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Clustering of Financial Ratios of the Quoted Companies Through Fuzzy Logic Method

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Abstract

Financial rates, in terms of investors, are of great importance in the expansion of the companies to whose share they are going to invest. Financial rates have been benefited from especially in determining the risk while a portfolio is being formed, in changing the existing risk or in determining the alternative shares. In literature has been researhed whether more than average income of the market is possible to obtain considering financial rates. In this respect, using fuzzy logic method the companies that are the subjects in the study are clustered and it is presented to the investors as a risk scale. The investor, according to the portfolio he/she is going to form, can not only determine which shares he/she should buy but he/she will be able to learn about the share which has the same profit level and the same risk as well if the share he/she wants to buy is not available. What is aimed to be achieved in this study is helping the investor form a portfolio and the companies at question be clustered with the help of financial rates.

Key words: Financial rates, Fuzzy logic, Factor Analysis

I. Introduction

Financial ratios have a great importance for investors in respect of company evaluation or in the selection of shares. Particularly, the ratios often used in the preferences of portfolios deal with many issues in literature

such as the characteristics of determining, changing of portfolio structure or determining the shares substituting each other, estimating the returns of shares to be obtained in the future. For example, Lüders [1], in his discussion of how the risk choices of investor would affect the price shares, claims that the return will be able to be estimated even markets have an informational efficiency. The author also claims that financial that are commonly used will be able to be used in the estimation of returns to be obtained in the future.

Pahor and Mramor [2] tested the hypotheses of specific industry independent nonlinear relationships between financial ratios and excess rate of return on equity for U.S. and Japan. The authors put forward that they reached the findings previously in the direction of supporting the results of similar investigation which was carried out for Slovakia and the relation between the financial ratios and the return ratio of over the market was independent from the sector.

Lewellen [3] provides a new test of the predictive ability of aggregate financial ratios. The author has investigated dividend yield predicts aggregate market returns from 1946 – 2000, for New York Stock Exchange as well as in various subperiods and reported that book-to-market and the earnings-price ratio predict returns during the shorter 1963 – 2000 sample. Author also claims the evidence remains strong despite the unusual price run-up in recent years.

Küçükkiremitçi [4] tested that whether or not the financial ratios taken into consideration in forming portfolio in the sectoral base of 104 industrial companies quoted in Istanbul Stock Exchange (ISE) by using the date of 1995 year. The author pointed out that the financial ratios showed differences in the sectoral base and claimed that the most popular ratios in the selection of shares were low market value/book value and total debt/total assets value with high assets development turn over ratio, gross income margin and stock turn over ratio.

Demir, Küçükkiremitçi, Pekkaya and Üreten [5] investigated the ratio of price/earning, the size of company and negative earning effects by taking advantage of the data of the companies quoted in ISE in the periods of 1990-1996. The authors stated that they found out the results of the returns of shares decreased as proceeding from the lowest price/earning

portfolio to the highest price/earning portfolio that were formed when the companies declaring their deficits were excluded. Besides this, they explained that the market value of the shares of the companies declaring deficits had high returns in the following period and found out the results that they would be able to beat the market in case of being formed portfolio according to the size of a company.

Karan [6] formed four portfolios by taking advantage of the ratios of price/earning and market value/book value of the companies quoted in ISE for the period of 1988-1995 and tested them whether or not the returns would be able to be obtained excess rate of return in the long term. The author stated that returns would be able to be obtained excess rate of return in the long term by taking advantage of the ratios of price/sales and market value/book value, that is, emphasized that ISE has not be weak form efficiency.

Also Demir, Küçükkiremitçi, Pekkaya and Üreten [7] investigated the relationships between the financial ratios and the returns of shares of the companies quoted in ISE by taking advantage of the data of the years of 1993 – 1994 and ranged the companies. The authors stated that there was not a meaningful relationship between the returns of shares and the ratios of price\earning in the relevant to that term as a result that they found out. This result was contradictory with the study which they previously carried out similarly (1996). Besides this, the authors stated that the highest relationship between the returns of shares and the financial ratios was seen in 1994 (with 83%) and 1999 (with 22%).

In this study, it is aimed at targeting clustering the companies involved in the investigation through their financial ratios and helping investors in forming portfolios. Study was ranged as follows besides the introduction, data structure and methodology in the section II, where empirical results in the section III and conclusions and evaluation in the section IV of the study.

II. Data and Methodology

In this study, the companies being excluded from financial sectors, which quoted in 2002 out of the companies, which were involved in ISE

100 Index were chosen. It was seen that some of the companies affected the results negatively because they had both incomplete data and extremity values. Therefore, these companies were determined through Factor Analysis, were extracted from data set and the size was eliminated. The companies involved in the study were presented at appendix 2. The data, size of 47X43, were taken from ISE web page address. In the study, 43 financial ratios were used and presented at appendix 1.

