Syllabus for PS 232A: Formal Models in Political Science, Spring 2021

Instructor: Andrew Little, andrew.little@berkeley.edu. Office hours: Wednesday 3:00-4:30pm or by appointment (email me with a few proposed times).
GSI: Jieun Kim, kimjieun@berkeley.edu. Office hours: Tuesdays 9:30-11am.
Class: 11:00am-12:29am, TuTh.
Recitation: 2:00-3:59, Th.
(See bcourses for all Zoom links)

This course introduces graduate students in political science and related fields to formal theory, a tool for studying strategic interaction that is now used throughout the discipline. Students will learn the basic concepts of game theory—the main branch of formal theory we use—and how to solve most of types of games used in applied political science work.

Goals For this Course and the Sequence

In addition to this course, the department offers a second formal theory course which covers some of the basics of this class in more technical detail and them moves on to more advanced material (232B) and "topics" courses (239) that focus on particular substantive applications. Students who want more advanced training should also consider taking math and theory classes in the economics department.

Since this is the first class in the sequence, one aim is to help you figure out how formal theory can make you a better researcher, and what further coursework will get you there. While you will get some sense of your interests from this class and problem sets, as well as readings you do for other classes, the only way to really know whether one likes doing original formal theory research is to do original formal theory research. The paper proposal assignment (see below) is a way to make sure everyone gets taste of what this is like.

Here is a personal view of what classes you should consider taking as a function of how you see formal theory fitting in to your research plans, lumped into general categories you might fall into:

- "General consumer": able to understand less technical, classic papers, and at least follow the gist of more technical papers. Definitely take this class, 232B is useful too.

- "Serious consumer": not necessarily using models in your own work, but doing empirical (often experimental) work that closely engages with cutting-edge formal theory. Definitely take this class and 232B, 239 would be great when relevant to your interests.

- "Light user": potentially overlapping with the previous category, but also doing some original modeling in your work. Definitely take this class and 232B, and some economics classes would be wise if you have the time. Taking topics classes would also be helpful even if not directly overlapping with your interests.

- "Heavy user": most work uses formal theory. Definitely take this class and 232B, and some of the Economics sequence is strongly recommended as well. Take the topics classes when possible unless they look totally uninteresting given your substantive focus.

It is important to emphasize that the classification above is ordered only in terms of what classes I recommend. There is no magical threshold at which one becomes a "real" formal theorist; learning formal theory can make you a better researcher and thinker regardless of what bin you fall into. And the main goal of this class (and all of your other classes) is to make you a better researcher and thinker.

Finally, I encourage everyone to enter this class with an open mind about how formal theory can fit into your research plans, regardless of your substantive interests, current knowledge of formal theory/math, or whether you think you are the kind of person who should do formal theory. This is not to deny that some topics are more amenable to formal theory than others, or that those with less math background will need to put in some work to catch up. But if you have the interest and ideas to pursue, I am committed to help you get there. Anyone can become a formal theorist, regardless of prior training, gender, race, ethnicity, or any other demographic characteristic. If you'd like to discuss your needs and plans in more detail feel free to set up a meeting.

A Note on Math

This class will make you feel dumb. In a sense, that is the point. I don't mean that the class is designed to be a cruel rite of passage. (Though going through challenging material with your cohort is a great means of bonding.) Rather, much of formal theory's power lies in making clear when our ideas for how "rational" people should behave are wrong, or at least incomplete.[1] Humans are almost universally bad at abstract and precise reasoning, and so without the rigor of formalizing our theories we frequently lull ourselves into a false sense of certainty that our intuitions are right.

Being confronted with one's wrongness and confusion is not fun, particularly for the kind of person who has done well enough in school to gain admission to a top PhD program. But if we

[1] "Behavioral" models which assume people are in some sense not fully rational are not off the hook on this front. There are an infinite number of ways to deviate from a standard rationalist benchmark, and without formalizing these deviations it is extremely hard to pin down their implications.

want our theories to be precise, clear, and true, running them through the gauntlet of formalization and seeing what survives is one of the best – if not the best – methods we have.

This means doing math. However, ours is not a math class, and we will spend much more time going through relatively simple examples than proving general theorems. While some formal theory in political science uses quite advanced math, a fair amount of applied work requires only high school algebra, and most can be done with the addition of some basic probability and multivariate calculus. I will only assume knowledge of algebra, and any probability, calculus and other notation used will be taught/reviewed as we go along. *All students capable of gaining admission to a Berkeley Ph.D. program can fully succeed in this class regardless of prior technical preparation other than the required skills listed above.*

Math is hard and frustrating at times for everyone. A few suggestions if you are nervous about this aspect of the class:

- Stay on top of the readings, and consult multiple texts if you are having a hard time (more on this below)
- Start problem sets early, even if this just means scanning the problems to get your thoughts percolating
- Most importantly: DO NOT BE EMBARRASSED TO ASK YOUR COLLEAGUES OR ME FOR HELP. Again, EVERYONE struggles with some of this material, so there is no shame in admitting you are confused. Much of the material in the class is cumulative, so it is important to clear up any issues early lest you enter the spiral described here: `http://mathwithbaddrawings.com/2013/04/25/were-all-bad-at-math-1-i-feel-stupid-too/`

General Policies

Teaching Mode

I am planning to primarily hold synchronous lectures during our normal class time. Depending on how things go, I might also do some recording of asynchronous lectures and cut down on the live class accordingly.

