

UNIVERSITY OF CHICAGO
Graduate School of Business

BUSINESS 506: GAME THEORY, INFORMATION AND UNCERTAINTY, II, Spring 1995

Milton Harris, Ro 214, 702-2549, FAX: 702-0118, E-mail: milt@uchicago.edu
Secretary: Joyce Van Grondelle, Ro 331, 702-0053

Introduction

The purpose of this course is to introduce students to a range of economic tools used to study models explicitly involving strategic behavior, information transmission and contracting in economics and finance. These tools include agency theory, signaling, and game theory. Applications are also considered as time permits.

Course Materials

The textbook for the course is

Dynamic Economic Analysis, by Milton Harris (Oxford University Press, 1987).

This text is referred to below as Harris (1987). We will probably cover only Chapter 5 of this book, although, if there is sufficient interest and time, I may cover part of Chapter 2. There is also a course packet. A textbook that is especially useful both for background material not covered in class and for a treatment of much of the material we will cover is

A Course in Microeconomic Theory, by David Kreps (Princeton University Press, 1990).

This book is recommended but not required. It is referred to below as Kreps (1990). Also recommended is

"The Theory of Contracts," by Oliver Hart and Bengt Holmstrom, Chapter 3 in *Advances in Economic Theory - Fifth World Congress*, Truman Bewley, ed. (Cambridge: Cambridge University Press, 1987).¹

The two books and the course packet are available from the Bookstore. All papers contained in the course packet are required reading. An approximate course schedule and a list of the contents of the course packet follows. Students are expected to read the assigned material *before* class. Also attached is an alphabetical reference list and the same list organized by topic. This list contains references both to readings in the packet (marked by *) and other papers that you may find useful either to fill in your

¹This paper is not included in the packet because Cambridge University Press will not give permission to reprint it. I have a copy.

background or to pursue further any of the topics covered. In the list organized by topic, some entries are marked by (S). These are suggested if you want to read one or two additional papers in an area covered in class. The list of references is not intended to be an exhaustive bibliography of papers in the areas covered in this course. It is simply a list of articles and books that I have found to be interesting or that are considered classics. Further references may be found in the reference lists of these articles.

Grading

Homework: To "practice" concepts covered in the course, homework will be required from time to time. The homeworks will not be graded, however, to make sure that you take them seriously, each assignment conscientiously done and handed in will count one point toward your final grade. Seven assignments are planned (these are in your course packet). Although I will not discuss the homeworks in class, answers will be distributed.

Final Exam: The remainder of your grade will depend entirely on your performance on a take-home final examination. The exam will require students to construct their own model of a given phenomenon and draw implications from it. The score on this exam will reflect the extent to which the model "captures" the given phenomenon, is tractable and the student is able to draw interesting implications from it. A copy of last year's exam and answer is in the packet.

Office Hours

Please call me at 312-702-2549, send me email at milt@uchicago.edu, or see me during class to set up an appointment.

APPROXIMATE CLASS SCHEDULE

Week	Topic	Reading
1-2	Static Agency Theory	Holmstrom (1979) *Kreps (1990, Ch. 16)
3	Validity of First-order Approach	Milgrom (1981) Rogerson (Nov. 1985) *Kreps (1990, Ch. 16)
4	Multi-task Agency Theory	Holmstrom and Milgrom (1991) *Kreps (1990, Ch. 16)
5	Dynamic Agency Theory	Rogerson (Jan. 1985)
6-7	Static Signaling	Riley (1979) *Kreps (1990, Ch. 17)
7-8	Application of Signaling	Rothschild/Stiglitz (1976)
8-9	Sequential Equilibrium and the Revelation Principle	Harris (1987, Ch. 5) *Kreps (1990, Chs. 11, 12, 13, 18)
10	Refinements of Sequential Equilibrium	Cho/Kreps (1987) Banks/Sobel (1987) *Kreps (1990, Chs. 12, 13)

*Reading is optional.

CONTENTS OF COURSE PACKET

This Syllabus
Homework Assignments
Final Exam from previous year

ARTICLES

Agency Theory

Holmstrom, B. (1979), "Moral Hazard and Observability," *The Bell Journal of Economics* 10, Spring, 74-91.

Milgrom, P. (1981), "Good News and Bad News: Representation Theorems and Applications," *The Bell Journal of Economics* 12, Autumn, 380-391.

Rogerson, W. (1985), "The First-Order Approach to Principal Agent Problems," *Econometrica* 53, November, 1357-1367.

Rogerson, W. (1985), "Repeated Moral Hazard," *Econometrica* 53, January, 69-76.

