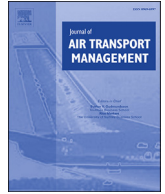




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Passenger booking timing for low-cost airlines: A continuous logit approach

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ABSTRACT

Low-cost airlines irregularly launch ticket promotions, where fares may differ by day of the week and departure dates. The timing for purchasing air tickets is thus closely associated with fares. Airlines should analyze booking timing for tickets and increase the accuracy of demand forecasts to achieve efficient use of airplane seating and plan for promotional activities. Therefore, this study develops a continuous choice model for timing decision making regarding bookings. A trigonometric function is used and interacts with trip and socioeconomic characteristics to capture the heterogeneous preferences of air passengers. Data were collected from low-cost airline passengers traveling from Taiwan to Singapore. The results of the continuous multinomial logit model indicate that lower fares increase the number of bookings and heterogeneous preferences in booking timing are present. Some travelers tend to book flights earlier than the other groups: these are the price-sensitive customers.

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1. Introduction

In the aviation industry, full-service and low-cost airlines both offer a variety of services. However, due to disparity in pricing, their operations and management are rather different (Mason, 2001; O'Connell and Williams, 2005). Full-service air tickets have fewer use restrictions and are travel agent-based. Additionally, the fare of full-service airlines for a specific route does not vary frequently. Conversely, low-cost airline customers must use the Internet or telephone to book their tickets, which have larger fare fluctuations and also face multiple flight restrictions. In other words, the fares of low-cost airlines are highly elastic. As such, these carriers occasionally provide ticket promotions, and thus fares may differ on each day of the week, with the company webpage only briefly displaying the remaining seats.

A flight has a fixed capacity for meeting passenger demand, and the ticket sales of airlines are offered on a temporary available basis. The unsold seats are perishable and cannot generate any revenue for airlines. This consequence forces airlines to adopt a dynamic floating strategy, as well as promotional campaigns, such as buy-one-get-one-free. Strategic methods, such as the aforementioned, will influence travelers' choice of airlines, and also the timing of

purchasing their ticket. Airlines, especially low-cost carriers, should analyze when air travelers purchase their tickets, and thus improve the accuracy of demand predictions for seat inventory control and promotional activities as to achieve efficient use of airplane seating.

The purpose of this study is to develop a model that analyzes the purchase timing of airline tickets for low-cost carriers. Travelers often do not buy airline tickets immediately when they determine their itinerary, and may choose to wait for fare promotions before making reservations. Therefore, this study examines the determinants of air ticket booking behavior.

We use a questionnaire survey to obtain data and identify the determinants of air travelers' booking timing decision. The survey instrument obtains information on the socioeconomic and trip characteristics of air travelers, and the length of time before departure to purchase air tickets. Because booking time, in days prior to flight departure, is a continuous-time variable, a discrete choice model is not suitable. Therefore, this study applies the continuous multinomial logit model to analyze travelers' booking choice behavior. While some studies use the continuous multinomial logit model to analyze departure times or time-of-day travel choice, few studies has used this model to analyze air travelers' booking timing. Thus, we propose a new methodology, in which the continuous multinomial logit model and survey data are used together in analyzing air travelers' booking time choice. Low-cost airlines can encourage travelers to purchase tickets in advance or attract potential customers through promotional activities. Particularly, low-

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cost airlines should develop strategies to change the behavior of travelers' booking decisions. Our results can offer valuable implications for low-cost carriers to manage fare promotions, seat control, and fleet assignments.

2. Literature review

Understanding booking patterns is critical for airline revenue management. The revenue management system analyzes flight booking patterns for predicting passenger demand and controlling seat availability under different fare classes. Weatherford and Kimes (2003) classify two data types—historical bookings and advance bookings—for analyzing booking behaviors in the airline industry. Historical bookings data are a collection of the final bookings of a particular flight at different days prior to departure. The models developed using historical bookings can predict final bookings for a flight on a specific day and time. Alternatively, for a future flight, the advance booking data become available and can be used to predict the number of bookings for the remaining days prior to departure. The typical approaches to analyzing historical and advance bookings data in the airline industry are multiple regression and time-series models (Lee, 1990; Sa, 1987).

Alternatively, Hetrakul and Cirillo (2013) develop various discrete logit models for rail ticket purchase timing choice, based on internet booking data. Their results find that rail fare, the number of days before departure, and departure day of week are important determinants influencing purchase timing decision. The booking choice model can be included in a revenue optimization problem to jointly determine pricing and seat allocation (Hetrakul and Cirillo, 2014). Using a dataset that consists of sale transaction records by airlines and their distribution channels, Chiou and Liu (2016a) investigate the advance purchase behaviors for air tickets in the discrete logit framework. Chiou and Liu (2016b) further apply the continuous multinomial logit model using the same dataset, and the results indicate that advance purchase timing is associated with airfare, uncertainty of airfare, time of day, days of the week, months of the year, and consecutive holidays. However, the dataset used by Chiou and Liu (2016a, 2016b) does not include the individual characteristics of air travelers and, as a result, knowledge regarding heterogeneous characteristics of air passenger booking behavior is still not identified.

