

## Ranking Pharmaceuticals Industry Using SD-Heuristics Approach

<sup>1\*</sup> S. H. Ahmadi, <sup>2</sup> S. R. Alizadeh Shani

<sup>1,2</sup> Department of Industrial Management, Tehran University, Tehran, Iran

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### ABSTRACT:

In recent years stock exchange has become one of the most attractive and growing businesses in respect of investment and profitability. But applying a scientific approach in this field is really troublesome because of variety and complexity of decision making factors in the field. This paper tries to deliver a new solution for portfolio selection based on multi criteria decision making literature and clustering approach. The paper results reveal that four basic indexes (including: leverage indices, efficiency ratio, liquidity ratio, and market value ratio) besides twenty four secondary indexes were effective in portfolio selection.

Multi attribute decision making method (MADM) and clustering were used as analytical tools. The cases of this study embrace pharmaceutical companies accepted in Tehran Stock Exchange. For clustering companies, they were divided into two clusters and finally the companies which located in optimum cluster were ranked via SD Heuristics method. This method eliminates considerable amount of cases and by doing so it helps the experts to sort and rank the alternatives more effectively. It's recommended by researchers to apply qualitative methods in addition to quantitative ones.

**Keywords:** Stock exchange, MADM, Clustering, Medical industry, SD heuristics method

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### INTRODUCTION

Nowadays financial investing methods have been replaced by multi attribute decision making methods (MADM) because of investors' variant preferences and lack of certainty in stock exchange. MADM is a branch of research that provides stable mathematical bases for portfolio selection problem, which is inherently a multi attributed problem. MADM methods are useful for studying different financial decision making problems. Variety of indexes on financial decision making (such as assessment of environment and purposes), complexities of economical, commercial and financial environments, and mental nature of financial decision making are amongst the features

related to decision making framework. Portfolio selection and management are the most significant fields in financial decision making. Selecting the optimal portfolio is a problem that all investors whether individual or collective may face with. Portfolio selection problem involves making a portfolio that may maximize the investors' ideals. Financial examiners and investigators always try to find the ideal way for making such a portfolio. Process of making optimum portfolio consists of two basic sections.

Since financial indexes of companies are so varied and abundant, the researchers decided to identify the most significant ones to rank the companies. The goal of doing this research is

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\*Corresponding Author, Email: [hosein.ahmadi@ut.ac.ir](mailto:hosein.ahmadi@ut.ac.ir)

identifying and ranking the most important indexes and criteria of pharmaceuticals companies. Besides, the paper tries to rank pharmaceuticals companies accepted in Tehran Stock Exchange from 3/20/2007 to 3/19/2012. For this reason a MADM method was used in combination with clustering method. Later, the companies located in the first cluster were ranked via SD Heuristics method. SD Heuristics method is superior to compensatory methods like TOPSIS and ELECTRE since this method considers all alternatives based on all of the criteria. Also, in above mentioned methods usually just one decision making matrix is applied, and in most cases subjectivity error occurs. But this recommended method is based on the comparison of all the alternatives in accordance with the experts' viewpoints. The more expert there are, the more accurate the method is. In order to enhance the accuracy of performance and the reliability of results, this paper benefits from seven experts' advice.

#### Literature Review

Foreign sanctions and embargos against Iran have increased and consequently providing finance for huge industrial projects has become a major problem in our country. Stock exchange is a suitable solution for funding industrial projects. Stock exchange leads the investments to the suitable and efficient markets and prevents from wasting wealth in inefficient markets. Stock exchange is amongst the most attractive and growing markets in the economy of Iran and it has turned to the best solution for financial supplying here. Expansion of stock exchange may lead to collecting and gathering small invests, reinforcing private (non-governmental) sections, founding commercial units, communicating with global market, getting access to foreign investments or privatizing public sections; in sum it may lead to significant results and effects (Hafezeieh, 2006).

