**An R package and web application to generate and conduct efficient Individually Adapted Sequential Bayesian discrete choice experiments to estimate the panel mixed logit model.**

**The mixed logit choice model (MMNL) has acquired a prominent place in the toolbox of most researchers interested in studying choice data. The MMNL extends the Multinomial Logit model (MNL) in the sense that it allows for heterogeneity in individual preference parameters. Along with this additional flexibility, the data collected in order to estimate such a model must also be of greater quality.**

**Given the limited amount of choice sets one can present to a participant, it is thus of great importance to include those choice sets that maximize the information gained from a stated preference survey. Besides orthogonal designs, a substantial amount of work focused on the generation of efficient designs. The latter are designed in such a way that they aim to reduce the standard error associated with the estimated parameters.**

**For the panel mixed logit model few methods exist to generate efficient designs. Most of the attempts aimed at optimizing the discrete choice design for the average respondent (aggregate customization). In the presence of consumer heterogeneity however such a method has the disadvantage that it is inefficient for respondents with part-worths located far from the population mean.**

**The generation of these aggregate customization designs is very complicated for local optimal designs and almost infeasible from a computational point of view when taking the uncertainty about the priors into account** (Bliemer & Rose, 2010)**.**

**A way to overcome these problems is to generate individually optimized designs. In this approach each respondent is presented with a different design.** Sándor & Wedel (2005) **demonstrated the advantage of presenting different designs to different respondents by randomly assigning optimal designs to them (for the cross-sectional mixed logit model).**

Yu, Goos, & Vandebroek (2011) **used a Bayesian approach in which a prior distribution, representing the parameter uncertainty, is updated for each participant individually as soon as a choice from that participant was observed. Using the updated prior, the next efficient choice set was generated while minimizing the DB-error. The latter method is referred to as individually adapted sequential Bayesian designs (IASB).**

**Afterwards** Crabbe, Akinc, & Vandebroek (2014) **extended the IASB method by introducing the Kullback-Leibler criterion, a modification which increased computation speed substantially. Both papers showed with simulation studies that there was a significant reduction in the standard errors of the population and individual estimated parameters using the IASB method in comparison to aggregate customization designs.**

**Because the advantage of the IASB approach can only be fully explored by making the method useful in practice, an R package along with a web application to generate and present the IASB surveys was developed.**

**The R package incorporates the methods described in** Yu et al. (2011) **and** Crabbe et al. (2014)**. To evaluate the efficiency of a proposed choice set the DB-error or Kullback-Leibler criterion is computed by averaging over a large number of draws from the posterior distribution. The samples are drawn using an importance sampling algorithm with extensible shifted lattice points. The package also includes all necessary functions to interact with the web application (e.g. transformation of the coded design matrix to meaningful attribute levels). Furthermore the modified Federov algorithm is also incorporated to generate (initial) aggregate designs if desired.**

**R shiny is a free web application framework for R. An R shiny script is provided which works hand in hand with the R package. The web application enables the researcher to present the generated choice sets to respondents in a web environment. The advantage is that the web application continuously interacts with R and thus makes it possible to gather data using the IASB approach. Software packages for conducting online discrete choice experiments exist, and some of them are able to adapt the survey to individual characteristics that are queried in advance. However, none of them enables the researcher to use the choices in a fully interactive way in order to generate and present choice sets that are completely tailor made for each participant.**

**In our opinion the application can be especially useful for academic researchers. With a minimum knowledge of R one can easily adjust the specifications to one’s needs. Of course each attribute as well as its levels can be modified, as well as the type of coding used for the design matrix. The default assumed decision model for each respondent is the Multinomial logit model which can be easily changed to for instance a random regret model by changing the likelihood function.**

**The tool provides a way to easily access possible respondents (by sending a weblink) and to store the collected empirical data locally or remotely (e.g. Dropbox). Afterwards, popular R packages such as bayesm or mlogit can be used to estimate the panel mixed logit model based on the data.**

**To summarize, the package and accompanying R shiny script makes it possible to create and conduct IASB choice surveys (or aggregated customized ones), and to analyze the data in the same free R environment.**

***References:***

Bliemer, M. C. J., & Rose, J. M. (2010). Construction of experimental designs for mixed logit models allowing for correlation across choice observations. *Transportation Research Part B: Methodological*, *44*(6), 720–734.

Crabbe, M., Akinc, D., & Vandebroek, M. (2014). Fast algorithms to generate individualized designs for the mixed logit choice model. *Transportation Research Part B: Methodological*, *60*, 1–15.

Sándor, Z., & Wedel, M. (2005). Heterogeneous Conjoint Choice Designs. *Journal of Marketing Research (JMR)*, *42*(2), 210–218.

Yu, J., Goos, P., & Vandebroek, M. (2011). Individually adapted sequential Bayesian conjoint-choice designs in the presence of consumer heterogeneity. *International Journal of Research in Marketing*, *28*(4), 378–388.