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DISTRIBUTION OF MICRO-CREDITS USING CLUSTER ANALYSIS

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Abstract

In this study, we cluster micro-credit to foundations or organizations based on the ABC Foundation.' The default state of maturity of micro-loans, payment history, amounts paid, total paid, and paying attention to the remaining amount (the base) was conducted based on clustering. The clustering results determine the types of micro-credit to be distributed to cities across the country.

The fight against poverty is one of the world's most important problems, world cities are the most important agenda. This increase is an inevitable response to the increasing population in the country so accurately put into production, one that is as important as the provision of employment. Turkey's young people constitute a significant portion of the population; increasing the production of these young people is the most important agenda. In this context, micro-credit facilities help recipients to develop a business and generate income with little startup capital.

Keywords: Clustering, Micro Credit, ABC Foundation.

1. INTRODUCTION

On account of globalization, the most important issue affecting the world is poverty. In this context, unemployment and income distribution seem to be unjust. Increasing global relationships while increasing international mobility reveals positive and negative effects for many developing cities. Reduction in demand for labor by developing technology, especially in underdeveloped and developing countries to increase domestic production, decreases the demand for imported goods; increased dependence on foreign counties enables the formation of poverty. This is especially true for economically weaker countries; it presents itself as the deepening of poverty (Kırbıyık, 2009).

Disparities between regions are at high levels in Turkey. One of the most important reasons for this development gap is the labor force; hence, the production workforce in this region is lower. As a result of differences in development between regions, the population living in rural areas has seen a rapid flow of immigration. This increases the development gap between the regions. To avoid this situation, people living in these areas may join the labor force by providing active participation.

Micro-credit has being implemented in 175 countries, including Turkey, for 600 million people, provide an honorable way to earn income. Micro-credit has become one of the most important poverty reduction strategies in the world(10.000'nci Üyeye Grameen Mikrokredi, 2008). In 1973, Muhammad Yunus (Gökyay, 2008), a professor of economics, began providing micro-credit to young women in Bangladesh. Micro-credit practices minimize the development disparities between regions as well as among farmers living in rural areas. The potential labor force is provided with new business opportunities.

Credit at very low levels and financial facilities provided for the poor, especially women, should be shared (Kırbıyık, 2009).

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Micro-credit has the basic philosophy that a loan is a human right. Commercial bank loans provide more credit with more margin. Micro-credit is also "reduce how much, if you have, the more priority it has" dominated by the principle(10.000'nci Üyeye Grameen Mikrokredi, 2008).

Turkey provides micro-credit activities in accordance with law number 5302 issued by the special provincial administrations. Micro-credit practices began in Turkey in 2003, launched by the Foundation (TİSVA, 2008) for Waste Reduction, which allows for micro credit (100TL to 700TL) to low-income women. Intodays, micro-credit has been successfully implemented in many countries including the US. People who have an idea for a new business can reach their goals with the help of micro-credit. When used for the purpose of the given micro-loans, micro-credit contributes greatly to a country's economy and labor force participation.

In our study, we assume X units of micro-credit type to those in need throughout the country, to be delivered in person or in acquired pieces of Y, based on the ABC foundation. Most micro-loans provided by the ABC foundation are distributed to people in urban areas, poor farmers, as well as unemployed women and young people deprived of the opportunity to work. In this way, the main goal is to raise the income of farmers.

The ABC Foundation has given more loans in recent years to ensure full and timely repatriation. In this context, micro-loans granted in previous years yielded the source of the return of the next year. With this work, more demand comes from cities A, B, C, D, E, F, G, H and K. The ABC foundation distributes three types of micro-credit, X, Y and Z, according to maturity status, payment dates, amounts paid, the total payees, amounts and states the criteria needed to function within a grouping based with clustering method.

According to the cluster analysis, micro-credit payments are paid on time and on a regular basis. Given that they are used for the purposes of micro-loans, cities should be given priority.

2. CLUSTER ANALYSIS

Cluster analysis divides data into groups so that similar data objects belong to the same cluster and dissimilar data objects to different clusters. The resulting data partition improves data understanding and reveals its internal structure. Partition clustering algorithms divide up a data set into clusters or classes. In other words, cluster analysis is an exploratory data analysis tool for organizing observed data such as people, brands, events, companies, cities, etc. into meaningful taxonomies, groups or clusters which maximizes the similarity of cases within each cluster and maximizes the dissimilarity between clusters or groups that are initially unknown. The term "cluster analysis" was first used by Robert C. Tryon (Tryon and Bailey, 1970). In the last few years, the science of cluster analysis has become popular in the physical, economic, finance and biological sciences.The cluster method can be applied in many cases, particularly in the areas of science and business. Cluster analysis used to determine the actual types, pre-estimation groups, and hypothesis testing; the data sets are also used for assessing and determining the presence of outliers (Özdamar, 2004).

