determine the lag length p for a VAR(p) model for Y_t :

$$Y_t = c + A_1 Y_{t-1} + \cdots + A_1 Y_{t-p} + + \varepsilon_t$$

(h) Based on your estimate for p, compute the Johansen trace and maximum eigenvalue statistics to determine the number of cointegrating vectors.

(i) Report the results for the cointegration vector and the VECM based on the Johansen Method. Are the results from the Johansen approach similar to the one obtained from the DOLS approach.