Economics 286: Game Theory

Stanford University, Fall 2020

Tue, Thu, 10:30 AM – 12:20 PM Pacific Time

https://canvas.stanford.edu/courses/125126

Syllabus version: September 11, 2020

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1 Overview

What this class is: This is an intermediate-level, mathematically oriented class in game theory, aimed at economics PhD students (but qualified students in other departments are very much welcome to attend). The goals are twofold: to provide technical tools for studying game-theoretic problems that arise in economic models, and to discuss conceptual issues in interpreting predictions made using game theory.

What this class is <u>not</u>:

- **A class just for micro theorists.** This class is meant to provide concepts and analytical tools useful in every area of economics (and beyond).
- **A first course in game theory.** Technically, the mathematical content will be developed in a way that doesn't presume game theory background; but in practice, if you haven't taken a previous game theory class it will be steep going. (The official prerequisite is ECON 203. If you have taken a different game theory class and are unsure if you are prepared, you are encouraged to discuss with me.)
- **An introduction to the research frontiers.** The intent is to give a solid grounding in the standard tools. One quarter isn't enough time to both do that and also survey the current frontiers, although we will run across some relatively recent papers from time to time. ECON 290 or MGTECON 616 are more like "advanced topics" classes.

Format: This class, like everything else, will take place online. This is a relatively new mode of interacting for most or all of us, so I hope for your patience—and your feedback—as we figure out how to make it work. In particular, I recognize that students may be located in many different time zones, may have limited connectivity or other constraints on real-time participation, and may be facing all sorts of other challenges in this presently chaotic world that require creative adaptation. Please do feel free to get in contact about your individual situation; I will do my best to work around logistical barriers and enable everyone to benefit from the course.

The home base for the course is the Canvas webpage (listed at the top of this syllabus). This page will include links to all written materials and to Zoom lectures.

Lectures: The nature of the subject matter calls for a mostly lecture-based format, but we will include some small group discussions.

Class sessions will be recorded and posted to Canvas for the benefit of those who cannot access them in real time. (Please do not create your own separate recordings without express permission.) Everyone is encouraged to join at the regular meeting time if at all possible.

Textbooks: The main official source for this class, which covers much (though not all) of the material, is the still-classic

- Drew Fudenberg and Jean Tirole, *Game Theory*, MIT Press, 1991.

Other books that will provide helpful reading for specific parts of the class are

- Drew Fudenberg and David Levine, *The Theory of Learning in Games*, MIT Press, 1998.
- Martin J. Osborne and Ariel Rubinstein, *A Course in Game Theory*, MIT Press, 1994.
- Donald M. Topkis, *Supermodularity and Complementarity*, Princeton University Press, 1998.

There are also a couple more recent books that overlap substantially with parts of the class. I haven't made them official materials for the course, and haven't referred directly to them on the reading list, but you might find them useful:

- George J. Mailath and Larry Samuelson, *Repeated Games and Reputations: Long-Run Relationships*, Oxford University Press, 2006.
- Michael Maschler, Eilon Solan, and Shmuel Zamir, *Game Theory*, Cambridge University Press, 2013.

The course will also refer, in greater or lesser degrees of detail, to numerous other papers, and occasionally to textbooks other than the above. In order to keep the reading list below manageable, I've listed only a few papers that are most central to the lecture material; these papers will also be linked from the class website. If you are interested in any of the other papers or books mentioned in class and need help finding them, let me know.

Other materials: Three students who took the class in 2017 (Lukas Bolte, Jacob Conway, and Seunghwan Lim) have carefully compiled a detailed series of notes based on the lectures. I cannot guarantee that it is error-free, and the content of the lectures will vary slightly from year to year, but in any case this set of notes will be made available on the course website. My own, less detailed (but more up-to-date) lecture outlines will also be available. (Please do point out any errors in either of these!)

Assignments: There will be three types of assignments.

- **Problem sets.** There will be three of these assigned (planned due dates 10/1, 10/22, 11/12). Grading, and writing of official solutions, will be done collaboratively, and everyone who is enrolled for credit is expected to pitch in. More details will be issued with the first problem set.