The clustering results depend on the choice of dissimilarity, so the question is how to measure the dissimilarity between samples. A common choice is Euclidean distance. In metric spaces, similarity is often defined by a distance norm. The distance norm or similarity is usually not known beforehand. In the case of continuous variables, there is a long list of distance functions. Each distance function implies a different view of the data because of their geometry. The following table defines the different distance functions.

- For every x; $d(x,x) = 0$
- For every x and y; $d(x,y) \geq 0$
- For every x, y; $d(x,y) = d(y,x)$
- For every x, y and z; $d(x,y) + d(y,z) \geq d(x,z)$

In the case of continuous variables, we have a long list of distance functions (which satisfies above properties). Each of distance functions implies different view of data because of their geometry. The following table illustrates the different distance functions with definitions, which are usually measure dissimilarity in cluster analysis.

Table 1: Formulas of Distance Functions

Distance Function	Formula (Definition)

Minkowski Distance	$d(x,y) = \sqrt[p]{\sum_{i=1}^{n}(x_i - y_i)^p}$
Hamming Distance	$d(x,y) = \sum_{i=1}^{n} \lvert x_i - y_i \rvert$
Euclidean Distance	$d(x,y) = \sqrt{\sum_{i=1}^{n}(x_i - y_i)^2}$
Angular Separation	$d(x,y) = \frac{\sum_{i=1}^{n} x_i y_i}{\left[\sum_{i=1}^{n} x_i^2 \sum_{i=1}^{n} y_i^2\right]^{1/2}}$
Tchebyschev Distance	$d(x,y) = \max_{i=1,2,...n} \lvert x_i - y_i \rvert$

In real applications, there is often no sharp boundary between clusters, so fuzzy clustering is often better suited for the data. Clustering can also be thought of as a form of data compression, where a large number of samples are converted into a small number of representative prototypes or clusters. Depending on the data and the application, different types of similarity measures may be used to identify classes, where the similarity measure controls how the clusters are formed.

The number of clusters is not known in advance; the data sets are obtained based on the current situation. Therefore, the results obtained cannot be used to estimate the future. In addition, the normality assumption of the cluster analysis is considered sufficient distance to normality values. There is no assumption about the covariance matrix (Tatlidil, 2002, s:329). This study examines two types of clustering: hierarchical and non-hierarchical techniques (Çakmak and Uzgören and Keçek, 2015).

In a very large data set, if one needs a clustering procedure that can rapidly form clusters on the basis of either categorical or continuous data; neither Hierarchical clustering nor k-means cluster works. In this study, we use two step clustering method using SPSS. In two step clustering method in SPSS, we have an option to create a separate cluster for cases that do not well into any other clusters and defined as outlier cluster.

Statistical Package for the Social Sciences (SPSS) has three different procedures that can be used to cluster data: hierarchical cluster analysis, k-means clusters and two step clusters. Hierarchical clustering requires a matrix of distances between all pairs of cases, and k-means cluster requires shuffling cases in and out of clusters and knowing the number of clusters in advances. In a very large data set, if one needs a clustering procedure that can rapidly form clusters on the basis of either categorical or continuous data; neither Hierarchical clustering nor k-means cluster works. In this thesis, we use two step clustering method using SPSS. In two step clustering method in SPSS, we have an option to create a separate cluster for cases that do not well into any other clusters and defined as outlier cluster.

Table 2: Clustering methods: Comparison

	Hierarchical	**K-means**	**GMM**
Running time	naively, $O(N^3)$	Fastest (each iteration is linear)	fast (each iteration is linear)
Assumptions	requires a similarity / distance measure	strong assumptions	strongest assumptions
Input parameters	none	K (number of clusters)	K (number of clusters)
Clusters	subjective (only a tree is returned)	exactly K clusters	exactly K clusters

3. APPLICATION

The ABC Foundation has identified needy citizens, unemployed youth, and women as the target audience. In this context, the ABC Foundation comes to people in need of assistance in order to obtain additional income and distributes various types of micro loans. In this way, the ABC Foundation contributes to national development, the prevention of internal migration and employment, economic development and social welfare.

