

PORTLAND STATE UNIVERSITY
Systems Science Ph.D. Program
Professor Martin Zwick
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Spring 2006
MW 4:00 - 5:50 PM
Harder House 104

GAME THEORY (SYSC 552/652)

Game theory involves the study of cooperation and competition, without regard to the particular entities involved, and issues of rationality associated with such phenomena. The course presents the basic ideas of game theory, especially those concerning (a) 2-person zero-sum games, which the theory *solves*, and (b) 2- (or $n_{\text{non-equivalent}}$ -) person nonzero-sum games, which have no *general* solution and which often exhibit paradoxical features. Of particular *substantive* interest are dilemmas of collective action, which characterize many social, economic, and political problems. Of particular *methodological* interest are simulation techniques used to extend game-theory into domains where analytical results are impossible.

Also covered are (c) 2-person cooperative games (bargaining & arbitration), which have alternative plausible solutions; (d) coalition theory ($n_{\text{non-equivalent}}$ -person games), in which stable solutions often do not exist; and (e) social choice theory, which reveals the difficulties in integrating individual preferences into collective decisions. Emphasis in the course is on the findings of game theory, especially as they apply to the social sciences, rather than on the purely technical aspects of the theory.

TEXTS:

1. R. Duncan Luce & Howard Raiffa, *Games and Decisions: Introduction and Critical Review*, Dover Publications, New York, 1989 (first published: 1957; paper, ISBN 0-486-65943-7).
2. Frank C. Zagare, *Game Theory (Concepts and Applications)*. Monograph #41 of Series: Quantitative Applications in the Social Sciences, Sage, Beverly Hills, 1984 (paper, ISBN 0-8039-2050-4)
3. Robert Axelrod, *The Evolution Of Cooperation*, Basic Books, New York, 1984 (paper, ISBN 0-465-021-212).
4. Morton D. Davis, *Game Theory: A Nontechnical Introduction*, Dover Publications, Mineola, NY, 1997 (first published 1983; paper, ISBN 0-486-29672-5).
5. Collection of xeroxed articles, available at Smart Copy, 1915 SW 6th Ave; 227-6137.

PREREQUISITES: Graduate status or permission of the instructor.

GRADING: Midterm & final.

OUTLINE

read in this order: X = xeroxed; Z = Zagare; D = Davis; L = Luce & Raiffa; [] = optional

- Apr 3 Course introduction.
- Apr 5 **I. Zero sum games**; extensive/normal forms, utility.
Z: Introduction, Ch. 1-2; D: Forward, Intro. Ch.1-4; L: Ch. 1,3,4,;
- Apr 10, 12 Zero sum games, continued; **exercises**
- Apr 17, 19 **II. 2-person non-zero sum games.**
X: Hamburger: Ch. 4.2, 7; Rapoport & Guyer; Rapoport.
Z: Ch. 3; D: 75-162 except: 104-107,119-123,135-153; L: Ch. 5
- Apr 24, 26 2-person non-zero sum games, continued; **exercises**
- May 1 **III. n-equivalent-person non-zero sum games**; tragedy of commons
X: Barry & Hardin: Preface, articles 1 (Olson), 3 (Rapoport), 5 (Schelling)
& their introductions; Hardin; Glance; Nowak, Sigmund.
- May 3 n-equivalent-person non-zero sum games, continued; **exercises**
- May 8 MIDTERM EXAM
- May 10, 15 **IV. Simulation experiments** in cooperation; over midterm exam.
Axelrod (whole book); [X: Lindgren]; D: 135-153.
- May 17 Research presentation: Jeff Fletcher
X: Fletcher & Zwick, Smith
- May 22 **V. Bargaining, negotiation, conflict resolution** (2-person coop. games)
X: Hamburger: Ch. 5.3, 6.1; D: 104-107,119-123; L: Ch. 6
- May 24 Simulation & bargaining: **exercises**
- May 29 PSU Holiday
- May 31 **VI. Theory of coalitions** (n-*non*-equivalent-person games)
X: Hamburger: Ch. 8.1; Z: Ch. 4; D: Ch. 6; L: Ch. [7,]8,9
- June 5 **VII. Theory of social choice** (Arrow)
X: Blair & Pollak; Hamburger: Ch. 8.2; Barry & Hardin: 12 (Plott),
13 (Arrow), Epilogue; L: Ch. 14
- June 7 Coalitions & social choice: **exercises**
- June 12 FINAL EXAM (mainly material since midterm)