Holmstrom, B. and P. Milgrom (1991), "Multi-Task Principal-Agent Analyses: Incentive Contracts, Asset Ownership, and Job Design," *Journal of Law, Economics, and Organization* 7, 24-52.

Static Signaling and Adverse Selection

Riley, J. (1979), "Informational Equilibria," *Econometrica* 47, 331-360.

Rothschild, M. and J. Stiglitz (1976), "Equilibrium in Competitive Insurance Markets," *Quarterly Journal of Economics* 90, 629-650.

Games of Incomplete Information and Sequential Equilibrium

Cho, I. K. and D. Kreps (1987), "Signaling Games and Stable Equilibria," *Quarterly Journal of Economics* 102, May, 179-221.

Banks, J. and J. Sobel (1987), "Equilibrium Selection in Signaling Games," *Econometrica* 55, pp. 647-661.

ALPHABETICAL REFERENCE LIST

Asterisk (*) indicates inclusion in course packet.

Admati, A. and M. Perry (1987), "Strategic Delay in Bargaining," *Review of Economic Studies* 54, 345-364.

Akerlof, G. (1970), "The Market for 'Lemons': Quality Uncertainty and the Market Mechanism," *Quarterly Journal of Economics* 84, 488-500.

Aron, Debra J. (1988), "Moral Hazard, Firm Size and Diversification," *Rand Journal of Economics* 19, Spring, 72-87.

Aumann, R. (1976), "Agreeing to Disagree," *Annals of Statistics* 4, pp. 1236-1239.

Ausubel, L. and R. Deneckere (1987), "One is Almost Enough for Monopoly," *Rand Journal of Economics* 18, Summer, 255-274.

(*) Banks, J. and J. Sobel (1987), "Equilibrium Selection in Signaling Games," *Econometrica* 55, pp. 647-661.

Baron, D. and R. Myerson (1982), "Regulating a Monopolist with Unknown Costs," *Econometrica* 50, July, 911-930.

Bizer, D. and P. DeMarzo (1990), "Labor Contracts with Banking," *Working Paper*, Finance Department, Kellogg School.

Butters, Gerard (1977), "Equilibrium Distributions of Sales and Advertising Prices," *Review of Economic Studies*, 465-491.

Chan, Yuk-Shee and Hayne Leland (1982), "Prices and Qualities in Markets with Costly Information," *Review of Economic Studies*, October, 499-516.

Chatterjee, K. and W. Samuelson (1983), "Bargaining Under Incomplete Information," *Operations Research* 31, September, 835-851.

(*) Cho, I. K. and D. Kreps (1987), "Signaling Games and Stable Equilibria," *Quarterly Journal of Economics* 102, May, 179-221.

Cramton, P. (1984), "Bargaining with Incomplete Information: An Infinite Horizon Model with Two-Sided Uncertainty," *Review of Economic Studies* 51, October, 579-594.

Crawford, V. (1985), "Efficient and Durable Decision Rules: A Reformulation," *Econometrica*.

- Dasgupta, Partha, Peter Hammond, and Eric Maskin (1979), "The Implementation of Social Choice Rules: Some General Results on Incentive Compatibility," *The Review of Economic Studies* XLVI, 185-216.
- DeGroot, M. H. (1970), *Optimal Statistical Decisions*, (New York: McGraw-Hill).
- Demski, J. and D. Sappington (1987), "Delegated Expertise," *Journal of Accounting Research* 25, Spring, 68-89.
- Demski, J. and D. Sappington (1984), "Optimal Incentive Contracts with Multiple Agents," *Journal of Economic Theory* 33, June, 152-171.
- Diamond, D. and R. Verrecchia (1982), "Optimal Managerial Contracts and Equilibrium Security Prices," *The Journal of Finance* 37, May, 275-287.
- Diamond, D. (1984), "Financial Intermediation and Delegated Monitoring," *Review of Economic Studies* 51, July, 393-414.
- Dreze, J. H. (1974), "Axiomatic Theories of Choice, Cardinal Utility and Subjective Probability: A Review," in *Allocation Under Uncertainty: Equilibrium and Optimality*, J. Dreze (ed.), (New York: Wiley), 3-23.
- Farrell, J. and R. Gibbons (1989), "Cheap Talk Can Matter in Bargaining," *Journal of Economic Theory* 48, June, 221-237.
- Fishman, M. (1989), "Preemptive Bidding and The Role of the Medium of Exchange in Acquisitions," *The Journal of Finance* 44, March, 41-57.
- Fudenberg, D., B. Holmstrom, and P. Milgrom (1990), "Short Term Contracts and Long Term Agency Relationships," *Journal of Economic Theory* 51, June, 1-31.
- Fudenberg, D., D. Levine, and J. Tirole (1985), "Infinite-Horizon Models of Bargaining with One-Sided Incomplete Information," forthcoming in *Game Theoretic Models of Bargaining*, ed. Alvin Roth, Cambridge University Press.
- Fudenberg, D. and E. Maskin (1986), "The Folk Theorem for Games with Discounting or with Incomplete Information," *Econometrica* 54, May, 533-554.
- Fudenberg, D. and J. Tirole (1988), "Moral Hazard and Renegotiation in Agency Contracts," working paper #494, Department of Economics, MIT, April.
- Fudenberg, D. and J. Tirole (1991), "Perfect Bayesian Equilibrium and Sequential Equilibrium," *Journal of Economic Theory* 53, April, 236-260.
- Gale, D. and M. Hellwig (1985), "Incentive Compatible Debt Contracts: The One Period Problem," *The Review of Economic Studies* 52, October, 647-663.

