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A New Approach to Investigate the Performance of Insurance Branches in Iran Using Best-Worst Method and Fuzzy Inference System

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Abstract

The purpose of this study is to present a fuzzy expert model to examine the performance of insurance branches in Iran. The aim is to weight the criteria for measuring the performance of insurance branches and according to the experts' perspectives. Our method is developed by the use of Best-Worst Method (BWM) and Fuzzy Inference System (FIS). BWM is used to determine the importance of each criteria and FIS to evaluate and rank the insurance branches. The data for this study was collected from the managers of 52 Dana insurance companies in Iran. By analyzing the data obtained by the questionnaire, it was determined that the criteria such as insurance costs, administrative, general and personnel costs, premium income, deferred claims, marketing and advertising costs, market share of number in issued insurance policies, degree of customer satisfaction, level of employee education, amount of investment, facility to employees, cost of education, research and development costs and manpower skills are the most important criteria for senior executives in measuring the performance of Dana insurance company. In addition, the results of BWM showed that the insurance costs criteria is the most important criteria among others. The results concluded that the proposed model is superior to other methods in the literature in terms of convenience and accuracy.

Keywords: Fuzzy Inference System, Best-Worst method, Performance, Insurance branches

1. Introduction

Performance assessment has been one of the most important issues in the organizations (Angle & Perry, 1981; Ellinger, Ellinger, Yang, & Howton, 2002; Katsikeas, Leonidou, & Morgan, 2000). According to (Gipps, 2002), performance assessment is defined as a "systematic attempt to measure a learner's ability to use previously acquired knowledge in solving novel problems or completing specific tasks". In the case of supply chain, it is defined "as an effectiveness process and activity's efficiency" (Nasab, 2012). It has been found that the performance evaluation of firms is crucial for the sector's development of firms (Ertuğrul & Karakaşoğlu, 2009).

Nowadays, most organizations are operating in a competitive and dynamic environment, an environment which is constantly changing which is difficult to predict. The organizations spend a lot of time to achieve their goals to make competitive advantages, therefore, knowing how much the organizations have achieved their goals, and understanding the organization's position in today's complex and dynamic environment is very important for assessing their performance (Delaney & Huselid, 1996). Currently, the insurance industry is one of the most important economic sectors in each country (Isa & Pope, 2011; Kirkbesoglu & Ozder, 2015). Insurance industry is considered as critical factor of economic development in developing and developed countries. The successful performance of this industry can create incentives for other industries for the development of their economy. Accordingly, insurance companies need to be aware of the environment, the competitors and their performance in order to achieve a strong and effective performance in their organizations and take the necessary actions with regard to this awareness. The evaluation of the performance is one of the important tools of this awareness. In other words, by evaluating performance, management can be aware of how to achieve the goals and perform the necessary operations to be successful in the economic development in national and international levels.

Many decision-making methods have been developed in the area of performance assessment (Georgy, Chang, &

Zhang, 2005; Kuo & Liang, 2012; Safaei Ghadikolaei, Khalili Esbouei, & Antucheviciene, 2014). Multi-Criteria Decision Making (MCDM) techniques such as Best-Worst Method (BWM) (Rezaei, 2015, 2016; Rezaei, Nispeling, Sarkis, & Tavasszy, 2016), Analytic Hierarchy Process (AHP) (Hwang, Moon, Chuang, & Goan, 2005; Zare et al., 2016; Zolfani, Chen, Rezaeiniya, & Tamošaitienė, 2012), Analytic Network Process (ANP) (Yang, Shieh, Leu, & Tzeng, 2008) and Decision-Making Trial and Evaluation Laboratory (DEMATEL) (Ahmadi, Nilashi, & Ibrahim, 2015; Nilashi, Zakaria, Ibrahim, Majid, Zin, & Farahmand, 2015; Yang et al., 2008) have been very effective in developing these methods (Safaei Ghadikolaei et al., 2014). These techniques are mainly used to find importance level of criteria to evaluate the organization performance (Ertuğrul & Karakaşoğlu, 2009).

In this research, using a combination of multi-criteria decision-making and fuzzy techniques methods, a hybrid method is presented for assessing the performance of insurance companies. We develop the method by employing Best-Worst Method and Fuzzy Inference System.

