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Analysis of airport passenger satisfaction based on combined weight-fuzzy comprehensive evaluation

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Abstract: *In order to make passengers' satisfaction with the airport improved again and the airport side to make passengers understand the improvement of the airport in recent years according to the evaluation results, this paper constructs an airport passenger satisfaction evaluation system based on fuzzy comprehensive evaluation by combining weight analysis with AHP-entropy weight method, and describes the specific evaluation process of the model. A case study of Lhasa Gonga Airport is conducted, and the results verify the reliability of the research method and the applicability of the evaluation model. The evaluation results can provide a reference for the passenger satisfaction analysis of this airport and similar airports.*

Keywords: *Passengers; AHP-Entropy Weight Method; Fuzzy Comprehensive Evaluation; Airport Passenger Satisfaction Evaluation System*

1. Introduction

With the development of social economy, civil airports are playing more and more important role in the development of transportation economy, and civil airport services as a part of service industry are more and more closely related to people's life, and the service quality of civil airports is increasingly concerned by the public and airport owners [1]. In order to make the passenger satisfaction level of the airport improved again, as well as the airport side also needs the evaluation results to make passengers understand the improvement of the airport in recent years, therefore, it is very important to conduct passenger satisfaction evaluation analysis research on the airport.

At present, many scholars at home and abroad have conducted research on airport satisfaction, and the existing research results can be divided into two categories: (1) the establishment of evaluation indicators; (2) the study of evaluation models. Among them, Hua Zhaosen constructed an overall service quality evaluation system applicable to Xinzheng Airport to provide a theoretical basis for the improvement of service quality of Xinzheng Airport [2]; He Qiuzhao et al. established a comprehensive evaluation index system of airport safety operation based on safety level based on the influence of unsafe events and accident signs occurring [3]; Zhang Jun et al. concluded that perceived value, service quality and corporate image all have a significant impact on airport passenger satisfaction by establishing corresponding measurement models and structural models. By establishing the corresponding measurement model and structural model, Zhang Jun et al. concluded that perceived value, service quality and corporate image all have a direct and significant impact on airport passenger satisfaction, and the correlation between them is strong [4]; Xie Fei constructed an airport competitiveness evaluation model based on accessibility perception, frequency perception, convenience perception, efficiency perception and service perception, and proved that the model can effectively identify the shortcomings of airport competitiveness through example verification [5].

However, the current airport passenger satisfaction evaluation method has the shortcomings of strong subjectivity and single expression, so this paper proposes an airport passenger satisfaction analysis model based on combined weight-fuzzy comprehensive evaluation, and establishes a good evaluation index system, and then analyzes and researches the airport passenger satisfaction.

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2. Analysis of Airport Passenger Satisfaction Based on Combined Weight-Fuzzy Comprehensive Evaluation

2.1 Combined weighting method

AHP is used to determine the subjective weight of the evaluation index, and the weight is corrected by the OWA operator, and at the same time, the index is objectively weighted by EWM, and finally, the combined weighting is carried out by the linear weighting method, which effectively solves the influence of subjective extreme value deviation on the weight accuracy and makes the calculated weight value reliable.

Combined weight W:

$$W = \alpha w_j + \beta h_j \tag{1}$$

where $\alpha + \beta = 1$.

2.2 Fuzzy comprehensive evaluation model

2.2.1 Establish a set of evaluation factors

The evaluation factor set U is the set of comprehensive evaluation indicators, which is hierarchical, that is, the first-level index $U_i = \{u_1, u_2, u_3, \ldots, u_n\}$, secondary indicator $U_{ij} = \{u_{i1}, u_{i2}, u_{i3}, \ldots, u_{in}\}$, where U_{ij} represents the jth indicator of the ith indicator layer.

2.2.2 Create a collection of comment levels

Comment set $V = \{v_1, v_2, v_3, \ldots, v_m\}$, where $v_j (j = 1,2,3, \ldots, m)$ refers to the jth evaluation result, m is the number of evaluation grades, and the evaluation level is generally about 5.

2.2.3 Build a membership matrix

According to the evaluation factor set U and the comment rank set V, the membership degree matrix R is established. Each influencing factor is selected and quantified, that is, the degree of affiliation of the evaluated subject to each subset of the level is determined from a single factor perspective (the ith evaluation factor u_i the degree of affiliation to the evaluation results V_j expressed as $R_i = \{r_{i1}, r_{i2}, r_{i3}, \ldots, r_{im}\}, i = 1,2,3, \ldots, n$). By comprehensively evaluating n evaluation factors one by one, a membership matrix R of n rows and m columns can be obtained.

$$R = \begin{bmatrix} r_{11} & \cdots & r_{1m} \\ r_{21} & \cdots & r_{2m} \\ \vdots & \vdots & \vdots \\ r_{n1} & \cdots & r_{nm} \end{bmatrix} \tag{2}$$

Among them, r_{ij} indicates the degree of affiliation of the evaluation factor u_i to the V_j. For qualitative indicators, expert scoring can be used to determine the index affiliation.

2.2.4 Multi-level fuzzy comprehensive evaluation

By multiplying the membership matrix with the weight coefficient matrix of the same level, the fuzzy comprehensive evaluation results of the superior evaluation factors can be obtained, and then the evaluation results of the factors at this level are used as the higher-level membership matrix, and the final evaluation results can be calculated by using the same method.

2.2.5 Analysis of evaluation results

The calculation result of fuzzy evaluation is a fuzzy vector, which represents the comprehensive membership of the evaluation object to the evaluation level, in order to be more intuitive and convenient to optimize, you can give each evaluation level a scale, such as $\sigma = \{\sigma_1, \sigma_2, \sigma_3, \ldots, \sigma_n\}$ The specific score of the comprehensive evaluation result $A = B * \sigma \times 100$ can be calculated, and each site scheme can be quickly sorted according to this score.

