

PSCI 407 MATHEMATICAL MODELING

Fall, 2024
MW 10:00–11:50
Harkness 112

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Hours: by appointment

This course is the first half of a two-course sequence consisting of PSCI 407 and PSCI 408. The goal of the sequence is to give students a rigorous introduction to the main concepts and models used in positive political theory and game theory. At the same time, we will teach you the mathematical tools necessary to understand and analyze these models, to incorporate them in your research, and (if it suits you) to push the frontier of mathematical modeling in political science. The sequence emphasizes rigorous logical and deductive reasoning—this skill will prove valuable, even to the student primarily interested in empirical analysis, rather than modeling.

The sequence is designed to serve both as a rigorous foundation for students planning to take further courses in the positive political theory field, and as a self-contained overview of the field for students who do not intend to do additional coursework in it. PSCI 407 is mainly concerned with rational decision making and preference aggregation—analyzing the choice problem of a rational agent and considering the challenges of reconciling conflict of preferences across agents—whereas PSCI 408 will focus on strategic interaction and game-theoretic analysis.

Students should have, at a minimum, a sound familiarity with basic algebra (solving equations, graphing functions, etc.) and a knowledge of basic calculus. Consistent with department policy, students are required (unless explicitly exempted) to attend the “math camp” offered in the weeks before the fall semester.

Homeworks, a midterm, and a final will be assigned to help develop and test your mathematical modelling 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 **Sunday, December 15, at 12:30pm**, and you will have three hours to complete it. This date is firm, so keep it in mind when making your travel plans for winter break.

There are multiple resources available in the [course Dropbox folder](#). The main sources for class lectures will be a manuscript in progress,

- *Formal Methods in Political Economy: A First Course*,

in which I collect the tools and applications needed (and more!) for PSCI 407. In addition, I recommend that all students obtain:

- Simon and Blume, *Mathematics for Economists*.

Simon and Blume is a valuable compendium of the mathematics used in the social sciences, but the applications are oriented toward economics. Nevertheless, it will be a valuable complement to the main volumes. For students who want more advanced references in positive political theory or selected topics in mathematics, I am glad to provide recommendations.

An outline of the topics to be covered is as follows (timing and topics should be taken with a grain of salt!)

Week	Topic	Material
1	logic and proofs	Chapter 2
2	set theory	Chapter 3
3	relations & choice	Chapter 4
4	mappings & utility	Chapter 5
5	social choice theory	Chapter 6
6	linearity & spatial model	Chapter 7
7	expected utility	Chapter 8
8	concavity & Pareto optimality	Chapter 9
9	real analysis	Chapter 10
10	analysis & spatial model	Chapter 10
11	multivariate calculus	Chapter 11
12	calculus & the core	Chapter 11
13	unconstrained optimization	Chapter 12
14	constrained optimization	Chapter 13

The teaching assistant for the course is **Andre Van Parys**, 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.

*All assignments and activities associated with this course must be performed in accordance with the University of Rochester's Academic Honesty Policy. Visit the [academic honesty webpage](#) for more information.

** 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. Visit [the office website](#) 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.