

**EC 821 Time Series Econometrics  
Spring 2000**

**Professor Jushan Bai**

**Tuesday-Thursday 12:00 noon-1:15 pm, Carney, Rm. 238**

**Office Hours: Tuesday and Thursday 1:30-2:30pm and by appointment**

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**Course Description**

This course explores models and statistical techniques for analyzing nonstationary data with a focus on unit root and cointegration. The course has two objectives. The first is to provide students with the tools necessary for modeling economic time series, particularly macroeconomic and financial time series. The second is to provide a solid foundation in time series econometrics.

**Course Requirements**

There will be two problem sets and a take-home final exam. Your course grade will be determined by your performance on the problem sets (50%) and the final exam (50%). It is essential to attempt all problems by yourself, even though you are allowed to work together on the assignments. However, you are expected to complete the final exam independently.

A good command of basic probability and statistics (e.g., Econ 770 or equivalents) as well as a good understanding of stationary time series analysis is necessary to successfully complete this course.

**Textbooks**

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

(FH) Fumio Hayashi: *Econometrics*, Lecture Notes.

**Other Useful Textbooks in Time Series**

P.J. Brockwell and R.A. Davis: *Time Series: Theory and Methods*. New York: Springer, 1990.

This is technical yet well written book on stationary time series analysis. It is highly recommended for students wishing to do time series econometrics.

W.A. Fuller: *Introduction To Statistical Time Series*, 2nd Edition. New York: Wiley, 1996.

C. Gouriéroux, and A. Monfort (1997): *Time Series and Dynamic Models*. Cambridge: Cambridge University Press.

Andrew Harvey: *Time Series Models*, MIT Press.

## Course Outline

### Part I: Unit Roots in Univariate Time Series

#### 1. Trend stationarity versus difference stationarity

JH: Chapters 15 and 16.

FH: Chapter 9.1

Nelson, C.R. and C.I. Plosser, "Trends and random walks in macroeconomic time series," *Journal of Monetary Economics* (1982) 129-162.

#### 2. Mathematical background in stochastic processes

Stochastic processes, Brownian motion, functional central limit theorem, continuous mapping theorem, stochastic integration, weak convergence to stochastic integrals.

JH: Chapters 17

FH: Chapter 9.2

Billingsley, P. (1968). *Weak Convergence of Probability Measures*, New York, Wiley.

Karatzas, I. and S.E. Shreve (1991). *Brownian Motion and Stochastic Calculus*. New York, Springer Verlag.

#### 3. Unit-root asymptotics and tests for unit roots

Dickey-Fuller test, DFA test, Phillips-Perron Test.

JH: Chapter 17

FH: Chapter 9.3-9.6

Cochrane, J.H. (1988), "How big is the random walk in GNP," *Journal of Political Economy*, 96, 893-920.

Dickey, D.A. and W.A. Fuller (1981). "Likelihood ration statistics for autoregressive time series with a unit root," *Econometrica*, 49 1057-1052.

Phillips, PCB (1987). "Time series regression with a unit root," *Econometrica*, 55, 277-301.

Phillips, PCB and P. Perron (1987). "Testing for a unit root in time series regression," *Biometrika*, 75 335-346.

## **Part II: Multiple Integrated Time Series**

### **1. Unit roots in multiple time series**

JH: Chapter 18

### **2. Cointegration**

Long-run relationships, co-movement, cointegration, representation theory.

JH: Chapters 19

FH: Chapter 10

Engle, R.F. and CWJ Granger (1987) "Cointegration and error correction: representation, estimation and testing," *Econometrica*, 55, 251-276.

Phillips, PCB (1991) "Optimal inference in cointegrated systems," *Econometrica*, 59 283-306.

Stock, J.H and M.W. Watson (1988) "Testing for common trends," *Journal of the American Statistical Association*, 83 1097-1107.

Watson, M. (1994), "Vector autoregressions and cointegration," *Handbook of Economet-*

*rics*, Vol IV, Chapter 47.

### 3. Maximum Likelihood Inference on Cointegrated Systems

Cointegration rank, cointegration space, likelihood ratio tests for cointegration.

Johansen, S. (1988) "Statistical analysis and cointegrating vectors," *Journal of Economic Dynamics and Control* 12 231-254.

JH: Chapter 20

FH: Chapter 10

### Part III: Time Series Conditional Heteroskedasticity

ARCH, ARCH in mean, GARCH, stochastic volatility

JH: Chapter 21

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