ECON 821: Time Series Econometrics

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1. COURSE OUTLINE

This is a course on time series econometric models offered for graduate students. Theory, empirical applications and computations will be covered, and both stationary and non-stationary time series will be considered. (See outline below for topics covered). Students are expected to have some background in statistics and linear regression theory. A long reading list is provided for your reference.

- **Time: Monday and Wednesday 12:00 - 1:15PM**

2. Requirements and Grading

- There will be an empirical exercises (homework) and an exam.
- Final grade: class participation: 10%; Empirical Exercises: 40%; Exam: 50%.

3. Text Books

- Time Series Analysis, J Hamilton, Princeton University Press.
- New Introduction to Multiple Time Series Analysis, 2005, H. Lutkepohl, Springer Verlag: New York.
- Asset Pricing, John Cochrane, Princeton University Press
- Nonparametric Statistics for Stochastic Processes
- Analysis of Financial Time Series, R.S. Tsay, Wiley.
- Stochastic Limit Theory: An introduction for Econometricians, J. Davidson, Oxford University Press.
- Financial Econometrics, by C Gourieroux and J. Jasiak, Princeton University Press.

- Time Series: Theory and Methods, Brockwell, P.J. and R.A. Davis, 1990, second edition, Springer.
- The Econometrics of Financial Markets, Campbell, Lo and Mackinlay, Princeton University Press.
- Nonlinear Time Series, Fan and Yao, Springer.
- Introduction to Multiple Time Series Analysis, 1991, H. Lutkepohl, Springer Verlag: New York.

Lecture Notes, Zhijie Xiao.

4. Outline of Topics

PART I: Stationary Time Series

4.1. Stationary ARMA Models

- Stochastic process, stationarity and strict stationarity.
- Parametric Time Series models: AR, MA, ARMA, ARIMA processes. Estimation and forecasting based on ARMA and ARIMA models.
- The autocorrelation function, invertibility. Variance ratio test, regression test; Mean reverting trading rules, Momentum trading rules.

4.2. Vector Processes and VAR

VAR; Multiple TS decomposition; Forecasting error variance decomposition; Impulse response; Cholesky Decomposition; Introduction of Asymptotic Theory.

4.3. Asymptotic Theory for Weakly Dependent Processes

Weak and Strict Stationarity; Ergodic Theorem; Weak Dependence and Mixing process.

Conditional Expectations and Hilbert Projection. The Wold decomposition. Linear Processes and Phillips-Solo device. Time Series Applications of martingales; martingale convergence theorem.

4.4. Spectrum and Frequency Domain Analysis

Complex-valued stationary time series, spectral density; the population spectrum, discrete Fourier transform, the periodogram, estimation of spectral densities. Spectral density of a linear process; Phillips-Solo decomposition in the frequency domain; Spectral regression. Estimation of Spectral density and Covariance Matrix. Smoothed periodograms. Nonparametric kernel estimation of spectrum.

PART II: Nonstationary Time Series

4.5. UNIT ROOT PROCESSES

Random Walk Behavior. FCLT. Inference for unit root nonstationary AR processes, Time Series Regression with a Unit Root, Multiple regression with integrated time series.

4.6. Cointegration and Models of Market Co-movements

Regression with Integrated processes.

Cointegration and Error Correcting Models. Asymptotic Properties of Least Squares Estimators of Cointegration Vectors. Residual based tests for cointegration. Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models.

Cointegration and portfolio allocation. Trading on market comovements.

Spurious regression.

PART III: Other Topics

4.7. Volatility Models

ARCH and GARCH models. Other types of models with conditional heteroskedasticity.. Implied Volatility Modelling. Trading Volatility.

4.8. Models of Permanent and Transitory Components

Kalman Filter. Trading Market Noise.

4.9. Models with Time Varying parameters

Models with Time Varying parameters; Rolling regression; Quantile regression; Functional Coefficient models. Trading on Fair values

4.10. Nonlinear and Nonparametric models

Statistical learning Theory.

Density estimator; Nonparametric kernel estimation; Local polynomial regression; Models with Asymmetric effects. Trading on nonlinear predictions.

4.11. Models with Haevy-tail Distributions.

4.12. Extreme Value Theory

Extreme Value Theory; Trading on Extreme Events.

4.13. Risk Management

Quantiles; Value at Risk; Conditional VaR; Risk measurment and portfolio allocation under risk criteria.

4.14. Processes with Deterministic Trends

4.15. MODEL SELECTION

Model Selection Criterion.

4.16. BOOTSTRAPPING TIME SERIES MODELS

Parametric Bootstrap. Block Bootstrap. Sampling properties of Bootstrapping models.