- Geanakoplos, John (1992), "Common Knowledge," *Economic Perspectives*, 6, 53-82.
- Gibbons, R. and K. J. Murphy (1990), "Relative Performance Evaluation for Chief Executive Officers," *Industrial and Labor Relations Review* 43, February, S30-S51.
- Green, J. and J.-J. Laffont (1987), "Posterior Implementability in a Two-Person Decision Problem," *Econometrica* 55, January, 69-94.
- Green, J. and N. Stokey (1983), "A Comparison of Tournaments and Contests," *Journal of Political Economy* 91, 349-364.
- Grinblatt, M. and C. Y. Hwang (1989), "Signalling and the Pricing of New Issues," *The Journal of Finance* 44, June, 393-420.
- Grossman, S. and O. Hart (1983), "An Analysis of the Principal-Agent Problem," *Econometrica* 51, 7-46.
- Grossman, S. and M. Perry (1986), "Sequential Bargaining Under Asymmetric Information," *Journal of Economic Theory* 39, June, 120-154.
- Grossman, S. J. and M. Perry (1986), "Perfect Sequential Equilibrium," *Journal of Economic Theory* 39, June, 97-119.
- Grossman, S. and O. Hart (1982), "Corporate Financial Structure and Managerial Incentives," in *The Economics of Information and Uncertainty*, ed. J. McCall, 107-140.
- Gul, F., H. Sonnenschein, and R. Wilson (1986), "Foundations of Dynamic Monopoly and the Coase Conjecture," *Journal of Economic Theory* 39, June, 155-190.
- Harris, M. (1987), *Dynamic Economic Analysis*, (New York: Oxford University Press).
- Harris, M. and B. Holmstrom (1982), "A Theory of Wage Dynamics," *Review of Economic Studies*, LXIX, July, 1982, 315-333.
- Harris, M. and B. Holmstrom (1987), "On the Duration of Agreements," *International Economic Review* 28, June, 389-406.
- Harris, M. and A. Raviv (1979), "Optimal Incentive Contracts with Imperfect Information," *Journal of Economic Theory* 20, 231-259.
- Harris, M. and A. Raviv (1978), "Some Results on Incentive Contracts with Applications to Education and Employment, Health Insurance and Law Enforcement," *American Economic Review* 68, 20-30.
- Harris, M. and A. Raviv (1981), "A Theory of Monopoly Pricing Schemes with Uncertain Demand," *American Economic Review* 71, 347-365.

