Inferring an Ideal-Point Product-Market Map from Consumer Panel Data

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Summary
A recent paper (see Elrod (1987)) introduced Choice Map, a model for inferring a product-market map from consumer panel data. Choice Map combines the rationale of random utility models, the parsimony of stochastic brand choice models, and the ability of multidimensional scaling procedures to simultaneously infer brand positions and consumer preferences for attributes from preference (choice) data. In its initial formulation, Choice Map represented consumers by vectors in one or two dimensions.

This paper presents an ideal-point version of Choice Map and compares it to the vector version. The ideal-point version fits a sample data set better, but brand loyalty is still underrepresented for some households.

1 Introduction
Brand managers of frequently-purchased consumer goods have access to the purchasing behavior by panels consisting of thousands of households. Scanner panel data allow the tracking of the actual purchasing behavior of households in an unobtrusive manner, and many brand managers obtain such data on a routine basis to monitor buying behavior for grocery and drug products. These data can be used to track trial and repeat rates for new brands and monitor mature product categories for changes in buyer behavior. For the latter purpose, switching matrices can be constructed periodically to determine whether or not the market is in equilibrium. Stochastic brand choice models such as the Dirichlet-multinomial (see Bass, Jeuland and Wright (1976)) are used to generate a basis for comparison by showing what switching would be expected given a stationary market, and how much of a deviation from predicted switching is within the range explainable by sampling error (see Goodhardt and Ehrenberg (1967); Morrison (1969); Morrison and Schmittlein (1981)). However, greater use of stochastic models in this way has been hampered by their neglect of brand attributes.

Choice Map in both of its versions is a brand choice model that assumes consumers perceive brands in terms of product attributes and that their evaluation of any brand is derived from their perception of the brand in terms of these attributes and the importance they attach to them; i.e., Choice Map assumes that brand choice behavior is explained by a product-market map. Furthermore, Choice Map infers the locations of brands and consumers in the map from real-world brand choice data. Rather than
periodically derive switching matrices from panel data, managers can derive product-market maps. Since the maps are estimated by the method of maximum likelihood, the manager can explicitly test hypotheses about changes in the map. For example, has a new advertising campaign successfully altered buyer perceptions of the brand? Are consumers attaching less importance to a dimension than previously? Since these questions are answered by examining actual choice behavior, only changes affecting behavior will be detected.

To generate a Choice Map, the manager requires a count of the number of times each household bought each brand during the observational period. The length of time required for observation varies with the typical interpurchase time for the product category, but it appears in practice that 3–6 months of purchasing is adequate for most frequently-bought goods.

Such data are different from the type of data normally required for market structure analysis. First, there is no opportunity to effect experimental control over the choice process, such as obtaining pairwise choices from consumers. Second, the average number of purchases from the choice set is small by MDS standards—most applications of Choice Map to date have averaged 6 purchases per household for six-brand product categories, or one purchase per household per brand.

Choice Map deals with the lack of data by estimating only aggregate-level parameters. Consumer heterogeneity in purchasing is preserved by postulating a distribution of consumer preferences, and then estimating the parameters of that distribution directly. Given that the sample includes (few) purchases by a large number of households, avoiding the estimation of household-level parameters greatly increases model parsimony. However, Choice Map requires intensive numerical integration, over as many dimensions as there are dimensions in the map, which makes the estimation process slow and limits it to (at present) only one or two dimensions.

2 Model Derivation

Observed for each household is a vector of brand choice frequencies $y = [y_1, \ldots, y_J]'$, where $y_i$ is a count of the number of times brand $i$ is bought during the observational period, and $J$ is the number of brands. Both versions of Choice Map assume that $y$ arises from a series of purchase occasions on which only a single brand is chosen. On each occasion the brand chosen (denoted $X$) is the one having the highest utility:

$$X = i \text{ if and only if } U_i = \max\{U_1, \ldots, U_J\},$$

(1)

where $U_i$ denotes the utility of brand $i$.

Brand utilities are stochastic over time, which explains why different brands are often bought by the same household on different choice occasions. The utility for a brand is a random variable $U$ which is the sum of a constant preference component (denoted $v$) and a stochastic component (denoted $\epsilon$) of zero mean:

$$U = v + \epsilon.$$  

(2)

Random utility models (see McFadden (1976); Manski and McFadden (1981); Currim (1982)) distinguish $v$ as the component of utility that is explained by observed