In the study, the method of fuzzy cluster was used as a method within the framework of fuzzy logic. Some samples can be ranked as follows concerning the usage of the method in social sciences. Tay and Linn [8] explained the reasons affecting the choices of investors in buying and selling shares through fuzzy logic. Toraman [9] presented the method of fuzzy logic to auditors as an alternative way in removing the indefiniteness they met in the audience of company. Şahin and Hamarat [10] clustered the countries forming the organizations towards international integration and cooperation with the method of fuzzy cluster by using 30 variations showing socio–economic structures.

In this study the fuzzy cluster method and oclid distance were used. The fuzzy cluster method appears a suitable method if the clusters cannot be separated from each other clearly or if some units in cluster membership are undecided. Fuzzy clusters are the functions determining each unit between 0 and 1 being defined as a membership of unit in cluster. The units quietly resembling to each other take place according to the relation of high membership in the same cluster. That's why the fuzzy cluster method calculates the coefficients of the units belonging to the cluster or clusters.

The total of membership coefficients is always equal to 1. So, the unit is assigned to the cluster that has the highest membership coefficient. The membership functions are the functions that characterize the fuzziness in a fuzzy cluster whether or not the elements in cluster are continual or transitory.

Fuzzy cluster has two basic methods. From these, c average cluster method depends on c divisions. The other method depending on fuzzy equality relation is called as a graded cluster method depending on fuzzy equality relation (11). The similarity structures of companies were found as a basis of Fanny Algorithm that depends on fuzzy equality relation. Fuzzy

cluster technique used in this algorithm aims at minimization of target function below the membership functions in this target function have these limitations:

$$u_{iv} \geq 0 \text{ if so} \qquad i=1,\ldots\ldots, n \text{ and } v=1,\ldots\ldots\ldots, k \tag{1}$$

$$\sum_{v=1}^{k} u_{iv} = 1 = \%100 \text{ if so} \qquad i=1,\ldots\ldots,n \tag{2}$$

Here, each unit i and each cluster v will be a member of u_{iv}. u_{iv} shows how much unit I belongs to cluster v. Under these circumstances, the target function is as follows;

$$C = \sum_{V=1}^{k} \frac{\sum_{i,j=1}^{n} u_{iv}^2 u_{jv}^2 d(ij)}{2\sum_{j=1}^{n} u_{jv}^2} \tag{3}$$

Here d(ij), i and j mean the resemblance among the units, whereas u_{iv} defines the unknown membership of unit i to cluster v. Total of membership coefficients of each unit in comparison with all the clusters is always positive as a figure 1 in fuzzy cluster. Fuzzy cluster is evaluated how far it is from certain cluster through Dunn decomposition coefficient. This coefficient gives an idea about how fuzzy the cluster gained is. Decomposition coefficient of Dunn takes place between (0 and 1). Dunn coefficient shows the situation of 0 as a complete fuzzy and the situation of 1 as a certain cluster. This coefficient can be normalized from the number of clusters independently from 1 (certain cluster) to 0 (complete fuzzy) out of cluster number. Normalized Dunn coefficient takes place at interval of (0,1) and is called as Non-fuzziness index. It is determined how gradually well the units cluster through silhouette coefficient in fuzzy cluster method. s(i), shows how gradually well the unit clusters and takes place between $-1 \leq s(i) \leq s(i)$ is an average silhouette image coefficient for all units in a cluster, s(i) is a coefficient showing how gradually well the units cluster according to the number of clusters for all units and equals to the average of

s(i), k the cluster number, being equivalent to the biggest $\bar{s}(i)$'s chosen as the most suitable cluster number (12, 13).

III. Empirical Results

It was investigated that the companies quoted in ISE 100 Index by making use of their financial ratios whether or not they clustered homogeneously by using S-PLUS 2000 statistical packet program. A suitable cluster number was determined by being changed the number of cluster between 2 and 10. So, the inter-cluster variations of companies started to be observed with the determination of the cluster numbers reflecting the natural classification appearing by coming together of variations. As a rule, the suitable cluster number was determined as 2 in respects of all the separate factors.

Fuzzy clustering (FC), in terms of liquidity rates; when the clustering of the companies are looked at in terms of liquidity rates, according to not only the division coefficient indicating how well the companies are clustered but also the silhouette coefficient, k=2 was found to be the most convenient cluster number. The membership number of the companies for k=2 was calculated and the findings obtained are shown in Table 1. When the membership values of the companies to the clusters are look at, the companies with 9, 14, 17, 23, 24, 26 and 43 numbers display a consistent membership to the clusters. FC and silhouette width values s(i) which signals the quality of clustering were calculated for k=2. These values are big, which indicates a good clustering has been formed and s(i) averages are big, which indicates a good and certain has been obtained. Now we can claim that the companies in the first clustering are better clustered than those in the second one. According to the cluster number k=2 the two clusters obtained cannot be said to be clustered highly well. Especially 9^{th}, 14^{th}, 17^{th}, 24^{th}, 26^{th} and 43^{rd} companies in the second cluster are observed not to be consistent in the cluster membership. Besides this, they are also observed not to consistent in the certain cluster membership. The results are shown in Table 1.

