COURSE SYLLABUS

ECON 8130  
Time Series Econometrics  
Fall 2015

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Classroom: Sanford 204  
Class time: TR, 9:30a to 10:45a  
Final exam: Tuesday Dec. 15, 8:00a-11:00a

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The course: This course is an introduction to the methods of time series analysis, with applications in macroeconomics and finance. Most of what we know empirically about the overall economy and much about financial markets and asset prices is based on data that vary over time. After the course, you should have a reasonably deep and broad understanding of the basic toolkit available to time series econometricians, an understanding that goes beyond knowing what buttons to click in a regression software program.

Students should have a solid foundation in probability theory, statistics, econometrics at the introductory level, linear algebra, and at least some experience with the standard tools of dynamic analysis such as difference and differential equations. In particular, you need a working knowledge of the classical linear regression model, in which the regressors are strictly exogenous. Time series regression models seldom satisfy the classical conditions, but this model is a starting point for the models we will discuss. To review classical regression, see Hayashi, chapter 1.1-1.4, and Hamilton, chapter 8.1 (textbook details below).

Course pre-requisites: ECON 8070 and ECON 8080.

Recommended textbooks:


Each of these texts is a useful reference for the course material; how the chapters correspond to the topics covered is given in the course outline below. Hamilton’s book remains the standard in the field and has the broadest coverage of the course material. It and Hayashi’s book provide good coverage for the econometric theory presented in class; Enders’s book is a user’s guide, lighter on theory but more intuitive and readable (it’s out in a fourth edition, but there’s not much added value beyond the third). I recommend that you have access to all three books, although how you use them is up to you. They can be purchased new or used, or rented, from amazon at very low prices (Enders is also available as an e-book on CourseSmart). The course outline contains links to selected articles that you might find useful. These readings are suggested, but not required.
Grading: Your final course grade will be a weighted average of your performance on a comprehensive, in-class final exam (40%), and five out-of-class assignments (60%). I will post problem sets as study guides on the course web page, but they will not be graded. Instructions for the out-of-class assignments are given on the course web page. Please note there the deadlines for these assignments, so plan accordingly.

Econometric software: You will need access to an econometric software program. I work primarily with RATS, but have some working knowledge of Stata, MATLAB, and R. You are free, however, to work with whatever software you prefer.

Attendance: I expect consistent class attendance from everyone. I reserve the right to withdraw from the class students who are excessively absent. If you must miss class, please let me know ahead of time. The final exam must be taken when scheduled.

Academic honesty: I expect all students in this course to fully understand and comply with UGA’s culture of academic honesty: As a University of Georgia student, you have agreed to abide by the University’s academic honesty policy, “A Culture of Honesty,” and the Student Honor Code. All academic work must meet the standards described in “A Culture of Honesty” found at: www.uga.edu/honesty. Lack of knowledge of the academic honesty policy is not a reasonable explanation for a violation. Questions related to course assignments and the academic honesty policy should be directed to the instructor.

This syllabus is a general plan for the course; deviations announced to the class by the instructor may be necessary.

Course outline:

1. Linear regression models using time series data
   
   (a) Preliminaries (Hayashi: 2.1, 2.2, 6.5; Hamilton: 7.1, 3.1, 3.2, 7.2)
      
      i. Large-sample theory
         A. Convergence of sequences of random variables
         B. Convergence of sample means
      ii. Fundamental concepts of time series analysis
         A. Stochastic processes
         B. Covariance stationarity and ergodicity
         C. Martingales and martingale difference sequences (MDS)
         D. LLN and CLT for ergodic stationary MDS
         E. LLN and CLT for general ergodic stationary processes
   
   (b) Time series regression models with predetermined regressors (Hayashi: 2.3-2.6, 2.10; Hamilton: 8.2)
      
      i. Lagged dependent variables
      ii. Serially correlated errors
      iii. Testing for serial correlation
iv. Examples (Bradford and Lastrapes 2014; Coibion and Gorodnichenko 2015.)

(c) Regression models with endogenous regressors and GMM (Hayashi: 3.1-3.7; Hamilton: 14.1, 14.2)
   i. Omitted variable and simultaneity bias
   ii. Identification
   iii. Generalized method of moments (GMM) estimator
      A. Just-identified models and IV
      B. Over-identified models and efficient GMM estimation
      C. Testing over-identifying restrictions
      D. Conditional homoskedasticity and 2SLS

2. Time series models for stationary processes

   (a) Difference equations (Enders: 1; Hamilton: 1,2)
      i. First-order univariate difference equations
      ii. First-order multivariate difference equations
      iii. Dynamic multipliers

