Dynamic Discrete Choice and Duration Analysis

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Description

This mini-course provides an introduction to the structural econometric analysis of durations and more general dynamic discrete outcomes. We first introduce the popular mixed proportional hazards model, and explore its relation to economic primitives. We then move to models that are more explicitly grounded in dynamic economic theory. We review what can be learned from the extensive literature on discrete-time dynamic discrete-choice models, and conclude by considering recent parallel developments in continuous-time duration analysis.

Throughout, we highlight the extent to which model primitives are uniquely determined by the data (identifiability), and consider computation and empirical methods. Theory and methods are illustrated with (potential) empirical applications. These may include the evaluation of labor market policies with job search models; asymmetric information in insurance markets; firm growth, learning, and survival; and marriage and labor market matching.

Tentative Outline and Tentative Readings

A. Hazard models (5–6 hours)

After a brief review of a few basic concepts and results in continuous-time duration analysis, we introduce the mixed proportional hazards (MPH) model. We discuss if and how this model allows researchers to distinguish state dependence and heterogeneity in duration data. Finally, we highlight the limits dynamic economic theory places on the structural application of the MPH model, using the empirical analysis of moral hazard problems in unemployment insurance and/or car insurance as examples.

To prepare for this part of the course, please

- *review basic concepts and results in Van den Berg (2001, Sections 2–4);*
- *have a first encounter with Elbers and Ridder's (1982) and Ridder's (1990) seminal identification results (see also Van den Berg, 2001, Section 5); and*
- *have a first look at Abbring et al.'s (2008) insurance application.*

My old lecture notes (Abbring, 2001) are an alternative source of background material, but are dated and not a good guide to the present course. Up-to-date slides will be distributed as we go.

Literature

Abbring, J. H. (2001). Econometric duration and event-history analysis. Lecture notes, Department of Economics, The University of Chicago. Revised, June 2002. 2

Abbring, J. H., P. A. Chiappori, and T. Zavadil (2008). Better safe than sorry? Ex ante and ex post moral hazard in dynamic insurance data. Discussion Paper 2008-77, CentER, Tilburg. 2

Elbers, C. and G. Ridder (1982). True and spurious duration dependence: The identifiability of the proportional hazard model. *Review of Economic Studies 64*, 403–409. 2

Ridder, G. (1990). The non-parametric identification of generalized accelerated failure-time models. *Review of Economic Studies 57*, 167–182. 2

Ridder, G. and T. Woutersen (2003). The singularity of the information matrix of the mixed proportional hazard model. *Econometrica 71*, 1579–1589.

Van den Berg, G. (1990). Nonstationarity in job search theory. *Review of Economic Studies 57*, 255–277.

Van den Berg, G. J. (2001). Duration models: Specification, identification, and multiple durations. In J. J. Heckman and E. Leamer (Eds.), *Handbook of Econometrics*, Volume 5, Chapter 55, pp. 3381–3460. Amsterdam: Elsevier Science. MPRA Working Paper version 2

The course's focus on structural duration analysis implies that we have to skip much of the vast literature on econometric and statistical duration analysis. Some good entry points in this literature are

Andersen, P. K., Ø. Borgan, R. D. Gill, and N. Keiding (1993). *Statistical Models Based on Counting Processes*. New York: Springer-Verlag.

Fleming, T. and D. Harrington (1991). *Counting Processes and Survival Analysis*. New York: Wiley.

Kalbfleisch, J. and R. Prentice (1980). *The Statistical Analysis of Failure Time Data*. New York: Wiley.

Lancaster, T. (1990). *The Econometric Analysis of Transition Data*. Cambridge: Cambridge University Press.

B. Discrete-Time Dynamic Discrete Choice (5–6 hours)

We continue by studying dynamic discrete-choice models that are more firmly grounded in dynamic economic theory. We first explore the discrete-time literature, which is much better developed than Part C's continuous-time literature. We review identification results and computational methods for dynamic discrete-choice models that satisfy Rust's (1987) conditional-independence assumption. We then move to models with static and dynamic unobserved factors, which involve nontrivial dynamic selection and are more closely related to Part C's continuous-time models. This last discussion will tentatively be based on an application to firm growth, learning, and survival.