The micro-loans are paid six months. Other payments are made in equal installments in following years. The Foundation's micro-credit finance does not meet the costs of inflation. This micro-credit is granted only to those in need to reach a commercial configuration.

Distributions in accordance with the targets set by the Foundation in subsequent years, actual and planned deployments, deployments of micro loans is in accordance with certain rules and frameworks. These assumptions are listed below:

A family residing in the same household is considered only a single application.

The goods or materials supplied for micro-credit given to the person to be taken before completing the loan debt may not be sold or transferred.

After giving micro-credit, ABC audits are conducted by the Foundation during certain periods. In the case of sold goods or materials, the loan shall be paid back with interest.

ABC Foundation does not require any document or collateral to receive micro-loans.

Citizens who apply for micro-loans receive preliminary consideration by the ABC Foundation. Credit accounts will be assessed fifteen days to three months before depositing the loan, depending on the type of micro-credit.

The ABC Foundation made distributions to those in need through micro-credit types X, Y, Z. Distributions were made by the Foundation micro-loans; credit limits are specified in Table 3.1.

Table 3.1. Credit Limits

Type of Micro-Credits	Limits (TL)
X	4000
Y	5000
Z	7500

The distribution of micro-credit has increased over the last three years. A, B, C, D, E, F, G, H and K are evaluated; citizens living in these cities will receive distributions over the next few years.In 2012, the ABC Foundation planned to distribute across the country separate micro-loans X, Y and Z totalling 750,000.00TL. These funds will be devoted to the cities, which must meet the requirements of three different types of micro-credit.

The micro-credit and micro-loans are evaluated according to maturity status, payment status, and micro-credit debt service. Micro-loan demand is the most intense in cities A, B, C, D, E, F, G, H and K.

4. ANALYSIS

Table 4.1 defines the labels for cluster analysis.

Table 4.1: Definitions of Labels

Maturity Status		Payment Status				Status		
At Maturity	**Before Maturity**	**Paid After Maturity**	**Paid at the Maturity**	**Paid Before Maturity**	**Waiting Payment**	**Paid**	**Non-paid**	**Semi-Paid**
1	**0**	**-1**	**0**	**1**	**-2**	**1**	**-2**	**-1**

We mainly focused on the X, Y and Z type of micro-credit in accordance with information on micro-loans. Based on micro-payment types, aggregation analysis is performed separately for each year. Finally, provincial clustering analysis is performed taking into account the return of micro-loans. We use Euclidean distance ($d(x,y) = \sqrt{\sum_{n}^{i=1} \quad (x_i - y_i)^2}$) to measure the similarities and dissimilarities of the clusters.

5. ASSESSMENT

Since 2005, the ABC Foundation has distributed three types of micro-credit. Micro-loans planned in 2012 are based on decision making principles of the return. Cluster analysis evaluates the maturity status, payment dates, payment status, amount paid, total paid, the remaining amount, and states. Micro-loans in 2012 are distributed in previous years will continue to be distributed based on feedback, the amount paid to loans granted to cities, and the total repaid in the remaining states.

5.1 Assessment of All Cities

A total of nine cities formed five different clusters (see Tables 5.1)b .

Table 5.1a: Cluster Analysis Based on All Cities

Cluster	Maturity Status		Maturity Dates		Payment Status	
	Mean	St. Deviation	Mean	St. Deviation	Mean	St. Deviation
1	1.00	0.044	05/12/2010	14.29	-0.91	0.290
2	1.00	0.000	10/06/2010	17.78	-1.00	0.028
3	1.00	0.000	04/05/2010	17.97	-0.95	0.222
4	1.00	0.000	26/05/2010	16.64	-0.99	0.108
5	0.34	0.475	02/02/2011	13.84	-0.40	1038

Table 5.1b: Cluster Analysis Based on All Cities

Cluster	Amount Paid		Total Amount		Remaining Amount		Status	
	Mean	St. Deviation	Mean	St. Deviation	Mean	St. Deviation	Mean	St. Deviation
1	1329.59	391.20	1394.44	314.07	-0.25	5.55	1.00	0.000
2	1186.30	269.79	1222.23	224.38	-0.23	7.03	1.00	0.000
3	1470.22	378.67	1510.98	317.77	-0.46	5.95	1.00	0.000
4	1015.11	199.44	1070.78	152.76	0.11	3.33	1.00	0.000
5	1207.14	484.13	1232.18	469.15	175.94	372.07	0.32	0.949

The results show 13% of B city in Cluster 1, 14.90% in Cluster 2, 68.00% in Cluster 4, and 4.10% in Cluster 5.

