

Applied Game Theory
APEC 8205: Fall 2007

Instructors:

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Overview: This course will cover topics in game theory and their application to economic problems. For each topic, important theory and equilibrium concepts will be covered. We will review evidence from experimental economics on how people actually play games and address in what ways behavior accords or contradicts theory. We will also introduce a number of important economic applications of game theory in each major topic area. There will be five main topics covered:

- static games of complete information
- dynamic games of complete information
- static games of incomplete information
- dynamic games of incomplete information
- equilibrium dynamics

Throughout the course, we will perform a number of informal experiments and stage simple games as part of the class to demonstrate concepts, while providing an active learning environment.

Prerequisites: Ph.D. sequence in microeconomic theory (8001-8004 or 8101-8104) or permission of the instructors.

Grading:

Problem Sets	30%
Midterm	35%
Final	35%

Required Text:

Gibbons, R. 1992. *Game Theory for Applied Economists*. Princeton University Press.
Camerer, C. 2003. *Behavioral Game Theory*. Princeton University Press.

Supplementary Texts:

Davis, D.D. and C.A. Holt. 1993. *Experimental Economics*. Princeton University Press.
Fudenberg, D. and J. Tirole. 1991. *Game Theory*. MIT Press.
Kagel, J.H. and A.E. Roth. 1995. *The Handbook of Experimental Economics*. Princeton University Press.
Mas-Colell, A., M. Whinston and J. Green. 1995. *Microeconomic Theory*. Oxford University Press.
Samuelson, L. 1997. *Evolutionary Games and Equilibrium Selection*. MIT Press.
Tirole, J. 1988. *The Theory of Industrial Organization*. MIT Press.

Useful Web Sites on Experiments

<http://www.people.virginia.edu/~cah2k/y2k.htm>

<http://www.marietta.edu/~delemeeg/expnom.html>

<http://www.economics.harvard.edu/~aroth/alroth.html>

Course Outline

Introduction: The Rules of the Game (Lecture 1: 9/4) (TMH)

1. Structure of Games: Description of a Game
 - a. Players (“who”)
 - b. Actions (“who can do what when”)
 - c. Information (“who knows what when”)
 - d. Strategies (“who does what when”)
 - e. Payoffs (“who gets what when”)
2. Representation of Games: Normal vs. Extensive Forms
3. A Taxonomy of Games
 - a. Dynamic vs. Static
 - b. Perfect vs. Imperfect Information
 - c. Complete vs. Incomplete Information
4. Experimental Methods and Behavioral Game Theory

Readings:

Required:

Hart, S. 1992. Games in extensive and strategic forms. In *Handbook of Game Theory with Economic Applications*, Vol. 1 (Ed. R. J. Aumann and S. Hart). North Holland.

Camerer, chapter 1 including the appendix.

(skim) Goeree, J.K. and C.A. Holt. 2001. Ten Little Treasures of Game Theory and Ten Intuitive Contradictions. *American Economic Review* 91:1402-22.

Static Games of Complete Information (Lectures 2-4)

1. Equilibrium Concepts: Pure and Mixed Strategy Nash Equilibrium, Dominant Strategies and Iterated Dominance (Lecture 2: 9/6) (THM)
Applications: Second Price Auctions, Cournot-Bertrand Oligopoly, Common Property Resources, Compliance
2. Alternative Explanations For Observed Behavior (Lecture 3 & 4: 9/11 & 9/13)
 - a. A Nash Equilibrium with Errors: Quantal Response Equilibrium (TMH)
 - b. Bounded Rationality (TMH)
 - c. Fairness and Altruism (SP)

Readings:

Required:

- Gibbons, chapter 1
- McKelvey, R.D. and T.R. Palfrey. 1995. Quantal Response Equilibria for Normal Form Games. *Games and Economic Behavior* 10:6-38.
- Stahl, D.O. and P.W. Wilson. 1995. On Player's Models of Other Players: Theory and Experimental Evidence. *Games and Economic Behavior* 10:218-254.
- Rabin, M. 1993. Incorporating Fairness into Game Theory and Economics. *American Economic Review* 83:1281-1302.
- Andreoni, J. 1990. Impure Altruism and Donations to Public Goods: A Theory of Warm-Glow Giving. *Economic Journal* 100:464-77.

Supplementary:

- Mas-Colell, Whinston, and Green, chapter 7 (except 7C), chapter 8, pp. 235-253
- Fudenberg and Tirole, chapters 1-2
- Walker, J.M., R. Gardner and E. Ostrom. 1990. Rent dissipation in a limited-access common-pool resource: experimental evidence. *Journal of Environmental Economics and Management* 19(3): 203-211.
- Gardner, R., E. Ostrom and J.M. Walker. 1990. The nature of common pool resource problems. *Rationality and Society*: 2335-2358.
- Cooper, R., D.V. De Jong, R. Forsythe and T.W. Ross. 1989. Communication and the Battle of the Sexes Game: Some Experimental Results. *Rand Journal of Economics* 20: 568-587.
- Harrison, G.W., and J. Hirshleifer. 1989. An experimental evaluation of weakest link/best shot models of public goods. *Journal of Political Economy* 97(1): 201-225.
- Millner, E.L., and M.D. Pratt. 1989. An experimental investigation of efficient rent seeking. *Public Choice* 62(2): 139-151.