- Harris, M. and A. Raviv (1981), "Allocation Mechanisms and the Design of Auctions," *Econometrica* 49, 1477-1500.
- Harris, M. and A. Raviv (1985), "A Sequential Signalling Model of Convertible Debt Call Policy," *Journal of Finance*, December, 1263-81.
- Harris, M. and A. Raviv (1993), "The Role of Games in Security Design," working paper, University of Chicago Graduate School of Business.
- Harris, M. and R. Townsend (1981), "Resource Allocation Under Asymmetric Information," *Econometrica* 49, 33-64.
- Harris, M. and R. M. Townsend (1985), "Allocation Mechanisms, Asymmetric Information, and the 'Revelation Principle'," with Robert M. Townsend, in *Issues in Contemporary Microeconomics and Welfare*, George R. Feiwel, editor, Macmillan, 379-394.
- Harsanyi, J. (1967-8), "Games with Incomplete Information Played by Bayesian Players," *Management Science* 14, 159-189, 320-334, and 486-502.
- Hart, O. and B. Holmstrom (1987), "The Theory of Contracts," Chapter 3 in *Advances in Economic Theory*, T. Bewley (ed.), Cambridge University Press.
- Herstein, I. N. and John Milnor (1953), "An Axiomatic Approach to Measurable Utility," *Econometrica* 21, pp. 291-97.
- Holmstrom, B. (1982), "Moral Hazard in Teams," *The Bell Journal of Economics* 13, Autumn.
- (*) Holmstrom, B. (1979), "Moral Hazard and Observability," *The Bell Journal of Economics* 10, Spring, 74-91.
- Holmstrom, Bengt (1982), "Managerial Incentive Problems - A Dynamic Perspective," in *Essays in Economics and Management in Honour of Lars Wahlbeck*, Swedish School of Economics and Business Administration.
- Holmstrom, B. and P. Milgrom (1987), "Aggregation and Linearity in the Provision of Intertemporal Incentives," *Econometrica* 55, March, 303-328.
- (*) Holmstrom, B. and P. Milgrom (1991), "Multi-Task Principal-Agent Analyses: Incentive Contracts, Asset Ownership, and Job Design," *Journal of Law, Economics, and Organization* 7, 24-52.
- Holmstrom, B. and P. Milgrom (1990), "Regulating Trade Among Agents," *Journal of Institutional and Theoretical Economics* 146, 85-105.
- Holmstrom, B. and R. Myerson (1983), "Efficient and Durable Decision Rules with Incomplete Information," *Econometrica* 51, 1799-1819.

- Holt, C., Jr. (1980), "Competitive Bidding for Contracts Under Alternative Auction Procedures," *Journal of Political Economy* 88, 433-445.
- Intriligator, Michael D. (1971), *Mathematical Optimization and Economic Theory*, (Englewood Cliffs, NJ: Prentice Hall).
- Jensen, M. and W. Meckling (1976), "Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure," *Journal of Financial Economics* 3, 305-360.
- Kahneman D. and A. Tversky (1969), "Prospect Theory: An Analysis of Behavior Under Risk," *Econometrica* 47, 263-291.
- Klein, B. and K. Leffler (1981), "The Role of Market Forces in Assuring Contractual Performance," *Journal of Political Economy* 89, 615-641.
- Kolberg, E. and J.-F. Mertens (1984), "On the Strategic Stability of Equilibria," Harvard Working Paper, forthcoming in *Econometrica*.
- Kreps, D. M. (1990), *A Course in Microeconomic Theory* (Princeton: Princeton University Press).
- Kreps, D. and R. Wilson (1982), "Reputation and Imperfect Information," *Journal of Economic Theory* 27, August.
- Kreps, D. and R. Wilson (1982), "Sequential Equilibria," *Econometrica* 50, 863-894.
- Kreps, D., P. Milgrom, J. Roberts, and R. Wilson (1982), "Rational Cooperation in the Finitely Repeated Prisoner's Dilemma," *Journal of Economic Theory* 27, 242-252.
- Laffont, Jean-Jacques (1985), *The Economics of Uncertainty and Information*, (Cambridge, MA: MIT Press).
- Laffont, J. J. and J. Tirole (1988), "Repeated Auctions of Incentive Contracts, Investment and Bidding Parity with an Application to Takeovers," *Rand Journal of Economics* 19, Winter, 516-537.
- Lambert, R. (1983), "Long-Term Contracts and Moral Hazard," *The Bell Journal of Economics* 14, (Autumn), 441-452.
- Lazear, E. and S. Rosen (1981), "Rank-Order Tournaments as Optimal Labor Contracts," *Journal of Political Economy* 89, 841-864.
- Leland, H. and D. Pyle (1977), "Informational Asymmetries, Financial Structure, and Financial Intermediation," *Journal of Finance* XXXII, May, 371-387.
- Machina, Mark (1982), "A Stronger Characterization of Declining Risk Aversion," *Econometrica* 50, pp. 1069-1080.

