

A Study on the Dynamic Refund Fee Model of Air Tickets Based on Win- to-Win Mechanism

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Received March, 2019

Accepted June, 2019

Abstract

Purpose: To achieve the balancing of interests between airlines and passengers, the dynamic refund fee model is designed, which meets the interests of both airlines and passengers.

Design/methodology: In the study, the expectation utility function is constructed respectively for passengers and airlines, and the equilibrium point of the two is chosen to solve the passenger refund fee. Then, a dynamic refund fee model based on refund time and real-time sales revenue is proposed according to the actual operating conditions of the flight.

Findings: The results show that refund fee is negatively related to three variables -- the ticket price, the probability of ticket sales and the probability of refund. Besides, The maximum payment limit is the airline single seat cost or the actual fare paid below it, and the lowest can be exempt.

Originality/value: A better standard of the refund is proposed. The refund mode breaks the traditional static charging mode, and charges different refund fees to passengers for different refund time and the real time income of flights. Comparing with the current refund policy, the new charge of refund fee could best meets the interests of both parties. a refund fee standard.

Keywords: traffic engineering refund fee model, voluntarily refund, rate of refund fee.

To cite this article:

Zhao, G., & Deng, J. (2019). A Study on the Dynamic Refund Fee Model of Air Tickets Based on Win- to-Win Mechanism. *Journal of Airline and Airport Management*, 9(2), 56-62. <https://doi.org/10.3926/jairm.129>

1. Introduction

Passengers buy airline tickets, that is, air transport contracts signed with airlines. When passengers choose to refund tickets voluntarily for some reasons, they terminate the contract with airlines, which is a breach of contract in law. The 114th provision of the contract law stipulates that "The parties may agree that when a party breaks a contract, it shall pay a certain amount of liquidated damages to the other party according to the situation of breach of contract, or it can also stipulate the calculation method of the amount of compensation for the loss arising from breach of contract". Thus, it is reasonable and legitimate for the airline to charge a certain refund for the passengers. However, the refund fee is charged at the corresponding percentage of the full fare when the discount ticket is returned, instead of the actual payment. This kind of approach to the lack of consideration of the interests of passengers, has caused a lot of controversy in the community. The high refund fee brings economic loss and dissatisfaction to passengers, but also reduces passengers' goodwill on airlines.

At present, the refund rates of China's airlines are generally designed based on the percentage of airline ticket discounts. Standards range from 5% to 100%, and different airline ticket refund rates are inconsistent. Whenever a ticket is refunded in China, passengers are always required to pay some refund fees. However, some airlines, such as the Russian Airlines, Japan Airlines, Delta Air Lines may cancel refund fees by voluntarily passengers' refund time, which plays a key role in maintaining a good customer relationship. On the other hand, the flight stages are divided into two phases - before and after the departure of the flight by two hours before the flight departure. The refund fee rate of the latter is generally higher than the former. In addition, there is no subdivision of the passenger's refund time before departure. With reference to the railway ticket refund in China, passengers' refund time is concentrated within 24 hours before departure, accounting for 73.5% of the total. The percentage of refunds for 24-48 hours before departure is 11.7%, and the percentage of refunds for tickets over 48 hours before departure is 14.8% (Jing, 2014). Similarly, the percentage of passengers' refunds at different time periods is also significantly different in the airline refund. Besides, the risk of airline seats is obviously different when the seats are reorganized and sold again. The charge of refund fees is a game between passengers and airlines. The two parties maintain their respective interests, realize their maximum utility, and seek the most balanced state. Thus, dynamic refund fees are imperative as the refund time bring different benefits and risks to airlines and passengers.

2. Research status

Airline ticket price is the embodiment of airline's expected utility value for airlines. Yaser E. Hawas found the factors that influence the effectiveness of passenger travel and the derivation of passenger utility (Hawas, 2004). Liu Wei proposed the effective arrival rate of passengers to consider the expected value of airline tickets, and constructed the airline ticket overbooking model (Wei, 2005), Akartunal et al. studied the choice behavior of air passengers and constructed the passenger utility curve (Akartunal, Boland, Evans, Wallace & Waterer, 2013). Gao Jin Min built the expected utility function of passengers, and established the ticket pricing model (Jin-Ming, Mei-Long & Chi-Lin, 2016). Jin Zeng set up the passenger utility function and used a quantitative method to measure the influence of travel time, travel cost, comfort, departure time and time of arrival (Zeng, Jin, Dong, & Clarke, 2016). Talebian pointed out that the goal of passenger travel is to maximize utility. In addition, delay and other factors will lead to the reduction of passenger utility (Talebian, Zou & Peivandi, 2018).