Table 5.1c: Clustering Results of Micro-Credits Based on Cities

Cities	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
A	85.40%	-	7.90%	0.70%	7.00%
B	13.00%	-	14.90%	68.00%	4.10%
C	-	97.90%	-	-	2.10%
D	17.50%	-	82.50%	-	-
E	12.60%	1.60%	69.30%	9.40%	7.10%
F	-	-	80.00%	-	20.00%
G	5.00%	-	81.30%	-	13.70%
H	0.40%	-	96.90%	-	2.70%
K	4.60%	-	19.30%	73.70%	2.40%

Three different types of micro-credit and the remaining amounts paid were examined for Cluster 4; cities A, B, E and K were found to be more suitable for micro-credit administration. People living in these cities and benefit from loans and micro-payments made on a regular basis.

5.2. Micro-Credit Evaluation of City A

Cluster analysis for city A with respect to state of maturity, payment dates, payment status, amounts paid, total paid, and status of the remaining amount is shown in Table 5.2.

Table 5.2a: Cluster Analysis of City A

Cluster	Maturity Status		Maturity Dates		Payment Status	
	Mean	St. Deviation	Mean	St. Deviation	Mean	St. Deviation
1	1.00	0.058	21/10/2010	14.94	-0.95	0.225
2	0.82	0.384	21/08/2010	19.07	-0.76	0.649
3	1.00	0.000	16/02/2011	49.96	-1.88	0.35

Table 5.2b: Cluster Analysis of City A

Cluster	Amount Paid		Total Amount		Remaining Amount		Status	
	Mean	St. Deviation	Mean	St. Deviation	Mean	St. Deviation	Mean	St. Deviation
1	1189.37	168.99	1210.13	91.681	0.00	0.00	1.00	0.00
2	1679.48	481.14	1804.48	203.955	0.00	0.00	1.00	0.00
3	1289.38	422.90	1520.63	384.693	41.88	104,572	-0.75	0.707

Three clusters emerged from the analysis. . Table 5.2c shows that 98.00% of X micro-credit are in Cluster 1, and 2.00% in Cluster 2.

Table 5.2c: Clustering Results of Micro-Credit in City A

Type of Micro-Credit	Cluster 1	Cluster 2	Cluster 3
X	98.00%	2.00%	-
Y	93.40%	5.20%	1.50%
Z	-	96.80%	3.20%

Payment status, amount paid, and total payments made to micro-credit were included in Cluster 1t. The X and Y types of micro-loans is seen as less risky than others.

5.3 Micro-Credit Evaluation of City B

Cluster analysis for city B is shown in Table 5.3.

Table 5.3a: Cluster Analysis of City B

Cluster	Maturity Status	Maturity Dates	Payment Status

	Mean	St. Deviation	Mean	St. Deviation	Mean	St. Deviation
1	0.99	0.101	26/06/2010	18.69	-0.92	0.27
2	1.00	0.000	27/06/2010	17.96	-0.98	0.16
3	0.29	0.470	16/02/2011	11.80	-0.35	1.37

Table 5.3b: Cluster Analysis of City B

Cluster	Amount Paid		Total Amount		Remaining Amount		Status	
	Mean	St. Deviation	Mean	St. Deviation	Mean	St. Deviation	Mean	St. Deviation
1	1703.99	510.52	1875.20	2.010	-0.20	2.010	1.00	0.000
2	1085.40	155.15	1100.93	122.85	0.00	0.000	1.00	0.000
3	1177.94	347.41	1177.94	347.41	123.53	341.81	0.41	0.939

Three clusters emerged from the analysis. Table 5.3c shows 97.70% of Y micro-credit in Cluster 2, and 2.30% in Cluster 3. The X and Y type micro-loans are not included in Cluster 1.

Table 5.3c: Clustering Results of Micro-Credit based on City B

Type of Micro-Credit	Cluster 1	Cluster 2	Cluster 3
X	-	95.50%	4.50%
Y	-	97.70%	2.30%
Z	95.20%		4.80%

5.4 Micro-Credit Evaluation of City C

Table 5.4 shows cluster analysis for city C.

