Econometrics III

Lab exercises

Instructions:

1. *Send a zipped folder with your code, .tex or .doc files and corresponding .pdf files with the answers to the exercises to both* ***massimiliano.marcellino@unibocconi.it*** *and* ***martin.fankhauser@phd.unibocconi.it****.*
2. *Make sure you include all the auxiliary codes required by the main code in the zipped folder. The codes should run and produce all the figures and all the results included in the pdf file. Check your results before handing in: all the numbers and the plots should be reasonable.*
3. *You can work on the Problem Sets in pairs. The pair should be agreed before the second TA session and must be kept for the whole course.*

Deadlines:

- Problem set I: 1, due by April 14th, 12:00 pm
- Problem set II: 2,3,4 due by April 27th, 12:00 pm
- Problem set III: 5 due by May 7th, 12:00 pm

Based on one of the countries you choose, collect data on (i) aggregate measure of the economic activity; (ii) aggregate measure of the inflation; (iii) short-term interest rate. Feel free to choose variables and frequency, but make sure that series are long enough. Answer the following questions.

1. VAR and impulse response functions (IRF):
   - Before fitting a trivariate VAR(p) for the 3-variable you just collect, briefly discuss if there are any transformations needed for the raw data;
   - Estimate the model based on transformed series, show the estimates of the coefficients and of the covariance matrix you obtain;
   - Use the estimates above as DGP to design a Monte Carlo experiment. Assess the accuracy of the AIC and BIC criterion in selecting the lag order of a VAR. Comment on the results you obtain.
   - Suppose now you want to identify and analyze the effects of a monetary policy shock:
     - Comment on the ordering of the variables you would use to recursively identify the shock;
     - Obtain IRFs estimates from both VAR and Local Projections method (Jorda (2005, AER)). Comment on the differences you find.

2. Forecasting. Consider the inflation series (measured by proper transformation), split the sample into two subperiods. Use the first part as the estimation sample and the remaining part as the forecast sample. Obtain 2-step-ahead forecasts of inflation series by both random walk model and AR(p) model. Select p based on the information criteria.

   - Compute root mean square forecast error (RMSFE) from the random walk model;
   - Compute root mean square forecast error (RMSFE) from the AR(p) model by iterated forecasts. Are the forecasts significantly better than those from a random walk?
   - Compute root mean square forecast error (RMSFE) from the AR(p) model by direct forecasts. Are the forecasts significantly better than those from a random walk?

3. Nonstationary time series model and cointegration. Consider again the raw time series you collect:

   - Test if all three variables are I(1);
   - Determine the optimal lag length needed in the Johansen test equation by running a VAR;
   - Test for cointegration and specify the number of cointegration equations;
   - Estimate the VECM. Comment on the estimated cointegrating relationship.

4. Spectral analysis. Consider now the series you collect for the aggregate measure of the economic activity:

   - Compute, graph and comment the estimated spectrum of the series in levels;
   - Compute, graph and comment the estimated spectrum of the series in growth rates.

5. Time-varying parameter model. Consider the Taylor rule specification:

$$R_t = \beta_{0,t} + \beta_{R,t} R_{t-1} + \beta_{y,t} y_t + \beta_{\pi,t} \pi_t + \varepsilon_t,\ t = 1, 2, \cdots, T, \tag{1}$$

   where R_t is a short-term interest rate, y_t is the aggregate measure of the economic activity and π_t is the inflation. Let $\beta_t = (\beta_{0,t}, \beta_{R,t}, \beta_{y,t}, \beta_{\pi,t})'$ and assume that

$$\beta_t = \beta_{t-1} + u_t,\ u_t \overset{i.i.d.}{\sim} \mathcal{N}(0, \Sigma_u), \tag{2}$$

   where Σ_u is assumed to be diagonal: $\Sigma_u = \text{diag}(\sigma_0^2, \sigma_R^2, \sigma_y^2, \sigma_\pi^2)$.

   - Write the time-varying model described in eq. (1) and (2) in a state-space form;
   - Estimate the model by the Kalman filter. Report both point estimates and 95% confidence intervals of the model parameters. Show the filtered time-varying coefficients. Is there any evidence of time-variation?
   - (*Optional*) Implement Kalman smoother and plot the smoothed time-varying coefficients and 95% confidence bands (Ch 13.6 and Ch 13.7 in Hamilton (1994)) ;
   - Estimate the same Taylor rule in eq. (1) but this time with constant coefficients, i.e. estimate the following equation:

$$R_t = \beta_0 + \beta_R R_{t-1} + \beta_y y_t + \beta_\pi \pi_t + \varepsilon_t. \tag{3}$$

     Discuss whether model (1) or(3) is more suitable for the country you are studying. Which kind of economic implications can you draw from this comparison?