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Product attributes and models of multiple discreteness

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Abstract

Demand for product characteristics is examined within the context of models that allow for both corner and interior solutions corresponding to zero and non-zero demand. Product attribute information is associated with marginal utility and curvature (satiation) parameters of various utility functions. Empirical applications demonstrate the need for incorporating characteristics in a fairly general way. We also compare our approach to an ideal point and pure Lancasterian versions of our nonlinear utility model. The data support our model over either the ideal point or Lancasterian variants.

JEL classification: M3; D1; C11

Keywords: Characteristic model; Non-homothetic utility; Multiple discreteness; Product attributes

1. Introduction

The profusion of disaggregate data on consumer demand obtained either from market place observation or surveys has simulated a great deal of work on models with discrete components. Multinomial choice models have been, by far, the most popular models used with disaggregate data. However, these choice models ignore the quantity aspects of demand and can only be applied to sets of goods for which demand is mutually exclusive,

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i.e. only one good is purchased on each occasion. Consumers are often observed to purchase or select multiple goods on the same occasion while revealing a demand of zero for the vast majority of the available offerings. This data requires a model with a mixture of corner and interior solutions. We may also require that our model be derived from a valid utility function to facilitate policy analysis.

Kim et al. (2002) offered a utility-based model of demand along with a practical method of conducting likelihood-based inference for this model. However, the simple model in Kim et al. is lacking several important features. In marketing applications, there are typically a very large number of product offerings with a wide variety of product attributes. In order to make policy statements about optimal product assortment or design of new products, it is important to allow for product characteristics or attributes to enter the utility function. The purpose of this paper is to consider a number of extensions of the Kim et al. model of demand to incorporate product attribute information. As the basic utility model is nonlinear and allows for satiation or diminishing marginal utility, we will have several different ways of incorporating product attributes—both to influence the level of marginal utility afforded by a product offering as well as to influence the rate of satiation.

Once product characteristics are considered as drivers of utility, it is natural to consider a characteristics approach to demand such as that offered by Lancaster (1966) (see also Berry and Pakes, 2002). In the Lancasterian approach, demand is defined over the level of characteristics provided by a given bundle of demanded products, rather than over the products themselves. In the characteristics space, we should not always assume that marginal utility is strictly increasing (decreasing) in characteristics and might consider the "ideal point" alternative in which consumers have an ideal level of product characteristics, any deviation from which will result in lower utility. We compare our extended model of demand with the ideal point and Lancasterian approaches.

Kim et al. (2002) consider the demand for different varieties of yogurt for which the set of characteristics is at least as large as the number of product offerings. In this paper, we consider two other data sets, which have products with well-defined characteristics. We have created a data set of demand for various salty snacks via field experimentation and also report on results using "volumetric" conjoint data in which respondents not only choose between alternative offerings but indicate the quantity demanded. These new datasets illustrate the importance of the model extensions. We find that variants of our extended model outperform various ideal point and Lancasterian specifications. Using the conjoint data, we compare our utility-based approach to a reduced form Poisson regression and find that our approach has superior predictive performance.

2. The demand model and alternative parameterizations

The standard choice model is derived from a linear utility specification. The linear utility specification gives rise to a corner solution in which only one product is purchased on any one-purchase occasion. In some cases, an outside alternative, or "no purchase" option, is included to allow for consumers to have a base or reference level of utility. This model assumes that all products are perfect substitutes, and results in one alternative with non-zero demand.

The "multiple discreteness" phenomena in which two or more (but not all) product offerings are purchased reveals that the product offerings are not viewed as perfect