BEPP 971: Market Design
Syllabus

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Time: Fridays, 9-12
Room: SHDH 1201

The course covers Market Design, the analysis and engineering of market rules and institutions. In the last 60 years practitioners and academics have deliberately engineered the rules of an increasing number of markets, with classic examples including medical resident matching (e.g., NRMP), spectrum auctions (e.g., FCC auctions), and organ donation exchanges. In the last few years, very large markets have been created from scratch, such as Ebay, Adwords, and many smaller markets like odesk.com and sittercity.com. These designs use a broad set of tools, including economic theory, empirical analysis and experiments (and a fair dose of trial-and-error). With this experience, useful principles have emerged, on what market failures typically have to be addressed, and on which rules work and which do not.

Course Objectives and Structure.
The goal of the course is to prepare students to do cutting edge research, and solve industry and policy problems in market design. As such, more than 70% of the course covers recent papers and empirical work. This reflects my view that many of the opportunities for high-impact research are in empirical work and investigating new markets. Because of the broad methodological scope of the field, the course takes a top-down perspective. You will learn, in the context of applications, the main tools of auction theory, matching theory, and experimental economics, but this is not a comprehensive review of these areas. If you want to, e.g., specialize in matching theory, Professor Mailath's course is a much better choice. What the course *will* offer is a good grasp of the tools and insights of market design, to navigate the large amount of information and methodologies used in the field, and a sense of what the key open problems are.

The course is structured in three parts. The first two parts cover classic applications, key ideas, and theoretical and empirical tools. Part I focuses on matching markets. While discussing engineering aspects of several markets, we will get an overview of matching theory, and the key market failures observed due to ill-designed rules. Part II covers auction markets, with applications including spectrum auctions and bidding rings. We will cover the most important points in auction theory, and empirical methods in auctions. Part III applies the tools developed in the first lectures to problems in the research frontier. Lectures in part III will involve guest speakers from industry and academia, and students in the course. Speakers for Spring 2014 include David Reiley from Google, Nikhil Agarwal from MIT Economics, Aaron Roth from UPenn CS, Michael Bailey from Facebook, and John Horton from NYU Stern IOMS and oDesk.com.

Lectures: Schedule and readings are listed below. You are responsible for readings with an *. Five papers have a *** mark, and I highly recommend reading them.

Grading: Students will be graded on class presentations of the papers in part III of the course. We will cover the necessary theory and statistics, so there are no requirements. PhD students in Economics, Operations, Computer Science, Marketing and related areas are welcome.

Course Outline and Readings

Week 1. Overview and Critiques of Market Design

- (*) Roth, Alvin E. "The economist as engineer: Game theory, experimentation, and computation as tools for design economics." *Econometrica* 70.4 (2002): 1341-1378.
- Roth, Alvin E. "What Have We Learned from Market Design?." *The Economic Journal* 118.527 (2008): 285-310.
- Milgrom, Paul Robert. *Putting auction theory to work*. Cambridge University Press, 2004.
- McAfee, R. Preston, and John McMillan. "Analyzing the airwaves auction." *The Journal of Economic Perspectives* 10.1 (1996): 159-175.
- Schmalensee, Richard, et al. "An interim evaluation of sulfur dioxide emissions trading." *The Journal of Economic Perspectives* 12.3 (1998): 53-68.

Part I: "Design" Market Failures and Matching Markets

Week 2. Matching Markets

The Evolution of the Medical Match:

- **(***)** Roth, Alvin E. "The evolution of the labor market for medical interns and residents: a case study in game theory." *The Journal of Political Economy*(1984): 991-1016.
- Roth, Alvin E., and Elliott Peranson. "The Redesign of the Matching Market for American Physicians: Some Engineering Aspects of Economic Design." *American economic review* 89.4 (1999): 748-782.

Matching Theory:

- **(***)** Gale, David, and Lloyd S. Shapley. "College admissions and the stability of marriage." *The American Mathematical Monthly* 69.1 (1962): 9-15.
- **(***)** Becker, Gary S. "A theory of marriage: Part I." *The Journal of Political Economy* (1973): 813-846.
- Azevedo, Eduardo M., and Jacob D. Leshno. "A supply and demand framework for two-sided matching markets." Mimeo, Wharton (2012).
- Roth, Alvin E., and Marilda A. Oliveira Sotomayor. *Two-sided matching: A study in game-theoretic modeling and analysis*. No. 18. Cambridge University Press, 1992.

