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CHOICE MODELLING

The State of the Art and the State of Practice

Choice Modelling

The State of the Art and the State of Practice

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7. Applied welfare economics with discrete choice models: implications of theory for empirical specification

Richard Batley and J. Nicolás Ibáñez

1. INTRODUCTION

The apparatus of the Random Utility Model (RUM) first emerged in the early 1960s, with Marschak (1960) and Block and Marschak (1960) translating models originally developed for discriminant analysis in psychophysics (Thurstone, 1927) to the alternative domain of discrete choice analysis in economics. Whilst some researchers were quick to see its practical potential (e.g. McFadden, 1968, 1975), it was not until the late 1970s and early 1980s that RUM was equipped with a reasonably comprehensive theoretical rationale in terms of the economics of consumption. An important tenet of this rationale was the link between discrete choice and welfare, which established a basis for applying RUM to public policy analysis, and paved the way for the plethora of applications which have been witnessed over the last 30 years.

It will be helpful to clarify precisely what we mean by 'discrete choice', since Small and Rosen (1981) – which will be referred to as 'S&R' in the remainder of this chapter – suggest three alternative rationales, as follows. First, commodities may be available in continuous quantities but only a limited number of varieties. Second, goods may be supplied in discrete units of such magnitude that only a small number of those units are typically consumed (in this case, S&R cite the example of travel mode choice). Third, if the search for the optimal consumption bundle entails a choice between alternative corner solutions, then the problem is reduced to discrete units. S&R draw particular motivation from the first rationale, introducing a general model of demand comprising both continuous and discrete components. That is to say, an individual is represented as choosing a quantity of a continuous commodity conditional upon discrete choice.

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(1981) and Williams (1977), S&R's analysis has proved particularly influential in establishing a basis upon which discrete choice models can be applied to welfare economics. S&R state that 'The purpose of [their] paper is to demonstrate that the conventional methods of applied welfare economics can be generalised to handle cases in which discrete choices are involved' (S&R, 1981, p. 106). Furthermore, they remark that: 'Throughout, the emphasis is on providing rigorous guidelines for carrying out empirical work' (p. 106). It is notable that, despite the intensity with which RUM has been applied over the last 30 years, S&R's paper has stood the test of time; the key propositions of the paper remain largely unchallenged and continue to underpin the analysis of significant public policy interventions.

That said, in the years following its publication, a small but significant literature (e.g. Hau, 1985, 1987; Jara-Díaz and Farah, 1988; Jara-Díaz, 1990; Karlström, 1999; Karlström and Morey, 2004) has clarified the properties of the consumer surplus measure emanating from S&R's paper. In particular, these contributors have considered the extent to which S&R admits income effects of both price and income changes. The present paper will seek to contribute to the aforementioned literature by furthering understanding of S&R, especially in a manner that appeals to the aspiration to provide '. . .rigorous guidelines for carrying out empirical work'. More specifically, our chapter will offer four substantive contributions, as follows:

1. Section 2 will introduce S&R's problem of discrete-continuous demand, before articulating the concept of a probabilistic demand function, and exposing the assumptions underlying this concept.
2. Section 3 will consider the application of the Slutsky equation to the discrete and continuous components of demand, from both individual-level and aggregate perspectives. In this regard, the present chapter will present a definitive account of the assumptions underpinning S&R's derivation of the Slutsky equation.
3. Sections 4 and 5 will reconcile S&R's model of discrete-continuous demand with four fundamental properties of demand functions, namely 'adding up', 'negativity', 'homogeneity' and 'symmetry'. For a restricted case of S&R's model involving only the probabilistic demand, the chapter will identify particular requirements on model specification, such that the aforementioned properties hold.
4. Finally, section 6 will review the rationale followed by S&R in deriving consumer surplus from discrete choice models. It will be shown that the 'log sum' measure of consumer surplus implies very particular requirements on model specification, consistent with those supporting the fundamental properties of demand functions.

McFadden, D. (1981), 'Econometric models of probabilistic choice', in C. Manski and D. McFadden (eds), *Structural Analysis of Discrete Data: With Econometric Applications*, Cambridge, Massachusetts: The MIT Press.
Marschak, J. (1960), 'Binary choice constraints and random utility indicators', in J. Marschak (1974), *Economic Information, Decision and Prediction: Selected Essays*, vol. 1, Dordrecht: D. Reidel.
Samuelson, P. (1942), 'Constancy of the marginal utility of income', in O. Lange, F. McIntyre and T.O. Yntema (eds), *Studies in Mathematical Economics and Econometrics in Memory of Henry Schultz*, Chicago: University of Chicago Press.
Samuelson, P. (1950), 'The problem of integrability in utility theory', *Economica*, **17** (68), 355–385.
Slutsky, E.E. (1915), 'Sulla teoria del bilancio del consumatore', *Giornale degli Economisti*, **51**, 1–26, reprinted as 'On the theory of the budget of the consumer', in J. Stigler and K.E. Boulding (eds), *A.E.A. Readings in Price Theory*, Chicago: Richard D. Irwin Inc.
Small, K.A. and H.S. Rosen (1981), 'Applied welfare economics with discrete choice models', *Econometrica*, **49** (1), 105–130.
Steenburgh, T.J. (2008), 'The invariant proportion of substitution property (IPS) of discrete-choice models', *Marketing Science*, **27** (2), 300–307.
Swait, J. and M. Ben-Akiva (1987), 'Empirical test of a constrained choice discrete model: mode choice in Sao Paulo, Brazil', *Transportation Research Part B*, **21** (2), 103–115.
Thurstone, L. (1927), 'A law of comparative judgement', *Psychological Review*, **34**, 273–286.
Williams, H.C.W.L. (1977), 'On the formation of travel demand models and economic evaluation measures of user benefit', *Environment and Planning A*, **9** (3), 285–344.