   (b) Univariate ARMA models (Enders: 2; Hamilton: 3.1-3.7; Hayashi: 6.1, 6.2)
      i. MA models
      ii. AR models
      iii. Correspondence between MA and AR representations
         A. Wold’s Theorem
         B. Stationarity conditions
         C. Invertibility of MA models
      iv. ARMA (mixed) models
      v. Autocovariance function

   (c) Estimation of ARMA models (Hamilton: 5, 13.1-13.4)
      i. Estimating AR models by Maximum Likelihood (MLE)
      ii. Estimating MA models
         A. MLE, numerical hill-climbing, and likelihood ratio tests
         B. Simulated method of moments
      iii. Building the likelihood function using the Kalman filter

   (d) Forecasting with ARMA models

   (e) VAR models (Enders: 5.5-5.14; Hamilton: 10.1-10.3, 11.1-11.7; Hayashi: 6.3,6.4)
      i. Vector processes
         A. VMA and VAR representations
B. Conditions for joint stationarity
C. Autocovariances

ii. Estimating VARs
A. Unrestricted VARs
B. VARs with general restrictions
C. VARs with block-exogenous restrictions
D. Hypothesis tests (Block-recursive restrictions, Granger-causality)
   - Block-exogeneity
   - Granger-causality

iii. Innovation accounting (Sims 1980)
A. Impulse response functions (IRFs)
   - Forecast revisions
   - Orthogonalized IRFs
   - An alternative to orthogonalization based on Generalized IRFs
B. Variance decompositions
C. Inference and standard errors (Sims and Zha 1999)
   - Asymptotic distributions of IRFs
   - Simulation methods: Monte Carlo Integration and bootstrapping
D. Estimating IRFs directly using local projections (Jorda 2005)

iv. Model specification
A. Lag-length selection
   - Hypothesis tests: general-to-specific
   - Selection criteria: AIC and BIC
   - Bayesian VARs
B. Deterministic variables
C. Dynamic factor models (Stock and Watson 2005)
   - Estimation
   - Factor-augmented VARs (Bernanke et al. 2005)
   - Ireland’s ‘hybrid’ model

v. Identifying VARs – Structural VARs (SVARs) (Stock and Watson 2001)
A. Structural and reduced form models: the identification problem
B. Achieving identification
   - Conditions for identification
   - Estimating the structural model
   - Covariance restrictions as IV estimation
C. Innovation accounting in identified systems
D. Identification strategies
   - Recursive and contemporaneous restrictions (Sims 1986)
• Infinite-horizon restrictions (Blanchard Quah 1989; Lastrapes 1992; Gali 1999)
• MaxShare restrictions (Francis, Owyang, Roush, and DiCecio 2012)
• Shape/sign restrictions (Uhlig 2005; Faust 1998; Fry and Pagan 2011)
• Heteroskedasticity (Rigobon 2003)

E. Sufficient information in structural VARs (Forni and Gambetti 2014; Fernandez-Villaverde, et al. 2007)

(f) Autoregressive Conditional Heteroskedasticity (ARCH) models (Enders: 3; Hamilton: 21)
   i. The ARCH(p) model (Engle 1982)
   ii. The GARCH(p,q) model
   iii. Asymmetric-Power ARCH and other specifications (Bollerslev 2008)
      A. Asymmetric-Power ARCH
      B. ARCH-in-mean
      C. Multi-variate ARCH
   iv. Estimation of GARCH models
      A. ARCH-GARCH under Gaussian errors
      B. Non-Gaussian ARCH estimation
      C. GMM
   v. Adding exogenous regressors to ARCH models
      A. Volume and volatility (Lamoureux and Lastrapes 1990)
      B. Options market efficiency (Lamoureux and Lastrapes 1993)

3. Non-stationarity: Unit roots and cointegration
   (a) Non-stationarity in univariate models (Enders: 4; Hamilton: 17, 18)
      i. Trend (deterministic) versus difference (stochastic) stationary
      ii. Estimating a linear trend
      iii. Beveridge/Nelson decomposition of a unit root process
      iv. Testing for unit roots
         A. Dickey-Fuller tests
         B. Bayesian tests
         C. Variance-ratios
   (b) Unit roots in vector models (Enders: 6; Hamilton: 19, 20) (Stock and Watson 1988)
      i. Estimating a VAR when \( \rho = 1 \)
      ii. Cointegration
         A. Cointegration illustrated and defined
         B. Interpretation
- Implications for VMA and VAR models
- Vector error correction models (VEC)
- Common stochastic trends interpretation
- The constant term in a cointegrating regression

C. Estimation and testing
- System estimation of cointegrated models
- Hypothesis tests: number of cointegrating vectors and restrictions

D. Identifying VEC models with permanent and transitory components
   (King, Plosser, Stock and Watson 1991; Gonzalo and Ng 2001)