The Qualiflex Method For The Insurance Company Selection Problem

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Abstract

Insurance is a tool for the process of protecting the people against the uncertainty and the loss of their life and property. This process is operated by an insurance company under a contract between insurance holder and insurance company. The contract may be signed for life, automobile, house etc. and the coverage of the contract may change from insurance company to company. So the selection of the most appropriate insurance company is not easy task. This selection may be handled as a MCDM (Multi Criteria Decision Making) problem. MCDM problems refer to make a decision for the alternatives characterized by multiple, usually conflicting, criteria. There are several methods for solving MCDM problems. In this paper, QUALIFLEX (QUALItative FLEXible) method, one of the MCDM methods, is applied to the insurance company selection problem. This method is based on the evaluation of all possible rankings (permutations) of alternatives in terms of concordance and discordance indices. The insurance company alternatives are ranked by this method and finally the results are discussed.

Keywords: MCDM, QUALIFLEX, insurance company selection

Introduction

Insurance is the protection against financial loss arising on the happening of unexpected events (Vaughan & Vaughan, 2009). Both individuals and businesses have significant needs for various types of insurance to provide protection for their health care, property and legal claims made against them by others (Mayer et al., 2012). They get insurance services through insurance companies which are financial institutions provide services as financial intermediaries of financial markets. In this manner insurance companies provide the coverage in the form of compensation resulting from loss, damages, injury, treatment or hardship in exchange for premium payments (Tadesse, 2014). Getting insurance services is a technical and complex task because of the various criteria that influence the businesses to make this decision. So it's important to choose the right insurance company for businesses as well as individuals.

In the literature, multiple criteria decision making methods have been widely applied in the domain of insurance decision making. Amiri et al. (2011) applied balanced scorecards and VIKOR method in rating of insurance companies. Doumpos et al. (2012) used PROMETHEE II method and regression analysis for the performance of nonlife insurers. Yücenur and Demirel (2012) analyzed five Turkish insurance companies for a foreign investor who wants to purchase a local insurance company and selected the most appropriate alternative with the extended VIKOR method. Alenjagh (2013) used ANP and PROMETHEE methods for financial performance evaluation and ranking of insurance companies in Tehran Stock Exchange. Akhisar (2014) obtained the financial performance ranking of Turkish Insurance companies for the period 2006-2010 with ANP method. Khodamoradi et al. (2014) combined DEMATEL and PROMETHEE II methods for rating of Iranian insurance companies listed in Tehran Stock Exchange for a period of 2010–2012. Sehhat et al. (2015) ranked the insurance companies in Iran with AHP and TOPSIS methods. Kirkbesoglu et al. (2015) used AHP method for testing the effectiveness of insurance companies to provide information to current and prospective policyholders in two separate international markets; United Kingdom (UK) and Turkey. Although a considerable numbers of MCDM methods have been employed to solve insurance company selection problems, QUALIFLEX (QUALItative FLEXible) method has not been applied to these problems. In this paper QUALIFLEX method is used for selecting the most appropriate alternative insurance company. It is one of the outranking methods and it depends on the pairwise comparisons of alternatives with respect to each criterion under all possible permutations of the alternatives and identifies the optimal permutation that maximizes the value of concordance/discordance index (Martel & Matarazzo, 2005; Zhang and Xu, 2015).

The rest of this paper is organized as follows. The background of QUALIFLEX method is presented. Then the application of this method is demonstrated with the insurance company selection problem. Lastly the results of the application and the recommendations for future studies are given.

QUALIFLEX Method

QUALIFLEX (QUALItative FLEXible) method is one of the outranking methods for solving MCDM problems. It was developed by Paelinck (1976, 1977, 1978) and Paelinck (1976) generalized Jacquet-Lagreze's permutation method to develop a flexible method (Chen et al., 2013, Wang et al., 2015). Its flexibility comes from the ability of handling cardinal and ordinal information simultaneously in the decision making process (Zhang & Xu, 2015). The QUALIFLEX method is based on a metric procedure namely the method performs the pairwise comparisons of alternatives with respect to each criterion under all possible permutations (rankings) of the alternatives. Then a concordance and discordance indices are computed for each couple of alternatives of permutations. Finally optimal permutation of the alternatives that maximizes the value of concordance/discordance index and the most preferred alternative among alternatives are determined (Martel & Matarazzo, 2005; Alinezhad & Esfandiari, 2012).