The remainder of this paper is organized as follows. In Section 2, we present the related work. In Section 3, we present the methodology. In Section 4, the data analyses are presented. Finally, the conclusion is presented in Section 5.

2. Related Work

In the context of insurance companies performance, several research have been conducted which some of them are discussed in this section.

Shiu (2004) conducted a study on determinants of United Kingdom general insurance company performance. The researchers addressed several important econometric problems in the insurance companies. Born, Gentry, Viscusi, & Zeckhauser (1995) investigated the performance of stock and mutual companies. Harris & Katz (1991) conducted a research on the organizational performance and information technology investment intensity in the insurance industry. They found that there is a positive relationship between firm performance and the level of information technology investment intensity. For general insurance companies in Kenya, Mwangi & Murigu (2015) developed their research on the determinants of financial performance. They used multiple linear regression to analysis the data. They found that there are positive relationships between profitability and leverage, equity capital and management competence index. Soekarno & Azhar (2009) performed analysis of financial ratio to distinguish Indonesia joint venture general insurance company performance by the use of discriminant analysis. They used 13 selected financial ratios as the variables in their research. They were in three main categories, Profitability, Management Efficiency and Solvency. The sub-factors were: Return on Assets, Return on Equity, Net Profit Margin, Investment Income Ratio, Claim Expense/Net Premium, Risk Based Capital, Liquidity Ratio, Technical Reverse to Investment Ratio, Debt Ratio Technical, Combined Ratio, Loss Ratio, Expense Ratio and Average Collection Period. Carter (2006) conducted a study on the coaching sequence for national insurance company. They found that effective sales management coaching can provide sales managers with the skills in insurance companies to professionally assist the salespeople grow and develop. A research was conducted by Burca & Batrinca (2014) to identify the determinants of financial performance in the Romanian insurance market during the period 2008–2012. According to their data analysis, the determinants of the financial performance in the Romanian insurance market were: the financial leverage in insurance, company size, growth of gross written premiums, risk retention ratio, underwriting risk and solvency margin. Oscar Akotey, Sackey, Amoah, & Frimpong Manso (2013) conducted a study on the financial performance of life insurance companies in Ghana. The samples of their study were annual financial statements of ten life insurance companies. They found that there is a relationship between underwriting profit and investment income to enhance the overall profitability of life insurers.

3. Methodology

In this research a hybrid method is developed to find the relative importance of criteria for assessing the performance of insurance companies. We develop the method by employing Best-Worst Method (Rezaei, 2015) and Fuzzy Inference System (Anderson & Hall, 1999; Nilashi, Zakaria, Ibrahim, Majid, Zin, Chugtai, et al., 2015). A general framework of the proposed method is presented in Fig. 1. In our method, first a list of the best criteria for assessing the performance of insurance companies from the literature is selected. Then, by using the questionnaire, the degree of importance (weight) of each criteria is obtained using the BWM technique.

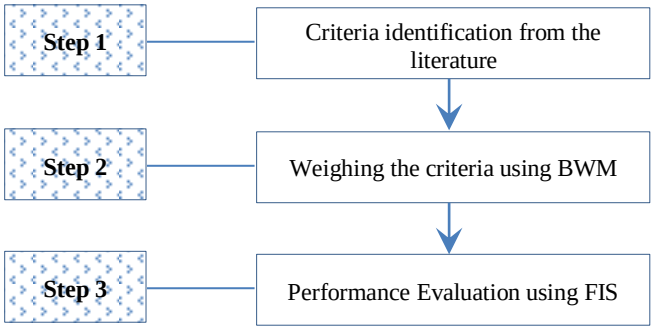

Fig. 1. General framework of the proposed method

After obtaining the weights of the criteria, according to the experts' responses, fuzzy rules are determined for the performance evaluation of insurance companies using FIS.

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3.1 Best-Worst Method (BWM)

The Best-Worst method was proposed for the first time by Rezaei (2015), as a new MCDM technique. This MCDM technique can effectively obtain the weights of criteria and alternatives in the complex decision-making systems. The procedure of this technique is presented in Fig. 2 (Rezaei, 2015). The mathematical background of this method is completely introduced in Rezaei (2015).

