

Game Theory

Vancouver Summer Program

July 14 – August 14, 2022

Monday-Friday, 1:00 PM - 4:00 PM

Course Description:

Game theory involves the study of cooperation and competition. It provides a theoretical framework for reasoning about a wide variety of phenomena including, for instance, the price of gasoline, nuclear proliferation, who pays for dinner when friends dine out, or the biological conditions necessary for the evolution of cooperation. This course presents the basic ideas of game theory, starting with how to represent and classify different kinds of interactions in terms of games where players choose among alternative strategies in order to maximize their own benefit. Game theory is useful across a broad range of scientific disciplines because situations involving conflicts of interest are ubiquitous, and because the meaning of “players” in game theory is very general. For example, players could be individual genes competing for representation in subsequent generations or whole countries negotiating trade agreements with each other. Of particular interest are social dilemmas where rational behaviour by individual players paradoxically does not necessarily lead to a collectively rational outcome. Such situations are sometimes referred to as a tragedy of the commons, a prisoner’s dilemma, or a public goods game and they characterize many social, economic, evolutionary biology, and political problems.

Emphasis in the course is on understanding the findings of game theory and its usefulness in analyzing a variety of interesting phenomena, rather than on the purely technical aspects of the theory. This course should be of particular interest to biologists and social scientists, but also to any student wishing to gain formal tools for reasoning about cooperation and competition in social interactions. The course emphasizes student participation, featuring seminar-style discussion as well as some traditional lectures. The course will culminate in a small research project in which students survey existing literature and possibly explore open research questions.

Learning Objectives:

By the end of the course, and for many years after, you should be able to:

Grasp, or recognize, real situations where game theory can be enlightening,
Abstract a real situation into game theoretic formalism,
Manipulate the formalism via game theory to reveal insights, and
Explain your insights in terms of the real situation.

Topics

Here are some topics you can expect to cover in this course (in no particular order):

- What is a game?
- Foundations of game theory
- Evolutionary game theory
- Payoff matrices
- Zero-sum games
- Extensive form
- Solution concepts
- Nash equilibria
- Pareto optima
- Mixed Nash equilibria
- Replicator equation
- Evolutionarily stable strategy
- Comparison of evolutionary and classical game theory
- Repeated games
- Many-player games
- Reward and punishment

Grading Scheme

The exact percentage breakdowns shown here may change. The following grading scheme should be approximately accurate and indicates the components upon which grades will be based.

<u>Name</u>	<u>% of Total Grade</u>
In-class Assignments	30
Project	30
Participation	10
Final Exam	30

Project

The course will culminate with a project that allows students to explore material that was not covered in class and to share that material with other students and instructors. The project may involve students writing a paper on a topic of interest within Game Theory or conducting and writing up some original research and/or analysis. More details on projects will be available as the course proceeds. Collaborative projects will be encouraged.

Text

There are no required texts for the course but the following books are useful resources:

Game theory: a nontechnical introduction by Morton D. Davis.

Call Number: QA269 .D38 1983

Location: I.K. BARBER LEARNING CENTRE

Evolutionary dynamics by Martin A. Nowak.

Call Number: QH371.3.M37 N69 2006

Location: WOODWARD LIBRARY

Essentials of Game Theory: A Concise Multidisciplinary Introduction by Kevin Leyton-Brown & Yoav Shoham

Available from [Morgan & Claypool](#) (free through UBC EZproxy).

Additional readings may be recommended during the course of the term.