

# **Applied Time Series Analysis**

**Leonardo Morales-Arias**

**Advanced Studies Program in International Economic Policy Research**

**August 2009**

## **Objective of the course**

The purpose of this 10-day course is to introduce students to applied time series analysis. Although the course will have a (mild) theoretical component it will be practical and exercise-driven. That is, instead of being exclusively a lecture-type course you will be given a set of exercises each day which you will tackle under my guidance.

We will employ different softwares (Matlab, Eviews, Jmulti) which are widely used in practice to analyze time series models. A particular advantage of this course is that we will perform analysis of time series models in Matlab. Working with matrix language softwares such as Matlab (or e.g. Gauss) may become indispensable for building your own models (e.g. econometric models, DSGE models, simulations, etc) and to implement econometric procedures which are not yet available in interface-driven softwares such as Eviews, Jmulti, Microfit, Stata, etc. Nevertheless, working knowledge of the latter softwares is also crucial for analysing popular time series models. In this course we will use the interface softwares Eviews and Jmulti. Empirical applications will be with financial data. The tentative course plan is as follows:

## **1. Autoregressive and Moving Average models**

Theory:

- a. Specifications (AR, MA, ARMA)
- b. Estimation
- c. Model order criteria
- d. Diagnostics

Exercise:

- a. Estimation, order selection and diagnosis of AR(p) model in Matlab.
- b. Estimation, order selection and diagnosis of MA and ARMA models in Eviews.

## **2. Testing for unit roots**

Theory:

- a. Stationarity vs non-stationarity concepts
- b. ADF test
- c. KPSS test
- d. HEGY test (seasonal unit roots)

Exercise:

- a. Unit root testing with the ADF test in Matlab
- b. Unit root testing with the KPSS in Eviews
- c. Unit root testing with the HEGY test in JMulti

### **3. Testing for cointegration**

Theory:

- a. Cointegration concept
- b. Engle-Granger two step test
- c. Johansen trace test
- d. Saikonnen and Luktepohl test

Exercise:

- a. Testing for cointegration with the Engle-Granger approach (Matlab)
- b. Testing for cointegration with Johansen trace test (Eviews)
- c. Testing for cointegration with Saikonnen and Luktepohl test (Jmulti)

### **4. Vector Autoregressions**

Theory:

- a. Specification
- b. VAR estimation
- c. Order selection
- d. VAR diagnostics
- e. Impulse responses
- f. Forecasting
- g. Structural VAR

Exercise:

- a. Estimation of VAR, diagnostics, impulse responses and forecasting in Matlab
- b. SVAR estimation, identification and analysis in Eviews and JMulti

### **5. Vector Error Correction Models**

Theory:

- a. Specification
- b. VECM estimation
- c. Forecasting
- d. Structural VECM

Exercise:

- a. Estimation of VECM, and forecasting in Matlab
- b. SVECM estimation, identification and analysis in Eviews and JMulti

### **6. Autoregressive Conditional Heteroskedasticity models (ARCH) (if time permits)**

Theory:

- a. Specifications (ARCH and GARCH)
- b. Estimation
- c. Forecasting

Exercise:

- a. Estimation and forecasting of a GARCH model in Matlab
- b. Estimation and forecasting of GARCH extensions (e.g, Threshold GARCH, EGARCH) in Eviews and JMulti

Reading material:

1. Lütkepohl, H. and Krätzig M. (eds.) (2004), *Applied Time Series Econometrics*, Cambridge University Press.
2. Tsay, R.S. (2002), *Analysis of Financial Time Series*, John Wiley and Sons.

Introductory econometric textbooks (in order of difficulty):

1. Gujarati, D. (2003), *Basic Econometrics*, McGraw-Hill.
2. Ramanathan, R. (2002) *Introductory Econometrics with Applications*, Harcourt College Publishers
3. Pindyck R. and Rubinfeld Daniel (1998) *Econometric Models and Economic Forecasts*, McGraw-Hill
4. Johnston J. and Dinardo J. (2001), *Econometric Methods*, McGraw-Hill