London School of Economics
Department of Economics

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Further Topics in Econometrics
Part IV
(Ec485)

Introduction

The course consists of 4 series of lectures of 10 hours. My series will focus on "Linear and Nonlinear Panel Data Modelling and an Introduction to Simulation-Based Inference."

Course Outline

1. Linear Panel Data Modelling
   1.1 Static Models
   1.2 Dynamic Models

2. Nonlinear Modelling
   2.1 Static LDV Models
   2.2 Nonlinear Models for Panel Data
   2.3 Dynamic LDV Models

3. An Introduction to Simulation-Based Inference
   3.1 Numerical Approximation vs. Simulation
   3.2 Basic Principles of Simulation
   3.3 General Theory of Simulation-Based Inference

Reading List

Note: Introductory readings are denoted by one asterisk and primary material by two asterisks. Non-starred readings are only meant for people with particular interest in the topic.

Background Texts:

- Baltagi, Badi 1995. *Econometric Analysis of Panel Data.* New York: Wiley (hereafter referred to as *Baltagi.*

- G.S. Maddala 1983. *Limited-Dependent and Qualitative Variables in Econometrics.* Cambridge: Cambridge University Press. (hereafter referred to as *Maddala*)

1 Time-Series Cross-Section Linear Models

1.1 Static Models

1. **Lecture notes

2. *Baltagi: Chapters 2-4, 9.

3. Maddala, G.S. (1977): *Econometrics.* New York: McGraw-Hill. Sections 14.1-14.3.

1.2 Dynamic Models

1. **Lecture notes

2. *Arellano, M. and S. Bond (1991): "Test of Specification for Panel Data: Monte-Carlo Evidence and an Application to Employment Equations," *Review of Economic Studies* 58, 277-297.

3. *Bhargava, A. and D. Sargan (1982): "Estimating Dynamic Random Effects Models from Panel Data Covering Short Time Periods," *Econometrica* 51, 1635-1660.

4. Baltagi: Sections 5.2, 8.1-8.3.

2 Nonlinear Modelling

2.1 Static LDV Models

- **Lecture notes

- *Maddala, G.S. 1977. *Econometrics.* New York: McGraw-Hill. Sections 14.1-14.3.

- *Maddala, Chapters 5, 7, 8

2.2 Nonlinear Models for Time-Series Cross-Section Data

- **Lecture notes

- Baltagi: Sections 10.4-10.5.

- *Hausman, J. and D. Wise 1979. "Attrition Bias in Experimental and Panel Data: The Gary Negative Income Maintenance Experiment," *Econometrica* 47, 445-473.

- *Heckman, J.J. 1981. "Statistical Models for Discrete Panel data," in *Manski and McFadden* (eds.), em Structural Analysis of Discrete Data with Econometric Applications, Cambridge, Massachusetts. (skim).

- Baltagi: Chapters 2-4, 5.2, 8.1-8.3, and 9.

2.3 Nonlinear Dynamic LDV Models: A General Framework

- **Hajivassiliou, V. 2019. "Estimation and Specification Testing of Panel Data Models with Non-Ignorable Persistent Heterogeneity, Contemporaneous and Intertemporal Simultaneity, and Observable and Unobservable Dynamics," URL LSEResearchOnline: `https://eprints.lse.ac.uk/102843/`

- *Heckman, J. 1981. "Dynamic Discrete Models." *Pages 114–178 of:* Manski, C., and McFadden, D. (eds), *Structural Analysis of Discrete Data with Econometric Applications*. M.I.T. Press.

- *Avery, R., L. Hansen, and V.Joseph Hotz 1983. "Multi-period Probit Models and Orthogonality Conditions," *International Economic Review*, 24, 21-35.

- Chamberlain, G. 1980. "Analysis of Covariance with Qualitative Data," *Review of Economic Studies* 47, 225-238.

- Hajivassiliou, V. 1989. "Do Secondary Markets Believe in Life After Debt?" In *Dealing with the Debt Crisis*, I. Husain and I. Diwan (eds.). Washington, D.C.: World Bank, 1989, pp.276–292.

3 An Introduction to Simulation-Based Inference

3.1 Numerical Approximation vs. Simulation

- *Butler, J.S., and Moffit, R. 1982. A Computationally Efficient Quadrature Procedure for the One-Factor Multinomial Probit Model. *Econometrica*, **50(3)**, 761–764.

- McFadden, D. 1996. "Lectures on Simulation-Assisted Statistical Inference." Presented at the 1996 EC-squared Conference, Florence, Italy. Sections 1-3 (pp.1-22).

