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## Statistical properties of consideration sets

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### ABSTRACT

The concept of a consideration set has become a central concept in the study of consumer behavior. This paper shows that the common practice of estimating models using only the set of alternatives deemed to be in the set considered by a consumer will usually result in estimated parameters that are biased due to a sample selection effect. This effect is generic to many consideration set models and can be large in practice. To overcome this problem, models of an antecedent volition process that defines consideration will effectively need to incorporate the selection mechanism used for inclusion of choice alternatives in the consideration set.

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### 1. Introduction

The concept of a consideration set is well-established in marketing (e.g., Kotler, 2003; Howard and Sheth, 1969; Roberts and Nedungadi, 1995; Roberts and Lattin, 1997; Chiang et al., 1999; Erdem and Swait, 2004; Salisbury and Feinberg, 2012). A search (August 29, 2013) of Google returned over a hundred thousand hits for “consideration set”, and assessment of the first 200 suggested that only a small fraction were not relevant. A search of Scholar Google returned over 8000 documents, and an assessment of the first 200 listings suggested that all these documents were relevant. Even taking duplicate and irrelevant documents into account, these searches clearly indicate that the concept of a consideration set is pervasive in marketing and related fields. This paper looks at statistical issues associated with the typical use of the consideration set concept to truncate the set of goods from which a consumer is assumed to choose. For applied researchers the main message of the paper is that the selection process that determines what goods are in the consideration set will almost always need to be successfully modeled in order to obtain consistent estimates of the choice process.

As a stylized example of the situation we address in this paper, consider a purchaser of a new good who is later surveyed and asked what alternatives were considered when making the purchase. The person provides a consideration set of alternatives that were the most likely to be chosen rather than all the alternatives explicitly or implicitly considered. Another stylized example occurs when a researcher has panel data on an individual’s purchases in a particular category over time and the researcher forms the consideration set by including all products in the category that were ever purchased rather than the larger set of alternatives in the category which may well have been considered in some fashion. In both examples, the problem we identify and discuss in this paper occurs when consideration sets used by researchers differ from those actually used by individuals. This problem arises (inter alia) because consumers typically will not reveal (e.g., recall and report) alternatives having a relatively low probability of being chosen, in either revealed or stated preference contexts.

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More generally, many research applications that focus on understanding and modeling consumer preferences often formally classify goods into two groups: 1) goods a consumer would consider purchasing and 2) goods a consumer would not consider purchasing (probabilistically or deterministically). Each good typically is represented as a bundle of attributes like price, size, color, quality and brand name. It also is common to ask consumers to answer survey questions about each good classified as being “in” a consideration set to elicit extra preference information. Such questions take many forms, such as: a) reporting any goods in the category ever purchased, b) directly identifying the consideration set (i.e., listing it or checking all that apply from a list), c) ranking or rating each “considered” good”, d) asking which one of the “considered” goods will be chosen next or was chosen most recently or last, and/or e) many other similar possibilities (i.e., questions that try to identify a consumer’s most preferred option – see, e.g., [Narayana and Markin, 1975](#); [Reilly and Parkinson, 1985](#); [Brown and Wildt, 1992](#); [Horowitz and Louviere, 1995](#)). The assumed consideration set, together with measured attributes/features of alternatives within it and the choice(s) actually made often are used to estimate statistical choice models. Such a modeling strategy effectively assumes a higher order antecedent volition process leading to the identified consideration set that has no direct link to choice processes within the consideration set. In this paper we show that although it is common in commercial and academic research to use such questions to identify consideration sets to proxy a person’s choice set and to estimate choice models conditional on these sets, using such consideration set measures raises statistical issues related to selection bias ([Heckman, 1979](#); [Vella, 1998](#)) that can have substantive implications for the way in which model estimates are interpreted and applied.

