

**Queen Mary College  
University of London**

**Course Outline**

Summer School

**Econometric Methods for Demand  
Systems in Economics and Marketing**

June 30th - July 2 2010

Dr. Melvyn Weeks, Faculty of Economics, University of Cambridge

**Course Aims**

This course is designed to introduce participants to the recent empirical literature on industrial organisation, with particular focus on demand systems. This literature brings together economic theory and recent advances in econometric inference, and enables academics, consultants and policy makers to evaluate a large number of interesting issues such as:

- i are high profits and markups a result of product differentiation, market share, a small number of substitutes, or some form of collusion
- ii the impact of new, yet to be introduced, products
- iii elicit consumer preferences for both existing and new products
- iv determine the impact of a tax on product demand
- v The impact of a merger on market power

The course combines theory, econometric methodology and hands-on computer sessions. Topics to be covered will include: demand estimation, the benefits of new products, estimation with a large number of differentiated products and merger simulation.

A primary objective of the course is that students should be able to formulate structural models of competition, understand and implement feasible econometric techniques, test hypothesis and perform policy analysis. Students completing the course should be able take an industrial organisation theory to data.

Day 1 - Wednesday 30th June

**Morning Session: 10am - 1pm**

**Topic 1**

**Course Overview**

**The Economic Model: Demand Systems in Empirical Industrial Organisation**

1. Empirical Industrial Organisation
2. Demand Estimation in Markets for Differentiated Products
3. Mergers with Differentiated Products
4. Product versus Characteristic Space Models
5. The Benefits of New Products
6. Recent Trends in Demand Estimation

*Slides: SLI\_TheEconomicModel*

**Overview**

**Topic 1: Lecture Notes**

Day 1 - Wednesday 30th June

**Afternoon Session: 2pm - 4pm**

**Topic 2**

**Discrete Choice Models I: Statistical Underpinnings**

1. Regression and the Linear Probability Model
2. Information and the Observational Rule
3. Statistical Underpinnings of Binary Response Models
4. The Likelihood and Score Equations
5. The Conditional and Multinomial Logit Model
6. Independence of Irrelevant Alternatives

*Slides: Filename: SLI-TheDiscreteChoiceModel*

**Topic 2: Lecture Notes**

**Topic 3**

**Discrete Choice Models II: The Random Utility Model**

1. Theoretical Underpinnings of Discrete Choice Models
2. Measurement
3. The Specification of a Random Utility Model
4. Identification
5. A General Model of Choice

*Slides: SLI\_RUM*

**Topic 3: Lecture Notes**

Day 2 - Thursday July 1

**Morning Session: 10am - 1pm**

**Topic 4**

**The Discrete Choice Models III: Logit**

1. The Logit Model
2. Demand Systems and New Methods in Empirical IO
3. Identification in Logit Models
4. Endogeneity in Discrete Choice Models
5. The Power and Limitations of Logit
6. Marginal Effects and Elasticities

*Slides: SLI.Logit*

**Topic 4: Lecture Notes**

**Topic 5**

**The Discrete Choice Model IV: Consumer Heterogeneity**

1. Issues in Modelling Heterogeneity
2. Inference in Random Coefficient Models
3. The Mixed Logit Model:
4. Error Component and Random Parameter Formulations
5. Vehicle Choices and the Demand for Electric Vehicles

*Slides: SLI.ConsumHeterog*

**Topic 5: Lecture Notes**

Day 2 - Thursday July 1

**Afternoon Session: 2pm - 4pm**

**Topic 6**

### **Endogeneity and Estimation**

1. Endogeneity in Discrete Choice Modelling
2. Estimation: Simulated Maximum Likelihood
3. Estimation: Non-Linear GMM

*Slides: SLI\_EndogEstimation*

**Topic 6: Lecture Notes**

**Topic 7**

### **Computer Lab I: Discrete Choice Models**

1. Estimating Discrete Choice Models using STATA
2. An introduction to programming in Ox-Metrics suite of programs
3. Hands-on experience in the use of Ox to estimate binary, multinomial and ordinal discrete choice models