When the results of fuzzy clustering are looked at in terms of activity rates; k=2 was found to be the most convenient cluster number according to not only division but also silhouette coefficient. Accordingly, all the companies in the second cluster are not consistent in cluster membership and can be said to be have fuzziness. The results are shown in Table 2. When the certain clustering membership is looked at in terms of activity rates of the companies the companies in the first cluster are highly well clustered where as those in the second are, on the contrary, highly well clustered. It was also found that some clusters have negative membership coefficient.

When fuzzy clustering results are investigated in terms of financial *rates*; k=2 was found to be the suitable cluster number. According to this, the companies with 10, 20, 24, 27, 31, 34, 46 numbers in were found to be close in cluster membership and although these companies can be said to be fuzzy, only the companies with 1, 46 numbers are not consistent in their cluster membership in the cluster that they belong to and can be said not to clustered for certain. Besides this, when the averages values of the companies s(i) in the first cluster are investigated, this cluster can be said to be less inconsistent than the second one. In terms of financial rates, of the companies, both clusters can be said to be well clustered. The results are shown in Table 3. According to the rates which indicate the relationship between the assets of the companies, when the fuzzy clustering results are given, according to not only division but also silhouette coefficient, k=2 was found to be the most convenient. According to this, when the similarities of the companies are investigated, it can easily be seen that they have membership at a high level. But, it was also found that the 18th company was not clustered for certain and the second cluster had quite low average silhouette coefficient. According to these rates it was found that s(i) coefficient of the companies, which is the scale of clustering, was very high. The results are shown in Table 4.

According to the rates which indicate the relationship between income and sale of the companies, when fuzzy clustering is looked at, k=3 was found to be the convenient cluster number in terms of income rates. According to this, the 11^{th} company has a high membership to the second cluster but it was low in terms of consistency in the certain cluster

membership. 44th company was determined to be similar to the first cluster at 48.90% and to the second one 49.82%. Consequently, this company is fuzzy and it is inconsistent between these two clusters. Its certain cluster coefficients was calculated as –0.088 and was found to be inconsistent in certain cluster membership. When s(i) average values which indicates FC quality in term of income rates of the company are investigated, the companies in the first cluster was found to be more homogenous than the others clusters in terms of income indicators. The results are shown in Table 5.

When the fuzzy clustering results are investigated in terms of the rates which indicate the relationship between income and equity of the companies, the companies, which belong to 1, 3, 4 and 5 clusters, are observed to display consistency in similarity to these clusters. Whereas those which belong to the other clusters are not so consistent in their similarity. Especially, all the companies in the second cluster displays similarity to the neighboring 8th cluster at the same level. Consequently, the companies in the second cluster can be said to be inconsistent at fuzzy. Similarly, the companies in the 8th cluster resemble the second cluster at the same level. The 13th company in the 7th cluster is approximately at the same similarity level to the neighboring cluster 2. Consequently, it's inconsistent between these two clusters. When the certain cluster memberships, the companies with 13, 15, 30, 34, 42 numbers were found to have low certain cluster membership when s(i) values, which signals the cluster quality, the 8th cluster can be said to be well-clustered but 6th cluster can be said not to be well-clustered. The results are shown in Table 6.

IV. Conclusions

For an investor who wants to form a portfolio, it's important that the companies be classified according to the risks. In our study, the investor was considered the one who does not avoid risk and if an portfolio is assumed to be formed, we expect the investor to prefer any of the share with the numbers 11, 15, 27, 31, 33, 34, and 42 according to the clustering formed by the help of liquidity rates.

In the same way, the investor may choose the companies in the first cluster according to the clustering formed by the help of activity rates. All the companies but 42nd resemble each other in terms of these rates. Thus, they can substitute each other.

The investor may choose all the shares of all the companies according to the clustering formed by the help of the rates used in the analysis of the relation between the assets.

The investor may choose all the shares but that of the 34th company whereas he/she may prefer second 4th 23rd, 27th, 31st, 47th. Companies in the second cluster according to the clustering formed by the help of the rates which indicate the relation between income and sales.

The investor may prefer shares of the companies with 43 and 44 numbers from the 8th cluster and the companies with 24, 26, 28, and 29 numbers from the 7th cluster and the companies with 7, 20, 36 from the 2nd cluster according to the clustering formed by the help of the rates which indicate the relationship between income and equity. If the investor is someone who avoids risk she/he will be able to prefer the shares of the companies which are negative and whose certain membership coefficient is over %50 in all the clusters.

