

Game Theory

Academic Year 2005-2006, First Semester

Jordi Massó

Program

1 Preliminaries

1.1.- Introduction and Some Examples

1.2.- Games in Normal Form

1.2.1.- Definition

1.2.2.- Nash Equilibrium

1.2.3.- The Mixed Extension

1.2.4.- Two-person Zero-sum Games: The Minimax Theorem

1.2.5.- Fictitious Play

1.3.- Games in Extensive Form

1.3.1.- Definition

1.3.2.- Perfect Information: Backwards Induction and Kuhn's Theorem

1.3.3.- Imperfect Information

REFERENCES

Bernheim, B., B. Peleg, and M. Whinston. "Coalition-proof Nash Equilibria I: Concepts", *Journal of Economic Theory* 42, 1987.

Debreu, G. "A Social Equilibrium Existence Theorem", *Proceedings of the National Academy of Sciences* 38, 1952.

Fan, K. "Fixed Point and Minimax Theorems in Locally Convex Topological Linear Spaces", *Proceedings of the National Academy of Sciences* 38, 1952.

Glicksberg, I. L. "A Further Generalization of the Kakutani Fixed Point Theorem with Application to Nash Equilibrium Points", *Proceedings of the National Academy of Sciences* 38, 1952.

Kakutani, S. "A Generalization of Brouwer's Fixed Point Theorem", *Duke Mathematical Journal* 8, 1941.

Krishna, V. "Learning in Games with Stochastic Complementarities", mimeo, 1991.

Kuhn, W. “Extensive Games and the Problem of Information”, *Annals of Mathematical Study* 28, 1953.

Kuhn, W. and A. Tucker (editors). *Contributions to the Theory of Games II*, Princeton University Press, 1953.

Miyasawa, K. “On the Convergence of the Learning Process in a 2×2 Non Zero-sum Two Person Game”, Economic Research Program, Princeton University, research memorandum No. 33, 1961.

Milgrom, P. and J. Roberts. “Adaptive and Sophisticated Learning in Normal Form Games”, *Games and Economic Behavior* 3, 1991.

Monderer, D. and A. Sela. “A 2×2 Game without the Fictitious Play Property”, *Games and Economic Behavior* 14, 1996.

Monderer, D. and L. Shapley. “Fictitious Play Property for Games with Identical Interests”, *Journal of Economic Theory* 68, 1996.

Nash, J. “Non-Cooperative Games”, *Annals of Mathematics* 54, 1951.

Nash, J. “Equilibrium Points in n -Person Games”, *Proceedings of the National Academy of Sciences* 36, 1950.

Owen, G. “An Elementary Proof of the Minimax Theorem”, *Management Science* 13, 1967.

Robinson, J. “An Iterative Method of Solving a Game”, *Annals of Mathematics* 54, 1951.

Shapley, L. “Some Topics in Two-person Games”, in *Advances in Game Theory*, editors: M. Dresher, J. Shapley, and A. Tucker. Princeton University Press, 1964.

Zermelo, E. “Über eine Anwendungen der Mengenlehre auf die Theorie der Schachspiels”, *Proceedings of the International Fifth Congress of Mathematicians* (Cambridge), Cambridge University Press, 1913.

