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Performance evaluation of the social security branches in Tehran using a combination of fuzzy data analysis model and balanced scorecard

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Abstract

Speed and diversity of the changes in the world around us have had a profound impact on all institutions of societies and faced them with multiple challenges. These challenges make organizations to achieve continuous progress using new management systems and implementing them practically. In this regard, one of the main tasks of managers is undoubtedly monitoring and evaluating the performance of their organization under their supervision. Senior managers have always been looking for a way to make sure of the implementation of their strategies and in this regard they consider the evaluation of organization performance as an inevitable necessity. But, what is raised as the main question before organizations and managerial advisors is that; by what means and how to identify basic problems and issues and areas to improve the organization and prepare oneself to participate in international competitions successfully? Therefore, existence of a model seems to be necessary and reason able to improve the performance of various branches of organizations and to achieve a tool to meet this need. One of these models is using a combination of data envelopment analysis model and balanced scorecard. Using fuzzy theory in this model can precisely control the factors affecting the performance of organization and also provides a clear picture of it. In this model, after determining and estimating the dimensions of balanced scored card in four aspects of: customer, internal processes, growth and learning and finance, the efficiency of branches is rated and ranked by using fuzzy data envelopment analysis and eventually the effective and ineffective branches are identified.

Keywords: performance evaluation, balanced scorecard, data envelopment evaluation, fuzzy sets theory.

Introduction

Over the past decade increasing attention is observed to issues such as global competition, the impact of the group activities on organizational success, the importance of relationship with customer and supplier, customer diversity and its consequences, product variety, value of information and innovation, the need for continuous improvement approach in strategy and competition. In order to enhance their competitive advantages, Organizations require a measuring performance system to realize their strategies. Performance evaluation system should control and supervise the strategy assumptions and performance of all the components of organization every moment and should be the best and most suitable system with organization features and its strategy.

Generally, Performance Evaluation refers to a set of actions and activities which are completed to improve optimal use of resources and equipment to achieve economic objectives and methods combined with efficiency and effectiveness and includes six general purposes

- Converging strategies and activities
- Controlling operations
- Awareness of the reasons for quality improvement or decline
- Interaction management with stakeholders
- Motivating and rewarding employees
- Accountability

Performance evaluation which leads to continuous training guarantees a high level of learning and motivates labor significantly. Therefore, there is no doubt that the performance evaluation system which can fulfill the objectives of society can greatly contribute to the efficacy of organization.

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To ensure of future successes, organizations must consider both financial and non financial aspects and this is possible only when the internal processes of organization provide exclusive competitive advantages to achieve its business goals. In addition, organizations must be able to constantly improve the value and synergies. Balanced scorecard provides this balance. Balanced scorecard with regard to all aspects which is somehow seen as an organization's competitive advantages is considered as greater advantage compared to other models. Since those models do not provide a comprehensive method for considering all potential objectives of different organs. By combining balanced scorecard and data envelopment analysis, the scorecard defect which is defining a base and standard can be removed.

Sampling and Research Method

The statistical population of this research includes branches of western head quarter of Social Security Administration of Tehran city. At first 75 indicators were determined by 16 experts and after their scoring finally 31 indicators were determined as the final indicators. They include:

Inputs: Inputs consist of Human resources and cost management each of which contains several sub-criteria.

A) Human resources: Academic skills: ratio of(distribution of manpower who are low literate, with diploma, BA, MA degrees) to the number of employees, 2. Empirical skills: Empirical skills (all experience of the employees by year to the number of employees)

B) Cost Management:

1- The ratio of Staff salary to the number of employees

2- The ratio of percentage of increase in costs to last year

3- The share of Short-term costs of total costs.

4- The ratio of allowances to the cases of annuitants

Outputs

Outputs consist of four standards such as market, income and growth, motivating employees and internal processes.

