Project title: How to measure choice behaviour? A comparative study of choice designs with applications in health economics

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Proposal: Standard discrete choice experiments (DCEs) are built around choice models that assume rational, utility-maximizing behaviour. The most popular of these choice models are McFadden's (1974) conditional logit model, awarded with the Nobel Prize in 2000, and the mixed logit model. Subsequent Nobel prize winning theories from behavioural economics (Kahneman, 2002; Thaler 2017) questioned this utility theory of so-called "optimal behaviour" because various anomalies resulting from individually irrational behaviour could be observed in reality.

The research by Kessels is widely known for the creation of partial profile designs for DCEs for the estimation of *compensatory choice models* in which people are assumed to make trade-offs between all attribute levels to maximize utility. Partial profile designs include a series of choice tasks that are characterized by overlapping attribute levels to make the choice tasks cognitively manageable for the respondents. The varying attributes distinguish the choice alternatives from each other. In the event of simple decision tasks, random utility theory is a good approximation of the decision process.

Here is an example of a partial profile task of 4 hypothetical medications or drugs where respondents have to choose the profile they prefer given that only 3 out of 5 attributes, indicated in yellow, are varying between the profiles. The other 2 attributes have overlapping levels:

Drug 1	**Drug 2**	**Drug 3**	**Drug 4**
Gel	Cream	Oil	Lotion / solution
Storage in refrigerator	Storage in refrigerator	Storage in refrigerator	Storage in refrigerator
Fresh for 5 weeks once opened	Fresh for 18 months once opened	Fresh for 3 months once opened	Fresh for 9 months once opened
Using roller ball	Using fingers	Using pad	Using tube
Once daily regimen	Once daily regimen	Once daily regimen	Once daily regimen
O	**O**	**O**	**O**

In contrast to considering all profiles in a choice task, respondents can also use non-compensatory heuristics by screening a choice set and ignoring certain profiles based on their attribute levels. Current research has shown that proper designs for *non-compensatory choice models* such as screening-rule based choice models are described by much level overlap.

The question therefore raises to what extent partial profile designs for compensatory choice models can be employed for the estimation of non-compensatory screening models, or even more, in which situations partial profile designs are equivalent to non-compensatory designs.

The objective of this proposal is threefold:

1. To compare compensatory partial profile design strategies with non-compensatory design strategies for the estimation of non-compensatory screening models underlying DCEs;
2. To develop new non-compensatory design methods, and even more, to come up with a universal design method that is robust to the decision process, whether it is compensatory or non-compensatory;
3. To apply and test these new (non-)compensatory or robust design methods to real-life DCEs in health in collaboration with the Faculty of Health, Medicine and Life Sciences (FHML – Dr. Mickael Hiligsmann).

Keywords: Programming and simulation, Algorithms, Optimization, Discrete choice experiment, Partial profile design, Choice modelling, Irrational choice behaviour

Requirements candidate: **Background in computational statistics and statistical programming (absolute must!)**, Proficient in English, Feel for economics and business

Top 5 selected publications by the supervisory team:

Hoogeveen H, Tomczyk J, van der Zanden TC (2016), "Flower power: Finding optimal flower cutting strategies through a combination of optimization and data mining", *Proceedings of the 114th European Study Group Mathematics with Industry*, 3-11.

Kessels R, Jones B, Goos P (2011), "Bayesian optimal designs for discrete choice experiments with partial profiles", *Journal of Choice Modelling*, *4*(3), 52-74. https://doi.org/10.1016/S1755-5345(13)70042-3

Kessels R, Jones B, Goos P (2015), "An improved two-stage variance balance approach for constructing partial profile designs for discrete choice experiments", *Applied Stochastic Models in Business and Industry*, *31*(5), 626-648. https://doi.org/10.1002/asmb.2065

Palhazi Cuervo D, Kessels R, Goos P, Sörensen K (2016), "An integrated algorithm for the optimal design of stated choice experiments with partial profiles", *Transportation Research Part B: Methodological*, *93*A, 648-669. http://dx.doi.org/10.1016/j.trb.2016.08.010

van der Zanden TC, Bodlaender HL, Hamers HJM (2023), "Efficiently computing the Shapley value of connectivity games in low-treewidth graphs", *Operational Research*, *23*(1), Article nr. 6. https://doi.org/10.1007/s12351-023-00742-4

Approved by the academic department, Dr. Burak Can