On the other side, portfolio selection is such a sensitive decision to make, regarding complexities of macro-economy and other influential factors which effect on stock prices, that it overshadows existence and collapse of commercial units. Risk taking and efficiency are quintessential aspects of financial management. In recent decades, they have been investigated extensively and have been noticed in investing

process. Investing process requires making decision about five factors including: 1. codifying investing strategies, 2. analyzing debenture bonds, 3. creating a portfolio, 4. revising the portfolio, and 5. evaluating portfolio performance. These five stages besides saving debenture bonds variety and other influential factors, which effect on these processes in whole, make investing methods variable and make decision making process more complex. Over times through globalizing financial markets, the amounts of dealings have increased and become more complex. This situation demands applying comprehensive and unified models so as to help investors and financial firms in decision making process. For this reason and for satisfying this demand, financial modeling and mathematical programming has been developed.

Modern theory of portfolio selection began by Harry Markowitz, when he wrote the article "*portfolio selection*" in 1952. In that paper he formulized variability and delivered it quantitatively. He analyzed the reason why variability decreases the risk taking of individual investors. He was the first person who gave a definition for portfolio selection. According to his assumptions, investors appreciate efficiency and refrain from risk taking. They make decision logically in order to maximize their optimum efficiency. So, the function of investors' satisfaction consists of their expected efficiency and risk taking (Markowitz, 1952).

After him, several other researchers have probed portfolio selection problem and presented several models. Some researchers like Hallerbach and Spronik claimed that a large number of these models were impotent at combining multi-dimensional nature of portfolio selection problem and merely concentrate on giving general viewpoints about managing portfolio (Jafapour, 2000).

Many articles have linked the field of portfolio selection management with multi criteria decision making (MCDM) field. Decision making researchers and financial researchers have considered portfolio selection problem as a multi-dimensional, multi-criteria problem. The particular feature of multi criteria decision making framework is its ability to consider multiple purposes of portfolio formation simultaneously. Some of the main

features of multi criteria decision making framework are given below:

1. The possibility of modeling more realistic models, by considering several indexes, especially two main basic criteria (that is efficiency and risk taking) and several other significant indexes like price per earnings ratio, and the ones related to stock exchange features.

2. The classic approach defined an average limit for investors' behaviors and that limit was restrictive since they couldn't follow their own individual purposes, preferences and opinions about risk taking.

In sum, it can be said that comprehensive and unified models give a chance to investors to utilize their own limitations and goals in selected model, and apply a model according to their own preferences in portfolio selection framework, and take notice of effective information in respect of short term and long term investments when making a decision (Nezhad, 2004).

In their article about utilizing multi criteria decision making method for assessing the performance of industrial companies, Diakoulaki et al. (1992) distributed a multi criteria profit theory into large number of Greek pharmaceutical industrial companies. They used common financial ratio as a general evaluation financial index. The results reflect that profitability was the most significant index for evaluating and classifying given companies. Also, a proper capital structure is essential to make sure of profitability and efficiency of companies performance (Diakoulaki, Mavrotas, & Papayannakis, 1992).

Siskos et al. (1994) presented a monolith system which supported decision making for analyzing and financing companies via an industrial developing bank in Greece. At first, this system analyzed the financial performance of companies using financial profitability ratio, management operation, and the ability to repay debts during five years. By doing so, developing possibilities are understood. In addition, variant statistical techniques are available to identify significant financial ratio and to categorize companies in related categories (Siskos, Zopounidis, & Pouliezios, 1994).

Samaras and et al. (2008), by using multi criteria decision making method and a system supporting decision making, have evaluated the companies' portfolios which were available in

Athens Stock Exchange. Their method was based on analysis ratio and benefits from UTE STAR method for ranking the companies from the best to the worst in order to observe investors risk-taking ability. This system which has been designed for both individual and collective investors, get use of large amount of related information and later apply it in real situations to keep data up-to-date (Samaras, Matsatsinis, & Zopounidis, 2008).

Jafarpour (2000) investigated the development of smart selection systems of stock sets. The purpose of his research was collecting the resources under uncertainty situations in an optimized way. He concluded that selected resource is asset which must be distributed optimally into the stocks' of exchange market (Jafarpour, 2000).

Delbari (2001) studied the indexes which effect on portfolio selection in Tehran stock exchange. His study is based on hierarchical analysis process. He believes that Tehran stock exchange is an inefficient market, because there the real value of portfolio is not equal to its price. Consequently he claims that the portfolio selection problem seems significant. In his paper the indexes influencing on portfolio selection embrace current ratio, debt ratio, stock turn rate, return on investment, and profit percentage divided to earning (Delbari, 2001).

