Sample Syllabus – Graduate Empirical Industrial Organization

Course Overview

This one-semester course teaches theoretical tools and quantitative techniques used in modern Industrial Organization. We will emphasize applications to market design and public policy. Knowledge of first-year microeconomic theory, game theory, and econometric theory is highly recommended. A first graduate course in industrial organization is useful but not necessary. This course is self-contained.

This course will cover four main areas: (i) identifying, estimating, and computing static and dynamic discrete choice models and differentiated-product demand systems; (ii) specifying, identifying, and estimating auction models; (iii) unifying the aforementioned topics in digital markets; and (iv) analyzing matching markets.

I. **Estimating demand systems.** We will cover methods for estimating demand systems; single-agent dynamic models; and discrete games. We will discuss the numerical and computational challenges that arise in practice, as well as how to overcome them.
II. **Estimating auction models.** Auction markets have been a natural setting for structural econometric analysis, because their theory are closely linked with institutions in the real world. In an auction market, the rules are clearly specified; moreover, rich data are often available. Hence, this setting lends itself well to studying strategic behavior and asymmetric information.
III. **Analyzing the digital economy.** The digital economy unites the techniques covered above. In the digital setting, two major changes are at the forefront. First, search, verification, and tracking costs have collapsed. Second, a wealth of "big data" is now available. What do these changes mean for consumer behavior, product variety, and antitrust?
IV. **Analyzing matching markets.** Like auctions, matching markets often have clearly specified rules, rich data, and additionally feature natural experiments permitting policy evaluation. In the past two decades, centralized matching markets in education, public housing, and other goods have been widely adopted and analyzed empirically. We will begin with theoretical foundations of matching, then discuss the empirics behind decentralized markets like finance, education and housing. We will end with centralized assignment mechanisms in school choice and public housing allocation.

Course Requirements

- The course requirements comprise (1) two empirical problem sets; (2) class preparation and participation; and (3) a draft research proposal, to be presented at the end of the course.
- Assigned papers are marked with an asterisk. Students are expected to read them and submit (1) a two-sentence summary of each paper; and (2) two questions about the research design, identification, as well as possible extensions.
- Grading is based on problem sets (30%), class preparation and participation (30%), and the research proposal and presentation (40%).

Course Outline and Short Reading List

I. (3 weeks) Estimating Demand Systems

1. **Identification of discrete choice models with endogeneity**
   - *Berry, Steven T., and Philip A. Haile. "Foundations of demand estimation." In Handbook of Industrial Organization, vol. 4, no. 1, pp. 1-62. Elsevier, 2021.
   - *Gandhi, Amit, and Aviv Nevo. "Empirical models of demand and supply in differentiated products industries." In Handbook of Industrial Organization, vol. 4, no. 1, pp. 63-139. Elsevier, 2021.
2. **Identification and estimation of dynamic discrete choice models**
   - C. Su and K. Judd, "Constrained Optimization Approaches to Estimation of Structural Models", Econometrica 2012.

- P. Arcidiacono and J. B. Jones, "Finite mixture distributions, sequential likelihood, and the EM algorithm," Econometrica, 2003, 933–946.
- Magnac and Thesmar, "Identifying Dynamic Discrete Decision Processes", Econometrica 2002.
- Kasahara and Shimotsu, "Nonparametric identification of finite mixture models of dynamic discrete choices", Econometrica 2012.

3. **Computational methods for dynamic discrete choice models**
   - *P. Arcidiacono and R. Miller, "Conditional choice probability estimation of dynamic discrete choice models with unobserved heterogeneity", Econometrica 79.6 (2011): 1823-1867.
   - J.-P. Dube, J. Fox, and C.-L. Su, "Improving the Numerical Performance of Static and Dynamic Aggregate Discrete Choice Random Coefficients Demand Estimation", Econometrica, 80(5):2231–2267, 2012.