Table 5.4a: Cluster Analysis of City C

Cluster	Maturity Status		Maturity Dates		Payment Status	
	Mean	St. Deviation	Mean	St. Deviation	Mean	St. Deviation
1	1.00	0.000	10/06/2010	18.40	-1.00	0.050
2	1.00	0.000	09/06/2010	17.55	-1.00	0.000
3	0.73	0.452	07/11/2010	16.60	-1.09	1.259

Table 5.4b: Cluster Analysis of City C

Cluster	Amount Paid	Total Amount	Remaining Amount	Status

	Mean	St.Deviation	Mean	St.Deviation	Mean	St.Deviation	Mean	St. Deviation
1	975.00	130.828	999.88	2.494	0.12	2.494	1.00	0.000
2	1285.83	250.179	1318.90	195.854	0.00	0.101	1.00	0.000
3	931.67	546.321	1179.39	520.438	282.73	377.090	-0.03	1.015

Three clusters emerged from the analysis. Table 5.4c shows 89% of Z micro-credit in Cluster 2 and 11% in the Cluster 3.

Table 5.4.III: Clustering Results of Micro-Credit in City C

Type of Micro-Credit	Cluster 1	Cluster 2	Cluster 3
X	99.50%	-	0.5%
Y	-	97.60%	2.40%
Z	-	89.00%	11.00%

Considering the results, city C should receive X type of micro-credit; however, if we consider the remaining payments, Y and Z type should be given.

5.5 Micro-Credit Evaluation of City D

Table 5.5 shows cluster analysis results for city D regarding state of maturity, payment dates, payment status, amounts paid, total paid, and status of the remaining amount.

Table 5.5.I: Cluster Analysis of City D

Cluster	Maturity Situation		Payment Dates		Payment Situation	
	Mean	St. Deviation	Mean	St. Deviation	Mean	St. Deviation
1	1.00	0.000	03/07/2010	24.08	-0.58	0.507
2	1.00	0.000	25/04/2010	22.43	-0.82	0.390

Table 5.5.II: Cluster Analysis of City D

Cluster	Amount Paid		Total Amount		Remaining Amount		Status	
	Mean	St. Deviation	Mean	St. Deviation	Mean	St.Deviation	Mean	St.Deviation
1	1250.00	0.000	1250.00	0.000	0.00	0.000	1.00	0.000
2	1875.00	0.000	1875.00	0.000	0.00	0.000	1.00	0.000

Two different clusters emerged. We find that 100% of Y and Z micro-credit belong to Cluster 1 and 2, respectively.

Table 5.5.III: Clustering Results of Micro-Credit based on City D

Type of Micro Credit	Cluster 1	Cluster 2
Y	100%	-

Z	-	100%

When we analyze Cluster 1 and Cluster 2 with the variables we defined, the Z type micro-credit is the most appropriate loan for this city.

5.6 Micro-Credit Evaluation of City E

Table 5.6 shows the clustering analysis for city E regarding state of maturity, payment dates, payment status, amounts paid, total paid, and status of the remaining amount.

Table 5.6a: Cluster Analysis of City E

Cluster	Maturity Situation		Payment Dates		Payment Situation	
	Mean	St. Deviation	Mean	St. Deviation	Mean	St. Deviation
1	1.00	0.000	18/04/2010	17.20	-1.00	0.000
2	1.00	0.000	18/04/2010	18.50	-1.00	0.000
3	0.33	0.492	17/05/2010	14.98	.67	0.492
4	1.00	--	08/03/2010	--	-2.00	--

Table 5.6b: Cluster Analysis of City E

Cluster	Amount Paid		Total Amount		Remaining Amount		Status	
	Mean	St.Deviation	Mean	St.Deviation	Mean	St.Deviation	Mean	St. Deviation
1	1179.88	225.397	1225.61	74.637	0.00	0.000	1.00	0.000
2	1875.63	3.536	1875.63	3.536	-0.63	3.536	1.00	0.000
3	1000	0.000	1000	0.000	0.000	0.000	1.00	0.000
4	1200		1200		50		-1.00	

As a result of cluster analysis for city E, four clusters emerge. We find that 10% of Z belongs to Cluster 2; 98.7% of Y belongs to Cluster 1 and the rest to Cluster 4.

