

SYLLABUS

Overview: This course analyzes the structural estimation and testing of nonlinear models. It has three segments. First, within three contexts, continuous choices in a competitive equilibrium, dynamic discrete choice optimization, and optimal contracting, we show how economics models induce a data generating process that provides the basis for estimating the structure of the economic environment, often critical for conducting counterfactual simulations. Then we profile many estimators that have been used to calibrate economic models, with say with an appeal to the law of large numbers. We place the estimators into four categories: estimators for linear data generating processes, parametric nonlinear processes, plus nonparametric and semiparametric estimation. The rationale for the third segment of the course is that the exact distribution of most nonlinear estimators is intractable, and this explains why we resort to large sample theory. We analyze several notions of convergence, derive the asymptotic distribution of several nonlinear estimators, and show how to conduct hypothesis tests.

Assessment: There is a final examination (40 percent) and three assignments (20 percent each). The assignments include a heavy dose of computational and empirical work, and the closed book final exam tests your understanding of the lecture material. The final examination will be held Friday December 19. You should form a study group as soon as possible.

Lectures, tutorials and assignments: The lecture notes and assignments are posted at:
<http://comlabgames.com/47-812>

You are welcome to attend the lecture presentations live, and/or review them asynchronously before class. The class will meet over zoom with me and my teaching assistants, Jaepil Lee and Martin Michelini, at the regularly scheduled times on Mondays and Wednesdays from 2:40PM to 4:30PM, to discuss the lecture material and the assignments.

DYNAMIC MODELS WITH DISCRETE AND CONTINUOUS CHOICES

Introduction to Dynamic Discrete Choice Models

Aguirregabiria, V., and P. Mira (2010): "Dynamic Discrete Choice Structural Models: A Survey," *Journal of Econometrics*, 156, 38-67.

Arcidiacono, P. and P. Ellickson (2011): "Practical Methods for Estimation of Dynamic Discrete Choice Models", *Annual Review of Economics*, 3, 363-394.

Miller, R. (1997): "Estimating Models of Dynamic Optimization with Microeconomic Data," in *Handbook of Applied Econometrics*, M. Pesaran and P. Schmidt, editors, Basil Blackwell, Vol. 2, 246-299.

Todd, P., M. Keane and K. Wolpin (2011): "The Structural Estimation of Behavioral Models: Discrete Choice Dynamic Programming Methods and Applications," in *Handbook of Labor Economics, Volume 4*, edited by O. Ashenfelter and D. Card. Elsevier, Chapter 4, 331-461.

Job Matching with Bayesian Learning

Arcidiacono, P. M. Aucejo, A. Maurel and T. Ransom (2016): "College Attrition and the Dynamics of Information Revelation," working paper.

Crawford, G. and M. Shum (2005): "Uncertainty and Learning in Pharmaceutical Demand," *Econometrica*, 73, 1137-1173.

Dillon E., and C. Stanton (2016): "Self-Employment Dynamics and the Returns to Entrepreneurship," working paper.

Hincapé, A. (2016): "Entrepreneurship over the Life Cycle," working paper.

James, J. (2011): "Ability Matching and Occupational Choice," working paper.

Miller, R. (1984): "Job Matching and Occupational Choice," *Journal of Political Economy*, 92, 1086-1020.

Pastorino, E. (2014): "Careers in Firms: Estimating a Model of Job Assignment, Learning, and Human Capital Acquisition," working paper.

Continuous Choices in Competitive Equilibrium

Altug, S. and R. Miller (1990): "Household Choices in Equilibrium," *Econometrica*, 58, 543-570.

Representative Agent Models of Consumption and Leisure Choice under Uncertainty," *The Quarterly Journal of Economics*, 103, 51-78.

Hansen, L. and K. Singleton (1982): "Generalized Instrumental Variables Estimation of Nonlinear Rational Expectations Models," *Econometrica*, 50, 1269-1286.

Hansen, L. and K. Singleton (1984): ERRATA, *Econometrica*, 52, 267-268.

Miller, R. and H. Sieg (1997): "A Microeconomic Comparison of Household Behavior between Countries," *Journal of Business and Economic Statistics*, 15, 237-254.

Limit Order Markets

Hollifield, B., R. Miller and P. Sandas (2004): "Empirical Analysis of Limit-Order Markets," *The Review of Economic Studies*, 71, 1027-1063.

Hollifield, B., R. Miller, P. Sandas and J. Slive (2006): "Estimating the Gains from Trade in Limit-Order Markets," *Journal of Finance*, 61, 2753-2804.

Sandas, P. (2001): "Adverse Selection and Competitive Market Making: Empirical Evidence from a Limit Order Market," *Review of Financial Studies*, 14, 705–734.

Pure Moral Hazard

Gayle, G., and R. Miller (2009): "Has Moral Hazard Become a More Important Factor in Managerial Compensation?" *American Economic Review* 99, 1740-69.

Margiotta, M., and R. Miller (2000): "Managerial Compensation and the Cost of Moral Hazard," *International Economic Review* 41, 669.719.

ESTIMATORS

Linear Estimators

Rao, C. (1973): *Linear Statistical Inference and its Applications* (second edition), John Wiley & Sons.

Nonlinear Parametric Estimators

Davidson, R. and J. MacKinnon (1993): *Estimation and Inference in Econometrics*, Oxford University Press.

Nonparametric Estimators

Li, Q. and J. Racine (2007): *Nonparametric Econometrics: Theory and Practice*, Princeton University Press

Prakasa Rao, B. (1983): *Nonparametric Functional Estimation*, Academic Press.

Semiparametric Estimators

Li, Q. and J. Racine (2007): *Nonparametric Econometrics: Theory and Practice*, Princeton University Press

Prakasa Rao, B. (1983): *Nonparametric Functional Estimation*, Academic Press.

ASYMPTOTIC THEORY FOR NONLINEAR MODELS

Probability and Convergence

Ash, R. (1972): *Real Analysis and Probability*, Academic Press.

Chung, K. (1974): *A Course in Probability Theory* (second edition), Academic Press.

Davidson, J. (1994): *Stochastic Limit Theory*, Oxford University Press.

Laws of Large Numbers and Central Limit Theorems

Ash, R. (1972): *Real Analysis and Probability*, Academic Press.

Chung, K. (1974): *A Course in Probability Theory* (second edition), Academic Press.

Davidson, J. (1994): *Stochastic Limit Theory*, Oxford University Press.

Asymptotic Distribution of Nonlinear Estimators

Amemiya T. (1985): *Advanced Econometrics*, Harvard University Press.

Hansen, L. (1982): "Large Sample Properties of Generalized Method of Moments Estimators," *Econometrica*, 50, 1029-1054.

Van der Vaart, A. (1998): *Asymptotic Statistics*, Cambridge University Press.

Efficiency

Hypothesis Tests

Lehmann, E. (1986): *Testing Statistical Hypotheses* (second edition), John Wiley & Sons.