4. **Bayesian methods and MCMC**
   - *S. Imai, N. Jain, and A. Ching, "Bayesian Estimation of Dynamic Discrete Choice Models", Econometrica 2009
   - *A. Norets, "Inference in Discrete Choice Models with Serially Correlated Unobserved State Variables", Econometrica 2009
   - A. Norets and X. Tang, "Semiparametric Inference in Dynamic Binary Choice Models", Review of Economic Studies 2014
   - V. Chernozhukov and H. Hong, "An MCMC approach to classical estimation", Journal of Econometrics 2003.
   - R. Neal, "MCMC using Hamiltonian dynamics", Handbook of Markov Chain Monte Carlo (Brooks, Gelman, Jones, Meng), Ch. 5, 2011.

5. **Computational methods for structural empirical models**
   - D. Ackerberg, "A new use of importance sampling to reduce computational burden in simulation estimation", Quantitative Marketing and Economics 2009.
   - Fox, Kim, Ryan, Bajari, "A Simple Estimator for the Distribution of Random Coefficients", Quantitative Economics 2011.
   - K. Train, "Discrete Choice Methods with Simulation", Cambridge University Press, 2009.
   - K. Judd, "Numerical Methods in Economics", MIT Press, 1998

II. (2 weeks) Auctions

1. **Single-unit auctions: Theory and methods**
   - P. Milgrom and R. Weber, "A Theory of Auctions and Competitive Bidding", Econometrica, 1982.
   - S. Athey and P. Haile (2007), "Nonparametric Approaches to Auctions", in Handbook of Econometrics, vol 6A, pp 3847-3965. (Sections 2,3,7)
   - *J.-J. Laffont, H. Ossard, and Q. Vuong, "Econometrics of first-price auctions", Econometrica, 1995.
   - *E. Guerre, I. Perrigne, and Q. Vuong, "Optimal Nonparametric Estimation of First Price Auctions", Econometrica, 2000.

2. **Alternative approaches to single-unit auctions**
   - *Hendricks, K. and R. Porter (1988) "An Empirical Study of an Auction with Asymmetric Information", American Economic Review, 865-883.
   - *Haile, P., and E. Tamer (2003) "Inference with an Incomplete Model of English Auctions", Journal of Political Economy, 111: 1-51.
   - Athey, S, J. Levin and E. Seira, "Comparing Open and Sealed Bid Auctions: Evidence from Timber Auctions", QJE 2011.

3. **Collusion**
   - Rotemberg, Julio J., and Garth Saloner. "A supergame-theoretic model of price wars during booms." The American Economic Review 76, no. 3 (1986): 390-407.
   - *J. Asker, "A Study of the Internal Organization of a Bidding Cartel", AER, 2010.
   - *S. Chassang and J. Ortner, "Collusion in Auctions with Constrained Bids: Theory and Evidence from Public Procurement," JPE 2018.
   - B. Baranek, L. Musolff, and V. Titl, "Detection of Collusive Networks in E-procurement", Mimeo, 2021.

- *L. Musolff, "Algorithmic Pricing Facilitates Tacit Collusion: Evidence from E-Commerce", Proceedings of the 23rd ACM Conference on Economics and Computation. 2022.

4. **Multi-unit auctions**
   - *Cassola, N., A. Hortacsu and J. Kastl (2013) "The 2007 Subprime Market Crisis Through the Lens of European Central Bank Auctions for Short-Term Funds," Econometrica
   - Hortacsu, A. and McAdams, D. (2010) "Mechanism Choice and Strategic Bidding in Divisible Good Auctions: An Empirical Analysis of the Turkish Treasury Auction Market," JPE
   - Altmann, S. (2022) "Choice, Welfare, and Market Mechanisms: A Revealed Preference Analysis of Feeding America's Choice System," Mimeo.