A) Market

Market share and customer capital constitute two sub criteria of markets whose amounts are calculated as follows with regard to their sub categories:

1- Market share (the ratio of insured persons in the branch to the total number of insured persons)

Customer's capital

1. Customer attraction (the number of insured persons in March of 2010 to the number of insured persons in March of 2009)

2. Customer satisfaction: (the number obtained from customer satisfaction in survey questionnaires),

3. The ratio of the number of technical inspection to the number of insured persons.

B) Growth and Income

1- The ratio of income increase percentage to the previous year.

2- The ratio of revenue performance to approved realized revenue.

3- The ratio of enforcement revenue to approved realized revenue at the performance level

4- The ratioof the sum of the determined unidentified sums to unidentified sums

C) Motivating Employee

1- Customer satisfaction (the number obtained from customer satisfaction in survey questionnaires).

2- Employees participation: the ratio of the number of suggested plans to the number of employees

D) Internal processes

Internal processes include seven sub-criteria each of which is obtained as follows:

Income:

1- The percentage of sending list to the active site (contractors)

2- the percentage of sending list to the active site (non contractors) ,

3- The ratio of issued votes (approved) to prosecuted files of the primary committee,

4- The ratio of the number of active sites to employed staff in income unit

Enforcement:

1- The ratio of closed files to the active category of Enforcement,

2- The ratio of Out of order categories to executive categories in the current order

Technical:(Average number of unemployment insurance cut off due to the re- employment)

Enrollment:

1- the ratio of number of proceeded records to total received requests,

2- The rate of medical Booklets (issued, renewed and duplication) to the number of employed personnel in the booklet issue unit.

To obtain the amounts of these indicators, converge must be done at all levels. It should be noted that the existing values for converging have been normalized regarding the following formula.

$$r_{ij} = \frac{w_{ij}}{\sqrt{\sum_{i-1}^{n} w_{ij}^2}}$$

I,j=1,2,...,n

In this research, customer's capital and personnel motivation are fuzzy indicators. Therefore, the input indicators and other output indicators are considered as definitive factors..

After collecting questionnaires, to determine personnel satisfaction rate, since answers in questionnaires had been mentioned by 5 options of qualitative numbers from highly satisfied to totally dissatisfied, to convert these numbers to definite quantitative numbers, a fuzzy triangle number was allocated to each option as figure 1:

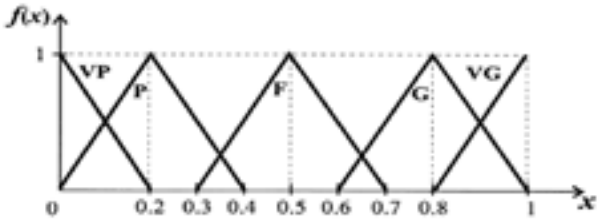


Figure 1: Displaying triangular figure of five options

Table1. Conversion method of5-option verbal phrase of survey questionnaire from customers

item	Verbal phrases	Fuzzy number
1	Totally satisfied	0,0,0,2
2	satisfied	0,0,2,0,4
3	Mediocre	0,3,0,5,0,7
4	dissatisfied	0,6,0,8,1
5	Totally dissatisfied	0,8,1,1

Also to determine customers' satisfaction rate, since the answers in questionnaires had been mentioned by 3 option qualitative numbers from satisfied to dissatisfied, to convert these numbers to definite quantitative numbers, each option was allocated a fuzzy triangle number as table 2:

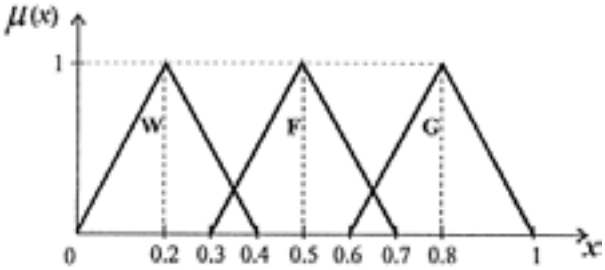


Figure 2.Displaying triangular fuzzy numbers of 3-options

Table 2. Conversion methods for 3-option verbal phrase of survey questionnaires from customers

item	Verbal phrases	Fuzzy number
1	Satisfied	0,6,0,8,1
2	Mediocre	0,3,0,5,0,7
3	dissatisfied	0,0,2,0,4