Week 3. Classic Market Failures in Market Design

Unraveling: law clerks, associates, medical residents, college bowls:

- (*) Roth, Alvin E. "A natural experiment in the organization of entry-level labor markets: regional markets for new physicians and surgeons in the United Kingdom." *The American economic review* (1991): 415-440.
- Roth, Alvin E., and Xiaolin Xing. "Jumping the gun: Imperfections and institutions related to the timing of market transactions." *The American Economic Review* (1994): 992-1044.

- (*) Li, Hao, and Sherwin Rosen. "Unraveling in matching markets." *American Economic Review* (1998): 371-387.
- Avery, Christopher, et al. "The market for federal judicial law clerks." *The University of Chicago Law Review* (2001): 793-902.
- Fréchette, Guillaume R., Alvin E. Roth, and M. Utku Ünver. "Unraveling yields inefficient matchings: evidence from post-season college football bowls." *The RAND Journal of Economics* 38.4 (2007): 967-982.

Congestion: clinical psychologists, AEA, online dating:
- (*) Roth, Alvin E., and Xiaolin Xing. "Turnaround time and bottlenecks in market clearing: Decentralized matching in the market for clinical psychologists." *Journal of Political Economy* 105.2 (1997): 284-329.
- Coles, Peter, et al. "The job market for new economists: A market design perspective." *The Journal of Economic Perspectives* 24.4 (2010): 187-206.
- Lee, Soohyung, et al. *Propose with a rose? signaling in internet dating markets*. No. w17340. National Bureau of Economic Research, 2011.

Week 4. Market Failures due to Strategic Complexity (i.e., Rules that are Easy to Game)

School choice reforms:
- (*) Abdulkadiroğlu, Atila, and Tayfun Sönmez. "School choice: A mechanism design approach." *American economic review* (2003): 729-747.
- Pathak, Parag A., and Tayfun Sonmez. "Leveling the playing field: Sincere and sophisticated players in the Boston mechanism." *The American Economic Review* 98.4 (2008): 1636-1652.
- (*) Abdulkadiroğlu, Atila, Parag Pathak, and Alvin E. Roth. "Strategy-Proofness versus Efficiency in Matching with Indifferences: Redesigning the NYC High School Match." *American Economic Review* 99.5 (2009): 1954-78.
- Kojima, Fuhito, and Parag A. Pathak. "Incentives and stability in large two-sided matching markets." *The American Economic Review* (2009): 608-627.
- Immorlica, Nicole, and Mohammad Mahdian. "Marriage, honesty, and stability."*Proceedings of the sixteenth annual ACM-SIAM symposium on Discrete algorithms*. Society for Industrial and Applied Mathematics, 2005.
- Lee, SangMok. "Incentive compatibility of large centralized matching markets."Mimeo, University of Pennsylvania (2011).

Strategyproofness, Wilson doctrine, Strategyproofness in the large:
- (*) Azevedo, Eduardo, and Eric Budish. “Strategyproofness in the large*”*. Mimeo, Wharton, 2011.
- (*) Abdulkadiroglu, Atila, Yeon-Koo Che, and Yosuke Yasuda. "Resolving Conflicting Preferences in School Choice: The" Boston Mechanism" Reconsidered." *American Economic Review* 101.1 (2011): 399-410.
- He, Yinghua. "Gaming the Boston School Choice Mechanism in Beijing." Mimeo, Toulouse School of Economics (2012).

- Carroll, Gabriel. "A quantitative approach to incentives: Application to voting rules." Mimeo, Stanford (2011).
- Pathak, Parag A., and Tayfun Sönmez. School Admissions Reform in Chicago and England: Comparing Mechanisms by their Vulnerability to Manipulation. *American Economic Review*, 103(1): 80-106, February 2013
- Featherstone, Clayton, and Muriel Niederle. "School choice mechanisms under incomplete information: an experimental investigation." Mimeo, Wharton (2011).

Part II: Auction Design

Week 5. Auctions, theory and practice.