- Hajivassiliou, V. 1984. *A Computationally Efficient Quadrature Procedure for the One Factor Multinomial Probit Model: A Comment.* MIT mimeo.

- Deák, I. 1980. Three Digit Accurate Multiple Normal Probabilities. *Numerische Mathematik*, **35**, 369–380.

- Moran, P.A.P. 1985. Calculation of Multivariate Normal Probabilities - Another Special Case. *Australian Journal of Statistics*, **27, No. 1**, 60–67.

- Moran, P.A.P. 1986. Orthant Probabilities and Gaussian Markov Processes. *Journal of Applied Probability*, 413–417.

- Press, W., Flannery, B., Teukolsky, S., and Vetterling, W. 1986. *Numerical Recipes.* Cambridge University Press.

- Devroye, L. 1986. *Non-Uniform Random Variate Generation.* Springer.

3.2 Basic Principles of Simulation

- *Hajivassiliou, V., McFadden, D., and Ruud, P. 1996. Simulation of Multivariate Normal Rectangle Probabilities and Their Derivatives: Theoretical and Computational Results. *Journal of Econometrics*, **72(1&2)**, 85–134.

- *Hajivassiliou, V.A. and A. Börsch-Supan 1993. "Smooth Unbiased Multivariate Probability Simulators for Maximum Likelihood Estimation of Limited Dependent Variable Models," *Journal of Econometrics*, Vol.58(3), 1993, pp.347–368.

- McFadden, D. 1996. "Lectures on Simulation-Assisted Statistical Inference." Presented at the 1996 EC-squared Conference, Florence, Italy. Sections 3-4 (pp.23-46).

- Keane, M. 1994. A Computationally Efficient Practical Simulation Estimator for Panel Data. *Econometrica*, **62(1)**, 95–116.

- Geweke, J. 1989. *Efficient Simulation from the Multivariate Normal Distribution Subject to Linear Inequality Constraints and the Evaluation of Constraint Probabilities.* Duke University working paper.

- Hajivassiliou, V. 1993. Simulation of multivariate normal rectangle probabilities and their derivatives: the effects of vectorization. *International Journal of Supercomputer Applications*, **Fall**, 231–253.

- Stern, S. 1992. A Method for Smoothing Simulated Moments of Discrete Probabilities in Multinomial Probit Models. *Econometrica*, **60**, 943–952.

3.3   General Theory of Simulation-Based Inference

- **Hajivassiliou, V.A. 1994. "Simulation Estimation Methods for Limited Dependent Variable Models," in the *Handbook of Statistics: Econometrics Volume*, G.S. Maddala, C.R. Rao and H. Vinod (eds.). Amsterdam: North-Holland.

- *Hajivassiliou, V. 1994. A Simulation Estimation Analysis of External Repayments Problems of Developing Countries. *Journal of Applied Econometrics*, **9(2)**, 109–132.

- *Hajivassiliou, V.A. and P.A. Ruud 1995. "Classical Estimation of LDV Models by Simulation," in the *Handbook of Econometrics, Volume IV*, R. Engle and D. McFadden (eds.). Amsterdam: North-Holland.

- Hajivassiliou, V.A. and D.L. McFadden 1997. "The Method of Simulated Scores for the Estimation of LDV Models," *Econometrica*, to appear.

- Laroque, G., and Salanié, B. 1989. Estimation of Multi-Market Disequilibrium Fix-Price Models: An Application of Pseudo Maximum Likelihood Methods. *Econometrica*, **57**, 831–860.

- Lerman, S., and Manski, C. 1981. On the Use of Simulated Frequencies to Approximate Choice Probabilities. *Pages 305–319 of:* Manski, C., and McFadden, D. (eds), *Structural Analysis of Discrete Data with Econometric Applications*. MIT Press.

- McCulloch, R., and Rossi, P. 1994. An Exact Likelihood Analysis of the Multinomial Probit Model. *Journal of Econometrics*, **64**.

- McFadden, D.L. 1989. "A Method of Simulated Moments for Estimation of Discrete Response Models without Numerical Integration," *Econometrica* 57, 995-1026.

- Pakes, A. and D. Pollard 1989. "Simulation and the Asymptotics of Optimization Estimators," *Econometrica* 57, 1027-1058.

- Ruud, P. 1991. Extensions of Estimation Methods Using the EM Algorithm. *Journal of Econometrics*, **49**, 305–341.