The model used in this research is data analysis fuzzy model which was presented by Sati and colleaguesin 2000.

$$\max \sum_{r=1}^{s} Y_{rp}$$

$$s.t. \quad \sum_{i=1}^{m} X_{ip} = 1$$

$$\sum_{r=1}^{s} Y_{rj} - \sum_{i=1}^{m} X_{ij} \le 0; \quad \forall j$$

$$ur, vi \ge 0; \quad \forall r, i$$

$$u_r\left(\alpha y_{rj}^{m} + (1-\alpha) y_{ri}^{l}\right) \le Y_{rj} \le u_r\left(\alpha y_{rj}^{m} + (1-\alpha) y_{rj}^{u}\right)$$

$$v_r\left(\alpha x_{ij}^{m} + (1-\alpha) x_{ij}^{l}\right) \le X_{ij} \le vi\left(\alpha x_{ij}^{m} + (1-\alpha) x_{ij}^{u}\right)$$

This model is not capable of ranking and only presents DMU efficiency rate. According to efficiency rate just ineffective DMU) θ^* <1 (can be rated so in this research, Saa'ti's et al (2002) method to perfectly rank DMUs in fuzzy conditions was used:

$$\min Z = \theta$$

$$s.t. \ \theta\left(\alpha x_{ip}^{m} + (1-\alpha) x_{ip}^{l}\right) \ge \sum_{j=1}^{n} \lambda_j \left(\alpha x_{ip}^{m} + (1-\alpha) x_{ip}^{u}\right); \quad \forall i$$

$$\left(\alpha x_{ip}^{m} + (1-\alpha) x_{ip}^{l}\right) \ge \sum_{j=1}^{n} \lambda_j \left(\alpha x_{ip}^{m} + (1-\alpha) x_{ip}^{u}\right); \quad \forall i$$

$$\lambda \ \ge 0$$

Also to convert definite m data to fuzzy (l, m, u),(m, m, m) conversion method has been used.

Accordingly, values of indicators were estimated in western branches of social security of Tehran was calculated. For example, Tables 3 and 4 show theses valuesin branch 1 of Tehran.

Data analysis

To find out the efficacy of social security branches in western Tehran, data collected from general administration of social security of western Tehran and data obtained from questionnaires completed in these branches were analyzed using LINGO software.

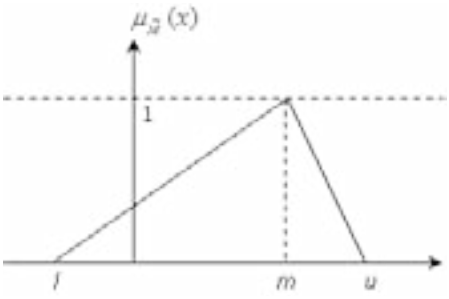


Figure 3. Triangular fuzzy figure in form of (l, m, u)

The numerical results of this software which show the efficiency of different branches of general administration of social security of western Tehran at different α levels is displayed in figure 4.

As it is observed, the efficiency of most of branches equals 1 and efficiency estimation model is not capable of rating these efficient units so the presented ranking model is used. Figure 5 shows the points allocated to each branch.

