This course examines the models and statistical techniques used to study time series data in economics. The course has two specific objectives. The first is to equip students who anticipate using time series data in their Ph.D. research with the tools they need for state-of-the-art empirical research. The second objective is to lay out the econometric theory of time series analysis, with an emphasis on recent developments. Problem sets will have both theoretical and empirical components. The substantive applications in the course will draw primarily from macroeconomics and to a lesser degree finance.

All the topics covered in the course are relevant to empirical applications. However, the course is organized so that the most important tools for applied researchers are presented first, without unnecessary mathematical rigor. Generally speaking, an increasing amount of theory is introduced as the course develops. Only a few of the papers listed under a topic will be covered; one role of this syllabus is to list additional references for those wishing to delve into specific topics in greater detail.

There will be two problem sets containing both theoretical and computational work, plus a final research paper. The final grade will consist solely of your grades on the problem sets and paper (25% weight on each problem set, 50% weight on paper). You are encouraged to work together on the problem sets, but you should write up problem set solutions on your own. The paper should make a new contribution to the literature on a topic of your choosing related to those covered in the course. Unless given explicit permission otherwise, the final research paper shall be sole authored. The paper can be either theoretical or empirical, and some topics will be suggested over the course of the semester.

Textbooks
The primary texts are Hamilton (1994) (for models and methods) and Hayashi (2000) (for GMM and basic limit theorems). The later sections of the course contains material not covered (at least not well) in textbooks and draws heavily on articles. In any event, the lectures will be self-contained.


Supplemental Texts (more specialized)


Hall, A.R., *Generalized Method of Moments*, Oxford: Oxford University Press, 2004 (Everything you every wanted to know and more about GMM under classical asymptotics.)


Course Outline

Primary readings are denoted by “*”.

1. Fundamentals of second order stationary time series
   Brockwell and Davis, Chs. 1, 3, Sect. 5.7
   *Hamilton, Chs. 1-5, 7, 13.
   Harvey, Chs. 1, 2.1-2.5, and 6

2. The spectrum and linear filtering theory in the frequency domain
   Brockwell and Davis, Ch.4, 6, 10
   *Hamilton, Ch. 6
   Harvey, Ch. 3
   Brillinger, Chs. 3-5

3. Inference and model selection in linear time series models
   *Hamilton, Ch. 7; Hayashi, Chapter 2

   Hall and Heyde, ch. 4.

5. Structural Breaks
   a. Testing

   b. Estimation


6. Heteroskedasticity and autocorrelation consistent (HAC) variance estimation


7. Generalized Method of Moments and Weak Instruments/Weak Identification


*Hayashi, Ch. 3 and 4 or Hamilton, Ch. 14.

Hall, A.R., ch. 4-5


8. The Kalman and NonGaussian filter and applications

a. The Kalman and NonGaussian filter


Harvey, Ch. 4; Ch. 5.1-5.4

*Hamilton, Ch. 22


b. Linear Gaussian models with unobserved components


c. Regime switching


d. Stochastic volatility and Markov Chain Monte Carlo (MCMC) methods
   Non-Gaussian State Space Models,” *Biometrika*.
*Geweke, John (2005), Contemporary Bayesian Econometrics and Statistics*, New York: Wiley, ch. 4


  Index, and Tests of Duration Dependence Based on a Dynamic Factor Model with


*Journal of the American Statistical Association*, 94(446), 590-599.

9. Modeling of and inference for persistent time series
a. Univariate unit roots: estimation, testing, and local to unity theory
     Time Series With a Unit Root,” *Journal of the American Statistical Association* 74,
     no. 366, 427-431.
     Unit Root,” *Econometrica* 64, 813-836.
     1411-1452.
     302.
  sections 1-4.*
b. Multivariate unit roots and cointegration

c. Predictive regression with persistent regressors

10. Vector Autoregressions and SVARs
a. Impulse response functions, variance decompositions, inference

b. Structural VARs: identification schemes


c. Inference with long-run restrictions


d. Inference for impulse responses


12. Estimation and inference of linearized DSGEs
*DeJong and Dave, ch.2-4


13. Large data sets: Dynamic Factor Models and FAVAR


14. Model evaluation and forecast comparison
Hansen, P.R. (2008), “In-Sample and Out-of-Sample Fit: Their Joint Distribution and its Implications for Model Selection,” manuscript, Stanford University

15. Topics in financial econometrics
* TBA