III. (2.5 weeks) Economics of Digitization

1. **How does digital technology change economic activity?**
   - *Goldfarb, Avi, and Catherine Tucker. "Digital economics." Journal of Economic Literature 57, no. 1 (2019): 3-43.
   - *Rochet, Jean-Charles, and Jean Tirole. "Platform competition in two-sided markets." Journal of the European Economic Association 1, no. 4 (2003): 990-1029.
   - Rochet, Jean-Charles, and Jean Tirole. "Two-sided markets: a progress report." The RAND Journal of Economics 37, no. 3 (2006): 645-667.

2. **What changes when retail moves online?**
   - *Brynjolfsson, Erik, and Michael D. Smith. "Frictionless commerce? A comparison of Internet and conventional retailers." Management Science 46, no. 4 (2000): 563-585.
   - *Chevalier, Judith, and Austan Goolsbee. "Measuring prices and price competition online: Amazon.com and BarnesandNoble.com." Quantitative Marketing and Economics 1, no. 2 (2003): 203-222.
   - Chevalier, Judith A., and Dina Mayzlin. "The effect of word of mouth on sales: Online book reviews." Journal of Marketing Research 43, no. 3 (2006): 345-354.
   - De los Santos, Babur, Ali Hortaçsu, and Matthijs R. Wildenbeest. "Testing models of consumer search using data on web browsing and purchasing behavior." American Economic Review 102, no. 6 (2012): 2955-80.
   - Einav, Liran, Chiara Farronato, and Jonathan Levin. "Peer-to-peer markets." Annual Review of Economics 8 (2016): 615-635.
   - Dinerstein, Michael, Liran Einav, Jonathan Levin, and Neel Sundaresan. "Consumer price search and platform design in internet commerce." American Economic Review 108, no. 7 (2018): 1820-59.
   - Quan, Thomas W., and Kevin R. Williams. "Product variety, across-market demand heterogeneity, and the value of online retail." The RAND Journal of Economics 49, no. 4 (2018): 877-913.
   - Reimers, Imke, and Joel Waldfogel. "Digitization and pre-purchase information: the causal and welfare impacts of reviews and crowd ratings." American Economic Review 111, no. 6 (2021): 1944-71.
   - Houde, Jean-François, Peter Newberry, and Katja Seim. "Nexus Tax Laws and Economies of Density in E-Commerce: A Study of Amazon's Fulfillment Center Network." Econometrica, forthcoming.

3. **Whither privacy?**
   - *Goldfarb, Avi, and Catherine Tucker. "Shifts in privacy concerns." American Economic Review 102, no. 3 (2012): 349-53.
   - Chen, Long, Yadong Huang, Shumiao Ouyang, and Wei Xiong. "Data privacy and digital demand." No. w28854. National Bureau of Economic Research, 2021.
   - *Beraja, Martin, David Y. Yang, and Noam Yuchtman. "Data-intensive innovation and the state: Evidence from AI firms in China." Review of Economic Studies, forthcoming.

4. **How should we regulate platforms?**
   - *Farronato, Chiara, and Andrey Fradkin. "The Welfare Effects of Peer Entry: The Case of Airbnb and the Accommodation Industry." American Economic Review 112, no. 6 (2022): 1782-1817.
   - *Farronato, Chiara, and Georgios Zervas. "Consumer reviews and regulation: Evidence from NYC restaurants." No. w29715. National Bureau of Economic Research, 2022.

- *Lee, Kwok Hao, and Leon Musolff. Entry into two-sided markets shaped by platform-guided search. mimeo, Princeton University, 2021.

