

Econ 411-001: Game Theory Summer II 2020

Instructor: Peter Norman Gardner 300C (maybe at some point), normanp@email.unc.edu

Logistics: We meet remotely 11:30-1:00 MoTuWeThFr using Zoom.

Office Hours With a few exceptions I will stay on after the lecture to answer questions. You can also request individual or group office hours using Zoom over email.

Honor Code: As all other UNC classes the honor code applies. See <https://studentconduct.unc.edu> for details.

Course Description: Game theory is the study of *strategic interactions*. That is, unlike traditional price theory, we are interested in situations where the best choice for the individual depends directly on what other individuals are doing. A few examples are:

- When a small number of sellers compete in the same market, each seller needs to factor in what they think other sellers are doing when deciding on what price to charge or how many units to produce.
- In a seal bid auction, every bidder needs to take bidding strategies of other bidders into consideration when deciding on how to bid.
- In war, the best location for an invasion depends on how the enemy positions its troops for defense.
- In poker, the decision to raise or fold depends on what cards other player that don't fold may hold, which in part depends on how the other players are playing.
- The decision to accept a job offer or a marriage proposal may depend on what alternative offers are likely to materialize in the future.

In this course we will formalize strategic interactions like the examples above as mathematical games. To do so we will define and examine the concept of a strategy, examine what it means to be rational or irrational, and define solution concepts that correspond to different assumptions about how well players can coordinate play as well as differences in assumptions about the sequential and informational structure. Most of these ideas will be illustrated in terms of applications such as auctions, bargaining, signalling, oligopoly, repeated interactions and dynamic pricing.

Game theory was initially developed as a branch of mathematics, initially to understand how certain card games should be played. However, it has had the largest impact in economics and is now a central part of every professional economists' training. It has also had influence in political science (understanding voting strategies and political bargaining), computer science (strategies being algorithms/computer programs), evolutionary biology (formalizing Darwinian selection), and been directly applied to many strategic problems in warfare.

Exams and Grades: All graded components fall under the jurisdiction of the Honor Code. If you have any questions concerning the Honor Code Policy for this course, please ask.

There will be two "in class" midterms (July 6 and July 16) and a final exam (July 27 11:30-2:30). There will also be a graded homework problem due every week. I will administer the tests by emailing the test 15 minutes prior to the official start time. After you finish, use your phone or a scanner to scan the test and email it back to me. You have 30 minutes to finish this task. If you use your phone, please download an app designated to scanning rather than just taking pictures and I also appreciate getting files in pdf format.

- The final accounts for 40% of the grade.

- Each midterm accounts for 25% of the grade.
- The homework problems account for the remaining 10% of the grade.

You are encouraged to cooperate when solving the problems, and you are allowed to hand in homeworks for a group of at most 3 students (you can also hand in for a group of 2 or individually). I do not have a grader, so homework problems are largely graded on effort and the grading scale is rather crude (A,B,F). However, the main role of the homework problems is **not** for me to evaluate you, but for **you** to learn the material. It is therefore a **bad** strategy to divide up the homework assignments. A **good** strategy is to attempt all problems individually, but to discuss the solutions in a small group before handing in the homework.

Syllabus Changes: Exam dates and other aspects of the syllabus may be changed if necessary.

Textbook: I strongly recommend that everyone purchases *An Introduction to Game Theory*, by M.J Osborne (Oxford University Press, 2003, ISBN-13: 978-0195128956). You can get a used copy for less than \$15 online and there is also a newer UK edition. It doesn't matter which version you get. My lecture notes and slides are in principle self-contained, but most students benefit from seeing the material more carefully explained in text. Also, some students find it hard to deal with typos. There are typos in my notes and in my slides.

R. Gibbons, *Game Theory for Applied Economists* (Princeton University Press, Princeton NJ, 1992, ISBN-13: 978-0691003955) is also recommended (and cheap). S. Tadelis, *Game Theory: An Introduction* (Princeton University Press 2013) contains many good discussions and examples, but does not cover all the material in the class.

Outline:

References to the textbook is for the edition I have. There may be slight discrepancies for other editions, but you should be able to find the right place by looking at the Chapter headings.

1. Games in Normal Form

- Dominant and dominated strategies, the prisoner's dilemma (2.2, 2.9)
- Rationality, coordination of beliefs, Nash equilibrium (2, 12)
- Mixed strategies (4)
- Oligopoly: Cournot vs. Bertrand competition vs. cartels (3.1, 3.2)

2. Games in Extensive Form

- Non-credible threats and backwards induction (5.1-5.4)
- Oligopoly: Cournot vs. Stackelberg (3.1, 6.2)
- Bargaining (16).

3. Games of Incomplete Information

- Bayesian Nash equilibrium (9).
- First and second price auctions. When should you shade your bid? (9.6 provides an introduction, mainly lecture notes)
- Signalling, playing poker, advertising, the value of unproductive education (10).
- Adverse selection in product, labor market and insurance (mainly lecture notes)

- Information disclosure (mainly lecture notes)

4. Repeated Games

- Sustaining cooperation, credible vs non-credible threats (14-15)
- Repeated oligopoly, sustaining a cartel using credible threats (14-15)

I have never taught this class in the summer before. I have also never taught it remotely. The time needed is therefore hard to predict, so I may have to drop some of the topics listed above, or be able to add a few other topics.