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A modified VIKOR multiple-criteria decision method for improving domestic airlines service quality

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A B S T R A C T

This study applies a modified VIKOR method to improve service quality among domestic airlines in Taiwan. Our model allows decision-makers to understand the gaps between alternatives and aspired-levels in practice. A large sample is used to establish a complete service quality evaluation framework for reducing the gaps to achieve the aspired-level. We then applied the modified VIKOR method to establish the gaps in priorities between alternatives and aspired-levels. Finally, based on these gaps in priorities, we provide managerial implications to improve different carriers for satisfying the customers' needs to achieve the aspired-level.

1. Introduction

In a competitive environment, delivering high-quality service is important but from 2008 the global economic downturn saw airlines are struggling just to survive. This paper evaluates the service level of Taiwan's domestic airlines and to identify gaps between what airlines provide and what customers' seek.

Traditional statistical testing and multiple-criteria decision-making (MCDM) methods have been used to establish service quality criteria, with most of the latter comparing all alternatives based on synthesized rankings. In practice, however, decision-makers often simultaneously evaluate their progress in attaining one or a limited number alternatives and thus need to know where gaps in alternatives exist to minimize them. Traditional methods are unsuitable for ranking these gaps because each alternative has its own criteria. This study uses a modified VIKOR (VlseKriterijumska Optimizacija I Kompromisno Resenje in Serbian, meaning multicriteria optimization and compromise solution) method for tackling this problem (Opricovic and Tzeng, 2004).

2. Service quality in the airline industry

There is no universally accepted definition of air service quality. In general, air service quality can be defined as a consumer's overall impression of the relative efficiency of a supplier's organization and services (Park et al., 2004) and involves various interactions between a passenger and airline employees, as well as anything that is likely to influence passengers' perceptions, of a carrier's image (Gursoy et al., 2005).

Understanding exactly what customers expect is a crucial step in delivering high-quality service, but only customers, however, can truly define service quality. Parasuraman et al. (1985), however, have developed a framework that defines service quality as the degree and direction of discrepancy between customers' expectations and perceptions. Their model, further developed, has become known as SERVQUAL, and contains five dimensions with 22 attributes of quality (Parasuraman et al., 1988). It has become the most widely used model of customer-perceived service quality.

Most previous MCDM models focus on ranking and selecting from a set of alternatives based on the synthesized scorings for each alternative with the same criteria. Our modified VIKOR method built on SERVQUAL allows solving MCDM problems with conflicting and non-commensurable criteria and provides a solution that is the closest to the optimum.

3. The modified VIKOR method

The main difference between our modified VIKOR and the original VIKOR (Opricovic and Tzeng, 2002) is the replacement of a fixed common number of criteria for all alternatives with a set of criteria for each alternative, and providing a method for ranking the

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Table 1
The normalized weight-rating table for modified VIKOR.

Alternative	Criteria						Alternative	Criteria				
	c_1	⋯	c_j	⋯	c_n			c_1	⋯	c_j	⋯	c_{n_i}
A_1	f_{11}	⋯	f_{1j}	⋯	f_{1n}		A_1	$w_1^1 r_{11}$	⋯	$w_j^1 r_{1j}$	⋯	$w_{n_1}^1 r_{1n_1}$
⋮	⋮		⋮		⋮		⋮	⋮		⋮		⋮
A_i	f_{i1}	⋯	f_{ij}	⋯	f_{in}		A_i	$w_1^i r_{i1}$	⋯	$w_j^i r_{ij}$	⋯	$w_{n_i}^i r_{in_i}$
⋮	⋮		⋮		⋮		⋮	⋮		⋮		⋮
A_m	f_{m1}	…	f_{mj}	⋯	f_{mn}	Normalized⇒ × w_j^i	A_m	$w_1^m r_{m1}$	…	$w_j^m r_{mj}$	⋯	$w_{n_m}^m r_{mn_m}$

unimproved gaps of alternatives. The alternatives are denoted as A_1, A_2, …, A_i,…, A_m and are assessed by n_1, n_2,…, n_i,…, n_m criteria. w_j^i is the weight attached to criterion j of alternative A_i and f_{ij} is the rating of criterion j of alternative A_i. The modified VIKOR involves:

Step 1. Determine the best f_j^* and the worst f_j^- values. Because each alternative is evaluated, not compared according to its own-criteria, an ideal and negative ideal point, as in the VIKOR method ($f_j^* = \max_i f_{ij}$ and $f_j^- = \min_i f_{ij}$), cannot be set. Therefore, the benefit or cost must be reset according to the expectation of the decision-maker for each criterion of the alternatives; the best f_{ij}^* is the aspired level and the worst f_{ij}^- the tolerable level; these functions are expressed as;

$$f_{ij}^* = \text{aspired\_}f_{ij}\left(\text{or } f_{ij}^* = \text{aspired\_level}\right),$$
$$f_{ij}^- = \text{tolerable\_}f_{ij},\ \left(\text{or } f_{ij}^- = \text{tolerable\_level}\right).$$

