Economics 613a

Advanced Macroeconomics I
Computational Methods for Macroeconomics
Fall 2006

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Office: SSC 4024
Office Hours: By Appointment
Course Time: Tuesdays and Thursdays 2:00-3:30pm
Location: SSC 4032
Course Web Page: http://publish.uwo.ca/~kkopecky/Teaching/eco613a/
Grading:

- Assignments
- Project/Presentation

Course Description

The primary goal of the course is to equip students with the numerical tools necessary to tackle interesting questions in macroeconomics. The course has two main focuses. The first is the study of numerical methods and algorithms pertinent to solving and analyzing macro models. The second is the study of good examples of their application by macroeconomists. While this is not a computer programming course, the course work will be computational in nature. Students should be familiar with some programming language such as Matlab, Fortran, or C. While all the course work can be completed with Matlab, my recommendation to students who are serious about macroeconomics is to use this course as an opportunity to learn either Fortran or C.

Useful Textbooks

- **Heer, Burkhard and Alfred Maussner.** 2005. *Dynamic General Equilibrium Modelling.* Berlin, Germany: Springer.
- **Judd, Kenneth L.** 1998. *Numerical Methods in Economics.* Cambridge, MA: MIT Press.
- **Cooley, Thomas. (ed.)** 1995. *Frontiers of Business Cycle Research.* Princeton, N.J.: Princeton University Press.
- **Press, William H.; Saul A. Teukolsky; William T. Vetterling; and Brian P. Flannery.** 1992. *Numerical Recipes in C.* New York, N.Y.: Press Syndicate of the University of Cambridge.

  Also *Numerical Recipes in Fortran 77*, *Numerical Recipes in Fortran 90*, and *Numerical Recipes in C++.*

All but C++ are available at
`http://www.library.cornell.edu/nr/index.html`.

- **Marimon, Ramon and Andrew Scott.** 1999. *Computational Methods for the Study of Dynamic Economies.* Oxford University Press.
- **Ljungqvist, Lars and Thomas Sargent.** 2000. *Recursive Macroeconomic Theory.* Cambridge, MA: MIT Press.
- **Miranda, Mario J. and Paul L. Fackler.** 2002. *Applied Computational Economics and Finance.* Cambridge, MA: MIT Press.
- **Adda, Jerome and Russell Cooper.** 2003. *Dynamic Economics.* Cambridge, MA: MIT Press.
- **Stokey, Nancy; Robert E. Lucas, Jr.; and Edward C. Prescott.** 1989. *Recursive Methods in Economic Dynamics.* Cambridge, MA: Harvard University Press.

Course Outline

1. **Motivation**
   - KYDLAND AND PRESCOTT (1996)
2. **Numerical Analysis**
   - Computing Basics
     - Towards good programming
     - Sources of error
     - Conditioning and stability
     - Iteration
     - JUDD (1998) CH. 2
     - PRESS (1996) CH. 1
   - Nonlinear Equation Solving
     - One dimensional root-finding methods
     - Solving systems of nonlinear equations
   - Function Approximation and Interpolation
     - SCHUMAKER (1983)
   - Numerical Differentiation and Integration
     - Approximating derivatives
     - Some classical quadrature
     - Gaussian quadrature
   - Optimization
     - Unconstrained optimization

        - gradient-based methods
        - non gradient-based methods
    - Constrained optimization
        - penalty methods

3. **Computation of Discrete Time Dynamic Models**

    - Discrete state space dynamic programming
        - Computing deterministic DGE models
            - Value function iteration
            - Policy function iteration
        - Computing stochastic DGE models
            - Markov chains
                - Tauchen (1986)
    - Continuous state space dynamic programming
        - Projection Methods
            - McGrattan (1999)
            - Judd (1992)
        - Parameterized expectations
            - den Haan and Marcet (1990)
            - Marcet and Lorenzoni (1999)
    - Comparing Methods
        - Aruoba, Fernandez-Villaverde and Rubio-Ramirez (2005)

4. **Calibration**

    - Cooley and Prescott (1995)
    - Gomme and Rupert (2005)
    - Prescott (Fall 1986)

5. **Transition Paths**

    - Extended path method
    - Selected Papers:
        - Hansen and Prescott (2002)
        - Galor and Weil (2000)
        - Greenwood and Seshadri (2002)
        - Greenwood, Seshadri and Yorukoglu (2005)

6. **Heterogeneous Agent Models**

    - Aiyagari (1994)
    - Hansen and Imrohoroglu (1992)
    - Rios-Rull (1996)
    - Chatterjee, Corbae, Nakajima and Rios-Rull (2005)

- KRUSELL AND SMITH JR. (1998)

7. **Additional Topics (time permitting)**

   - Computational methods for continuous time modeling
   - Estimating DGE Models

Papers

Aiyagari, S. Rao. 1994. "Uninsured Idiosyncratic Risk and Aggregate Saving." *Quarterly Journal of Economics*, *109* (3), pp. 659–684.