Table 5.6.c: Clustering Results of Micro-Credit based on City E

Type of Micro-Credit	Cluster 1	Cluster 2	Cluster 3	Cluster 4
X	40%	-	60%	-
Y	98.70%	-	-	1.30%
Z	-	100%	-	-

All of the Z type of micro-credit belongs to Cluster 2. Considering the standard deviation of clustering variables of each cluster and the minimum values of the risky ones, city E should receive X type of micro-credit, which belongs to Cluster 3. This type of micro-credit has the greatest paid amount.

5.7. Micro-Credit Evaluation of City F

In our data, only Z type of micro-credit is given to City F. Table 5.7 shows the cluster analysis for this city.

Table 5.7.I: Cluster Analysis of City F

Cluster	Maturity Situation		Payment Dates		Payment Situation	
	Mean	St. Deviation	Mean	St. Deviation	Mean	St. Deviation
1	1.00	0.000	11/03/2010	18.60	-1.00	0.000
2	0.11	0.333	05/02/2011	20.94	0.78	0.667

Table 5.7.II: Cluster Analysis of City F

Cluster	Amount Paid		Total Amount		Remaining Amount		Status	
	Mean	St. Deviation	Mean	St. Deviation	Mean	St. Deviation	Mean	St. Deviation
1	1875	0.000	1875	0.000	0.00	0.000	1.00	0.000
2	1877.78	8.333	1877.78	8.333	-2.78	8.333	1.00	0.000

Two clusters aemerge, with 77.5% of Z in cluster 1 (Table 5.7c).

Table 5.7.III: Clustering Results of Micro-Credit based on City F

Type of Micro-Credit	Cluster 1	Cluster 2
Z	77.50%	22.50%

As a result of the analysis, we can say that Z type of micro-credit should be given to city F.

5.8 Micro-Credit Evaluation of City G

Cluster analysis results for the city G are shown in Table 5.8.

Table 5.8.I: Cluster Analysis of City G

Cluster	Maturity Situation		Payment Dates		Payment Situation	
	Mean	St. Deviation	Mean	St. Deviation	Mean	St. Deviation
1	0.51	0.507	09/03/2011	98.85	-0.09	1.011
2	0.99	0.099	01/04/2010	18.60	-1.00	0.000
3	1.00		03/09/2010		-2.00	

Table 5.8.II: Cluster Analysis of City G

Cluster	Amount Paid		Total Amount		Remaining Amount		Status	
	Mean	St. Deviation	Mean	St. Deviation	Mean	St. Deviation	Mean	St. Deviation
1	1053.57	226.559	1082.14	174.007	0.00	0.000	1.00	0.000

2	1858.88	131.229	1877.09	12.996	-1.89	12.874	1.00	0.000
3	25.00		25.00		1850.00		-1.00	

Three clusters emerge. Table 5.8c shows that 100% of X and Y belong to Cluster 1, while 98% of Z belongs to Cluster 2.

Table 5.8.III: Clustering Results of Micro-Credit based on City G

Type of Micro-Credit	Cluster 1	Cluster 2	Cluster 3
X	100%	-	-
Y	100%	-	-
Z	1%	98%	1%

Cluster analysis for city G reveals three different clusters: 100% of X and Y belong to Cluster 1 and 98% of Z to Cluster 2. The standard deviation of clustering variables in Cluster 2 is less than the other clusters. Thus, Z type of micro-credit should be given to city G.

5.9 Micro-Credit Evaluation of City H

Cluster analysis of city H results in two different clusters (Table 5.9).

Table 5.9.I: Cluster Analysis of City H

	Maturity Situation		Payment Dates		Payment Situation	
Cluster	**Mean**	**St. Deviation**	**Mean**	**St. Deviation**	**Mean**	**St. Deviation**
1	1	0.000	26/05/2010	17.97	-0.95	0.222
2	0.90	0.303	01/12/2010	19.69	-0.92	0.804

Table 5.9.II: Cluster Analysis of City H

	Amount Paid		Total Amount		Remaining Amount		Status	
Cluster	**Mean**	**St. Deviation**	**Mean**	**St. Deviation**	**Mean**	**St. Deviation**	**Mean**	**St. Deviation**
1	1233.99	226.014	1275.38	146.965	-0.08	1.957	1.00	0.000
2	1180.78	744.424	1490.18	589.116	162.32	365.983	0.44	0.907

Table 5.9.III: Clustering Results of Micro-Credit based on City H

Type of Micro-Credit	Cluster 1	Cluster 2
X	90.50%	9.50%
Y	97.60%	2.40%
Z	50.70%	49.30%

From the above table and statistical properties of the clustering variables, the X and Y type of micro-credit should be given to city H.

