

# Economics 408

## Time Series Econometrics

### Spring 2020

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This is an introduction to modeling time series data. The prerequisites are mathematical economics (or math through multivariable calculus) and econometrics or mathematical statistics.

#### Texts

James D. Hamilton, *Time Series Analysis* (QA 280.H264 1994, on reserve)  
David F. Hendry, *Dynamic Econometrics* (HB 141.H458 1995, on reserve)

Other readings are available from the Blackboard site:

Johnston and DiNardo, *Econometric Methods*, Fourth Edition (J&D).  
Maddala, G.S., *Introduction to Econometrics*, Second Edition (M).  
Moody, *Basic Econometrics with Stata* (BES)

#### Grading

Forecasting test	20%
Homework	20%
Modeling test	20%
Term paper	40%
There is no final exam.	

All homework assignments must be completed. Questions based on the homework assignments will be on the final exam.

Grading scale: A 90-100, B 80-89, C 70-79, D 60-69. Numerical grades are rounded up.  
Add/drop deadline (Jan. 31); withdraw deadline (March 23).

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## Introduction and Review

Matrix derivatives

Least squares

Assignment 1: matrix algebra, write a Stata regression program

Gauss-Markov theorem

### Trigonometry (Hamilton 704-711)

Complex numbers  
Circular functions  
DeMoivre's Theorem

### Difference Equations (Hamilton ch. 1)

Dynamic multipliers (P&R 413-431)  
Eigenvalues (Johnston, J. "The Eigenvalue Problem")  
Stability conditions: roots inside the unit circle

### Lag Operators (Hamilton ch. 2)

Lag polynomials  
Stability conditions: roots outside the unit circle

## Stationary Time Series Models

### Univariate Time Series Models and ARMA's

(P&R 463-601; Hamilton ch. 3, 4; J&D 204--215)

Stationary ARMA processes

White noise

Covariance stationarity

MA(q) processes

AR(p) processes

### **Digression: nonstationary processes and ARIMA**

### **Box-Jenkins forecasting philosophy (M, 542-549; J&D 228-234)**

a. Identification

b. Estimation

c. Forecasting

Assignment: forecasting

### **Multi-Equation models: VAR's**

(P&R 399-407, 431-435; M, 578-80, 592-7; Hamilton ch. 11; J&D 287-301)

VAR's and reduced form equations

Matrix notation

Stability conditions

Impulse response functions

Hypothesis tests

Granger causality tests (P&R 216-7; M, 393-4)

Assignment: VAR (crime and punishment)

## **Models of Nonstationary Time Series**

### **Unit Roots (Hamilton ch. 15, 17)**

Trend Stationary vs Difference Stationary Models (M, 258-264)

Persistence of shocks

Dickey-Fuller tests (P&R 507-513; M 582-588; J&D 215-228; BES Ch. 15, 16)

Assignment: Diebold and Senhadh, "The Uncertain Unit Root in Real GNP: Comment," *American Economic Review*, 86, 1996, 1291-98.

Assignment: Lothian and Taylor "Real Exchange Rate Behavior: The Recent Float from the Perspective of the Past Two Centuries," *Journal of Political Economy* 104, 1996, 488-509.

### **Unit root tests and structural breaks**

Is Crime a Random Walk?

### **Multivariate Time Series Models: Cointegration (Hamilton ch. 19)**

Cointegration and long term equilibria

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

Tests for cointegration (P&R 513-516; M, 588-600; J&D 301-305)

Enders, W. "Characteristic Roots, Rank, and Cointegration." 385-405.

Estimating the cointegration vector (dynamic ordinary least squares)

Assignment: Warner, "Does world investment demand determine U.S. imports?" *American Economic Review*, 84, 1994, 1409-1422.

Assignment: Demand for money in the US, Stock and Watson, "A simple Estimator of Cointegrating Vectors in Higher Order Integrated Systems," *Econometrica*, 61, 783-820, 1993. Read section 7 (Stock&Watson.pdf).

## **Modeling Time Series Data: David Hendry and the British School**

(Hendry, *Dynamic Econometrics*)

Levels of knowledge (ch 1)

Econometric Concepts (ch 2)

Nonsense regressions and spurious detrending (ch 4)

Exogeneity (ch 5)

Typology of linear dynamic models (ch 7)

Dynamic systems (ch 8)

Theory of reduction (ch 9)

Simultaneous equations (ch 11)

Encompassing (ch 14)

Modeling issues (ch 15)

Example: demand for money in the U.K.(ch 16)

Hendry and Ericsson, "An econometric analysis of U.K. money demand in monetary trends in the United States and the United Kingdom by Milton Friedman and Anna J. Schwartz."

*American Economic Review* 81, March 1991, 8-49.

Granger, C.W.J. "Where are the Controversies in Econometric Methodology?"

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

Pagan, A.R. "Three Econometric Methodologies: A Critical Appraisal."

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

"Professor Hendry's Econometric Methodology."

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

Review and integration with mainstream econometrics: Johnston & Dinardo, 244-265.

## **Panel Data (BES Ch. 17)**

Fixed effects model

Panel unit root tests

Panel cointegration tests