Economics 205C: Econometric Methods III

Spring Quarter 2005

Instructor: Tae-Hwy Lee
Lectures: TR 12:10-1:30 p.m., SPR 2206
Office Hours: TR 9:00-9:25 a.m. and TR 2:00-2:30 p.m. or by appointment

TA: Weiping Yang
Discussion: F 10:10-11:00 a.m., SPR 2206
Office Hours: F 2:00-4:00 p.m.

Course Description: The course covers the basic methods and theory of modern time series econometrics while it is also intended to provide a foundation for applied research. The goal of the course is that the student acquires knowledge of the relevant concepts necessary to be able to understand the empirical and theoretical econometric literature as exposed in the leading journals. More advanced time series econometrics will be treated in ECON 285F (Advanced Time Series II). The course deals with the analysis of univariate and multivariate, stationary and non-stationary, and linear and nonlinear models. Topics such as forecasting, unit roots, VAR, cointegration, ARCH, bootstrap theory, quantiles, will be covered. ECON 205A and ECON 205B are assumed.

Course Outline: This course covers various issues in time series analysis, especially recent developments for dependent processes, nonstationary time series, nonlinear models, volatility, and forecasting. The course contains essentially three parts. The first concerns the standard theory of stationary stochastic processes. This includes the characterization and estimation in the time domain as well as the frequency domain (spectral analysis). Also covered are vector autoregressive models including the analysis of causality and variance decomposition. We also highlight the importance of the concept of the spectral density function at the zero frequency. The second part of the course concerns the more recent theory pertaining to the analysis of nonstationary data. We start with some basic concepts for continuous time processes to introduce the Wiener process. We take a close look at the asymptotic distribution theory in the leading case of an AR(1) model and especially the case with an autoregressive unit root. Tests related to unit root processes are discussed. We also discuss the characterization, estimation and tests in cointegrated systems, including the problem of the decomposition of a time series in common permanent and idiosyncratic temporary components. The third part of the course concerns the topics such as specification, testing, and estimation of nonlinear time series models and their diagnostic checking, volatility modeling, the conditional quantile estimation, and bootstrap for time series.

1. Stationary Time Series Models

   (a) Introduction to the theory of time series: Definitions of stationarity, Autocorelations and autocovariances, Wold decomposition theorem, Autocovariance generating function, Autoregressive moving-average models, Invertibility, Autocovariance functions

   (b) Spectral analysis: Spectral density function for stationary stochastic processes, Filters, Spectral density function at frequency zero, Estimation, Robust standard errors for the linear model estimated by OLS and for GMM estimators

   (c) Building linear time series models: Identification, Diagnostic checking

   (d) Estimation of ARMA models: Limiting distribution of the sample meanand the autocovariances, Estimation of autogressive models, Estimation of moving-average models, Asymptotic results (weak and strong laws of large numbers, central limit theorems) for dependent processes and Martingale difference series

   (e) Forecasting: Using ARMA models, evaluation, comparison, combination

   (f) Vector autoregressive processes: Causality, Impulse response, Variance decomposition

   (g) State Space models and the Kalman filter: Description of state space models, The likelihood function, Kalman filter

2. Non-stationary Time Series Models

   (a) Trend and unit root: Wiener process, Functional central limit theorem, Testing for a unit root, Asymptotic theory, Dickey-Fuller tests, Phillips-Perron tests

   (b) Permanent and transitory components in economic time series: Beveridge-Nelson decomposition, Measures of persistence

   (c) Cointegration: General concepts, Granger representation, Error correction model, Tests for cointegration, Estimation of models with cointegration, Results for static OLS regressions, Asymptotically optimal single equation methods, Asymptotically optimal full system methods

3. Topics

   (a) Nonlinear time series models: Testing, Estimation, Diagnostics

   (b) Conditional Variance: ARCH, GARCH, Testing, Estimation, QML, Consistency, Asymptotic distribution, Forecasting, Multivariate models

   (c) Conditional Quantile: QML, Consistency, Asymptotic distribution

   (d) Bootstrap

Exams and Grading: There will be weekly homework assignments (30%), a midterm exam (30%, in class, May 19), and a final exam (40%, 9 am-12 noon, June 8). The final exam is comprehensive. Homework problem sets will consist of analytical exercises as well as computer exercises. Late homework will not be considered. Questions regarding GAUSS programming should be directed to the TA. The assignments will be graded by the TA and will then be reviewed by the instructor. The exams will be graded by the instructor. You are fully responsible for following up all the announcements made during the lectures. The computation should be done with GAUSS. The latest version of GAUSS is installed in Collab.

Main Textbooks

Granger, C.W.J. and P. Newbold (1986), *Forecasting Economic Time Series*, 2ed., Academic Press.

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

General Econometrics

Davidson, J. (1994), *Stochastic Limit Theory*, Oxford University Press.

Engle, R.F. and D. McFadden (1993), *Handbook of Econometrics*, Volume 4, North Holland.

Hansen, Bruce (2005), *Lecture Notes*, www.ssc.wisc.edu/~bhansen

Hayashi, Fumio (2000), *Econometrics,* Princeton University Press.

Newey, W.K. and D.L. McFadden (1994), "Large Sample Estimation and Hypothesis Testing", in R.F. Engle and D.L. McFadden (eds.), *Handbook of Econometrics,* Vol. 4, 2113-2247, North Holland.

