Original Research

Modification of the EDAS method for controlling outlier data

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Received: 2021-01-23/ Accepted: 2021-12-27/ Published online: 2021-12-30

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Abstract
The purpose of this study is to modify the Evaluation based on Distance from Average Solution (EDAS) method so that it can control Outlier data. In multi criteria decision making methods, the distances between the data are the criterion for calculating the score, so the existence of significant distance of Outlier data from other data, can make the score of the criteria exclusive to Outlier data. Therefore, in addition to weighting the criteria, which is a kind of valuing the criteria relative to each other, weighting within the criteria by evaluating effective distances will be necessary. Despite the special conditions, the data distribution can be approximated to the normal distribution based on the central limit theorem. In this study, the normal distribution mechanism has been used to identify and evaluate effective distances. The proposed technique has been used for about 1950 branches of the Agricultural Bank of Iran and the results have been analyzed while comparing with the classic method.

Keywords - EDAS method; Data outlier; Normal distribution; Central limit theorem

1- Introduction

In the last decade, multi criteria decision making methods have been used significantly in various sciences and various techniques such as VIKOR, TOPSIS, AHP, EDAS, etc. have been designed and presented. In the real world, using any of these methods has its challenges, and this has led to the development of these techniques. The development of multi-criteria decision methods in interval and fuzzy environments with the aim of providing the possibility of using multi-criteria decision methods in uncertain environments is an example of research activities. Identifying diverse and weighted methods to criteria and combining it with multi-criteria decision-making methods is another issue that has been done in the real world of needs assessment and research. In this research, a new needs assessment will be proposed. The existence of Outlier data is inevitable, which for various reasons can be observed at the time of formation of the decision matrix. Different strategies can be adopted depending on the cause of the outlier data. For example, if the outlier data is due to a measurement error, it can be corrected. However, in this study, the conditions are assumed in such a way that the data are measured without any computational error. Therefore, controlling the impact of outlier data on multi-criteria decision-making methods will be the infrastructure of the proposed technique.

In previous research, weighting has generally been done in one of the following ways: qualitative and quantitative or a combination of it. For example, the weight obtained from experts is the use of Professional knowledge and it is based on the policies set in the organization. Another type of weight, such as entropy, is based on data knowledge. They are in the qualitative weight class. The third type is the simultaneous use of expert knowledge and data knowledge, which it is necessary to calculate each separately and then use a combination of these two weights. In this research, a new species of weight that is in the quantitative class and is based on data knowledge will be introduced. Which will be considered directly in the soluble method and cannot be combined with previously described species. In fact, at the same time, when the positive and negative distances from the mean are calculated, it shows its effect.

- With the explanations provided, the most important parts of the research are as follows. 1- The effect of Outlier data on EDAS method will be examined from a mathematical and intuitive perspective.
- The normal probability distribution basis will be used to organize the data intervals in the EDAS method. For this purpose, the coefficient of deviation of the criteria will be evaluated according to the amount of data accumulation in the average distances, and it will be used to evaluate the effective distances in each criterion.
- 1951 branches of Agriculture Bank of Iran are evaluated using two methods: Classic EDAS and modified EDAS, then the results are analyzed and reviewed.

2- Theoretical Foundations and Research Background

2-1- EDAS Method

A summary of the EDAS method is shown in Figure 1. Here:

x_{ij}: *Decision matrix element*
$\bar{x}_j$: *Average performance per criterion*
PD_{ij}&ND_{ij}: *Positive and negative distances from the mean*
SP_i&SN_i&NSP_i&NSN_i: *Computational operator*
AS_i: *Points calculated for each option*

In methods such as TOPSIS or VICOR, we measure the optimal option based on the distance from the positive and negative ideal, that is, the optimal option that has the shortest distance from the positive ideal and the maximum distance from the negative ideal. But in the EDAS method, the best solution is the distance from the average solution (AV). In this method, we do not need to calculate the positive and negative ideals, but consider two criteria for evaluating the desirability of options; the first is a measure of positive distance from the mean (PD) and the second is a negative distance from the mean (ND).

Step1

$$\bar{x}_j = \frac{1}{n}\sum_{i=1}^{n} x_{ij}$$

Positive | Negative

Step2

Positive:

$$PD_{ij} = \frac{\max_i \left(0, \left(x_{ij} - \bar{x}_j\right)\right)}{\bar{x}_j}$$

$$ND_{ij} = \frac{\max_i \left(0, \left(\bar{x}_j - x_{ij}\right)\right)}{\bar{x}_j}$$

Negative:

$$PD_{ij} = \frac{\max_i \left(0, \left(\bar{x}_j - x_{ij}\right)\right)}{\bar{x}_j}$$

$$ND_{ij} = \frac{\max_i \left(0, \left(x_{ij} - \bar{x}_j\right)\right)}{\bar{x}_j}$$

Step3

$SP_i = \sum_{j=1}^{m} w_j\, PD_{ij}$ & $SN_i = \sum_{j=1}^{m} w_j\, ND_{ij}$

$NSP_i = \frac{SP_i}{\max_i (SP_i)}$ & $NSN_i = 1 - \frac{SN_i}{\max_i (SN_i)}$

Step4

$$AS_i = 1/2(NSP_i + NSN_i)$$

FIGURE 1- EDAS METHOD

2-2- OUTLIER DATA

Data is said to be significantly different from other data in the same group. This is how Grabs (1967) defined outlier data pert. Outlier data is data that, significantly different have from the rest of the sample members in which it occurred. Outlier data can create problems for analyzing the community and the statistical sample in which it is located. Therefore, identifying and dealing with this data is an important issue in statistics. There are several ways to identify Outlier data, these methods are usually done with the aim remove Outlier data. In this research, only a matter of controlling the distance of Outlier data from other data. So its identification is not very important. Therefore, an attempt will be made to identify effective data distances based on the normal distribution mechanism.

