**Tutorial Activity 11**

**Week 12**

Unit root tests, Engle-Granger procedure for cointegration,

error correction model

In this tutorial, the objectives are as follows:

* To formulate the hypothesis test for non-stationarity.
* To determine the integration order of the series.
* To sepcify and estimate long-run equations.
* To specify and estimate the error correction model and interpret your results.

1. What kinds of variables are likely to be non-stationary? How can such variables be made stationary?

Many series in finance and economics in their levels (or log-levels) forms are non-stationary and exhibit stochastic trends. They have a tendency not to revert to a mean level, but they “wander(徘徊する)” for prolonged periods in one direction or the other. Examples would be most kinds of asset or goods prices, GDP, unemployment, money supply, etc. Such variables can usually be made stationary by transforming them into their differences or by constructing percentage changes of them.

1. A researcher wants to test the order of integration of some time series data. He decides to use the DF test. He estimates a regression of the form

and obtains the estimate with standard error = 0.31.

(a) What are the null and alternative hypotheses for this test?

(b) Given the data, and a critical value of , perform the test.

(c) What is the conclusion from this test and what should be the next step?

(d) Why is it not valid to compare the estimated test statistic with the corresponding critical value from a *t*-distribution, even though the test statistic takes the form of the usual t-ratio?

**Student Activity:**

Using the same regression as above, but on a different set of data, the researcher now obtains the estimate with standard error = 0.16.

(a) Perform the test.

(b) What is the conclusion, and what should be the next step?

1. Consider the randomly generated data set in the Engle-Granger.R script file. Your goal is to specify the ECM by using and series.

(a) Determine the integration order of the series first.

(b) Estimate the long-run equations.

(c) Can you find cointegration relations for the model?

(d) Specify the ECM and interpret your results with respect to the error correction term.

1. Consider the data set **Raotbl3** in the contributed package **urca**. Demonstrate the Engle-Granger two-step procedure by estimating a consumption function and its error-correction form for the United Kingdom as in Holden and Perman (1994).

(a) Determine the integration order of the variables.

(b) Estimate the long-run equations.

(c) Can you find cointegration relations for different functions?

(d) Specify the ECM and interpret your results with respect to the error correction term.