Many factors need to be considered in the dynamic pricing of airline tickets, and scholars have done a lot of researches on it. According to the characteristics of the cumulative probability distribution of passenger reservations, Xu Hong set up a dynamic model of airline ticket pricing based on the number of days and the cost of seating time as the main variable (Hong, Yun-Quan & Jun, 2004). Cheng Xiaokang thought that we can confirm the seat stock control and the discount fare distribution by predicting the demand probability distribution curve of different flights fare (Xiao-kang, 2007). Chen Ruirui proposed the use of dynamic pricing method to standardize the pricing process of airlines, and used the dynamic recursive method to build a continuous pricing model under the competitive environment of the airlines (Rui-Rui, 2010). Hsu and Lee studied the application of different price information in the dynamic price changes, and explained the association between airline sales seats and pricing methods (Hsu & Lee, 2012). Escobari, Diego used Markov switching model with time varying probability to capture the response of price adjustment to time change

(Escobari, 2013). Song Jia-Qiang studied the factors affecting the price discrimination of civil aviation passenger tickets in China, and found that there were significant differences in the influence factors of ticket pricing in different market structures (Jia-Qiang, 2014). Kirshner, Samuel Nathan and Nediak, Mikhail reserached the optimal control problem of airline revenue management based on continuous time (Kirshner & Nediak, 2015). Otero, Daniel F, Akhavan-Tabatabaei, Raha proposed a stochastic dynamic pricing model. The phase distribution and update process were used to simulate the arrival time of the two subscriber and the probability of the customer to buy the ticket, and the problem of the cabin pricing at different time was solved (Otero & Akhavan-Tabatabaei, 2015). Hu et al. applied dynamic programming methods to analyze the dynamic pricing problem, and the positive impact of passenger psychology on airline fare and revenue is analyzed (Hu, Li & Ran, 2015). Wittman, Michael, Belobaba, Peter discussed how to predict the willingness to pay for passengers and provide personalized services and discounts for the passengers based on the dynamic dynamic income management of the airline (Wittman & Belobaba, 2017).

On the related issues of refund, Zhong Nin and Tian Peng used the expected marginal value difference of ticket at the time of ticket sales and refunds to determine the refund fee. The corresponding refund rate calculation model has been established to realize the dynamic ticket regression moddle of the amount of the refund fee and the time of ticket sale, the time of refund and the state of the ticket sale (Ning & Peng, 2007). Iliescu and others applied to discrete-time selection methods to research the behavior of airline passengers, and they found that the behavior of passengers is strongly influenced by the time of air ticket purchase and flight take-off (Iliescu, & Garrow, 2008). Wang Jing studied the railway echelon refund, and put forward that the fee of different refund is charged by the step refund system according to the time of advance refund 1. Mirzaei, Fouad analyzed the relationship between the change cost and service, passengers in the plane of the price (Mirzaei, Ødegaard & Yan, 2017).

In brief, dynamic pricing is the core of airline revenue management. Regarding refund fees, the two have not yet been combined to conduct research. In addition, scholars mostly study from the perspective of the expected value of transportation companies, and do not stand on the perspective of both passengers and airlines to resolve the issue of refunds. Based on this, this paper uses the principle of dynamic pricing to solve the equilibrium points of passengers and airlines, and proposes a dynamic refund fee model based on refund time and real-time sales revenue.