2-3- NORMAL DISTRIBUTION

In statistic and probability theory, the Normal Distribution is one of the most important statistical distributions. Of course, this distribution is sometimes called the Gaussian distribution or the Laplace-Gaussian distribution. Because this distribution has a bell curve, it is sometimes called a "bell curve". The rules governing most random phenomena in life follow a normal distribution, and on the other hand, according to the Central Limit Theorem, the approximate distribution of other phenomena can be considered normal. Therefore, the application of this distribution is wide in all fields from sociology to medicine and engineering. The importance and application of the normal distribution is due to the "Central Limit Theorem". This theorem states that for random variables of finite variance, the mean samples of the randomly distributed, independent random variables will tend to be normally distributed. This is why the distribution of most physical quantities obtained as the sum of several independent processes (eg measurement error) is assumed to be normal. Carl Gauss (1809), a German physicist, mathematician, and scientist, studied phenomena that were likely to be bell-shaped. In his book, examined the error rate, the Least Square method, and the Maximum Likelihood. The famous French mathematician, statistician and physicist Marquis de Laplace in the eighteenth century was able to prove the central limit theorem, which is very important in statistics.

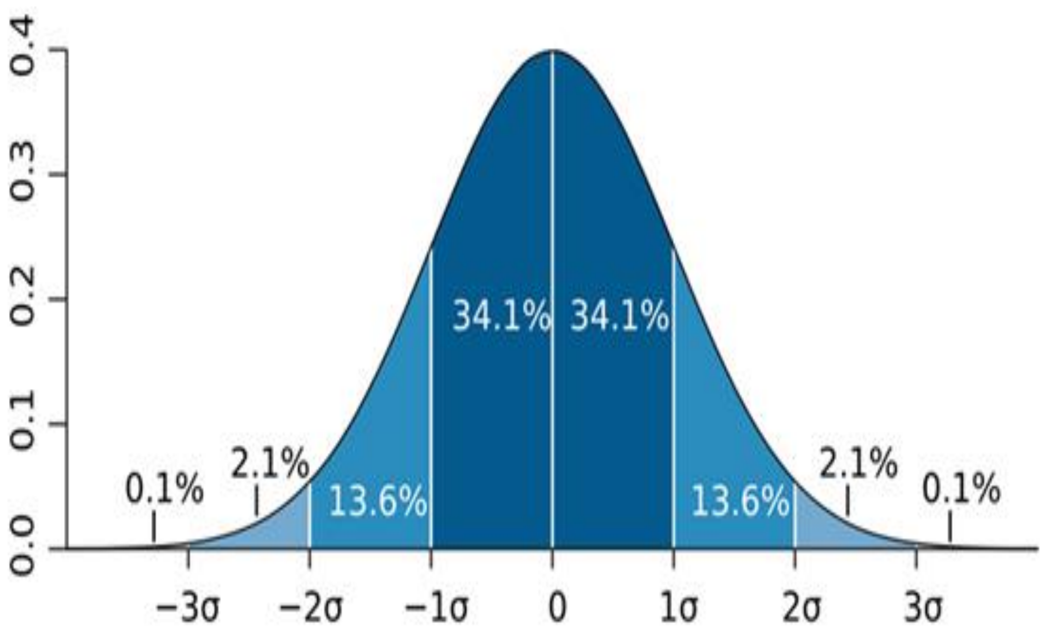

FIGURE 2- NORMAL DISTRIBUTION

2-4-PAST STUDIES

The purpose of this study is to provide a suitable method for evaluating the units of financial and credit institutions. Refer to some of the research that has been done in this area. Shahbandarzadeh [1] has evaluated Bank Mellat branches in Bushehr by using a new stable balanced scorecard considering quantitative and qualitative indicators. Rasouli Nejad [2] has used multi-criteria decision-making methods to rank the branches of Bank Saderat in Tehran province. Sakmeh et al. [3] evaluated the 5 largest Turkish banks. Motameni et al. [4] calculated the weight of each criterion using the fuzzy hierarchical analysis method and then ranked the three largest Iranian banks using the TOPSIS method. Garcia et al. [5] used the TOPSIS method to rank Spanish banks and acknowledged that the selection of criteria has produced different results for ranking. Azar and Vafaei [6] ranked the units using multi criteria decision making methods in a fuzzy environment and compared the results with the data envelopment analysis method. Aghaei et al. [7] ranked 15 branches of Saman Bank in Tehran using a combination of hierarchical analysis methods and TOPSIS in a fuzzy environment. Kazemi and Mousavi [8] calculated the weights of the criteria using the entropy method and then reviewed and compared the ranking results using 4 conventional methods in multi-criteria decision making including TOPSIS and VICOR. Mahmoudi and Bagherlou [9] ranked the 9 stock exchanges using the hierarchical weight analysis method of the criteria and then using the TOPSIS method in the fuzzy environment. Alidadeh and Ghasemi [10] calculated the performance of Sepah Bank branches in Sistan and Baluchestan province using the BSC / FAHP model and then ranked them using the TOPSIS method.

