The Journal of Choice Modelling 11 (2014) 57–68

Contents lists available at ScienceDirect

The Journal of Choice Modelling

journal homepage: www.elsevier.com/locate/jocm

Influence of rudimentary attribute non-attendance (ANA) on choice experiment parameter estimates and design efficiency: A Monte Carlo Simulation analysis

Alex Kravchenko

Waikato University, Department of Economics, Hamilton, New Zealand

ARTICLE INFO

Article history:
Received 13 August 2013
Received in revised form
10 February 2014
Accepted 17 February 2014
Available online 21 June 2014

Keywords:
Attribute non-attendance
Choice modeling
Monte-Carlo simulation

ABSTRACT

The issue of attribute non-attendance (ANA) has been gaining increasing attention in the field of choice modeling. While the modeling issues, effects on parameter estimation, and, to a lesser degree, causes of ANA have been the main concern of research in this area, to date few studies have produced generalizable results about the effects of ANA on parameter estimates and little attention has been paid to the efficiency of experimental design in the face of ANA. This paper looks at these issues and also introduces a distinction between random and systematic ANA, which is defined to be ANA that is persistent in the face of choice task and/or attribute order randomization. As part of this study, Monte Carlo simulations are run to examine the effects of ANA on parameter estimation, under the conditions of random and systematic ANA. Simulations with respondent heterogeneity are also carried out to test the efficiency of latent class model estimations. The models perform well, but it is argued that the underlying assumption of serial ANA is indistinguishable from zero preferences with respondent heterogeneity, and such ANA is inconsequential to the choice made (i.e. the same choice is made whether or not the attribute is being attended to). In contrast, when a non-zero preference attribute is ignored, the latent model does not pick up the effects of ANA and additional data is required. Not incorporating ANA data significantly biases estimates of all parameters, especially when the marginal effects of the ignored attribute are relatively large. Finally, it is shown that orthogonal design is significantly disturbed by systematic ANA, and there is scope to improve it by using a D-efficient design.

1. Introduction

The study of the effects of heuristics in choice modeling has been gaining increasing attention in the choice modeling literature. The role of attribute non-attendance (ANA), a heuristic which seeks to decrease cognitive burden by ignoring certain attribute levels in choice tasks or whole experiments, has been particularly prominent. Most literature, however, concentrates on the modeling issues of ANA, examining its effect only on parameter estimation in specific case studies, without resorting to making generalized statements about the role of ANA other than that not accounting for it may (or may not) substantially alter willingness-to-pay (WTP) estimates. This study seeks to examine the effects of ANA with regard to parameter estimation and design through the use of Monte-Carlo simulations. A parsimonious main-effects only binary

E-mail address: alexk@waikato.ac.nz

http://dx.doi.org/10.1016/j.jocm.2014.02.002
1755-5345/

choice model with binary attributes is used, with various ANA specifications included for one of its parameters. The findings effectively conclude that not accounting for ANA, particularly if the true models parameters are relatively large, may substantially bias all parameters in the estimated model. In terms of design efficiency, random ANA, while disturbing choice-task level design efficiency, maintains high design efficiency across pooled responses. However, if ANA is systematic, due to perhaps the effect of other variables or the order of choice tasks, resultant correlations disturb the pooled design efficiency as well. D-efficient design is shown to significantly outperform fractional factorial orthogonal main-effects design. The structure of this paper is as follows. First, the ANA literature will be reviewed, followed by a brief overview of design efficiency concepts. Next, each simulation scenario and its motivation will be explained in detail. Finally, the main results are discussed, followed by concluding remarks. It must be noted, however, that these results are limited in their scope as they were simulated and hence do not allow for any demand-induced design artifacts that would be present should real people be faced with choice tasks. Further study is needed with regard to analysis of the issues described in the real world, particularly with respect to the cognitive processes responsible for ANA, their differences and ultimately how these different types of ANA impact on parameter estimation and design.