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Table 1. The Values of Companies According to Clusters and Certain Clusters (According to Liqudity Ratios)

Companies	Clusters 1	Clusters 2	Companies	Member Cluster	Neighbor Cluster	s(i)	$\bar{s}(i)$	$\bar{\bar{s}}(i)$
1	0.7954462	0.2045538	11	1	2	0.5681796		
2	0.6705500	0.3294500	34	1	2	0.5601970		
3	0.3350214	0.6649786	47	1	2	0.5518462		
4	0.6153809	0.3846191	27	1	2	0.5501937		
5	0.3390829	0.6609171	31	1	2	0.5308316		
6	0.3296594	0.6703406	33	1	2	0.5273222		
7	0.1856194	0.8143806	15	1	2	0.5255485		
8	0.5875097	0.4124903	42	1	2	0.5024819		
9	0.4143821	0.5856179	2	1	2	0.4962756		
10	0.7808890	0.2191110	44	1	2	0.4810752	75300	
11	0.7995595	0.2004405	35	1	2	0.4687276		
12	0.2582107	0.7417893	25	1	2	0.4647353		
13	0.3434067	0.6565933	1	1	2	0.4596722		
14	0.4284274	0.5715726	30	1	2	0.4258959		
15	0.8259778	0.1740222	10	1	2	0.4135757		
16	0.3646511	0.6353489	18	1	2	0.3880194		
17	0.4380727	0.5619273	4	1	2	0.3817236		
18	0.7580598	0.2419402	8	1	2	0.3757900		
19	0.2535810	0.7464190	23	1	2	0.2109790		
20	0.2099523	0.7900477	20	2	1	0.5066991		
21	0.3604677	0.6395323	7	2	1	0.5048198		
22	0.3762754	0.6237246	45	2	1	0.4995925		
23	0.5352701	0.4647299	12	2	1	0.4983843		
24	0.4352458	0.5647542	36	2	1	0.4776546		0.4215069
25	0.7431750	0.2568250	37	2	1	0.4709165		
26	0.4441825	0.5558175	28	2	1	0.4624097		
27	0.8320748	0.1679252	46	2	1	0.4615789		
28	0.2055997	0.7944003	41	2	1	0.4598817		
29	0.3031481	0.6968519	32	2	1	0.4379685		
30	0.7865069	0.2134931	19	2	1	0.4366886		
31	0.8239411	0.1760589	38	2	1	0.4247093		
32	0.2337826	0.7662174	6	2	1	0.3955878		
33	0.7244524	0.2755476	3	2	1	0.3867825		
34	0.7631837	0.2368163	16	2	1	0.3839815		
35	0.7878832	0.2121168	29	2	1	0.3824563		
36	0.2844405	0.7155595	21	2	1	0.3753590		
37	0.2692354	0.7307646	5	2	1	0.3750849		
38	0.2550291	0.7449709	40	2	1	0.3599074		
39	0.3940642	0.6059358	39	2	1	0.3330569	0.3902769	
40	0.3124557	0.6875443	22	2	1	0.3192243		
41	0.2084479	0.7915521	13	2	1	0.3150062		
42	0.8232236	0.1767764	24	2	1	0.3086469		
43	0.4613545	0.5386455	17	2	1	0.3057627		
44	0.7714436	0.2285564	14	2	1	0.2998776		
45	0.1920907	0.8079093	9	2	1	0.2860780		
46	0.2303889	0.7696111	43	2	1	0.2384670		
47	0.7297801	0.2702199	26	2	1	0.2211710		
Dunn cofficient dunn_coefficient normalized								0.6026337 0.2052673

Table 2. The Values of Companies According to Clusters and Certain Clusters (According to Activity Rates)

