Georgetown University **ECON-616, Fall 2016**

Macroeconometrics

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Office Hours: by appointment

Scheduled Class Time and Organization: Class will meet once a week *Tuesdays from 6:30p-9:00* for lecture in Room 204A, Intercultural Center.

Course Description: The course is an introduction to univariate and multivariate time series models. Time domain methods, including VAR's, structural VAR's, Bayesian VAR's for linear models and GMM for non-linear stationary models are covered. An introduction to non-stationary time series models is given. Frequency domain methods and their applications to business cycle inference is also covered. The course starts by introducing basic concepts and progresses to more complicated models. The course intends to meet two goals. It provides tools for empirical work with time series data, mostly for macroeconomic applications and provides a heuristic introduction into the theoretical foundation of time series models.

Prerequisites: Econ 613 and 614.

Course Web Page: Course documents and information are available via [tba]

Course Requirements:

- **Problem Sets**: There will be approximately 6 problem sets, assigned during the semester. The problem sets are designed to give the students the opportunity to review, enhance, and extend the material learned in class. Students are encouraged to form small study groups, however, each student has to submit

his or her own write-up of the solution. These solutions must be submitted on the specified due dates. [50%]

- **Final Exam** : Date [tba] [50%]

Programming and Computation: Macroeconometrics is an intensely computational field. It is important to be proficient in at least one interpeted programming language popular in economics. The assignments will require (some) light programming. I'll say more about this on the first day of class.

Course text:

There is no one textbook that exactly matches the material covered in class. I will make my lecture notes available on the internet. You should get a copy of Hamilton (1994), which broadly classical approach to time series analysis (and some Bayesian analysis).

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

Other textbooks that you might find helpful are (though I recommend that you take a close look before you purchase any of them):

General Econometrics:

Amemiya, T. (1985): "*Advanced Econometrics*," Harvard University Press.

Davidson, R. and J. MacKinnon (1993): "*Estimation and Inference in Econometrics*," Oxford University Press.

White, H. (1984): "*Asymptotic Theory for Econometricians*," Academic Press.

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

Time Series Analysis:

Brockwell, P.J. and R.A. Davis (1991): "*Time Series: Theory and Models*," Springer-Verlag.

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

Granger, C.W.J. and P. Newbold (1987): "*Forecasting Economic Time Series*," Academic Press.

Harvey, A.C. (1990): "*The Econometric Analysis of Time Series*," MIT Press.

Modern Macroeconometrics:

Canova, Fabio (2007): *Methods for Applied Macroeconomic Research,* Princeton University Press.

DeJong, David and Chetan Dave (2007): *Structural Macroeconometrics,* Princeton University Press.

Herbst, Edward and Frank Schorfheide (2015): *Bayesian Estimation of DSGE Models,* Princeton University Press.

Bayesian Statistics and Econometrics:

Gelman, Andrew, John B. Carlin, Hal S. Stern, and Donald B. Rubin (1995): *"Bayesian Data Analysis,"* Chapman & Hall, New York.

Geweke, John (2005): *"Contemporary Bayesian Econometrics and Statistics,"* Wiley, New York.

Koop, Gary (2003): *"Bayesian Econometrics,"* John Wiley & Sons.

Lancaster, Tony (2004): *"An Introduction to Modern Bayesian Econometrics,"* Blackwell Publishing.

Poirier, Dale (1995): *"Intermediate Statistics and Econometrics - A Comparative Approach,"* MIT-Press.

Robert, Christian P. (1994): *"The Bayesian Choice,"* Springer-Verlag, New York,

Further references are provided in each section of the lecture notes.

Macroeconometrics – Course Outline

Note: The course outline is subject to change during the semester!

1 Time Series Models

1.1 Basics

Concepts: least squares estimation, asymptotic behavior of estimators, rates of convergence, large sample behavior of dependent processes.

(i) Analysis of the Deterministic Trend Model: Rates of Convergence, OLS Estimation and Serial Dependence

(ii) Empirical Measures of Dependency

(iii) Covariance Stationarity, Stationarity and Ergodicity

(iv) Martingales and Martingale Difference Sequences

1.2 Stationary ARMA Processes

Concepts: Lag operators, difference equations, maximum likelihood estimation.

(i) Theoretical Properties: Moving Average Processes

(ii) Theoretical Properties: Autoregressive Models

(iii) ARMA Models

(iv) Frequentist Maximum Likelihood Estimation of the Gaussian AR(p) Model

(v) Vector extension: VAR Models

James H Stock and Mark W Watson. Vector autoregressions. *Journal of Economic Perspectives*, 15(4):101–115, 2001

1.3 Analysis of Difference Stationary Time Series

Concepts: Frequentist unit root asymptotics.

(i) Autoregressive Models with a Unit Root

(ii) Testing for Unit Roots

(iii) Unit Roots from the Frequentist and the Bayesian Perspective

(iv) Cointegration and Error Correction Models

1.4 Introduction to Spectral Analysis

Concepts: Fourier transformations, introduction to Kernel smoothing.

(i) Typical Spectrum of Macroeconomic Time Series

(ii) Spectral Representation for the Linear Cyclical Model

(iii) Spectral Representation for Stationary Processes

(iv) Filters

(v) Spectral Estimation

1.5 Extremum Estimation

(i) Generalized method of moments and maximum likelihood estimation interpreted as extremum estimation.

(ii) Consistency

(iii) Asymptotic Normality

(iv) Further Issues

1.6 Factor Models

Concepts:

(i) Principal Components Analysis

(ii) Dynamic Factors

(iii) Determining Number of Factors

(iv) Factor Augmented VAR

1.7 Bayesian Analysis of Linear Time Series Models

Concepts: Bayesian inference, model selection, forecasting.

(i) Introduction to Bayesian Statistics: Point Estimation, Testing Theory

(ii) Bayesian Analysis of AR Models

(iii) Bayesian Model Selection: Determining the Order of an AR process

(iv) Markov-Chain Monte Carlo Methods to Generate Draws from Posteriors

1.8 State Space Models

(i) Bayesian Interpretation of the Kalman Filter

(ii) Computing likelihood functions for LRE models

(iii) Nonlinear Models: Markov-Switching

2 Structural Models

2.1 Structural VARs

(i) Identification

(ii) Algorithms for Inference

(iii) Extensions: MS-VAR, TVP-VAR, Proxy-SVAR

2.2 Linear (and Nonlinear) Rational Expectations (LRE) Models

(i) LRE models as approximations to dynamic stochastic equilibrium (DSGE) models.

(ii) Moment-based Estimation of linear and nonlinear rational expectations models

(iii) Likelihood-based Estimation of LRE models.

2.3 Hybrid Models

(i) DSGE-VARs

(ii) DSGE-DFM

(iii) Proxy SVAR

3 Advanced Topics

3.1 Monte Carlo Methods

(i) Sequential Monte Carlo for static parameters

(ii) Particle Filtering

(iii) Advanced MCMC

References

[1] James H Stock and Mark W Watson. Vector autoregressions. *Journal of Economic Perspectives*, 15(4):101–115, 2001.