Dynamic Games of Complete Information (Lectures 5 –11)

1. Subgame Perfect Equilibrium (Lectures 5: 9/18) **(TMH)**
Applications: Entry Deterrence, Stackelberg Duopoly
2. Two-Stage Games (Lectures 6 & 7: 9/20 & 9/25) **(TMH)**
Applications: Tariffs and Imperfect Competition, Duopoly Investment, Regulatory Game, Tournaments
3. Dictator, Ultimatum, and Bargaining Games (Lecture 8 & 9: 9/27 & 10/2) **(THM & SP)**
4. Repeated Games, History Dependent Strategies, and Folk Theorem (Lecture 10: 10/4) **(THM)**
Applications: Collusion, Cooperation in the Commons
5. Dynamic Games: Markov Perfect Equilibrium (Lectures 11: 10/9) **(SP)**
Applications: Resource Oligopoly, Common Property Resource Game

Readings:

Required:

Gibbons, chapter 2

Camerer, chapter 2, 2.1-2.6, pp. 73-83, chapter 4, 4.1, 4.2, pp. 151-182

Fehr, E. and S. Gächter. 2000. Fairness and Retaliation: The Economics of Reciprocity. *Journal of Economic Perspectives* 14:159-81.

Supplementary:

Mas-Colell, Whinston, and Green, section 7C; chapter 9, pp. 267-282, 296-299; chapter 12, pp. 400-411, 414-427

Tirole, chapters 6 & 8

Fudenberg and Tirole, chapters 3-5

Binmore, K., A. Shaked and J. Sutton. 1985. Testing non-cooperative bargaining theory: a preliminary study. *American Economic Review* 75: 1178-1180.

Plott, C.R. and M. Levine. 1978. A model of agenda influence on committee decisions. *American Economic Review* 68: 146-160.

Static Games of Incomplete Information (Lectures 12-14)

1. Bayesian Nash equilibrium (Lectures 12 & 13: 10/11 & 10/16) **(SP)**
Applications: Private Provision of Public Goods, Rent Seeking, Duopoly with Private Costs, First Price Auctions
2. Double Auction Game (Lecture 14: 10/18) **(SP)**

Readings:

Required:

Gibbons, chapter 3

Kagel, J.H. 1995. Auctions: a survey of experimental research. In *Handbook of Experimental Economics* (Eds. Kagel and Roth).

Supplementary:

Mas-Colell, Whinston, and Green, chapter 8, pp. 253-257

Fudenberg and Tirole, chapters 6-7

Midterm I (October 23)

Dynamic Games of Incomplete Information (Lectures 15-22)

1. Perfect Bayesian Equilibrium and Refinements (Lectures 15, 16 & 17: 10/25, 10/30 & 11/1) **(TMH)**
Applications: Environmental Conflict
2. Signaling Game (Lectures 18 & 19: 11/6 & 11/8) **(SP)**
Applications: Spence's Education Game, Lemon Markets

3. Heterogeneous Agent Types (Lectures 20, 21 & 22: 11/13, 11/15 & 11/20) **(SP)**
Applications: Game of Entry, Bank Loans

Readings:

Required:

- Gibbons, chapter 4
- Camerer, chapter 8

Supplementary:

- Mas-Colell, Whinston, and Green, chapter 9, pp. 282-296; chapter 13
- Tirole, chapter 9
- Fudenberg and Tirole, chapters 8-10
- Banks, J., C. Camerer, and D. Porter. 1994. An experimental analysis of Nash refinements in signaling games. *Games and Economic Behavior* 6: 1-31.
- Camerer, C.F. and K. Weigelt. 1988. Experimental tests of a sequential equilibrium reputation model. *Econometrica* 56(1): 1-36.
- McKelvey, R.D., and T.R. Palfrey. 1992. An experimental study of the centipede game. *Econometrica* 60: 803-836.
- Brandts, J. and C. A. Holt. 1992. An experimental test of equilibrium dominance in signaling games. *American Economic Review* 82: 1350-1365.
- Jung, Y.J., J.H Kagel and D. Levin. 1994. On the existence of predatory pricing: an experimental study of reputation and entry deterrence in the chain-store game. *Rand Journal of Economics* 25(1): 72-93.

Equilibrium Dynamics (Lectures 23-26)

1. Evolutionary Game Theory: Replicator Dynamics and Dynamic Stability (Lectures 23 & 24: 11/27 & 11/29) **(SP)**
Applications: evolution of cooperation
2. Experience-Weighted Attraction Learning As A Synthesis of Reinforcement Learning and Belief Based Fictitious Play (Lecture 25 & 26: 12/4 & 12/6) **(TMH)**
3. Summary and Review (12/11)

Readings:

Required:

- Saumelson, Chapters 1 – 3.
- Camerer, chapter 8

Supplementary:

- Freidman, D. 1991. Evolutionary games in economics. *Econometrica* 59: 637-666.
- Mailath, G. 1998. Do people play Nash equilibrium? Lessons from evolutionary game theory. *Journal of Economic Literature* 36: 1347-1374.
- Axelrod, R. 1984. *The Evolution of Cooperation*. Basic Books.
- Maynard-Smith, J. 1982. *Evolution and the Theory of Games*. Cambridge University Press.

- Friedman, D. 1996. Equilibrium in evolutionary games: some experimental evidence. *Economic Journal* 106: 1-25.
- Camerer, C. and T. Ho. 1999. Experience –Weighted Attraction Learning in Normal Form Games. *Econometrica* 67:827-874.
- Ido, E. and A.E. Roth. 1998. Predicting How People Play Games: Reinforcement Learning in Experimental Games with Unique, Mixed Strategy Equilibria. *American Economic Review* 88:848-881.
- Cheung Y. and D. Friedman. 1997. Individual Learning in Normal Form Games: Some Laboratory Results. *Games and Economic Behavior* 19:46-76.

Summary: Lessons Learned and Research Agenda (Lecture 28: 12/14)

Readings:

Required:

Camerer, chapter 9

Goeree, J.K. and C.A. Holt. 2001. Ten Little Treasures of Game Theory and Ten Intuitive Contradictions. *American Economic Review* 91:1402-22.