The studies that used the EDAS method for evaluation are as follows: valuation Based on Distance from Average Solution (EDAS) technique means evaluation based on distance from the average solution. This technique was first proposed by Mehdi Keshavarz Ghorabaei et al. [11] In his study, he developed the EDAS method in a fuzzy environment. To show the validity of the proposed method and its application, a case study has been used to select suppliers. Zhang et al. [12] provided the EDAS method for MCGDM (Multi-Criteria Group Decision Making) issues with picture fuzzy information. Peng and Liu [13] designed the neutrosophic soft decision-making algorithms on the basis of EDAS and novel similarity measures. Feng et al. [14] integrated the EDAS method with an extended hesitant fuzzy linguistic environment. He et al. [15] designed the EDAS method for MAGDM with probabilistic uncertain linguistic information. Karasan and Kahraman [16] designed a novel interval-valued neutrosophic EDAS method. Li et al. [17] defined the EDAS method for MAGDM issues under a q-rung orthopair fuzzy environment. Wang et al. [18] proposed the EDAS method for MAGDM under a 2-tuple linguistic neutrosophic environment. Ghorabaee et al. [19] presented the EDAS method with normally distributed data to tackle stochastic issues. Zhang et al. [20] extended the EDAS method to picture a 2-tuple linguistic environment. Kiani Ghaleh No et al. [21] By making changes in the EDAS method in the interval environment, it has evaluated the branches of Iran banks. In recent years, the development of MCDM methods, including the EDAS method, has been widely used in applications and in uncertain environments. For example, in the research of Bushra et al. [22], he used the EDAS method in a fuzzy environment to identify the drug that affects coronary heart disease. In this paper, the fuzzy EDAS method is used to address the best renewable energy consumption by taking political, economic, social, technological, legal, and environmental (PESTLE) dimensions into account. In paper Ozgur et al. [23], the fuzzy EDAS method is used to address the best renewable energy consumption by taking political, economic, social, technological, legal, and environmental (PESTLE) dimensions into account. But in the present study, the aim was to modify the EDAS method for practical use in the real world. This method is presented in line with the needs of financial and credit institutions to improve the results of the EDAS method.

3. PROBLEM STATEMENT

Methods and techniques are generally based on theoretical principles, and in the real world, the existence of challenges will cause changes in the basic and classical techniques in accordance with the needs assessment. Outlier data is one of the most challenging cases that has been introduced in statistics as an inevitable thing and several methods have been proposed to identify and deal with it. The EDAS method, like other multi criteria decision making methods, scores based on data scatter. And the presence of outliers-data will cause, the value of the distance between other data, to be affected by the considerable distance of outlier data. And The Effectiveness of the distance other data relative to each other, tends to zero. Therefore, two important issues will be on the agenda. To be proved that, when data is outlier, normal data distance to be affected by, and are ineffective, and the EDAS method will be modified to solve the challenge of outlier data.

3-1- INVESTIGATING THE EFFECT OF OUTLIER DATA ON EDAS METHOD FROM A MATHEMATICAL PERSPECTIVE

Proposition: Outlier data can monopolize a criterion score.

Proof: Suppose, there are "n" options and "m" criteria, Criterion j: 0<j<m is considered. And $x_{sj}: 0 < s < n$ is Outlier data. Since the Outlier data is significantly different from the other data, we assume that $x_{sj} = M$, where M is a very large positive number. In which case, we will have, $\bar{x}_j = kM : for\ 0 < k < 1$. Step 2 calculations in the method EDAS will be as follows.

$$\lim_{M\to\infty} \frac{(x_{sj} - \bar{x}_j)}{\bar{x}_j} = \lim_{M\to\infty} \frac{M - kM}{kM} = \lim_{M\to\infty} \frac{(1-k)M}{kM} = \frac{(1-k)}{k} > 0 \quad (1)$$

$$\lim_{\substack{M\to\infty \\ i<>s}} \frac{(x_{ij} - \bar{x}_j)}{\bar{x}_j} = \lim_{M\to\infty} \frac{x_{ij} - kM}{kM} = \lim_{M\to\infty} \frac{x_{ij}}{kM} - \lim_{M\to\infty} \frac{kM}{kM} = -1 \quad (2)$$

$$PD_{ij} = \max_i \left(0, \frac{(x_{ij} - \bar{x}_j)}{\bar{x}_j}\right) = \begin{bmatrix} 0 & \dots & 0 & \frac{(1-k)}{k} & 0 & \dots & 0 \end{bmatrix} \quad (3)$$

$$\lim_{M\to\infty} \frac{(\bar{x}_j - x_{sj})}{\bar{x}_j} = \lim_{M\to\infty} \frac{kM - M}{kM} = \lim_{M\to\infty} \frac{(k-1)M}{kM} = \frac{(k-1)}{k} < 0 \quad (4)$$

$$\lim_{\substack{M\to\infty \\ i<>s}} \frac{(\bar{x}_j - x_{ij})}{\bar{x}_j} = \lim_{M\to\infty} \frac{kM - x_{ij}}{kM} = \lim_{M\to\infty} \frac{kM}{kM} - \lim_{M\to\infty} \frac{x_{ij}}{kM} = 1 \quad (5)$$

$$ND_{ij} = \max_i \left(0, \frac{(x_{ij} - \bar{x}_j)}{\bar{x}_j}\right) = [1 \quad \dots \quad 1 \quad 0 \quad 1 \quad \dots \quad 1] \quad (6)$$

TABLE 1- OUTPUT OF STEP 2 OF THE EDAS METHOD

$i =$	1	…	s-1	s	s+1	…	n
$\frac{PD_{ij}}{max\,(PD_{ij})}$	0	0	0	1	0	0	0
$1 - \frac{ND_{ij}}{max\,(ND_{ij})}$	0	0	0	1	0	0	0

The results of Table 1 show that the score orientation in criterion "j" is completely towards the option "s" and the score is enclosed by this option.

