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The "Shopping Basket": A Model for Multicategory Purchase Incidence Decisions

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Abstract

Consumers make multicategory decisions in a variety of contexts such as choice of multiple categories during a shopping trip or mail-order purchasing. The choice of one category may affect the selection of another category due to the complementary nature (e.g., cake mix and cake frosting) of the two categories. Alternatively, two categories may co-occur in a shopping basket not because they are complementary but because of similar purchase cycles (e.g., beer and diapers) or because of a host of other unobserved factors. While complementarity gives managers some control over consumers' buying behavior (e.g., a change in the price of cake mix could change the purchase probability of cake frosting), co-occurrence or co-incidence is less controllable. Other factors that may affect multi-category choice may be (unobserved) household preferences or (observed) household demographics. We also argue that not accounting for these three factors simultaneously could lead to erroneous inferences. We then develop a conceptual framework that incorporates complementarity, co-incidence and heterogeneity (both observed and unobserved) as the factors that could lead to multicategory choice.

We then translate this framework into a model of multicategory choice. Our model is based on random utility theory and allows for simultaneous, interdependent choice of many items. This model, the multi*variate* probit model, is implemented in a Hierarchical Bayes framework. The hierarchy consists of three levels. The first level captures the choice of items for the shopping basket during a shopping trip. The second level captures differences across households and the third level specifies the priors for the unknown parameters. We generalize some recent advances in Markov chain Monte Carlo methods in order to estimate the model. Specifically, we use a substitution sampler which incorporates techniques such as the Metropolis Hit-and-Run algorithm and the Gibbs Sampler.

The model is estimated on four categories (cake mix, cake frosting, fabric detergent and fabric softener) using multicategory panel data. The results disentangle the complementarity and co-incidence effects. The complementarity results show that pricing and promotional changes in one category affect purchase incidence in related product categories. In general, the cross-price and cross-promotion effects are smaller than the own-price and own-promotions effects. The cross-effects are also asymmetric across pairs of categories, i.e., related category pairs may be characterized as having a "primary" and a "secondary" category. Thus these results provide a more complete description of the effects of promotional changes by examining them both within and across categories. The co-incidence results show the extent of the relationship between categories that arises from uncontrollable and unobserved factors. These results are useful since they provide insights into a general structure of dependence relationships across categories. The heterogeneity results show that observed demographic factors such as family size influence the intrinsic category preference of households. Larger family sizes also tend to make households more price sensitive for both the primary and secondary categories. We find that price sensitivities across categories are not highly correlated at the household level. We also find some evidence that intrinsic preferences for cake mix and cake frosting are more closely related than preferences for fabric detergent and fabric softener.

We compare our model with a series of null models using both estimation and holdout samples. We show that both complementarity and co-incidence play a significant role in predicting multicategory choice. We also show how many single-category models used in conjunction may not be good predictors of joint choice.

Our results are likely to be of interest to retailers and manufacturers trying to optimize pricing and promotion strategies across many categories as well as in designing micromarketing strategies. We illustrate some of these benefits by carrying out an analysis which shows that the "true" impact of complementarity and co-incidence on profitability is significant in a retail setting. Our model can also be applied to other domains. The combination of item interdependence and individual household level estimates may be of particular interest to database marketers in building customized "cross-selling" strategies in the direct mail and financial service industries.

(*Multicategory Models*; *Shopping Baskets*; *Retailing*; *Micromarketing*; *Multivariate Probit Model*; *Hierarchical Bayes Models*)