Numerous studies have explored the pricing strategies of low-cost airlines and the variables that cause variations in their airfares. Earlier studies examined the relationship between price and the number of days between the advance reservation and the flight date using a hyperbolic function (Malighetti et al., 2009). Airlines often charge lower fares to passengers who book early before flight departure, and the fare may increase as the flight departure date approaches. Salanti et al. (2012) apply a similar price function as Malighetti et al. (2009) to analyze fare differences between leisure and business routes using the fare database of easyJet. They conclude that the setting of the initial fare (e.g., three months before departure) is critical for leisure routes, while, for business routes, the carrier should pay attention to determining the rate of price increases during the last few days prior to flight departure. In addition to the number of days before departure, Alderighi et al. (2015) assess capacity (seat availability) impact on airfare to gain insight into Ryanair's pricing strategies and confirm that capacity component is a significant determinant of airline pricing.

Price discrimination based on the day of the week of purchase is often implemented by airlines. For instance, Mantin and Koo (2010) investigate whether a weekend effect occurs in daily airfares and price dispersion. They find a strong weekend effect for airfare dispersion (high from Friday through Sunday), but not for price level. Puller and Taylor (2012) identify that airfares are lower when

tickets are purchased on weekends and demonstrate that the price strategy could have significant impact on airline profits. Therefore, dynamic pricing can help increase airline revenue (Petrick et al., 2010). Airlines can offer dynamic ticket fares and promotional seats at different times to affect passenger decisions, and thereby maximize their revenue (Park and Seo, 2011). A recent study by Dominguez-Mencheró et al. (2014) explores the best time to purchase an air ticket using non-parametric isotonic regression approaches, as opposed to parametric regression models, which were typically used to analyze airline fares. They suggest customers can purchase an air ticket until 18 days before departure without any substantial economic loss.

3. Data

A questionnaire was designed to collect survey data from air passengers who used low-cost airlines to fly between Taiwan and Singapore. The survey consists of two major components. In the first section, the profile information of respondents (i.e., gender, age, occupation, education level, and annual personal income) was obtained. The second section inquired about respondents' current trip information, including trip purpose, the number of times flown by low-cost airlines, which low-cost airline is being used, flight schedule, purchase time of air ticket, weekly frequency of checking airfare online, who paid the airfare, and travel companions.

From 2004 to 2012, Taiwan had increased flight charters to include 11 foreign low-cost carriers. These low-cost airline routes are mostly concentrated to Southeast Asian countries (e.g., Singapore, Thailand, and Malaysia) and Northeast Asian countries (Japan and Korea). The low-cost airline market share increased to 2.9% from 0.3% in Taiwan, and 93% of the air seats sold are among low-cost airlines operating within this range. Therefore, low-cost airlines have great potential for development in Taiwan.

The selected low-cost airlines that fly between Taiwan and Singapore include Jetstar Airways, Scoot, and Tigerair. Air Asia was excluded because it usually does not provide direct flights, its airfares are more expensive, and total flying time, including a temporary stop at Kuala Lumpur, is longer than for other non-stop airlines. The survey was conducted by well-trained interviewers who can interact with Taiwanese air travelers from April 1–6, 2014 at the Taiwan Taoyuan International Airport, the main one providing services on the study route. The sample size for each three low-cost airlines is determined based on the number of daily flights offered for the study route. To avoid sampling bias, the required sample size of each airline is distributed proportionate to the sampled flights. A total of 639 questionnaires were distributed, and 580 valid questionnaires were returned, yielding an effective questionnaire return rate of 90.8%. Of these valid questionnaires, 196 were from respondents who traveled with Jetstar, 185 from those traveling with Scoot, and 199 from those traveling with Tigerair.

The profiles of respondents and trip characteristics are reported in Table 1. The data consist of more female respondents than males. Most respondents are unmarried, accounting for 64.7%. Regarding annual personal income, the majority are under TWD 250,000 per year. Moreover, 71.2% of respondents are from northern Taiwan. The majority listed visiting relatives and friends as travel purpose, as the survey period covers the Tomb Sweeping Festival holiday. The age groups in the sample are concentrated on the 21–30 segment (30.2%), with travelers typically being young adults. Among those surveyed, the main types of occupation are in the service and business industries (42.8%), and students account for 18.4%.

The survey can only be administered to travelers paying for their airfare at a specific booking time. Therefore, ticket prices for one-way flights between Taiwan and Singapore were collected online

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