2 Nash Equilibrium and Related Issues

2.1.- Dominant Strategies

2.2.- Elimination of Dominated Strategies

2.3.- Subgame Perfect Equilibrium

2.4.- Perfect Equilibrium

2.5.- Proper Equilibrium

2.6.- Stable Sets of Equilibria

2.7.- Rationalizable Strategic Behavior

2.8.- Correlated Equilibrium

REFERENCES

- Aumann, R. "Subjectivity and Correlation in Randomized Strategies", *Journal of Mathematical Economics* 1, 1974.
- Bernheim, B. "Rationalizable Strategic Behavior", *Econometrica* 53, 1984.
- Black, D. "On the Rationale of Group Decision Making", *Journal of Political Economy* 56, 1948.
- Calvó-Armengol, A. "The Set of Correlated Equilibria of 2×2 Games", mimeo, 2003. <http://selene.uab.es/acalvo/correlated.pdf>
- Dalkey, N. "An Approach to Communication Equilibria", DP 8435, CORE, 1984.
- Foster, D. and R. Vohra. "Calibrated Learning and Correlated Equilibrium", *Games and Economic Behavior* 21, 1997.
- Fudenberg, D. and D. Levine. "Conditional Universal Consistency", *Games and Economic Behavior* 29, 1999.
- Gibbard, A. "Manipulation of Voting Schemes: A General Result", *Econometrica* 41, 1973.
- Hart, S. and A. Mas-Colell. "A Simple Adaptive Procedure Leading to Correlated Equilibrium", *Econometrica* 68, 2000.
- Hart, S. and A. Mas-Colell. "A General Class of Adaptive Strategies", *Journal of Economic Theory* 98, 2001.
- Hillas, J. "On the Definition of the Strategic Stability of Equilibria", *Econometrica* 58, 1990.
- Kalai, E. and D. Samet. "Persistent Equilibria", *International Journal of Game Theory* 13, 1984.
- Kholberg, E. and J. F. Mertens. "On the Strategic Stability of Equilibria", *Econometrica* 54, 1986.
- Mertens, J. F. "Stable Equilibria - A Reformulation I. Definition and Basic Properties", *Mathematics of Operations Research* 14, 1989.
- Mertens, J. F. "Stable Equilibria - A Reformulation II. Discussion of the Definition, and Further Results". With Errata to: [Mertens, J. F. "Stable Equilibria - A Reformulation I. Definition and Basic Properties", *Mathematics of Operations Research* 14, 1989], *Mathematics of Operations Research* 16, 1991.
- Moulin, H. "Dominance Solvable Voting Schemes", *Econometrica* 47, 1979.
- Moulin H. "On Strategy Proofness and Single-Peakedness", *Public Choice* 35, 1980.
- Myerson, R. "Refinements of the Nash Equilibrium Concept", *International Journal of Game Theory* 7, 1978.
- Pearce, D. "Rationalizable Strategic Behavior and the Problem of Perfection", *Econometrica* 52, 1984.

Rosenthal, R. “Games of Perfect Information, Predatory Pricing and the Chain-store Paradox”, *Journal of Economic Theory* 25, 1981.

Satterhwaite, M. “Strategy Proofness and Arrow’s Conditions: Existence and Correspondence Theorems for Voting Procedures and Social Welfare Functions”, *Journal of Economic Theory* 10, 1975.

Selten, R. “Spieltheoretische Behandlung eines Oligopolmodells mit Nachfragertrgheit”, *Zeitschrift für die gesamte Staatswissenschaft* 12, 1965.

Selten, R. “Reexamination of the Perfectness Concept for Equilibrium Points in Extensive Games”, *International Journal of Game Theory* 4, 1975.

Thompson, F. “Equivalence of Games in Extensive Form”, RM 759, The Rand Corporation, 1952.

Thompson, F. “Behavior Strategies in Finite Games”, RM 769, The Rand Corporation, 1952.

van Damme, E. *Stability and Perfection of Nash Equilibria*, Springer-Verlag, 1991.

3 Repeated Games

3.1.- Strategies

3.2.- Payoffs

3.3.- “Folk” Theorems

3.4.- Bounded Rationality, Evolution and Learning

3.5.- Stochastic Games

REFERENCES

Aumann, R. “Survey of Repeated Games”, in *Essays in Game Theory and Mathematical Economics in Honor of Oskar Morgenstern*, 1981.

Aumann, R. and L. Shapley. “Long Term Competition -A Game Theoretic Analysis”, Mimeo, The Hebrew University, 1976.

Benoît, J.P. and V. Krishna. “Finitely Repeated Games”, *Econometrica* 53, 1985.

Benoît, J.P. and V. Krishna. “Nash Equilibria of Infinitely Repeated Games”, *International Journal of Game Theory* 16, 1987.

Friedman, J. “A Non-cooperative Equilibrium for Supergames”, *The Review of Economic Studies* 38, 1971.

Fudenberg, D. and E. Maskin. “The Folk Theorem in Repeated Games with Discounting or with Incomplete Information”, *Econometrica* 54, 1986.

Kalai, E. and W. Stanford. “Finite Rationality and Interpersonal Complexity in Repeated Games”, *Econometrica* 56, 1988.

