Syllabus for

COMPUTATIONAL METHODS FOR ECONOMIC DYNAMICS
ECON 561a

Course Objectives: Most of the dynamic models used in modern quantitative research in economics do not have analytical (closed-form) solutions. For this reason, the computer has become an indispensable tool for conducting research in economics. The goal of this set of lectures is to provide an introduction to computational tools for conducting numerical analysis of dynamic economic models.

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Office hours: Thursdays from 2:30PM to 4PM, or by appointment

Class Meetings: The course meets on Tuesdays and Thursdays from 10:30AM to 11:50AM in Room B1 (28 Hillhouse). This is a half-semester course; the last lecture is on Thursday, October 18.

Prerequisites: This course is designed for graduate students in economics who have taken first-year graduate courses in microeconomics, macroeconomics, and econometrics. No prior knowledge of either numerical methods or computer programming is assumed, but some familiarity with a programming language would prove helpful.


**Exercises:** The best (and really the only) way to learn numerical methods is to use them in actual problems. Accordingly, each week of lectures will be accompanied by a set of problems for students to solve. It is highly recommended that students attempt to work these problems!
SCHEDULE OF LECTURES

Week 1

Introduction (built around some simple examples from economics, including the stochastic-growth model and a canonical consumption-savings model).

General considerations in numerical analysis: convergence, roundoff error, truncation error.

Numerical differentiation.

Root-finding in one or more dimensions: bisection, secant method, Newton’s method, fixed-point iteration, Gauss-Jacobi, Gauss-Seidel, Brent’s method.

Suggested readings:

Chapters 1, 5.7, and 9 in *Numerical Recipes*; Appendix 2A, Chapter 3, and Chapter 5.6 in Miranda and Fackler; Chapters 1, 2, 5, and 7.7 in Judd.


Week 2

Minimization in one or more dimensions: golden section search, Brent’s method with or without derivatives, simplex method, Newton-Raphson, variable metric methods.

Suggested readings: Chapter 10 in *Numerical Recipes*; Chapter 5 in Miranda and Fackler; Chapter 4 in Judd.
Week 3

Interpolation and approximation of functions: linear interpolation in several dimensions, cubic splines, polynomial interpolation, orthogonal polynomials.

*Suggested readings:* Chapters 3 and 6 in *Numerical Recipes*; Chapter 5 in Miranda and Fackler; Chapter 6 in Judd.

Week 4

Numerical integration: cubic spline integration, Gaussian quadrature, Monte Carlo integration, integration of multivariate normal densities.

*Suggested readings:* Chapters 4 and 7 in *Numerical Recipes*; Chapter 5 in Miranda and Fackler; Chapters 7 and 8 in Judd.

Week 5

Numerical dynamic programming: value iteration, Euler equation methods, rules of thumb, perturbation methods, parameterized expectations, linear-quadratic (first-order) and second-order methods.

*Suggested readings:*

Chapters 7, 8, and 9 in Miranda and Fackler; Chapters 12, 13, 16, and 17 in Judd.


Kim, J., S. Kim, E. Schaumburg, and C.A. Sims (2003), “Calculating and Using Sec-


**Week 6**

Computation of dynamic equilibrium models with heterogeneous actors.

*Suggested readings:*


