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Estimation of retail sales under competitive location in Mexico

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ABSTRACT

This study proposes a useful combination of a spatial interaction model and simulation approaches for the reliable estimation of retail interactions and store sales based on data of consumer shopping behavior. The real case study empirically demonstrates this approach by building an operational retail interaction model to estimate expenditure flows from households to retail stores in Mexico. The analysis compares the results from the proposed forecasting method to actual performance data. The forecasting accuracy is satisfactory even when little retail and consumer information is available.

1. Introduction

Latin America represents the most dynamic retail market in the world (DTTL & STORES Media, 2012). Despite its potential, the presence of international retailers in grocery retailing is quite limited, accounting for only few major companies in most national markets. In fact, several retailing multinational have had to divest in some Latin American countries due to their disappointing performance. Others, such as Wal-Mart, acquired local chains that have been present in these countries for decades and have increased understanding of local consumers, such as in the case of Mexico (Euromonitor, 2013).

The complexity of the Latin American retail markets can be explained by the lack of reliable information with which to conduct site evaluations and understand buying habits of Latin American consumers, which results in economic challenges for retailers. In particular, most of the local markets are driven by small average receipts and low-margin products that threaten retail profitability. As a result, simple expansion by major chains in order to satisfy geographic proximity has been shown to have a negative effect on financial performance of major supermarket chains in Latin America. Therefore the selection of locations with high market potential and the generation of accurate sales forecasts are critical before deciding to open a new store.

Store location still represents a crucial driver of store performance in modern retail environments (Pan and Zinkhan, 2006). For most Latin American consumers, travel distance to the store strongly affects the store's attractiveness due to low car ownership levels. From a retailer perspective, store location decisions represent significant and sunken capital investments that, given shopping patterns, largely determine the trade area of the store (Achabal, Gorr, and Mahajan 1982; Ailawadi and Keller 2004; Briesch, Chintagunta, and Fox 2009; Gonzalez-Benito and Gonzalez-Benito, 2005). In fact, successful retailers constantly evaluate the performance of their current stores and predict the sales impact of potential location changes or new store openings (Gauri, Pauler, and Trivedi 2009; Ghosh and Craig 1983).

In Mexico, large retailers have increased the number of their stores to reach more consumers, generating high levels of store concentration. One of the implications is saturation in many large markets, which makes good locations even scarcer and harder to obtain. Competitive pressures and rising property costs make location decisions paramount to retailers' financial performance (Levy and Weitz 2004).

Despite the belief that distribution intensity is a critical success factor to a retailer's sales and market share, empirical support is not consistent (Bucklin, Siddarth, and Silva-Risso, 2008). Therefore, a precise sales forecast for new store locations is fundamental in the current retail environment. The main aim of this paper is to propose a methodology that combines two independent approaches for forecasting sales potential of

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new retail location with a high level of precision. The paper is organized as follows: in Section 2, each of the approaches is described, whereas Section 3 introduces the proposed methodology. In Section 4 the new method is empirically tested using real data from two cases in Mexico. The final section generates some conclusions and future research opportunities.

2. The Huff and simulation models

Retail trade area analysis focuses on locating and describing the target market for a given store. This knowledge is critical for both marketing and merchandising purposes, as well as for choosing new retail locations. This analysis employs a wide array of techniques addressing retail trade area analysis that vary in complexity, from using experience and a simple checklist on site visits, to analogues, gravity models (that recently have been embedded within Geographical Information Systems (GIS), and ultimately, neural networks) (Mendes and Themido, 2004).

According to Anderson et al. (2010), three primary types of trading area models are useful for analyzing store location potential and trading area: analog, regression, and gravity. An analog model uses revenues of similar stores in the market area, the competitors' position, the new store's expected market share, and the size and density of the trade area to approximate new store sales. A regression model relates potential store sales, as the dependent variable, with a number of independent variables such as population size, average income, the number of households, direct competitors, traffic patterns, etc. Gravity models assume that a certain radius or group of customers within a radius are drawn to stores in a particular area on the basis of variables, such as distance to market, distance between markets, relative market population, store image, etc. Gravity models get their name from being based on Newton's Law of Gravity and the premise that the probability that a given customer will shop at a particular store or market becomes greater as the size of the store or market increases and the distance or travel time to the store or market decreases. This paper proposes a methodology that combines one of the most popular gravity models (the Huff model) with simulation to estimate the potential sales of a new store. Simulation allows disaggregating retail interaction models to accurately estimate expenditures from households to each store in a certain trade area.

