Game Theory and Rationality

Masters level course (7.5 hec), starts first week of study period 2 (LP2)
Teachers:
- Kristian Lindgren (teacher, examiner)
- Torbjörn Lundh (teacher)
- Erik Sterner (course administrator)
- Vilhelm Verendel (course assistant)

Guest lecturers representing disciplines such as environmental economics, biology and mathematics (including Olof Johansson-Stenman, Thomas Sterner)

Course description:

Background
Game theory is the scientific study of strategic interaction between rational agents, involving analysis of phenomena such as cooperation and conflict in a wide range of biological, economic and social systems. Game theory and its extensions are continuously applied to understand situations such as climate negotiations, how plants grow their roots and distribute seeds under competition, to warfare and auctions.

Aim
The aim of the course is to give an introduction to fundamental concepts of game theory and to explore the concept of rationality and a series of applications and extensions of game theory. We focus on the effects of individual rationality and also the aggregate behaviour between agents in a large population. What are general principles for rational action? How well does this describe human behavior in practice? Secondary aims are to get some basic modelling experience within game theory and for students to develop their ability to read and present scientific papers. The course offers an opportunity for students to deepen understanding of their own discipline by studying applications related to their field of interest.

Content
The final content of the course can and will be influenced by the students attending it (i.e. other topics may be added to this list). Topics that were covered in last year's version of the course include:
Basic game-theoretic concepts, theory and principles of rational decision-making, backward induction and the rationality paradox, analysis of repeated interaction, tragedy of the commons, evolutionary game theory, public good games, agent-based models in economics, behavioural economics and the environment, bargaining theory and dynamic games.

Learning outcomes (After completion of the course, the student should be able to)
Formulate a game given a specific strategic interaction of interest within their own discipline.
Read and present game-theoretic literature as assigned during the course.
Explain and apply the following basic game-theoretic concepts in the context of creating a formal model:

- Decision-making agents with actions, interactions and strategies
  Students will construct a set of own strategies that will compete in a computer-based tournament with the iterated Prisoners' Dilemma game
- Backward induction and the rationality paradox
  Students will be able to compare the expected outcome from the Backward Induction principle with situations in real life
- Dominating strategies
  Students will be able to eliminate strategies from a game based on domination arguments
- Nash equilibrium
  Students will be able to use different techniques to find the Nash equilibria in games
- Pareto optimality, core
- Mixed-strategy equilibrium
- Evolutionary stable strategies

Differentiate between and apply:

- Extensive and normal (or strategic) form games
- Zero-sum and non zero-sum games

Organization

- One weekly lecture/discussion led by a teacher
- One weekly student-led discussion meeting: groups of two-three students prepare and organize a discussion around a topic (see Appendix for recommended topics) based on two or more papers. All students should read the papers in advance.
- One course project (33-50%) with report and presentation
- One or two computer exercises including a tournament between the students computerized strategies
- 2-4 guest lectures

Examination

Project report. Oral presentation. Student lead discussion meeting. Short compulsory assignments. Compulsory attendance at lectures (50-67%).

Grade

5, 4, 3 or non-pass.

Eligibility

A bachelor's degree within natural-, engineering- or economical sciences and some experience of programming/modelling.

Literature

Game theory basics

Selected chapters and examples from:

- *Fudenberg and Tirole*, Game Theory (1991)
- *Herbert Gintis*, Game Theory Evolving (2009)

Applications

A number of selected research articles with application of game theory within biological, economic and social systems.