Lockwood, B. “The Folk Theorem in Stochastic Games with and without Discounting”, *Birkbeck College Discussion Paper in Economics* 18, 1990.

Massó, J. and A. Neme. “Equilibrium Payoffs of Dynamic Games”, *International Journal of Game Theory* 25, 1996.

Maynard Smith, J. *Evolution and the Theory of Games*. Cambridge University Press, 1982.

Rubinstein, A. “Equilibrium in Supergames”, Mimeo, The Hebrew University, 1977.

Rubinstein, A. “Finite Automata Play the Repeated Prisoner’s Dilemma”, *Journal of Economic Theory* 39, 1986.

Shapley, L. “Stochastic Games”, *Proceedings of the National Academy of Sciences* 39, 1953.

4 Games of Incomplete Information

4.1.- The Harsanyi Solution

4.2.- Bayesian-Nash Equilibrium

4.3.- Sequential Equilibrium

4.4.- Using Bayesian-Nash Equilibria to Justify Mixed Equilibria

4.5.- Signalling Games and Forward Induction

REFERENCES

Harsanyi, J. “Games with Incomplete Information Played by “Bayesian” Players”, *Management Science* 14, 1967-68.

Harsanyi, J. “Games with Randomly Distributed Payoffs: A New Rationale for Mixed-Strategy Equilibrium Points”, *International Journal of Game Theory* 2, 1973.

Kreps, D. and R. Wilson. “Sequential Equilibria”, *Econometrica* 50, 1982.

Kreps, D. and R. Wilson. “Reputation and Imperfect Information”. *Journal of Economic Theory* 27, 1982.

Mertens, J. F. and S. Zamir. “Formulation of Bayesian Analysis for Games with Incomplete Information”, *International Journal of Game Theory* 14, 1985.

van Damme, E. *Stability and Perfection of Nash Equilibria*, Springer-Verlag, 1991.

5 Bargaining Theory

- 5.1.- The Bargaining Problem
- 5.2.- The Nash Bargaining Solution
- 5.3.- The Kalai-Smorodinsky Solution
- 5.4.- Strategic Bargaining

REFERENCES

Binmore, K. “Nash Bargaining Theory II”. In *The Economics of Bargaining*, editors: K. Binmore and P. Dasgupta, 1987.

Kalai, E. and M. Smorodinsky. “Other Solutions to Nash’s Bargaining Problem”, *Econometrica* 45, 1975.

Nash, J. “The Bargaining Problem”, *Econometrica* 18, 1950.

Nash, J. “Two-Person Cooperative Games”, *Econometrica* 21, 1953.

Osborne, M.J. and A. Rubinstein. *Bargaining and Markets*. Academic Press, 1990.

Roth, A. “Individual Rationality and Nash’s Solution to the Bargaining Problem”. *Mathematics of Operations Research* 2, 1977.

Roth, A. *Axiomatic Models of Bargaining*. Springer-Verlag, 1979.

Rubinstein, A. “Perfect Equilibrium in a Bargaining Model”, *Econometrica* 50, 1982.

6 Cooperative Games with Transferable Utility

- 6.1.- Stable Sets, Core, Bargaining Sets, and Kernel
- 6.2.- Shapley Value, Nucleolus, and other Values
- 6.3.- Division Rules and Solutions for the Bankruptcy Problem

REFERENCES

Aumann, R. and M. Maschler. “The Bargaining Set for Cooperative Games”, in *Advances in Game Theory*, editors: M. Dresher, J. Shapley, and A. Tucker. Princeton University Press, 1964.

Aumann, R. and M. Maschler. “Game Theoretic Analysis of a Bankruptcy Problem from the Talmud”, *Journal of Economic Theory* 36, 1985.

Bondareva, O. N. “Certain Applications of the Methods of Linear Programming to the Theory of Cooperative Games”, *Problemy Kibernet* 10, 1963.

Gillies, D. B. *Some Theorems on n -Person Games*. Ph.D. Thesis, Princeton University Press, 1953.

Hurt, S. and A. Mas-Colell. "Potential, Value and Consistency", *Econometrica* 57, 1989.

Mas-Colell, A. "An equivalence Theorem for a Bargaining Set", *Journal of Mathematical Economics* 18, 1989.

