Game Theory and Applications

Economics 682
Spring 2009

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Office Hours: Wednesday 1.30-2.30 or by appointment.
Course URL is linked from: www.ssc.upenn.edu/~kircher/teaching

The aim of this course is to introduce the basic principles of game theory to you. Game theory has two parts. *First*, it is a language to describe a strategic interaction. It formalizes problems such as: Firm A first sets its price, then Firm B sets its price, then consumers decide where to buy. Luckily for us, game theory is "rich" enough to describe much more interesting environments, starting from arms races to the problem of finding out which physicians are actually good. (We will see that this is a hard problem.) *Second*, game theory proposes solution concepts. It tries to predict what rational players would do if they were faced with a specific game. In the example above: Which price should Firm A set? You will see that the idea how economists think about the solution to a game-theoretic situation is always the same. Yet there are some adjustment to the specific context. The specific context is whether all people act at the same time or subsequently, and whether they know everything about the other players or whether there is some hidden information that players possess (the latter is important in auctions, where you know how much you like the good but you might not know how much the other people like the good).

In the end every student should be able to read applied research papers. They should also understand why economists have chosen these concepts, what limitations they have, and how one could change them to write one's own research paper or derive one's own econometric specification.

The class will meet Tuesdays and Thursdays from 12.00 - 1.30 pm in McNeil 395. Additional material will be posted on the course website. A tentative course outline is listed below. The course will be evaluated on the basis of four problem sets, one midterm and one final exam. The midterm is worth 40% of the grade, and the final 60%. Performance in the problem sets will be taken into account for tie break grades. The final is cumulative but with emphasis on the second half of the course. (There might be additional small homework assignments - for these one of the students is selected at the beginning of the next class to present the result.)

Timetable.
Due dates for problem sets: Feb 3, Mar 3, April 2, April 23
Midterm: March 5, 12.00 - 13.30pm
Final: April 28, 12.00 - 13.30pm

The main texts used are (emphasis is on the first):

- Gibbons, Robert, *Game Theory for Applied Economists*, Princeton University Press, 1992 - HB144.G49 1992.
- Mas-Collel, Andreu, Michael D. Whinston and Jerry R. Green, *Microeconomic Theory*, Oxford University Press, 1995 - HB172.M6247 1995.

Other texts for further reference are

- Fudenberg, Drew and Jean Tirole, *Game Theory*, MIT Press, 2000 - HB144.F83 1991
- Osborne, Martin J. and Ariel Rubinstein, *A Course in Game Theory*, MIT Press, 1994 - HB144.O733 1994.
- Myerson, Roger B., *Game Theory. Analysis of Conflict*, Harvard University Pres, 1997 - H61.25.M94 1991.

For a popular introcuction to game theory, you can consult

- Dixit, Avinash and Susan Skeath, *Games of Strategy*, Norton, 1999 - HB144.DS9.
- Dixit, Avinash and Barry Nalebuff, *Thinking Strategically*, Norton, 1991, HD30.28 .D59 1991.

Course Outline

1. Review of Decision Theoretic Foundations

   (How a rational agents makes choices, even in situations where the outcome is stochastic, like in financial markets.)

2. Static Games of Complete Information

   (We will learn what a game is. We will see that it incorporates any situation in which agents interact: Two firms that try to attract customers, two countries in an arms-race, people driving on the road, people polluting lakes, etc. After we have discussed what a game is, we try to make predictions about the outcome. That is: What would rational players do?)

   (a) Games in Normal Form
   (b) Iterated Elimination of Dominated Strategies
   (c) Nash Equilibrium (!)
   (d) Market Games

   (In this part we apply the theory to a number of market games, including the problem of a monopolist, the static oligopoly problem, arbitration, and competitive limits.)

   (a) Mixed Strategies and Existence

3. Dynamic Games of Complete Information

   (We will learn about games where players act in different points in time. For example, a new firm might first decide whether to enter a market, and afterwards it engages in price competition with the existing firm. We will see how such an interaction can be described. Then again we will make predictions how rational agent will behave. In the example: Should the new firm enter in the first place, given that competition with the existing firm might be fierce.)

   (a) Extensive Form Games
   (b) Backward Induction and Credible Threats

(c) Subgame Perfection

(d) Repeated Games

(e) More Market Games (repeated oligopoly, entry of new firms,...)

4. Games of Incomplete Information

(In this part we learn to deal with some of the most interesting aspects of economics: People have imperfect information about each other. For example: A manager wants his subordinates to work hard, but he can only observe whether the project is successful or not (but not how hard the people actually worked). This is called "moral hazard". Other examples include "signalling": You want to hire a smart worker, but you might not directly observe who is smart. But a person might convince you that he is smart simply by taking lots of education (even if that does not bring him any benefits). These problems arise in many settings. In hospitals the quality of physicians is private information, and there is also moral hazard in the sense that not all their effort is privately observed. Current research analyses exactly this aspect. In the housing market, agents are supposed to sell your house at a high price, but you cannot observe how much effort they spend in finding a buyer. We will discuss that case, as well as many others. Finally, we will discuss how to optimally deal with the problem of incomplete information. This area is called "mechanism design", because we are trying to find the optimal mechanism to deal with the problem.)

(a) Static Games and Bayesian Nash Equilibrium

(b) The Revelation Principle and the Connection to Mechanism Design

(c) Dynamic Games of Incomplete Information

(d) Signalling and Screening

(e) Adverse Selection

(f) More Mechanism Design