Game Theory for Researchers
PhD-Level Introductory Course

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Course Overview

This course provides a rigorous yet accessible introduction to game theory for PhD students with no prior formal training in the subject. It emphasizes applications to a wide range of disciplines including economics, political science, computer science, and sociology.

Course Objectives

By the end of the course, students will:

- Understand core game-theoretic concepts such as Nash equilibrium and subgame perfection.

- Analyze strategic interactions using formal models.

- Apply game theory to real-world research problems.

- Critically assess the assumptions and limitations of game-theoretic reasoning.

Prerequisites

Basic comfort with mathematical reasoning, elementary probability, and linear algebra. No prior game theory background required.

Course Schedule

Lecture 1 Introduction and Motivation. Modeling Games.

- What is game theory? Strategic vs cooperative games, static vs dynamic games. Applications from economics, politics, and biology.
- Players, (mixed) strategies, payoffs.

Lecture 2 Solving Games: Equilibrium Concepts.

- Dominant and Dominated Strategies. Iterated Solutions.
- Nash Equilibrium: Definition, examples, and existence. Pure vs mixed strategies.

Lecture 3 Oligopoly. Incomplete Information.

- Important Applications in Industrial organization
- Incomplete information, types, and beliefs. Bayesian Nash Equilibrium. Poker.

Lecture 4 Dynamic Games.

- Game trees and Extensive Form Games.
- Backward induction, and subgame perfection
- Stackelberg Equilibrium.

Lecture 5 Computational Aspects.

- Reinforcement Learning in Games
- Computing Equilibria with Gröbner Bases

Exam

Oral Exam on a topic of the students choice or problem set.

Background and Introductory Texts

- Gibbons, *Game Theory for Applied Economists*
- Dixit and Nalebuff, *The Art of Strategy*

Suggested (Rigorous) Textbooks

- Osborne and Rubinstein, *A Course in Game Theory*
- Tadelis, *Game Theory: An Introduction*
- Mas-Colell, Whinston, and Green, *Microeconomic Theory* (Chs. 23–24)