CAL POLY

September 2008

MATH 437 Game Theory

1. Catalog Description

MATH 437 Game Theory (4)

Development of the mathematical concepts, techniques, and models used to investigate optimal strategies in competitive situations; games in extensive, normal, and characteristic form, Nash equilibrium points and Nash Bargaining Model. 4 lectures. Prerequisite: MATH 206 or MATH 244, and MATH 248 with a grade of C- or better, or consent of instructor.

2. Required Background or Experience

Math 206 or Math 244, and Math 248 with a grade of C- or better.

3. Learning Objectives

The student should:

a. Obtain an understanding of the types of mathematical models used to describe and study situations involving conflict and cooperation.
b. Know the connection that two person zero-sum game theory has with duality in linear programming.
c. Be introduced to *n*-person games and utility theory.
d. Obtain an appreciation of the variety of techniques that one uses in studying these models, e.g. separation theorem, Brouwer fixed point theorem, graph theory, complementary pivot algorithms.

4. Suggested Texts and References

Binmore, K., Fun and Games, D.C Heath and Co., 1992.
Eatwell, John, et al. (eds.), Game Theory, New Palgrave Series, W.W. Norton, 1989.
Jones, A. J., Game Theory: Mathematical Models of Conflict, Horwood, 2000.
Mehlmann, Alexander, The Game's Afoot!, American Mathematical Society, 2000.
Stahl, Saul, A Gentle Introduction to Game Theory, American Mathematical Society, 1999.
Straffin, Phillip D., Game Theory and Strategy, Mathematical Association of America, 1993.

5. Minimum Student Materials

Paper, pencils and notebook.

6. Minimum University Facilities

Classroom with ample chalkboard space for class use.

7. Content and Method

a. **Games in extensive form (game trees)**
   1) Examples, including probability games
   2) Zermelo - von Neumann Theorem on finite games (*n*-person) with perfect information
   3) Strategies

b. **Games in normal form (matrix games)**
   1) Examples, including matrix and bimatrix games
   2) Two-person zero-sum games and mixed strategies
   3) von Neumann Minimax Theorem and duality (linear programming)
   4) Non-zero-sum games and the Prisoners' Dilemma
   5) Non-cooperative games, equilibrium solutions, and security-level solutions
   6) Cooperative solutions and the Nash arbitration solution

c. **Games in characteristic function form (a study of coalitions)**
   1) Examples
   2) Nash equilibrium solution (Brouwer fixed point theorem)
   3) Solution concepts, including the core, stable sets, and the Shapley Value
   3) Fair division
   4) Voting models

8. Methods of Assessment

Exams, assigned problems, and student reports.