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 a rigorous introduction to the main concepts and results in positive political theory. At the same time, we will teach you the mathematical tools necessary to understand these results, to use them, and (if it suits you) to surpass them in your own research in political science. The course will emphasize rigorous logical and deductive reasoning — this skill will prove valuable, even to the student primarily interested in empirical analysis rather than modelling.

The sequence is designed to be both a rigorous foundation for students planning on taking further courses in the positive political theory field and serve as a self-contained overview of the field for students who do not intend to do additional coursework in the field. The sequence will cover both social choice theory, which concerns finding an axiomatic basis for collective decision making, and game theory, which analyzes individual behavior in strategic situations.

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 to attend the “math camp” offered in the weeks before the fall semester.

Homeworks, possibly a midterm, and definitely a final will be assigned to help you develop your mathematical skills. There are three textbooks for the course.

- O’Leary (L), *The Structure of Proof*
- Simon and Blume (SB), *Mathematics for Economists*
I will supplement these with some of my own notes.

- Duggan (D), *Introduction to Formal Political Theory*

The teaching assistant for the course is Tugba Guvenc, who will hold a weekly recitation and have office hours. Tentatively, recitation will be held in [ROOM], [DAY & TIME]. Keep in mind that Tugba’s primary responsibility during recitation is to answer your questions, so come prepared.

An outline of the topics to be covered is as follows. Next to each, I list readings from the texts. It will be clear from the selections of readings that the authors, especially Simon and Blume, organized their books differently than I’m organizing the course. Later chapters, say Simon and Blume’s Chapter 22 on “Economic Applications,” won’t be easily accessible the first time through.

1. logic and sets [L 1–4; SB A1]
   - logical connectives, necessary and sufficient conditions, direct proof, proof by contradiction, set operations, quantifiers, natural numbers, real numbers, maximum and supremum

2. Relations and the Finite Choice Model [L 6; O 1.1–1.2; D 2]
   - relations, transitivity, weak orders, maximal elements, individual preference, strict and weak preference

3. The Social Choice Model [O 2.1–2.2; D 4–6]
   - majority preference, core/Condorcet winner, Pareto dominance, Pareto optimality, aggregation rules, voting paradoxes, sincere agendas, May’s theorem, Arrow’s Theorem

4. Mappings, Utility, and the Unidimensional Spatial Model [SB 2–3, 5, A2; O 4.6; D 7]
   - mappings, domain and range, utility functions, monotonicity, concavity and quasi-concavity, continuous/differentiable functions, maximization, single-peakedness and the median voter theorem

- vector addition, scalar multiplication, lines and hyperplanes, convex sets, simplexes, multivariate functions and level sets, concavity and quasi-concavity, dot products and orthogonality, Euclidean norm, open and closed sets, gradients, maximization

6. The Multidimensional Spatial Model [O 1.3–1.4, 2.3, 4.7; D 8]

- convex and continuous preferences, indifference curves, utility representations, Plott’s theorem, McKelvey’s theorem and the top cycle set, uncovered set

7. Manipulability [O 2.4; D 8]

- misrepresentation of preferences, Gibbard-Satterthwaite theorem