Management Science and Engineering 336
Topics in Game Theory with Engineering Applications

Mondays and Wednesdays, 2:15-3:30 PM
Terman Engineering Center, Room 453
3 units

Instructor:

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Note that there will be no lecture on Monday, April 20.

Course webpage: http://eeclass.stanford.edu/msande336

Course description:

The goal of this course is to introduce students to the frontiers of the intersection between game theory and engineering. This year, our investigation will focus on the analysis and design of markets. The course will develop a theoretical foundation, as well as on discussion of topics of active research. Particular emphasis will be placed on the role that dynamics, incomplete information, and network structure play on design, analysis, and efficiency of markets.

1. Introduction: general equilibrium models vs. microstructure models

2. Part I: Price equilibrium (general equilibrium; applications to resource allocation; tatonnement processes and the Walrasian auctioneer)

3. Part II: Equilibrium with asymmetric information (no-trade theorem; rational expectations equilibrium; information aggregation)

4. Part III: Overview of market microstructure (order-driven vs. quote-driven markets; continuous vs. static markets; basic strategic models)

5. Part IV: Prediction markets (market scoring rules; cost-function-based markets; parimutuel markets via convex optimization)

6. Part V: Herd behavior (herding in a sequential model; herding with network structure; herding in financial markets)

7. Part VI: Networked models of markets (networked information structure among market participants; graphical economics; networks of market participants)

The course will be taught using a mix of lecture format and seminar-style guided discussion. Much of what we will discuss is active research, so the reading material will be drawn from relevant papers in the literature; this material will be available from the course website. The focus will be on encouraging discussion of both open theoretical questions and modeling issues. This is particularly important since the course content draws from a range of disciplines (operations research, economics, network engineering, computer science). The course should provide a unique forum for a lively exchange of ideas across these boundaries.

Given the advanced nature of the material, it is emphasized that the course should be viewed as a *research seminar* by prospective students.

Grading

The grade will be based 75% on a project to be completed at the end of the quarter, and 25% on two problem sets to be assigned during the course of the quarter. The choice of topics for the final project will be quite broad: students can choose to either discuss and present recent research results in the field, or develop their own problem statement and analysis.

Prerequisites

Above all, the course requires broad mathematical maturity. Despite the applied interest in the material, this is a course with significant theoretical content; an ability to read, write, and think rigorously is essential to understanding the material.

The following are all required prerequisites; if you do not meet them, you may audit the class but should not register:

1. Real analysis, at the level of Math 115 or preferably Math 171, or equivalent.

2. Optimization, at the level of MS&E 211 or equivalent.

3. Probability and random processes, at the level of MS&E 220 and 221, or equivalent.

4. Game theory, at the level of Econ 203 or MS&E 246, or equivalent.

In addition, dynamic optimization at the level of MS&E 251 or equivalent is strongly recommended.

Intending students who are not comfortable with the material from the prerequisites listed above should expect to audit the course; any questions or concerns can be directed to Prof. Johari at the e-mail address above.

Textbooks

There will be no required textbook for this course; almost all of what we discuss will be drawn from research papers. However, you may find some of the following books helpful.

Game theory books:

1. *Game Theory*, Fudenberg and Tirole. This reference should be on the shelf of every game theorist, but it is not necessarily the easiest book to learn from.

2. *A Course in Game Theory*, Osborne and Rubinstein. This is a good introductory level text in game theory, that still is quite rigorous. Although many game theory books are out there, I have found that this one is a good introduction for engineers.

3. *Game Theory: Analysis of Conflict*, Myerson. This is a more mathematically sophisticated treatment of the subject.

4. *Microeconomic Theory*, Mas-Colell, Whinston, and Green. This very large textbook is an encyclopedic reference on the subject, and likely very useful for many parts of this course.

5. *Game Theory for Applied Economists*, Gibbons. This is a basic undergraduate level text in game theory, appropriate if you have never seen the subject before; it provides an elementary treatment of most of the major topics.

Specific topics:

1. *Repeated Games and Reputations*, Mailath and Samuelson. A recent text that covers most models of reputation studied in economics. It can be somewhat hard to navigate, but otherwise is a very good reference for this area.