- Maskin, E. and J. Riley (1984), "Optimal Auctions with Risk Averse Buyers," *Econometrica* 52, (November), 1473-1518.
- Maskin, E. and J. Riley (1984), "Monopoly with Incomplete Information," *The Rand Journal of Economics* 15, Summer, 171-196.
- Maskin, E. and J. Tirole (1992), "The Principal-Agent Relationship with an Informed Principal, II: Common Values," *Econometrica* 60, 1-42.
- Matthews, S., "Selling to Risk Averse Buyers (1983)," *Journal of Economic Theory* 30, 370-400.
- Matthews, S. and J. Moore (1987), "Monopoly Provision of Quality and Warranties: An Exploration in the Theory of Multidimensional Screening," *Econometrica* 55, March, 441-467.
- Milgrom, P. (1987), "Auction Theory," in *Advances in Economic Theory: Invited Papers for the Fifth World Congress of the Econometric Society*, T. Bewley, ed. (Cambridge: Cambridge University Press).
- (*) Milgrom, P. (1981), "Good News and Bad News: Representation Theorems and Applications," *The Bell Journal of Economics* 12, Autumn, 380-391.
- Milgrom, P. (1981), "An Axiomatic Characterization of Common Knowledge," *Econometrica* 49, pp. 219-222.
- Milgrom, P. (1981), "Rational Expectations, Information Acquisition, and Competitive Bidding," *Econometrica* 49, July.
- Milgrom, P. (1979), "A Convergence Theorem for Competitive Bidding with Differential Information," *Econometrica* 47, May, 679-688.
- Milgrom, P. and J. Roberts (1982), "Predation, Regulation, and Entry Deterrence," *Journal of Economic Theory* 27, August, 280-312.
- Milgrom, P. and J. Roberts (1982), "Limit Pricing and Entry Under Incomplete Information: An Equilibrium Analysis," *Econometrica* 50, March, 443-460.
- Milgrom, P. and J. Roberts (1986), "Price and Advertising Signals of Product Quality," *Journal of Political Economy*, 796-821.
- Milgrom, P. and J. Roberts (1986), "Relying on the Information of Interested Parties," *Rand Journal of Economics*, 18-32.
- Milgrom, P. and N. Stokey (1982), "Information, Trade and Common Knowledge," *Journal of Economic Theory* 26, 17-27.

- Milgrom, P. and R. Weber (1982), "A Theory of Auctions and Competitive Bidding," *Econometrica* 50, 1089-1122.
- Miller, M. and K. Rock (1985), "Dividend Policy under Asymmetric Information," *The Journal of Finance* XL, September, 1031-1051. [CRSP #R.133]
- Mirrlees, J. (1971), "An Exploration in the Theory of Optimum Income Taxes," *Review of Economic Studies* 38, 175-208.
- Mirrlees, J. (1975), "The Theory of Moral Hazard and Unobservable Behavior," Oxford, mimeo.
- Miyazaki, H. (1977), "The Rat Race and Internal Labor Markets," *The Bell Journal of Economics*, Autumn, 167-207.
- Mossin, J. (1973), *Theory of Financial Markets*, (Englewood Cliffs, NJ: Prentice Hall), Chapter 2.
- Mussa, M. and S. Rosen (1978), "Monopoly and Product Quality," *Journal of Economic Theory* 18, 301-317.
- Myerson, R. (1981), "Optimal Auction Design," *Mathematics of Operations Research* 6, 58-73.
- Myerson, R. (1983), "Mechanism Design by an Informed Principal," *Econometrica* 51, November, 1767-1798.
- Myerson, R. and M. Satterthwaite (1983), "Efficient Mechanisms for Bilateral Trading," *Journal of Economic Theory* 29, 265-281.
- Myerson, R. (1979), "Incentive Compatibility and the Bargaining Problem," *Econometrica* 47, 61-74.
- Nalebuff, B. and J. Stiglitz (1984), "Prizes and Incentives: Towards a General Theory of Compensation and Competition," *The Bell Journal of Economics* 15, Autumn, 21-43.
- Palfrey, T. and S. Srivastava (1989), "Implementation with Incomplete Information in Exchange Economies," *Econometrica* 57, January, 115-134.
- Pratt, J. (1964), "Risk Aversion in the Small and in the Large," *Econometrica* 32, 122-136. (D&R)
- Radner, R. (1985), "Repeated Principal-Agent Games with Discounting," *Econometrica* 53, September, 1173-1198.
- Rasmusen, Eric (1989), *Games and Information*, (Oxford: Basil Blackwell).
- Riley, J. and W. Samuelson (1981), "Optimal Auctions," *American Economic Review* 71, 381-392.
- (*) Riley, J. (1979), "Informational Equilibria," *Econometrica* 47, 331-360.

