

Course Outline for MATH 4911, Game Theory

MATH 4911 Game Theory (3 units)

Prerequisite: MATH 248 or [MATH 2031](#), and one of the following: MATH 206, MATH 244, [MATH 1151](#), or [MATH 2341](#); or graduate standing in Mathematics.

Mathematical concepts, techniques, and models used to investigate strategies in competitive situations, matrix games, linear programming, nonzero sum games, evolutionarily stable systems, indices of power, Nash arbitration. May include multiplayer games, fair division, and combinatorial game theory. 3 lectures. Formerly MATH 437.

Course Learning Objectives	
1	Construct solutions to matrix games.
2	Use linear programming in the context of game theory.
3	Analyze the behavior of nonzero-sum games.
4	Apply the Nash arbitration scheme to examples of bimatrix games.
5	Determine the Shapley value for multi-player games.
6	Provide game theoretic models for specific applications.

Expanded Course Content

Textbooks, materials, and/or other resources	
1.	“A Course in Game Theory”, by Thomas Ferguson (with Linear Programming supplement)
2.	“Game Theory”, by Owen Guillermo
3.	“Playing for Real”, by Ken Binmore
4.	“Game Theory and Strategy”, by Phillip Straffin
5.	“Game Theory: Mathematical Models of Conflict”, by A.J. Jones

Week	Readings	Topics of Discussion
1	Ferguson II.1.1--II.1.3	Strategic form, matrix games, mixed strategies
2	Ferguson II.1.4--II.2.3	Minimax theorem, domination, saddle points, 2 x 2 games
3	Ferguson II.2.4--II.3.1	Solving 2 x n games, the equilibrium theorem

Week	Readings	Topics of Discussion
4	Ferguson II.3.2--II.3.3	Nonsingular games, Shapley Snow procedure, diagonal games
5	Ferguson II.4.4, LP 1	Solving finite games, standard max and min linear programs
6	Ferguson LP 2, 3	Duality in linear programming, pivoting
7	Ferguson LP 4	The simplex algorithm with applications to matrix games
8	Ferguson II.6.1--II.6.3	Recursive games, multistage games
9	Ferguson Appendix 1, Owen VII	Utility theory, continuous games
10	Ferguson III.1.1--III.1.5	Bimatrix games, safety levels, equilibria
11	Owen VIII.3	Evolutionarily stable systems
12	Owen XII.1, XII.2	Indices of power, Shapley value
13	Owen XII.3, XII.4	Banzhaf-Coleman index, Nash arbitration
14	Owen XIII	Multiplayer games and the core
15	Instructor supplement	Fair division, cake cutting

Method of Assessment

The possible methods of assessment are written individual examinations, quizzes, in-class worksheets and presentations, projects, and homework. One or more midterms and a cumulative final exam are required.

Instructional Mode

The instructional mode for this class is face-to-face. This designation means that the essential academic standards of the course require in-class student engagement, and thus remote instruction is not appropriate.