Spectrum Auctions:

- Binmore, Ken, and Paul Klemperer. "The biggest auction ever: the sale of the British 3G telecom licences." *The Economic Journal* 112.478 (2002): C74-C96.
- (*) Bulow, Jeremy, Jonathan Levin, and Paul Milgrom. *Winning play in spectrum auctions*. No. w14765. National Bureau of Economic Research, 2009.
- Cramton, Peter, "Spectrum Auctions," in Cave et al. eds., *Handbook of Telecommunications Economics,* 2002.
- (*) Klemperer, Paul. "What really matters in auction design." *The Journal of Economic Perspectives* 16.1 (2002): 169-189.

Mechanism Design and Auction Theory:

- (*) Krishna, Vijay. *Auction theory*. Academic press, 2009.
- (***) Myerson, Roger B. "Optimal auction design." *Mathematics of operations research* 6.1 (1981): 58-73.
- Myerson, Roger B. "Incentive compatibility and the bargaining problem."*Econometrica* (1979): 61-73.
- (***) Milgrom, Paul R., and Robert J. Weber. "A theory of auctions and competitive bidding." *Econometrica* (1982): 1089-1122.
- Bulow, Jeremy, and John Roberts. "The simple economics of optimal auctions." *The Journal of Political Economy* (1989): 1060-1090.

Week 6. Econometric Analysis of Auctions

Theory:

- (*) Hendricks, Kenneth, and Robert H. Porter. "An empirical study of an auction with asymmetric information." *The American Economic Review* (1988): 865-883.
- Guerre, Emmanuel, Isabelle Perrigne, and Quang Vuong. "Optimal Nonparametric Estimation of First-price Auctions." *Econometrica* 68.3 (2000): 525-574.

Collusion, comparison of auction formats, combinatorial auctions, online auctions:

- (*) Asker, John. "A study of the internal organization of a bidding cartel." *The American Economic Review* (2010): 724-762.

- Athey, Susan, Jonathan Levin, and Enrique Seira. "Comparing open and Sealed Bid Auctions: Evidence from Timber Auctions*." *The Quarterly Journal of Economics* 126.1 (2011): 207-257.
- Roth, Alvin E., and Axel Ockenfels. "Last minute bidding and the rules for ending second price auctions: evidence from ebay and amazon auctions on the internet." *American Economic Review* 92.4 (2002): 1093-1103.

Part III: Current Research Topics, Policy and Industry Applications

Week 7. Wharton's Course Match / Combinatorial Procurement Auctions

- (*) Budish, Eric. "The combinatorial assignment problem: Approximate competitive equilibrium from equal incomes." *Journal of Political Economy* 119.6 (2011): 1061-1103.
- Budish, Eric, and Estelle Cantillon. "The Multi-unit Assignment Problem: Theory and Evidence from Course Allocation at Harvard." *American Economic Review* 102.5 (2012): 2237-71.
- Krishna, Aradhna, and M. Utku Ünver. "Improving the Efficiency of Course Bidding at Business Schools: Field and Laboratory Studies." *Marketing Science* 27.2 (2008): 262-282.
- (*) Olivares, M., G.Y. Weintraub, R. Epstein, and D. Yung (2011), Combinatorial Auctions for Procurement: An Empirical Study of the Chilean School Meals Auction, *Management Science*, Vol. 58, No. 8 (August),1458-1481.

Week 8. FCC Repackaging Auction / Medicare Auction

- http://www.fcc.gov/incentiveauctions
- (*) Cramton, Peter, Sean Ellermeyer, and Brett E. Katzman. "Designed to Fail: The Medicare Auction for Durable Medical Equipment." *University of Maryland*(2011).
- Merlob, Brian, Charles R. Plott, and Yuanjun Zhang. "The CMS auction: experimental studies of a median-bid procurement auction with nonbinding bids." *The Quarterly Journal of Economics* 127.2 (2012): 793-827.
- Cramton, Peter. "Letter from 167 Concerned Auction Experts on Medicare Competitive Bidding Program." (2010).

Week 9. Sponsored Search

- (*) Edelman, Benjamin, Michael Ostrovsky, and Michael Schwarz. "Internet Advertising and the Generalized Second-Price Auction: Selling Billions of Dollars Worth of Keywords." *American Economic Review* 97.1 (2007): 242-259.
- Ghose, Anindya, and Sha Yang. "An empirical analysis of search engine advertising: Sponsored search in electronic markets." *Management Science* 55.10 (2009): 1605-1622.
- Athey, Susan, and Glenn Ellison. "Position auctions with consumer search." *The Quarterly Journal of Economics* 126.3 (2011): 1213-1270.
- Celis, L. Elisa, et al. "Buy-it-now or take-a-chance: a simple sequential screening mechanism." *Proceedings of the 20th international conference on World wide web*. ACM, 2011.
- Ostrovsky, Michael, and Michael Schwarz. "Reserve prices in internet advertising auctions: A field experiment." *Proceedings of the 12th ACM conference on Electronic commerce*. ACM, 2011.