- Rock, K. (1986), "Why New Issues Are Underpriced," *Journal of Financial Economics* 15, 187-212.
- (*) Rogerson, W. (1985), "The First-Order Approach to Principal Agent Problems," *Econometrica* 53, November.
- (*) Rogerson, W. (1985), "Repeated Moral Hazard," *Econometrica* 53, January, 69-76.
- Rogerson, W. (1983), "Reputation and Product Quality," *The Bell Journal of Economics* 14, Autumn, 508-516.
- Ross, S. A. (1981), "Some Stronger Measures of Risk Aversion in the Small and the Large with Applications," *Econometrica*, May, pp. 621-638.
- Ross, S. (1977), "The Determination of Financial Structure: The Incentive Signalling Approach," *The Bell Journal of Economics* 8, 23-40.
- Ross, S. (1973), "The Economic Theory of Agency: The Principal's Problem," *American Economic Review* 63, May, 134-139.
- Rothschild, M. (1974), "Searching for the Lowest Price When the Distribution of Prices is Unknown," *Journal of Political Economy* 82, 689-711.
- Rothschild, M. and J. E. Stiglitz (1970), "Increasing Risk I: A Definition," *Journal of Economic Theory* 2, pp. 225-243.
- Rothschild, M. and J. E. Stiglitz (1971), "Increasing Risk II: Its Economic Consequence," *Journal of Economic Theory* 3, 66-84.
- (*) Rothschild, M. and J. Stiglitz (1976), "Equilibrium in Competitive Insurance Markets," *Quarterly Journal of Economics* 90, 629-650.
- Rubinstein, A. (1985), "A Bargaining Model with Incomplete Information about Time Preferences," *Econometrica* 53.
- Samuelson, W. (1984), "Bargaining Under Asymmetric Information," *Econometrica* 52, July, 995-1006.
- Selten, R. (1975), "Re-examination of the Perfectness Concept for Equilibrium Points in Extensive Form Games," *International Journal of Game Theory* 4, 25-55.
- Shapiro, C. (1982), "Consumer Information, Product Quality and Seller Reputation," *The Bell Journal of Economics* 13, Spring, 20-35.
- Shavell, S. (1979), "Risk Sharing and Incentives in the Principal-Agent Relationship," *The Bell Journal of Economics* 10, Spring, 55-73.

- Shleifer, A. and R. Vishny (1986), "Large Shareholders and Corporate Control," *Journal of Political Economy* 94, 461-488. [CRSP #R.146]
- Spence, M. (1973), "Job Market Signalling," *Quarterly Journal of Economics* 87, 353-374.
- Stiglitz, J. and A. Weiss (1981), "Credit Rationing in Markets with Imperfect Information," *American Economic Review* 71, 393-410.
- Stokey, Nancy, "A Simple Proof of Blackwell's Theorem," CMSEMS², Northwestern University.
- Townsend, R. (1979), "Optimal Contracts and Competitive Markets with Costly State Verification," *Journal of Economic Theory* 21, 265-293.
- Townsend, R. (1982), "Optimal Multiperiod Contracts and the Gain from Enduring Relationships under Private Information," *Journal of Political Economy* 90, December, 1166-1187.
- Townsend, R. M. (1988), "Information Constrained Insurance, The Revelation Principle Extended," *Journal of Monetary Economics* 21, 411-450.
- Tirole, Jean (1988), *The Theory of Industrial Organization*, (Cambridge, MA: MIT Press).
- Vickrey, W. (1961), "Counterspeculation, Auctions and Competitive Sealed Tenders," *Journal of Finance* 16, 8-37.
- Welch, Ivo (1989), "Seasoned Offerings, Imitation Costs, and the Underpricing of Initial Public Offerings," *Journal of Finance* 44, June, 421-449.
- Wilson, C. (1977), "A Model of Insurance Markets with Asymmetric Information," *Journal of Economic Theory* 16, 167-207.
- Wilson, R. (1978), "Information, Efficiency and the Core of an Economy," *Econometrica* 46, 807-816.
- Wilson, R. (1977), "A Bidding Model of Perfect Competition," *Review of Economic Studies* 44, 511-518.

²Center for Mathematical Studies in Economics and Management Science.

REFERENCES BY TOPIC

See alphabetical list for complete references. Asterisk (*) indicates inclusion in course packet, (S) indicates papers that are Suggested for those wishing to read one or two additional papers in an area to be discussed in class.

