University of Rochester Political Science

Psc 281
Formal Models in Political Science

Prof. Mark Fey
Spring 2025

Syllabus

Office: Harkness 109
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Office Hours: Friday, 1:30-3:00

This course is an introduction to the use of mathematical models in the study of politics. We will survey a broad range of models that are applicable to many aspects of political science. Many of the models that we will consider are parts of "positive political theory," which can be further subdivided into social choice theory and game theory. We will also consider models rooted in probability theory, network theory, as well as computational models. The course rests on the premise that formal political theory can offer insights to those who want to better understand why and how political actors behave the way they do. We will use both strategic and nonstrategic models to further our understanding of political events.

I have set two goals in teaching this course. First, I want to introduce students to the tools of positive political theory using a number of classic political situations ranging from voting, legislative politics, and political campaigns to the comparison of electoral systems, collective action and political participation, and international relations. Second, and as important, I want to show students how positive political theory allows us to sharpen our intuitions and provides us with new ways of looking at familiar topics. In short, this course will try to offer those interested in politics a new way of thinking about political institutions and political behavior, and show those interested in mathematics a broad and fertile area in which its tools have many applications.

While there are no formal mathematical prerequisites for the course, some familiarity with mathematical reasoning and logic is a must.

Course Meetings: Lectures for the course will be twice weekly, Mondays and Wednesdays from 10:25-11:40 in Hylan 203.

Course Work: Student performance will be evaluated on the following activities:

1. Approximately six problem sets covering the lecture material and readings. Due dates for the problem sets will be announced and late work will not be accepted. However, I will drop the lowest score from the problem sets over the semester in calculating the final grade. (40%)

2. An in-class midterm on a date to be announced. (30%)

3. A 10-15 page paper due at the end of the semester that demonstrates an ability to develop and apply formal modeling skills. This can be an original model, a modification of an existing model or an new application of an existing model. (30%)

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Academic Honesty: All assignments and activities associated with this course must be performed in accordance with the University of Rochester's Academic Honesty Policy. More information is available at:

http://www.rochester.edu/college/honesty

Course Readings: Readings will be assigned from the following three textbooks:

1. *The Mathematics of Politics*, 2nd Edition, by E. Arthur Robinson Jr. and Daniel H. Ullman,

2. *The Mathematics of Voting and Elections: A Hands-On Approach*, 2nd Edition, by Jonathan K. Hodge and Richard E. Kilma, and

3. *Analyzing Politics: Rationality, Behavior and Instititutions*, 2nd Edition, by Ken Shepsle.

Additional readings will be from *Networks, Crowds, and Markets: Reasoning about a Highly Connected World*, by David Easley and Jon Kleinberg. The full text of this book is available at http://www.cs.cornell.edu/home/kleinber/networks-book/

There are two optional books:

1. *Making Democracy Count: How Mathematics Improves Voting, Electoral Maps, and Representation*, by Ismar Volić

2. The Mathematics of Elections and Voting, by W.D. Wallis (full text available at https://link.springer.com/book/10.1007/978-3-319-09810-4)

The remaining readings are available online or will be posted on Blackboard.

Course Schedule

Topic 0 Logistics

Topic 1 Why Model?

- Shepsle, Chapter 1
- Joshua Epstein, "Why model?" *Journal of Artificial Societies and Social Simulation*, Vol. 11, No. 4 (2008) (link)
- Philip Schrodt, "Mathematical Modeling," in Jarol Mannheim and Richard Rich, *Empirical Political Analysis*, (2nd edition), Englewood Cliffs: Prentice-Hall, 1986 (Blackboard)
- Morris Fiorina, "Formal Models in Political Science" *American Journal of Political Science*, Vol. 19, No. 1 (Feb, 1975), pp. 133–159 (JSTOR)

Topic 2 Voting With Two Candidates

- Robinson and Ullman, Chapter 1
- Hodge and Klima, Chapter 1
- Volić, Chapter 1

Topic 3 Apportionment

- Robinson and Ullman, Chapters 7, 8, and 9
- Hodge and Klima, Chapter 11
- Volić, Chapters 8,9, and 10

