Stochastics and Statistics

The nested consideration model: Investigating dynamic store consideration sets and store competition ☆

Joseph Pancras *

University of Connecticut, School of Business, Marketing Department, 2100 Hillside Road, Unit 1041, Storrs, CT 06269-1041, United States

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ABSTRACT

The nested logit model has been widely used to study nested choice. A typical example of such nested choice is store patronage and brand choice. An important limitation of the nested logit model is that it assumes that all alternatives at both levels of the nest are available in the choice set of the consumer. While there is a wide literature on the incorporation of restricted choice sets into the logit model, the logical extension of this analysis to nested restricted choice sets has not been pursued in the literature. In this study we develop a nested consideration model that integrates store choice and brand choice incorporating the formation of dynamic restricted choice sets of both stores and brands. We term the model the nested consideration model and derive the related probabilities in a manner analogous to the well-known nested logit model. In an empirical illustration, we find that the nested consideration model shows better prediction than nested logit models (with the same explanatory variables). We find that it is important to account for dynamic store consideration sets rather than static sets or store loyalty measures. We also conduct simulations to demonstrate the importance of the nested consideration set model for correct pricing and store location decisions of business managers.

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1. Introduction

Nested choice has been widely studied in various areas of study such as marketing and transportation research. The widely used model used to study nested choice has been the nested logit model (Ben-Akiva and Lerman, 1985; Train, 2003). Applications in marketing of the nested logit model include Kannan and Wright (1991) and Bell and Lattin (1998). Recently there has also been increasing interest in the operations research literature on the theory and applications of the nested logit model and related choice modeling approaches, including Bekhor et al. (2006), Bierlaire (2004), Kalouptsidis et al. (2007), Baltas (2004), García-Ródenas and Ángel Marín (2009) and Schön (2010). While a robust literature has been developed in marketing and transportation literature on incorporating *restricted* choice sets into the logit model, the logical extension of incorporating restricted choice sets into a nested choice model has not, to our knowledge, been pursued in either literature.

Developing such a model is important for business managers for the following reasons. One, managers need to be able to predict store and brand choice accurately in making optimal decisions on marketing mix variables such as prices and promotions. Two, the manager of a focal store needs to estimate the effect of competition from nearby competing stores on the focal store. The recent travails of retail outlets such as Starbucks (which needed to close hundreds of outlets in the US) due to cannibalization between nearby stores (Kiviat, 2008) underscore the importance of better methods to predict store choice decisions of consumers. Three, while our empirical application is in the context of frequently purchased packaged goods, the problem of spatial competition between nearby outlets is relevant for any business with a widely dispersed distribution network. An important recent example is the auto industry in the US, where Chrysler dealerships were being shut down due to competition between dealers that were located closer together (Kiley, 2009). Understanding how store consideration sets and state dependence in store salience and/or choice affect spatial competition thus is critical for businesses.

This article makes the following methodological contributions to the study of store choice. One, we develop a model that incorporates restricted choice set formation at both the brand choice and store choice stages. Two, we demonstrate the importance of dynamic store consideration sets as compared to store loyalty or static store consideration sets, which have been traditionally utilized in explaining store choice. By incorporating store state dependence

into the model of store salience and choice, we provide an integrated framework that store managers can use to set pricing strategies. The paper also makes the substantive contributions through two simulations that could be used by store managers, which could lead to better pricing and store location strategies.

The subsequent sections of this article are organized as follows. First, we discuss the relevant literature on store choice and consideration sets. Then we develop our model of nested consideration, building on assumptions and hypotheses about the choice process. Then we discuss our operationalization of the proposed model, and benchmark the performance vis-a-vis alternative, commonly used models of store choice. We also discuss two simulations that demonstrate the utility of this modeling approach to store managers. Finally we discuss the managerial implications of the proposed model and conclude.

2. Relevant literature

In Table 1 we lay out the contributions of this study with respect to the earlier literature.