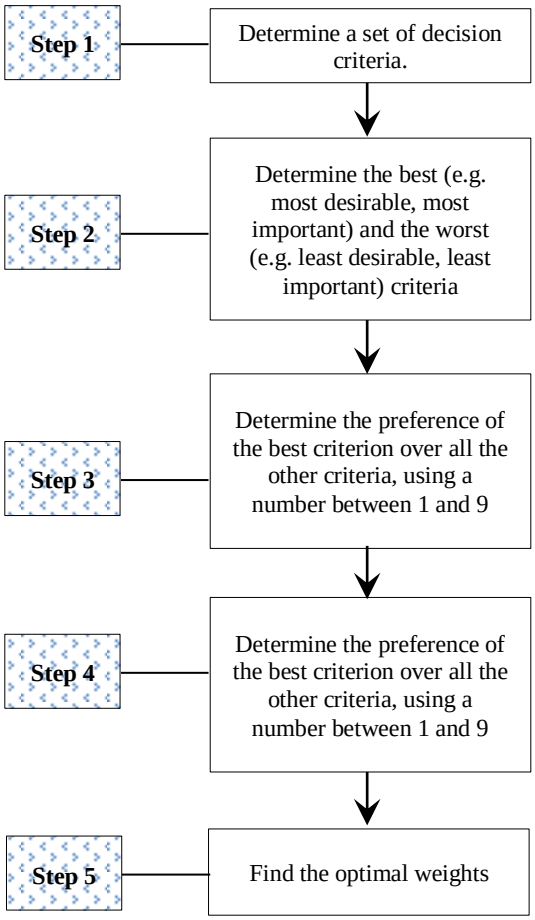

Fig. 2. The steps for Best-Worst method

3.1 Fuzzy Inference System (FIS)

According to Rowlands & Wang (2000), "fuzzy inference (reasoning) is the actual process of mapping from a given input to an output using fuzzy logic". Fuzzy Inference System has been effectively applied in many fields such as: data classification (Lotte, 2006; Nilashi, Ibrahim, Ahmadi, & Shahmoradi, 2017), decision analysis (Efendigil, Önüt, & Kahraman, 2009; Yadegaridehkordi, Nilashi, Nasir, & Ibrahim, 2018), automatic control (Gao & Er, 2003), computer vision (Alshennawy & Aly, 2009), and expert systems (Nilashi, bin Ibrahim, & Ithnin, 2014b; Nilashi & Ibrahim, 2014). In the literature, it called by different names, fuzzy-rule-based system, fuzzy expert system, fuzzy model, fuzzy logic controller and fuzzy associative memory. The main components of the process in a FIS are: Membership Functions (MFs), fuzzy logic operators, and if-then rules. The architecture of the FIS is presented in Fig. 3.

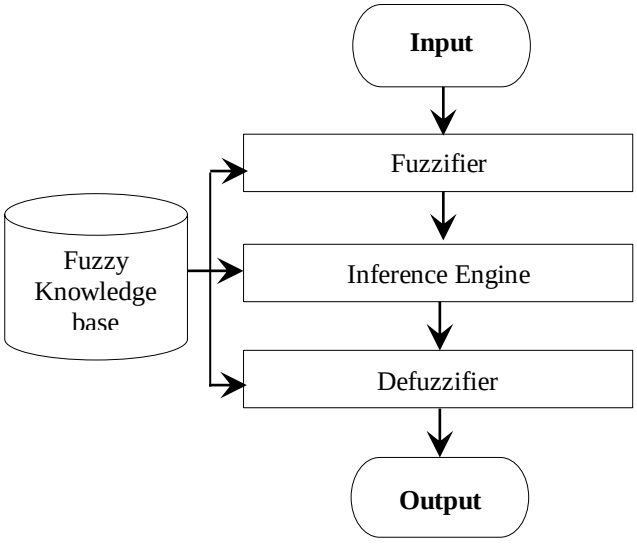

Fig. 3. The architecture of the FIS

In the first step, which is called fuzzification, the input variables are compared with the MFs on the antecedent part for obtaining the membership values of each linguistic label (Nilashi, bin Ibrahim, & Ithnin, 2014a). Then, the membership values of the previous step on the premise part are combined to get firing strength of each rule in the FIS. In the next step, the qualified consequents or each rule are generated. In the last step, which is called Defuzzification (Nilashi, Ibrahim, & Ahani, 2016), the qualified consequents are aggregated to produce a crisp output.

