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Stated choices and benefit estimates in the context of traffic calming schemes: Utility maximization, regret minimization, or both?

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ABSTRACT

This paper proposes a discrete mixture model which assigns individuals, up to a probability, to either a class of random utility (RU) maximizers or a class of random regret (RR) minimizers, on the basis of their sequence of observed choices. Our proposed model advances the state of the art of RU–RR mixture models by (i) adding and simultaneously estimating a membership model which predicts the probability of belonging to a RU or RR class; (ii) adding a layer of random taste heterogeneity within each behavioural class; and (iii) deriving a welfare measure associated with the RU–RR mixture model and consistent with referendum-voting, which is the adequate mechanism of provision for such local public goods. The context of our empirical application is a stated choice experiment concerning traffic calming schemes. We find that the random parameter RU–RR mixture model not only outperforms its fixed coefficient counterpart in terms of fit—as expected—but also in terms of plausibility of membership determinants of behavioural class. In line with psychological theories of regret, we find that, compared to respondents who are familiar with the choice context (i.e. the traffic calming scheme), unfamiliar respondents are more likely to be regret minimizers than utility maximizers.

1. Introduction

As the common place saying goes, a glass holding some wine can be perceived—depending on the perspective of the onlooker—either as partly 'empty' or as partly 'full'. The potential consequences of these subjective and different views of reality may well extend to choice behaviour. Such consequences, however, tend to be systematically under-investigated. Especially so in empirical studies based on discrete choice models where the well-established paradigm of random utility (RU) maximization dominates. This paper moves from the premises that both the above views can be argued to underlie the rationale for deliberative choice. As a practical consequence, they both should be systematically accommodated in empirical analysis of choice outcomes.

A decision-maker who is inclined to see the glass partly 'empty' might be more inclined to focus on regret minimization, rather than focussing on utility maximization. Therefore, when a series of alternatives are evaluated by a subject with such a behavioural inclination, some evidence of this regret minimizing behaviour should be detectable in the sequence of observed

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choices. Regret minimization leads to a systematically different pattern of choices from those made by subjects who strictly comply with the received view of utility maximization in their choice behaviour.

Beyond pessimism, there may be many other reasons that may induce decision makers to engage in regret minimization, including having achieved an already satisfactory level of utility as provided by the status quo after a long and costly search. This would be a 'satisficing' approach that might be attractive to those who wish to avoid the risk of change or the search cost involved in a new choice. So, extreme risk aversion or perception of unusually high information search cost can also motivate random regret (RR). Further examples include those who feel their choices will be judged by others with potentially different values. Or those who feel that vulnerable dependents, such as young children or elderly, might suffer as a consequence of their decision-making (Zeelenberg and Pieters, 2007). All such subjects may be more inclined to choose trying to minimize expected regret, rather than to seek utility maximization.

Regardless of the motivating factors, the availability of empirically tractable models of RR choice behaviour is desirable to practitioners. Recent work by Chorus (2010) provide analysts with exactly such a category of choice models, conveniently framed around the popular logit specification for the computation of choice probabilities. Given the availability of empirically tractable minimum regret models of discrete choice, in this paper we investigate the implications of simultaneously modelling two mutually exclusive rationales for choice behaviour: (i) the standard RU maximization and (ii) the much more seldom employed RR minimization. That is, we hypothesize that while the sequence of choices made by some decision-makers are more likely to result from regret minimization behaviour, those made by others are instead more likely to result from utility maximization behaviour.

Such heterogeneity in choice behaviour is modelled by assuming the existence of two behaviourally different latent classes, one including regret minimizers and the other utility maximizers. This gives rise to a probabilistic decision process similar in form to the conventional panel latent class (LC) models for discrete preference heterogeneity. In our model, instead classes describe specific decision paradigms or heuristics. Analogous approaches based on behaviourally separate Latent classes have been used by others (Scarpa et al., 2009; Hensher and Greene, 2010; Hess et al., 2012; Campbell et al., 2012) and are collectively called probabilistic decision processes (PDPs).

By doing so our study moves away from the conventional, and behaviourally quite restrictive, assumption that only one of the two paradigms (utility or regret) would be the best representation for all choices observed in the sample (e.g., Chorus et al., 2011; Hensher et al., 2013; Chorus, 2012; Thiene et al., 2012; Boeri et al., 2012a,b; Chorus and Bierlaire, 2013; Kaplan and Prato, 2012). Furthermore, we make three novel contributions compared to a recent similar study by Hess et al. (2012), which is the only other study we know of that accommodates regret minimization and utility maximization by means of latent classes.[1] First, we empirically study the determinants for both choice behaviours by means of a membership function explaining membership probability to both choice behaviours. Second, we overlay a characterization of random preference heterogeneity to each specific choice behaviour. By doing so we achieve the desirable outcome of simultaneously accounting for both taste and choice behaviour heterogeneity in one single model that combines a discrete mixing process (across regret and utility classes) and a continuous mixing process (across coefficient values within each behavioural class). Third, we evaluate the user benefits or welfare effects associated with selected public programs (in particular: traffic calming schemes) under the proposed model. More specifically, we suggest an estimation of the monetary value predicted to obtain a 50% support of a proposed traffic calming scheme.

For the purpose of illustration of this method we explore choice data from a classic experiment on traffic calming schemes conducted in the year 2000. See Barbosa et al. (2000) for a relevant previous study on traffic calming which was published in this journal; while that paper focuses on the impact of traffic calming on speed profiles, our study concerns preferences for different alternative specifications of such schemes. We note that the data used here were not previously used except for the technical report to the funding agency, while results from its twin study based on other Northern England locations was published in 2002 (Garrod et al., 2002). The population under study were those that at the time resided in Sherburn in Elmet, a rural town in Northern England which is crossed by trunk road traffic. Residents of these types of rural towns typically suffer the negative consequences from through traffic and enjoy little of the benefits since most vehicles tend not to stop in town. Long-haul freight transport on wheels across England and Scotland often induces heavy vehicle traffic along these trunk roads and as a consequence they exacerbate the production of negative local externality. Specifically the experiment concerned separate features of a traffic calming project designed to reduce the negative consequences for residents of the traffic through the town, such as excessive speed, community severance and noise.

Importantly, we wish to state up front that our aim is not to compare the RR and RU paradigm. Many recent papers have provided such comparisons, and the over-all result is becoming increasingly clear. Chorus et al. (working paper) present a critical overview of more than forty empirical comparisons between RR and RU: differences in model fit between the RR and RU model are generally small but statistically significant at conventional sample sizes, the RR model outperforming linear-additive RU formulations in about 50% of cases. Also differences in predictions for out of sample performance are found to be small. Interestingly, though, differences in terms of elasticities and in terms of choice probabilities for individual choice situations can be quite large. As a consequence, the two model types can lead to markedly different policy implications Chorus et al. (working paper). This paper does not aim to provide yet another comparison of the two model types. Rather,

[1] Note that the conventional approach to applying latent class models in transportation is to assume that classes differ in terms of preference intensities, in the form of estimable parameters which differ between preference classes (e.g. Olaru et al., 2011; Beck et al., 2013; Vij et al., 2013).