

# Research on Multidimensional Quantitative Evaluation System of Airline Marketing Strategies

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## Abstract

**This paper constructs an evaluation system for airline marketing strategies, and quantitatively analyzes the typical strategies of airlines using fuzzy comprehensive evaluation method, analysis hierarchical method (AHP) and Topsis method. The study firstly screens strategies from product, price, channel and promotion dimensions, and obtains evaluation data from industry experts through expert scoring method. Based on the fuzzy comprehensive evaluation model, the evaluation is carried out from the first-level indexes of input cost, output benefit, and innovation drive, and the advantage score of each strategy is calculated. Then, with the help of AHP to determine the weights of the indicators, it is found that the output benefit is dominant in the evaluation of strategies, followed by the input cost. Combined with the Topsis method to rank the strategies, the results show that there are significant differences in the overall effectiveness of different strategies, with one strategy performing best by balancing costs and benefits, and the other ranking lower due to lack of innovation. This study provides a scientific and quantitative method for airlines to optimize their marketing strategy combinations and verifies the applicability of the multidimensional evaluation model in the field of airline marketing.**

## Keywords

**Airline Marketing; Fuzzy Composite Rating Method; Hierarchical Analysis; Topsis.**

## 1. Introduction

In the context of increasingly fierce competition in the air transportation industry, scientific assessment of the comprehensive benefits of marketing strategies has become the key to enhance the competitiveness of enterprises[1]. The traditional single-dimension evaluation method is difficult to fully reflect the complexity of marketing strategy, especially in the dynamic market environment, the cost input, output benefit and innovation-driven nature of the strategy need to be considered in multiple dimensions. This paper takes an airline company as the research object and constructs an integrated assessment model that integrates the fuzzy comprehensive evaluation method[2], hierarchical analysis method (AHP)[3] and Topsis method[4], aiming to break through the limitations of traditional methods. The study firstly screens typical strategies from four core dimensions: product, price, channel and promotion, and obtains multi-dimensional evaluation data of strategies from industry experts through the expert scoring method[5]. Based on the fuzzy comprehensive evaluation model, we quantitatively analyze the first-level indicators of input cost, output benefit and innovation drive, and determine the weights of each indicator by combining with the AHP, so as to reveal the balanced relationship between cost control and benefit creation of different strategies. Finally, the Topsis method is used to rank the strategies and identify the strategy combinations

with outstanding performance in terms of cost-effectiveness, innovation value and market impact. This study provides a scientific decision-making tool for airlines to optimize their marketing strategies, verifies the feasibility and practicability of multi-method integrated model in airline marketing evaluation, and provides theoretical support for the industry to formulate differentiated competitive strategies[6].

## **2. Overview of the Methodology**

### **2.1. Research Involving Elements**

#### **2.1.1. Product**

A product is an entity or intangible vehicle that satisfies needs and desires. Products can be categorized into five levels: core products, formal products, desired products, additional products and potential products. Among them, the core benefit is the most basic part of the product. After satisfying the basic needs, extension and value needs become the focus of airline competition. The services provided by airlines usually include:

Core services: such as long-distance and short-distance transportation, passenger and cargo transportation.

Convenience services: e.g. ticket booking, baggage check-in, airport transfers, etc.

Auxiliary services: such as providing newspapers, catering, souvenirs, travel brochures, Internet services, etc. These services add value to the product and help differentiate it from competitors. While core and convenience services are the basis of a company's business, ancillary services are the key to competitive differentiation.

#### **2.1.2. Price and Cost**

Price strategies are developed based on different market positioning, and pricing is based on the company's brand strategy and brand value. Costs, on the other hand, are formulated from the consumer's perspective, focusing on what he or she is willing to pay to satisfy a need, not just the price of the product. Price and cost are considered from the business perspective and the consumer perspective, respectively. Price involves price levels, discounts, payment methods, and credit, while cost includes monetary expenses, time costs, physical costs, emotional costs, and purchasing risks.

#### **2.1.3. Channels**

Companies usually do not face consumers directly, but rather cultivate distributors and build sales networks to reach customers. In the case of Hainan Airlines, its marketing channels are divided into two parts: direct sales and distribution. In addition, emerging channels such as live sales and price comparison search engines are becoming important components.