IV. (4.5 weeks) Matching Markets

1. **Two-sided matching theory**
   - *A. Abdulkadiroglu and T. Sonmez, "Matching Markets: Theory and Practice," Advances in Economics and Econometrics Theory and Applications, Econometric Society Tenth World Congress, volume 2, pages 1-47, 2010.
   - *E. Azevedo and J. Leshno, "A Supply and Demand Framework for Two-Sided Matching Markets," Journal of Political Economy, 2016.
2. **Estimating matching models with data on matches**
   - *N. Agarwal, "An empirical model of the medical match," American Economic Review, 2015.
   - *M. Sørensen, "How smart is smart money? a two-sided matching model of venture capital," Journal of Finance, 62(6):2725–2762, 2007.
3. **Assignment problems**
   - *E. Budish and E. Cantillon, "The multi-unit assignment problem: Theory and evidence from course allocation at Harvard," American Economic Review, 102(5):2237–71, 2012.
   - *Prendergast, Canice. "The allocation of food to food banks." Journal of Political Economy 130, no. 8 (2022)
4. **School choice mechanisms**
   - *N. Agarwal and P. Somaini, "Demand Analysis using Strategic Reports: An application to a school choice mechanism," American Economic Review, 2018.
   - *A. Kapor, C. Neilson, S. Zimmerman, "Heterogeneous Beliefs and School Choice Mechanisms," American Economic Review, 2020.
5. **Lotteries as "experiment generators"**
   - *Abdulkadiroglu, Atila, Joshua D. Angrist, Yusuke Narita, and Parag A. Pathak. "Research design meets market design: Using centralized assignment for impact evaluation." Econometrica 85, no. 5 (2017): 1373-1432.
   - Abdulkadiroglu, Atila, Joshua D. Angrist, Yusuke Narita, and Parag Pathak. "Breaking ties: Regression discontinuity design meets market design." Econometrica 90, no. 1 (2022): 117-151.
6. **Waitlist mechanisms**
   - *Agarwal, Nikhil, Itai Ashlagi, Michael A. Rees, Paulo Somaini, and Daniel Waldinger. "Equilibrium allocations under alternative waitlist designs: Evidence from deceased donor kidneys." Econometrica 89, no. 1 (2021): 37-76.
   - *Leshno, Jacob. "Dynamic matching in overloaded waiting lists." American Economic Review, forthcoming.
   - Agarwal, Nikhil, Charles Hodgson, and Paulo Somaini. "Choices and outcomes in assignment mechanisms: The allocation of deceased donor kidneys." No. w28064. National Bureau of Economic Research, 2020.
   - Ferdowsian, Andrew, Kwok-Hao Lee, and Luther Yap. "Build to Order: Endogenous supply in centralized mechanisms." Mimeo, 2022.
7. **Demand for schools and neighborhoods**
   - S. E. Black, "Do better schools matter? Parental valuation of elementary education," Quarterly Journal of Economics, 1999, 577–599.
   - *P. Bayer, F. Ferreira, and R. McMillan, "A Unified Framework for Measuring Preferences for Schools and Neighborhoods," Journal of Political Economy, 2007.
   - P. Bayer, R. McMillan, A. Murphy, and C. Timmins. "A dynamic model of demand for houses and neighborhoods," Econometrica, 2017
   - *Almagro, Milena, and Tomás Domınguez-Iino. "Location sorting and endogenous amenities: Evidence from Amsterdam." Mimeo, 2021.
8. **Housing markets**
   - *S. Galiani, A. Murphy, and J. Pantano, "Estimating neighborhood choice models: Lessons from a housing assistance experiment," American Economic Review, 2015.

- *C. Fu and J. Gregory, "Estimation of an Equilibrium Model with Externalities: Post-Disaster Neighborhood Rebuilding," Econometrica 2018.

9. **Allocating public housing**
   - *van Dijk, Winnie. "The socio-economic consequences of housing assistance." Mimeo, 2019.
   - Sieg, Holger, and Chamna Yoon. "Waiting for affordable housing in New York City." Quantitative Economics 11, no. 1 (2020): 277-313.
   - *Waldinger, Daniel. "Targeting in-kind transfers through market design: A revealed preference analysis of public housing allocation." American Economic Review 111, no. 8 (2021): 2660-96.
   - *Lee, Kwok-Hao, Andrew Ferdowsian, and Luther Yap. "The dynamic allocation of public housing: Policy and spillovers." Mimeo, 2022.