Companies	Clusters 1	Clusters 2	Companies	Member Cluster	Neighbor Cluster	s(i)	$\bar{s}(i)$	$\bar{\bar{s}}(i)$
1	0.6414526	0.3585474	27	1	2	0.780093566		
2	0.4600179	0.5399821	26	1	2	0.773467858		
3	0.4932412	0.5067588	17	1	2	0.773071393		
4	0.7022499	0.2977501	25	1	2	0.772643932		
5	0.4547832	0.5452168	44	1	2	0.770822580		
6	0.6152278	0.3847722	37	1	2	0.768808212		
7	0.6825671	0.3174329	4	1	2	0.762790231		
8	0.6653044	0.3346956	11	1	2	0.750389154		
9	0.3694712	0.6305288	41	1	2	0.749071648		
10	0.4708460	0.5291540	7	1	2	0.745309283		
11	0.6733311	0.3266689	8	1	2	0.729814871		
12	0.4187724	0.5812276	34	1	2	0.727536584	0.7069800	
13	0.5658095	0.4341905	19	1	2	0.722792612		
14	0.6259454	0.3740546	1	1	2	0.720545534		
15	0.4255122	0.5744878	18	1	2	0.720545534		
16	0.6448905	0.3551095	16	1	2	0.719366434		
17	0.7016751	0.2983249	22	1	2	0.701194034		
18	0.6414526	0.3585474	14	1	2	0.700246400		
19	0.6497001	0.3502999	6	1	2	0.687118908		
20	0.5436325	0.4563675	39	1	2	0.686832741		
21	0.4023410	0.5976590	40	1	2	0.672318108		
22	0.6312486	0.3687514	47	1	2	0.664631703		
23	0.4625736	0.5374264	36	1	2	0.655569699		
24	0.4039717	0.5960283	13	1	2	0.644585532		
25	0.6941784	0.3058216	20	1	2	0.621695807		
26	0.6920900	0.3079100	30	1	2	0.574200615		0.3011453
27	0.7253187	0.2746813	42	1	2	0.492998298		
28	0.4215698	0.5784302	46	2	1	0.184574016		
29	0.3950333	0.6049667	2	2	1	0.142543640		
30	0.5614441	0.4385559	10	2	1	0.121688615		
31	0.4854951	0.5145049	12	2	1	0.121151705		
32	0.4506333	0.5493667	33	2	1	0.008014063		
33	0.3934160	0.6065840	38	2	1	-0.01639811		
34	0.6561596	0.3438404	24	2	1	-0.02159411		
35	0.4728955	0.5271045	23	2	1	-0.22312900		
36	0.5902103	0.4097897	29	2	1	-0.25415897	-0.246731	
37	0.6850901	0.3149099	9	2	1	-0.25975208		
38	0.4374100	0.5625900	28	2	1	-0.33683838		
39	0.6089698	0.3910302	43	2	1	-0.38455195		
40	0.5943640	0.4056360	21	2	1	-0.39902023		
41	0.6666724	0.3333276	45	2	1	-0.44238005		
42	0.5352039	0.4647961	5	2	1	-0.46552983		
43	0.4167944	0.5832056	15	2	1	-0.48044631		
44	0.7132261	0.2867739	32	2	1	-0.51255553		
45	0.4876226	0.5123774	35	2	1	-0.55673970		
46	0.4199448	0.5800552	31	2	1	-0.56977251		
47	0.5935188	0.4064812	3	2	1	-0.58973868		
Dunn coefficient								0.5302738
Dunn coefficient normalized								0.06054766

Table 3. The Values of Companies According to Clusters and Certain Clusters (According to Financial Ratios)

Companies	Clusters		Companies	Member Cluster	Neighbor Cluster	s(i)	$\bar{s}(i)$	$\bar{\bar{s}}(i)$
	1	2						
1	0.59905247	0.4009475	46	1	2	-0.0041698		
2	0.15590171	0.8440983	1	1	2	-0.5023584		
3	0.05882275	0.9411772	25	1	2	-0.7801718	-0.63349	
4	0.14762933	0.8523707	23	1	2	-0.7909216		
5	0.05888657	0.9411134	34	1	2	-0.8335068		
6	0.07724130	0.9227587	41	1	2	-0.8898207		
7	0.07247354	0.9275265	17	2	1	0.96812548		
8	0.07341503	0.9265850	42	2	1	0.96787823		
9	0.14438370	0.8556163	22	2	1	0.96779492		
10	0.43408028	0.5659197	5	2	1	0.96773205		
11	0.08111586	0.9188841	3	2	1	0.96765387		
12	0.24577902	0.7542210	13	2	1	0.96745762		
13	0.05987067	0.9401293	15	2	1	0.96701845		
14	0.07921786	0.9207821	37	2	1	0.96686139		
15	0.07976345	0.9202365	14	2	1	0.96661673		
16	0.07271078	0.9272892	45	2	1	0.96630659		
17	0.06229529	0.9377047	38	2	1	0.96626791		
18	0.08159711	0.9184029	8	2	1	0.96623145		
19	0.07251330	0.9274867	6	2	1	0.96614723		
20	0.47804669	0.5219533	11	2	1	0.96588238		
21	0.08727969	0.9127203	16	2	1	0.96574350		
22	0.05802081	0.9419792	21	2	1	0.96571080		
23	0.64521105	0.3547889	7	2	1	0.96567295		
24	0.44373768	0.5562623	19	2	1	0.96565852	0.9519863	0.7495849
25	0.63984349	0.3601565	44	2	1	0.96529342		
26	0.11566300	0.8843370	36	2	1	0.96490324		
27	0.42577033	0.5742297	18	2	1	0.96468239		
28	0.36320921	0.6367908	35	2	1	0.96437992		
29	0.32923723	0.6707628	9	2	1	0.96155025		
30	0.38016792	0.6198321	26	2	1	0.96137894		
31	0.44430179	0.5556982	33	2	1	0.96128440		
32	0.18567430	0.8143257	4	2	1	0.95959474		
33	0.14656713	0.8534329	2	2	1	0.95894870		
34	0.50280917	0.4971908	32	2	1	0.95686458		
35	0.08200455	0.9179954	47	2	1	0.95579032		
36	0.07877436	0.9212256	40	2	1	0.95524872		
37	0.06714996	0.9328500	43	2	1	0.95329468		
38	0.07192874	0.9280713	39	2	1	0.95056434		
39	0.23695568	0.7630443	12	2	1	0.94905982		
40	0.17478443	0.8252156	28	2	1	0.93082546		
41	0.58040377	0.4195962	29	2	1	0.92928816		
42	0.06616890	0.9338311	30	2	1	0.91756879		
43	0.17999542	0.8200046	24	2	1	0.91612189		
44	0.07634128	0.9236587	10	2	1	0.91593384		
45	0.07415833	0.9258417	27	2	1	0.90128970		
46	0.54120155	0.4587984	31	2	1	0.89633002		
47	0.18544893	0.8145511	20	2	1	0.84048083		
Dunn cofficient								0.727397
Dunn coefficient normalized								0.4547939