#### **2.1.4. Promotion**

The core of promotion is to stimulate consumers by changing sales behaviors, to promote consumption growth with short-term activities (e.g., discounts, buy-one-get-one-free, creating a live atmosphere, etc.), and to attract users of other brands or early consumption.

### **2.2. Strategy Matching**

Since the marketing elements have been selected, several typical marketing strategies of HNA can be categorized and divided. It should be noted that the quantitative control between the strategies and the basis of division is particularly important, because it will directly affect the subsequent use of the Topsis method to rank the elements in order of preference.

### 2.3. Strategy Level Processing

#### 2.3.1. Expert Scoring Method

This study mainly selected 50 experts who are influential in this field, including airline marketing department (deputy) managers, civil aviation research institute related practitioners, civil aviation colleges and universities (deputy) professors, and teachers of civil aviation majors, and seniors in the profession. After the selection was completed, the group appointed a person to contact the experts' survey intention and create a list of experts by phone, micro letter, email and meeting.

This study used partly electronic questionnaire and partly offline submission to complete the survey. Among them, the questionnaire, i.e., the strategy evaluation form, is sent to the surveyed experts through Wechat, e-mail and other ways after the completion of the survey, and the evaluation results are recovered after the experts complete it within the specified time, and the personal information of the participating experts is kept strictly confidential.

#### 2.3.2. Fuzzy Comprehensive Evaluation Method

##### 1. Table of evaluation indicators

The evaluation indicators involved in the fuzzy evaluation are shown in Table 1 below.

**Table 1.** Evaluation index table

Level 1 indicators		Level 2 indicators
Inputs, costs		Fixed Costs
		Variable Costs
		Potential Costs
Outputs, benefits		Direct Benefits
		Indirect Benefits
		Innovation-driven
Other	Social impact	Market competitiveness
	Strategy persistence	Consumer feedback
		Stability
		Consistency

Regarding Cost Inputs for Airline Marketing Strategies.

(1) Fixed Costs: these are costs that do not vary with external factors during the production process of a company and are usually associated with the fixed assets and infrastructure of a company, such as facility costs, fixed staff salaries, etc.

(2) Variable costs: these are costs that change in response to changes in external factors, especially fluctuating with increases or decreases in production volume, and are directly related to production activities.

(3) Potential costs: These are hidden costs that airlines invest in order to attract more passengers. These costs are not directly reflected in the financial statements, but they are vital to the operation and marketing activities. Specifically, they include brand marketing costs, promotion costs, channel costs, and customer relationship management costs.

About the outputs and benefits of airline marketing strategies:

(1) Direct benefits: these are benefits directly related to sales and marketing, such as increased flight bookings, higher fares, and improved customer conversion rates.

(2) Indirect benefits: These are benefits related to sales and marketing but do not directly result in sales gains, such as increased brand awareness, increased customer satisfaction, improved word-of-mouth, etc.

(3) Innovation: Innovation and creativity of airlines in the field of marketing is the key to attracting customers and improving customer satisfaction and loyalty. Specific innovative ways

include social media marketing, personalized service, digital marketing, joint marketing, and sustainable marketing.

Regarding the degree of influence and durability of airline marketing strategies:

(1) Strategy influence degree: it is closely related to market competitiveness and consumer feedback. Market competitiveness refers to an airline's advantages and capabilities in the marketplace relative to its competitors, while consumer feedback refers to customers' perceptions and feelings about the company's products, services, and marketing activities, collected through online surveys, social media, and customer service centers.

(2) Strategy durability: related to stability and consistency. Stability refers to the consistency and continuity of a company's marketing strategy over a long period of time, avoiding frequent changes to the strategy, so as to build brand awareness and credibility, increase market share, improve customer loyalty, reduce marketing costs, and better adapt to market changes. Coherence, on the other hand, refers to the coordination and consistency between strategies in all aspects of the marketing process, from brand positioning to promotion and sales, to ensure that all strategies support the company's brand image and objectives and form a complete marketing plan.

## 2. Post-evaluation data processing

Known: the allocation of the weight of each evaluation index fuzzy set is  $\tilde{A} = (a_1, a_2, \dots, a_m)$ , the set of comments  $V = (v_1, v_2, \dots, v_m)$ .