Texts

There are countless introductory game theory textbooks, and even more opinions on the best individual or set of books to use for a class like this. These vary on their level of technicality, focus on political science, and clarity of writing. I think the one that best suits are purposes and hence will serve as the main text is:

- Steven Tadelis, “Game Theory: An Introduction”

A list of typos and corrections to the book (which are incorporated in my version of the book, but perhaps not if you get a used version) can be found here:

`http://assets.press.princeton.edu/releases/m10001.pdf`

When studying game theory (and other technical topics), it is often extremely useful to consult more than one source. For simplicity I will primarily work off Tadelis and won’t require any additional text, but I strongly recommend you acquire at least one of these based on your needs.

Here are two other good books at a similar level as Tadelis:

- Robert Gibbons, “Game Theory for Applied Economists”
- Martin Osborne, “An Introduction to Game Theory”

If you are uncomfortable with the technical aspects of the course, you should try reading the corresponding section in this text before Osborne:

- Avinash Dixit, Susan Skeath, and David H. Reiley Jr., “Games of Strategy”

If your book must be written by Political Scientists, try:

- Nolan McCarty and Adam Meirowitz, “Political Game Theory”

For those who want a more detailed and technical treatment, a good (free!) choice is:

- Martin J. Osborne and Ariel Rubinstein, “A Course in Game Theory”

Two other popular sources among Game Theorists are

- Roger Myerson, "Game Theory”
- Drew Fudenberg and Jean Tirole, “Game Theory”

Another nice source are some videos by William Spaniel:

- `https://williamspaniel.com/on-youtube/`

The list could go on; ask me, others, or the internet if none seem to suit your needs.

Evaluation

- Class Participation: 10%. While this is mostly a lecture class, it should be relatively interactive: I expect to be interrupted a lot, and will sometimes have the class break into groups to work on problems together. So, regular attendance and participation will be necessary to do well.

- Problem Sets: 40%. Problem sets will be given out most weeks by Thursday evening at the latest. The problem sets are the following Thursday (exact logistics at the discretion of the GSI)

- Final Exam: 30%. I usually give a 48 hour take-home exam which can be taken any time during finals week, though the exact format will be negotiable.

- Final Paper: 20%. The paper is akin to a proposal for a model that could be a part of a research paper (about 5 pages). Alternatively, if you incorporate a model into a seminar paper for another class that will count as well, provided you have permission from the other instructor.

Collaboration and Academic Honesty for Problem Sets

The plurality of your grade for the class will come from the nearly-weekly problem sets. I strongly encourage you to work together on the problem sets. Collaboration benefits both the receivers of help as well as the givers: being able to explain something to others is one of the best ways to truly master it. Three important guidelines for collaboration:

1. You should always spend some time trying to figure out the problems on your own before turning to others. This is both to keep a check on how well you understand the material, and because the initial stages of trying to crack a problem on your own are an important – if hard! – way on the path to understanding.

2. Your solution must be written in your own words. As a concrete point, **you should never copy any code or prose when writing things up electronically.** Again, copying is a waste of everyone's time.

3. If your solution to a problem comes from one of your colleagues – and this is more than fine as long as you follow guidelines 1 and 2 – acknowledge them in your write up. For example "Joe M provided the general approach to solving part a"

What you learn from doing the problem sets is far more important than your grades. To be blunt, rote copying of an answer from your colleagues or other sources is a waste of your time and the grader's time, in addition to violating academic honesty. Further, I am open about the fact that I re-use problems across years (some of them are pretty good!) and circulate answer keys, so answers may be out there. I expect that you will not seek these out or use them.

Schedule

Headers refer to approximately one class. The exact pace of the class is endogenous: comprehending what we do cover will be prioritized over getting through everything.

Introduction; Why do Game Theory; Preferences, Choice, and Utility

Background

Ben Orlin, "What it Feels Like to Be Bad at Math"

Little, Andrew and Thomas Pepinsky. 2016. "Simple and Formal Models in Comparative Politics," Chinese Political Science Review. Vol 1, No 3, 425–447.

Covered

My lecture notes on preferences (**or** Tadelis Chapter 1)

Decision-making with uncertainty and time

Tadelis Chapter 2

What is a (normal form) game? What is a solution?

Tadelis Chapter 3

Pre-Nash solutions

Tadelis Chapter 4. Can skim 4.2 and later references to Iterated Deletion of Strictly Dominated Strategies.

Nash Equilibrium, Discrete Applications

Tadelis Chapter 5.1

Nash Equilibrium, Continuous Applications

Tadelis Chapter 5.2-5.3 (particularly 5.2.3, 5.2.5)

Mixed Strategies

Covered: Tadelis Chapter 6.1-6.2
Optional: Tadelis Chapter 6.3-6.4

Extensive Form Games

Tadelis Chapter 7

Solving Extensive Form Games

Tadelis Chapter 8.1-8.2

Examples of Extensive Games

Tadelis Chapter 8.3, 11.2

Multistage Games

Tadelis Chapter 9

Infinitely Repeated Games 1

Tadelis Chapter 10.1-10.5

Infinitely Repeated Games 2, the Folk Theorem

Tadelis Chapter 10.6

Examples of Infinitely Repeated Games

Tadelis Chapter 11.3-11.4

Bayes Rule and Bayesian Games

Tadelis Chapter 12.1

Applications of Bayesian Games

Tadelis Chapter 12.2-12.4 (12.5 Optional)

Extensive Games of Incomplete Information; Beliefs

Tadelis Chapter 15.1

Perfect Bayesian(/Sequential) Equilibrium

Tadelis Chapter 15.2-15.4

Signaling and Screening

Tadelis Chapter 16

Cheap Talk

Tadelis Chapter 18