Table3. Fuzzy inputs (l, m, u) of branch 1

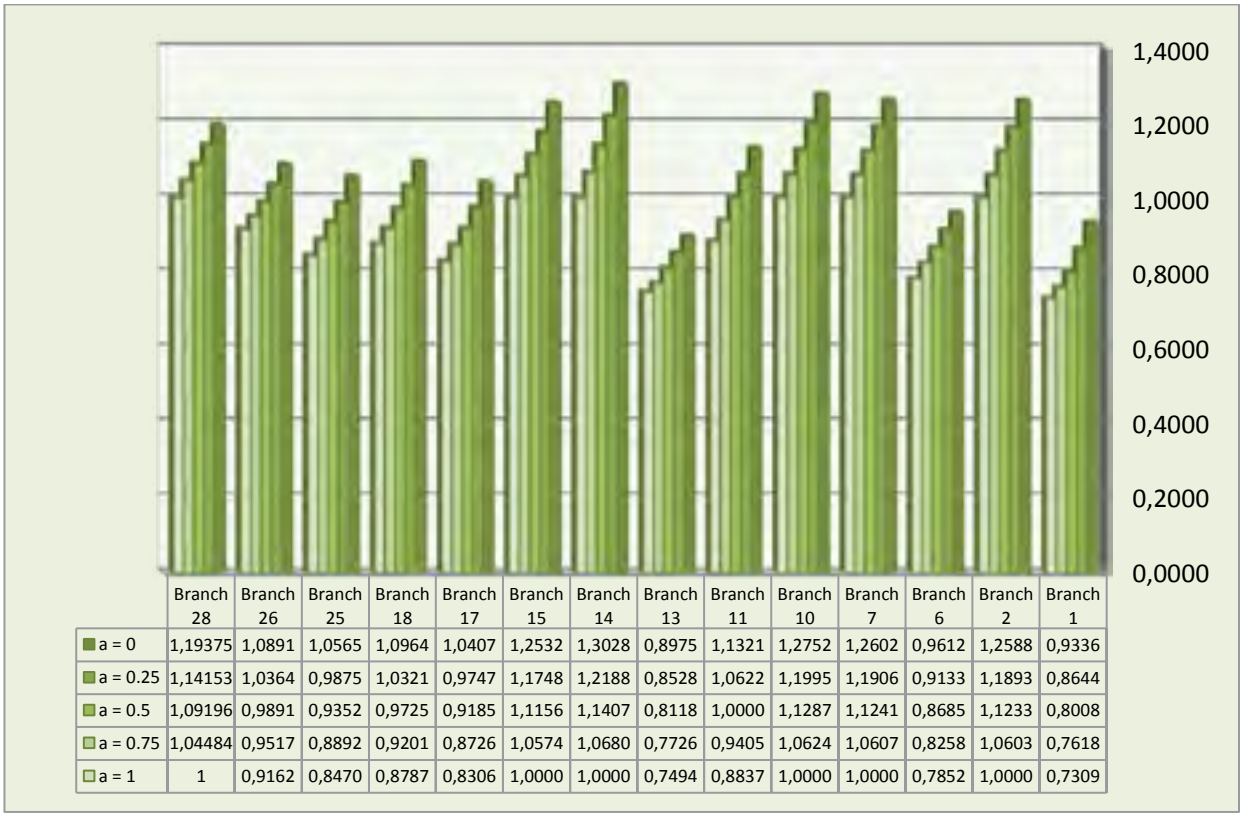
Name of branch	Inputs					
	Human resources			Cost management		
Branch 1	0.522416	0.522416	0.522416	1.77902	1.77902	1.77902

Table 4. Fuzzy outputs (l, m, u) of branch 1

Name of branch	Outputs											
	market			Growth and income			Employee motivation			Internal processes		
Branch 1	0.878517	1.078517	1.278517	0.750606	0.750606	0.750606	0.717616	0.543616	0.406416	2.758076	2.758076	2.758076