### (1) Establish fuzzy evaluation matrix

For each evaluation index, according to the voting results, the corresponding rubric set can be derived:

$$r_i = (r_{i1}, r_{i2}, \dots, r_{in}) \tag{1}$$

Where  $r_{ij} = \frac{\text{Votes for indicator } j}{\text{Total votes}}$ , and  $\sum_{j=1}^n r_{ij} = 1$ .

In this way, m the judgment set of each indicator constructs a total evaluation matrix:

$$R = (r_{ij})_{m \times n} = \begin{bmatrix} r_{11} & \dots & r_{1n} \\ \vdots & \vdots & \vdots \\ r_{m1} & \dots & r_{mn} \end{bmatrix} \tag{2}$$

### (2) Perform fuzzy synthesis and establish a fuzzy comprehensive evaluation model $\tilde{B}$

Here, the desire  $\tilde{B}$ , i.e., the use of each evaluation index weight assignment fuzzy set  $\tilde{A} = (a_1, a_2, \dots, a_m)$  and evaluation matrix  $R$ , the composite operation of fuzzy relationship (taking the smallest and the largest), namely:

$$\tilde{B} = \tilde{A} \circ R = (a_1, a_2, \dots, a_m) \circ \begin{bmatrix} r_{11} & \dots & r_{1n} \\ \vdots & \vdots & \vdots \\ r_{m1} & \dots & r_{mn} \end{bmatrix} \tag{3}$$

### (3) Calculate the degree of dominance $w_i$

Using the comment set  $V = (v_1, v_2, \dots, v_m)$  and the fuzzy comprehensive evaluation model  $\tilde{B}$  to calculate the degree of superiority of each strategy, i.e., through the formula  $w_i = V \cdot \tilde{B} = x_i$ , the calculation results, as the starting score of the Topsis method.

## 2.4. Strategy Secondary Processing

### 2.4.1. Analysis of Hierarchy (AHP)

In the first step, construct a hierarchical model.

In the second step, a judgment matrix cluster is built. According to the scale, for an element in the upper level, the elements related to it in the lower level are compared two by two and rated according to their importance.

The third step is to calculate the weight vector by regularized summation method, and the process is shown in Figure 1.

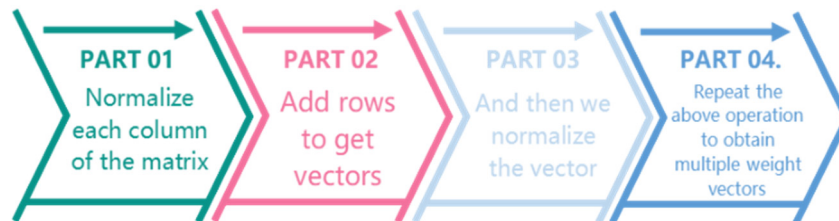


Figure 1. Regularized summation process

### 2.4.2. Approximation to Ideal Value Ranking Method (Topsis)

When analyzing multiple strategies belonging to the same marketing element, the Topsis method is used for calculation and evaluation. The method ranks the strategies by measuring the distance of the evaluation object from the ideal solution (optimal solution) and the negative ideal solution (worst solution), thus providing a basis for the analysis of aviation marketing strategies.

The first step is to establish a canonical decision matrix. The decision matrix of the multi-attribute decision problem is  $B = (b_{ij})_{n \times m}$ , where  $b_{ij}$  is the percentage superiority degree of each strategy derived from the fuzzy comprehensive evaluation method,  $n$  is the number of strategies, and  $m$  is the number of indexes; utilizing the formula  $r_{ij} = \frac{b_{ij}}{\sqrt{\sum_{i=1}^n b_{ij}^2}}$ , which is

transformed into the normalization matrix  $R = (r_{ij})_{n \times m}$ .

In the second step, the weighted decision matrix is constructed. The weight vector obtained from the aforementioned AHP method is used as the weight vector  $W = (\omega_1, \omega_2, \dots, \omega_m)^T$  of each indicator of the Topsis method, and then the weighting matrix  $Z = (z_{ij})_{n \times m}$  is constructed, where  $z_{ij} = \omega_j \times r_{ij}, i = 1, 2, \dots, n, j = 1, 2, \dots, m$ .

