Spring 2008
Columbia University

Industrial Organization III (G6255):

Theory of Auctions, Matching, and Market Design

Yeon-Koo Che

Market Design is an emerging field in economics that attempts to devise a practical scheme for allocating scarce resources to individuals who value them. Its applications involve many important real life problems ranging from allocation of government resources such as public land, fishing/mineral rights, radio spectrum licenses, allocation of school choice and transplantable human organs, assignment of workers to jobs, to placement of advertising in Internet search engines. Mechanism design underpins the field as a general methodological framework, which is in turn operationalized by two branches of theories: (1) Auction Theory and (2) Matching Theory. The course shall provide a guide through these theories and discusses a few applications, along the way.

- **General Information:**

  Class Hours: Tuesday, 11:00A-12:50P

  Place: IAB 326

  Contract Information: (Phone) 854-8276; (E-mail) yk.che@columbia.edu

- **Grading:**

  1. Occasional Problem Sets

  2. Research Proposal with Preliminary Results

- **Text Books**

  Milgrom, Paul, *Putting Auction Theory to Work,* Cambridge University Press, 2004.

  Alvin Roth and Marilda Sotomayor, *Two-sided Matching: A Study in Game-theoretic Modeling and Analysis*, Econometric Society Monographs.

  Krishna, *Auction Theory*, Academic Press, 2002.

- **Reading Group**: *Optional but encouraged.*

  The reading group meets on (almost) every Friday and covers additional related literature.

Lecture Schedules

Part I: Mechanism and Auction Design

Lecture 1: General Overview, Revelation Principle, VCG, and AGV

- Roth, Alvin, 2002, "The Economist as Engineer: Game Theory, Experimental Economics and Computation as Tools of Design Economics," *Econometrica*, 70, 4, July 2002, 1341-1378.

- Chapter 23 of A. Mas-Colell, M.D. Whinston, and J.R. Green, *Microeconomic Theory*, Oxford University Press, 1995.

- Chapter 5 of Krishna.

Lecture 2: Optimal Auction Design in IPV auctions, Scoring Rule Auctions

- Milgrom, Paul, and Ilya Segal, 2000, "Envelope Theorems for Arbitrary Choice Sets," *Econometrica*, 70, 583-601

- Myerson, Roger, 1981, "Optimal Auction Design," *Mathematics of Operations Research*, 6, 58-73.

- Che, Yeon-Koo, 1993, "Design Competition through Multidimensional Auctions," *Rand Journal of Economics*, 24, 668-80.

Lecture 3: Public Good, Bilateral Bargaining, Property Right Allocation

- Schweizer, U, 2006, "Universal Possibility and Impossibility Results", Games and Economic Behavior 57, 2006, 73-85.

- Myerson, R., and Satthethwaite, M., 1983, "Efficient Mechanisms for Bilateral Trading" Journal of Economic Theory, 29, 265-281

- Cramton, P., Gibbons, R., and Klemperer, P., 1987. "Dissolving a Partnership Efficiently," Econometrica, 55(3), 615-32.

Lecture 4: Correlated Types, Interdependent Values, and Winners' Curse

- Crémer, Jacques, and Richard McLean, 1985, "Optimal Selling Strategies under Uncertainty for a Discriminating Monopolist when Demands are Interdependent," *Econometrica*, 53, 345-362.

- Crémer, Jacques, and Richard McLean, 1988, "Full Extraction of the Surplus in Bayesian and Dominant Strategy Auctions," *Econometrica*, 56, 1247-1257.

- Milgrom, Paul and Weber, Robert, 1982, "A Theory of Auctions and Competitive Bidding," *Econometrica*, 50, 1089-1122.

- Maskin, Eric, 2000, "Auctions, Development and Privatization: Efficient Auctions with Liquidity-Constrained Buyers," *European Economic Review*, 44, 667-681.

- Dasgupta, P., and Maskin, 2000, "Efficient Auctions," Quarterly Journal of Economics, 115, 341-388.

Lecture 5: Multidimensionsional Types, Budget Constraints

- Che, Yeon-Koo and Ian Gale, 1998, "Standard Auctions with Financially Constrained Bidders," *Review of Economic Studies*, 65, 1-21.