*Slides: SLI\_STATA*

**Topic 7: Lecture Notes**

Day 3 - Friday July 2

**Morning Session: 10am - 1pm**

**Topic 8**

**Applications**

1. Sources of Identification
2. Product versus Market Level Approaches to Identification
3. Market Level Data with Distribution of Consumer Preferences
4. Quantifying the Benefits of New Products
5. The Demand for Cars and Their Attributes

*Slides: SLI.Applications*

**Topic 8: Lecture Notes**

**Topic 9**

**Bayesian Estimation of Discrete Choice Models**

1. Bayesian inference in the Binomial Probit Model
2. Bayesian Analysis of Binary Choice: Data Augmentation
3. The EM Algorithm and Data Augmentation
4. Bayesian inference in the Mixed Logit Model

*Slides: SLI.BayesianEstimation*

**Topic 9: Lecture Notes**

Day 3 - Friday July 2

**Afternoon Session: 2pm - 4pm**

**Topic 10**

**Inference For Individual Level Parameters**

1. Bayesian Statistics and Marketing
2. Individual Level Parameters

*Slides: SLI\_BayesianIndividParams*

**Topic 10: Lecture Notes**

**Topic 11**

**Computer Lab II: Estimating High Dimensional Discrete Choice Models using DCM**

1. Tractable and Flexible Discrete Choice Models
2. Discrete Choice and Empirical I-O
3. The OxMetrics computing environment
4. An Overview of the software package DCM (Discrete Choice)

*Slides: SLI\_DCMv2*

**Topic 11: Lecture Notes**

## Reading List

Throughout the course we will make use of many published articles. Note that some of the readings appear in more than one section.

## Some Texts

- [1] Cameron, A.C. and Trivedi, P.K. (2005). *Microeconometrics: Methods and Applications*, Cambridge University Press, New York.
- [2] Hensher, D. A., Rose, J.M. Greene, W.H. (2005) *Applied Choice Analysis*, Cambridge University Press.
- [3] Koop, G. (2003) *Bayesian Econometrics*. John Wiley and Sons. UK.
- [4] Mariano, B., M. Weeks, and T. Schuermann (eds.) (2000): *Simulation Based Inference: Theory and Applications*. Cambridge University Press.
- [5] Pepall, L, D. Richards and G. Norman (2008) *Industrial Organization: Contemporary Theory and Empirical Applications* 4th edition. Blackwell Publishing, Oxford UK.
- [6] Peter E. Rossi, Greg Allenby, and Rob McCulloch (2005). *Bayesian Statistics and Marketing*. John Wiley and Sons, UK.
- [7] Train, K. (2003) *Discrete Choice Methods with Simulation*, Cambridge University Press.
- [8] Wooldridge, G. (2006) *Introductory Econometrics: A Modern Approach*, third edition. Cincinnati, OH: South-Western College Publishing.
- [9] Wooldridge, G. (2002) *Econometric Analysis of Cross Section and Panel Data*. Cambridge, MA: MIT Press.

## Some Key Papers

- [1] Akerberg, D., L. Benkard, S. Berry, and A. Pakes (2005) "Econometric Tools for Analyzing Market Outcomes", forthcoming, *Handbook of Econometrics*, vol. 5. Heckman and Leamer (eds).
- [2] Berry, S. (1994) "Estimating Discrete-Choice Models of Product Differentiation". *Rand Journal of Economics* Vol. 25(2), pp. 242-262.

- [3] Berry, S. Levinsohn, J. and Pakes, A. (1995). "Automobile Prices in Market Equilibrium". *Econometrica* 63 (July), pp. 841-990.
- [4] Deaton, A. and Muellbauer, J. (1981) "An Almost Ideal Demand System", *American Economic Review*, 70.
- [5] Goldberg, P.K. (1995). "Product Differentiation and Oligopoly in International Markets: The Case of the US Automobile Industry". *Econometrica* 63 (July), pp. 891-951.
- [6] Hausman, J., G. Leonard and D. Zona (1992) "A Proposed Method for Analysing Competition Among Differentiated Products", *Antitrust Law Journal*, 60.
- [7] Nevo, A. (2001) "Measuring Market Power in the Ready-to-Eat Cereal Industry". *Econometrica* 69(2), pp. 307-342.
- [8] Reiss, P. and Wolak, F. (2004) "Structural Econometric Modeling: Rationales and Examples from IO". *Handbook of Econometrics*, Vol. 5
- [9] Pakes, A. (2003) "Common Sense and Simplicity in Empirical Industrial Organization" Working Paper 10154, NBER, Cambridge, Mass. USA