	Branch 28	Branch 26	Branch 25	Branch 18	Branch 17	Branch 15	Branch 14	Branch 13	Branch 11	Branch 10	Branch 7	Branch 6	Branch 2	Branch 1
a = 0	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	0,8780	1,0000	1,0000	1,0000	0,9624	1,0000	0,9336
a = 0.25	1,0000	1,0000	0,9854	1,0000	0,9555	1,0000	1,0000	0,8386	1,0000	1,0000	1,0000	0,9150	1,0000	0,8644
a = 0.5	1,0000	0,9891	0,9336	0,9517	0,8879	1,0000	1,0000	0,8012	0,9933	1,0000	1,0000	0,8700	1,0000	0,8008
a = 0.75	1,0000	0,9517	0,8886	0,8991	0,8471	1,0000	1,0000	0,7654	0,9329	1,0000	1,0000	0,8270	1,0000	0,7618
a = 1	1,0000	0,9162	0,8457	0,8609	0,8147	0,9966	1,0000	0,7380	0,8752	1,0000	1,0000	0,7860	1,0000	0,7309

Figure 4.Coefficient resulted from performing fuzzy model in different α-cuts



	Branch 28	Branch 26	Branch 25	Branch 18	Branch 17	Branch 15	Branch 14	Branch 13	Branch 11	Branch 10	Branch 7	Branch 6	Branch 2	Branch 1
a = 0	1,19375	1,0891	1,0565	1,0964	1,0407	1,2532	1,3028	0,8975	1,1321	1,2752	1,2602	0,9612	1,2588	0,9336
a = 0.25	1,14153	1,0364	0,9875	1,0321	0,9747	1,1748	1,2188	0,8528	1,0622	1,1995	1,1906	0,9133	1,1893	0,8644
a = 0.5	1,09196	0,9891	0,9352	0,9725	0,9185	1,1156	1,1407	0,8118	1,0000	1,1287	1,1241	0,8685	1,1233	0,8008
a = 0.75	1,04484	0,9517	0,8892	0,9201	0,8726	1,0574	1,0680	0,7726	0,9405	1,0624	1,0607	0,8258	1,0603	0,7618
a = 1	1	0,9162	0,8470	0,8787	0,8306	1,0000	1,0000	0,7494	0,8837	1,0000	1,0000	0,7852	1,0000	0,7309

Figure 5. Advantages resulted from implementing fuzzy model in different α-cuts

Regarding the results of ranking model, the allocated rank for each branch have been presented in charts 7-8

As it is observed level $\alpha = 1$ is not reliable for ranking because 6 branches have gained point 1. At other levels with a good approximation it can be stated that the results are similar. In all levels of α, branch 14 has gained first rank among other branches and after that branch 10 and branch 7 have gained second and third ranks respectively. At the level of $\alpha = 0.5$ which is a balanced level for α, ranking 14 branches of social security has been mentioned in table 5.