- Che, Yeon-Koo and Ian Gale, "Revenue Comparisons for Auctions When Bidders Have Arbitrary Types," *Theoretical Economics*, (2006), 1, 95 - 118.

- Jehiel, Philippe, and Benny Moldovanu, 2001, "Efficient Design with Interdependent Valuations," *Econometrica*, 69, 1237-1259.

Lecture 6: Multiunit Auctions and Package Auctions

- Milgrom, Paul, 2000, "Putting Auction Theory to Work: Simultaneous Ascending Auction," *Journal of Political Economy*, April.

- Milgrom, Paul and Larry Ausubel, 2002, "Ascending Auctions with Package Bidding," *Frontiers of Theoretical Economics*, 1(1), August 2002: Article 1.

- Ausubel, Larry, 2004, "An Efficient Ascending-Bid Auction for Multiple Objects," *American Economic Review*, 94, 1452-1475.

Lecture 7: Internet Ad ("Sponsored Links") Auctions

- Edelman, B., Ostrovsky, M. and Schwarz, M. (2007), "Internet Advertising and the Generalized Second Price Auction: Selling Billions of Dollars Worth of Keywords," forthcoming, *American Economic Review.*

- Edelman, B. and Ostrovsky, M., "Strategic Bidder Behavior in Sponsored Search Auctions," Decision Support Systems, v. 43(1), February 2007, pp. 192-198.

- Varian, H. (2007), "Position Auctions," forthcoming, *International Journal of Industrial Organization.*

- Borgers, T., Cox, I., Pesendorfer, M., and Petricek, V. (2007), "Equilibrium Bids in Sponsored Search Auctions: Theory and Evidence," mimeo., University of Michigan.

Part II: Matching Theory and Market Design

Lecture 8. One-Sided Matching

- Zhou, Lin, 1990, "On a Conjecture by Gale About One-Sided Matching Problems," *Journal of Economic Theory*, 52, 123-135.

- Abdulkadiroglu, Atila, and Tayfun Snmez, 1998, "Random Serial Dictatorship and the Core from Random Endowments in House Allocation Problems," *Econometrica*, 66, 689-701

- Roth, Alvin E. [1982b], "Incentive Compatibility in a Market with Indivisible Goods," *Economics Letters*, 9, pp127-132.

- Hylland, Aanund and Richard Zeckhauser, 1979, "The Efficient Allocation of Individuals to Positions," *Journal of Political Economy*, 87, 293-314.

- Bogomolnaia, Anna and Moulin, Herve, 2001, "A New Solution to the Random Assignment Problem," *Journal of Economic Theory*, 100, 295-328.

Lecture 9. Two-Sided Matching: One-to-one Matching ("Marriage Problem")

- Gale, David and Lloyd Shapley (1962), "College Admissions and the Stability of Marriage," *American Mathematical Monthly*, 69, pp9-15.

- Roth and Sotomayor, Chapters 2 and 3

Lecture 10. Two-Sided Matching: Incentives and Equilibria

- Roth and Sotomayor, Chapter 4

Lecture 11. Two-Sided Matching: Many-to-one Matchings ("College Admissions Problem")

- Roth and Sotomayor, Chapter 5

Lecture 12. Two-Sided Matching: Unified Approach in Matchings

- Roth and Sotomayor, Chapter 5

- Kelso, Alexander S.,Jr. and Vincent P. Crawford, 1982, Job Matching, Coalition Formation, and Gross Substitutes", *Econometrica*, 50, 1483-1504.

- Hatfield, John William and Milgrom, Paul R. (2005), "Matching with Contracts," The American Economic Review, Volume 95, Number 4, September 2005, pp. 913-935(23)

Lecture 13: Many-to-Many Matchings

- Ostrovsky, M., "Stability in Supply Chain Networks," American Economic Review, forthcoming.

Lecture 14: School Choice Application

- Abdulkadiroglu, Atila, and Tayfun Snmez, "School Choice: A Mechanism Design Approach", American Economic Review 93-3: 729-747, June 2003.

- Abdulkadiroglu, Atila, Parag A. Pathak, Alvin E. Roth, and Tayfun Snmez, "Changing the Boston School Choice Mechanism," January, 2006.

- Abdulkadiroglu, Atila, Yeon-Koo Che, and Yosuke Yasuda, "Expanding Choice to School Choice." (to be made available soon)