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Utility Covariances and Context Effects in Conjoint MNP Models

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Abstract

Experimental conjoint choice analysis is among the most frequently used methods for measuring and analyzing consumer preferences. The data from such experiments have been typically analyzed with the Multinomial Logit (MNL) model. However, there are several problems associated with the standard MNL model because it is based on the assumption that the error terms of the underlying random utilities are independent across alternatives, choice sets, and subjects. The Multinomial Probit model (MNP) is well known to alleviate this assumption of independence of the error terms. Accounting for covariances in utilities in modeling choice experiments with the MNP is important because variation of the coefficients in the choice model may occur due to context effects. Previous research has shown that subjects' utilities for alternatives depend on the choice context, that is, the particular set of alternatives evaluated. Simonson and Tversky's tradeoff contrast principle describes the effect of the choice context on attribute importance and patterns of choice. They distinguish *local contrast effects*, which are caused by the alternatives in the offered set only, and *background contrast effects*, which are due to the influence of alternatives previously considered in choice experiments. These effects are hypothesized to cause correlations in the utilities of alternatives within and across choice sets, respectively.

The purpose of this study is to develop an MNP model for conjoint choice experiments. This model is important for a more detailed study of choice patterns in those experiments. In developing the MNP model for conjoint choice experiments, several hurdles need to be taken related to the identification of the model and to the prediction of holdout profiles. To overcome those problems, we propose a random coefficients (RC) model that assumes a multivariate normal distribution of the regression coefficients with a rank one factor structure on the covariance matrix of these regression coefficients. The parameters in this covariance matrix can be used to identify which attributes and levels of attributes are

potential sources of dependencies between the alternatives and choice sets in a conjoint choice experiment. We present several versions of this model. Moreover, for each of these models we allow utilities to be either correlated or independent across choice sets. The Independent Probit (IP) model is used as a benchmark. Given the dimensionality of the integrations involved in computing the choice probabilities, the models are estimated with simulated likelihood, where simulations are used to approximate the integrals involved in the choice probabilities.

We apply and compare the models in two conjoint choice experiments. In both applications, the random coefficients MNP model that allows choices in different choice sets to be correlated (RC) displays superior fit and predictive validity compared with all other models. We hypothesize that the difference in fit occurs because the RC model accommodates correlations among choice sets that are caused by background contrast effects, whereas the model that treats choice sets as independent (iRC) accounts for local contrast effects only. The iRC model shows superior model fit compared with the IP model, but its predictions are worse than those of the IP model. We find differences in the importance of local and background contrast effects for choice sets containing different numbers of alternatives: The background contrast effect may be stronger for smaller choice sets, whereas the local contrast effect may be stronger for bigger choice sets.

We illustrate the differences in simulated market shares that are obtained from the RC, iRC, and IP models in three hypothetical situations: product modification, product line extension, and the introduction of a me-too brand. In all of those situations, substantially different market shares are predicted by the three models, which illustrates the extent to which erroneous predictions may be obtained from the misspecified iRC and IP models.

(*Conjoint Choice Experiments; Multinomial Probit; Random Taste Variation; Random Utility*)