White, Halbert (2001), *Asymptotic Theory for Econometricians*, 2ed., Academic Press.

General Time Series

Box, G. E. and G. M. Jenkins (1976), *Time Series Analysis : Forecasting and Control*, 2nd edition, Holden-Day.

Brockwell, P. J. and R. A. Davies (1991), *Time Series : Theory and Methods*, 2nd ed., Springer-Verlag.

Enders, W. (1995), *Applied Econometric Time Series*, John Wiley.

Granger, C. W. J. (ed.) (1990), *Modelling Economic Time Series*, Oxford University Press.

Granger C. W. and R. F. Engle (1984), "Applications of spectral analysis in econometrics," in Handbook of Statistics, Vol. 3, D. R. Brillinger and P. R. Krishnaiah, eds. Amsterdam : Elsevier Science Publishers.

Gourieroux, C. and A. Monfort (1996), *Time Series and Dynamic Models*, Cambridge University Press.

Harvey, A. C. (1981), *Time Series Models*, Phillip Allen.

Lutkephohl, H. (1993), *Introduction to Multiple Time Series Analysis*, 2nd ed., Springer-Verlag.

Mills, T. C. (1990), *Time Series Techniques for Economists*, Cambridge University Press.

Mills, T. C. (1993), *The Econometric Modelling of Financial Time Series*, Cambridge University Press.

Priestley, M. B. (1981), *Spectral Analysis and Time Series*, Academic Press.

Unit Root and Cointegration

Banerjee, A., J. Dolado, J.W. Galbraith and D.F. Hendry (1994), *Co-Integration, Error Correction and the Econometric Analysis of Non-Stationary Data*, Oxford University Press.

Engle, R.F. and C.W.J Granger (1991), *Long-Run Economic Relationships,* Oxford University Press.

Fuller, W. A. (1976), *Introduction to Statistical Time Series*, John Wiley & Sons.

Hargreaves, C., ed., (1994), *Nonstationary Time Series Analysis and Cointegration*, Oxford University Press.

Hatanaka, M. (1996), *Time Series-Based Econometrics,* Oxford University Press.

Hendry, D.F. (1995), *Dynamic Econometrics*, Oxford University Press.

Johansen, S. (1995), *Likelihood-Based Inference in Cointegrated Vector Autoregressive Models,* Oxford University Press.

Tanaka, K. (1996), *Time Series Analysis: Nonstationary and Noninvertible Distribution Theory*, John Wiley.

White, Halbert (2001), *Asymptotic Theory for Econometricians*, 2ed., Academic Press, Chapter 7.

Nonlinear Time Series

Campbell, J.Y., A.W. Lo, and A.C. MacKinlay (1997), *The Econometrics of Financial Markets,* Princeton University Press. Chapter 12

Fan, J. and Q. Yao (2003), *Nonlinear Time Series: Nonparametric and Parametric Methods*, Springer Verlag.

Granger, C. W. J. and T.-H. Lee (1999), "The Effect of Aggregation on Nonlinearity", *Econometric Reviews*, 18(3), 259-269.

Granger, C.W.J. and T. Teräsvirta (1993), *Modelling Nonlinear Economic Relationships,* Oxford University Press.

Lee, T.-H., H. White and C. W. J. Granger (1993), "Testing for Neglected Nonlinearity in Time Series Models: A Comparison of Neural Network Methods and Alternative Tests", *Journal of Econometrics*, 56, 269-290.

Forecasting

Bates, J.M. and C.W.J. Granger (1969), "The Combination of Forecasts", *Operations Research Quarterly,* 20, 451-468. Also see Granger and Newbold (1986, Chapter 9)

Diebold, F. X. and R. Mariano. 1995. Comparing predictive accuracy. *Journal of Business and Economic Statistics* 13: 253-265.

Granger, C.W.J. (1999), *Empirical Modeling in Economics,* Cambridge University Press.

West, K.D. (1996), "Asymptotic Inference about Predictive Ability", *Econometrica,* 64 1067-1084.

ARCH

Campbell, J.Y., A.W. Lo, and A.C. MacKinlay (1997), *The Econometrics of Financial Markets,* Princeton University Press. Chapter 12

Engle, R.F. (1995), *ARCH Selected Readings,* Oxford University Press.

Gourieroux, C. and J. Jasiak (2001), *Financial Econometrics,* Princeton University Press.

Tsay, R.S. (2002), *Analysis of Financial Time Series*, Wiley.

Quantile

Koenker, R. and Bassett, G. (1978), "Regression Quantiles", *Econometrica*, 46, 33-50.

Komunjer, I. (2004), "Quasi-Maximum Likelihood Estimation for Conditional Quantiles", *Journal of Econometrics*, forthcoming.

Bootstrap

Efron, B. and R. LePage (1992), "Introduction to Bootstrap", in *Exploring the Limits of Bootstrap*, R. LePage and L. Billard (eds.), Chapter 1, 3-10, John Wiley & Sons, Inc.

Hall, Peter (1992), *The Bootstrap and Edgeworth Expansion*, Springer Verlag. (Chapters 1-3)

Horowitz, J. (2001), "The Bootstrap", *Handbook of Econometrics,* Vol. 5, North Holland.

Spanos, A. (1986), *Statistical Foundations of Econometric Modelling*, Cambridge University Press. (error bounds and asymptotic expansions, pp. 202-208)