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# A new hybrid simulation-based assignment approach for evaluating airlines with multiple service quality criteria

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ABSTRACT

Evaluation of airlines based on service quality criteria can help to improve the processes of airlines, and also can give guidance to travel agencies to provide better choices for passengers and tourists. In this study, a hybrid simulation-based assignment approach is proposed to deal with multi-criteria decision-making problems with a group of decision-makers. A probability distribution is used to model decision-makers' opinions and constructing a stochastic decision matrix. Then some efficient multi-criteria decision-making methods are utilized for evaluating alternatives in a simulation process. The proposed approach is applied to a problem of evaluation of five airlines with respect to opinions of 58 experts on 28 criteria. The results show the efficiency of the proposed to handle decision-making problems with a large number of experts. Moreover, the evaluation results are more reliable than the other decision-making approaches because of simulating decision-makers' opinions, using multiple methods and evaluating based on aggregative results.



## 1. Introduction

Service quality can be defined as consumer's overall feeling of the relative superiority or inferiority of an organization and its services which is a result of comparing between customers' expectations and actual services performed (Rust and Oliver, 1993). Service quality is an important factor for airlines and many researchers have applied service quality related theories and methods in the airline industry. Providing high quality services which satisfy passengers and tourists is a core competitive advantage for an airline to reach profitability and sustainable development (Chen, 2008). Most of the studies in airline service quality evaluation presumed the quality of services as a multi-dimensional factor and measured it by a well-known instrument called SERVQUAL (Saha and Theingi, 2009). SERVQUAL is a multi-dimensional measuring instrument which is designed to capture consumer expectations and perceptions of a service in terms of five dimensions including reliability, assurance, tangibles, empathy and responsiveness that are believed to represent the quality of services (Parasuraman et al., 1988).

Because of the multi-dimensional nature of SERVQUAL, this instrument can be integrated with multi-criteria decision-making (MCDM) approaches for evaluation of quality of service (Mardani et al., 2015c). In this field, Awasthi et al. (2011) developed hybrid approach based on fuzzy TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) method and SERVQUAL model for evaluation of transportation service quality. They used the dimensions of the SERVQUAL model as criteria for evaluation and ranking some alternatives. Kuo (2011) proposed a novel interval-valued fuzzy MCDM approach for evaluation of Chinese cross-strait airlines based on service quality criteria. The approach was based on combining VIKOR (in Serbian: VlseKriterijumska Optimizacija I Kompromisno Resenje) and grey relational analysis (GRA) methods, and the SERVQUAL model was used to development of evaluation criteria. In this study, we also use the SERVQUAL model and propose an MCDM approach based on its dimensions. Chou et al. (2011) presented a fuzzy weighted SERVQUAL model and applied it to the evaluation of airline service quality. The dimensions of their SERVQUAL model are used in this study as the evaluation criteria.

It is important to make the evaluation of airlines with multiple

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service quality criteria based on opinions of people who have experience of traveling by the considered airline. Different opinions can result in different evaluations, and it may be more complicated when the number of people increases. The group decision-making approaches are efficient in such situations. In the group decision-making approaches, all the people, who are involved in the evaluation process, are considered as a group of decision-makers. What a majority of individuals prefer should be reflected as a solution in the group decision-making (Kacprzyk, 1986).

In this study, a new hybrid simulation-based assignment approach is developed to deal with multi-criteria decision-making problems with a group of decision-makers. In the proposed approach, the PERT distribution is used to model opinions of the group of decision-makers. This distribution is a special case of the beta distribution and has three parameters (minimum, most likely and maximum) in its standard format. This is a very flexible distribution for modelling expert opinions and can be viewed as a smooth version of the uniform distribution or triangular distribution. After defining a stochastic MCDM problem by this distribution, the Monte Carlo simulation process is started with a predefined number of iterations. In the simulation process, a random MCDM problem generated in each iteration, and the alternatives are evaluated using some MCDM methods. Although the TOPSIS, COPRAS (COmplex PRoportional ASsessment), WASPAS (Weighted Aggregated Sum Product Assessment) and EDAS (Evaluation based on Distance from Average Solution) methods are used in this study, the proposed approach is not limited to these methods, and we aim to increase the accuracy of the evaluation by using multiple methods and reach to more reliable results. The normalized ranking scores obtained from these evaluations at the end of iterations are aggregated and used as the parameters of a linear assignment model. Solving the assignment model, we can determine the final rank of alternatives. The proposed approach is applied to a case study of evaluation and prioritization of airlines with multiple service quality criteria defined in the SERVQUAL model of Chou et al. (2011).