In the third step, determine the positive and negative ideal solutions. Let the  $j$ th attribute value of the positive ideal solution  $Z^*$  be  $Z_j^*$  and the  $j$ th attribute value of the negative ideal solution  $Z^0$  be  $Z_j^0$ , then:

positive ideal solution:

$$Z_j^* = \begin{cases} \max z_{ij}, & j \text{ is a benefit type attribute} \\ \min z_{ij}, & j \text{ is a cost-based attribute} \end{cases} \quad (j = 1, 2, \dots, m) \quad (4)$$

Negative ideal solution:

$$Z_j^0 = \begin{cases} \max z_{ij}, & j \text{ is a cost-based attribute} \\ \min z_{ij}, & j \text{ is a benefit type attribute} \end{cases} \quad (j = 1, 2, \dots, m) \quad (5)$$

In the fourth step, the distance to the approximated ideal solution is solved.

For strategy  $X_i$ , the distance to the positive ideal solution is:

$$d_i^* = \sqrt{\sum_{j=1}^m (z_{ij} - z_j^*)^2} \quad i = 1, 2, \dots, n \tag{6}$$

Its distance to the negative ideal solution is:

$$d_i^0 = \sqrt{\sum_{j=1}^m (z_{ij} - z_j^0)^2} \quad i = 1, 2, \dots, n \tag{7}$$

In the fifth step, the comprehensive evaluation index is calculated. The comprehensive evaluation index is calculated based on the distance of each strategy to the ideal solution:

$$C_i^* = \frac{d_i^0}{d_i^0 + d_i^*} \quad i = 1, 2, \dots, n \tag{8}$$

Step 6, determine the order of program advantages and disadvantages. Order the strategies according to the size of  $C_i^*$ , the larger the value of  $C_i^*$ , the better the comprehensive benefit of the strategy.

### 3. Example Calculation Study - Taking HNA as an Example

#### 3.1. Strategy Set under Product

The following HNA strategies are selected for analysis and research:

All the way for children; baggage at home; people and pets in the same cabin; VIP lounge entertainment; "Fly" series.

#### 3.2. Expert Scoring and Fuzzy Comprehensive Evaluation

First, the expert scoring method is applied to obtain the cumulative results through the scoring (voting) process.

For the strategy "All the way for children" (referred to as A), get the fuzzy set of weight allocation of each evaluation index, the set of input comments, and the set of "other" comments. Third, establish fuzzy evaluation matrix  $R$ .

Fourth, carry out fuzzy synthesis and establish fuzzy comprehensive evaluation model  $\tilde{B}$ .

Calculate the dominance degree  $W_i$ ;

Similarly, take baggage to home as strategy B, human and pet in the same cabin as strategy C, VIP lounge entertainment strategy as strategy D, and "Fly" series as strategy E, and repeat the above analysis and calculation process respectively. The final results of the degree of dominance are shown in Table 2 below:

**Table 2.** Advantageousness result

Strengths	Inputs	Outputs	Other
Strategy A	0.588	0.598	0.518
Strategy B	0.757	0.624	0.616
Strategy C	0.658	0.521	0.534
Strategy D	0.821	0.505	0.592
Strategy E	0.608	0.711	0.711

#### 3.3. AHP Analysis with Topsis Strategy Ranking

First, a judgment matrix cluster is established, and for an element in the upper layer, the elements related to it in the lower layer are compared two by two and rated according to their importance.

Second, calculate the weight vector by regularized summation method. By combining  $C1 = (Cij) n \times n$  the elements by column normalization, using the formula to get:

$$C1(\tilde{C}_{ij})_{n \times n} = \begin{bmatrix} 0.492 & 0.511 & 0.581 & 0.333 & 0.387 \\ 0.123 & 0.128 & 0.097 & 0.200 & 0.194 \\ 0.164 & 0.256 & 0.194 & 0.200 & 0.290 \\ 0.082 & 0.043 & 0.065 & 0.067 & 0.032 \\ 0.123 & 0.064 & 0.065 & 0.200 & 0.097 \end{bmatrix} \tag{9}$$

Add the elements in  $C1 = (Cij) n \times n$  by rows.