Topic 4 Voting Power

- Robinson and Ullman, Sections 19.3 and 19.4
- Hodge and Klima, Chapter 8
- Wallis, Chapter 8
- Shapley and Shubik, "A Method for Evaluating the Distribution of Power in a Committee System," *American Political Science Review*, Vol. 48, No. 3. (1954), pp. 787-792. (JSTOR)

Topic 5 Gerrymandering

- Hodge and Klima, Chapter 12

- Volić, Chapters 11 and 12

- Jordan S. Ellenberg, "Geometry, inference, complexity, and democracy,"
  Bulletin of the American Mathematical Society 58 (2021), pp. 57-77 (link)

- Jonathan K. Hodge, Emily Marshall, and Geoff Patterson, "Gerrymandering
  and Convexity," *The College Mathematics Journal*, 41:4 (2010), pp. 312-324
  (link)

Topic 6 Voting With Many Candidates

- Robinson and Ullman, Chapters 2 and 3

- Hodge and Klima, Chapters 2 and 3

- Shepsle, Chapter 2, pp. 13–29, Chapter 3, and Chapter 7, pp. 191–202

- Easley and Jon Kleinberg, Sections 23.2–23.4

- Volić, Chapters 2 and 3

- Wallis, Chapters 2 and 3

Topic 7 What Voting System is Best?

- Robinson and Ullman, Chapters 4 and 5

- Hodge and Klima, Chapters 4 and 5

- Shepsle, Chapter 4

- Easley and Jon Kleinberg, Sections 23.5 and 23.11

- Volić, Chapter 4

- Wallis, Chapters 4 and 5

Topic 8 The Spatial Model of Voting

- Shepsle, Chapter 5

- Easley and Jon Kleinberg, Section 23.6

- Duncan Black, "On the Rationale of Group Decision-making," *Journal of
  Political Economy*, Vol. 56, No. 1. (Feb., 1948), pp. 23-34. (JSTOR)

Topic 9 Models of Diversity

- Scott Page, *The Difference*, Chapter 6 (Blackboard)
- Lu Hong and Scott Page, "Groups of diverse problem solvers can outperform groups of high-ability problem solvers," PNAS, 2004 (link)

Topic 10 Models of Neighborhood and Networks

- Thomas Schelling, *Micromotives and Macrobehavior*, 1978, Chapter 4 (Blackboard)
- Easley and Jon Kleinberg, Section 4.5
- Celina Troutman, Brady Clark, and Matthew Goldrick (2008) "Social networks and intraspeaker variation during periods of language change," *University of Pennsylvania Working Papers in Linguistics*, Vol. 14, Issue 1, Article 25. (link)
- Note: These topics will be explored using the NetLogo software package, available at (http://ccl.northwestern.edu/netlogo)

Topic 11 Utility Theory and Applications to Voting and Surprise

- Shepsle, pp. 293–301
- Keith Dowding, "Is it Rational to Vote? Five Types of Answer and a Suggestion," *The British Journal of Politics and International Relations*, Vol. 7, No. 3 (link)
- Robert Axelrod, "The Rational Timing of Surprise," *World Politics*, Vol. 31, No. 2. (1979), pp. 228-246. (JSTOR)

Topic 12 Information Aggregation and Democratic Theory

- Easley and Jon Kleinberg, Section 23.7
- Grofman and Feld, "Rousseau's General Will: A Condorcetian Perspective," *American Political Science Review*, Vol. 82, No. 2. (Jun., 1988), pp. 567-576 (JSTOR)
- Philip Boland, "Majority Systems and the Condorcet Jury Theorem," Philip J. Boland *Journal of the Royal Statistical Society. Series D*, Vol. 38, No. 3 (1989), pp. 181–189 (JSTOR)

Topic 13 Information Cascades

- Easley and Jon Kleinberg, Chapter 16

Topic 14 Information in Networks

- Easley and Jon Kleinberg, Chapters 18 and 19

Topic 15 Jury Theories Reconsidered

- Easley and Jon Kleinberg, Sections 23.8 and 23.9