Nezhad (2004) has identified effective factors influencing on portfolio selection in Tehran stock exchange by utilizing multi criteria decision making method. His paper was limited to cement companies. In these companies the investors must evaluate different factors influencing on portfolio selection. His paper utilized Likert questionnaire and could identify and choose twenty four criteria as primary indexes effective on portfolio selection in Tehran stock exchange regarding cement companies. These factors include profitability, technological and economical controlling consecutively. The other important indexes include economical regulations and strategies, financial ratios related to portfolio profitability, fulfillment of research and development projects (Nezhad, 2004).

To finish, another paper evaluated and ranked stock exchange companies based on sales increase indexes, marginal profit increase, and payoff average, assignable profit increase,

foreign exchange rate, and changeability of basic metals prices, competitiveness benefit of industry, and economical deflation or inflation. AHP technique was used as analytical tool, Shannon Entropy method was used for weighting and TOPSIS for ranking (Motameni & Salim, 2012).

#### Multi Criteria Decision Making (MCDM) Method

Multicriteria decision making methods have been widely applied in theoretical frameworks of industrial engineering field (Triantaphyllou & Evans, 1999). Some of these researches utilize numbers and fuzzy information (Chiadamrong, 1999; Chuu, 2009; Huang, Chiu, Yeh, & Chang, 2009; Sarker & Quaddus, 2002; Vasant, 2006; Wang & Elhag, 2007; Yaman & Balibek, 1999) and some others benefit from probable variables (Martel & Zaras, 1995; Nowak, 2004a, 2004b, 2006, 2007; Nowak et al., 2002; K. Zaras, 1999; K. Zaras, Martel, dominance. In B. Munier & M. J. Machina (Eds.), Academic, & Publishers., 1994; Kazimierz Zaras, 2001; Zawisza & Trzpiot, 2002). In this article SD heuristic model was applied to rank the pharmaceutical companies.

#### SD Heuristic Model Steps

In this part a heuristic model is presented that is a brand new statistic model working based on superiority.

#### First Step: Linear Normalization of Datum and Collecting Single Matrixes

In this step, via using linear normalization method and through formula number 1, collected matrix of experts' opinions was normalized.

$$a_{ij} = \frac{x_{ij}}{\sum x_{ij}} \quad (1)$$

#### Second Step: Checking the Statistical Dominance of Alternatives

In this model the dominance of alternatives is verified at the outset. Therefore, the collective function of alternatives' values regarding alternative 1 will be compared with alternative 2 based on the second definition. If collective function of alternative 1 is less than two, alternative 1 asserts dominance over alternative 2. In this case, FSD<sup>1</sup> would be defined for ratio of alternative 1 to alternative 2. Otherwise,

second step should be taken and SSD<sup>2</sup> relation would be scrutinized based on the second definition. Hence, if integral ratio of alternative 1 to alternative 2 is less during the whole procedure, alternative 1 asserts dominance over alternative 2 (SSD). If they cross each other, third step dominance or TSD<sup>3</sup> would be considered based on the third definition. It must be reminded that when alternative 1 asserts first stochastic dominance (FSD) over alternative 2, it definitely will assert second and third stochastic dominance, but the reverse is not correct. Inspection of FSD, SSD and TSD would be done for all pairs of alternatives. The purpose of stochastic dominance inspection is to recognize the statistical superiority of each alternative in comparison with all other alternatives. Therefore, if alternative 1 asserts any kinds of stochastic dominance, it certainly will be superior to alternative 2 statistically. However, sorts of stochastic dominance in the second step would specify kinds of alternative 1 priority to alternative 2, or vice versa.