Table 4. The Values of Companies According to Clusters and Certain Clusters (According to Relationship Between Asset Ratios)

Companies	Clusters 1	Clusters 2	Companies	Member Cluster	Neighbor Cluster	s(i)	$\bar{s}(i)$	$\bar{s}(i)$
1	0.9760464	0.023953594	42	1	1	0.972368197		
2	0.9832037	0.016796321	14	1	1	0.972299342		
3	0.9608966	0.039103429	47	1	1	0.972273407		
4	0.9848687	0.015131334	26	1	1	0.972265801		
5	0.9881359	0.011864121	38	1	1	0.972041530		
6	0.9881952	0.011804806	37	1	1	0.971966205		
7	0.9367880	0.063212005	16	1	1	0.971925625		
8	0.9411293	0.058870747	15	1	1	0.971801838		
9	0.9827697	0.017230275	31	1	1	0.971801483		
10	0.9735655	0.026434463	30	1	1	0.971604276		
11	0.9499003	0.050099728	27	1	1	0.971318401		
12	0.9752204	0.024779568	6	1	1	0.971124133		
13	0.9783289	0.021671136	5	1	1	0.971088014		
14	0.9899274	0.010072641	17	1	1	0.970906542		
15	0.9891943	0.010805684	21	1	1	0.969834447		
16	0.9893726	0.010627361	4	1	1	0.968878147		
17	0.9878671	0.012132855	23	1	1	0.968775929		
18	0.1972842	0.802715760	43	1	1	0.967694382		
19	0.9195057	0.080494341	2	1	1	0.967675077		
20	0.9581142	0.041885755	9	1	1	0.967378830	0.9575997	0.8820636
21	0.9863150	0.013685013	22	1	1	0.967331585		
22	0.9825877	0.017412341	33	1	1	0.966728219		
23	0.9847864	0.015213581	29	1	1	0.964720896		
24	0.9782605	0.021739538	13	1	1	0.964427697		
25	0.9781395	0.021860476	39	1	1	0.964408943		
26	0.9898780	0.010122008	24	1	1	0.964202675		
27	0.9884922	0.011507770	25	1	1	0.964111815		
28	0.9750936	0.024906404	34	1	1	0.963730630		
29	0.9787764	0.021223643	32	1	1	0.963670592		
30	0.9889105	0.011089479	1	1	1	0.962622870		
31	0.9891890	0.010811030	12	1	1	0.962032107		
32	0.9775118	0.022488163	41	1	1	0.961965110		
33	0.9817042	0.018295836	28	1	1	0.961940240		
34	0.9775944	0.022405646	10	1	1	0.960841737		
35	0.2712892	0.728710753	3	1	1	0.952382892		
36	0.7342861	0.265713943	20	1	1	0.950420900		
37	0.9894361	0.010563859	11	1	1	0.944599384		
38	0.9895464	0.010453621	8	1	1	0.938288217		
39	0.9785513	0.021448680	7	1	1	0.935129413		
40	0.9364996	0.063500417	40	1	1	0.934895424		
41	0.9751257	0.024874293	44	1	1	0.932315675		
42	0.9900276	0.009972441	19	1	1	0.922181899		
43	0.9832529	0.016747053	36	1	1	0.758817672		
44	0.9329791	0.067020871	46	2	2	0.335432950		
45	0.3567138	0.643286236	35	2	2	0.334329193	0.0700507	
46	0.1237189	0.876281143	18	2	2	-0.00989249		
47	0.9898880	0.010111982	45	2	2	-0.37966686		
Dunn coefficient								0.920215
Dunn coefficient normalized								0.84043

Table 5. The Values of Companies According to Clusters and Certain Clusters (According to Relationship Between Income and Sale Rates)

