PSC 585: Dynamic and Computational Modeling

Spring 2011
T 14:00-16:40pm
Harkness 112

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Dynamic considerations are becoming increasingly important in the study of such political processes as stability of international systems, the conduct of war, legislative policy making, regime change, and the impact of political variables on economic growth and industry dynamics. The course provides theoretical and computational tools for the analysis and estimation of models of strategic interaction with an emphasis on dynamic games. In the first half of the course theory and numerical methods for Markov chains, dynamic programming, general dynamic games are covered in some detail. In the second half we focus on issues of identification and estimation with an emphasis on efficient numerical algorithms. Non-parametric methods are discussed when applicable. Applications include but are not limited to models of bargaining, voting, and the non-parametric estimation of voter preferences. The goal of the course is to equip graduate students with analytical and numerical tools that can be used in their future research on applied topics.

Students are expected to have taken the first-year sequence in formal theory, PSC 407 and 408, as well as PSC 584. Some familiarity with a programming language is a plus, but the dedicated student should be able to acquire basic programming skills needed for the course. MATLAB will be the default programming language in class and for assignments.

There will be approximately four homework assignments and a final exam. Each assignment will encompass a mix of theoretical and applied problems with an emphasis on the latter. You will be expected to write your own code and implement numerical methods related to the various course topics.

There are three textbooks for the course.

- N. Stokey and R. Lucas with E. Prescott (1989) *Recursive Methods in Economic Dynamics,* Cambridge, MA: Harvard University Press.

- M. Miranda and P. Fackler (2002) *Applied Computational Economics and Finance,* Cambridge, MA: MIT Press.

- K. Judd (1998) *Numerical Methods in Economics,* Cambridge, MA: MIT Press.

The books by Judd and Miranda and Fackler are available online via the University library.

The content of the course is broken into seven sections, although the bulk of the class will likely be devoted to the first five. Note that some of the readings referenced below are mathematically demanding. Mathematical background will be interspersed throughout the course and, where appropriate, simplified versions of the readings will be presented.

SCHEDULE

Topic 1 Markov chains

Finite and infinite state spaces. Classification of states. Long-term stability. Speed of convergence. Strong Law of Large Numbers.

Algorithms: Depth-first search. Tarjan and Kosaraju. Coupling From The Past. Grassman-Taksar-Heyman.

Numerical Methods: Integration.

Related readings: Stokey-Lucas-Prescott, chapters 11, 14. Miranda and Fackler, chapter 5. Judd, chapter 7. Class notes. [14], [20], [23], [50], [59], [60], [45].

Topic 2 Dynamic Programming

Finite and infinite state space. Uncertainty. Bellman equation. Principle of optimality. Computation.

Algorithms: Value iteration. Error bounds. Policy iteration. Gauss-Jacobi and Gauss-Seidel. Approximate policy iteration.

Numerical Methods: Function interpolation. Projection methods.

Related readings: Stokey-Lucas-Prescott, chapters 4, 9. Miranda and Fackler, chapters 6, 7.1, 8.1-8.4 Judd, chapter 6, 11, 12. Class notes. [54], [56].

Topic 3 Dynamic Games

Determinacy of equilibrium and equilibrium outcome distributions. Stochastic games. Computation of Nash equilibrium. The tracing procedure.

Algorithms: Globally convergent homotopy. HOMPACK.

Numerical Methods: Perturbation methods.

Related readings: Miranda and Fackler, chapters 8.5, 9. Judd, chapters 4.9, 5. Class notes. [13], [15], [17], [18], [28], [27], [26], [21], [22], [25], [42], [61], [62],[64].

Topic 4 Structural Models – Identification

Generalized extreme value distribution model. Dynamic Discrete Choice models. Quantal response equilibrium. Parametric and non-parametric identification. Identification of utility functions.

Related readings: Class notes. [3], [12], [43], [7], [24], [32], [36], [40], [37], [44], [51], [54], [57].

Topic 5 Structural Models – Estimation & Inference

Maximum Likelihood. Two- and n-step estimator. Minimum distance, GMM, MSM estimators.

Algorithms: Nested Fixed Point. Swapped Nested Fixed Point.

Related readings: Class notes. [9], [2], [4], [5], [6], [10], [11], [19], [29], [30], [31], [35], [46], [47], [48], [49], [52], [53], [55], [58].

Topic 6 Non-Parametric Preference Estimation

Revealed preference theory. Shape restrictions. Non-parametric roll-call voting models.

Related readings: [1], [38], [39], [41], [40], [33], [34], [63].

Topic 7 Continuous Time Models

Models of continuous time. Computation and estimation.

Related readings: Miranda and Fackler, chapter 10-11. [8], [16].

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