

Economics 220 C

Special Topics in Industrial Organization

Computational and Econometric Methods of Industrial Organization

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This course is designed as an introduction to numerical and statistical techniques employed in the modern structural research in Industrial Organization. As the main focus of the course is methods rather than models, it does not aim at covering all “classical” topics in the empirical IO (such as analysis of productivity, advertising, etc). During the course we will use as examples the following classes of models:

1. Models of demand on differentiated product markets.
2. Static games and auctions.
3. Dynamic games of incomplete information.

The main goal of this course is to provide students with a set of tools so that they can begin to write their own original research in empirical IO.

Requirements and grading:

Since the best method of learning the empirical tools is to apply them, there will be 5 large empirical exercises including work with real data. The final assignment will be write a research proposal for a project in empirical industrial organization or a related area. There will be no in class exam. The grade will be based on the problem sets and the final proposal. Students are encouraged to work together by discussing the papers and in implementing the estimators. It is instrumental that students familiarize themselves with the papers discussed during the class

before the class. It is also important to make sure that you are familiar with a suitable programming language (Matlab, Gauss, Fortran 77/90, C/C++) before the class. It will be implied that students are familiar with basic programming concepts and they will not be discussed in class.

1 Nonlinear Moment-Based Models: Demand on Differentiated Markets

- *Technical background*

- Pakes, A. and Pollard, D. “Simulation and the Asymptotics of Optimization Estimators”, *Econometrica*, Vol. 57, No. 5 (Sep., 1989), pp. 1027-1057
- Hajivassiliou, V. and Ruud, P. “Classical Estimation Methods for LDV Models using Simulation”, *Handbook of Econometrics*, vol. 4 (1994), Engle, R.F. and McFadden, D. (ed.)
- Geweke, J. and Keane M. “Computationally intensive methods for integration in econometrics”, *Handbook of Econometrics*, vol. 5 (2001), Engle, R.F. and McFadden, D. (ed.)
- Judd, K. “Numerical Methods in Economics”, MIT Press (1998)

- *Empirical work*

- Akerberg, Benkard, Berry and Pakes, ”Econometric Tools for Analyzing Market Outcomes”, in *The Handbook of Econometrics*, J. J. Heckman (ed.), 2007.
- Patrick Bayer, Fernando Ferreira, Robert McMillan, A Unified Framework for Measuring Preferences for Schools and Neighborhoods, *Journal of Political Economy*, August 2007.
- Berry, S.T. Estimating Discrete Choice Models of Product Differentiation, *RAND Journal of Economics* (25), Summer 1994, 242-62.
- Berry, S., J. Levinsohn, and A. Pakes, Automobile Price in Market Equilibrium, *Econometrica* (63), July 1995.

- Brett, C. Pinkse, J. and Slade, M. Spatial Price Competition: a Semiparametric Approach *Econometrica*, 70-3, 1111-1153. 2001.
- Hausman, Jerry, Gregory, Leonard and J. Douglas Zona. Competitive Analysis with Differentiated Products. *Annales d'Economie et de Statistique* (34) 159-80, 1987.
- McCulloch, R. and Rossi, P. Bayesian Analysis of the Multinomial Probit Model (with R.McCulloch), *Simulation Methods in Econometrics* (2000) (Cambridge University Press).
- Nevo, A A Practitioners Guide to Estimation of Random Coefficients Logit Models of Demand, *Journal of Economics & Management Strategy*, 9(4), 513-548, 2000.
- Nevo, A. Measuring Market Power in the Ready-to-Eat Cereal Industry, *Econometrica*, 69(2), 307-342, 2001.
- Petrin, A. Quantifying the Benefits of New Products: The Case of the Minivan,” *Journal of Political Economy*, 110:705-729, 2002.
- Petrin, A. and Goolsbee, A. The Consumer Gains from Direct Broadcast Satellites and the Competition with Cable TV, forthcoming, *Econometrica*.

2 Systems of nonlinear equations: Discrete static games

– *Technical background*

- * Judd, K. “Numerical Methods in Economics”, MIT Press (1998)
- * McKelvey, R. and McLennan A. “Computation of Equilibria in Finite Games,” Handbook of Computational Economics, vol.1 (1996), Amman, H. and Kendrick, D. and Rust, J. (ed.)
- * Paarsch, H. and Hong, H. “An introduction to the structural econometrics of auction data”, MIT Press (2006).
- * Chen, X. “Large Sample Sieve Estimation of Semi-Nonparametric Models”, Handbook of Econometrics, vol. 7 (2006), Heckman, J. and Leamer, E. (ed.)