$$F_{ik}FSD_KF_{jk} \text{ only and if only } F_{ik} \neq F_{jk}, F_{ik}(X_k) \leq F_{jk}(X_k) \text{ for all } X_k \in [c_k, d_k], \succ [c_k, d_k] \quad (2)$$

$$F_{ik}SSD_KF_{jk} \text{ only and if only } F_{ik} \neq F_{jk}, \int F_{ik}(x_k) \leq F_{jk}(X_k) \text{ for all } X_k \in [c_k, d_k] \quad (3)$$

$$F_{ik}TSD_KF_{jk} \text{ only and if only } F_{ik} \neq F_{jk}, \iint F_{ik}(x_k) \leq \iint F_{jk}(x_k) \text{ for all } X_k \in [c_k, d_k] \mu(F_{ik}) \geq \mu(F_{jk}) \quad (4)$$

#### Third Step: Calculating the Number of SDs

After comparing alternatives and investigating statistical dominance of every alternative in relation with others, in this step the coefficients 1, 0.5, and 0.33 were assigned to FSD, SSD, and TSD in consequence. The reason behind it is to distinguish the first step

dominance (or FSD), which embraces SSD and TSD, from the second step dominance, which embraces TSD, and from third step dominance. Afterwards, regarding the total value obtained from three sorts of dominance values, an ultimate score will be obtained for each sub-index.

**Fourth Step: Final Ranking**

In this step, the scores of all alternatives were compared together and the general priority was achieved at. Accordingly, it must be detailed that the scores which have been obtained by each alternative was obtained in comparison with other ones. If the scores of any alternative was more than the other, it would be signified by ">" symbol, and if they were equal, it would be signified by "=" symbol. Lastly, the final ranking would be accomplished by checking the totals of symbols. In this model, some alternatives which have got the same amount of ">" symbol may be located in one place; these alternatives are called peer-rank.

**RESEARCH METHOD**

In general, research methods can be classified based on research purpose and data collecting process. Considering the goals of papers, researches can be divided into three groups including applicable, fundamental, and developmental. The purpose of this research is ranking different companies based on financial indexes. As it was mentioned earlier researchers believe that present indexes for ranking companies have non-harmonized values. Therefore this paper faced with two questions. The first question wonders whether these twenty four recognized indexes have the same value and

significance. And the second question wonders how mentioned companies should be ranked. The weighting method was utilized to reply the first question. And for the second one, a heuristic method of weights combination, hierarchical analysis process and Kmean clustering were utilized. Figure 1 represents this process.

In this section a field study has been done and scientific articles in the field of financial management were reviewed, and consequently significant indexes of companies' financial matters were discussed. The results are delivered below.

**Selecting Financial Indexes**

**Classifying Indexes Effective on Decision Making**

When analyzing and categorizing of past studies was done, financial indexes were categorized into five main categories:

1. Profitability ratio,
2. Liquidity ratio,
3. Market value ratio,
4. Efficiency ratio, and
5. Leverage ratio.

**Weighting the Indexes via Entropy Method**

In order to estimate the weights of financial indexes Shannon Entropy technique was applied. This technique works based on variant data related to indexes. Weights of indexes have been obtained via Shannon Entropy technique and it is represented in the last row of table 1. There can be seen that one of sub-indexes of leverage ratio, frequency of achieving, has gained the highest value. After that the sub-indexes of price per earnings ratio, net working capital, and debt per value ratio have got higher values consecutively (Lee, Tzeng, Guan, Chien, & Huang, 2009).

