

PROPOSES AND EVALUATES SIMILARITY METHOD IN TEHRAN STOCK EXCHANGE

Jahan Biglari Arash

Researcher

EUA, Chair of Management

ajahanbiglari@yahoo.com

Abstract

One of the most issues for managers and traders has been deciding on a worthwhile portfolio for yielding and investing money. There are distinctive methods for rating and weighting offering exclusive results. This paper proposes a new method to rank the alternatives with or without knowing about the weight of the criteria and examine them. The intention of this study proposes the Similarity method and evaluates it in the Iranian capital market hence imparting a new way to assist investors in selecting a satisfactory portfolio. All calculations for the portfolio had been based totally on the information of the Tehran Stock Exchange from 2014 to 2021.

The Similarity method can assign rank and weight to the alternatives and construct portfolios with acceptable performance on the Tehran Stock Exchange. This approach performs as good as to other MCDM (Multi Criteria Decision Making) methods. According to the findings, this strategy can create an efficient portfolio with a higher return on bank interest and the market index.

Keywords: Portfolio, MCDM, Criteria, Shannon, Decision Matrix, Normalizing

1. Introduction

Past researchers have already utilized Decision Matrix (DM) in decision-making the use of quite a number of mathematical models, heuristics and MCDM techniques. The benefit of MCDM methods is that they reflect on the consideration of each qualitative parameter as nicely as quantitative ones. MCDM consists of many methods such as Simple Additive Weighting (SAW), Weighting Product (WP), and AHP [Mohammadinejad et al.,3]. For this reason, the portfolio supervisor as a decision-maker desires a decision matrix that is a listing of values in rows and columns. The matrix is beneficial for searching at vast information of selection elements and assessing every factor's relative significance. The quality aspect of the decision matrix is, able use many kinds of decisions. However, it is mostly fine when you are evaluating a couple of alternatives or criteria that want to be narrowed down to one last desire [Lucid, Team, 1].

Scientific Novelty

This study proposes and evaluates a new approach with acceptable performance as a technique of Multi-Criteria Decision Making

(MCDM) methods. The Similarity method can give weight and compute the rank of alternatives. The Similarity method can construct valuable portfolios with returns more than the activity of financial institutions and stock market index. This technique works as well as different MCDM methods.

Structure

The rest of this paper is organized as follows. Section two defines the basic concepts of the research. The third section proposes the Similarity method. In part four, the Similarity approach is utilized for real-world problems. Section five illustrates the results of the real-world and comprehensively contrasts them with the Bank Interest and Stock Market Index. The conclusions and pointers for the future lookup are represented in part six.

2. Literature review

This section explains the concepts of the Similarity Method these principles are consisted of calculating the size of the vector and normalizing with the similarity between satisfactory vector and others.

2.1 Decision Matrix

A decision matrix is a listing of values in rows and columns that permit an analyst to systematically identify, analyze, and score the overall performance of relationships between alternatives and criteria.

$$DM = \begin{matrix} & A_i & C1 & \dots & Cn \\ \begin{matrix} A1 \\ \vdots \\ Am \end{matrix} & \begin{pmatrix} a_{11} & \dots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1} & \dots & a_{mn} \end{pmatrix} \end{matrix} \quad (1)$$

Where $\{A_1, A_2, \dots, A_m\}$ is a set of possible alternatives $\{C_1, C_2, \dots, C_n\}$ is a set of decision-making criteria, and a_{ij} is the value of alternative i

with respect to criterion j [When to Use a Weighted Decision Matrix, 1].

2.2 Criteria

This phase explains the criteria used in this paper. The criteria have consisted of *Return*, *Reliability* and *Risk*.

Return

The main idea in investment is the return. The return incorporates value changes and proprietorship benefits. To assess the financial investment needs the return on resources more than the costs [Beattie, 1].

The return equation in the stock market is as follows:

Percentage of Stock Return

$$= \frac{\text{Real price of last trading day} - \text{Real price of first trading day of the year}}{\text{Real share price on the first trading day of the year}} \times 100 \quad (2)$$

Reliability

Reliability is the lack of failures and Reliability engineering is the management action that prevents the development of failures. Also, Reliability engineering is the capacity of components that can work without break [Barnard, 8].