## The Benefits of New Products

- [1] Beggs, S., S. Cardell and J. Hausman (1981). "Assessing the Potential Demand for Electric Cars", *Journal of Econometrics* 16, pp. 1-19.
- [2] Chapman, R.G. and R. Staelin (1982) "Exploiting rank-ordered choice set data within the stochastic utility model", *Journal of Marketing Research* 14, pp. 288-301.
- [3] Calfee, J. C. Winston and R. Stempiski, (2001) "Econometric issues in estimating consumer preferences from stated preference data: A case study of the value of automobile travel time", *Review of Economics and Statistics*, 83, pp. 699-707.
- [4] Hausman, J. and P. Ruud (1987) "Specifying and testing econometric models for rank-ordered data" *Journal of Econometrics*, 34, pp. 83-103.
- [5] Hausman, J. (1997). "Valuation of new goods under perfect and imperfect competition". In Timothy F. Bresnahan and Robert J. Gordon, (eds) *The Economics of New goods*, Vol. 58 of *NBER Studies in Income and Wealth*, ch. 5. University of Chicago Press.

- [6] Louviere, J.J., D.A. Hensher and J.D. Swait (2000) "Stated Choice Methods: Analysis and Applications", New York: Cambridge University Press.
- [7] Nevo, Aviv (2003). "New products, quality changes, and welfare measures computed from estimated demand systems". *Review of Economics and Statistics*, 85(2): pp. 266-75.
- [8] Petrin, A. (2002) "Quantifying the benefits of new products: The case of the minivan". *Journal of Political Economy*, 110(4), pp. 705-29.
- [9] Trajtenberg, M. (1989) "The welfare analysis of product innovations, with an application to computed tomography scanners. *Journal of Political Economy*, 97(2) pp. 444-479.

## Marketing

- [1] Allenby, G.M. and P.E. Rossi (1999) "Marketing Models of Consumer Heterogeneity", *Journal of Econometrics*, 89, 57-78.
- [2] Allenby, G.M., N. Arora and J.L. Ginter (1998) "On the Heterogeneity of Demand", *Journal of Marketing Research*, 35 384-389.
- [3] Blundell, R., P. Pashardes and G. Weber (1993). "What do we Learn about Consumer Demand Patterns from Micro Data?" *American Economic Review* Vol. 83, No. 3.
- [4] Bradlow, E.T. and D.C. Schmittlein (1999) "The Little Engines that Could: Modeling the Performance of World Trade Web Search Engines", *Marketing Science*, forthcoming.
- [5] Bradlow, E.T. and A.M. Zaslavsky (1999), "A Hierarchical Latent Variable Model for Ordinal Data from a Customer Satisfaction Survey with "No Answer" Response", *JASA* 94, 43-52.
- [6] Kamakura, W. and G. Russell (1989), "A Probabilistic Choice Model for Market Segmentation and Elasticity Structure", *Journal of Marketing Research* 26, 379-90.
- [7] Kim, B.D. (1995). "Incorporating heterogeneity with store-level aggregate Data. *Marketing Letters* 6, pp. 159-169.
- [8] Nevo, A. (2001). "Measuring Market Power in the Ready-to-Eat Cereal Industry". *Econometrica* 69, 307-342.

- [9] Rossi, P.E. and G.M. Allenby (2000). *Statistics and Marketing*, mimeo, Graduate School of Business, University of Chicago.
- [10] Rossi, P.E. and G.M. Allenby (2003). "Bayesian Statistics and Marketing", *Marketing Science* Vol. 22(3), 304-328.
- [11] Rossi, P.E., Z. Gilula and G.M. Allenby (2001), "Overcoming Scale Usage Heterogeneity: A Bayesian Hierarchical Approach", *Journal of the American Statistical Association*, vol. 96, No. 453.
- [12] Rossi, P.E., R.E. McCulloch, and G.M. Allenby (1996). "The value of purchase history data in target marketing, *Marketing Science* 15, pp. 321-340.