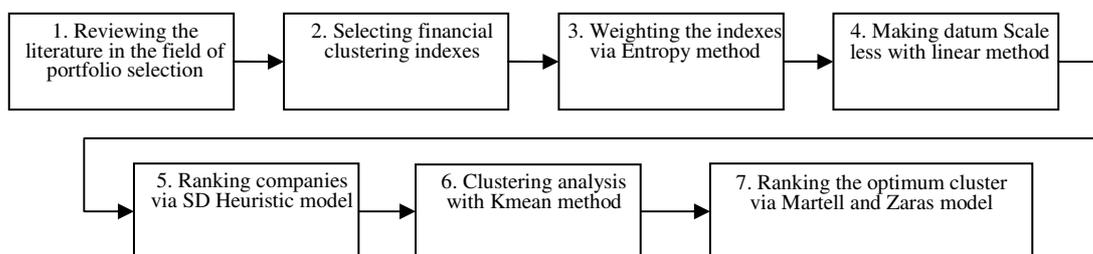


Figure 1: The research process

### Case of Study

The statistical group of this study consists of all pharmaceutical companies accepted in Tehran stock market from 3/20/2007 to 3/19/2012. The companies which were omitted by Tehran stock exchange were excluded from study. The limitation of this study backs to financial year. The financial year had to be ended in 20th of March (that is the end of Persian year). In addition, the stocks of each company must be investigated at least for nine months of each year. Noticing performance variety of companies accepted in Tehran Stock Exchange, the active companies of pharmaceutical industries were chosen as the case of this study. The total number of these companies is twenty-nine. The utilized data is reliable and valid, since they were exploited from financial statements and legal announcements of companies. In this study the whole data was collected from audited financial statements, consequently the companies which haven't got any audited financial statement were excluded from study.

In this paper, stock2 software was used. To collect information, Tehran Stock Exchange web pages such as *sena.ir* and *rdis.ir* and *dirbours.com* were searched. It needs mentioning that stock2 software is online and it is supported by Tadbir Pardaz Inc. that provides data and information related to stock exchange companies for users. As it was mentioned before, financial ratio of twenty seven pharmaceutical companies available in stock exchange were utilized so as to assess their financial performance. Twenty four sub-indexes of financial ratio were scrutinized. The amounts of companies' ratios are demonstrated in table 1. Some financial ratios have increased as performance ratio increased. This matter is specified in table by + symbol. Vice versa, some other ratios have increased as performance ratio decreased. This matter is specified in table by – symbol. For instance, financial ratio of net working capital is amongst the first group of ratios which has got + symbol. In other words it is a positive index. Or, financial ratio of debt per value is a negative index and it has got – symbol.

### Clustering the Companies via Kmean Method

Clustering methods are divided into certain

and uncertain (fuzzy) methods. Certain methods consist of two general groups: hierarchical and denotative. The difference between these two groups is that in denotative methods the number of clusters is a supposed number. Furthermore, hierarchical methods can be divided into two general groups: integrating and segregating methods. In integrating methods everything is regarded as an independent cluster and later during clustering process, clusters merged together so that a unique cluster is achieved. On the other hand, in segregating methods everything is located in just one cluster and later during clustering process they will be separated. Regarding the purpose of paper which is obtaining a definite number of clusters, Kmean method is utilized, which is a common integrating clustering method. This method is widely applied for clustering and it is usually utilized for solving big significant problems.

Kmean method consists of following steps:

Initial step: separating primary data into K clusters

Repetitive step: A) estimating the distance of each object from the center of its own cluster. B) Error estimating.

Improvement step: moving the member which is furthest from the center of its own cluster to the cluster which has the shortest distance.

Stop command: when clusters' members do not change or error function does not decrease the stop command will be given.

### Data Analysis

As it was mentioned before, this paper utilized Kmean method in combination with MCDM. One of the suppositions of this technique is that specific number of clusters must be existent. In order to fulfill clustering process, following steps were taken:

### Preparing Data for Clustering

At first, data of decision matrix was obtained from secondary data (is shown in table 1). Then, they were changed to weightless linear data by using Excel Program. Linear weightless data was preferred so that the influence of cost and profit variables can be avoided. After that, weights obtained by Entropy Shannon technique were put into MATLAB software.

**Assessing the Validity of Clustering**

In order to handle this method out put more properly, algorithm was accomplished supposing the amount of different clusters. Then, Silhouette coefficient was estimated (table 1).

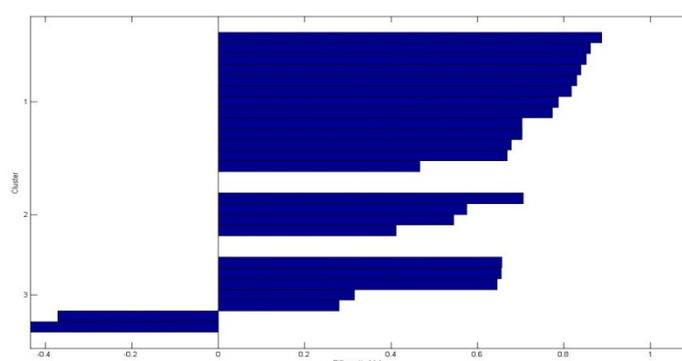
Now, the question is: how many clusters are proper for ranking the companies. There are different criteria for clustering evaluation. They can be divided into three categories of criteria: external, internal, and relative criteria. Some criteria work properly when clusters are condensed and compressed like a ball. But if clusters are not compressed (like space or biological data) some criteria won't be

applicable.