5.10. Micro-Credit Evaluation of City K

With respect to previous years, three types of micro-credit given to the city K. The cluster analysis results are shown in Table 5.10.

Table 5.10.I: Cluster Analysis of City K

Cluster	Maturity Situation		Payment Dates		Payment Situation	
	Mean	St. Deviation	Mean	St. Deviation	Mean	St. Deviation
1	1.00	0.000	23/06/2010	16.82	-0.96	0.195
2	1.00	0.000	28/05/2010	16.80	-1.00	0.107
3	0.35	0.487	18/03/2011	17.02	-0.43	1.237

Table 5.10.II: Cluster Analysis of City K

Cluster	Amount Paid		Total Amount		Remaining Amount		Status	
	Mean	St. Deviation	Mean	St. Deviation	Mean	St. Deviation	Mean	St. Deviation
1	1737.32	471.237	1875.89	7.957	-0.79	7.842	1.00	0.000
2	1018.18	143.921	1038.57	90.756	0.17	4.104	1.00	0.000
3	1295.00	556.088	1338.70	485.986	183.04	428.665	0.48	0.898

Table 5.10.III: Clustering Results of Micro-credits based on City K

Type of Micro-Credit	Cluster 1	Cluster 2	Cluster 3
X	-	99%	1%
Y	-	94.1%	5.9%
Z	94.4%	-	5.6%

Three different clusters emerge. The X and Y type of micro-credit belong to Cluster 2, while Z type of micro-credit belongs to Cluster 1. The third cluster consists of a small part of all types of micro-credit. Considering the statistical properties of the three clusters, Z type of micro-credit should be provided to this city.

5.11. EVALUATION OF X MICRO LOANS

Table 5.11 A total of nine cities in the previous years as the ABC Foundation, the distribution of X is made of micro-credit, maturity status, payment dates, payment status, amounts paid, total paid, with the remaining amount.

Table 5.11a: Statistical Cluster Information of X Micro-Credit

Cluster	Maturity Situation		Payment Dates		Payment Situation	
	Mean	St. Deviation	Mean	St. Deviation	Mean	St. Deviation
1	1.00	0.000	16/02/2010	15.83	-0.99	0.095

2	0.95	0.210	28/09/2010	15.77	-0.88	0.428

Table 5.11b: Clustering Results of X Micro-Credit

Cluster	Amount Paid		Total Amount		Remaining Amount		Status	
	Mean	St. Deviation	Mean	St.Deviation	Mean	St. Deviation	Mean	St. Deviation
1	981.74	112.259	999.91	2.130	0.09	2.130	1.00	0.000
2	988.60	94.896	998.69	22.460	1.31	22.460	1.00	0.000

Two different clusters of X emerge (see Table5.11c).

Table 5.11c: Cluster Analysis for X type of Micro-Credit

Cities	Cluster 1	Cluster 2
A	41%	95.9%
B	-	100%
C	85.1%	14.9%
D	-	-
E	10%	90%
F	-	-
G	-	100%
H	19%	81%
K	38%	62%

Micro-loans to pay for X are lower than their standard deviations for Cluster 1 located within the city, so micro-credit X is seen as more appropriate. In this context, a cluster of nine cities distribution X 1 is contained in micro-credit A, C, E, H and K in order to ensure that the return of cities is considered suitable.

5.12. EVALUATION OF Y MICRO LOANS

A total of three different clusters emerge for X, Y and Z micro-loans in the nine cities examined. Clustering analysis was based on maturity status, payment dates, payment status, amounts paid, total paid; the remaining were analyzed according to the amount and status (see Table 5.12).