## Retail

- [1] Competition Commission (2000). *Supermarkets: A Report on the Supply of Groceries from Multiple Stores in the United Kingdom*. The Stationery Office, London, UK.
- [2] Cotterill, R. W. (1986). "Market Power in the Retail Food Industry: Evidence from Vermont", *Review of Economics and Statistics*, 68, 379-386.
- [3] Davis, P. (1998). "Spatial Competition in Retail Markets: Motion Theaters". Discussion Paper, Yale University.
- [4] Pesendorfer, M., (2002). "Retail Sales: A Study of Pricing Behaviour in Supermarkets". *Journal of Business*, 75, 33-66.
- [5] Pinkse, J. and M. Slade (1998). "Contracting in Space: An Application of Spatial Statistics to Discrete-Choice Models", *Journal of Econometrics* 85, 125-154.

## Mergers

- [1] Carlton, D.W. (2003) "The Relevance for Antitrust Policy of Theoretical and Empirical Advances in Industrial Organisation" in *George Mason Law Review*.
- [2] Ferraz, G., E.P.S. Fiuza and R. Serôa da Motta. (2001) "Measuring the Effects of Environmental Regulation in Oligopolistic Markets with Differentiated Products". Working Paper No. 36. International Institute for Environment and Development, London.

- [3] Fershtman, C. and N. Gandal and S. Markovich (1999) "Estimating the Effect of Tax Reform in Differentiated Product Oligopolistic Markets". Working Paper Department of Public Policy, Tel Aviv University.
- [4] Hausman, J. G. Leonard, and J.D. Zona (1994). "Competitive Analysis with Differentiated Products". *Annales D'Economie et de Statistique* no. 34.
- [5] Mariuzzo, F., P. Walsh, and C. Whelan (2005) "Merger Control in Differentiated Product Industries". Working Paper Department of Economics, Trinity College of Dublin.
- [6] Nevo, A. (2000) "Mergers with differentiated products: the case of the ready-to-eat cereal industry". *Rand Journal of Economics*, Vol. 31, pp. 395-421.

## Endogeneity

- [1] Petrin, A. and Train, K. (2003) "Omitted Product Attributes in Discrete Choice Models". NBER Working Paper 9452, Cambridge, Mass. USA

## Estimation

- [1] Imbens, G. W. and T. Lancaster (1994) "Combining Micro and Macro Data in Microeconomic Models", *Review of Economic Studies* vol. 61. pp. 655-680.
- [2] Manski, C. and S. Lerman (1981). "On the Use of Simulated Frequencies to Approximate Choice Probabilities" in *Structural Analysis of Discrete Data with Econometric Applications*, ed. by C. Manski and D. McFadden, pp. 305-319, MIT Press, Cambridge, Massachusetts.
- [3] McFadden, D. (1989). "A Method of Simulated Moments for Estimation of Discrete Response Models without Numerical Integration", *Econometrica*, 57, 995-1026.
- [4] Pakes, A. and D. Pollard (1989). "Simulation and Asymptotics of Optimization Estimators", *Econometrica* 54, pp. 755-785.
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- [6] Train, K. (2003) *Discrete Choice Methods with Simulation*, Cambridge University Press.

## Pure Characteristics Demand Model

- [1] Berry, S., and A. Pakes (2007) "The Pure Characteristics Demand Model" *International Economic Review* Vol. 48(4) pp. 1193-1225, November.
- [2] Bajari, P. and L. Benkard (2001) "Discrete Choice Models as Structural Models of Demand: Some Economic Implications of Common Approaches" Stanford University, Department of Economics Working Papers Series No. 01-016
- [3] Caplin, A. and B. Nalebuff (1991) "Aggregation and Imperfect Competition: On the Existence of Equilibrium", *Econometrica*, 59(1) January 1991, pp. 1-23.