The Reliability function is hypothetically characterized as the likelihood of success at time t . This likelihood is assessed by examining past informational indexes or through reliability methods. Reliability frequently assumes a vital part in the expense viability of systems.

Most reliability techniques are utilized in numerous scientific strategies. Mean Days Failures (MDF) is one of the methods for calculating reliability that has been used as one of the criteria in this research. MDF be able to calculate the ratio of fail days based on the total days that the asset is in use.

$$MDF = \frac{\sum(\text{fail days})}{\text{total number of trading days}} \quad (3)$$

MDF defines mean days failures, system failures are days the stock price is traded less than a certain amount for each period the investor determined. MDF is total failure days divided by the sum of the trading days [Jahan Biglari, 282].

Risk

Risk implies future uncertainty about deviation from anticipated profits or outcomes. Risk measures the uncertainty of recognizing a gain from an investment that an investor is wishing to take it. Risks are of unique kinds and originate from special situations. In finance, the beta (β or market beta or beta coefficient) is a measure of how an asset performs (on average) when a standard market will increase or decrease. Thus, beta is a beneficial measure of the contribution of an asset to the threat of the market portfolio. Therefore beta is defined as systematic risk or market risk [Kenton,1].

2.3 Compute Return of a portfolio

The return of a portfolio defines in equation (4):

$$\text{Portfolio return} = \sum_{i=1}^m w_i r_i \quad (4)$$

r_i is the return of every alternative and w_i is the weight of every alternative in the portfolio and m is the number of alternatives.

2.4 Length of Vector

Most frequent distance measure, particularly Euclidean distance. It measures the distance between two points in space. The Euclidean distance uses the Cartesian coordinates and the Pythagorean Theorem [Brownlee, 1].

$$D_{eucl}(p - q) = \sqrt{\sum_{i=1}^n (p_i - q_i)^2} \quad (5)$$

Assume q_i origin of coordinate is **zero** then according to the formula (5) length of vector is:

$$D_{eucl}(v) = \sqrt{\sum_{i=1}^n (p_i)^2} \quad (6)$$

2.5 Vector Normalizing

The vector normalization is used in the TOPSIS technique. Like other multi-criteria decision methods, the decision matrix must be normalized. The vector normalization method is used to normalize the values. Vector method is performed as follows [Habibi, 1]:

$$n_{ij} = \frac{x_{ij}}{\sqrt{\sum_1^m x_{ij}^2}} \quad (7)$$

2.6 Cosine Similarity

Cosine similarity is a measure of similarity that can be used to examine vectors, and supply a rating of them with comparison to a satisfactory vector. Let x and y be two vectors for comparison [Han et al., 77-78].

$$Sim(x, y) = \frac{x^T \cdot y}{\|x\| \cdot \|y\|} \quad (8)$$

Utilizing the cosine function as the Similarity method, Where $X = (x_1, x_2, \dots, x_n)$ and $Y = (y_1, y_2, \dots, y_n)$, and where X^T is a transposon of vector x . $\|x\|$

and $\|y\|$ are the education of the norm of vector x and y .

$$\|x\| = \sqrt{x_1^2 + x_2^2 + \dots + x_n^2}, \quad \|y\| = \sqrt{y_1^2 + y_2^2 + \dots + y_n^2}$$

The Similarity method measures the cosine of the angle between vectors x and y . A cosine with zero value means the angle of two vectors is ninety degrees and has no match. The cosine with the nearer amount to one explains the smaller surface between vectors and the increased similarity between them.

Note the cosine similarity is referred to as a nonmetric measure.

2.7 Entropy Shannon

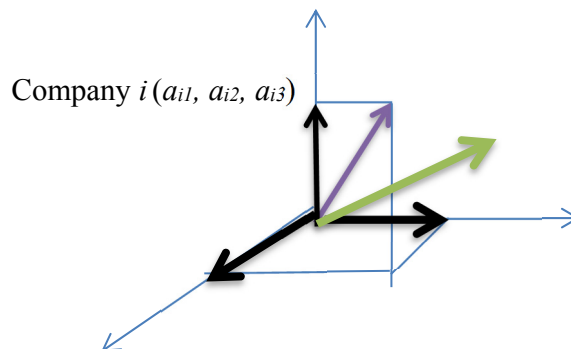
The entropy technique is one of the multi-criteria decision-making strategies for calculating the weight of criteria. In this method, a decision matrix is required. This approach was once proposed by using Shannon and Weaver in 1974. Entropy expresses the quantity of uncertainty in a non-stop likelihood distribution [Hosseinzadeh Lotfi, F and Fallahnejad, 55].