I. Surveys and General References

- (S) Hart and Holmstrom, "The Theory of Contracts"
- Intriligator, *Mathematical Optimization and Economic Theory*
- (S) Kreps, *A Course in Microeconomic Theory*
- Laffont, *The Economics of Uncertainty and Information*
- Rasmusen, *Games and Information*
- Tirole, *The Theory of Industrial Organization*

II. FoundationsA. Utility theory, risk aversion, and stochastic dominance

- DeGroot, *Optimal Statistical Decisions*
- Dreze, "Axiomatic Theories ..."
- Herstein and Milnor, "An Axiomatic Approach ..."
- Kahneman and Tversky, "Prospect Theory ..."
- Machina, "A Stronger Characterization ..."
- Mossin, Chapter 2 of *Theory of Financial Markets*
- Pratt, "Risk Aversion in the Small ..."
- Ross, "Some Stronger Measures of Risk Aversion ..."
- Rothschild and Stiglitz, "Increasing Risk I ..."
- Rothschild and Stiglitz, "Increasing Risk II ..."

B. Information theory

- Auman, "Agreeing to Disagree"
- (S) Geanakoplos, "Common Knowledge"
- Milgrom, "An Axiomatic Characterization of Common Knowledge"
- Milgrom and Roberts, "Relying on the Information of Interested Parties"
- (S) Milgrom and Stokey, "Information, Trade and Common Knowledge"
- Stokey, "A Simple Proof of Blackwell's Theorem"

C. Search

- Butters, "Equilibrium Distributions of Sales and ..."
- Rothschild, "Searching for the Lowest Price ..."

III. Agency and Theory of ContractsA. Static Models1. One agent, one principal

- Demski and Sappington, "Delegated Expertise"
- (S) Diamond, "Financial Intermediation and ..."
- Gibbons and Murphy, "Relative Performance Evaluation ..."
- (S) Grossman and Hart, "An Analysis of the Principal-Agent ..."
- Grossman and Hart, "Corporate Financial Structure ..."
- (S) Harris and Raviv, "Optimal Incentive Contracts ..."
- Harris and Raviv, "Some Results on Incentive Contracts ..."
- (*) Holmstrom, "Moral Hazard and Observability"
- (*) Holmstrom and Milgrom, "Multi-Task Principal-Agent Analyses ..."
- Holmstrom and Milgrom, "Regulating Trade Among Agents"
- Jensen and Meckling, "Theory of the Firm ..."
- Maskin and Tirole, "The Principal-Agent Relationship with an Informed ..."
- (*) Milgrom, "Good News ..."
- Mirrlees, "The Theory of Moral Hazard ..."
- (*) Rogerson, "The First-Order Approach ..."
- Ross, "The Economic Theory of Agency ..."
- Shavell, "Risk Sharing and Incentives ..."

2. Many agents

- Aron, "Ability, Moral Hazard, and Firm Diversification"
- Demski and Sappington, "Optimal Incentive Contracts ..."
- Green and Stokey, "A Comparison of Tournaments ..."
- (S) Holmstrom, "Moral Hazard in Teams"
- (*) Holmstrom and Milgrom, "Multi-Task Principal-Agent Analyses ..."
- (S) Holmstrom and Milgrom, "Aggregation and Linearity ..."
- (S) Lazear and Rosen, "Rank-Order Tournaments ..."
- Nalebuff and Stiglitz, "Prizes and Incentives ..."

B. Dynamic Models

- (S) Bizer and DeMarzo, "Labor Contracts with Banking"
- (S) Fudenberg, Holmstrom and Milgrom, "Short Term Contracts and ..."
- Fudenberg and Tirole, "Moral Hazard and Renegotiation ..."
- Holmstrom, "Managerial Incentive Problems ..."
- Lambert, "Long-Term Contracts and Moral Hazard"
- Radner, "Repeated Principal-Agent Games ..."
- (*) Rogerson, "Repeated Moral Hazard"

IV. Games of Incomplete InformationA. General

- (S) Fudenberg and Maskin, "The Folk Theorem ..."
- Fudenberg and Tirole, "Perfect Bayesian and Sequential Equilibria: ..."
- Harris, Chapter 5 of *Dynamic Economic Analysis*
- Harris and Townsend, "Allocation Mechanisms, Asymmetric Information, ..."
- Harsanyi, "Games with Incomplete Information ..."
- Kolberg and Mertens, "On the Stability of Equilibria"
- Kreps and Wilson, "Sequential Equilibria"