In addition, we rewrite the normalized weight-rating table for the new method in real world as Table 1: where n_i is the number of criteria in each alternative A_i because each alternative has its own assessing criteria. The weights w_j^i must be normalized under the same alternative (where $j = 1, \ldots, n_i$), i.e., $\sum_{j=1}^{n_i} w_j^i = 1$. In addition, the best f_{ij}^* is the desired level, and the worst f_{ij}^- is the tolerable level for each criterion of each alternative. The normalized ratings r_{ij} are

$$r_{ij} = \left(\left|f_{ij}^* - f_{ij}\right|\right) \Big/ \left(\left|f_{ij}^* - f_{ij}^-\right|\right). \tag{1}$$

Step 2. Compute S_i and Q_i, $i = 1, 2, \ldots, m$. The functions are

$$S_i = \sum_{j=1}^{n_i} w_j^i r_{ij}, \quad i = 1, 2, \ldots, m \text{ and } \sum_{j=1}^{n_i} w_j^i = 1 \tag{2}$$

$$Q_i = \max_j \{r_{ij} | j = 1, 2, \ldots, n_i\}, \quad i = 1, 2, \ldots, m \tag{3}$$

In the traditional VIKOR method, Q_i is represented as $\max_j \{w_j r_{ij} | j = 1, 2, \ldots, n\}$, implying that group utility is more important than maximum regret. Because Q_i is only a part of S_i, S_i must exceed $Q_i \cdot S_i$ is emphasized more than Q_i in the traditional VIKOR method. However, the maximum regret is often important in practice and is usually taken into account. To balance S_i and Q_i, Eq. (3) is used instead of the traditional Q_i in VIKOR. We use Eq. (3) $\max_j \{r_{ij} | j = 1, 2, \ldots, n_i\}$ in $i = 1, 2, \ldots, m$ as showing the maximum gap to be improved.

Step 3. Compute the index values R_i, $i = 1, 2, \ldots, m$.

$$R_i = v\left(S_i - S^*\right) \Big/ \left(S^- - S^*\right) + (1-v)\left(Q_i - Q^*\right) \Big/ \left(Q^- - Q^*\right), \tag{4}$$

where $0 \le v \le 1$; when $v > 0.5$, this indicates that S is emphasized more than Q in Eq. (4), whereas when $v < 0.5$, Q is emphasized. More specifically, when v equals unity, it represents a decision-making process that could use the strategy of maximizing group utility, whereas when v is zero, it represents a process that could use a minimum individual regret strategy that is found among maximum individual regrets/gaps of lower-level criteria of each alternative. The weight v would affect the ranking of the alternatives and is usually determined externally by the experts. Moreover, S^*, S^-, $Q^*$and Q^- are rewritten and listed as

$$S^* = \min_i S_i,\ S^- = \max_i S_i \quad \text{or} \quad S^* = \text{best\_}S,\ S^- = \text{worst\_}S,$$

$$Q^* = \min_i Q_i,\ Q^- = \max_i Q_i \quad \text{or} \quad Q^* = \text{best\_}Q,$$
$$Q^- = \text{worst\_}Q$$

In the VIKOR method, we set S^*, S^-, Q^* and Q^- by $S^* = \min_i S_i$, $S^- = \max_i S_i$, $Q^* = \min_i Q_i$ and $Q^- = \max_i Q_i$. However, in the modified VIKOR method, we append an aspired level and a tolerable level for S and Q of the compared alternatives respectively to obtain absolute relations for the index values R_i. Here we can decide the best $S^* = 0$ and $Q^* = 0$, the worst $S^- = 1$ and $Q^- = 1$ to get absolute relations for the index values R_i, we can re-writing Eq. (4) as $R_i = vS_i + (1 - v)Q_i$. Specifically, if we use $\min_i S_i$ as S^* and $\min_i Q_i$ as Q^*, it implies a relative relation for the index relations R_i of these alternatives, whereas if we use a zero gap as the best level and unity as the worst, it implies an absolute relation for the index relations R_i of these alternatives.

Table 2
Passenger profiles.

Attributes/distribution	Sample number	Frequency (%)
Gender		
Male	3426	61.7
Female	2127	38.3
Age		
20 or younger	291	5.2
21–30	1322	24.0
31–40	1356	24.4
41–50	1293	23.3
51–60	967	17.4
61 or older	322	5.7
Occupation		
Government employee	1386	24.0
Private-sector employee	1170	21.1
Student	384	6.9
Private business	555	10.0
Management	547	9.8
Others	1511	28.2
Education		
Junior high or below	519	9.3
Senior high	1447	26.1
College	2851	51.3
Graduate school	736	13.7