Table 5.12a: Cluster Analysis for Y type of Micro-Credit

Cluster	Maturity Situation		Payment Dates		Payment Situation	
	Mean	St. Deviation	Mean	St. Deviation	Mean	St. Deviation
1	1	0.000	25/05/2010	17.42	-0.98	0.148
2	1	0.000	20/05/2010	17.03	-1.00	0.67
3	0.91	0.283	11/12/2010	13.38	-0.91	0.556

Table 5.12b: Cluster Analysis for Y type of Micro-Credit

Cluster	Amount Paid	Total Amount	Remaining Amount	Status

	Mean	St. Deviation	Mean	St. Deviation	Mean	St.Deviation	Mean	St.Deviation
1	1209.17	183.525	1250.04	2.075	-.04	2.075	1.00	0.077
2	1222.00	147.028	1250.00	0.000	0.00	0.000	1.00	0.000
3	1186.67	237.257	1219.38	157.963	30.62	157.963	0.88	0.472

Table 5.12c: Cluster Probabilities for Y Micro-Loans

Cities	Cluster 1	Cluster 2	Cluster 3
A	2.30%	3.7%	96.3%
B	_	3.7%	60.9%
C	_	95.3%	4.7%
D	_	63.2%	36.8%
E	97.30%	-	2.70%
F	_	-	-
G	_	-	100%
H	96.70%	-	3.3%
K	3%	57.4%	39.6%

Cluster analysis for Y micro-credit reveals three different clusters comprised of nine different cities. The amount paid, total paid, and the examination of the situation in these sections compared to the standard deviations was lower than in the other two clusters. In this context, Y micro-credit, particularly credits contained in Cluster 2, includes cities A, B, C, D and K. Thus, Y micro-credit could ensure a better return of administration.

5.13 EVALUATION OF Z MICRO LOANS

Table 5.13 shows the clustering results for Z micro-loans.

Table 5.13a: Cluster Analysis for Z type of Micro-Credit

Cluster	Maturity Situation		Payment Dates		Payment Situation	
	Mean	St. Deviation	Mean	St.Deviation	Mean	St. Deviation
1	1.00	0.000	08/04/2010	17.98	-0.98	0.179
2	1.00	0.061	17/06/2010	18.61	-0.94	0.242
3	0.44	0.501	05/01/2011	15.60	-0.44	1.472

Table 5.13b: Cluster Analysis for Z type of Micro-Credit

Cluster	Amount Paid		Total Amount		Remaining Amount		Status	
	Mean	St. Deviation	Mean	St. Deviation	Mean	St. Deviation	Mean	St. Deviation
1	1808.99	304.68	1877.16	17.782	-2.08	17.747	0.98	0.179

2	1727.28	479.79	1875.91	8.609	-0.83	8.507	1000	0.000
3	1575.10	533.03	1632.92	472.430	244.27	471.030	0.13	1.003

For Z micro-loan distributions, three clusters emerge: 90.3% of city A in Cluster 2 and 9.70% in Cluster 3. Cluster 2 was concentrated entirely in E.

Table 5.13.III: Cluster Probabilities for Z Micro-Loans

Cities	Cluster 1	Cluster 2	Cluster 3
A	__	90.3%	9.7%
B	__	95.2%	4.8%
C	96.3%	-	3.7%
D	95.5%	4.5%	__
E	__	100%	__
F	__	80,00%	20%
G	97.1%	__	2.9%
H	__	94%	6%
K	__	94.4%	5.6%

The Z cluster is composed of three different clusters. The amount paid, total paid and the examination of the situation in these sections compared to the standard deviations were lower than in the other two clusters. In this context, particularly for Z micro credits contained in cluster 2, A, B, D, E, F, H and K would be more appropriate distribution of cities in this type of micro-payment.

6. CONCLUSION

In 2005, in order to obtain additional revenue, micro-loans were granted to eligible persons. The ABC Foundation has determined that distributions of micro-credit to those in need will continue in coming years.

This study examined three different types of micro-credit to determine the type most appropriate to be distributed to cities.

Table 6.1: Cluster Analysis Results

Cities	Type of Micro-Credit		
	X	**Y**	**Z**
A	+	+	
B	+	+	
C		+	+
D			+
E	+		
F			+
G			+

H	**+**	**+**	
K			**+**

As seen in Table 6.1, the X type of micro-credit is more appropriate for cities A, B, E and H; Y micro-credit more appropriate for A, B, C and H cities; and Z micro credit more appropriate for cities C, D, F, G and K. There are numerous ways or methods that one can sort situations or cases into groups. The main aim of our study was to identify priorities through cluster analysis.

By the help of this study we propose a new method to distribute loans among the person in need. It is obvious that this is a fair and efficient method since it measures all parameters with the help of distance functions. So we can say this method is fair because the clusters are not formed by chance, it formed with some parameters. In addition for future work one can add some parameters, conditions when you consider giving credits, and find more applicable results. The most important thing that we want to highlight with this study, cluster analysis can be applicable to areas such as finance and economics.

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