2. ANA and heuristics background

The use of what are argued to be less than ideal strategies in decision making has long been recognized in the decision-making literature. Deviation from ideal, or non-fully compensatory processes can, however, "lead to elimination of potentially good alternatives early in the decision process" (Payne et al., 1993, p. 5). The authors argue that there is a trade-off between effort and the accuracy of a decision—more information gathering for more accurate decisions requires more effort. Humans' limited cognitive capacity for storing information in short-term memory has been famously recognized by Miller (1956), who showed that on average only 7 "chunks" of information can be stored in the cognitive brain to help with judgments; whereas typical choice modeling applications involve significantly more than 7 attribute levels per choice task. Shah and Oppenheimer (2008) follow the work of Payne et al. (1993) and introduce an effort reduction framework which summarizes recent research in the field of heuristics—strategies to, broadly speaking, decrease the cognitive burden during decision making "...the weighted additive rule and other optimal strategies place five demands on people: to consider all available cues; to retrieve cue values accurately; to weight cues properly; to integrate information for each alternative, and to examine all alternatives. We therefore believe that people confront limited cognitive resources by addressing these five demands. They can reduce the effort associated with any of these five demands individually or collectively" (p. 219).

Perhaps it is the role of unconscious thought that has been underestimated in models that attempt to only tap into the processing power of the prefrontal cortex. Unconscious thought is distinguished from conscious thought through the role of attention (Dijksterhuis and Nordgren, 2006). Conscious thinkers recall less information overall than unconscious thinkers and the majority of conscious thinkers indicate that they base their decisions on only one or two attributes (hence 7 "chunks" may only be recalled consciously, whereas all or nearly all information can be unconsciously used to make near-optimum decisions). In his earlier work, Dijksterhuis et al. (2004) demonstrated experimentally that people make better decisions when they are induced to do so using subconscious processes.

At the same time, Gigerenzer and Brighton (2009) argue strongly against the common accuracy-effort trade-off paradigm, and suggest that heuristics that incorporate less information, computation and time can actually improve decision accuracy. In fact, they view heuristics as a superior alternative to a fully additive view of decision making, a "less-is-more" view. The crux of the argument is that precisely because of people's limited cognitive resources, forcing respondents to consciously consider more information leads to lower precision in decision making than when using simplifying heuristics.

Seeking to find the underlying reasons behind ANA in stated choice experiments, Alemu et al. (2012) added debriefing questions in their stated choice study. Their conclusion is that although ANA is in most cases a manifestation of zero preferences, combining a simplifying heuristic also plays a part. In addition, the authors find that eliciting the reasons behind ANA may improve parameter estimation.

Yet, as Hensher (2009) states, nearly all practitioners of choice modeling still opt for the conventional full compensatory approach where all attributes are fully considered in the model. Willemsen and Johnson (2010) also note that "decision making research has largely progressed through the use of models that account solely for observed choices without extensive consideration of underlying cognitive structures and processes".

While there are many classifications of heuristics in decision-making research (e.g., Shah and Oppenheimer, 2008), the most common one examined (at least in the context of environmental economics) is that of attribute non-attendance (ANA)—when the respondents ignore one or more attribute levels over the whole experiment (serial ANA) or at a choice task level. Under Shah and Oppenheimer's classification ANA can be a symptom of 'examining fewer clues' and 'integrating less information'.

Choice modeling studies that do consider heuristics (ANA in particular) generally find that it has significant impact on the WTP and parameter estimates. Hensher (2009) concludes that "failure to accommodate process heterogeneity is a significant contributing influence [of a large hypothetical bias]" p. 27. Hensher and Greene (2010) and Hensher and Rose (2009) find the WTP is significantly higher than full relevance and attribute preservation specification. Hensher et al. (2005b) also find that non-accounting for ANA produces significantly different WTP estimates. Scarpa et al. (2010, 2009) note that including ANA data in model estimation improves fit and provides a 'more plausible pattern of signs and greater