## Demand Estimation and Discrete Choice

- [1] Anderson, S.P., A. de Palma and J. Thisse (1992) "Discrete Choice Theory of Product Differentiation, MIT Press.
- [2] Athey, S. and G. Imbens (2007) "Discrete Choice Models with Multiple Unobserved Product Characteristics", *International Economic Review*, forthcoming.
- [3] Berry, S. (1994) "Estimating Discrete-Choice Models of Product Differentiation". *Rand Journal of Economics* Vol. 25(2), pp. 242-262.
- [4] Berry S. and A. Pakes (2007) "The Pure Characteristics Discrete Choice Model of Differentiated Products Demand", *International Economic Review*, forthcoming.
- [5] Boatwright, P. and P.E. Rossi (1999) "Estimating Price Elasticities with Theory-based Priors", forthcoming, *Journal of Marketing Research*.
- [6] Bresnahn, T. (1987) "Competition and Collusion in the American Automobile Market: The 1955 Price War". *Journal of Industrial Economics*, 35 (June) pp. 457-482.
- [7] Davis, P. (2000) "Empirical models of demand for differentiated products". *European Economic Review* 44, pp. 993-1005.

- [8] Elrod, T. and M.P. Keane (1995) "A factor-analytic probit model for representing the market structure in panel data". *Journal of Marketing Research*, 32 pp. 1-16.
- [9] Gorman, W.M. (1959) "Separable Utility and Aggregation" *Econometrica* vol. 27, no. 3, pp. 469-81.
- [10] Keane, M. P. (1997). "Modeling heterogeneity and state dependence in consumer choice behaviour. *Journal of Business and Economic Statistics*, 15(3), pp. 310-27.
- [11] Mazzeo, M.J. (2002). "Product choice and oligopoly market structure. *RAND Journal of Economics*, 33(2), pp. 221-242.
- [12] McFadden, D., and K. Train (2000) "Mixed MNL Models of Discrete Response" *Journal of Applied Econometrics*, 15, pp. 447-470.
- [13] Nevo, A. (2000) "A Practitioners Guide to Estimation of Random Coefficients Logit Models of Demand". *Journal of Economics and Management Strategy*, 9(4), pp. 513-548.
- [14] Park, S. and S. Gupta (2008). "A Simulated Maximum Likelihood Estimator for the Random Coefficient Logit Model Using Aggregate Data". *Journal of Marketing Research* Vol. XLV.
- [15] Train, K. (2003) *Discrete Choice Methods with Simulation*, Cambridge University Press.

## Bayesian

- [1] Musalem, A. E.T. Bradlow and J.S. Raju (2009). "Bayesian Estimation of Random-Coefficients Choice Models Using Aggregate Data". *Journal of Applied Econometrics* 24 pp. 490-516.
- [2] Tanner, M.A. and W.H. Wong (1987). "The Calculation of Posterior Distribution by Data Augmentation". *Journal of the American Statistical Association* 82, pp. 528-550.

## Computer Sessions

- [1] Cameron, A.C. and P.K. Trivedi (2009) *Microeconometrics Using Stata*, Stata Press.

- [2] Herriges, J.A. and C.L. Kling (1999) "Nonlinear Income Effects in Random Utility Models" *Review of Economics and Statistics*, Vol. 81, pp. 62-72.
- [3] Hole, A.R. (2003) Fitting mixed logit models using maximum simulated likelihood. *The Stata Journal*, vol. 7, No. 3.

## Other References

- [1] Bresnahn, T. (1981) "Departures from marginal-cost pricing in the American automobile industry: Estimates for 1977-1978." *Journal of Econometrics*, 17(2), pp. 201-227.
- [2] Bresnahn, T. (1987) "Competition and Collusion in the American Automobile Market: The 1955 Price War". *Journal of Industrial Economics*, 35 (June) pp. 457-482.
- [3] Berry, S. (1992) "Estimation of a model of entry in the airline industry. *Econometrica*, 60(4), pp. 889-917.
- [4] Eklof, M. and M. Weeks (2003) "On Specification, Identification and Estimation in a Class of Discrete Choice Models" Cambridge Working Papers in Economics, No. 0352.
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- [6] Hausman, J. and D. Wise (1978). "A Conditional Probit Model for Qualitative Choice: Discrete Decisions Recognizing Interdependence and Heterogeneous References", *Econometrica*, pp. 403-429.
- [7] Thurstone, L. (1927). "A Law of Comparative Judgement", *Psychological Review*, 34, 273-286.