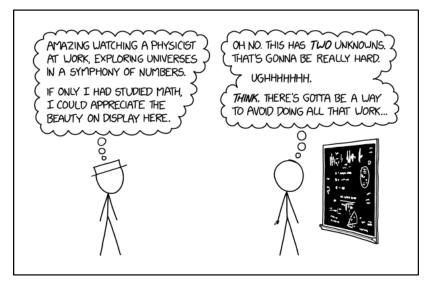# PSCI552 - Formal Theory I (Graduate) (1.0)

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Schedule: Tuesday & Thursday 3:00-4:30PM
Office Hours: Tuesday 4:30-6:30PM.
Class Location: PCPSE 200.
Course Website: On Canvas.

Course Overview

This is a formal theory course oriented towards political science graduate students, though it is open to undergraduate students who are interested in a course that adopts this kind of approach. It should be a useful "jumping off" point for those interested in using formal models in their work, a good course for those who are interested in being better able to read work in formal theory, and more generally a good course for those who are interested in learning a particular "lens" for looking at the world - one in which a particular commitment to precision is emphasized, which can be useful even if you primarily are interested in empirical work.

The course content will start with pre-game theory preliminaries, including preferences and utility, choices under uncertainty, and some of the basics of optimization theory. We will then cover the most fundamental concepts and refinements in game theory: Nash equilibrium along with refinements like subgame perfection, Bayesian equilibrium, and perfect Bayesian equilibrium. In each case, depth will be emphasized over breadth of coverage; it turns out, most formal theory work uses only a few basic methods/solution concepts!

We will not assume significant prior mathematical training, but will introduce some important mathematical concepts/techniques as we go along, and basic facility with mathematics would certainly be an asset. Some of the questions will involve writing mathematical proofs, and we will thus spend some time talking about how to do that as well.

Course Grading Breakdown

50% - Problem Sets (10 total, 5% each)
20% - Midterm
30% - Final

Problem Sets

Problem sets will go out weekly (even the first week!), and are designed to give you some practice applying the content of the previous week. One should not expect these assignments to be particularly long. While there will be 14 total of these, only your top 10 will be included in your grade. I am largely indifferent to you working in groups on these (I understand that some of you enjoy socializing with others), but I would recommend that you take a stab at the questions first before meeting as a group. Each person must submit their own problem set.

Midterm and Final

There will be a midterm and final exam, and the final will be cumulative-ish (i.e. it will cover all of the content in the course, except for content I explicitly tell you will not be included, and the weighting will be towards post-midterm content). Many of the questions will be closely related to questions that appear on the problem sets.

Late Policy

You have seven free late days to allocate across problem sets. So, for example, you could submit one problem set seven days late, or five of the problem sets one day late and another problem set two days late. However, if you run out of late days, it is unlikely you will be granted any other extensions or accommodation, whatever the reason, so you should use these judiciously.

Books and Other References

There is one required book for this course and a bunch of recommended references. A lot of the content will also be conveyed through course notes, which will be updated and provided via the course website. In general, I think consulting more than one reference on particular concepts in game theory can be helpful when you get stuck, so it may be worth getting your hands on a copy of some of the additional references. The broader advice here is: be proactive! If you don't understand one book's treatment of a concept, seek out other explanations, including in office hours.

- **(Required)** Steven Tadelis - Game Theory: An Introduction
  This is a relatively new textbook that is becoming a popular choice for political science graduate courses, as it is precise and uses a bit of math, but tones things down a bit from the standard graduate-level econ treatment. We will use this as the main course textbook, though we will also cover content not included in this book.

- (Recommended) Martin Osborne - Introduction to Game Theory
  The main advantage of this book is that it's a fairly precise take on many of the core concepts in game theory, but it doesn't use a lot of advanced math.

– (Recommended) Robert Gibbons - Game Theory for Applied Economists
This book is about the level I'd like to pitch the course, but the substantive content is a little economics-y for a political science course. If you can get over that, it would be a great, easy to read reference.

– (Recommended) Mas-Colell, Whinston, Green (MWG) Microeconomic Theory
So, this is the standard textbook for a first-year Ph.D microeconomic theory sequence in economics programs. It has a reputation for being... difficult... which I think is slightly overblown, but it is indeed pitched at a higher level than this course. Some of the preference theory content will be loosely drawn from this book, but you probably don't need to buy it if you don't intend to pursue this stuff more seriously over the long term.

– (Recommended) James Morrow - Game Theory for Political Scientists
This book is great, and used to be the standard book for grad political science game theory courses, but is maybe a touch behind the times in terms of the level of technicality given that it was published in 1994. Still a great reference for getting the intuitions.

– (Recommended) McCarty and Meirowitz - Political Game Theory
This book is probably the closest thing we have to a modern game theory book oriented towards political scientists.

– (Recommended) William Spaniel - YouTube Videos on Game Theory
So, for something a little less traditional, William Spaniel (Rochester Ph.D and Pittsburgh Assistant Professor of Political Science) has YouTube videos which could be a fun complement to some of the textbook resources here.

Course Schedule

- Topic 0: Mathematical Proofs, What They Are and How to Write Them.
  Also, what is formal theory? Why is formal theory?

  – Healy - Fuck Nuance
  – Krugman - Two Cheers for Formalism

- Topic 1: Preferences, Utility Function Representations of Preferences.

  – Tadelis - Chapter 1.
  – MWG - Chapters 1-3.
  – Morrow - Chapter 2.

- Topic 2: Choices Under Uncertainty

  – Tadelis - Chapter 2.

- Topic 3: Optimization Theory, Comparative Statics

  – Tadelis - Chapter 19.
  – Ashworth and Bueno de Mesquita - Monotone Comparative Statics.

- **–** Clarke - The Phantom Menace: Omitted Variable Bias in Econometric Research.
- Topic 4: What is a solution concept? Rationalizability, Common-Knowledge.
  - **–** Tadelis - Chapter 3-4.
- Topic 5: Nash Equilibrium.
  - **–** Tadelis - Chapter 5-6.
- Topic 6: Dynamic Games of Complete Information (Subgame Perfection)
  - **–** Tadelis - Chapters 7-8.
- Topic 7: Static Games of Incomplete Information (Bayesian Nash Equilibrium)
  - **–** Tadelis - Chapters 12-13.
- Topic 8: Dynamic Games of Incomplete Information (Perfect Bayesian Nash Equilibrium)
  - **–** Tadelis - Chapters 15-16.
- Topic 9: Repeated Games
  - **–** Tadelis - Chapters 9-10.
- Topic 10 (Time-Permitting): Applications of Game Theory in Political Science
  - **–** Various papers/references. May end up being integrated into earlier parts of the course.