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**University of New South Wales**  
**School of Economics**  
**Financial Econometrics**  
**Tutorial 5**

1. (Error correction and common trend)

Suppose that I(1) series  $y_t$  and  $x_t$  are cointegrated and  $\varepsilon_t = y_t - \beta x_t$  is an independent white noise process. Assume that  $\Delta x_t = \gamma \Delta x_{t-1} + \eta_t$  where  $\eta_t$  is also an independent white noise process. Here  $\beta$  and  $\gamma$  are constant parameters. Show that the changes in  $y_t$  and  $x_t$  are governed by the vector error correction model

$$\Delta x_t = \alpha_1(y_{t-1} - \beta x_{t-1}) + \phi_{11}\Delta x_{t-1} + u_{1t},$$

$$\Delta y_t = \alpha_2(y_{t-1} - \beta x_{t-1}) + \phi_{21}\Delta x_{t-1} + u_{2t}.$$

Express the coefficients  $\alpha_1, \alpha_2, \phi_{11}, \phi_{21}$  in terms of the original parameters  $\beta$  and  $\gamma$ . Express the shocks  $u_{1t}$  and  $u_{2t}$  in terms of the white noise processes  $\varepsilon_t$  and  $\eta_t$ . What is the common trend in this example and why?

2. In light of stylized facts of financial returns, how likely is that an AR(p) or MA(q) or their combination ARMA(p,q) model are suitable for modeling financial return series? Which stylized facts are likely to be violated?

3. (Cointegration and error correction model)

This question is based on the data in the Excel file [fisher\\_update.XLS](#). The file contains 171 quarterly observations, from 1969Q4 to 2012Q2, on the Australian Consumer price Index (P) and on the yield to maturity of 90-day bank accepted bills (R).

(a) Generate the inflation rate as:  $INF = 400 * (\log(P(1)) - \log(P))$ . When we construct the inflation rate this way, we lose the last observation, namely, 2012Q2. We change the sample to 1984Q1 to 2012Q1, which is the post-float period of the exchange rate. Plot R and INF. Comment on whether or not R and INF co-move.

(b) Throughout this and the following parts of the question, continue to use the sample **1984Q1-2012Q1**. Assume that both R and INF are I(1) processes. Estimate the regression

$$R_t = \beta_0 + \beta_1 INF_t + \varepsilon_t$$

and perform an ADF test, without intercept and time trend, on the residuals from the regression. What do you conclude?

(c) Carry out the Engle-Granger cointegration test. Comment on the result.

(d) Regardless of your result in (c), assume that  $R_t$  and  $INF_t$  are cointegrated. If the cointegration error  $\varepsilon_t = R_t - \beta_0 - \beta_1 INF_t$  is positive at  $t$ , what would you say about the likely movements in  $R_{t+1}$  and  $INF_{t+1}$ ?

(e) Estimate the following two error-correction equations separately using OLS

$$\Delta R_t = c_1 + \alpha_1(\text{resid01})_{t-1} + \sum_{j=1}^4 (\phi_{11,j} \Delta R_{t-j} + \phi_{12,j} \Delta INF_{t-j}) + u_{1t},$$

$$\Delta INF_t = c_2 + \alpha_2(\text{resid01})_{t-1} + \sum_{j=1}^4 (\phi_{21,j} \Delta R_{t-j} + \phi_{22,j} \Delta INF_{t-j}) + u_{2t}.$$


Comment on your results. Do you observe error correction mechanism in the estimated equations?

(f) Can you reduce the “size” of the model in (e) by dropping some lags? Re-estimate the error-correction equations when insignificant lagged terms of  $\Delta R_t$  and  $\Delta INF_t$  are dropped from the equations you estimated in part (e). Comment on the new results.

#### 4. Simulation Exercise in Excel.

The Analysis ToolPak is a Microsoft Office Excel add-in program that is available when you install Microsoft Office or Excel.

To use the Analysis ToolPak in Excel (however, you need to load it first).

1. Click the **Microsoft Office Button** , and then click **Excel Options**.
2. Alternatively you may get to **Excel Options** from your Excel file, **File -> Options**
3. Click **Add-Ins**, and then in the **Manage** box, select **Excel Add-ins**.
4. Click **Go**.
5. In the **Add-Ins available** box, select the **Analysis ToolPak** check box, and then click **OK**.
  - a. **Tip** If **Analysis ToolPak** is not listed in the **Add-Ins available** box, click **Browse** to locate it.
  - b. If you get prompted that the Analysis ToolPak is not currently installed on your computer, click **Yes** to install it.
6. After you load the Analysis ToolPak, the **Data Analysis** command is available in the **Analysis** group on the **Data** tab.

Generate 2 random walk series:

$$y_t = y_{t-1} + \varepsilon_t, \varepsilon_t \sim iid WN N(0,1)$$

$$x_t = x_{t-1} + u_t, u_t \sim iid WN N(0,1)$$

To do this in excel first generate two standard normal random variables. **Data -> Data Analysis -> Random number generation**. We need:

Number of variables 2

Number of random numbers 1000

Distribution: Normal

**OK**

This gives you two random normal variables. Set  $y_1 = 0$ ,  $x_1 = 0$ . Generate  $y_t, x_t$   $t > 1$  using the equations above.

Regress  $y$  on  $x$  using **Data -> Data Analysis -> Regression**

Select range for  $y$  and  $x$  and press ok.

Analyse the output of the regression. Do you expect these results? What is going on?

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