Entropy is a basic concept in physical sciences, social sciences and systems. Entropy represents the amount of uncertainty resulting from the content of a message. In other words, entropy in information theory is an index to measure uncertainty expressed by a probability distribution [Azar, 8].

3. Similarity method

The decision matrix based on three criteria means each alternative can be a vector with three dimensions. The criteria are *Return*, *Reliability* and *Risk*.

Figure 1



The Similarity method is based on the similarity between the best vector and an alternative

In the above figure, the vector blue is a company as an alternative and the green vector is the best vector between alternatives that its attributes consisted of the best value of each criterion.

Similarity Steps

Step1. Construct the decision matrix (It is explained in part 2.1)

Step2. Normalize the decision matrix (It is explained in part 2.5)

Step3. Similarity (It is explained in part 2.6)

This step must compute the sum of similarities of each alternative with the best vector calculated in the previous step.

Step4. Weight to alternatives

As rule, give zero if the similarity value is less than zero. Then normalize the new matrix that

consisted of similarity values with linear normalizing. The normalized matrix illustrates the weight of alternatives.

4. A Real World Example

This section explains the Similarity approach with an instance in the actual world. This paper tries to use the actual world as an example for utilize the Similarity technique.

The decision matrix included twenty companies as alternatives and three criteria *return*, *reliability* and *risk*.

Constructing Decision Matrix

The decision matrix in table (1) is an example of the year 1397 (Solar system calendrer) that consisted of values obtained from previous parts.

Table 1

DECISION MATRIX PerYear							
1397	Return	Reliability	RISK	Company	Return	Reliability	RISK
<i>Iran Mineral P.</i>	55.863	0.390	-0.677	<i>Sobhan Pharm.</i>	-5.011	1.000	1.064
<i>Behbahan Cement</i>	-12.664	0.973	-0.614	<i>Iran Mobil Tele</i>	30.115	0.504	0.573
<i>Dadeh pardazi Iran co</i>	15.865	0.237	1.283	<i>Chadormalu</i>	31.688	0.712	1.081
<i>Fanavaran Petr.</i>	54.682	0.589	0.069	<i>Iran Khodro</i>	0.755	1.000	1.563
<i>S*North Drilling</i>	-48.540	1.000	0.181	<i>Khouz. Steel</i>	57.449	0.310	1.142
<i>S*IRI Marine Co.</i>	-1.458	1.000	0.596	<i>S*I. N. C. Ind.</i>	65.427	0.500	0.757
<i>Butane Group</i>	49.162	0.813	0.770	<i>Azar Refract.</i>	-	0.845	-
<i>Shahrout Sugar</i>	5.874	0.131	2.083	<i>S*Tehran Const.</i>	-	1.000	-
<i>Yazd Jooshkab</i>	6.575	0.315	0.796	<i>MAPNA</i>	-	1.000	0.839
<i>Sahand Rubber</i>	7.722	0.292	1.021	<i>S*Mellat Bank</i>	-	1.000	0.393
					10.531		

An example of a decision matrix

Normalizing Decision Matrix

Two strategies of normalization that have been used to deal with incongruous standards dimensions are linear normalization and vector normalization. Vector normalization was merged with the main

TOPSIS method, and is calculated by the usage of the following method (7). The vector normalization makes produces smoother trade-offs for the non-linear distances between single-dimension rankings and ratios [Pavić and Novoselac 7].