3-2- INVESTIGATING THE EFFECT OF OUTLIER DATA ON EDAS METHOD FROM AN APPLIED PERSPECTIVE

Example: Table 2 shows the decision matrix containing 4 options and 3 criteria, and after weighing, the steps of the EDAS method are calculated for it.

TABLE 2- IMPACT OF OUTLIER DATA IN THE EDAS METHOD

W	**2**	**3**	**3**	Spi	NSi	NSPi	NSNi	ASi	**rank**
	C1	C2	C3						
A1	10	640	350	3.00	1.02	1.00	0.41	0.71	1
A2	2	990	460	1.07	1.00	0.36	0.42	0.39	2
A3	3	980	350	0.45	0.77	0.15	0.55	0.35	3
A4	1	796	380	0.00	1.73	0.00	0.00	0.00	4

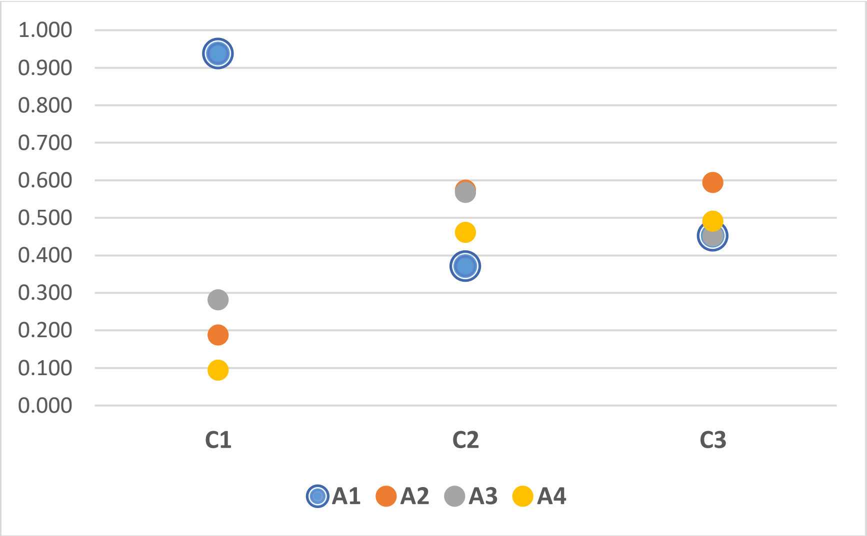

FIGURE 3- POSITION THE POINTS IN THE PRACTICAL EXAMPLE

Table 2- shows that option (**A1**) could be ranked first with a significant difference in compared to other options. But the performance review shows that option (**A1**) in the second and third criteria, which happen to have a higher weight, has the weakest performance compared to the other options and only in the first criterion has a better recorded performance. The reason for the score of option (**A1**) is the significant deviation of its performance with other options in a way that has been able to enclose the score of this criterion.

Figure 1 Designed to clarify the subject. In this diagram, the blue circle shows the function of option (**A1**). In the criterion (**C1**), we see, option (**A1**), have very large performance distance from other options, and in the other two criteria, the performance of option (**A1**) is less than the other options.

Note: If the decision maker claims that due to different performance, points and ranks should be awarded to Option (**A1**), that's it. But, if the decision maker places more weight on the normal operating range in which the expected performance occurs and scores less on out-of-range performance, the EDAS method needs to be modified.

3.3. Modified EDAS method

Based on the central limit theorem, if the data of a statistical population have three independent conditions, co-distribution and finite variance, the data distribution can be approximated to the normal distribution. Figure 4 shows the distribution of data in three standard deviations. Inspired by the amount of data scattering from the three standard deviations in the normal distribution, the evaluation of the distances from the average in proportion to the amount of data presence has been done. And accordingly, the EDAS method has been modified.

- Valuation for the distance from the average to the first standard deviation:34.1%
- Valuation for the distance from the first standard deviation to the second standard deviation:13.6%
- Valuation for distances more than twice the standard deviation:2.3%

3-4- Description of Modified EDAS method

Step 1	Calculates the average of recorded data for each criterion.
	Calculates the standard deviation of the recorded data for each criterion.
Step 2	For criteria that are positive in nature, the positive distance from the mean (PD) is calculated and the negative distance from the mean (ND) is calculated.
	For criteria of a negative nature, the positive distance from the mean (PD) is calculated and the negative distance from the mean (ND) is calculated.
Step 3	In this step, the values of SP and SN are calculated, in this step, weight is assigned to PD and ND.
Step 4	In this step, the SP and SN values calculated in the previous step are normalized.