In the literature QUALIFLEX method and its extensions have been employed to solve MCDM problems. Alinezhad and Esfandiari (2012) solved suitable site selection problem for building a dam with QUALIFLEX and VIKOR methods. The authors developed the sensitivity analysis of these methods and proposed a method based on changes in the weights. Chen and Tsui (2012) performed a multi criteria decision analysis related with medical decision making problem by combining optimistic and pessimistic estimations with intuitionistic fuzzy QUALIFLEX method. Chen et al. (2013) developed an extended QUALIFLEX method based on interval type-2 trapezoidal fuzzy numbers and applied the extended QUALIFLEX method to a medical decision making problem. Wang et al. (2015) proposed a likelihood-based QUALIFLEX method for handling multi criteria decision making problems within the interval type-2 fuzzy decision environment. The proposed method was applied to a medical decision making problem. Zhang and Xu (2015) proposed a hesitant fuzzy QUALIFLEX method with a signed distance-based comparison method for solving a green supplier selection problem of an automobile manufacturing company. Zhang (2015) combined the QUALIFLEX method with interval-valued hesitant fuzzy decision environment then the new method was called interval-valued hesitant fuzzy QUALIFLEX method. They applied the new method to the problem of Zhang and Xu (2015). Xue et al. (2016) solved robot selection problems by a new integrated linguistic MCDM approach using hesitant 2-tuple linguistic term sets and an extended QUALIFLEX method.

The application steps of QUALIFLEX method are presented in the following (Chen & Tsui, 2012; Alinezhad & Esfandiari, 2012; Xue et al., 2016):

Step 1: A multiple criteria decision making problem is formulated. It is assumed that there is a set of *m* feasible alternatives, A_i (i=1,2,…,m), against to a finite set of *j* evaluation criteria C_j (j=1,2,…,n). Then the decision matrix *X* is formed. It shows the performance of different alternatives with respect to various criteria.

$$X = [x_{ij}]_{mxn} = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \qquad (i = 1,2\ldots,m;\ j = 1,2,\ldots,n)$$

(1)

x_{ij} presents the performance value of *i*th alternative on *j*th criterion, *m* and *n* are the numbers of alternatives and criteria respectively.

Step 2: All possible permutations of ranking of the alternatives are listed. The number of these permutations is *m!*. Let P_l denote the *l*th permutation as:

$$P_l = (\ldots, A_i, \ldots, A_{i'}, \ldots) \qquad l = 1, 2, \ldots, m!$$

(2)

where the alternative A_i is ranked higher than or equal to $A_{i'}$.

Step 3: For each couple of alternatives of permutations, a concordance and discordance indices are computed which reflects the concordance and discordance of their ranks and their evaluation preorder derived from the decision matrix. This index is firstly computed at the level of single criterion and then at a comprehensive level with respect to all possible rankings. The concordance/discordance index $I_j^l(A_i, A_{i'})$ for each pair of alternatives $(A_i, A_{i'})$ at the level of preorder with respect to *j*th criterion and the ranking corresponding *l*th permutation is computed as:

$$I_j^l = \sum_{A_i, A_{i'} \in A} I_j^l(A_i, A_{i'})$$

(3)

where

$$I_j^l(A_i, A_{i'}) = \begin{cases} 1 & \text{if there is concordance} \\ 0 & \text{if there is aequo} \\ -1 & \text{if there is discordance} \end{cases} \qquad (4)$$

There are concordance and discordance if A_i and $A_{i'}$ are ranked or not ranked in the same order within the preorder and permutation respectively. If they have the same rank, then the situation is ex aequo.

Step 4: Sometimes decision makers want to give more importance to a criterion than the others. If the importance weight of a criterion is taken into account, in this step the weighted concordance/discordance is calculated as:

$$I_j^l = \sum_{A_i, A_{i'} \in A} I_j^l(A_i, A_{i'}) w_j \qquad (5)$$

w_j denotes the weight of *j*th criterion.

Step 5: The overall concordance/discordance index (I^l) for the permutation P_l is computed as:

$$I^l = \sum_{j=1}^{n} \sum_{A_i, A_{i'} \in A} I_j^l(A_i, A_{i'}) w_j \quad (6)$$

The final ranking order of all alternatives is obtained from the overall concordance/discordance index of each permutation. The bigger the overall concordance/discordance index value, the better ranking of the alternatives.