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Table 2

Normalized Decision Matrix 1397

<i>Company</i>	<i>RETURN</i>	<i>RELIABILITY</i>	<i>RISK</i>	<i>Company</i>	<i>RETURN</i>	<i>RELIABILITY</i>	<i>RISK</i>
<i>Iran Mineral P.</i>	0.365	0.11656	-0.155	<i>Sobhan Pharm.</i>	-0.0327	0.2990	0.2437
<i>Behbahan Cement</i>	-0.082	0.29097	-0.140	<i>Iran Mobil Tele</i>	0.1968	0.1507	0.1312
<i>Dadeh pardazi Iran co</i>	0.103	0.07088	0.2939	<i>Chadormalu</i>	0.2070	0.2128	0.2478
<i>Fanavarana Petr.</i>	0.357	0.17604	0.0158	<i>Iran Khodro</i>	0.0049	0.2990	0.3582
<i>S*North Drilling</i>	-0.317	0.29901	0.0415	<i>Khouz. Steel</i>	0.3754	0.0926	0.2617
<i>S*IRI Marine Co.</i>	-0.0095	0.29901	0.1366	<i>S*I. N. C. Ind.</i>	0.4275	0.1495	0.1735
<i>Butane Group</i>	0.3212	0.24302	0.1763	<i>Azar Refract.</i>	-0.2552	0.2526	-0.094
<i>Shahrout Sugar</i>	0.0383	0.03917	0.4773	<i>S*Tehran Const.</i>	-0.1723	0.2990	-0.288
<i>Yazd Jooshkab</i>	0.0429	0.09415	0.1824	<i>MAPNA</i>	-0.0737	0.2990	0.1923
<i>Sahand Rubber</i>	0.0504	0.08726	0.2339	<i>S*Mellat Bank</i>	-0.0688	0.2990	0.0899

The decision matrix is normalized

Using the Similarity method

According to part 2.4, the table 3 below shows the length of each alternative as a vector and the

similarity between them is computed based on the equation (8).

Table 3

<i>1397</i>	<i>Return</i>	<i>Reliability</i>	<i>Risk</i>	<i>Length of Alternatives</i>	<i>M_{alternatives} * A*</i>	<i>SIM</i>
<i>Iran Mineral P.</i>	0.133288	0.013587	0.024047	0.4134	0.0867	0.3265
<i>Behbahan Cement</i>	0.006850	0.084666	0.019772	0.3336	-0.0911	-0.4254
<i>Dadeh pardazi Iran co</i>	0.010750	0.005025	0.086422	0.3197	0.1874	0.9132
<i>Fanavarana Petr.</i>	0.127712	0.030991	0.000252	0.3987	0.1673	0.6535
<i>S*North Drilling</i>	0.100635	0.089408	0.001723	0.4379	-0.1041	-0.3703
<i>S*IRI Marine Co.</i>	0.000091	0.089408	0.018674	0.3289	0.0729	0.3451
<i>Butane Group</i>	0.103232	0.059062	0.031106	0.4398	0.2311	0.8184
<i>Shahrout Sugar</i>	0.001474	0.001534	0.227854	0.4805	0.2458	0.7968
<i>Yazd Jooshkab</i>	0.001847	0.008866	0.033275	0.2097	0.1091	0.8105

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<i>Sahand Rubber</i>	0.002547	0.007615	0.054737	0.2548	0.1367	0.8356
<i>Sobhan Pharm.</i>	0.001072	0.089408	0.059421	0.3872	0.1141	0.4589
<i>Iran Mobil Tele</i>	0.038736	0.022739	0.017214	0.2805	0.1527	0.8478
<i>Chadormalu</i>	0.042887	0.045298	0.061421	0.3868	0.2152	0.8665
<i>Iran Khodro</i>	0.000024	0.089408	0.128351	0.4667	0.1848	0.6169
<i>Khouz. Steel</i>	0.140968	0.008577	0.068490	0.4669	0.2891	0.9643
<i>S*I. N. C. Ind.</i>	0.182838	0.022352	0.030121	0.4851	0.2715	0.8719
<i>Azar Refract.</i>	0.065159	0.063828	0.008865	0.3713	-0.1442	-0.6049
<i>S*Tehran Const.</i>	0.029718	0.089408	0.083157	0.4498	-0.1997	-0.6914
<i>MAPNA</i>	0.005434	0.089408	0.037003	0.3631	0.0720	0.3089
<i>S*Mellat Bank</i>	0.004737	0.089408	0.008095	0.3198	0.0252	0.1229
A*	0.427596	0.0391719	0.477340			

Similarities between alternatives and the best vector

A* is the best alternative base on the best value of criteria.

Table 4 shows according to equation (2) the return of the portfolio in 1397 by the Similarity method has been 78.70.