  The problem sets will offer a mix of pure theory and applications for you to choose from. On each problem set, you should plan to participate in at least three problems — where "participating" means either turning in a written solution, or helping with grading or with writing official solutions. However, you are encouraged to solve all the problems! They will help build your intuitions for the concepts in the course, and will also cover some classic results not covered in lecture. The problem sets are not meant to be onerous, but they are substantial; several past students have commented that they are harder than they look. Don't leave them for the last day.
- **Final projects.** These are not expected to be original research. Instead, you will pick a topic related to the course that interests you, and summarize and critically

review several existing papers that are representative of the current state of knowledge on the topic. You can choose either pure theory papers, or papers that do more applied modeling as long as they draw on some tools from the course. The intent is for you to get a productive potential start on a possible research topic, by understanding the perspectives and the approaches that existing research has taken, and the challenges and possible limitations. These will be due 11/20, the last day of the quarter. More instructions will emerge later.

- **Summaries.** At the beginning of each class, one student will briefly (in about 3 minutes) summarize the main content of the previous class, and field questions from other students about the previous class. No presentation slides needed. Students will sign up on Canvas for dates. This is meant to be a relatively minor responsibility. Again, everyone should contribute.

2 Schedule of classes

The lectures will aim to adhere roughly to the schedule below. Some adjustments will surely be needed as the quarter proceeds.

2.1 First part: Static games

- 9/15: Basics of static games, solution concepts
  - Fudenberg & Tirole, chapters 1, 2, sections 6.1–6.6
- 9/17: Zero-sum and potential games
  - Osborne & Rubinstein, section 2.5
  - Dov Monderer and Lloyd S. Shapley (1996), "Potential games," *Games and Economic Behavior* 14 (1), 124–143
- 9/22, 9/24, 9/29, 10/1: Supermodular games, global games
  - Fudenberg & Tirole, section 12.3
  - Susan Athey, Paul Milgrom and John Roberts (1998), "Robust comparative statics," draft teaching notes, available online from `https://people.stanford.edu/athey/sites/default/files/draftmonograph98.pdf`

- Topkis, chapter 2, sections 3.1–3.3, chapter 4
- Paul Milgrom and John Roberts (1990), "Rationalizability, learning, and equilibrium in games with strategic complementarities," *Econometrica* 58 (6), 1255–1277
- Timothy Van Zandt and Xavier Vives (2007), "Monotone equilibria in Bayesian games of strategic complementarities," *Journal of Economic Theory* 134 (1), 339–360

2.2 Second part: Dynamic games

- 10/6: Basics of dynamic games
  - Fudenberg & Tirole, chapter 3, sections 4.2, 8.1–8.3
- 10/8: Intuitive criterion, forward induction
  - Fudenberg & Tirole, sections 11.2–11.3
- 10/13, 10/15, 10/20, 10/22: Repeated games, stochastic games
  - Fudenberg & Tirole, sections 5.1, 5.5–5.6, 13.1–13.2
  - Drew Fudenberg, David Levine, and Eric Maskin (1994), "The folk theorem with imperfect public information," *Econometrica* 62 (5), 997–1039
- 10/27, 10/29: Reputation
  - Fudenberg & Tirole, sections 9.1–9.2
  - Jeffrey Ely and Juuso Välimäki (2003), "Bad reputation," *Quarterly Journal of Economics* 118 (3), 785–814
- 11/3, 11/5: Bargaining
  - Fudenberg & Tirole, section 4.4, chapter 10
  - Dilip Abreu and Faruk Gul (2000), "Bargaining and reputation," *Econometrica* 68 (1), 85–117

2.3 Third part: Foundational issues

- 11/10, 11/12: Knowledge and rationality
  - Osborne & Rubinstein, chapter 5
  - Fudenberg & Tirole, chapter 14
  - Eddie Dekel, Drew Fudenberg, and Stephen Morris (2007), "Interim correlated rationalizability," *Theoretical Economics* 2 (1): 15–40
- 11/17, 11/19: Evolutionary foundations
  - Fudenberg & Levine, sections 1.1–1.6, 2.1–2.4, 5.1–5.5
  - Julia Robinson (1951), "An iterative method of solving a game," *Annals of Mathematics* 54 (2), 296–301
  - Dov Monderer and Lloyd S. Shapley (1996), "Fictitious play property for games with identical interests," *Journal of Economic Theory* 68 (1), 258–265