The literature on consideration sets has evolved in several distinct directions:

1. In one dominant stream, consideration sets are seen as endogenous quantities to be estimated from consumer panel data and/or from consumer choice experiment data. Examples include a) [Gensch \(1987\)](#), [Andrews and Srinivasan \(1995\)](#) and [Swait \(2001a; 2001b\)](#), which is a small sample of researchers who proposed and estimated two stage models of consideration and choice; b) [Roberts and Lattin \(1991\)](#), who developed a model of how consumers form a consideration set at a particular point in time; and c) [Chiang et al. \(1999\)](#), who developed a model of consideration set formation and choice that allows for heterogeneity in the parameters of both processes. Thus, this research stream focuses on drivers of consideration and choice.
2. A second major research stream treats consideration sets as exogenous quantities defined by some type of direct measurement process. Examples include a) [Narayana and Markin \(1975\)](#), who classified brands into “inept” and “inert”; b) [Wright and Barbour \(1977\)](#), who coined the term “consideration set” and suggested that brands “known” to consumers can be classified into acceptable and unacceptable; and c) [Horowitz and Louviere \(1995\)](#), who used aided and unaided recall questions to measure which brands were/were not considered.

Many variations on the above two research streams exist, such as [Fotheringham’s \(1988\)](#) treatment of consideration sets as ‘fuzzy’ and [Yee et al.’s \(2007\)](#) practical computational way to look at many non-compensatory rules that could be used to form choice sets.<sup>1</sup> A common feature of most of these more technical papers on consideration sets is that they try to nest the standard neoclassical model of consumer choice as a special restricted case. Thus, a statistical specification issue that impacts the standard model is relevant to many more complex models.

The concept of a consideration set is valuable for modeling consumer choice in fields like marketing because it allows more flexibility in variables and degrees of influence that can occur at different points in decision making processes. This paper is agnostic with respect to whether the standard neoclassical model is correct or adequate. In particular, we leave that debate aside, and instead focus on a more basic question, namely what happens if a typical statistical analysis is performed using only a consideration subset of known alternatives, however defined, in the standard neoclassical model.<sup>2</sup> This is the most straightforward case. Yet, a motive for using consideration sets often seems to be the belief that parameters and/or variables that drive consideration fundamentally differ from those that drive choice. Hence, estimating a model that includes all available choices will lead to biased parameter estimates and misleading views of consumer behavior. We believe this may well be true in many situations of interest to researchers. However, we show that one cannot avoid sample selection issues by simply assuming that there is an antecedent volition process driving consideration that differs and is not linked to the one driving choice. In fact, selection problems are generally worse in this case.

Some researchers who used consideration sets tried to correct for selection bias (e.g., [Ben-Akiva and Boccato, 1995](#); [Paap et al., 2005](#); [von Haefen, 2008](#)), but our review of the literature in marketing suggests that this is not typical of empirical practice. For example, in an early use of consideration sets, [Krishnamurthi and Raj \(1985\)](#) defined a household’s consideration set as any brand in the category purchased during a prior 52 week period. Of course, households might have purchased other brands if (for example) there was a large price decrease in one or more brands not purchased in the previous year.<sup>3</sup> A well-known paper by [Allenby and Ginter \(1995\)](#) uses a heteroscedastic logit framework to flexibly fit price and promotional parameters, which nicely illustrates one way in which consideration sets are used.<sup>4</sup> They eliminated all

<sup>1</sup> See also the special issue of *International Journal of Research in Marketing* on consideration sets edited by [Roberts and Nedungadi \(1995\)](#).

<sup>2</sup> Including alternatives that an agent is unaware of in the set from which the agent is assumed to have chosen can also create substantial statistical problems not pursued in this paper.

<sup>3</sup> [Hauser and Wernerfelt \(1990\)](#) show this is a common way to define consideration sets.

<sup>4</sup> [Baltas and Doyle \(2001\)](#) note that a common practice in using scanner panel research is to drop smaller brands, and that “such sample selection

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