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Introduction to Non-linear Time Series Econometrics

Instructor: Junsoo Lee

Contact: jlee@cba.ua.edu

Time and Location: June 13 – June 17 (Monday to Friday)
Faculty of Economics and Business, University of Zagreb
Trg J. F. Kennedyja 6, 10000 Zagreb
Computer lab classroom 42 (ground floor)

Tuition fee: No tuition fee

How to apply: Register at <http://goo.gl/forms/8gjMbT6hDlaDJ4oh2>. Maximum number of participants is limited to 30.

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Course Objectives and Description

The course is organized as an *intermediate* computer lab guide to non-linear time series models in economics and finance which can be useful for academic researchers, graduate students (both Master and Ph.D.) and professional economists working at banks, insurance companies, government offices, and others. It is an *intermediate* course which requires basic prerequisite required, and it adopts a strong empirical and ‘learning-by-doing’ approach.

The course objective is to introduce popular non-linear time series models and to give a hands-on experience in examining the results of some important research papers. The course would be focused on explaining logics and intuitions behind non-linear models rather than deriving mathematical models. However, necessary equations and mathematics will be discussed.

Topics include nonlinear unit roots, threshold and smooth transition models, multivariate GARCH models, Regime switching models, State Space models, factor models and other related issues. Participants are encouraged to seek related research topics to pursue.

Data necessary to replicate results of the most important papers will be provided, but students are also encouraged to bring their data sets. After the course, students will be able to estimate various nonlinear models and test for nonlinearity in time series.

To learn how to estimate and test for various non-linear time series models, we will learn how to obtain the results by using two most popular software packages, RATS and STATA. During the course, all computer codes *will be provided to students*. The main goal for all participants would be to develop an idea to write a research paper using non-linear time series techniques.

Course Syllabus

The course lasts five days. Each day lecture consists of two sessions: “lectures session” from 10:00 to 13:00, and “tutorials session” from 15:00 to 17:00.

Note: The specific sub-topics will be subject to change.

Day 1: Univariate Models

- Models for Structural Changes
 - Bai-Perron tests and related issues
 - Davies’ problem and Andrew-Ploberger test
- Forecasting with Linear and Nonlinear Models
- Recent Developments in Unit Root tests: Breaks and Non-normal errors
- Application papers and Exercises (Energy/poverty convergence issue)

Day 2: Threshold and Smooth Transition Models

- Threshold models
 - Testing for threshold
 - Confidence Intervals in TAR Models
 - Threshold unit root tests and extensions
- Smooth transition, ESTAR and LSTAR models
 - ESTAR and LSTAR Smooth transition Models
 - Confidence Intervals in ESTAR/LSTAR Models
 - ESTAR and LSTAR unit root tests
- Time-varying Coefficients Models
- Application papers and Exercises (Tayler Rule models)

Day 3: Fourier and Regime Switching Models

- Fourier function Approach
 - Fourier function models
 - Fourier unit root tests of Enders and Lee
 - Fourier function VAR models
- Regime Switching Models
 - Markov Regime Switching Models
 - Move-Stay Models
- Application papers and exercises (AJAE paper)

Day 4: State Space and Unobserved Component models, Kalman filter and Factor Models

- What is a state space model? What is the Kalman filter?
 - Examples and motivation of the state space models
- Unobserved component and State Space Model
 - Trend Models
 - Dynamic factor model
 - Bivariate Unobserved Component Models
- Factor VAR Models
- Application papers and Exercise (Plucking Models,..)

Day 5: GARCH and multivariate GARCH

- Multivariate GARCH and different models (CCC, DCC, BEKK, VCC, Vech)
- Time varying correlation
- Application papers and Exercises

Lecturer (Dr. Junsoo Lee, University of Alabama, USA):

Dr. Junsoo Lee is Professor of Economics and Rick and Elaine Horsley Faculty Fellow at the University of Alabama, USA. His research interests are econometrics and applied macroeconomics. He has published in journals such as *Review of Economics and Statistics*, *International Economic Review*, *Journal of Money, Credit, and Banking*, *Econometric Theo-*

ry, *Journal of Health Economics*, *Journal of Applied Econometrics*, *Economics Letters*, and *Oxford Bulletin of Economics and Statistics*, *Southern Economic Journal*, *Studies in Nonlinear Dynamics & Econometrics*, and other quality journals. His primary research topics have been in the area of time series econometrics, focusing on developing new unit root tests, cointegration tests, and nonlinear time series models. His research interests also cover issues in cross-sectional econometrics including dynamic panel data models, count data models, duration models, stochastic frontier models, and treatment effect models. He is President-elect of the Korean American Economic Association (KAEA), and a member of the American Economic Association, the Econometric Society, and the American Agricultural Economic Association.

Potential Applicants

This course could be interesting for the following groups:

- Professional macroeconomists in banks, insurance, Ministry of finance, central banks, and government
- Macroeconomic and finance specialist interested in forecasting
- Academic researchers who are interested in modern time series analysis
- Graduate and Ph.D. students in economics and finance

Prerequisite

Reading

The course is at an intermediate level, and it aims at students who are familiar with basics of econometrics and have some practical experience. It is suggested that participants are familiar with a basic regression analysis, concepts such as t-statistics, standard errors, ARIMA, and leads and lags. Students should be familiar with properties of OLS estimators. Good command of undergraduate econometrics is enough for understanding all concepts. Graduate econometrics will be enough for active participation in the course. Great refresher is Enders (2008), chapters 2, 3, and 4, or any undergraduate econometrics textbook, such as Wooldridge (2015).

Software

Prior programming knowledge would be helpful, but it is not a prerequisite for the course, while it is recommended that participants be familiar with the very basic concepts of software. During the course, RATS and STATA will be used for analysis. The most basic introduction to RATS could be found on [Estima's](#) website, or [download a trial version](#), and read the Introduction. STATA offers a different type of [tutorials for beginners](#).

Tuition Fee

There is no tuition fee. The workshop is co-financed by the European Union from the European Social fund. The number of participants is limited to 30.

Quality Control

The course and the lecturer will be evaluated by students through an individual and anonymous survey that takes into account the organizational and academic progress.

Cited Literature

Enders, W. (2008). *Applied econometric time series*. John Wiley & Sons.

Wooldridge, J. (2015). *Introductory econometrics: A modern approach*. Nelson Education.