Step 1	$\bar{x}_j = \frac{1}{n}\sum_{i=1}^{n} x_{ij}$		(7)
	$var_j = \frac{1}{n}\sqrt{\sum_{i=1}^{n}(x_{ij}-\bar{x}_j)^2}$		(8)
Step 2	Positive criteria	$PD_{ij} = \frac{0.341 * \max_i\left(0, min\left((x_{ij}-\bar{x}_j), var_j\right)\right)}{\bar{x}_j} + \frac{0.136 * \max_i\left(0, min\left((x_{ij}-\bar{x}_j-var_j), var_j\right)\right)}{\bar{x}_j} + \frac{0.023 * \max_i\left(0, (x_{ij}-\bar{x}_j-2var_j)\right)}{\bar{x}_j}$	(9)
		$ND_{ij} = \frac{0.341 * \max_i\left(0, min\left((\bar{x}_j-x_{ij}), var_j\right)\right)}{\bar{x}_j} + \frac{0.136 * \max_i\left(0, min\left((\bar{x}_j-var_j-x_{ij}), var_j\right)\right)}{\bar{x}_j} + \frac{0.023 * \max_i\left(0, (\bar{x}_j-2var_j-x_{ij})\right)}{\bar{x}_j}$	(10)
	Negative criteria	$PD_{ij} = \frac{0.341 * \max_i\left(0, min\left((\bar{x}_j-x_{ij}), var_j\right)\right)}{\bar{x}_j} + \frac{0.136 * \max_i\left(0, min\left((\bar{x}_j-var_j-x_{ij}), var_j\right)\right)}{\bar{x}_j} + \frac{0.023 * \max_i\left(0, (\bar{x}_j-2var_j-x_{ij})\right)}{\bar{x}_j}$	(11)
		$ND_{ij} = \frac{0.341 * \max_i\left(0, min\left((x_{ij}-\bar{x}_j), var_j\right)\right)}{\bar{x}_j} + \frac{0.136 * \max_i\left(0, min\left((x_{ij}-\bar{x}_j-var_j), var_j\right)\right)}{\bar{x}_j} + \frac{0.023 * \max_i\left(0, (x_{ij}-\bar{x}_j-2var_j)\right)}{\bar{x}_j}$	(12)
Step 3	$SP_i = \sum_{j=1}^{m} w_j\, PD_{ij}$	$NSP_i = \frac{SP_i}{\max_i(SP_i)}$	(13)
	$SN_i = \sum_{j=1}^{m} w_j\, ND_{ij}$	$NSN_i = 1 - \frac{SN_i}{\max_i(SN_i)}$	(14)

Step 4	$AS_i = 1/2(NSP_i + NSN_i)$	(15)

3-5- Calculate the practical example of Section 2-3 with the modified EDAS method

Table 3- Impact of outlier data in the modified EDAS method

W	**2**	**3**	**3**	Spi	NSi	NSPi	NSNi	ASi	**rank**
	C1	C2	C3						
A1	10	640	350	1.39	1.02	0.02	0.41	0.21	3
A2	2	990	460	83.78	1.00	1.00	0.42	0.71	1
A3	3	980	350	54.23	0.77	0.65	0.55	0.60	2
A4	1	796	380	0.00	1.73	0.00	0.00	0.00	4

In the EDAS method, option A1 was able to gain significant points due to different performance in the first criterion. And only by relying on performance in this criterion with a significant score was ranked 1st. However, with the modification of the EDAS method and the evaluation of the mean distances to the standard deviations, the rating of option A1 was reduced from 1 to 3. Which method to choose depends on the decision maker, who wants to use which Strategy? It is possible that the decision maker will accept the different performance of Option A1 and the score obtained from it, and on the other hand, it is possible that the decision maker will give more points to the performance balance and will know the modified method, more effectively.

4. Case Study

In this section, the modified EDAS method will be used in the real world and in large spaces.

1951 The branch of the Agricultural Bank of Iran is ranked using this method. According to the central limit theorem, as the number of data increases, the normal distribution approximation will improve. We know that there is a condition for data independence and that the data have the same distribution, so the use of a modified EDAS method mechanism is available. Because there is a large amount of data and its inclusion in the article is not reasonable, it is only possible to describe the data using SPSS software.

4.1. Selection of criteria and weight

The choice of criteria and how to weigh it is one of the most important issues in multi criteria decision making methods. Each organization identifies effective metrics by experts according to its strategy.

Due to the quality of this issue, there is no standard model and the researcher has to use the comments of experts of the organization under study. In this research, 4 general criteria have been considered. Profit and loss status of the branch, financial risk, the level of physical activity of the branch staff and finally the success rate of the branch in attracting customers to use the electronic services of the bank, which are selected and weighted as follows.

Criterion 1- is return and shows the balance of income and expenses. The weight of this criterion is 40 out of 100.

Criterion 2 - shows the risk. This risk is not related to return fluctuations. Is risk of non-repayment of the loan, which has a negative impact on expected income. The weight of this criterion is 20 out of 100.
Criterion 3- Volume of work includes resources and expenses, the main part of which is the deposit and loan payment of the branch.

The purpose of this criterion is to measure the volume of activity and busyness in the branch. The weight of this criterion is 25 out of 100.

Criterion 4- is Diversity of services in the branch. The focus of this criterion has been on e-services and the amount of outsourcing of branch work. The weight of this criterion is 15 out of 100.

4-2- DECISION MATRIX

Because the 1951 evaluation of the Agricultural Bank branch is on the agenda, it is not possible to display the decision matrix, so only the data are described in Table 4.

TABLE 4- DESCRIBE THE DECISION MATRIX

	N	Minimum	Maximum	Mean	Std. Deviation
Return	1951	-14078797.02	5992709.98	6840.9911	397206.78049
Risk	1951	.00	100.00	9.6735	13.81968
Work	1951	.00	219133900.00	1167240.0344	5412514.42864
Variety	1951	.00	3341.32	421.6176	312.64444

In order to investigate the data distribution of each criterion, Figure 6 in software SPSS has been used. The comparative graph of normal distribution and data distribution is drawn separately for each of the four criteria. The presence of outlier data indicated by the red arrow in the figure shows a clear picture of the deviation of outlier data from the template distribution. Existence of these data out of equilibrium and normal conditions is the main reason for using the modified EDAS method.