In this research, the aim is to develop a fuzzy-rule-based system for assessing the performance of insurance companies by a set of criteria. We identify the inputs and output of the system and develop the membership functions and fuzzy rules to construct the FIS.

4. Data collection and analysis

4.1 Data collection

The data for this study was collected from the managers of 52 Dana insurance companies in Iran. We used a questionnaire to collect the data. The questionnaire includes two main sections. The first section includes the demographic information of the respondent. The information in this section includes the age, level of education and work experience of the respondent in Dana insurance. The descriptive statistics of respondents was done by SPSS Ver. 22 software. In Table 1, we present the demographic information of the respondents of this study. As can be seen from this table, the majority of the respondents have the age between 31 to 40 years old (59.61%). In addition, most of the respondents have master's degree (60%). Furthermore, 78.844% of the respondents have more than eleven years work experiences in Dana insurance companies.

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Table 1. Respondent demographic information

Item	Levels	Frequency	%
Age	31-40	31	59.61
	41-50	11	21.15
	>=50	10	19.23
Education	Bachelor	21	40.00
	Master	31	60.00
Experience	<=10	11	21.153
	11-15	25	48.076
	16-20	7	13.461
	21-25	5	9.615
	26-30	4	7.692

4.1 Data analysis

The data was analysed with two techniques, Best-Worst Method and Fuzzy Inference System. In this section the results of our data analysis are presented and discussed.

After criteria identification from the literature and their selection by the managers, in the first step of our data analysis, we applied Best-Worst Method to find the most important criteria for assessing the performance of insurance companies' performance. The main criteria from the literature were (see Table 2): insurance costs, administrative, general and personnel costs, premium income, deferred claims, marketing and advertising costs, market share of number in issued insurance policies, degree of customer satisfaction, level of employee education, amount of investment, facility to employees, cost of education, research and development costs and manpower skills.

Table 2. The final criteria selected by the managers

Criteria ID	Criteria
C1	Insurance costs
C2	Administrative, general and personnel costs expenses
C3	Premium income
C4	Deferred claims
C5	Marketing and advertising costs
C6	Market share in number of issued insurance policies
C7	Degree of customer satisfaction
C8	Level of employee education
C9	Amount of investment
C10	Facility to employees
C11	Education cost
C12	Research and development costs
C13	Manpower skills

The criteria in Table 2 were used in Best-Worst Method. The questionnaire for Best-Worst Method was based on the AHP questionnaire; "assign a number from 1/9 to 9 to show the preference of a criterion over the others" (Rezaei, 2015). After performing the pairwise comparisons by the experts, in the final step, LINGO Ver. 9 was used to obtain the final weights of 13 criteria. We present the weights (w_is) of the criteria in Table 3. This table reveal that the best weight is belong to insurance costs (w=0.359) and the worse weight is belong to level of employee education (w=0.060).

Table 3. The final criteria weights

Criteria ID	Criteria	Weights
C1	Insurance costs	0.359
C2	Administrative, general and personnel costs expenses	0.120
C3	Premium income	0.089
C4	Deferred claims	0.089
C5	Marketing and advertising costs	0.071
C6	Market share in number of issued insurance policies	0.089
C7	Degree of customer satisfaction	0.120
C8	Level of employee education	0.060
C9	Amount of investment	0.210
C10	Facility to employees	0.079
C11	Education cost	0.179
C12	Research and development costs	0.089
C13	Manpower skills	0.071

In the next step of our analysis, we used Fuzzy Inference System to find the performance of Dana insurance companies. The data was collected from the managers' of insurance companies. Based on the experts' perspective, we could construct the membership function for the designed FIS. In addition, the fuzzy rules were generated from the data to assess the performance of Dana insurance companies. The linguistic terms for the design of FIS were: Very Poor (VP), Poor (P), Moderate (M), Good (G) and Very Good (VG). In Fig. 3, we present the form of membership function for the variables. This figure shows the range of membership function in five regions. The ranges are [0 0 25], [0 25 50], [25 50 75], [50 75 100] and [75 100 100].

