Central European University

Department of Economics

1. **Name of Course:** Advanced Time Series Analysis
2. **Lecturer:** James Davidson
3. **No. of Credits:** 2 Credits
4. **Dates:** 20th April to 9th May 2009
5. **Prerequisite:** Intermediate Econometrics.
   Recommended co-requisite: Advanced Econometrics.
6. **Course Level:** MA/PhD
7. **Course Outline**: A survey of modern time series analysis with emphasis on econometric models, techniques and applications
8. **Goals of the Course:** The course will review the underlying probability foundations, the principles of time series modelling, and econometric techniques of estimation and inference in time series. A range of linear and nonlinear time series models, both univariate and multivariate, will studied.
9. **Learning outcomes**: a knowledge of the relevant mathematics and probability concepts, including asymptotic theory, an understanding of the theory of estimation and inference as it applies to time series, knowledge of a range of time series models and a practical grasp of computational methods. Hands-on experience with a specialist computer package is offered as an option for private study.
10. **Lecture Topics and Reading**
    24 50-minute lectures will be given over three weeks, (3.30-5.20 pm Tuesday-Friday). The following provisional list of topics is subject to modification, depending on both the rate of progress and the declared interests of students. The lectures will be illustrated by projected notes that will also be posted on the internet as PDF documents. Study of these notes prior to the class is strongly recommended.

    <u>Week 1.</u>

    1. The underlying probability model. Statistical properties of time series; stationarity, memory properties. The autocorrelation function. Wold representation of a stationary time series. Linear models. Spectral Analysis.
    2. Difference equations and stochastic difference equations; the lag operator, lag polynomials, stability conditions; the autoregressive (AR) and moving average (MA) models.
    3. Some statistical theory for time series; conditional expectations and martingales. The laws of large numbers and the central limit theorem.

    <u>Week 2.</u>

    4. Estimation and inference for AR and MA models. Properties of Least squares and maximum likelihood estimators.

5. Modelling and forecasting with ARMA and ARIMA models; "Box-Jenkins" methodology.
6. Trends and integrated processes. The functional central limit theorem. Testing for unit roots. Testing the "I(0)" hypothesis.

Week 3.

7. Long memory models and fractional integration.
8. Nonlinear models. Conditional heteroscedasticity, ARCH, GARCH and other variants; bilinear models; regime switching models.
9. Regression analysis in stationary time series.

Reading:

The following two texts both contain chapters pertaining to most of the course topics, and are strongly recommended for thorough study. Ideally, read the relevant sections of both books.

The Econometric Modelling of Financial Time Series (2nd Edition) by Terence C. Mills (Cambridge University Press, 1998).

*Applied Econometric Time Series (*2nd Edn) by Walter Enders (John Wiley, 2005)

A comprehensive (but large and expensive) text for background reference is

Time Series Analysis by James Hamilton (Princeton University Press, 1994)

Reference will be made in the lectures to sections of

Econometric Theory by James Davidson (Blackwell Publishers, 2000).

For a background reading on statistical and asymptotic theory, also see Chapter 5 in the *Palgrave HandBook of Econometrics* Vol. 1, eds. T. Mills and K. Patterson (Palgrave-Macmillan 2006).

Course Web Page http://www.timeseriesmodelling.com/ATSA/

Homework

Problem sheets will be distributed and solutions discussed in class. Estimation and simulation exercises using the software package Time Series Modelling 4 (see http://www.timeseriesmodelling.com) will be set for optional individual study.
Homework exercises are for self-assessment only, and will not enter the final grade.

11. Assessment: 2 hour unseen examination at the end of the course. There will be a choice of three questions out of about seven.