4.3. EVALUATION RESULTS USING EDAS AND MODIFIED EDAS METHODS

Due to the large file size, only the evaluation results for the top 30 branches in the modified EDAS method will be displayed and compared with the EDAS method at the same time. Due to the large file size, only the evaluation results for the top 50 branches in the modified EDAS method will be displayed and compared with the EDAS method at the same time.
The result is shown in Table 5, 14 of the top 30 branches have had rank changes compared to the classic EDAS method.

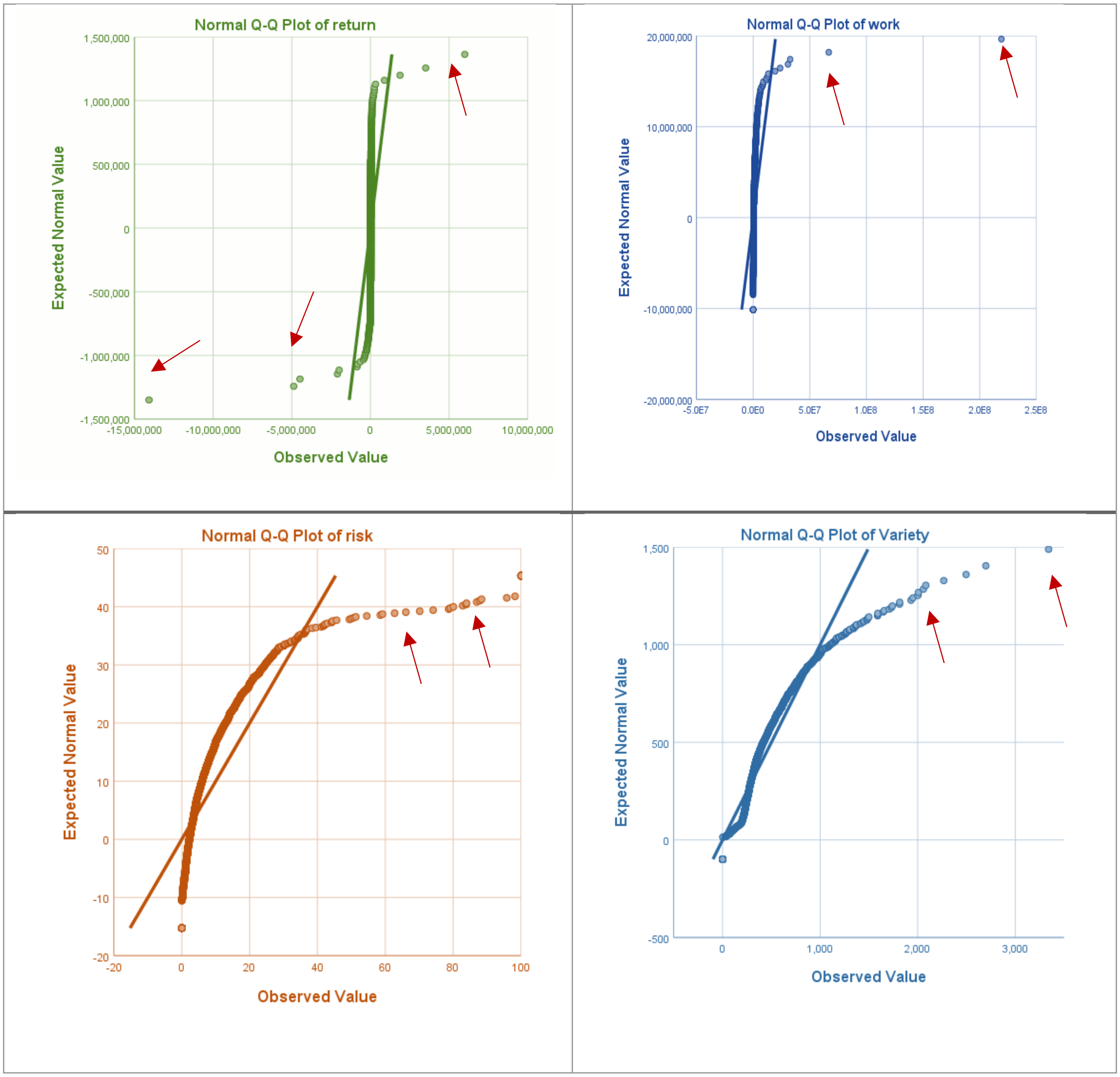

FIGURE 4- ABUNDANCE OF DATA IN NORMAL DISTRIBUTION

Table 5- Describe the decision matrix

Modified EDAS			Classic EDAS		Rank comparison
code number	score	rank	score	rank	
Code 1951	0.997941618	1	0.999772833	1	0
Code 12	0.950053263	2	0.859759699	2	0
Code 124	0.865056564	3	0.665548202	3	0
Code 160	0.825700477	4	0.577570209	4	0
Code 526	0.681638679	5	0.527664591	5	0
Code 87	0.650546071	6	0.523838692	6	0
Code 165	0.639804972	7	0.52123344	7	0
Code 270	0.634088829	8	0.520664607	8	0
Code 90	0.614636491	9	0.518327335	10	-1
Code 32	0.605326737	10	0.516031788	11	-1
Code 26	0.58927982	11	0.520465749	9	2
Code 534	0.588200142	12	0.513407262	12	0
Code 352	0.579395438	13	0.512932293	13	0
Code 107	0.567303695	14	0.510237746	14	0
Code 364	0.563681914	15	0.509911438	15	0
Code 92	0.561419941	16	0.509373592	19	-3
Code 625	0.561346082	17	0.509639622	16	1
Code 1563	0.559694597	18	0.509374351	18	0
Code 17	0.558658688	19	0.509117789	20	-1
Code 1561	0.558135265	20	0.509405546	17	3
Code 197	0.557647738	21	0.508749945	21	0
Code 144	0.556306166	22	0.508546318	22	0
Code 635	0.555039126	23	0.508484846	23	0
Code 168	0.551545756	24	0.507831249	26	-2
Code 875	0.55001183	25	0.507694131	27	-2
Code 1344	0.549808089	26	0.507833631	25	1
Code 362	0.548558542	27	0.507385962	29	-2
Code 1713	0.547883572	28	0.507311751	30	-2
Code 547	0.547036518	29	0.507241941	31	-2
Code 1338	0.546560248	30	0.50824943	24	6