Companies	Clusters			Comp.	Mem Clust	Neighb Cluster	S(i)	$\bar{s}(i)$	$\bar{\bar{s}}(i)$
	1	2	3						
1	0,7840	0,2141	0,0017	5	1	2	0,8688		
2	0,0458	0,9535	0,0005	7	1	2	0,8687		
3	0,9450	0,0542	0,0006	28	1	2	0,8679		
4	0,0458	0,9535	0,0005	36	1	2	0,8677		
5	0,9725	0,0267	0,0002	32	1	2	0,8676		
6	0,8110	0,1862	0,0027	16	1	2	0,8676		
7	0,9720	0,0276	0,0003	17	1	2	0,8669		
8	0,8691	0,1296	0,0011	19	1	2	0,8663		
9	0,9311	0,0680	0,0008	21	1	2	0,8661		
10	0,7647	0,2333	0,0018	13	1	2	0,8647		
11	0,3837	0,6135	0,0027	20	1	2	0,8624		
12	0,9288	0,0702	0,0008	26	1	2	0,8619		
13	0,9624	0,371	0,0004	42	1	2	0,8617		
14	0,8582	0,1405	0,0012	33	1	2	0,8607	0,815	
15	0,9575	0,0421	0,0004	22	1	2	0,8570		
16	0,9728	0,0268	0,0003	3	1	2	0,8558		
17	0,9722	0,0275	0,0002	15	1	2	0,8542		
18	0,9272	0,0719	0,0007	35	1	2	0,8539		
19	0,9710	0,0287	0,0003	38	1	2	0,8478		
20	0,9571	0,0424	0,0005	9	1	2	0,8473		
21	0,9714	0,0282	0,0003	12	1	2	0,8458		
22	0,9606	0,0390	0,0004	40	1	2	0,8441		
23	0,1430	0,8544	0,0025	25	1	2	0,8413		0,724
24	0,9200	0,0791	0,0008	29	1	2	0,8351		
25	0,9425	0,0568	0,0006	30	1	2	0,8320		
26	0,9667	0,0329	0,0003	18	1	2	0,8291		
27	0,1565	0,8407	0,0028	24	1	2	0,8239		
28	0,9707	0,0289	0,0003	39	1	2	0,8136		
29	0,9295	0,0697	0,0007	45	1	2	0,8007		
30	0,9089	0,0899	0,0011	43	1	2	0,7806		
31	0,0469	0,9524	0,0006	8	1	2	0,7800		
32	0,9723	0,0274	0,0002	14	1	2	0,7692		
33	0,9640	0,0356	0,0004	37	1	2	0,7650		
34	0,5641	0,4200	0,0157	41	1	2	0,7641		
35	0,9569	0,0426	0,0004	6	1	2	0,7475		
36	0,9687	0,0309	0,0003	1	1	2	0,6959		
37	0,8282	0,1693	0,0023	10	1	2	0,6747		
38	0,9329	0,0662	0,0008	34	1	2	0,3150		
39	0,9101	0,0890	0,0009	2	2	1	0,5531		
40	0,9264	0,0727	0,0008	4	2	1	0,5531		
41	0,8274	0,1701	0,0024	47	2	1	0,5526		
42	0,9558	0,0437	0,0005	31	2	1	0,5511	0,381	
43	0,8700	0,1287	0,0011	23	2	1	0,5432		
44	0,4891	0,4982	0,0127	27	2	1	0,5336		
45	0,8928	0,1061	0,0011	44	2	1	-0,088		
46	0,0226	0,0229	0,9999	11	2	1	-0,149		
47	0,0460	0,9534	0,0006	46	3	2	0,000	0,000	
Dunn coefficients									0,8420
Dunn Coefficients Normalized									0,7631

Table 6. The Values of Companies According to Clusters and Certain Clusters (According to the Relationship Between Income and Equity Rates)