– *Empirical work*

- * Akerberg, D. and Gowrisankaran, G. ”Quantifying Equilibrium Network Externalities in the ACH Banking Industry, December 2002, Working Paper, Wash U. St. Louis.
- * Aradillas-Lopez, A. and Tamer, E. The Identification Power of Equilibrium in Games, Northwestern Working Paper.
- * Bajari, P., Hong, H. and Ryan, S. Identification and Estimation of Discrete Games of Complete Information, NBER Working Paper.
- * Bajari, P., Hong, H., Krainer, J. and Nekipelov, D. Estimating Static Models of Strategic Interactions, NBER working paper.
- * Berry, S., Estimation of a Model of Entry in the Airline Industry, *Econometrica*, 60 (July 1992), 889-918
- * Bresnahan, T.F. and P.C. Reiss (1991), Empirical Models of Discrete Games, *Journal of Econometrics* 48(1-2):57-81.
- * Brock, W. and Durlorf, S. Discrete Choice with Social Interactions, *The Review of Economic Studies*, Apr 2001.
- * Brock, W. and Durlorf, S. Multinomial Choice with Social Interactions, Wisconsin Working Paper.

- * Ciliberto, F. and Tamer, E. Market Structure and Multiple Equilibrium in Airline Markets, Working Paper, Princeton and NC State.
- * McKelvy, R. and Palfrey, T. Quantal Response Equilibrium for Normal Form Games, *Games and Economic Behavior* 10 (July 1995): 6-38.
- * Pakes, A., Porter, J., Ho, K. and Ishi, J. Moment Inequalities and Their Application, Harvard Working Paper.
- * Tamer, E. T. Incomplete Bivariate Discrete Response Model with Multiple Equilibria, *Review of Economic Studies*, 70, 147167.

3 Systems of nonlinear functional equations: Dynamic games

– *Technical background*

- * Judd, K. “Numerical Methods in Economics”, MIT Press (1998)
- * Carrasco, M. and Florens, J. and Renault, E. “Linear inverse problems in structural econometrics: Estimation based on spectral decomposition and regularization”, Handbook of Econometrics, vol. 6 (2006).
- * Ai, C. and Chen, X. “Efficient Estimation of Models with Conditional Moment Restrictions Containing Unknown Functions”, Econometrica, volume 71(6), 1795 - 1843.
- * Doraszelski, U. and Satterthwaite, M. “Foundations of Markov-perfect industry dynamics: Existence, purification”, Working paper, Hoover Institution, Stanford (2003)
- * Doraszelski, U. and Judd, K. “Avoiding the Curse of Dimensionality in Dynamic Stochastic Games”, Working paper, Harvard University (2005)
- * Pakes, A. and McGuire, P. “Stochastic Algorithms, Symmetric Markov Perfect Equilibrium, and the ‘curse’ of Dimensionality”, Econometrica, volume 69(5), 1261 - 1281.
- * Rust, J. Structural Estimation of Markov Decision Processes, Handbook of Econometrics, vol 4.

– *Empirical work*

- * Aguirregabiria, V. and Mira, P., Sequential Simulated-Based Estimation of Dynamic Discrete Games , Econometrica, 75, 153.
- * Bajari, P. Benkard, C.L. and Levin, J.D. Estimating Dynamic Games of Incomplete Information. , Econometrica, 75, 1331-1370.
- * Bajari, P., Chernozhukov, V., Hong, H., and Nekipelov, D. Semiparametric Estimation of a Dynamic Game of Incomplete Information, University of Minnesota Working Paper.
- * Berry, S. and Pakes, A. Estimation From the Optimality Conditions for Dynamic Controls, Working Paper, Yale University.

- * Berry, S. Ovstrovsky, M. and Pakes, A. Simple Estimators for the Parameters of Dynamic Discrete Games, Working Paper, Harvard University.
- * Doraszelki, U. and Pakes, A., A Framework for Applied Dynamic Analysis in IO, forthcoming Handbook of IO Volume 3.
- * Hopenhayn, Hugo, Entry, Exit and Firm dynamics in Long-run Equilibrium, *Econometrica* (60), 1127-50.
- * Jofre-Bonet, M. and Pesendorfer, M. Estimation of a Dynamic Auction Game, *Econometrica*, forthcoming.
- * Hotz, V. and Miller, R. Conditional Choice Probabilities and the Estimation of Dynamic Models, *Review of Economic Studies*, 60, 397-429.
- * Judd and Su (2007), A New Optimization Approach to Maximum Likelihood Estimation of Structural Models, Stanford University Working Paper.
- * Kasahara, H. and Shimotsu, K., Nonparametric Identification of Finite Mixture Models of Dynamic Discrete Choices, *Econometrica*, forthcoming
- * Keane, M. and Wolpin, K. The Career Decisions of Young Men, *Journal of Political Economy*, 105:3, 473-522.
- * Olley, S. and A. Pakes, The Dynamics of Productivity in the Telecommunications Equipment Industry, EMA, November 1996. Pakes, A. A Framework for Dynamic Analysis in I.O., Mimeo Yale University.
- * Pesendorfer, M. and Schmidt-Dengler, P. Identification and Estimation of a Dynamic Game, working Paper, London School of Economics.
- * Ryan, S. (2005), The Costs of Environmental Regulation in a Concentrated Industry, mimeo, MIT.