In the following and in Table 6, the amount of rank changes in the two methods of classical EDAS and modified EDAS is shown. To determine the extent of rank changes in two ways, Table 6 is designed and the range of rank changes is divided into 9 intervals. For example, the change in the position of the evaluated branches, which have been upgraded by more than 200 ranks in the modified EDAS method compared to the classical EDAS method, is 3 branches, and the number of branches in the evaluation of the modified EDAS method has decreased by 10 to 50 ranks compared to the classical EDAS method, is 412 branches.

TABLE 5- DESCRIBE THE DECISION MATRIX

x<-200	*-200<x-<-50*	*-50<x<-10*	*-10<x<0*	*x=0*	*0<x<10*	*10<x<50*	*50<x<200*	***x>200***
3	88	407	550	100	335	412	47	**9**

4-3- ANALYSIS OF RESULTS

Table 5 shows that 985 branches have changed less than 10 ranks with the classic and modified EDAS evaluation methods, so in other words, about 50% of the branches have not changed significantly in their rank by changing the calculation method. But 12 branches have had more than 200 rank changes, in this section, the performance of the branches with the most changes of rank will be discussed.

Code 51 is the branch that has had the most rank of changes. This branch has been ranked 54 in the evaluation using the classic EDAS method, with the change of the computational method to the modified EDAS method, its rank has been reduced to 1656.

A very important question can be asked. Is the rank declared by the classical EDAS method, which considers the branch with code 51 in the group of branches with good performance, acceptable, or is the rank of the modified EDAS method, which considers it in the group with poor performance, acceptable? To answer this question, Table 6 has been designed to examine the performance rank of Branch 51 for each of the indicators.

TABLE 6- DESCRIBE THE DECISION MATRIX

	Return	*Risk*	*Work*	*Variety*	*Classic*	*Modify*
Weight	40	20	25	15		
Rank	1901	1848	**5**	121	54	1656

A very important question can be asked. Is the rank declared by the classical EDAS method, which considers the branch with code 51 in the group of branches with good performance, reliable, or is the rank of the modified EDAS method, which considers it in the group with poor performance, acceptable? To answer this question, Table 7 has been designed to examine the performance rank of Branch 51 for each of the indicators.

Table 6 shows that Branch 51 has a very poor performance in return and risk. 1901 rank in return and 1848 rank in risk means that it is at the bottom of the ranking table in two indicators that are of special importance and the decision maker has considered 60% of the score weight for it. Is it acceptable for a branch with this poor performance to be ranked 54th and considered as a leading branch of performance?

In order for the method to be validated, the standard weight of return was reduced from 40 to 25 and on the other hand, the standard weight of workload was increased from 25 to 40, other information remained unchanged and the problem was solved again. The rank of Branch 51 was increased to 13 in the classic EDAS method and to 131 in the modified EDAS method. This indicates that Branch 51 is a branch that has a high volume of banking work, but does not have an acceptable financial balance.

In the classical EDAS method, due to the different performance of Branch 51, which is a kind of outlier data compared to other data, a very high score has been considered for this branch, To the extent that the low score covers other indicators. But, in the modified EDAS the workload score of Branch 51 is controlled, so that, it cannot cover the performance of other criteria under review.

Figure 5 examines the changes made in step 2 of the EDAS method, which is the basis of this research.

In order to express the effect of the modified step in the EDAS method intuitively, the classical EDAS method and the modified EDAS method have been solved as a single criterion and its scoring results are shown in Figure 5. Examining the results of two methods for each criterion, it is observed that in the modified EDAS method, the relevant score has a better dispersion. In fact, the scoring of the branch are controlled with different performance, to prevent the scoring of other branches from tending to the minimum.

5- Conclusion

In this study, the EDAS method has been modified to control outlier data that is significantly different from other data. Section 2 provides a brief overview of the quality of the outlier data. The idea of outlier data control is derived from the normal distribution. In the following, Section 2 describes the normal distribution and its thematic relationship to the topic of the article. Then, in Section 3, the challenge of outlier data on the EDAS method is examined and its negative effect is examined and shown from both mathematical and intuitive perspectives. The existence of a large number, that is the result of the distance of the outgoing data from other data and its effect on the small numbers is the most important issue raised in Section 3 of the research. In this section it is shown that the outlier data, Monopolize a criterion score. The result is the elimination of points for other options, without valuing their competition. In fact, outlier data will prevent them from identifying better options and earning points for them, as they will greatly reduce the scoring value of that criterion for other options. In order to solve this challenge, a new weight has been designed that modified Step 2 of the EDAS method.