Companies	Similarity: Member Cluster	Similarity: Neighbor Cluster	Companies	Member Cluster	Neighbor Cluster	S(i)	$\bar{s}(i)$	$\bar{\bar{s}}(i)$
1	0,7298	0,07348	1	1	7	0,4875		
2	0,2165	0,1536	18	1	7	0,3621	0,362	
3	0,2692	0,2692	10	1	7	0,3362		
4	0,1258	0,1258	2	1	7	0,2626		
5	0,3909	0,3909	20	2	8	0,6025		
6	0,2160	0,1849	36	2	8	0,5937		
7	0,3749	0,3749	7	2	8	0,5514		
8	0,4780	0,1853	40	2	8	0,4853		
9	0,3555	0,3555	5	2	8	0,4700		
10	0,6259	0,1131	9	2	8	0,4644	0,448	
11	0,2804	0,1193	3	2	8	0,4510		
12	0,3403	0,2129	32	2	8	0,4494		
13	0,2395	0,2361	33	2	8	0,4196		
14	0,3536	0,2519	21	2	8	0,3803		
15	0,3536	0,3536	15	2	8	0,0577		
16	0,3518	0,1854	23	3	8	0,4692		
17	0,2892	0,1837	47	3	8	0,4427		
18	0,6495	0,0995	27	3	5	0,4418	0,352	
19	0,3805	0,2147	31	3	8	0,2624		
20	0,3633	0,3633	4	3	8	0,1452		
21	0,3570	0,3570	37	4	2	0,3779		
22	0,3885	0,2783	6	4	5	0,3477		0, 337
23	0,3688	0,0933	19	4	5	0,1100	0,132	
24	0,5651	0,0948	30	4	2	0,0063		
25	0,2205	0,1613	39	4	8	-0,180		
26	0,6885	0,0705	8	5	4	0,4863		
27	0,3698	0,1187	45	5	4	0,4568		
28	0,6884	0,0701	25	5	4	0,3057	0,319	
29	0,5411	0,0912	14	5	4	0,2520		
30	0,3241	0,1600	22	5	4	0,0959		
31	0,3360	0,1090	41	6	5	0,2878		
32	0,3153	0,3153	11	6	5	0,2140		
33	0,3572	0,3572	42	6	5	-0,011	-0,012	
34	0,1522	0,1424	34	6	5	-0,043		
35	0,3463	0,1826	17	6	5	-0,510		
36	0,3799	0,3799	26	7	2	0,6474		
37	0,2312	0,1445	28	7	8	0,6373		
38	0,3312	0,1464	29	7	8	0,6272	0,440	
39	0,3267	0,1406	24	7	8	0,5499		
40	0,2929	0,2929	38	7	2	0,4639		
41	0,4502	0,1061	12	7	1	0,4372		
42	0,7575	0,0522	16	7	2	0,3393		
43	0,2481	0,2481	35	7	8	0,2627		
44	0,2649	0,2649	13	7	2	-0,003		
45	0,4761	0,1869	43	8	2	0,7997	0,785	
46	0,9999	0,000	44	8	2	0,7712		
47	0,5963	0,0621	46	9	3	0,0000	0,000	
Dunn coefficient								0,2753
Dunn coefficients normalized								0,1847

Appendix 1.

Financial Ratios

Financial ratios have investigated by dividing 6 groups. These are: Liqudity Ratios: Current ratio, acid test ratio, cash ratio and inventory/net working capital, Activity Ratios: Inventory turnover ratio, accounts receivable turnover ratio, average revenues term for accounts receivable, average sale of inventory term, activity rate, receivebles turnover ratio, net working capital turnover ratio, cash and marketable securites turnover ratio, current assets turnover ratio, fixed assets turnover ratio, total current liabilities turnover ratio, average payment term of the liabilities, total current liabilities turnover ratio, Financial Structural Ratios: Equity/total assets rate, otofinancing rate, fixed assets/equity rate, total liabilities/fixed assets, long term debt/total liabilities, fixed assets/equity+long term liabilities, fixed assets/equity, current liabilities/total liabilities, Rates of Relationship Between Assets: Fixed assets/total assets, current assets/total assets, fixed assets/long term liabilities, Rates of Relationship Between Income and Equity: Net income/equity, net income/assets, current assets turnover ratio, economic rantability, deprication of equity rate, Rates of Relationship Between Income and Sales: Gross profit/net sales, net income/net sales, net income/number of shares outstanding, price/earnings rate, market/book ratio, earnings before interest and taxes/net sales, earnings before taxes/net sales, net income/net sales, selling expenses+deprication expense/net sales.

When the rate which it's numerator and denominator have negative values, we have multiplied denomitator or numerator by -1 to avoid get positive result.

Appendix 2.

Using Companies For Study

1. M. ZORLU HOLDİNG
2. MİLPA
3. BOSSA
4. ANADOLU CAM
5. KORDSA SABANCI
6. ÇELEBİ
7. ADANA ÇİMENTO
8. İZMİR DEMİR ÇELİK
9. DEVA HOLDİNG
10. İHLAS HOLDİNG
11. TANSAŞ
12. ASELSAN
13. TRAKYA CAM
14. TOFAŞ OTO FAB.
15. ANADOLU EFES
16. HÜRRİYET GAZETESİ
17. TÜPRAŞ
18. H. ÖMER SABANCI HOLDİNG
19. DOĞAN BURDA YAYINCILIK
20. ALARKO CARRIER
21. AKIN TEKSTİL
22. SODA
23. ÇARŞI
24. ALCATEL
25. ŞİŞECAM
26. AK ENERJİ
27. FORD OTOMOTİV
28. VESTEL
29. NETAŞ
30. TURKCELL
31. UZEL MAKİNA
32. BSH PROFİLO
33. OTOKAR
34. GİMA
35. MENDERES TEKSTİL
36. ÇİMSA
37. USAŞ UÇAK
38. PARK
39. BEKO
40. AKSA
41. PETROL OFİSİ
42. AYGAZ
43. FAVORİ DİNLENME YER
44. PETKİM
45. ESCORT COMPUTER
46. NET TURİZM
47. ARAT TEKSTİL