Aruoba, S. Boragan; Jesus Fernandez-Villaverde; and Juan F. Rubio-Ramirez. 2005. "Comparing Solution Methods for Dynamic Equilibrium Economies." *Journal of Economic Dynamics and Control*, *forthcoming.*

Chatterjee, Satyajit; Dean Corbae; Makoto Nakajima; and Jose-Victor Rios-Rull. 2005. "A Quantitative Theory of Unsecured Consumer Credit with Risk of Default."

Cooley, Thomas and Edward C. Prescott. 1995. "Economic Growth and Business Cycles." in Thomas Cooley, ed., *Frontiers of Business Cycle Research.* Princeton, N.J.: Princeton University Press, pp. 1–38.

den Haan, Wouter J. and Albert Marcet. 1990. "Solving the Stochastic Growth Model by Parameterizing Expectations." *Journal of Business and Economic Statistics*, *8* (1), pp. 31–34.

Galor, Oded and David N. Weil. 2000. "Population, Technology, and Growth: From Malthusian Stagnation to the Demographic Transition and beyond." *The American Economic Review*, *90*, pp. 906–828.

Gomme, Paul and Peter Rupert. 2005. "Theory, Measurement and Calibration of Macroeconomic Models." *Journal of Monetary Economics*, *forthcoming.*

Greenwood, Jeremy; Ananth Seshadri; and Mehmet Yorukoglu. 2005. "Engines of Liberation." *Review of Economic Studies*, *72* (1), pp. 109–133.

_____ **and** _____**.** 2002. "The U.S. Demographic Transition." *The American Economic Review*, *92* (2), pp. 153–159.

Hansen, Gary D. and Ayse Imrohoroglu. 1992. "The Role of Unemployment Insurance in an Economy with Liquidity Constraints and Moral Hazard." *100* (1), pp. 118–142.

_____ **and Edward C. Prescott.** 2002. "Malthus to Solow." *The American Economic Review*, *92* (4), pp. 1205–1217.

Judd, Kenneth L. 1992. "Projection Methods for Solving Aggregate Growth Models." *Journal of Economic Theory*, *58*, pp. 410–452.

_____**.** 1998. *Numerical Methods in Economics.* Cambridge, MA: The MIT Press.

Krusell, Per and Anthony A. Smith Jr. 1998. "Income and Wealth Heterogeneity in the Macroeconomy." *106* (5), pp. 867–896.

Kydland, Finn E. and Edward C. Prescott. 1996. "The Computational Experiement: An Econometric Tool." *The Journal of Economic Perspectives*, *10* (1), pp. 69–85.

Marcet, Albert and Guido Lorenzoni. 1999. "The Parameterized Expectations Approach: Some Practical Issues." in Ramon Marimon and Andrew Scott, eds., *Computational Methods for the Study of Dynamic Economies.* Oxford University Press, pp. 142–171.

McGrattan, Ellen. 1999. "Application of Weighted Residual Methods to Dynamic Economic Models." in Ramon Marimon and Andrew Scott, eds., *Computational Methods for the Study of Dynamic Economies.* Oxford University Press, pp. 114–142.

Prescott, Edward C. Fall 1986. "Theory Ahead of Business Cycle Measurement." *Federal Reserve Bank of Minneapolis Quarterly Review*, pp. 9–22.

Press, William H.; Saul A. Teukolsky; William T. Vetterling; and Brian P. Flannery, eds. 1992. *Numerical Recipes in C.* New York, N.Y.: Press Syndicate of the University of Cambridge. or Numerical Recipes in Fortran 77, Numerical Recipes in Fortran 90, or Numerical Recipes in C++ All but C++ are available at http://www.library.cornell.edu/nr/index.html.

Rios-Rull, Jose-Victor. 1996. "Life-Cycle Economics and Aggregate Fluctuations." *Review of Economic Studies*, *63* (3), pp. 465–489.

Schumaker, Larry L. 1983. "On Shape Preserving Quadratic Spline Interpolation." *SIAM Journal on Numerical Analysis*, *20* (4), pp. 854–864.

Tauchen, George. 1986. "Finite State Markov-Chain Approximations to Univariate and Vector Autoregressions." *Economics Letters*, *20*, pp. 177–181.