Practical Econometrics for Finance and Economics

Exercises 5:

1. The file `USbonds` behind this exercise sheet contains US 3 month and 1 year (12 month) treasury rates.

   a) Make the log transformation $100 \cdot \log(1 + 0.01 \cdot r)$ where r is the treasury rate (in percents p.a.).

   b) Compare the sample statistics of the original and the log transformed series.

   Work in the following only with the log transformed series.

   c) Plot the log transformed treasury rates.

   d) Test whether the series are $I(1)$.

   e) Define a spread as the difference of the log treasury rates and test whether the spread is stationary or integrated. Rephrase your test result in terms of cointegration between the 3 month and 12 month treasury rates.

   f) Test for cointegration between the 3 month and 12 month treasury rates using the Engle-Granger method.

   g) Test for cointegration between the 3 month and 12 month treasury rates using Johansens cointegration tests.

   h) Set up a vector error correction model for the treasury rates. Can we reject the hypothesis that the cointegrating vector is (1,-1)?

2. Prove formula (5.5) of the lecture notes. *Hint: The slope coefficient* β_i *in the market model regression* $R_{it} = \alpha_i + \beta_i R_{mt}$ *is* $\mathbb{C}\mathrm{ov}(R_{it}, R_{mt})/\mathbb{V}\mathrm{ar}(R_{mt})$.

3. a) Using the notation of the lecture notes, show that

$$\frac{1}{L_1}\boldsymbol{X}_i'\boldsymbol{X}_i \stackrel{L_1\to\infty}{\longrightarrow} \begin{pmatrix} 1 & E(R_m) \\ E(R_m) & E(R_m^2) \end{pmatrix},$$

   where $\boldsymbol{X}_i$ is defined in (5.8) and L_1 is the length of the estimation window. *Hint: By the law of large numbers* $\frac{1}{n}\sum_{i=1}^n x_i \stackrel{n\to\infty}{\longrightarrow} E(X)$.

   b) Using your result from (a), show that $\mathbf{V}_i = \mathbf{I}\sigma_{\epsilon_i}^2 + \mathbf{X}_i^*(\mathbf{X}_i'\mathbf{X}_i)^{-1}\mathbf{X}_i^{*\prime}\sigma_{\epsilon_i}^2$ defined in (5.17) converges to $\mathbf{I}\sigma_{\epsilon_i}^2$ for $L_1 \to \infty$.
   Hint: $\mathbf{X}_i^*(\mathbf{X}_i'\mathbf{X}_i)^{-1}\mathbf{X}_i^{*\prime} = \frac{1}{L_1}\mathbf{X}_i^*(\frac{1}{L_1}\mathbf{X}_i'\mathbf{X}_i)^{-1}\mathbf{X}_i^{*\prime}$.

c) Prove formula (5.20) of the lectures. *Hint:* $V(X) = E(X^2) - E(X)^2$.

4. Consider the stock and index returns in the event study file behind this exercise sheet. Let $L_1 = 195$ and $L_2 = 11$.

   a) Calculate the abnormal returns for the stock using the market model. *Hint: The commands for obtaining the intercept and slope of a linear regression in excel are INTERCEPT and SLOPE.*

   b) Confirm the cumulative abnormal return estimate (5.18), the variance of the estimated cumulative abnormal returns (5.20) and the standardized cumulative abnormal return (5.21) in column B of the output sheet by calculations in excel. *Hint: The excel commands for obtaining the inverse of a matrix and the product of two matrices are MINVERSE and MMULT, respectively.*

   b) Fill out the remaining entries in column B of the output sheet taking into account the entries for all 25 stocks in columns B to Z.