At this weight, the valuation for the expected performance distances is greater than the valuation for the long distances. In fact, a significant score is considered a criterion for the normal distribution of data, and part of the score is considered for options with different performance from other options. In order to validate the method, in section 4 of the research, a case study of 1951 branches of the Agricultural Bank of Iran with 4 criteria has been reviewed. The evaluation was performed with the methods of classical EDAS and modified EDAS and the ranking was compared for the two methods. The analysis shows that the distribution of branch scores, after modification of the method has been removed from the monopoly of a few specific branches. Also In the analyzes, Rank changes were compared in two ways, The results showed that Branch 51 was able to climb to the top of the table in the classical EDAS method due to different performance in an criteria, but in the modified EDAS method, with normal distribution of points in each criteria, the situation has changed and the score of this branch has decreased.

The results also showed that, about 50% of the branches did not have a serious rank change, and due to normal functional behavior in both methods, their rank was maintained. Only 12 branches have had rank changes of more than 200.

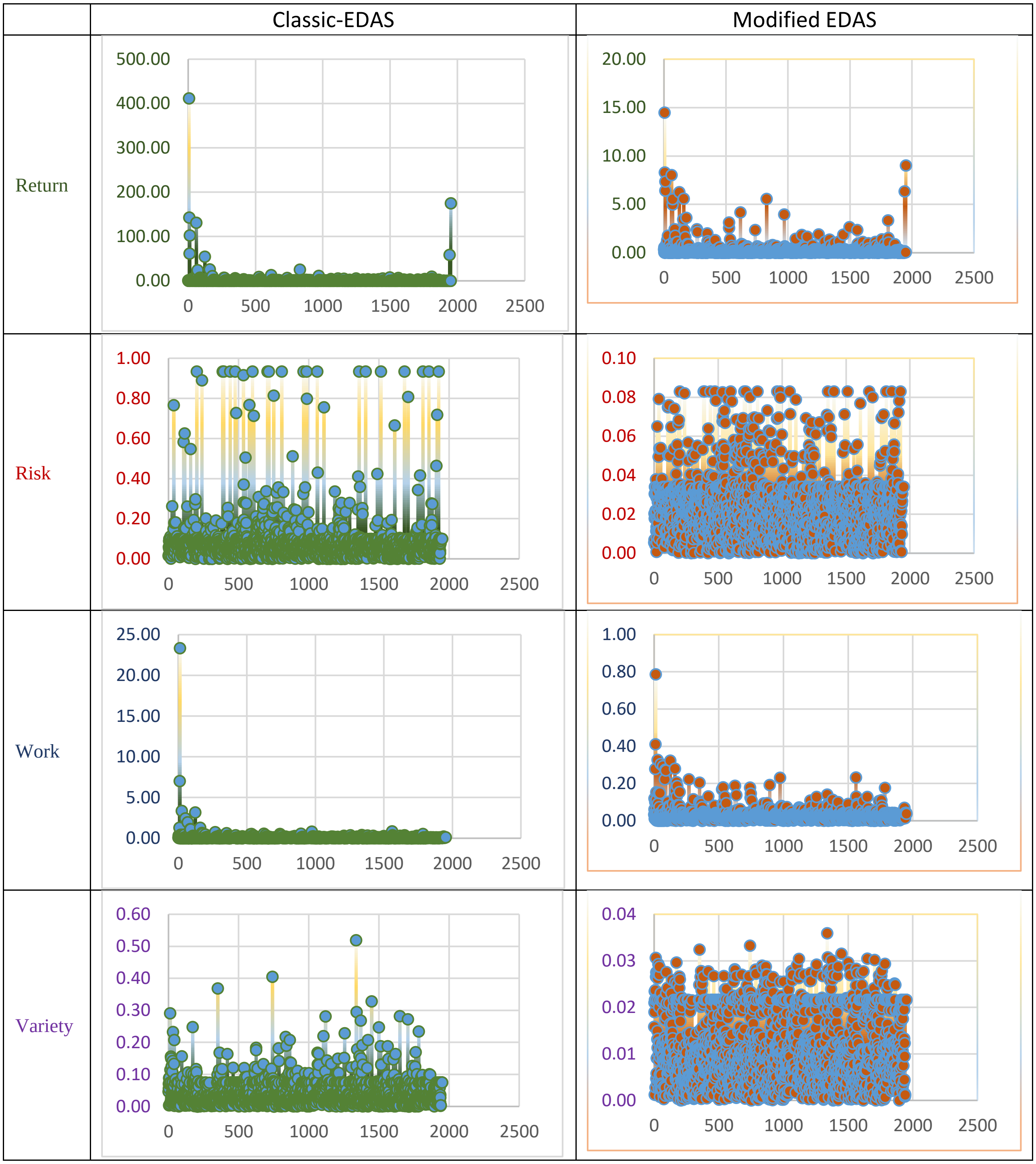

FIGURE 5- CORRECTION OF SCATTER POINTS OBTAINED BY MODIFYING THE EDAS METHOD

Other branches also had their rankings with changes between 10 and 200, which generally changed less than 50 ranks. The general conclusion is that, by Give credit for the distances in each criterion, the performance value of the options that behaved normally, can be maintained, and the score of a criterion can be taken out of the monopoly of several specific options. In this research, the normal distribution mechanism has been used to Give credit for the distances. It is suggested that researchers or operators use other methods of estimating distances in each criterion according to their needs.

Suggestions for future research: As mentioned in the introduction, the use of MCDM methods in fuzzy environments has developed significantly in recent years, and a variety of studies have been conducted to meet the needs of the real world with uncertain data. in this research, the steps of EDAS method in a definite environment and in accordance with the needs assessment of financial and credit institutions have been modified. It is suggested that the modified EDAS method be developed in an uncertain environment.

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