External and internal criteria need statistical samples. In addition, these two groups of criteria are time-consuming regarding the required estimation. On the other side, third group of criteria does not require statistical samples. One of common tools for checking the validity of clustering is Silhouette coefficient and Silhouette diagram. The amounts of Silhouette coefficient and Silhouette diagram were calculated for clusters 2, 3, 4, and 5. If silhouette coefficient is more than 0.6, or silhouette coefficient average is higher, it signifies betterment of cluster amounts.

**Table 1: Inspecting clusters' members amounts**

Silhouette coefficient average	Frequency of clusters' members	Number of clusters
0.6651	Cluster 1 (7 companies), cluster 2 (14 companies)	K=2
0.5232	Cluster 1 (13 companies), cluster 2 (4 companies), cluster 3(7 companies)	K=3
0.5355	Cluster 1 (1 company), cluster 2 (10 companies), cluster 3 (4 companies), cluster 4 (9 companies)	K=4
0.6027	Cluster 1 (1 company), cluster 2 (11 companies), cluster 3 (3 companies), cluster 4 (4 companies), cluster 5 (5 companies)	K=5



**Figure 2: Silhouette diagram for clustering data in three clusters**

It can be seen in figure 2 that silhouette coefficient of clusters is almost always higher than 0.6. Just in cluster 3 the amount of silhouette coefficient is negative. In general,

silhouette coefficient was estimated for different clusters (table 2). The results mirror that two cluster ranking is the best for clustering.

**Table 2: Companies, criteria, and weights**

Weights	Criteria	Alternatives	Row
0.07	Liquidity ratio	Exir Inc.	1
0.14	Leverage ratio	DR. Abidi Inc.	2
0.34	Market value ratio	AlborzDaroo Inc.	3
0.38	Efficiency ratio	Osveh Inc.	4
		JaberibnHayan Inc.	5
0.07	Profitability ratio	Damlaran Inc.	6
		Razak	7

**Table3: Checking alternatives' dominance**

x1	1	2	3	4	5	6	7
1					SSD		SSD
2	FSD			SSD			
3	FSD	FSD		SSD		SSD	
4	FSD						
5		FSD	FSD	FSD		SSD	
6	FSD	FSD		FSD			
7		FSD	FSD	FSD	FSD	FSD	

x2	1	2	3	4	5	6	7
1				FSD	FSD		FSD
2	FSD						
3	FSD	FSD		FSD	FSD	SSD	FSD
4		FSD			FSD		
5		FSD					SSD
6	FSD	FSD		FSD	FSD		
7		FSD		FSD		FSD	

x3	1	2	3	4	5	6	7
1					FSD		SSD
2	FSD			FSD	FSD		SSD
3	FSD	FSD		TSD	SSD		SSD
4	FSD				FSD		SSD
5							
6	FSD	FSD	FSD	FSD	FSD		FSD
7					FSD		

x4	1	2	3	4	5	6	7
1		FSD	FSD	SSD	FSD	FSD	FSD
2			TSD	SSD			SSD
3				SSD			TSD
4							
5		FSD	FSD	FSD			SSD
6		FSD	FSD	FSD	FSD		SSD
7				FSD			

x5	1	2	3	4	5	6	7
1						FSD	SSD
2	FSD		FSD		FSD	FSD	
3	FSD				SSD	FSD	SSD
4	FSD	FSD	FSD		FSD	SSD	
5	FSD						SSD
6					FSD		
7		FSD		FSD		FSD	

**Ranking Companies via SD Heuristics Method**

According to SD Heuristics method, which is a non-compensatory multi criteria decision making method, and based on five primary criteria identified at the beginning of the article, the pharmaceutical companies located in the first cluster were ranked, keeping in mind the conclusion of clustering validity and the point that two is the best amount of clusters.

