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Advance purchase behaviors of air passengers: A continuous logit model

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ABSTRACT

Modeling the advance purchase behaviors of air passengers is essential when airlines develop revenue management strategies. Therefore, this study empirically investigates advance purchase behaviors based on the air ticket transaction data by using a continuous logit model. The estimation results show that advance purchase behaviors are significantly affected by price, price uncertainty, time of day (morning, afternoon and evening flight), days of week (flight on Friday), months of year (peak or off-peak seasons), and consecutive holiday. Accordingly, different pricing strategies should be used for different flights to maximize revenue.

1. Introduction

How air passengers choose departure times and purchase tickets in advance is essential for airlines to develop revenue management (RM) strategies. The advance purchase pattern provides valuable insights that can be used to make decisions about seat allocation, pricing, marketing and flight scheduling.

Effective revenue management strategies have clearly helped airlines to increase profit and allocate resources more efficiently. Airlines typically implement RM strategies to optimize selling strategies according to remaining capacity, current market conditions and anticipated demand. Through setting the booking limits and fare restrictions to each designed fare classes, airlines are able to distinguish passengers with different levels of willingness to pay for air tickets. However, if these restrictions force passengers to make trade-offs between price and product attributes, they may change the purchase behaviors. Additionally, online sales have become one of major distribution channels for airlines and travel agencies. From the passenger perspective, online purchases allow passengers to compare different product offerings easily. Therefore, it increases price transparency. Passenger nowadays may perceive fare classes as different prices for a seat on an airplane and purchase based on price rather than product characteristics (Garrow, 2009). However, because of the rapid growth in low cost carriers (LCCs) market, which prevailing one-way pricing models, many airlines have virtually removed typical fare restrictions which are used to be applied for market segmentation. These market changes have made traditional fare products less clearly defined, and assumptions of traditional RM models such as independence across fare classes may no longer be valid.

Recently, discrete choice models such as the multinomial logit (MNL) have been used to account for passenger preferences and purchase behaviors in RM system. The discrete choice models provide a methodology for tracing individual decision making processes and for profitably exploiting their preferences for product attributes. However, some choices are continuous response variables such as advance purchase time, departure time, and location. Arbitrarily discretizing these

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continuous choices variables may lead to an erroneous result. Therefore, this study contributes to the literature in three ways. Firstly, this study empirically analyzed factors influencing advance purchase behaviors of air passengers and provided empirical evidences to support existing decision theory. Secondly, advance purchase behaviors were modeled using an easily acquired and continuously growing transaction dataset to prevent the cost of a large-scale questionnaire survey. Finally, a continuous logit model was constructed to avoid the subjective segmentation of advance purchase horizon.

The remainder of this paper is organized as follows. Section 2 reviews the relevant literature of choice based RM models and continuous logit models. Section 3 introduces the study data and methods. Sections 4 and 5 describe the model specifications and present estimation results, respectively. Finally, concluding remarks and suggestions for future studies follow.

2. Literature review

The advance purchase behaviors of airline passengers have received increasing attention from researchers and marketing managers. In RM contexts, airlines employ different pricing strategies in response to intense market competition, differentiated demand patterns, and achieving effective customer segmentation (Bilotkach et al., 2010). For example, advance purchase behaviors can be used as a means of discriminating between passengers with high and low willingness-to-pay based on their time value and can improve the efficiency of seat allocation. By setting advance purchase discount, airlines can induce price-sensitive passengers to purchase tickers earlier and induce passengers who are less price-sensitive but more time-sensitive to make purchases later (Gallego et al., 2008; Dana, 1999, 1998; Gale and Holmes, 1993). Escobari (2014) also proposed a dynamic demand model with a panel dataset and analyzed how valuations change as the departure date nears. They concluded that the lower valuations consumers become more price sensitive as their departure day approaches whereas high-valuation consumers tend to purchase earlier. Hotle et al. (2015) examined how passengers respond to advance purchase ticket deadlines and price uncertainties. Their works showed that changes in both the search and purchase behaviors of air passengers depend upon the advance purchase restrictions. While airlines adjust prices dynamically based on learning demand from historical sale patterns, passengers can also decide to make advance purchase at the going price or to delay their purchase decision (Escobari, 2012; Deneckere and Peck, 2012). Dynamic pricing strategies decrease the value of the product and force passengers to make trade-offs between price, product attributes and deadlines, and therefore, change their purchase behaviors. The market conditions today have more complicated the purchase decisions process for air passengers. Without knowing the actual purchase behaviors of air passengers, the proposed RM strategies may obtain erroneous results.

To trace the advance purchase decisions of air passengers, recent researches have introduced discrete choice models to RM for its ability to accommodate passenger preferences in RM strategies that can better explain how individuals making trade-offs. The approach supports RM decisions by replacing typical demand forecasting models of probability and time-series models with models based on discrete choice theory (Barnhart and Smith, 2012; Garrow, 2009; Talluri and van Ryzin, 2004a, 2004b). Although demand models based on discrete choice models may be more appropriate in RM applications, empirical studies are limited due to the high cost of data acquisition. The decision process of passengers can be modeled with either stated preferences data which is collected through designed scenario surveys, or using revealed preferences data based on the real booking/transactions. One advantage of using revealed preferences data is that transaction data provide a direct record of the actual choices of air passengers and are easily collected by airlines. Using revealed preferences data also avoids the risk of response bias from the questionnaire surveys associated with the hypothetical nature of stated preference data (Carrier, 2008). However, for revealed preference model implementations, both chosen and non-chosen alternatives are needed to replicate the purchase scenario. Although the support of computer systems has reduced the cost of data collection, most firms only record data for passengers who had decided to purchase and information about non-chosen alternatives had been difficult to obtain. Therefore, inferring the true demand with available data remains a challenge issue.

Previous studies have used logit models of demand to analyze advance purchase behavior based on revealed preferences data for the airline industry (Escobari and Mellado, 2014; Vulcano et al., 2010; Carrier, 2008), hotel (Newman et al., 2014) and railway industry (Hetrakul and Cirillo, 2015, 2014, 2013). Within the airline industry, Carrier (2008) modeled time-of-travel choice for airline travelers based on the latent class model with booking and seat availability data from Amadeus database. The choice set for each booking was reconstituted from data for booking, fare rules, and seat availability. To date, to represent time as a continuous variable, a trigonometric function was used. Their model extends the application of passenger choice model to airline pricing and revenue management. Vulcano et al. (2010) proposed a choice-based RM model with readily available airline data such as data for flight schedules, revenue accounting, seat availability and screen scrape (sample information about alternatives and fares offered by competitors at different points in time during the booking horizon). To exploit passenger preferences, a single-segment MNL model was constructed. Their simulation result showed significant improvements (1–5%) in average revenue in the tested markets. Escobari and Mellado (2014) empirically estimated advance purchase behaviors of air tickets with discrete choice random utility model. Their preference dataset included detailed data for contemporaneous prices and for characteristics of both chosen and non-chosen flights. The estimated results shown that quantity demanded is more responsive to prices for departures in the morning and evening when compared to departures in the afternoon. This study used actual transaction dataset from billing and settlement plan (BSP) that can be easily acquired by every airline to support the development of airline RM strategies.