PSC 407 Mathematical Modeling

Fall, 2020
MW 9:15–10:30am
Harkness 329

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Hours: by appointment

This course is the first half of a two-course sequence consisting of PSC 407 and PSC 408. The goal of the sequence is to give students an introduction to the main concepts and models used in formal political theory and game theory. The sequence emphasizes rigorous analysis and the development of modeling skills needed for work in applied modeling. It is designed to serve both as a foundation for students planning on taking further courses in formal political theory and as a self-contained overview of the field for students who do not intend to do additional coursework in the field. Students should have, at a minimum, a sound familiarity with basic algebra (solving equations, graphing functions, etc.) and a knowledge of basic calculus.

Homeworks, a midterm, and a final will be assigned to help develop and test students' mathematical modeling skills. Students are allowed to collaborate on homework, but after discussion with others, each student is expected to write up her or his answers independently. The date and time of the final are set by the University Registrar: it will take place on **Tuesday, December 15, at 12:30,** and you will have three hours to complete it.

The primary source material for lectures will consist of videos, which will be made available before each lecture, along with supplemental readings drawn from two manuscripts (pdfs of chapters will be distributed, as needed) and a textbook:

- Duggan and Fey, *Analytical Methods in Political Economy: The Mathematics of Voting*
- Duggan, *Analytical Methods in Political Economy: The Mathematics of Spatial Modeling*
- Simon and Blume, *Mathematics for Economists*

Lectures will be held in person, and they will focus on discussion of relevant video content and readings. Students are expected to familiarize themselves with the lecture material prior to attending class, to bring questions, and to be prepared to engage in discussion.

Attendance of lectures is mandatory, but *in-person attendance is not:* if a student prefers not to attend in-person, then they may switch to attend online. This is not intended to be a weekly choice, but rather as an option to be exercised because of health concerns. If the number of students attending in person falls below an adequate level, then the course will convert to online lectures at the same time slot.

Students attending class in person must adhere to University and New York State guidelines for protecting health and safety of the community, and in particular, each student must wear a mask

covering their mouth and nose for the duration of each class session, and students must maintain social distancing of six feet. See the COVID-19 Community Commitment and University Testing and Safety Protocols for more information.

The teaching assistant for the course is **Jacque Gao,** who will hold a weekly recitation and office hour. Keep in mind that the TA's primary responsibility during recitation is to answer your questions, so come prepared.

An outline of the topics to be covered is as follows.

1. *Overview of Formal Models*—a survey of the basic toolkit of rational choice models
2. *Preference and Choice*—preference relations, utility, voting rules, majority core, Arrow's theorem
3. *Cost-benefit Analysis*—cost-benefit model, comparative statics, multiple agents, social surplus
4. *One-dimensional Policy Choice*—Quadratic utility, single-peakedness, median voter theorem, dynamic games and backward induction, policy choice with status quo
5. *Consumer Choice*—consumer demand, endowments and the Edgeworth box, Walrasian equilibrium, Pareto optimality
6. *Multidimensional Policy Choice*—Quadratic utility, spatial preferences, Pareto optimality, policy choice with status quo, Plott's theorem and instability
7. *Public Good Provision*—static games and Nash equilibrium, public goods, externalities, Pareto inefficiency, mechanism design
8. *One Dimension with Voter Uncertainty*—expected utility, von Neumann-Morgenstern axioms, mean-variance analysis, probabilistic voting, symmetric Nash equilibrium.

*All assignments and activities associated with this course must be performed in accordance with the University of Rochester's Academic Honesty Policy; for more information, visit the University webpage on Academic Honesty.

** The University of Rochester respects and welcomes students of all backgrounds and abilities. In the event you encounter any barrier(s) to full participation in this course due to the impact of disability, please contact the Office of Disability Resources at `disability@rochester.edu`. Visit the Office of Disability webpage for more information.

*** This course follows the College credit hour policy for four-credit courses. This course meets twice per week for a total of four hours per week; in addition, the course includes one hour of recitation per week.