Table 2 represents name of companies, criteria, and weights based on which SD Heuristics method prioritizing was accomplished. It's needed to mention that the obtained weights were estimated via aggregating the weights of five criteria's sub-indexes, whose weights were gained by utilizing Entropy Shannon method.

**First Step: Linear Normalization of Datum and Collecting Single Matrixes**

In this step, by using linear normalization method and through formula number 1, collected matrix of experts' opinions was normalized.

$$a_{ij} = \frac{x_{ij}}{\sum x_{ij}}$$

**Second Step: Checking the Statistical Dominance of Alternatives**

In continue the alternatives dominance is inspected by using Martell and Zaras method. The results obtained from this step are illustrated in table 3. The exploited weights via Entropy Shannon method were estimated in previous steps.

**Third Step: Calculating the Number of SDs**

The results obtained from this step are illustrated in table 4.

**Fourth Step: Final Ranking**

In this step the general priority of alternatives was gained by comparing the scores of all alternatives. For instance, when comparing alternative 1 with alternative 2, alternative 1 achieved 4scores. So, ">" symbol is put into the table for alternative 2 in comparison with alternative 1. And if they were equal, "="symbol would be put into the table. At the end, final ranking was accomplished by regarding the total amounts of symbols visible in table 5 and figure 3.

**Table 4: Alternatives' scores**

	1	2	3	4	5	6	7
1		1	1	1.5	3.5	2	3.5
2	4		1.33	2	2	1	1
3	4	3		2.33	2	2	2.33
4	3	2	1		3	0.5	0.5
5	1	3	2	2		0.5	1.5
6	3	4	2	4	4		1.5
7	0	3	1	4	2	3	

Table 5: Final ranking

	1	2	3	4	5	6	7	Final ranking
1					>		>	4
2	>							6
3	>	>		>	=	=	>	1
4	>	=			>			4
5		>						6
6	>	>		>	>			1
7		>		>	>	>		1

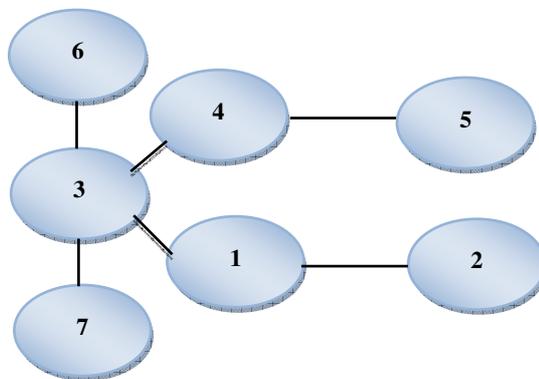


Figure 3: Final ranking

In this example, the peer-rank alternatives were 3, 6, and 7. Also, alternatives 1 and 4 were peer-rank. Alternatives 5 and 2 were peer-rank as well.

**CONCLUSION**

In this research an integrated method of multi criteria decision making (MCDM) and clustering method was utilized for portfolio selection and management. Financial data of companies was analyzed by using this tool. Comparing this approach with past approaches, which merely utilized multi criteria decision making (MCDM) or multi objective decision making method (MODM), in this recommended approach decision making process leads to delivering a portfolio. In addition, this method takes notice of criteria with discordant effects more attentively. This paper benefited from Entropy Shannon

technique for estimating weights of each criterion. Then, based on SD Heuristics model the companies, which were located in the first cluster, were ranked. The results demonstrated that Alborz, Damlran and Razak Pharmaceutical companies were selected as the first rank companies.

**RECOMMENDATION**

- ✓ Weighting of indexes is valid if it is done by experts. In this article it is supposed that the variance among indexes is reflective of risk existence, and as a result it may lead to an increase in indexes' weights. Therefore, some techniques such as analytical hierarchical process (AHP), analytical network process (ANP), and DEMATEL can be applied to normalize the exploited weights(Xidonas et al., 2011).

- ✓ It is recommended to apply SD Heuristics model for ranking second cluster or for other ranking problems.
- ✓ It is recommended that SD Heuristic model be applied for decision making and ranking in other sorts of problems and the results be compared with other compensatory and non-compensatory methods and analysis be made on them.

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