2.1. The Huff model

The Huff model (1964) represents the original framework of the spatial-interaction models for estimating retail trade areas. Huff argues that when consumers have a number of alternative shopping opportunities, they may visit several different stores rather than restrict their patronage to only one outlet. Customer choice rules are therefore probabilistic, with consumers splitting their demands among the stores proportionally to the utility each store provides relative to the overall utility perceived by the customer from all the available stores. The Huff Model of Trade Area Attraction estimates the probability that a customer residing in a particular trade area will shop at a particular store or shopping center. To forecast sales from a particular trade area, the trade area's population is multiplied by the estimate of expenditures per customer, which is then multiplied by this probability. Finally, all of the calculated trade areas sales forecasts are aggregated to estimate total sales from all of the areas. As with other gravity models, the ability of a shopping center to attract customers is in direct proportion to the size of the shopping center (relative to competing shopping centers) and in inverse proportion to the distance or travel time to the shopping center (relative to competing shopping centers).

The Huff model conceptualizes the trade area as a probability surface, which represents the likelihood of customer patronage. The creation of probability surface is based on a spatial interaction model that takes into account such variables as distance, attractiveness and competition. The probability surface can be contoured to produce regions of patronage probability, which can then be further used as weights in the preparation of market profile. This characteristic of the model explains its recent success in Geographical Information Systems (GIS) (Birkin et al., 2002).

Relative to the Huff model, the calculation of the patronage probability is shown in Eq. (1):

$$p_{ij} = \frac{a_j / d_{ij}^k}{\sum_{j=0}^{N} a_j / d_{ij}^k} \quad (1)$$

where,

a_j normalized attractiveness value of store j
d_{ij} distance between location of customer i and store j
k distance decay parameter

These parameters are estimated based on actual survey data. Therefore, actual choice decisions must be obtained empirically by a survey of residents of geographic subareas within some larger study trade areas. Choices must be obtained for all competitive stores considered by such residents. As shown in Eq. (1), the larger the value of k, the greater the effect of travel time or distance on the probability that a customer will shop at a given center. A larger value of k should therefore be assigned to a shopping center offering convenience goods than to a shopping center offering specialty goods. As such, the Huff model is highly product specific and yields different trade areas and sales forecasts based on different product categories. When a product is of great value to a customer, then all locations become equally attractive. This "inertia–distance factor," or k-value, is usually determined through surveys of shopping patterns or from previous experience and generally ranges from 4 to 1. The estimated nature of this "inertia–distance factor" is important as a subjective trade area model driver.

Once the parameters are estimated, the model can predict sales. To get the estimated sales figures for a certain store, the probability that a consumer will visit the store from a particular geographic area is multiplied by an estimate of the (average) expenditures in that area and by population size or, alternatively, by (average) expenditures per household and number of households. The total sales of each store in the study area are the sum of the expected expenditures from each geographic area for all stores.

The Huff model plays an important part in the development of store choice and retail trade-area estimation models by being the first framework to suggest that market areas were complex, continuous and probabilistic rather than non-overlapping geometrical areas. Most empirical studies support the usefulness of the Huff model in predicting with reasonable accuracy the market share of shopping centers, which is the main purpose of this study in Mexico. However, the standard spatial interaction model makes two strong assumptions: the demand of all customers is fixed and known in advance (perfectly inelastic), and all the stores in the area have the same characteristics, making proximity to each customer the only difference. In response to these assumptions, some authors argue that the utility function should include additional variables, originating the multiplicative models as MCI—multiplicative competitive interaction model (Nakanishi and Cooper, 1982). One of the limitations of the Huff model is the lack of sensitivity to market segmentation because the model assumes homogeneity in consumers and so is not useful in specialized retailing. Additionally, as suggested by Boufounou (1995), the Huff model does not consider outlets as an entire network, but rather evaluates sites in isolation.

This paper combines the geographic-based probabilities obtained by using the Huff model with simulation to imitate the shopping behavior of customers in the estimated retail area. Extending the outcome of the Huff model by including simulation enables the model to consider different shopping behavior among customers. These differences may be

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