Department of Economics
Rutgers University
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ECONOMICS 510
APPLIED ECONOMETRICS FOR MACROECONOMICS

Learning Goals and Assessment

The objective of this course is to learn quantitative and empirical methods that have proven to be useful in macro research. We will emphasize applications rather than the development of the methods, but we will also cover their foundations and intuition.

Because current research in macroeconomics focuses on growth and business cycle phenomena, the appropriate methods are dynamic, time series oriented. Hence we will discuss time series, recursive methods, and other dynamic tools. Given its increasing prominence, we will cover some basic numerical and computational issues as well. By the end of the course, course participants should be familiar with a quantitative and empirical arsenal applicable to their own research projects.

The grade for the course will be determined by class assignments (60%) and a term project (40%) to be discussed later.

References, Prerequisites, Activities

This course will draw on multiple references, but the following ones are probably the most useful ones (depending on topic):

1. *D. DeJong and C. Dave, *Structural Macroeconometrics,* Princeton University Press, Second Edition, 2011 (DD hereon)
2. *M. Miranda and P. Fackler, *Applied Computational Economics and Finance*, MIT Press, 2002 (MF)
3. *V. Martin, S. Hurn, and D. Harris, *Econometric Modelling with Time Series*, Cambridge University Press, 2014 (MHH)
4. J. Hamilton, *Time Series Analysis,* Princeton University Press, 1994 (H)
5. Herr, Burkhard, and Alfred Maussner, *Dynamic General Equilibrium Modeling*, 2nd Edition, Springer 2009 (HM)
6. L. Ljungvist and T. Sargent, *Recursive Macroeconomic Theory,* Third Edition, MIT Press, 2012 (LS)
7. N. Stokey and R. Lucas (with E. Prescott), *Recursive Methods in Economic Dynamics*, Harvard University Press, 1989 (SL)

8. K. Judd, *Numerical Methods in Economics*, MIT Press, 1998 (J)

The most essential sources for our purposes are marked with an asterisk (*).

Working knowledge of a computer programming language, such as GAUSS or MATLAB will be necessary. Knowledge of an econometrics package such as RATS will be also useful.

Outline and Basic Readings

The literature is huge and, in some cases, still evolving. Here is a list the main topics and associated basic references. This is only a start, and we will add (or drop) readings and topics as needed.

1. Growth vs Cycles. Dealing with Trends

Macroeconomic Time Series. Trend versus Cycle Decomposition. Stationarity. Differencing. HP and Other Filters.

DD, chapter 6

2. Univariate Time Series Analysis

Covariance Stationary Processes. The Wold Decomposition. Characterization: Covariogram and Spectrum. ARMA processes. Difference Stationarity. Estimation, Specification, and Testing.

DD, ch. 7
MHH, ch. 13
H, ch. 3, 5-8

3. Multivariate Time Series: VARs and Related Topics

Stationary Vector Processes. Cointegration. Vector Autorregresions. Structural VARs and Identification.

MHH, ch. 14
H, ch. 10, 11

4. Numerical Topics: Optimization and Equation Solving

Numerical Solution of Linear and Nonlinear Equations. The Complementarity Problem. Optimization.

MF, ch. 2-5
J, ch. 3-5, 7
MHH, ch. 3

5. State Space Methods: Kalman, Applications

State Space Representations and the Kalman Filter. Markov Switching Models. Dynamic Factor Models. FAVAR Models.

MHH, ch. 15
DD, ch. 8
H, ch. 13

6. Generalized Method of Moments

GMM Basics. GMM Estimation of Dynamic Models.

DD, ch. 12
MHH, ch. 10
H, ch. 14

7. Dynamic Programming and Recursive Methods

Basic Functional Analysis. Bellman's Principle of Optimality. Recursive Equilibria and Functional Equations. Applications.

SL, ch. 3-5, 9-10
LS, ch. 3-6

8. Numerical Topics: Function Approximation and Practical Dynamic Programming. Functional Equations

Finite State Approximations to the DP problem. Projection Methods.

MF, ch. 6-9

J, ch. 6, 11-12
LS, ch. 12
HM 4, 6

9. Numerical Topics: Integration and Simulation Methods

Numerical Differentiation and Integration. Estimation by Simulation.

MF, ch. 5
J, 7-9
DD, ch. 9, 12.2
MHH, ch. 12

10. Using DYNARE

Some fine points and pitfalls with DYNARE. Solving models with occasionally binding constraints

Adjemian, S., H. Bastani, M. Juillard, F. Mihoubi, G. Perendia, M. Ratto, and S. Villemot (2014). "DYNARE Reference Manual, Version 4".

Guerrieri, Luca, and Matteo Iacovello, "OccBin: A toolkit for solving dynamic models with occasionally binding constraints easily", *Journal of Monetary Economics*, 70 (2015), 22-38

11. Maximum Likelihood and Bayesian Estimation of DSGE Models

DD, ch. 13-14
MHH, ch. 1-2, 4