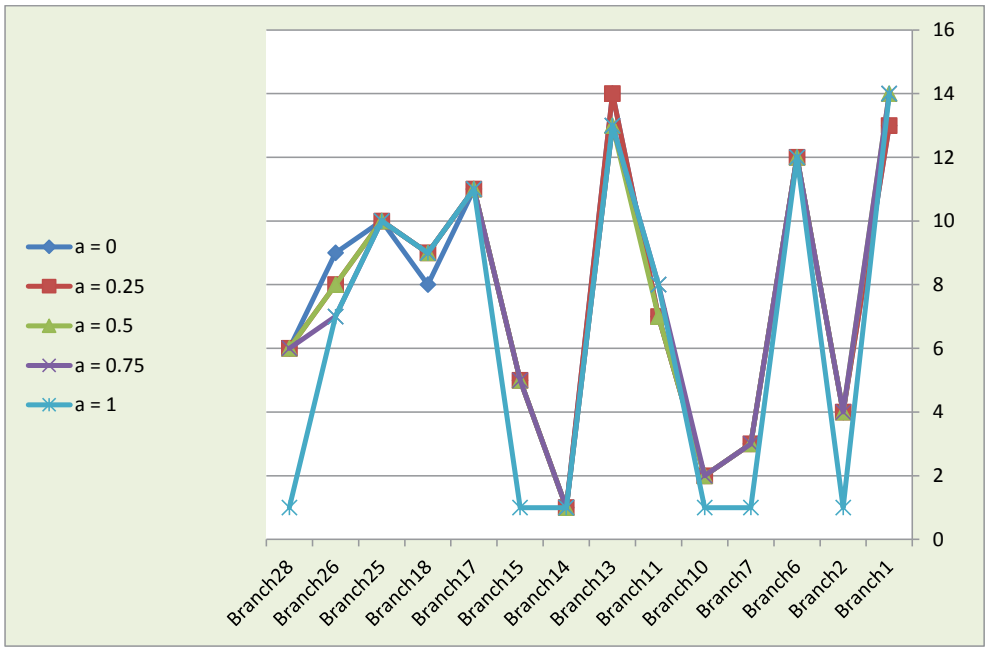
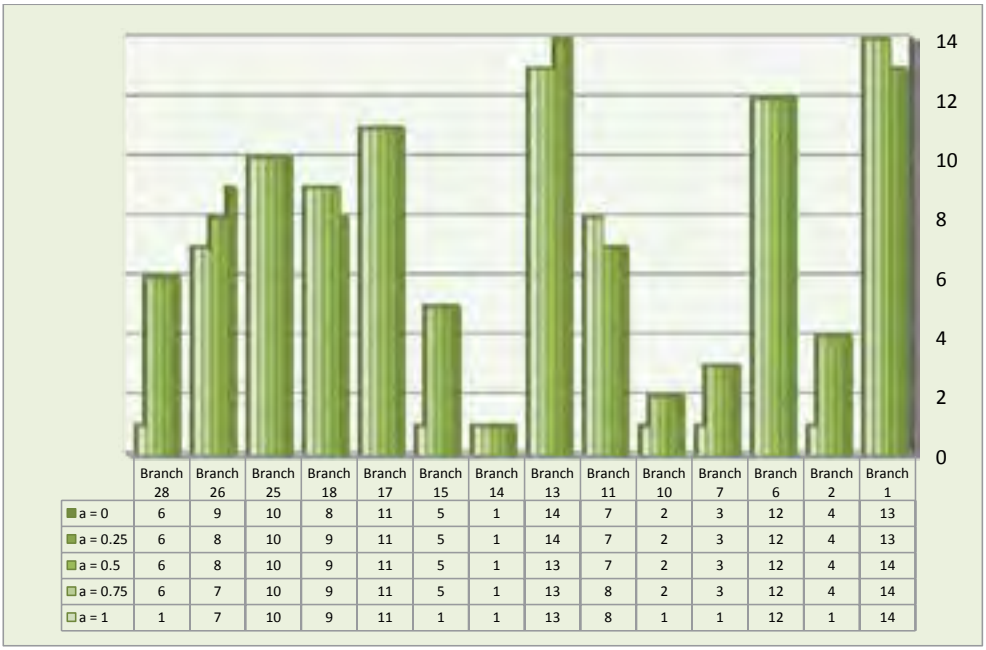


Figure 6. Allocated rank to different branches of social security in ranking



	Branch 28	Branch 26	Branch 25	Branch 18	Branch 17	Branch 15	Branch 14	Branch 13	Branch 11	Branch 10	Branch 7	Branch 6	Branch 2	Branch 1
a = 0	6	9	10	8	11	5	1	14	7	2	3	12	4	13
a = 0.25	6	8	10	9	11	5	1	14	7	2	3	12	4	13
a = 0.5	6	8	10	9	11	5	1	13	7	2	3	12	4	14
a = 0.75	6	7	10	9	11	5	1	13	8	2	3	12	4	14
a = 1	1	7	10	9	11	1	1	13	8	1	1	12	1	14

Figure 7. Allocated rank to different branches of social security in ranking

Table 5. Branch ranking at the level of $\alpha = 0.5$

Rank	Name of branch	Rank	Name of branch
1	14	8	26
2	10	9	18
3	7	10	25
4	2	11	17
5	15	12	6
6	28	13	13
7	11	14	1

Conclusions

With regard to ranking the branches by using fuzzy model, the fuzzy model has been emphasized perfectly and the results obtained from fuzzy model shows the efficiency of the branches and determined that all branches are efficient at the level of (α=0) x and it is minimized at the level of further α –cuts.

