Game Theory

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Place:	1 Washington Place, Room 204, Newark, NJ 07102
Time:	Wednesdays 10:00-12:50
Instructor:	Thomas Lidbetter
Office:	1 Washington Place, Room 1076, Newark, NJ 07102
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Office Hours:	Wednesday 15:30-16:30 or by appointment.

Teaching Material:

- **Required Texts:**

  B. von Stengel, *Game Theory Basics*

  This introductory text has a very clear exposition, and although it is mathematical in spirit, it is intended for students of economics, management and the social science. The notes are available to download from Blackboard.

  M. Maschler, E. Solan and S. Zamir: Game Theory, CUP, 2013

- **Recommended Texts:**

  K. Binmore, Playing for Real: Game Theory CUP, 2007

  E. Mendelson, Introducing Game Theory and Its Applications, CRC 2004.

  M. J. Osborne and A. Rubinstein, A Course in Game Theory, MIT press, 1994

  Other resources: References to relevant papers will also be provided in class.

Prerequisites: This class is for PhD students and assumes a background in basic calculus and mathematical methods.

Grading: Midterm: 30%, Homework 20%, Final Exam: 50%.

Outline of the Course: This is a first course in game theory that does not assume any previous knowledge of game theory. The course starts with combinatorial games, which is not a standard topic for a game theory class. This is the most mathematical and formal part of the course and comes at the begin to test whether students can cope with the more abstract side of game theory. The remainder of the course covers more standard topics you would expect in an introductory game theory class. Although the material will be covered in a rigorous way, it focuses on methods rather than theory, and by the end of the course students should be well equipped to apply game theory in a diverse set of situations.

Game theory is about understand interactions between "players" with non-aligned preferences and motivations. Those players may be competing businesses, voters, politicians, governments or traders. As such, game theory provides an invaluable set of tools that can be used for understanding and analyzing problems in disciplines such as economics, business and political science, to name but a few.

Homework: Assignments, given on a weekly/biweekly basis, are to be done individually unless otherwise stated. You may discuss the problems with each other, but the work that you submit must be your own. You are expected to

refrain from using solutions from other sources (e.g. previous years', classes, etc). If you do use outside information, you must state your sources.

Participation: Classes will be a two-way process, and you will be expected to participate in class discussions and activities. You may be asked to prepare presentations for classes. I will be available after class for questions, and will respond to emails promptly.

Course Syllabus:

- Week 1: (von Stengel, Chapter 1) Introduction to combinatorial games, the game of Nim, sums of games.
- Week 2 (von Stengel, Chapter 1): Equivalent games, sums of Nim heaps, Poker Nim and the mex rule, equivalence of combinatorial games to Nim, finding Nim values.
- Week 3 (von Stengel, Chapter 2): A quick tour of game theory, games as trees and in strategic form, backward induction, reduced strategies.
- Week 4 (von Stengel, Chapter 2): Nash Equilibrium, subgame perfect Nash Equilibrium, examples: The Threat Game, The Prisoner's Dilemma, Chicken, The Battle of the Sexes, Matching Pennies, Rock-Paper-Scissors, Committment Game.
- Week 5 (von Stengel, Chapter 3): Mixed strategy Nash equilibria. Inspection games, bimatrix game payoffs, best response condition, the "difference trick", the upper envelope method, degenerate games .
- Week 6 (von Stengel, Chapter 3): Mixed strategy Nash equilibria continued. Brouwer's fixed point theorem, proof of existence of Nash equilibria, finding mixed equilibria, zero-sum games, the minimax theorem.
- Week 7: MIDTERM EXAM
- Week 8 (von Stengel, Chapter 6): Geometric representation of equilibria, Lemke-Howson algorithm for efficient calculation of equilibria, odd number of Nash equilibria.
- Week 9 (von Stengel, Chapter 4): Game trees with imperfect information. Information sets, perfect recall, behavior strategies, Kuhn's Theorem, subgames and subgame perfect equilibria, signally games.
- Week 10 (von Stengel, Chapter 5): Bargaining. Bargaining sets and bargaining axioms, the Nash bargaining solution, splitting the unit pie, the ultimatum game and stationary strategies, relation between the Nash bargaining solution and the ultimatum game.
- Week 11 (Maschler *et al.*, Chapter 16) Coalitional games with transferable utility. Definition, examples: simple games, weighted majority games. Solution concepts, imputations, the core.
- Week 12 (Maschler *et al.*, Chapter) The Bondareva-Shapley Theorem, market games, the Shapley value.
- Week 13: FINAL EXAM