Profile Construction in Experimental Choice Designs for Mixed Logit Models

Zsolt Sándor • Michel Wedel
Econometric Institute, Erasmus University Rotterdam, P.O. Box 1738, 3000 DR Rotterdam, The Netherlands
Department of Marketing and Marketing Research, University of Groningen, P.O. Box 800, 9700 AV Groningen, The Netherlands, and the University of Michigan Business School, 701 Tappan Street, Ann Arbor, Michigan 48109
sandor@few.eur.nl • wedel@umich.edu

Abstract
A computationally attractive model for the analysis of conjoint choice experiments is the mixed multinomial logit model, a multinomial logit model in which it is assumed that the coefficients follow a (normal) distribution across subjects. This model offers the advantage over the standard multinomial logit model of accommodating heterogeneity in the coefficients of the choice model across subjects, a topic that has received considerable interest recently in the marketing literature. With the advent of such powerful models, the conjoint choice design deserves increased attention as well. Unfortunately, if one wants to apply the mixed logit model to the analysis of conjoint choice experiments, the problem arises that nothing is known about the efficiency of designs based on the standard logit for parameters of the mixed logit. The development of designs that are optimal for mixed logit models or other random effects models has not been previously addressed and is the topic of this paper.

The development of efficient designs requires the evaluation of the information matrix of the mixed multinomial logit model. We derive an expression for the information matrix for that purpose. The information matrix of the mixed logit model does not have closed form, since it involves integration over the distribution of the random coefficients. In evaluating it we approximate the integrals through repeated samples from the multivariate normal distribution of the coefficients. Since the information matrix is not a scalar we use the determinant scaled by its dimension as a measure of design efficiency. This enables us to apply heuristic search algorithms to explore the design space for highly efficient designs. We build on previously published heuristics based on relabeling, swapping, and cycling of the attribute levels in the design.

Designs with a base alternative are commonly used and considered to be important in conjoint choice analysis, since they provide a way to compare the utilities of profiles in different choice sets. A base alternative is a product profile that is included in all choice sets of a design. There are several types of base alternatives, examples being a so-called outside alternative or an alternative constructed from the attribute levels in the design itself. We extend our design construction procedures for mixed logit models to include designs with a base alternative and investigate and compare four design classes: designs with two alternatives, with two alternatives plus a base alternative, and designs with three and with four alternatives.

Our study provides compelling evidence that each of these mixed logit designs provide more efficient parameter estimates for the mixed logit model than their standard logit counterparts and yield higher predictive validity. As compared to designs with two alternatives, designs that include a base alternative are more robust to deviations from the parameter values assumed in the designs, while that robustness is even higher for designs with three and four alternatives, even if those have 33% and 50% less choice sets, respectively. Those designs yield higher efficiency and better predictive validity at lower burden to the respondent. It is noteworthy that our “best” choice designs, the 3- and 4-alternative designs, resulted not only in a substantial improvement in efficiency over the standard logit design but also in an expected predictive validity that is over 50% higher in most cases, a number that pales the increases in predictive validity achieved by refined model specifications.

(Conjoint Choice; Design Efficiency; Heterogeneity; Base-Alternative)