XEROXED ARTICLES

New York Times article (Oct. 12, 1994) on Nobel awards to game theorists John Harsanyi, Reinhard Selten, and John Nash.

Article from Science & Technology (around March, 1994) on game theory and FCC auctions.

Royal Swedish Academy of Sciences: The (Nobel) Prize in Economic Sciences 2005 to Robert Aumann and Thomas Schelling.

R. Duncan Luce & Howard Raiffa, *Games and Decisions: Introduction and Critical Review*, Dover Publications, New York, 1989 (first published 1957), chapters 1-5.

Selections from Henry Hamburger, *Games as Models of Social Phenomena*. W. H. Freeman & Co., San Francisco, 1979: Ch. 4.2, 5.3, 6.1, 7, 8.

Anatol Rapoport & Melvin Guyer, "A Taxonomy of 2x2 Games." *General Systems*, vol. XXIII, 1978, pp. 125-136.

Anatol Rapoport, "Games." *Peace and Change*, vol. XIII, 1988, pp.18-43.

Selections from Brian Barry & Russel Hardin, editors, *Rational Man and Irrational Society?* Sage Publications, Beverly Hills, 1982: Ch. 1 (Olson), 3 (Rapoport), 5 (Schelling), 12 (Plott), 13 (Arrow); Introductions to these articles & Epilogue.

Garrett Hardin, "The Tragedy of the Commons." *Science*, vol. 162, 1968, pp. 1243-1248.

Natalie S. Glance & Bernardo A. Huberman, "The Dynamics of Social Dilemmas." *Scientific American*, March 1994, pp. 76-81.

John Maynard Smith, "The Evolution of Behavior." *Scientific American*, Sept. 1978, pp. 176-192.

Martin A. Nowak, Robert May, & Karl Sigmund, "Arithmetic of Mutual Help." *Scientific American*, June 1995, pp. 76-81.

Karl Sigmund, Ernst Fehr, & Martin A. Nowak, "The Economics of Fair Play." *Scientific American*, January 2002, pp. 83-87.

Fletcher, Jeffrey A. and Zwick, Martin, "Simpson's Paradox Can Emerge from the N-Player Prisoner's Dilemma: Implications for the Evolution of Altruistic Behavior." *Proceedings of World Congress of the Systems Sciences & 44th Annual Meeting of the International Society for the Systems Sciences*, Toronto, July 16-22, 2000.

Fletcher, Jeffrey A. and Zwick, Martin, "N-Player Prisoner's Dilemma in Multiple Groups: A Model of Multilevel Selection." *Seventh International Conference on Artificial Life*, Workshop on Group Selection, Reed College, Portland OR, 1-6 Aug. 2000.

Fletcher, Jeffrey A. and Zwick, Martin, "Altruism, The Prisoner's Dilemma, and the Components of Selection." *Proceedings of the 2001 IEEE Systems, Man, and Cybernetics Conference*, Tucson, Arizona, 2001.

Kristian Lindgren, "Evolutionary Phenomena in Simple Dynamics." *Artificial Life II, Santa Fe Studies in the Sciences of Complexity, vol. X*, edited by C. G. Langton, C. Taylor, J.D. Farmer, & S. Rasmussen, Addison-Wesley, Redwood City, CA, 1991, pp. 295-312.

Blair, Douglas H. and Pollak, Robert A., "Rational Collective Choice." *Scientific American*, Aug. 1983, pp. 88-95.