Similarly, for C2, C3 the group of judgment matrices is computed.

Third, the conclusion is stated. Influence product marketing strategy factors in descending order of weight: output, benefits (56.0%), inputs, costs (31.2%), other indicators (12.8%).

Fourth, Topsis sorting calculation.

(1) Establish the canonical decision matrix:

Establishment of decision matrix  $B = (b_{ij})_{n \times m}$  where  $b_{ij}$  is the percentage dominance degree of each strategy derived from the fuzzy comprehensive evaluation method,  $n$  is the number of strategies,  $m$  is the number of indicators; and then use the formula, to get the normalized matrix.

$$r_{ij} = \frac{b_{ij}}{\sqrt{\sum_{i=1}^n b_{ij}^2}} \tag{10}$$

$$R = (r_{ij})_{n \times m} \tag{11}$$

$$B = \begin{bmatrix} 58.8 & 59.8 & 51.8 \\ 75.7 & 62.4 & 61.6 \\ 65.8 & 52.1 & 53.4 \\ 82.1 & 50.5 & 59.2 \\ 60.8 & 71.1 & 71.1 \end{bmatrix} \tag{12}$$

$$R = \begin{bmatrix} 0.380 & 0.448 & 0.387 \\ 0.489 & 0.468 & 0.461 \\ 0.425 & 0.391 & 0.399 \\ 0.530 & 0.379 & 0.443 \\ 0.393 & 0.533 & 0.532 \end{bmatrix} \tag{13}$$

(2) Construct weighted decision matrix

The weights  $W = (0.312 \ 0.560 \ 0.128)$  of the indicators calculated using the AHP method were used to construct the weighting matrix,  $i = 1, 2, \dots, n, j = 1, 2, \dots, m$ .

(3) Determine the positive and negative ideal solutions

Positive ideal solution:

$$Z_j^* = (0.119 \ 0.298 \ 0.068) \tag{14}$$

Negative ideal solution:

$$z_j^0 = (0.165 \ 0.212 \ 0.050) \tag{15}$$

(4) Solve for the distance to approximate the ideal solution.

(5) Comprehensive evaluation index calculation results

$$C = (0.545 \ 0.510 \ 0.287 \ 0.067 \ 0.960) \tag{16}$$

(6) Determine the order of program advantages and disadvantages

The strategies are ranked according to the size of  $C_i$ , and the larger the value of  $C_i$ , the better the comprehensive benefit of the strategy.

The above results show that the comprehensive benefits of the strategies are ranked as follows:  $A > B > C > E > D$ , i.e., all the way to the children's line>luggage to home>people and pets in the same cabin>lounge entertainment> "Fly" series.

#### 4. Conclusion

This study provides a new method for quantitative analysis of airline marketing strategies by constructing a multidimensional assessment model. The results of this study show that output benefits occupy a central role in strategy evaluation, highlighting the need for airlines to prioritize the actual benefit conversion ability of their strategies. There are significant differences between strategies in terms of cost control, benefit creation and innovation value, with one strategy excelling in achieving the optimal balance between cost and benefit, while another strategy has a low overall benefit due to insufficient innovation. The model effectively reveals the internal logical relationship of marketing strategies and verifies the scientific and practicality of multi-method integration in aviation marketing evaluation. The research contribution is reflected in both methodological innovation and practical guidance. On the theoretical level, the fuzzy comprehensive evaluation method, hierarchical analysis method and Topsis method are combined for the first time, and a four-dimensional evaluation system covering input, output, innovation and impact is constructed, which expands the theoretical framework of airline marketing research. On the practical level, the study provides quantitative tools for airlines to optimize their strategy mix, helping them to identify high-value strategies and optimize resource allocation. The limitations of the study are the singularity of the sample and the short-term nature of the evaluation period. In the future, the sample can be further expanded to include airlines of different sizes and types to enhance the generalizability of the study's conclusions. At the same time, it is necessary to establish a dynamic evaluation mechanism to track the evolution of the long-term effects of the strategies and improve the evaluation index system by taking into account the changes in the market environment.

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