- Myerson, "Incentive Compatibility and ..."
 Selten, "Re-examination of the Perfectness Concept ..."
 Townsend, "Information Constrained Insurance: ..."
- B. Efficiency concepts
 (S) Crawford, "Efficient and Durable Decision Rules ..."
 (S) Harris and Townsend, "Resource Allocation ..."
 (S) Holmstrom and Myerson, "Efficient and Durable Decision Rules ..."
 Myerson, "Mechanism Design by an Informed Principal"
 Myerson and Satterthwaite, "Efficient Mechanisms for ..."
 Wilson, "Information, Efficiency and the Core of an Economy"
- C. Auctions, Pricing Schemes, and Other Bidding Models
 Fishman, "Preemptive Bidding and the Role ..."
 Harris and Raviv, "Allocation Mechanisms and the Design ..."
 (S) Harris and Raviv, "A Theory of Monopoly Pricing Schemes ..."
 Holt, "Competitive Bidding for Contracts ..."
 Laffont and Tirole, "Repeated Auctions of Incentive Contracts, ..."
 Maskin and Riley, "Optimal Auctions with Risk Averse Buyers"
 (S) Matthews, "Selling to Risk Averse Buyers"
 (S) Myerson, "Optimal Auction Design"
 Milgrom, "Auction Theory"
 Milgrom, "A Convergence Theorem ..."
 Milgrom, "Rational Expectations, Information Acquisition ..."
 (S) Milgrom and Weber, "A Theory of Auctions ..."
 Riley and Samuelson, "Optimal Auctions"
 (S) Shleifer and Vishny, "Large Shareholders and ..."
 Vickrey, "Counterspeculation, Auctions, ..."
 Wilson, "A Bidding Model of Perfect Competition"
- D. Implementation
 Dasgupta, et. al., "The Implementation of Social Choice Rules: ..."
 Green and Laffont, "Posterior Implementability ..."
 Palfrey and Srivastava, "Implementation with Incomplete ..."
- E. Bargaining
 Chatterjee and Samuelson, "Bargaining Under Incomplete ..."
 Cramton, "Bargaining With Incomplete Information ..."
 Farrell and Gibbons, "Cheap Talk Can Matter ..."
 Fudenberg, et. al., "Infinite-Horizon Models of Bargaining ..."
 Grossman and Perry, "Sequential Bargaining ..."
 Gul, et. al., "Foundations of Dynamic Monopoly ..."
 Rubinstein, "A Bargaining Model with ..."
 Samuelson, "Bargaining Under Asymmetric Information"
- F. Signaling

1. Static
 (S) Akerlof, "The Market for 'Lemons' ..."
 Grinblatt and Hwang, "Signalling and the Pricing of ..."
 (S) Leland and Pyle, "Informational Asymmetries, Financial ..."
 Milgrom and Roberts, "Limit Pricing and Entry ..."
 Miller and Rock, "Dividend Policy Under ..."
 Myazaki, "The Rat Race and Internal Labor Markets"
 (*) Riley, "Informational Equilibria"
 Ross, "The Determination of Financial Structure ..."
 Spence, "Job Market Signalling"
 Welch, "Seasoned Offerings, Imitation Costs, and the Underpricing of ..."
2. Dynamic
 (*) Banks and Sobel, "Equilibrium Selection in Signaling Games"
 (*) Cho and Kreps, "Signaling Games and Stable Equilibria"
 (S) Grossman and Perry, "Perfect Sequential Equilibrium"
 (S) Harris and Raviv, "A Sequential Signalling Model ..."
3. Multidimensional
 Matthews and Moore, "Monopoly Provision of Quality ..."
 (S) Milgrom and Roberts, "Price and Advertising ..."
- G. Adverse selection
 (S) Baron and Myerson, "Regulating a Monopolist ..."
 Chan and Leland, "Prices and Qualities in Markets ..."
 (S) Gale and Helwig, "Incentive Compatible Debt Contracts ..."
 Harris and Holmstrom, "On the Duration of Agreements ..."
 Maskin and Riley, "Monopoly with Incomplete Information"
 Mirrlees, "An Exploration in the Theory of ..."
 (S) Rock, "Why New Issues Are Underpriced"
 (*) Rothschild and Stiglitz, "Equilibrium in Competitive Insurance ..."
 Stiglitz and Weiss, "Credit Rationing in Markets ..."
 (S) Townsend, "Optimal Contracts and Competitive Markets ..."
 Townsend, "Optimal Multiperiod Contracts and ..."
 Wilson, "A Model of Insurance Markets ..."
- H. Reputation
 Ausubel and Deneckere, "One is Almost Enough ..."
 Klein and Leffler, "The Role of Market Forces ..."
 (S) Kreps and Wilson, "Reputation and Imperfect Information"
 Kreps, et. al., "Rational Cooperation in ..."
 (S) Milgrom and Roberts, "Predation, Regulation, and ..."
 Mussa and Rosen, "Monopoly and Product Quality"
 (S) Rogerson, "Reputation and Product Quality"
 Shapiro, "Consumer Information, Product Quality, ..."