Table 4

1397	IF(S_i<0,0,S_i)	Weight	Return	Company	IF(S_i<0,0,S_i)	Weight	Return
<i>Iran Mineral P.</i>	0.32645080	0.0309	3.45	<i>Sobhan Pharm.</i>	0.45887435	0.0435	1.25
<i>Behbahan Cement</i>	0	0.0000	0.00	<i>Iran Mobil Tele</i>	0.84779334	0.0803	1.36
<i>Dadeh pardazi Iran co</i>	0.91320732	0.0865	1.79	<i>Chadormalu</i>	0.86651851	0.0821	14.97
<i>Fanavaran Petr.</i>	0.65351179	0.0619	6.12	<i>Iran Khodro</i>	0.61688302	0.0584	0.25
<i>S*North Drilling</i>	0	0.0000	0.00	<i>Khouz. Steel</i>	0.96429152	0.0913	12.20
<i>S*IRI Marine Co.</i>	0.34507638	0.0327	0.75	<i>S*I. N. C. nd.</i>	0.87185186	0.0826	7.70
<i>Butane Group</i>	0.81844761	0.0775	4.68	<i>Azar Refract.</i>	0	0.0000	0.00
<i>Shahrud Sugar</i>	0.79678845	0.0755	11.53	<i>S*Tehran Const.</i>	0	0.0000	0.00
<i>Yazd Jooshkab</i>	0.81047821	0.0768	1.27	<i>MAPNA</i>	0.30890880	0.0293	1.60
<i>Sahand Rubber</i>	0.83561541	0.0791	7.60	<i>S*Mellat Bank</i>	0.12290250	0.0116	2.17
PORTFOLIO RETURN		78.70					

The weight of alternatives and the return of each one

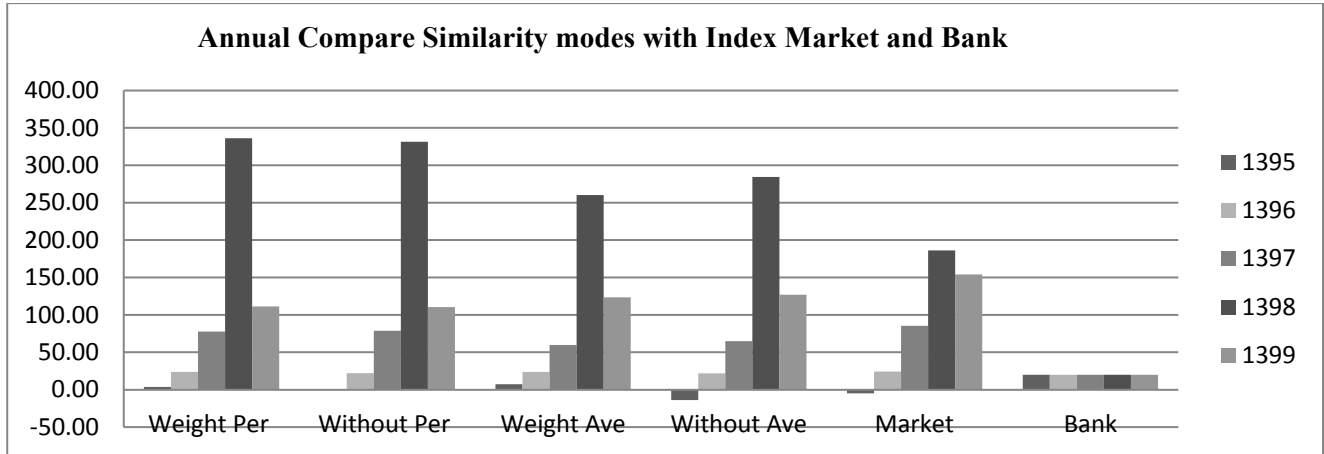
5. Results and Discussion

This section shows the result of giving weight to alternatives with the Similarity method for five years and comparing them with market index, and bank interest and using four modes of Similarity for calculating the return of each portfolio. Shannon is a

default method used for giving weight to criteria. These portfolios compare with each other and show results with charts. These charts help to find which method has better performance.

Figure 2 shows the return of Similarity modes, market index and bank interest for five years.