Maschler, M. "The Bargaining Set, Kernel, and Nucleolus". In *Handbook of Game Theory with Economic Applications I*, editors: R. Aumann and S. Hart. North-Holland, 1992.

Schmeidler, D. "The Nucleolus of a Characteristic Function Game", *SIAM Journal on Applied Mathematics* 17, 1969.

Shapley, L. "A Value for n -Person Games". In *Contributions to the Theory of Games II*, editors: H. Kuhn and A. Tucker. Princeton University Press, 1953.

Shapley, L. "On Balanced Sets and Cores", *Naval Research Logistics Quarterly* 14, 1967.

Tijs, S. H. "Bounds for the Core and the τ -value". In *Game Theory and Mathematical Economics*, editors: O. Mouschlin and D. Pallaschke. North-Holland, 1981.

Zhou, L. "A New Bargaining Set of an N -Person Game and Endogenous Coalition Formation", *Games and Economic Behavior* 6, 1994.

7 Cooperative Games with Non-Transferable Utility

7.1.- The Core

7.2.- The λ -transfer Extensions

7.3.- Bargaining and Value

7.4.- Market Games

REFERENCES

Hurt, S. and A. Mas-Colell. "Bargaining and Value", *Econometrica* 64, 1996.

Shapley, L. "Utility Comparison and the Theory of Games". In *La Decision: Aggregation et Dynamique des Ordres de Preference*, Editions du Centre National de la Recherche Scientifique, 1969.

Shapley, L. and M. Shubik. "Solutions of N -Person Games with Ordinal Preferences", *Econometrica* 21, 1953.

Shapley, L. and M. Shubik. "On Market Games", *Journal of Economic Theory* 1, 1969.

8 Miscellaneous

- 8.1.- Games with Infinitely Many Players
- 8.2.- Matching Models: Stability and Incentives
- 8.3.- Experiments on Game Theory
- 8.4.- Implementation

REFERENCES

- Barberà, S. “An Introduction to Strategy-proof Social Choice Functions”, *Social Choice and Welfare* 18, 2001.
- Jackson, M. “A Crash Course in Implementation Theory”, *Social Choice and Welfare* 18, 2001.
- Roth, A. “Game Theory as a Part of Empirical Economics,” *Economic Journal* 101, 1991.
- Roth, A. and M. Sotomayor. *Two-Sided Matching: A Study in Game-Theoretic Modeling and Analysis*. Econometrica Society Monograph, Cambridge University Press, 1990.
- Schmeidler, D. “Equilibrium Points of Nonatomic Games”, *Journal of Statistical Physics* 7, 1973.

Text Books

- Binmore, K. *A Primer in Game Theory*. D. C. Heath and Company, 1992.
- Driessen, T. *Cooperative Games, Solutions and Applications*. Kluwer Academic Publishers, 1988.
- Friedman, J. *Game Theory with Applications to Economics* (second edition). Oxford University Press, 1991.
- Fudenberg, D. and J. Tirole. *Game Theory*. MIT Press, 1991.
- Gibbons, R. *A Primer in Game Theory*. Harvester Wheatsheal, 1992.
- Harsanyi, J. and R. Selten. *A General Theory of Equilibrium Selection in Games*. MIT Press, 1988.
- Kreps, D. *Game Theory and Economic Modeling*. Clarendon Press, 1990.
- Luce, R., and H. Raiffa. *Games and Decisions*. Wiley, 1957.
- Mas-Colell, A., M. Whinston, and J. Green. *Microeconomic Theory*. Oxford University Press, 1995.

Moulin, H. *Game Theory for the Social Sciences* (second edition). New York University Press, 1986.

Moulin, H. *Axioms of Cooperative Decision Making*. Cambridge University Press (Econometric Society Monographs), 1988.

Myerson, R. *Game Theory: Analysis of Conflict*. Harvard University Press, 1991.

Osborne, M. J. and A. Rubinstein. *A Course in Game Theory*. MIT Press, 1994.

Owen, G. *Game Theory* (second edition). Academic Press, 1982.

Schelling, T. *The Strategy of Conflict*. Harvard University Press, 1960.

Shubik, M. *Game Theory in the Social Sciences*. MIT Press, 1984.

von Neumann, J. and O. Morgenstern. *The Theory of Games and Economic Behavior*. Princeton University Press, 1944.