These contributions can be classified into the following three broad streams:

(1) Incorporation of store salience into the store choice model, characterizing store salience by a threshold and store state dependence as opposed to earlier methods of using either only a store state dependence model (Popkowski Leszczyc et al., 2000) or using only store loyalty (Bell and Lattin, 1998; Bell et al., 1998) to explain store choice. Unlike earlier models of store state dependence, our approach also preserves the advantages of using the category inclusive value in explaining store choice.
(2) Integrating dynamic brand salience and store salience into the same choice model, unlike earlier papers that modeled either brand salience (Bronnenberg and Vanhonacker, 1996) or store salience (Fotheringham, 1988), but not both.
(3) Our approach, uniquely among the consideration set literature (Mehta et al., 2002), incorporates both the parsimonious sku (stock-keeping unit) characteristics approach and accounts for sku availability (Campo et al., 2003).

We next describe the relevant literature in these three streams.

2.1. State dependence in store choice and store consideration sets

The phenomenon of state dependence in brand purchase has been studied in the context of brand purchase (Seetharaman et al., 1999) as well as store choice (Popkowski Leszczyc et al., 2000, 2004). Positive state dependence leads to a higher probability of future purchase of the currently chosen brand/store and is termed 'inertia' while negative state dependence leads to a lower probability of future purchase of the currently chosen brand, a behavior termed 'variety seeking'. Popkowski Leszczyc et al. (2000) use a hazard approach to model state dependence in store choice. This approach does not take into account store salience and store consideration sets. It also does not take into account category inclusive values. The other approach that has been used to study store choice is the nested logit approach of Bell and Lattin (1998). While this approach uses category inclusive values to explain store choice, it does not include dynamic store salience or store consideration sets. The approach of Bell and Lattin (1998) is rather to use 'preprocessed' (static) consideration sets, i.e., stores that have been visited in a calibration period, as variables to explain store choice. They also use store loyalty rather than store state dependence to explain store choice.

Our study incorporates dynamic store salience and consideration sets, with store state dependence being used to parameterize the dynamic store salience,[1] and we show that this approach dramatically improves the predictive power of the store choice model.

2.2. Two stage models of store and brand choice

Considerable evidence has been presented in the restricted choice set literature that households form consideration sets of brands, and then choose brands from the household's consideration set, rather than choose brands in a single stage, from the set of all available brands (Mehta et al., 2002; Pancras, 2010). The literature on *store* consideration sets has however been somewhat limited. Fotheringham (1988) argues that consumers limit search not only with respect to brands but also with respect to stores. Consumers may not have the ability or time to evaluate all stores within a city, and may make an initial choice of a cluster of stores, a shopping district or perhaps a mall, then select a store from this reduced set of stores. An extreme example of such a set is where a consumer always buys from a single store or a single chain of stores. In general this phenomenon of limited search of stores is either ignored or accounted for in using simple indicator variables of which stores were chosen in an initialization period (Bell and Lattin, 1998). The latter approach may be suitable when the number of stores is smaller but may not capture the dynamics of store consideration sets which change over time, a lacuna that can become more pronounced when a larger number of stores/store formats are available to the consumer. Our study combines the advantages of the hierarchical choice approach (Bell and Lattin, 1998) with the advantages of accounting for dynamic store consideration sets.

2.3. Availability of SKUs across stores and the SKU characteristics approach

Recent research has pointed out that there is considerable variation in the availability of skus in stores (Bell et al., 2005). For the empirical researcher this variation in sku availability poses an issue since the competitive set in a store will vary over time. This has led researchers to use average prices across skus for a brand, a method used in several notable papers in the literature on store competition such as Bell and Lattin (1998). However, the varying availability of skus constitutes information on sku level competition between stores that should be utilized in modeling store choice and store competition. In our study, we adopt the sku characteristics approach of Fader and Hardie (1996) to account for sku level competition, and account for the varying availability of skus across stores over time, two aspects that distinguish our study from the earlier literature on consideration sets.

3. Model formulation

A hierarchical model of salience and choice for both the store and brand choice stages is shown in Fig. 1. A customer will first choose a store from a set of salient stores (the 'store consideration set'), then choose a brand from the set of salient brands (the 'brand consideration set'). We present below a short derivation of the nested consideration model (for the full derivation please see the Supplementary Materials on the journal website).

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[1] In the restricted brand choice set literature the brand state dependence variable has been used to parameterize the 'brand salience' construct (Bronnenberg and Vanhonacker, 1996) which has been shown to directly impact the formation of restricted brand choice sets. We utilize this approach to parameterize the store salience construct with the store state dependence variable.