Figure 2

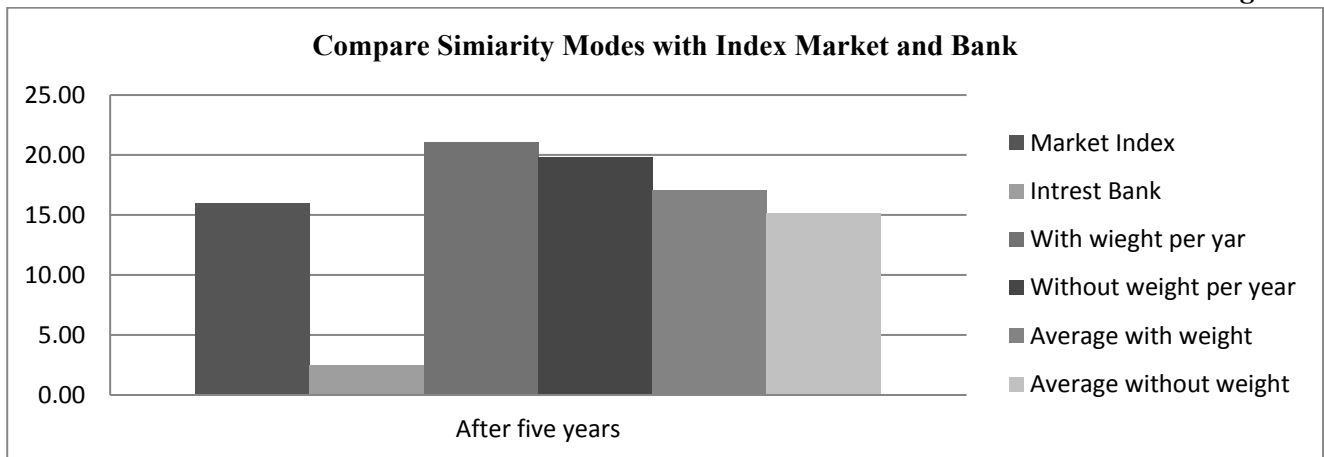


The results of the annual return of the Similarity method in comparison with the market index and bank interest

Figure 3 shows the performance of different modes of Similarity and compares them with the yield of the market index and the interest of the bank. The results illustrate the return of Similarity modes after five years is better than the market index and

bank interest. Shannon makes a profitable portfolio that has a better return than others when the criteria are calculated based on per year in the Shannon technique.

Figure 3



The results of the Similarity method in comparison with the market index and bank interest after five years

According to the results above the recommended portfolio constructed with the similarity method for 1400 is recommended in the below table (5). This portfolio is constructed based

on three criteria *return, reliability and risk*. The criteria are calculated according to Per Year mode and given weight to criteria by the Shannon method.

Table 4

Company	Weight	Company	Weight
Iran Mineral P.	0.043	Sobhan Pharm.	0.042
Behbahan Cement	0.063	Iran Mobil Tele	0.060
Dadeh pardazi Iran co	0.062	Chadormalu	0.064
Fanavaran Petr.	0.064	Iran Khodro	0.063
S*North Drilling	0.000	Khouz. Steel	0.063
S*IRI Marine Co.	0.014	S*I. N. C. Ind.	0.064
Butane Group	0.040	Azar Refract.	0.008
Shahrour Sugar	0.058	S*Tehran Const.	0.059
Yazd Jooshkab	0.058	MAPNA	0.058
Sahand Rubber	0.060	S*Mellat Bank	0.056

Recommended portfolio with Similarity method for 1400 (2021-2022)

6. Conclusion and Recommendations

One of the most concerns for managers and investors has been choosing the best portfolio for yielding and investing money. There are different techniques for ranking and weighting alternatives that each gives different results. This research goal is to propose the Similarity method to assign weight to alternatives with a known weight of criteria or without knowing them.

The main part of the paper is devoted to expressing the Similarity method in content analysis by mentioning the example to further explain it, then the practical implementation of this method and comparing it with the current data analysis method. Finally, the validity of the results of the method in comparison with the market index and bank interest has been analyzed.

According to the findings, the Similarity method assesses the weight of alternatives to a portfolio with the acceptable performance on the Tehran Stock Exchange. The results illustrate the return of Similarity modes after five years is better than the market index and bank interest. Shannon makes a profitable portfolio that has a better return than others when the criteria are calculated based on per year in the Shannon technique.