Application

In this section, an insurance company selection problem in a textile company is performed to demonstrate the applicability of QUALIFLEX method. The textile company has purchased automobiles for their managers. The models and features of the automobiles are same. The company wants to have their new automobiles insured so the company searches the best insurance company. A committee from the purchasing department is interested in this task as a decision maker. Firstly the committee identifies the evaluation criteria as C_1 (insurance premium in TRY), C_2 (insurance coverage in TRY), C_3 (discounts in %), C_4 (reputation) and C_5 (service quality). The data for C_1, C_2 and C_3 are quantitative whereas data for the C_4 and C_5 are qualitative. 5 point scale (5: Excellent, 4: Very good, 3: Good, 2: Fair, 1: Poor) is used while evaluating the alternatives for C_4 and C_5. Also C_2, C_3, C_4 and C_5 are beneficial criteria where higher values are desirable; C_1 is non-beneficial criterion where smaller value is always preferred. Considering these criteria the committee determines 4 different insurance company alternatives (A_1, A_2, A_3, A_4) for their automobiles and receives insurance proposals from these insurance company alternatives. The decision matrix shown in Table 1 is formed by these proposals.

Table 1. Decision matrix

	A_1	A_2	A_3	A_4
C_1	921,82	966,11	1.067,89	918,11
C_2	112.500	113.000	111.500	110.750
C_3	40	30	35	40
C_4	5	3	5	4
C_5	3	5	5	4

Considering the data in Table 1, the ranking of alternatives with respect to each criterion is given in Table 2.

Table 2. Rank evaluation of alternatives

	A_1	A_2	A_3	A_4
C_1	2	3	4	1
C_2	2	1	3	4
C_3	1	3	2	1
C_4	1	3	1	2
C_5	3	1	1	2

The QUALIFLEX method begins with listing all possible permutations of ranking of the alternatives. 4! permutations of alternatives ranking are possible for this problem. “>” sign in the permutations means “is preferred to”. The permutations are generated as:

$P_1 = A_1>A_2>A_3>A_4$	$P_9 = A_2>A_3>A_1>A_4$	$P_{17} = A_3>A_4>A_2>A_1$
$P_2 = A_1>A_2>A_4>A_3$	$P_{10} = A_2>A_3>A_4>A_1$	$P_{18} = A_3>A_4>A_1>A_2$
$P_3 = A_1>A_3>A_2>A_4$	$P_{11} = A_2>A_4>A_1>A_3$	$P_{19} = A_4>A_2>A_3>A_1$
$P_4 = A_1>A_3>A_4>A_2$	$P_{12} = A_2>A_4>A_3>A_1$	$P_{20} = A_4>A_2>A_1>A_3$
$P_5 = A_1>A_4>A_2>A_3$	$P_{13} = A_3>A_2>A_1>A_4$	$P_{21} = A_4>A_3>A_2>A_1$
$P_6 = A_1>A_4>A_3>A_2$	$P_{14} = A_3>A_2>A_4>A_1$	$P_{22} = A_4>A_3>A_1>A_2$
$P_7 = A_2>A_1>A_3>A_4$	$P_{15} = A_3>A_1>A_2>A_4$	$P_{23} = A_4>A_1>A_2>A_3$
$P_8 = A_2>A_1>A_4>A_3$	$P_{16} = A_3>A_1>A_4>A_2$	$P_{24} = A_4>A_1>A_3>A_2$

The concordance/discordance index for each pair of alternatives at the level of preorder with respect to *j*th criterion and the ranking corresponding *l*th permutation is computed by Eq. (3) –(4). For instance the necessary operations are presented for the first permutation *(P_1)*:

P_1: $A_1>A_2>A_3>A_4$

C_1		C_2		C_3		C_4		C_5	
$A_1>A_2$	$\rightarrow 1$	$A_1<A_2$	$\rightarrow -1$	$A_1>A_2$	$\rightarrow 1$	$A_1>A_2$	$\rightarrow 1$	$A_1<A_2$	$\rightarrow -1$
$A_1>A_3$	$\rightarrow 1$	$A_1>A_3$	$\rightarrow 1$	$A_1>A_3$	$\rightarrow 1$	$A_1=A_3$	$\rightarrow 0$	$A_1<A_3$	$\rightarrow -1$
$A_1<A_4$	$\rightarrow -1$	$A_1>A_4$	$\rightarrow 1$	$A_1=A_4$	$\rightarrow 0$	$A_1>A_4$	$\rightarrow 1$	$A_1<A_4$	$\rightarrow -1$
$A_2>A_3$	$\rightarrow 1$	$A_2>A_3$	$\rightarrow 1$	$A_2<A_3$	$\rightarrow -1$	$A_2<A_3$	$\rightarrow -1$	$A_2=A_3$	$\rightarrow 0$
$A_2<A_4$	$\rightarrow -1$	$A_2>A_4$	$\rightarrow 1$	$A_2<A_4$	$\rightarrow -1$	$A_2<A_4$	$\rightarrow -1$	$A_2>A_4$	$\rightarrow 1$
$A_3<A_4$	$\rightarrow -1$	$A_3>A_4$	$\rightarrow 1$	$A_3<A_4$	$\rightarrow -1$	$A_3>A_4$	$\rightarrow 1$	$A_3>A_4$	$\rightarrow 1$

