Linking decision rules to underlying constructs in a latent variable latent class approach

Stephane Hess*   Amanda Stathopoulos†

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Abstract

Motivation The relevance of so-called 'behaviourally anomalous' decision rules, that is, instances that do not follow the axioms of utility maximisation, has been widely established through experiments. Current focus in the research community is shifting towards the development of appropriate models to understand violations of decision making axioms. In the discrete choice community probabilistic random utility models are the state of the art to infer respondent decision paradigm heterogeneity. The intention is to enable clustering of respondents according to the decision rules used (Adamowicz and Swait, 2013; Hess et al., 2012). In this paper we propose to enrich such paradigms with stated behaviour data motivated by the ability to *explain* the use of decision rules in addition to classifying respondent behaviour. The approach is illustrated with an empirical application. We focus on a latent class framework of regret minimisation and utility maximisation where decision segment allocation is driven by a measurement model with indicators constructed to define disappointment (the gap between currently experienced and declared ideal travel attribute performance).

Explaining the reliance on different decision paradigms Early explorations of latent variable models (e.g. Ben-Akiva et al., 1999) discuss the impact of latent constructs in influencing decision processes. Similarly, the seminal paper by Swait (2001) on non-compensatory preference cutoffs promotes the use of behavioural indicators to improve the identification of these cutoffs as an important future area of research. These insight are echoed also for the specific context of regret minimisation modelling in Chorus and Bierlaire (2012) who underscore the need to explore to what extent circumstances or personality can trigger the decision process under study (in their case linking decision processes to the preference for compromise alternatives).

Despite these propositions there has been no systematic development of models using behavioural constructs to elucidate the motivations for the use of decision processing.

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*Institute for Transport Studies, University of Leeds, Leeds LS2 9JT, s.hess@its.leeds.ac.uk, Tel: +44 (0)113 34 36611, Fax: +44 (0)113 343 5334

†Transport and Mobility Laboratory, École polytechnique fédérale de Lausanne, GC B3 425, Station 18, 1015 Lausanne, Switzerland, amanda.stathopoulos@epfl.ch, Tel: +41 (0)21 6932435

Empirical application The model is tested on data from an online survey with rail and bus commuters collecting 3,680 observations. The survey gathered information on experienced trip features (averaged across 10 typical trips corresponding to a week of commuting). This data was used to generate a choice experiment with a reference scenario, kept invariant across 10 tasks, complemented by two designed alternatives. Six attributes were used to characterise the commute: travel time in minutes, fare in £, rate of crowded trips, rate of delays, average length of delays and the provision of a delay information service with different pricing. The survey was designed using the D-efficiency criteria alongside appropriate conditions to avoid dominant alternatives (ChoiceMetrics, 2012). Socio-demographic information and several other attitudinal data were gathered following the choice experiment to avoid fatigue. Relevant to the analysis of regret avoidance we focus on declared data concerning acceptable and ideal conditions for each attribute. The underlying hypothesis is that a declared shortfall from ideal reference values is related to feelings of regret. The approach used in this paper is to test whether the size of the gap between ideal or acceptable versus current values is related to the predisposition to use a regret minimising decision rule. The main point here is that the stated disparities are used to construct measurable indicators of underlying discontent or regret feelings. However, the suspected inaccuracy of such stated indicators prompt us to employ measurement equations to pin down the latent construct.

Model A general finding in applied regret minimisation work is the presence of the compromise effect (e.g. Chorus and Bierlaire, 2012). That is, a decision maker seems to favour familiar or compromise options with an average performance across attributes. This, in practice, leads to favouring the status quo option (Kahneman et al., 1991) which is used in the current experiment to anchor the choice representation. A general problem however in the vast literature exploring status quo bias is the lack of consideration of choice motivation, in particular goals and norms used to guide decisions (Chernev, 2004). Regret can be said to relate to prevention-based decision making where individuals are concerned with avoiding unsatisfactory outcomes (Crowe and Higgins, 1997). This is in contrast with promotion-based decisions where choices are driven by the desire to approach a desired end-state. In line with these insights we use data on aspirations to explain regret minimisation efforts. We postulate that the further a respondent is from their aspirational commute outcome the more likely it is that they will resort to a regret minimisation strategy.

In particular, the modelling framework stochastically assigns probabilities of belonging to behavioural classes in a finite mixture framework, allowing for the identification of both compensatory (max utility) and non-compensatory (min regret) behavioural sub-groups. The choice probability is determined by the decision rule used by each respondent. Assignment to a latent decision segment is thus done on the basis of fit of the behavioural indicators with regard to the particular decision rule studied rather than imposing the assignment based exclusively either on declared or on revealed behaviour in line with the standard practice.

Results The results indicate that a connection can be made between the selected behavioural indicators and decision rules. In particular, we observe that travellers

declaring a larger shortfall from their ideal fare and travel time have a higher value for the latent regret variable. This means that they are more likely to be assigned to the regret class. The indicator coefficients have a positive impact on the latent regret, generally with a larger coefficient related to the gap from maximum acceptable levels of the trip variable (e.g. fare, time, etc). This is reasonable considering that the acceptable threshold is connected to a mediated ideal, where any shortcoming is likely to be more unpleasant than those relating to an ideal value.

Expected gains & Outlook This work points towards a more subtle characterisation of the motivation for the use of different decision rules benefitting from the advantages of both declared and revealed data. The fundamental issue of explaining why a specific decision process prevails is essential to derive meaningful conclusions from these model exercises. Without being able to anchor the decision rule to behavioural motivations we are unable to know whether it expresses real preferences or is a coping strategy. Similarly we will struggle to trace the implications in real world terms if we are unable to define who uses a process and why.

Many open issues remain. On the side of model estimation and econometrics these models are challenging and require fundamental work to improve and test the specification of the structural and measurement equations linked to a latent class model that identifies decision rules. On the behavioural plane we intend to continue exploring the following interrogatives: Are aspirations driven by experience or vice versa? Which other indicators are useful to aid allocation to decision rule classes (e.g. personality, life-situation, constrains, past habits)? In most cases appropriate data is not available to carry out detailed analysis in this direction so a desirable continuation of this effort is the design of appropriate data-collection tools, ideally in a more realistic setting than current stated choice studies.

Keywords: decision rules, random regret minimisation, latent class, latent variable

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