Modeling Choice Reversal Due to the Decoy Effect[1]

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Abstract

Empirical evidence suggests that, under some circumstances, the introduction of a new alternative in a choice set can increase the probability of choice of other alternatives. This is known as the decoy effect. The standard models of choice, mainly those based on the Random Utility Maximization (RUM) (Marschak, 1960; Manski, 1977) cannot account for this effect, since they are based on a regularity condition, which allows them only to decrease or maintain the choosing probability with the introduction of a new alternative.

The decoy effect and the behavioral mechanisms behind it were first studied by Huber et al. (1982), who named it as the Asymmetrically Dominated (AD) decoy effect. In this case, the newly added alternative, or "decoy", was inferior in every attribute if compared to the "dominant" alternative, and superior in some, but inferior on other attributes, if compared with the "non-dominant" alternative. This gave as a result an increase in the choosing probability of the dominating alternative. The effect was further replicated and studied across a vast variety of areas and contexts, from animal behavior (Shafir et al, 2002), to human behavior in real life purchase decisions (Doyle et al. 1999), but not so far in transportation. The great body of evidence suggesting the prevalence of the decoy effect in many areas, and the lack of probabilistic prediction models to account for it, motivates the need for formal models to explain and predict this behavior.

In this research we first created new probabilistic choice models rooted in psychological theory that had been suggested as possible explanations for the decoy effect. First we investigated theories based in the work of Wedell (1991) who proposed, as possible decoy effect explanation, three context dependent changes in the utility function of the evaluated alternatives. The first model proposes that the decoy effect could be explained by changes in the weights or preferences that each person gives to alternatives attributes. The second model explained the effect by contextual induced changes of the valuation of the attributes, based on the Range-Frequency theory of Parducci (1975). The third model was based on the work of Simonson (1989) who used the easiness to justify the chosen alternative as a value added to increase the utility of choosing the alternative. Other proposed theory was based in the work of Schley (2005) in which the decoy effect was explained by the Regret theory concept in which persons evaluate the convenience of choosing an alternative based on the regret of choosing the wrong alternative. This theory is based on the works of Bell (1982), Fishburn (1982), Loomes and Sugden (1982). For this final case, we did not need to adapt the regret approach from behavioral psychology into a probabilistic choice model, because that was already done by Chorus (2010), in what was termed the Random Regret Minimization (RRM) model.

In a second step we proposed a formal definition of the decoy effect in the form of a statistic

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that can be used as test to detect this behavior in probabilistic choice models. Then, we analyzed and tested each of the four probabilistic choice models created, together with the classic choice models based in the RUM approach: the Multinomial Logit (Ben Akiva, 1974; McFadden, 1974) and the Nested Logit (Williams, 1977). We found that, among the models analyzed, at least the RRM can account for the decoy effect, but not the Logit, neither the Nested Logit.

We are developing (ongoing research) a stated preference survey of transport choices, with two objectives in mind. To detect the presence of the decoy effect on a travel alternative choice scenario, and to assess the different probabilistic choice models studied with real data. For this survey we will interview a set of undergraduate students giving them two scenarios of transport mode choice. First, a base scenario without the decoy alternative present in the choice set, and then a scenario where the decoy alternative is added to the choice set.

The main contribution of this research is in the provision of probabilistic choice model and a test, which can be used as an analysis tool to detect and to simulate the decoy effect. In transportation, this tool can be used, for example, to determine the optimal decoy or to avoid decoy effect in the design of public policy.

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