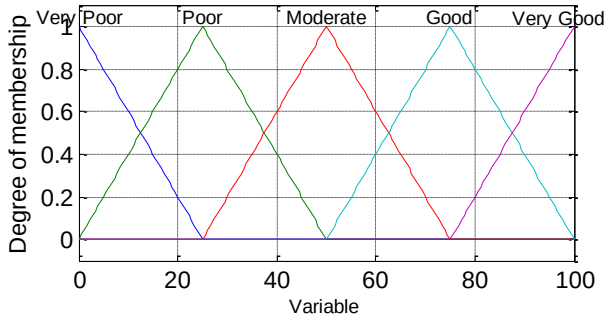

Fig. 3. The form of membership function for the variables

For designing the FIS, the fuzzy rules were designed by an expert. The formation of the fuzzy rules is presented in Table 4. These fuzzy rules are used in the FIS to reveal the performance level of the insurance companies.

Table 4. The formation of fuzzy rules used in the FIS

Second Criteria	First Criteria				
	VP	**P**	**M**	**G**	**VG**
VP	VP	VP	P	P	M
P	VP	P	P	M	M
M	P	P	M	M	V
G	P	M	M	G	V
VG	M	M	G	G	VG

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After distributing the questionnaires to the managers and obtaining their opinions about 52 Dana insurance branches according to the 13 criteria, the performance of the branches was obtained by the designed FIS. The results of the performance assessment for all branches are presented in Table 5. As the results show only the Sari Branch has a very good performance. These results are obtained from the managers' perspectives on the assessment criteria which have been selected by Best-Worst Method and the fuzzy rules defined by the experts in the fuzzy rule-based system. Overall, from the results we can find that the use of fuzzy rule-based system combined with the multi-criteria decision making techniques can be effective in assessing the performance of insurance companies based on several assessment criteria.

Table 5. The performance of 52 Dana insurance branches

Branch Name	Performance	Branch Name	Performance	Branch Name	Performance	Branch Name	Performance
Ferdosi	M	Boshehr	M	Kerman	M	Enghelab	M
Kashani	P	Khalij Fars	M	Kermanshah	M	Brojerd	M
Imam Hossein	P	Masjid Kabood Tabriz	VP	Ahmad Abad	P	Nour	P
Taleghani	M	Khoram Abad	M	Hamedan	M	Abadan	M
Azadi	M	Rasht	M	Yasouj	M	Vahdat	M
Amirkabir	M	Zanjan	M	Yazd	VP	Isfahan	M
Ilam	P	Zahaden	M	Haft Tir	P	Beihaghi	M
Ardabil	M	Semnan	M	Ghazvin	P	Birjand	VP
Arak	M	Sanandaj	P	Ghom	M	Khoi	M
Zayanderood Isfahan	M	Sari	VG	Nushahr	M	Iranshahr	M
Oromia	M	Shahr Kord	P	Gorgan	P	Chabahar	P
Ahvaz	P	Saadi Shirazi	P	Abeko Mashhad	M	Bojnord	P
Ostad Shahriar Tariz	M	Azadi Mashhad	M	Ghardad Vizheh	M	Sardar Jangal	P

5. Conclusion

In this paper attempts have been made to develop a hybrid method for the evaluation of insurance companies' performance. The method was developed using Best-Worst Method and Fuzzy Inference System. The Best-Worst Method was used to assess the criteria in the system and Fuzzy Inference System to reveal the performance of insurance companies' performance. The data for this study was collected from the managers of 52 Dana insurance companies in Iran. We used a questionnaire to collect the data. The results of Best-Worst Method showed the weights of the criteria as: insurance costs (0.359), administrative, general and personnel costs expenses (0.120), premium income (0.089), deferred claims (0.089), marketing and advertising costs (0.071), market share in number of issued insurance policies (0.089), degree of customer satisfaction (0.120), level of employee education (0.060), amount of investment (0.210), facility to employees (0.079), education cost 0.179), research and development costs (0.089) and manpower skills (0.071). In addition, the results of Fuzzy Inference System showed that Sari branch has the best performance among other Dana insurance branches.

In this research the crisp Best-Worst Method was used to evaluate the performance criteria for insurance companies. Accordingly, the future studies can extend the proposed method by fuzzy Best-Worst Method. In addition, the fuzzy rules for performance assessment were identified by the experts. The future studies may relies on the other techniques Adaptive Neuro-Fuzzy Inference System for generating the fuzzy rules from the data. Furthermore, in this study we did not considered the effect of interdependencies among the assessment criteria. Accordingly, other MCDM techniques such as DEMATEL are recommended to find these interdependencies before the criteria are used in Fuzzy Inference System for performance assessment.

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