3. Refund fee model

When a passenger purchases a ticket with price P_i : There is a certain chance p_{t_i} that the passenger will choose to refund the ticket at a certain time t_i . The cost to be paid by the passenger is not only the refund fee paid to the airline in a narrow sense, but also the generalized costs including the time and transportation costs due to the refund; If the passengers successfully fly, the perceived utility of the passengers embodies the utility gained by completing the journey from the point of origin to the destination, in addition to the discounted fare of the tickets. Then, the expected utility function of the passenger is:

$$U = (1 - p_{(t_i)}) \cdot (P_0 - P_i + \theta) - p_{(t_i)} \cdot (f + \phi) \quad (1)$$

The parameters involved in formula (1) are defined as follows: t represents the refunding time before departure; t_1 , t_2 and t_3 respectively represents 2 hours before departure, 2-24 hours before departure and 24 hours before departure; f represents the refund fee; $p_{(t_i)}$ represents the passenger's refund probability in each time period; the class fare combination is $\{P_1, P_2, P_3, \dots, P_n\}$, in which the ticket's full ticket price is P_0 ; U represents the perceived utility brought by the ticket; θ is the service utility perceived by the passenger when completing the travel; ϕ is the passenger Non-economic costs such as time costs on refunding tickets.

The airline implements revenue management, combines fare combinations for different seats, and sells at different times with different probability $\lambda_i(t_i)$. The charge of air refund fees is to compensate for the economic losses caused by the unsuccessful sales of the re-release of lock seats in the flight due to refunds.

When the tickets have been sold: if the passenger successfully completes the journey, the airline reaps the profits for the sale of airline tickets; if the passenger chooses to refund the ticket, the airline gains the return fee paid by the passenger; in addition, the airline also expects to obtain the customer loyalty accumulated during sales,

service and other processes, which means that passengers are expected to choose the airline's own flight on their next trip to bring potential future benefits. Then, the airline single ticket expected utility function is:

$$V = [(1 - p_{(t)}) \cdot P_i + p_{(t)} \cdot f + \gamma] \cdot \lambda_i(t_i) \tag{2}$$

The parameters involved in formula (2) are defined as follows: t represents the refunding time before departure; t_1, t_2 and t_3 respectively represents 2 hours before departure, 2-24 hours before departure and 24 hours before departure; f is the refund fee; $p_{(t)}$ represents the passenger's probability of refund within each time period; the combination of cabin fare is $\{P_1, P_2, P_3, \dots, P_n\}$; the probability of corresponding sales at the moment is $\lambda_i(t_i)$; V indicates the utility brought by the airline ticket; γ indicates the customer loyalty.

The level of refund fees affects the expected utility of passengers, which in turn influences loyalty of passengers and thus affects the expected benefits of airlines. Therefore, the design of the flight refund fees need to be viewed from the perspective of both airlines and passengers, seeking the most balanced status of the two. Combined formula(1) and formula (2), when the utility of the passenger and airline is balanced, the expected refund costs are:

$$f = \frac{(1 - p_{(t)}) \cdot (P_0 - P_i + \theta - \lambda_i(t_i) \cdot P_i) - p_{(t)} \cdot \phi - \lambda_i(t_i) \cdot \gamma}{[1 + \lambda_i(t_i)] \cdot p_{(t)}} \tag{3}$$

It should be noted that: If $f < 0$, then it is taken as $f = 0$.

On this basis, consider the actual income of the flight, combine the flight seat cost, construct the constraint conditions and design the refund model again.

Set the airline refund fee as F ; $\{P_1, P_2, P_3, \dots, P_n\}$ represents the combination of the class fare; $\{m_1, m_2, m_3, \dots, m_n\}$ represents the number of sales seats corresponding to the refund time; C is the flight operation cost, and M is the total number of seats, then the single seat cost is $c = C/M$, and the flight sales revenue at the refund time is

$R_i = \sum_{i=1}^n P_i \cdot m_i$. If $R_i = C$, the flight was in break-even. At this time, the number of sales seats \bar{n} is variable, since

the fare combination P and the number of sales seats m are variable.

The mathematical model for constructing refund fees is as follows:

$$\text{If } R_i \leq C \text{ or } n \leq \bar{n}, F = \begin{cases} \min\{\max\{f, c\}, P_i\}, P_i \leq c \\ c, P_i > c \end{cases} \tag{4}$$

$$\text{If } R_i > C \text{ or } n > \bar{n}, F = \begin{cases} \min\{f, c\}, \bar{n} < n < M \\ 0, n > M \end{cases} \tag{5}$$

If $n > M$, the flight was in an oversold condition and passenger refund fees should not be charged, that is $F = 0$. Thus, the refund fee rate is

$$I_i = F/P_i \tag{6}$$

Based on the consideration of passenger utility, this model combines the interests of the airline so that the charge of refund fees can satisfy passengers' interests to the maximum extent and achieve the optimal results to meet the satisfaction of both parties. By formula (3), we can see that the lower the probability of flight seat sales, the greater the sales risks faced by the airlines, the higher the refund fee rate, and the higher refund fees that passengers will have to pay. According to formula (4) and formula (5), we can see that in combination with the actual operation of the flight, the maximum amount of refund fees is only the single seat cost of the flight, which ensures that the interests of both the passenger and the airline are not damaged.