Only the computational results of the concordance and discordance indices for the first permutation are presented in Table 3 because of the page constraint. Then the weighted concordance and discordance indices are computed by Eq. (5). In this paper it is assumed that criteria are weighted equally as 1/5.

Table 3. The concordance and discordance indices for the first permutation

P_1	***C_1***	***C_2***	***C_3***	***C_4***	***C_5***
$I_j^1(A_1,A_2)$	1	-1	1	1	-1
$I_j^1(A_1,A_3)$	1	1	1	0	-1
$I_j^1(A_1,A_4)$	-1	1	0	1	-1
$I_j^1(A_2,A_3)$	1	1	-1	-1	0
$I_j^1(A_2,A_4)$	-1	1	-1	-1	1
$I_j^1(A_3,A_4)$	-1	1	-1	1	1

Table 4. The weighted concordance and discordance indices for the first permutation

	$I_1^l(A_i,A_{i'})$	$I_2^l(A_i,A_{i'})$	$I_3^1(A_i,A_{i'})$	$I_4^1(A_i,A_{i'})$	$I_5^1(A_i,A_{i'})$
P_1	0	0,8	-0,2	0,2	-0,2

Table 5. The overall concordance and discordance indices for the all permutations

	P_1	***P_2***	***P_3***	***P_4***	***P_5***	***P_6***	***P_7***	***P_8***
I^l	0,6	0,2	0,6	1	0,6	0,6	0,2	-0,2
	P_9	***P_{10}***	***P_{11}***	***P_{12}***	***P_{13}***	***P_{14}***	***P_{15}***	***P_{16}***
I^l	-0,6	-0,6	-0,2	-1	-0,6	-0,6	-0,2	0,2
	P_{17}	***P_{18}***	***P_{19}***	***P_{20}***	***P_{21}***	***P_{22}***	***P_{23}***	***P_{24}***
I^l	-0,2	0,2	-0,6	0,2	-1,4	-0,2	0,6	0,6

Finally the overall concordance/discordance index for the permutation P_l is computed by Eq. (6) and results are given in Table 5. According to Table 5, permutation 4 (P_4) is greater than the others so A_1 is the best alternative.

Conclusion

Although automobile insurance is made optionally, companies want to get the automobile insurance for their automobiles in order to protect themselves against the potential risks that may arise. In this paper, choosing the right insurance company of a textile company is examined regarding the important criteria influencing the decision and QUALIFLEX method, which is one of the outranking methods, is applied. The objective of this paper is to find out overall ranking of automobile insurance companies alternatives under the evaluation criteria. In this manner firstly the insurance company selection problem of the textile company is defined by determining the criteria and alternatives. Then the necessary data are gathered. After forming all permutations of alternatives ranking, a concordance and discordance indices are computed for each couple of alternatives of permutations at the single criterion level and the comprehensive level. Finally the best permutation of alternatives ranking and the best alternative are determined according to the overall concordance/discordance indices. Permutation 4 (P_4) and also A_1 are the best for this problem.

The QUALIFLEX method provides some advantages to the decision makers. Firstly the mathematical background of QUALIFLEX method is not complex so it is easy understandable and applicable. The method is flexible in terms of handling both cardinal and ordinal data of the problem. The method is suitable for the problems where the number of criteria exceeds the number of alternatives (Chen et al., 2013). But the number of permutations increases when the number of alternatives increases. In this situation the computational procedure becomes time consuming and tedious. This is the main disadvantage of the method. This situation may be overcome by developing a software which performs QUALIFLEX method steps.

This paper shows that the QUALIFLEX method is performed efficiently for the insurance company selection problem. In future studies, the number of criteria and alternatives may be changed for the same selection problem. The weights of the criteria may be derived from different weighting methods. The ranking of the alternatives may be performed with other MCDM methods and the obtained results may be compared. The QUALIFLEX method may also be applied to other selection problems. Also fuzzy extension of this method may be applied to the same problem or other selection problems.

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