Dual random utility maximisation

Paola Manzini [a,b,1], Marco Mariotti [c,*,2]

[a] *University of Sussex, United Kingdom*
[b] *IZA, Germany*
[c] *Queen Mary University of London, United Kingdom*

Abstract

Many prominent regularities of stochastic choice, such as the attraction, similarity and compromise effects, are incompatible with Random Utility Maximisation (RUM) as they violate Monotonicity. We argue that these regularities can be conveniently represented by a variation of RUM in which utility depends on only two states and state probabilities are allowed to depend on the menu. We call this model Dual Random Utility Maximisation (dRUM). dRUM is a parsimonious model that admits violations of Monotonicity. We characterise dRUM in terms of three transparent expansion/contraction conditions. We also characterise the important special case in which state probabilities are constant across menus.
© 2018 Elsevier Inc. All rights reserved.

---

1. Introduction

In Random Utility Maximisation (RUM) choices are determined by the maximisation of a utility that depends on stochastic states. RUM satisfies the property of Monotonicity (the addition of a new alternative cannot increase the probabilities of choice of the existing alternatives). As a consequence, in spite of its popularity both in theory and applications, this model suffers from the weakness that it cannot handle a host of prominent regularities related to violations of Monotonicity.

With a view to expanding the explanatory power of the theory in a tractable way, in this paper we modify RUM in two ways. First, we allow state probabilities to depend on the menu. This move immediately makes the model consistent with the regularities. However, completely unrestricted RUM with menu dependent states is a very permissive model. Our second assumption, which substantially disciplines the theory while maintaining the crucial relaxation of Monotonicity, is that the number of states is exactly two. This particular restriction is motivated – as we detail below – by the 'binariness' intrinsic both in the regularities and in several other cognitive mechanisms or population assumptions that have been examined in the literature. We call this model dual RUM (or dRUM in short).

Our main contribution is a characterisation of the behaviour of a dual random utility maximiser with a small set of conditions. These conditions are transparent restrictions on behaviour, and they are structurally similar to standard expansion/contraction axioms in revealed preference theory – a form of characterisation that at present the RUM model lacks. As an intermediate step, we also characterise the special case of a menu-independent dual random utility maximiser. We argue that, while limited as a model of individual decision making due to the reasons just explained, this special case of RUM may be of independent interest for certain types of population data.

Several types of behaviour that have been perceived as 'anomalies' for the utility maximisation model are binary in nature. For example, the 'similarity' and 'attraction' effects have received much attention in the psychology and behavioural economics literature. These effects display a dual form of behaviour, with the switch from one to the other being triggered by the presence or absence of a 'decoy'. We can model such effects naturally as dual RUM. Analogous considerations apply for the 'compromise effect', according to which the frequency of choice of an alternative jumps upwards when its position switches from extreme to intermediate in the space of characteristics. We discuss these anomalies further in section 4.

While it perhaps involves a different cognitive mechanism, a formally similar dual structure features in the well-rehearsed 'frog legs' thought experiment (Luce and Raiffa's, 1957). Here the logic is that the presence of a specific item a^* (frog legs in the example) in a menu triggers the maximisation of a different preference order because a^* conveys information on the nature of the available alternatives. Dual RUM generalises this idea to a probabilistic context, avoiding the extreme assumption that one item is chosen for sure depending on the availability of a^*.

An attractive aspect of dual RUM is that it captures many other scenarios of interest. Here are a few examples:

- *Dual-self processes.* The decision maker may be either in a 'cool' state, in which a long-run utility is maximised, or in a 'hot' state, in which a myopic self, subject to short-run impulses (such as temptation), takes control. Indeed, the menu-independent version of dRUM appears in the contracting model by Eliaz and Spiegler (2006), and the menu-dependent version describes the implicit second-stage choices of the dual-self model characterised by