Game Theory for Grad Students

Games with incomplete information & mechanism design
ECN 203B Syllabus Winter Quarter 2017

WELCOME!
Game theory is the foundation of recent economic theory but it is also successfully applied to evolutionary biology, computer science, political science etc. It is the mathematics of interaction between humans, firms, animals, genes, countries, computers etc. studying the phenomena of conflict and cooperation. Mathematics is not learned by listening or reading. This means that besides participating in the lectures, you will have to do “learning by doing” through homework (problem solving), work independently on a research problem or present non-trivial recent research papers in class. This year’s course will focus on games with incomplete information and mechanism design. During lectures we will discuss concepts of game theoretic and mechanism design. In the homework you should apply those concepts. The idea of the course is to equip PhD students for their research and at the same time discuss recent research topics. Mathematically proficient students without prior knowledge of game theory should be able to follow the course but prior knowledge of game theory is certainly helpful. Throughout the course, we will try to identify potential research topics. Previously also students of computer science, mathematics, electrical engineering, evolutionary biology, psychology, political science, and philosophy successfully took my course.

LECTURE TIME, PLACE, AND CRN
Tuesdays and Thursdays, 9:00–10:20 am, WELLMN 109, CRN 51303

GRADING
The fact that you were admitted to the PhD program shows already that you know how to take exams. But can you do research? The grading is based on the homework and a research paper or presentations of recent sophisticated articles on the topics of the lecture. There is no midterm or final exam. If some students have a specific game theoretic topic they want to explore, I am happy if they write a paper as part of the course requirements. Some students may contemplate to audit the course only. I encourage them to sign up for at least satisfactory/unsatisfactory. Without some form of commitment you are most likely to drop out during the quarter. Although there are just 15 seats in the course, we will fit you in.

Information on S/U grading: Ph.D. students who are not yet advanced to candidacy (who have not yet passed the oral exam and not yet submitted an Advancement to Candidacy application to the Grad Studies Office and had that form approved by the Grad Studies Office) may petition to take one graded upper division or graduate course per quarter on an S/U basis (provided that the course is not in their own major) with the approval of their Graduate Adviser. Students who are advanced to candidacy for the Ph.D. can take unlimited courses S / U with approval of their Graduate Adviser. S / U petitions must be submitted to the Grad Studies Office by the end of the 5th week of the Quarter. See the policy https://grad.ucdavis.edu/resources/graduate-student-resources/academic-information-and-services/grading-courses-and-credit and the grade option change petition https://grad.ucdavis.edu/sites/default/files/upload/files/current-students/gs336-grading-option-change-petition.pdf.
TEXTBOOKS & MATERIALS

There is no suitable textbook for an advanced graduate course on game theory or mechanism design. A useful book containing many basic concepts of game theory is Osborne, M. J. and A. Rubinstein (1994). *A course in game theory*, The MIT Press. A useful reference on mechanism design is Chapter 23 in Mas-Colell, A., Whinston, M., and J. Green (1995). *Microeconomic Theory*, Oxford University Press. In addition, I will use some of own notes, chapters of some other books as well as some published and unpublished papers that I will announce in class.

PRELIMINARY COURSE OUTLINE

This year’s course will focus on games with incomplete information as well as mechanism design. These two topics complement each other nicely since mechanism design makes use of games with incomplete information.

Most decisions are taken under some form of incomplete information. This may be uncertainty about the game in addition to uncertainty about opponents’ actions. We first review theories of decision making under uncertainty including von Neumann-Morgenstern expected utility, subjective expected utility, theories of decision making under ambiguity such as Choquet expected utility and maximin expected utility, Case-based decision theory, and finally unawareness. These will be the ingredients to studying games with incomplete information. Then we will study modelling approaches to games of incomplete information including Bayesians games, extensive-form games with incomplete information, games with ambiguity, and games with unawareness. I should emphasize that topics like games with ambiguity or games with unawareness are current topics of active research. Many conceptual questions are not completely resolved yet. This means that there are opportunities for research. At the same time “text-book” style presentations of the current material is not available yet.

The second part of the course focuses on mechanism design. In game theory we usually define a game and ask for a solution. This is contrasted with mechanism design where we fix a desirable outcome and ask for a game with which we can implement this outcome as a solution. It takes more of an engineering perspective and attacks questions like how to design auctions, elections rules, political institutions, resource sharing mechanisms etc. The topics of games with incomplete information and mechanism design are complementary to each other because desirable outcomes to be implemented may depend on the private information of agents. Any mechanism that is implement such outcomes induces a game with incomplete information. Again, I should emphasize that mechanism design is a current topic of active research especially when it comes to the robustness to various types of incomplete information and dynamic mechanism design.

In terms of style, I will lecture on topics and students will follow up with a presentation of most recent research papers published in this area. The goal is to understand the frontier of research and identify potential research topics. We will also discuss experimental results on games with incomplete information and mechanism design.