2.3 Establishment of evaluation index system

According to previous research, many indicators affect the satisfaction of airport passengers, so a sound and reasonable evaluation index system must be established before the service quality evaluation.

Based on the principles of objectivity and scientificity, comparability and feasibility, comprehensiveness and conciseness, the airport passenger satisfaction evaluation index system is established, as shown in Figure 1. The index system includes three layers: the index to be evaluated, the first level of indicators, the second level of indicators, and the first level of indicators to evaluate the passenger satisfaction of Lhasa Gonggar Airport; The second-level indicators are evaluated from five aspects: airport service, airport safety, airport facilities, airport environment, and airport transportation; There are a total of 15 evaluation indicators in the three levels of indicators.

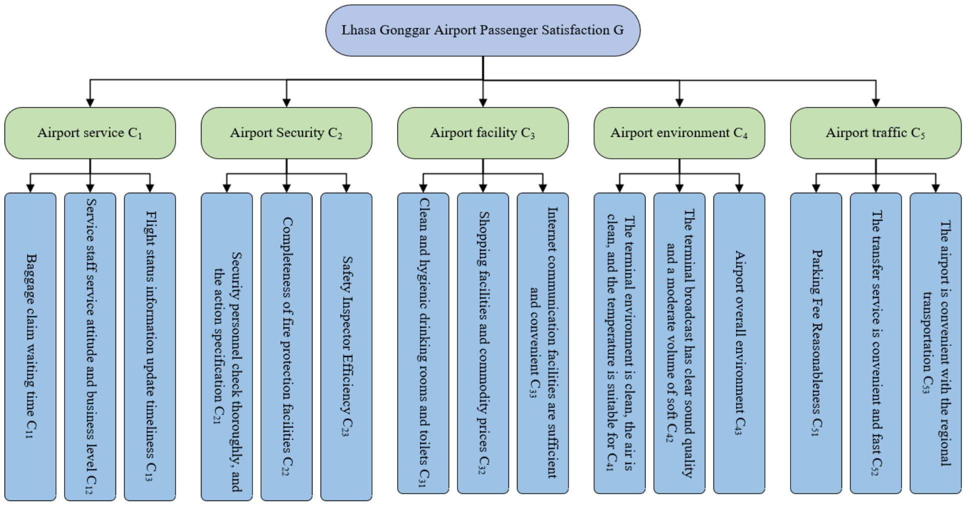

Figure 1: Airport passenger satisfaction evaluation index system

3. Case Study

3.1 Determination of evaluation index weights

This paper selects Lhasa Gonga Airport as a typical representative of the airport, and uses the constructed airport passenger satisfaction evaluation model to evaluate and analyze its airport passenger satisfaction, and uses the comprehensive scoring method of experts and passengers to construct the airport passenger satisfaction evaluation matrix. This paper analyzes the airport passenger satisfaction evaluation index system by five highland transportation experts, uses the combined weight method to calculate the weights, and calculates the subjective weights of each index based on AHP-OWA; at the same time, the entropy weights of the evaluation indexes are calculated based on the entropy weight method, and then the objective weights of the lines are obtained. Finally, the index weights are determined according to the combined weight formula, where α=0.7, and the results are shown in Table 1.

Table 1: Combined weight results of airport passenger satisfaction evaluation indicators

One layer of metrics	Subjective weight	Objective weights	Combine weights	Two Layer of indicators	Subjective weight	Objective weights	Combine weights
C_1	0.1973	0.1949	0.1956	C_{11}	0.3065	0.3509	0.3376
				C_{12}	0.3509	0.3006	0.3157
				C_{13}	0.3426	0.3485	0.3467
C_2	0.2398	0.2407	0.2405	C_{21}	0.3277	0.2853	0.2980
				C_{22}	0.3854	0.3763	0.3790
				C_{23}	0.2869	0.3384	0.3230
C_3	0.1645	0.1691	0.1677	C_{31}	0.3355	0.3000	0.3107
				C_{32}	0.3158	0.3671	0.3517
				C_{33}	0.3488	0.3330	0.3377
C_4	0.1858	0.1738	0.1774	C_{41}	0.3609	0.3590	0.3596
				C_{42}	0.2961	0.3193	0.3123
				C_{43}	0.3430	0.3217	0.3281
C_5	0.2127	0.2215	0.2188	C_{51}	0.2900	0.3583	0.3378
				C_{52}	0.3318	0.3332	0.3328
				C_{53}	0.3782	0.3085	0.3294

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3.2 Rating and affiliation

When determining the concluding grade of the comprehensive evaluation results, the airport passenger satisfaction rating is divided into 5 levels, that is, the evaluation rating set is $V = \{v_1, v_2, v_3, v_4, v_5\} = \{\text{Very poor, poor, average, better, very good}\}$, through the scoring of 5 plateau experts, the scoring results of different satisfaction levels are counted, and the index layer membership matrix is constructed to calculate the membership degree of the index layer.

4. Conclusion

Based on the AHP-entropy weight method, this paper constructs an airport passenger satisfaction analysis model based on the principle of second-level fuzzy comprehensive evaluation, and uses this method to comprehensively evaluate the airport passenger satisfaction of Lhasa Gonggar Airport. The evaluation results can be used as a reference for passenger satisfaction analysis at this airport and similar airports.

This paper believes that service quality management is a scientific and comprehensive service quality evaluation system and evaluation process, which provides a certain reference significance for better promoting the improvement of the overall service quality of the airport and benefiting more passengers.

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