4. Analysis of examples

4.1. The calculation of the refund fees for high class seats, 24 hours before the departure

Assuming that the airline's airline ticket has a full price of 1,000 yuan, that is $P_0 = 1000$. If a passenger purchases an airline ticket for 800 yuan at 20 days before departure, it is recorded as $P_0 = 1000$. 24 hours before departure, the passenger chooses to refund the airline ticket for his own reasons. According to the airline's statistics and budget, the probability of passengers returning the airline ticket at this time is that $P_{(t_2)} = 0.1$; and the seat's corresponding probability with a price of 900 yuan is that $\lambda_2(t_2) = 0.4$. The service utility perceived by the passenger when completing the travel is that $\theta = 200$, the passenger Non-economic costs is that $\varphi = 50$, and the customer loyalty is that $\gamma = 300$.

By substituting the above data into formula (3), the solution is obtained: $f < 0$.

When $R_{t_2} < C$, the flight is in a state of loss. Assume the cost of a single seat is 300 yuan. If $P_1 > c$, the refund fee should be charged as the cost price of 300 yuan according to the formula (4).

When $R_{t_2} > C$, the flight is in a profitable state, and the number of seats sold at this time is that $\bar{n} < n < M$.

Assume the cost of a single seat is 300 yuan. If $P_1 > c$, the refund fee for the flight shall be charged 0 yuan according to the formula (5).

According to the refund fee model, when the airline is in a loss state, the passenger only needs to pay the refund fee for the single-seat cost of the flight; when the airline is in a profitable state, the refund fee that the passenger needs to pay is much cheaper than the traditional charges. It can even be free of charge.

4.2. The calculation of the refund fees for low class seats, 2 hours before the departure

On the same flight, if a passenger to buy an eighty percent off ticket, that is $P_2 = 200$. 2 hours before the departure, the passengers choose to refund for their own reasons. According to the airline's statistics and budget, the probability of passengers returning the airline ticket at this time is that $P_{(t_1)} = 0.2$; and the seat's corresponding probability with a price of 200 yuan is that $\lambda_3(t_1) = 1$. By substituting the above data into formula (3), the solution is obtained: $f = 825$.

When $R_{t_1} < C$, the flight is in a state of loss. Assume the cost of a single seat is 300 yuan. If $P_1 > c$, the refund fee should be charged the actual payment of 200 yuan according to the formula (4).

When $R_{t_1} > C$, the flight is in a profitable state, and the number of seats sold at this time is that $\bar{n} < n < M$.

Assume the cost of a single seat is 300 yuan. If $P_1 > c$, the refund fee for the flight shall be charged as according to the formula (5), that is 200 yuan.

Above all, it is reasonable for airlines not to refund the price of a very low discount.

5. Conclusion

The research result of this paper is to get the dynamic refund fee satisfied by both airlines and passengers. The refund mode breaks the traditional static charging mode, and charges different refund fees to passengers for different refund time and the real time income of flights. In general, the charge of refund is negatively related to the airline ticket price, the probability of sale and the probability of refund. When the flight is in the state of loss, the cost of refund will not exceed the cost of single seat. Compared with the current airline refund rules, the model reduces the cost of refund to the maximum extent: The maximum payment limit for passengers is the single seat cost of airline flights, and the minimum is the exemption from refund fees. Furthermore, the refund fee of high-class seats is lower than the current refund regulation, and the refund fee of low class seats is in accordance with the current refund regulation.

However, the dynamic model lacks the in-depth study on the distribution of the probability of air ticket sales and the distribution of passenger refund probability. In the future, we can combine the passenger selection behavior and other factors to discuss the sales and refund situation of the airline ticket, establish the probability distribution model of the ticket sales and refund, and further improve the airline ticket refund model.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

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