The rest of this paper is organized as follows. In Section 2, we briefly review the literature on the airline service quality and multi-criteria decision-making approaches. In Section 3, the methodological components of the study and the proposed approach are presented in detail. Section 4 describes the application of the proposed approach in evaluation of airlines with multiple service quality criteria. Section 5 presents discussion, and finally conclusions and future directions are presented in Section 6.

## 2. Literature review

In this section, we present a brief review of some studies on airline service quality and multi-criteria decision-making methods.

### 2.1. Airline service quality

There have been many studies in the field of airline service quality and the researchers have worked on different aspect of this field and used different methodologies in their studies. In the following we summarize some of the important studies in this field.

Tsaur et al. (2002) applied the fuzzy set theory for evaluation of the service quality of airline. They used the analytic hierarchy process (AHP) method for determination of criteria weights. Then the TOPSIS method is utilized for ranking the alternatives. The dimensions of the SERVQUAL model were used to define the evaluation criteria, and the tangibles and empathy were found as the most and the least important criteria of their study, respectively.

Park et al. (2004) studied on understanding of air passengers' behavioral intentions by testing a conceptual model. Their model considers some variables including service perception, service expectation, airline image, passenger satisfaction, service value and behavioral intentions simultaneously. They applied path analysis via maximum likelihood estimator to data collected from Korean passengers, and found that passenger satisfaction, service value and airline image have a direct effect on air passengers' behavioral intentions.

Chen and Chang (2005) examined the gaps between the service expectations of passengers and two other variables of a Taiwanese airline: the real service received and the perceptions of the expectations by frontline managers and employees. Then for determining areas for improvement, they applied the importance-performance analysis to construct service attribute evaluation maps. Results showed that the passengers were more concerned about the responsiveness and assurance dimensions from airline frontline staff. The tangibles dimension was identified as an important dimension for evaluation of in-flight service quality.

Pakdil and Aydın (2007) studied on expectations and perceptions in airline services. Based on data collected at a Turkish airline, they measured airline service quality using a weighted SERVQUAL model and factor analysis. The results of their research showed that the responsiveness was the most important dimension and the availability was the least important dimension of service quality. The educational level of passengers was an important variable in their study affecting the expectations and perceptions of them.

An and Noh (2009) investigated the impact of the in-flight service quality on airline customer satisfaction and loyalty. Data from two classes of passengers including prestige (business) and economy were analyzed in their study. The results showed that different factors are important in the in-flight service quality according to the passengers' class. The findings implied that different delivery strategies should be chosen by airline companies' in-flight service based on the passengers' class.

Liou et al. (2011) applied a modified VIKOR method to improve service quality of domestic airlines in Taiwan. Their model helps decision-makers to identify the gaps between alternatives and aspired levels in practice. To establish a comprehensive service quality evaluation framework and reduce the gaps for achieving the aspired-level, a large sample was used by them. They also provided some managerial implications to improve the level of service quality of different airlines.

Baker (2013) studied on the service quality and customer satisfaction of the top 14 U.S. airlines between 2007 and 2011. His study had two objectives: comparison of customer satisfaction and service quality based on service quality dimensions of the airlines and examination of the relationships between the dimensions of service quality and passengers' satisfaction. Implications related to operating costs, market share, infrastructure and customer service confirmed that the service quality of low cost airlines was higher than that of traditional legacy airlines.

Muturi et al. (2013) examined the impact of airline service quality on passenger satisfaction and loyalty in Uganda. Their study used random sampling technique and with 303 respondents. The results of their study showed that the quality of pre-flight, in-flight and post-flight services had a statistically significant effect on passenger satisfaction, and also passenger satisfaction had a significant effect on passenger loyalty. They suggested that airlines should consider different strategies based on characteristics of the customers such as occupation, age, gender and education level, to improve their service quality.

Choi et al. (2015) applied a service quality-adjusted data envelopment analysis (SQ-adjusted DEA) to study operational efficiency of US airlines. They found that, in the long-term, a focus on service quality can help to increase customer satisfaction and improve service productivity and overall organizational