2. *Information and Learning in Markets: The Impact of Market Microstructure*, Vives. This book has an interesting take on market microstructure: rather than focusing on detailed models of the inner workings of financial markets, this book uses a Bayesian game theoretic approach to study the interaction between market participants in noncooperative models of market interaction.

3. *Social and Economic Networks*, Jackson. This book is an excellent overview of the role of network structure in a variety of socioeconomic settings. Some of the material we discuss on networked markets will be related to content in this book, but students interested in further coverage of the material in this book should take Econ 291.

4. *Market Microstructure Theory*, O'Hara. This book is a classic theoretical treatment of a range of microstructure models for markets.

BAGT

On May 1, the sixth Bay Algorithmic Game Theory Symposium (BAGT) will be held at Berkeley. I strongly encourage you to attend if you are attending this class. It's a great place to meet other researchers in this field in the Bay Area, and also learn about some interesting research related to topics of this course.

Register according to instructions on this page:

https://research.microsoft.com/en-us/um/siliconvalley/events/bagt/

Game theory tries to enlighten the interactions between individuals or groups of people whose goals are...Â Cachon, G.P.: Competitive and Cooperative Inventory Management in a Two-Echelon Supply Chain with Lost Sales. The Fuqua School of Business, Dyke University, working paper (1999)Google Scholar. 12.Â 2.Department of Production Engineering and ManagementTechnical University of CreteGreece. About this chapter. Cite this chapter as: Chinchuluun A., Karakitsiou A., Mavrommati A. (2008) Game Theory Models and Their Applications in Inventory Management and Supply Chain. In: Chinchuluun A., Pardalos P.M., Migdalas A., Pitsoulis L. (eds) Pareto Optimality, Game Theory And Equilibria. Springer Optimization and Its Applications, vol 17. Game Theory and its engineering applications delivered at ViTECoN 2019 at VIT, Vellore. It gives introduction to types of games, sample from different engineerâ€¦Â 23. Game Theory: Engineering Applications â€¢ Electronics and Communication â€" Power Allocation â€" Cognitive Radio Networks â€" Wireless Networks â€¢ Computer Science â€" Distributed systems â€" Computer Networks â€" Artificial Intelligence â€" Multi-agent systems â€¢ Electrical Engineering â€" Smart Grid â€" Voltage Regulation â€¢ Civil â€" Construction Engineering 3/29/2019 Dr Ganesh Neelakanta Iyer 23 http://www.cee.ntu.edu.sg/Programmes/graduate/MSc_CE/Pages/Overview.aspx https @inproceedings{Bauso2016GameTW, title={Game Theory with Engineering Applications}, author={Dario Bauso}, year={2016} }. Dario Bauso. Published 2016. Computer Science. This unique book addresses the foundations of game theory, with an emphasis on the physical intuition behind the concepts, an analysis of design techniques, and a discussion of new trends in the study of cooperation and competition in large complex distributed systems. View PDF. Save to Library. Home Â» Courses Â» Electrical Engineering and Computer Science Â» Game Theory with Engineering Applications. Game Theory with Engineering Applications. Course Home. Syllabus.Â Motivations are drawn from engineered/networked systems (including distributed control of wireline and wireless communication networks, incentive-compatible/dynamic resource allocation, multi-agent systems, pricing and investment decisions in the Internet), and social models (including social and economic networks). The course emphasizes theoretical foundations, mathematical tools, modeling, and equilibrium notions in different environments. Other Versions. Other OCW Versions. Archived versions: 6.972 Game Theory and Mechanism Design (Spring 2005). Related Content. Management Science and Engineering Stanford University, Stanford, CA 94305-4026. PÄ±nar Keskinocak. âˆ—. School of Industrial and Systems Engineering Georgia Institute of Technology, Atlanta, GA, 30332-0205. August 2003.Â 1Principal-agent problems fall under the more general topic of information economics, which deals with situations where there is lack of information on the part of some market participants, such as what others know, or what others are doing. 2Authorsâ€™ note: Moral hazard occurs when the agent takes an action that aects his utility as well as the principalâ€™s in a setting where the principal can only observe the outcome, but not the action of the agent.Â What makes game theory dierent than other analytical tools such as decision trees or optimiza-tion?