To prepare for this part of the course, please

- *consult Rust (1987) and/or Rust (1994) for some some first understanding of the econometric analysis of dynamic discrete-choice models under conditional independence.*

If you are familiar with these papers, you may already want to check

- *Magnac and Thesmar (2002) and Abbring and Heckman (2007, Sections 3.4.1–3.4.1.2) for some further results on the identifiability of models with dynamic selection on unobservables; and*
- *Abbring and Campbell (2005) for an application to firm growth, learning, and survival.*

Literature

Abbring, J. H. and J. R. Campbell (2005). A firm's first year. Discussion Paper 05-046/3, Tinbergen Institute, Amsterdam. Under revision. 4

Abbring, J. H. and J. J. Heckman (2007). Econometric evaluation of social programs, part III: Distributional treatment effects, dynamic treatment effects and dynamic discrete choice, and general equilibrium policy evaluation. In J. J. Heckman and E. E. Leamer (Eds.), *Handbook of Econometrics*, Volume 6B, Chapter 72, pp. 5145–5303. Amsterdam: Elsevier Science (Sections 3.4.1, 3.4.1.1 & 3.4.1.2 in particular). 4

Ackerberg, D., C. Benkard, S. Berry, and A. Pakes (2007). *Econometric Tools for Analyzing Market Outcomes*, Volume 6A, Chapter 63, pp. 4171–4276. Amsterdam: Elsevier Science (Section 3.4 only).

Aguirregabiria, V. and P. Mira (2002). Swapping the nested fixed point algorithm: An estimator for discrete Markov decision problems. *Econometrica 70*, 1519–1543.

Hotz, V. J. and R. A. Miller (1993). Conditional choice probabilities and the estimation of dynamic models. *Review of Economic Studies 60*(3), 497–529.

Judd, K. and C.-L. Su (2008). Constrained optimization approaches to estimation of structural models. Mimeo, University of Chicago Booth School of Business, Chicago.

Magnac, T. and D. Thesmar (2002). Identifying dynamic discrete choice processes. *Econometrica 70*, 801–816. 4

Rust, J. (1987). Optimal replacement of GMC bus engines: An empirical model of Harold Zurcher. *Econometrica 55*, 999–1033. 4

Rust, J. (1994). Structural estimation of Markov decision processes. In R. Engle and D. McFadden (Eds.), *Handbook of Econometrics*, Volume 4, pp. 3081–3143. Amsterdam: North-Holland. Other version 4

C. Hitting-Time Models (4–5 hours)

Finally, we consider recent, closely-related developments in continuous-time duration analysis. We introduce mixed hitting-time models and show how their identification can be analyzed using techniques from the MPH literature discussed in Part A. We explore their relation to continuous-time optimal-stopping problems in economics, by studying potential applications to investment timing and firm entry, unemployment durations, and/or labor and marriage market match durations.

To prepare for this part of the course, please start reading Abbring (2007).

Literature

Abbring, J. H. (2007). Mixed hitting-time models. Discussion Paper 07-57/3, Tinbergen Institute, Amsterdam. Revised, April 2009. 6

Abbring, J. H. and T. Salimans (2009). Estimating mixed hitting-time models. Mimeo, CentER, Department of Econometrics & OR, Tilburg University, Tilburg.

We will only be able to touch the surface of the rich theoretical literature on optimal stopping in continuous time. Theory and applications in economics and finance can be found in

Boyarchenko, S. and S. Levendorskiĭ (2007). *Irreversible Decisions under Uncertainty: Optimal Stopping Made Easy*. Berlin: Springer-Verlag.

Dixit, A. K. and R. S. Pindyck (1994). *Investment under Uncertainty*. Princeton University Press.

Kyprianou, A. E. (2006). *Introductionary Lectures on Fluctuations of Lévy Processes with Applications*. Berlin: Springer-Verlag.

Stokey, N. L. (2009). *The Economics of Inaction: Stochastic Control Models with Fixed Costs*. Princeton, NJ: Princeton University Press.