According to the studies done about14 branches of general office of west Tehran, based on the fuzzy model, Branch 14 and branch 1 have gained first and 14th ranks respectively.

This model also gives special weight to each of the parameters that indicates the degree of importance and effectiveness sharein the branches. The weight of these indicators could be observed in Table 6.

It is observed that Among inputs the cost management indicator has high weight which means the effective branches minimized this indicator and consequently the ineffective branches can reach effectiveness with minimizing this indicator. Among the output indicators, indicator of employees' motivation, internal processes and market are critical in most branches. Therefore it should be noted that these indicators have the greatest effect on the amount and order of performance efficiency of the branches.

In order to show how to reach inefficient decision-making units to effective units, two input or output perspectives should be considered perfectly. To find the input reduction amount, the primary efficiency is multiplied by inputs. Obviously for effective decision making branch whose efficiency value equals 1 no changes observed in inputs and in other branches with efficiency amount lower than 1, it is multiplied by primary inputs and the suggested inputs are minimized. But from outputs perspective, to find out the increase rate of efficiency of the output performance the inverse of obtained efficiency rate is multiplied in primary values of the outputs.

In this research some improvement suggestions were presented for ineffective branches to reach effectiveness aspects from two perspectives of input and output and using the obtained efficiency at the level of α=0.5 and multiplying it in inputs and outputs, as mentioned before, the efficiency values were recalculated which using both perspectives, inputs and outputs were improved and the efficiency of all branches becomes1. Tables 7 and 8, typically display these values in branch 1 of Tehran.

Table 6. Allocated weights to input and output indicators at the level of α

Name of branch	Output			Input		
	Human resources	Cost management	market	Growth income	Employee motivation	Internal processes
Branch 1	0	1.914184	0.6927884	0	0	0.5173440
Branch 2	0	2.011356	0.2352678	0	0	0
Branch 6	0.7567758	1.668371	0	0.4632602	0.2759841	0
Branch 7	0	1.888751	0	0.6188754	0	0
Branch 10	0	1.771963	0	0	0	0.5702644
Branch 11	0.4433239	1.832065	0.3324858	0	0	0.6196481
Branch 13	0.5288812	1.717432	0.5542142	0	0.1536413	0.4331807
Branch 14	0.1524221	1.524471	0	0	0	0.6169007
Branch 15	0	2.077251	0.1163289	0	0.1667801	0.3319873
Branch 17	0.6149105	1.810386	0.4478986	0	0.1654141	0.4922201
Branch 18	0.4075642	1.684286	0.3056666	0	0	0.5696656
Branch 25	0.3739465	1.741423	0	0	0.2304486	0.5026721
Branch 26	0	2.109951	0.9773797	0	0.1776577	0.4010028
Branch 28	0	1.747513	0.1872771	0	0.1041751	0

Table 7. Improved fuzzy data (l, m, u) of the branch 1 at the level of α

Name of the branch	inputs					
	Human resources			Cost management		
Branch 1	1.424596	1.424596	1.424596	0.418338	0.418338	0.418338

Table 8.Improved fuzzy data (l, m, u) of branch 1 at the level α

Name of branch	Outputs											
	market			Growth and income			Employee motivation			Internal processes		
Branch 1	1.097083533	1.346841	1.596599	0.937349309	0.937349309	0.937349309	0.896151	0.678862	0.507527872	3.4442577	3.4442577	3.4442577

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