Week 10. Organ Donation Exchanges

- Zenios, Stefanos A., Glenn M. Chertow, and Lawrence M. Wein. "Dynamic allocation of kidneys to candidates on the transplant waiting list." *Operations Research* 48.4 (2000): 549-569.
- Zenios, Stefanos A. "Optimal control of a paired-kidney exchange program." *Management Science* 48.3 (2002): 328-342.
- (*) Roth, Alvin E., Tayfun Sönmez, and M. Utku Ünver. "Kidney exchange." *The Quarterly Journal of Economics* 119.2 (2004): 457-488.
- Roth, Alvin E., Tayfun Sönmez, and M. Utku Ünver. "Efficient kidney exchange: Coincidence of wants in markets with compatibility-based preferences." *The American economic review* (2007): 828-851.
- Ünver, M. Utku. "Dynamic kidney exchange." *The Review of Economic Studies*77.1 (2010): 372-414.

Week 11. Financial Markets

High Frequency Trading:

- (*) Budish, Eric, Peter Cramton, and John Shim. "The High-Frequency Trading Arms Race: Frequent Batch Auctions as a Market Design Response." (2013).
- Clark-Joseph, Adam D. "Exploratory Trading." *Unpublished job market paper). Harvard University, Cambridge MA* (2013). http://www.nanex.net/aqck2/4136/exploratorytrading.pdf
- http://www.nanex.net/flashcrash/ongoingresearch.html
- Kirilenko, Andrei A., and Andrew W. Lo. "Moore's Law versus Murphy's Law: Algorithmic Trading and Its Discontents." *The Journal of Economic Perspectives* 27.2 (2013): 51-72.

Centralized and Decentralized Markets:

- (*) Duffie, Darrell, and Haoxiang Zhu. "Does a central clearing counterparty reduce counterparty risk?." *Review of Asset Pricing Studies* 1.1 (2011): 74-95.
- Zhu, Haoxiang. "Do dark pools harm price discovery?." *Available at SSRN 1712173* (2012).
- Biais, Bruno, Larry Glosten, and Chester Spatt. "Market microstructure: A survey of microfoundations, empirical results, and policy implications." *Journal of Financial Markets* 8.2 (2005): 217-264.

CDS Auctions:

- Du, Songzi, and Haoxiang Zhu. "Are CDS auctions biased?." *Available at SSRN 1804610* (2012).

Week 12. Reputation Systems / Antitrust of the Medical Match

- (*) Bolton, Gary, Ben Greiner, and Axel Ockenfels. "Engineering trust: reciprocity in the production of reputation information." *Management Science* 59.2 (2013): 265-285.
- (*) Agarwal, Nikhil. "An Empirical Model of the Medical Match." Mimeo, MIT (2012).

Week 13. Healthcare Exchanges

- Ericson, Keith Marzilli, and Amanda Starc. "Heuristics and heterogeneity in health insurance exchanges: evidence from the Massachusetts Connector."*The American Economic Review* 102.3 (2012): 493-497.

- Ericson, Keith M. Marzilli, and Amanda Starc. *Pricing Regulation and Imperfect Competition on the Massachusetts Health Insurance Exchange*. No. w18089. National Bureau of Economic Research, 2012.
- Marzilli Ericson, Keith M., and Amanda Starc. "Designing and Regulating Health Insurance Exchanges: Lessons from Massachusetts." *Inquiry* 49.4 (2012): 327-338.
- Einav, Liran, Amy Finkelstein, and Mark R. Cullen. "Estimating welfare in insurance markets using variation in prices." *The quarterly journal of economics* 125.3 (2010): 877-921.
- Hackmann, Martin B., Jonathan T. Kolstad, and Amanda E. Kowalski. "Health Reform, Health Insurance, and Selection: Estimating Selection into Health Insurance Using the Massachusetts Health Reform." *The American Economic Review* 102.3 (2012): 498-501.