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# A Hierarchical Bayes Model of Primary and Secondary Demand

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## Abstract

Product design, pricing policies, and promotional activities influence the primary and secondary demand for goods and services. Brand managers need to develop an understanding of the relationships between marketing mix decisions and consumer decisions of whether to purchase in the product category, which brand to buy, and how much to consume. Knowledge about factors most effective in influencing primary and secondary demand of a product allows firms to grow by enhancing their market share as well their market size.

The purpose of this paper is to develop an individual level model that allows an investigation of both the primary and secondary aspects of consumer demand. Unlike models of only primary demand or only secondary demand, this more comprehensive model offers the opportunity to identify changes in product features that will result in the greatest increase in demand. It also offers the opportunity to differentially target consumer segments depending upon whether consumers are most likely to enter the market, increase their consumption level, or switch brands.

In the proposed hierarchical Bayes model, an integrative framework that jointly models the discrete choice and continuous quantity components of consumer decision is employed instead of treating the two as independent. The model includes parameters that capture individual specific reservation value, attribute preference, and expenditure sensitivity. The model development is based upon the microeconomic theory of utility maximization. Heterogeneity in model parameters across the sample is captured by using a random effects specification guided by the underlying microeconomic model. This requires that some of the effects are strictly positive. This is accommodated through the use of a gamma distribution of heterogeneity for some of the parameters. A normal distribution of heterogeneity is used for the remaining parameters. Gibbs sampling is used to estimate the model.

The key methodological contribution of this paper is that we show how to specify a hierarchical Bayes continuous random effects model that integrates consumer choice and quantity decisions such that individual-level parameters can be

estimated. Individual level estimates are desirable because insights into primary demand involve nonlinear functions of model parameters. For example, consumers not in the market are those whose utilities for the choice alternatives fall below some reservation value. The proposed methodology yields individual specific estimates of reservation values and expenditure sensitivity, which allow assessment of the origins of demand other than the switching behavior of consumers. The methodology can also be used to help identify changes in product features most likely to bring new customers into a market.

Our work differs from previous research in this area as we lay the framework needed to obtain individual-level parameter estimates in a continuous random effects model that integrates choice and quantity. The methodology is demonstrated with survey data collected about consumer preferences and consumption for a food item. For the data available, a large response heterogeneity was observed across all model parameters. In spite of limited data available at the individual level, a majority of the individual level estimates were found to be significant. Predictive tests demonstrated the superiority of the proposed model over existing latent class and aggregate models. Particularly, significant gains in predictive accuracy were observed for the “no-buy” behavior of the respondents. These gains demonstrate that by structurally linking the choice and quantity models results in a more accurate characterization of the market than existing finite mixture approaches that model choice and quantity independently. We show that our joint model makes more efficient use of the available data and results in better parameter estimates than those that assume independence.

Finally, the individual level demand analysis is illustrated through a simple example involving a \$1.00 price cut. We demonstrate practical usefulness of the model for targeting by developing the demographic, attitudinal, and behavioral profiles of consumer groups most likely to increase consumption, enter the market, or switch brands because of a price cut decision.

*(Demand Analysis; Choice Models; Product Design; Product Repositioning; Discrete Continuous Models; Gibbs Sampling; Metropolis-Hastings Algorithm)*