The recommendation for more research is to compare this method with TOPSIS, AHP and other MCDM methods and survey the performance of this method in other markets and change the number of criteria or change the normalizing method that is used to normalize the decision matrix.

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Appendix

Company Name	Industry	Symbol
<i>Iran Mineral P.</i>	<i>Production of zinc sheets and ingots</i>	<i>FRVRI</i>
<i>Behbahan Cement</i>	<i>Production of type I, II & V gray cement</i>	<i>SBHNI</i>
<i>DPI</i>	<i>DPI can be present and act on all fields concerning information and communications technology</i>	<i>DADEI</i>
<i>Dadeh pardazi Iran co</i>		
<i>Fanavaran Petr.</i>	<i>Manufacturing, commissioning and extraction of methanol units, acetic acid and carbon monoxide to meet the needs of domestic and export target markets</i>	<i>PFANI</i>
<i>S*North Drilling</i>	<i>A leading company in oil and gas well drilling</i>	<i>HSHMI</i>
	<i>Purchasing, operating, renting, leasing and selling any type of ship and vessel for any purpose, including freight and passenger transport, refueling and the like.</i>	
<i>S*IRI Marine Co.</i>	<i>Undertaking any activity complementary to the activities subject to paragraph 1 above, such as the construction, operation or rental of port facilities, offshore structures and facilities related to the construction and repair of ships and vessels, and all types of cargo and passenger terminals. Production, import and purchase of various installation products, gas appliances, home appliances, parts and raw materials - manufacture and operation of production equipment and machinery - establishment, rent and management of factories in or outside the country - distribution, sale and export of products Above.</i>	<i>KSHJI</i>
<i>Butane Group</i>		<i>BOTAL</i>
<i>Shahroud Sugar</i>	<i>Production of sugar from sugar beet and refining of raw sugar to white sugar and selling them.</i>	<i>SHKRI</i>

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<i>Yazd Jooshkab</i>	<i>Manufacturer of cables with rubber and silicone insulation</i>	<i>JOSHI</i>
<i>Sahand Rubber</i>	<i>Rubber liner - Conveyor belt - Roller cover - Rubber parts - Flooring</i>	<i>SHNDI</i>
<i>Sobhan Pharm.</i>	<i>Pharmaceutical Holding</i>	<i>DSOBI</i>
<i>Iran Mobil Tele</i>	<i>The biggest mobile operator in the country in both call and mobile internet</i>	<i>HMRZI</i>
<i>Chadormalu</i>	<i>The subject of the company is: a- Main topics - Exploration and exploitation of iron ore mines and production of concentrate from it and production of pellets, production of iron ore (lamp over), production of steel products b- Sub-topics - installation and commissioning, maintenance, repairs, inspection Technical, service of machinery equipment required by the company</i>	<i>CHMLI</i>
<i>Iran Khodro</i>	<i>Establishment, construction and management of factories in any place, inside or outside the country in order to produce and supply all kinds of cars and means of transportation.</i>	<i>IKCOI</i>
<i>Khouz. Steel</i>	<i>The main topics include smelting, casting and rolling operations of ferrous metals and alloy steels to produce standard geometric sections. Sub-topics include supply and production of spare parts, renovation and factory management, business operations, investment in companies related to the subject of the company.</i>	<i>FKHZI</i>
<i>S*I. N. C. Ind.</i>	<i>Exploration, extraction and exploitation of Iranian copper mines</i>	<i>MSMII</i>
<i>Azar Refract.</i>	<i>Production of various shaped and amorphous refractory products</i>	<i>NSAZI</i>
<i>S*Tehran Const.</i>	<i>Mass construction and real estate investments</i>	<i>NSTHI</i>
<i>MAPNA</i>	<i>Construction of power plant equipment and</i>	<i>MAPNI</i>
<i>S*Mellat Bank</i>	<i>1- Opening and maintaining current Gharz al-Hasna deposit accounts, savings and short-term and long-term investment deposit accounts and other similar accounts, and issuing various types of licensed cards and issuing various types of deposit certificates. 2- Granting all kinds of financial and credit facilities to natural and legal persons in the form of current laws of the country</i>	<i>BMLTI</i>

Ներկայացվել է՝ 22.10.2022թ.
Ուղարկվել է գրախոսման՝ 07.11.2022թ.