

TIME SERIES ECONOMETRICS

PEKING UNIVERSITY, SPRING 2021

BO HU

General Information

Time: Mondays 3:10pm - 6:00pm

Location: 二教314

Instructor: Bo Hu

Email: bohu@nsd.pku.edu.cn

Website: <https://www.econbohu.com/teaching/tsa/>

Course Description

Time series econometrics has been widely used in analyzing economic dynamics. This graduate course introduces theoretical background and tools for time series analysis. This course contains two parts. Part I introduces statistical foundations for time series econometrics, including theories for stationary time series and non-stationary time series. Part II focuses on selected econometric time series models and methods that are relevant and useful for conducting empirical research in dynamic settings.

Prerequisites

Students are supposed to have taken Advanced Econometrics I and II.

Textbook

There is no required textbook for this course. I will use my own lecture notes. You can download it on the course website. The following books are for reference.

Aït-Sahalia, Y. and Jacod, J. (2014). *High-Frequency Financial Econometrics*. Princeton University Press.

Brockwell, P. and Davis, R. A. (1991). *Time Series: Theory and Methods*. Springer, 2nd edition.

Canova, F. (2007). *Methods for Applied Macroeconomic Research*. Princeton University Press.

DeJong, D. N. and Dave, C. (2011). *Structural Macroeconometrics*. Princeton University Press, 2nd edition.

Hamilton, J. D. (1994). *Time Series Analysis*. Princeton University Press.

Lütkepohl, H. (2005). *New Introduction to Multiple Time Series Analysis*. Springer.

Tsay, R. S. (2010). *Analysis of Financial Time Series*. Wiley, 3rd edition.

Computer Usage

This course requires programming. You may use any software package/programming language to solve homework problems. I suggest choosing from Matlab, Python, or R.

In-Class Presentations

The last few classes will be devoted to student presentations. You may choose to present a paper at your own choice from a reading list, which will be available in the middle of the semester. Or you may choose to present a relevant research project by yourself. In both cases, you need to get my approval in advance. You should go through everything carefully in the paper and try to replicate the results.

Grading

For those who take this course for credit, a final grade will be assigned based on your grades of homework assignments (30%), the midterm exam (30%) and the final presentation (40%). Also, a maximum of 10% bonus may be given based on class participation.

The mid-term exam is tentatively set on **April 26, 2021** in class.

Office Hours

If you wish to meet me outside class, please make an appointment in advance via email at bohu@nsd.pku.edu.cn.

Course Contents

This course will cover a selection from the following topics as well as other relevant ones.

Part I

1. Introduction
 - 1.1. Introduction to Time Series
 - 1.2. A Review of Probability Theory
 - 1.3. Basic Theory of Hilbert Space
2. Mathematical Theory of Stationary Processes
 - 2.1. Stationary Processes in the Time Domain

- 2.2. Stationary Processes in the Frequency Domain
- 2.3. Prediction of Stationary Processes
- 3. Statistical Theory of Stationary Processes
 - 3.1. Estimation of Sample Mean and Autocovariance Function
 - 3.2. Inference for Spectrum
- 4. Basic Asymptotics for Non-stationary Time Series
 - 4.1. Functional Central Limit Theorem
 - 4.2. Asymptotics for Non-stationary Regressions
- 5. Unit Roots and Cointegration
 - 5.1. Testing for Unit Roots
 - 5.2. Inference in Cointegrated Models
- 6. Non-linear Non-stationarity
 - 6.1. Non-linear non-stationary Asymptotics
 - 6.2. Inference in Non-stationary Nonlinear Models

Part II

- 7. Vector Autoregression
 - 7.1. VAR
 - 7.2. Structural VAR and its identification
 - 7.3. The Error Correction Models
- 8. Volatility Models
 - 8.1. ARCH and its Variants
 - 8.2. Stochastic Volatility Models
 - 8.3. Non-linear Non-stationary Heteroskedasticity
- 9. Principal Component Analysis and Factor Models
 - 9.1. Factor Models in Macroeconomics and Finance
 - 9.2. Principal Component Analysis
 - 9.3. Statistical Theory of Factor Analysis
 - 9.4. Factor-Augmented VAR
- 10. Models with Latent Factors
 - 10.1. State Space Models and the Kalman Filter
 - 10.2. Markov Switching Models
 - 10.3. Markov Chain Monte Carlo Methods
- 11. Continuous Time Models
 - 11.1. Mathematical Foundations of Continuous Time Econometrics
 - 11.2. Diffusion Type Models
 - 11.3. Inference in Continuous Time Models at High Frequency