Economics 180: Honors Game Theory

Stanford University, Fall 2016

https://canvas.stanford.edu/courses/49584

Syllabus version: October 21, 2016

Lectures: Tue, Thu 1:30 – 3:20 PM, Landau 218

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1 Overview

What the class is about: Game theory is the study of *strategic interactions*: situations where your decision of what to do depends on what you think others will do. Here are a few examples:

- When a small number of companies compete to sell some product, each company's decision about what price to charge depends on what its competitors are charging.
- Your decision whether to accept a job offer, or a marriage proposal, or Google's offer to buy out your startup, might depend on what alternative offers are likely to come along if you wait. But others' decisions to make offers to you will in turn depend on whether they think their offers will be accepted.
- Your decision to help out a neighbor in need — say, by lending her money — might depend on whether you think she will pay you back by helping you later. And her doing so, in turn, depends on whether she'll expect your help again in the future.
- Politicians' decision about whether to take a bribe might depend how likely they are to be caught, which in turn depends on how many other people are taking bribes.

Game theory provides a toolkit for formulating mathematical models of these situations and thinking through predictions about how people will behave. Game theory was initially developed as a branch of mathematics, but it has had the greatest impact in economics and is now part of any professional economist's training. It has also been influential in other fields such as political science, computer science, and evolutionary biology.

This course provides a mathematically rigorous introduction to game theory, covering basic concepts and results, and applications from economics and elsewhere. This course forms a sequence with Econ 181: Honors Information and Incentives and Econ 182: Honors Market Design. Taking all three courses will provide an overview of much of modern microeconomic theory, but the courses can also be taken independently.

The economics department also offers another game theory class, Econ 160, which covers much of the same material but at a less sophisticated level. There is also PoliSci 153, which is also a more introductory class that leans more toward political applications.

Prerequisites: There are no formal prerequisites. However, the course will be taught at a high level of mathematical rigor and will have a heavy workload. You should be comfortable with basic calculus and probability, and be willing to look things up as needed. The most important requirement is "mathematical maturity" — you should be comfortable reasoning with formal definitions, and reading and writing proofs. Accordingly, it is strongly recommended that you have at least some coursework in abstract mathematics, such as Math 113, 115, or 120, before taking this class. No background in economics is required.

Grading: 40% problem sets, 20% midterm, 40% final exam.

There will be 7 problem sets, assigned on Tuesday beginning the second week, and due the following Tuesday, except for the midterm week when you will have an extra week (and except for the Thanksgiving break). You may work in groups, but you should write your own solutions, and indicate who else you worked with. I encourage you to do as much as you can on your own, and talk to your classmates only when you get stuck. You learn much more by struggling with a problem yourself than by hearing someone else explain it.

This course conforms to the economics department common syllabus, which is at `http://economics.stanford.edu/undergraduate/major/economics-common-syllabus` and describes policies for deadlines, exam absences, regrades, and so forth. In particular, it prohibits me from giving extensions on homework.

Reading: Unfortunately, there isn't really a single textbook that is appropriate for this class. Therefore, the lectures are the primary source for the class. Coming to lecture is important. However, I'll post reasonably detailed outlines for each lecture on the course website in advance, so that you can get a preview of material before the class and a handy

source for review afterwards.

In addition, there are two good textbooks that are imperfect substitutes for the lecture material:

- Steven Tadelis, *Game Theory: An Introduction*, Princeton University Press, 2013.
- Drew Fudenberg and Jean Tirole, *Game Theory*, MIT Press, 1991.

The Tadelis book covers much of the material for this class, and has lots of additional examples and discussion, but it is at a more introductory level and doesn't hit on all the topics we will cover. Fudenberg and Tirole is a more advanced text and covers more of this class (but still not everything). It is a graduate textbook and is not quite ideal for someone who has not seen game theory before.

You may find both books to be helpful references as you go along. The schedule below indicates the most relevant sections of each book for each part of the class, although the correspondence isn't perfect. If you want to buy just one of the two books, Tadelis is likely to be the better option. In any case, you will be held responsible for the material covered in lectures and in the problem sets, but not for anything else that you may encounter in the textbook sections. For the segments of the class that aren't covered in either textbook, I am happy to suggest additional readings, but I haven't included them here to avoid overloading you with readings.

Schedule: The class will aim to adhere to the schedule below, but there may be some adjustment.

- 9/27, 9/29, 10/4: Introduction to games, strategies, and equilibrium

  Tadelis: chapters 3–6

  Fudenberg & Tirole: chapter 1

- 10/6: Rationality and rationalizability

  Fudenberg & Tirole: section 2.1

- 10/11: Special classes of games: zero-sum and potential games

- 10/13, 10/18: Dynamic games of complete information

  Tadelis: chapters 7–9

  Fudenberg & Tirole: chapter 3, sections 4.2, 4.3

- 10/20, 10/25: Repeated games

  Tadelis: sections 10.1–10.3, 10.6

  Fudenberg & Tirole: section 5.1

- 10/27: Bargaining

  Tadelis: chapter 11

  Fudenberg & Tirole: section 4.4

- 11/1: Static games of incomplete information

  Tadelis: chapter 12

  Fudenberg & Tirole: sections 6.1–6.5, 6.7

- 11/3: Auctions

  Tadelis: chapter 13

- 11/8: Dynamic games of incomplete information

  Tadelis: chapter 15

- **11/10: Midterm exam**

- 11/15: Signaling games, cheap talk

  Tadelis: sections 16.1, 18.1, 18.2

  Fudenberg & Tirole: sections 8.1–8.3

- 11/17: Reputation formation

  Tadelis: chapter 17

  Fudenberg & Tirole: sections 9.1–9.2

- 11/29, 12/1: Evolution and learning in games

- 12/6, 12/8: Introduction to cooperative game theory

Final exam time: 12/12, 12:15 – 3:15 PM