Game Theory

SYSC 452/552, Fall 2025

Professor: J. J. P. Veerman
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Main Text: P.D. Straffin. Game Theory and Strategy. Number v. 36 in Anneli Lax New Mathematical Library. Mathematical Association of America, 1993.

Supplementary Text: R. Axelrod, *The Evolution of Cooperation: Revised Edition*, Basic-Books, Harper-Collins, 2006.

Course Description: In this course, students are introduced to fundamentals of game theory as well as its applications. In essence, game theory studies rational decision making in an environment where decisions affect others. In this course we explain how quantitative methods can be used to analyze social decisions and their effects.

Decisions in social context have a substantial influence on our lives. For instance, the decision by many to take the bus to work or to buy a car (and pollute more), has considerable impact on our lives. The same can be said of posturing of national leaders in international politics. Game theory also plays a very important role in, for example, economics and evolutionary biology.

The concepts necessary to translate real life situations to basic game theory are trees and matrices. Once these concepts and their rules are understood, we can ask what the best strategy is to optimize the outcome, or, put differently, what is the best play? For certain classes of games, one can answer this question.

The material corresponds roughly to Straffin's book plus Axelrod's book for reading material.

Course Objectives: Develop an understanding of the essentials of 2 person games (zero-sum and non-zero-sum) and their applications to the social sciences and biology. Develop an understanding of how the mathematics applies to real life situations. Develop an intuitive understanding of the mathematics itself (but formal proofs are not part of this course).

Student Learning Outcomes: An clear understanding of the significance of game theory in the social sciences, and in particular of the Prisoner's Dilemma and its many applications such as the study of warfare, evolutionary biology, and so on with an emphasis on the emergence of cooperation between competitive agents. The difference between single play and repeated play. The student will also develop a clear understanding of 0-sum 2 person games and non-0-sum 2-person games and Nash equilibria in these games. The student will be able to solve for the Nash equilibrium in simple 2-person games, including mixed strategies. Understanding

Nash Arbitration, Evolutionary stability, perfect and imperfect information, duopoly, auctions, etc. The student will learn many of the classical games such the already mentioned prisoner's dilemma. matching pennies, battle of the sexes, and others.

Prerequisites: There are no formal prerequisites. The student is expected to have a very good grasp of high school mathematics, and a willingness to learn some more mathematical concepts as we go.

Grading: Your course grade will be based on class participation (25%), homework (25%), and exams (50%).