Identify Valuable Customers of Taavon Insurance in Field of Life Insurance with Data Mining Approach

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ABSTRACT

Today the most crucial tasks of mentioned organizations is to recognize and attract customers and make a distinction between different groups of customers and ranking them and trying to keep the customers. To do this, the use of customer relationship management, and measurement of customer value is helpful. The main objective of this paper is segmentation insurance customers based on the factors affecting the value of our customers. In line with this objective, all data from 2311 life insurance customers are extracted from Taavon Insurance Company in a period of one year and according to the specification of insurance policy it was clustered by use of K-Means algorithm. Based on the results, customers were divided into five clusters. According to the insurance experts view, chosen specifications were weighted. After calculating the CLV, customers were ranked. Each cluster got specific name like, "Golden Customer", "Valuable Customer", "Favorable Customer", "Less Favorable Value Customer" and "Less Valuable Customer". By discovery of association rules based on the features of insured people, golden customers cluster for study of insurer's behavior was analyzed at first step. By use of algorithm, decision tree for life insurance data was classified based on insured feature in order to predict position of every new entrance customer in each cluster. This research can be used to develop marketing plans and develop and offer products and services for each group of customers.

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INTRODUCTION

The insurance industry has been considered in different fields. Recognition, customer acquisition and retention, risk recognition, damage estimation, insurance supports and all other subjects related to insurance show the importance of this matter more than before. Today universal economy creates strong competition among organizations for customer acquisition and retention. At the moment there are different choices in purchasing due to variety in products and services by organizations. In competitive world, organizations attempt to catch more customers so they should find ways to keep customer and increase their loyalty to the company [13]. They also attempt to keep their customers because a little increase of customer retention rate has strong effect in increase of profitability for organization [26].As insurance industry is a servicing industry, customers has a vital effect in survival and growth of insurance organization [2]. Customer recognition in order to keeping them is one of the important objects of these organizations. For this, real value of customers and groups of customers should be recognized in order to have suitable strategies for keeping and managing customer profitability by using it through managers and decision makers [19].

The objective of this article is to present a diagram for insurance customer segmentation and ranking them based on effective factors on rating for insurers of surveyed organization. By changing social and economic condition, working condition of organization also changes. Today attention to the customer and focusing on customers is an important factor for insurance company. All insurance organization has got to this result that their most important property is their customer. So all efforts of an organization is being focused to get more of customers and then creating values for valuable customers. So customer segmentation in similar groups is necessary. The correct customer segmentation to different levels cause a better understanding of customer lifetime value (CLV) and getting suitable strategies so as a result it creates more customer satisfaction. In second part, surveying in related researches and thesis has been done. In third part, a suggested pattern for clustering and recognizing of valuable customers has been explained completely. All results are gathered in fourth part.

1. LITERATURE REVIEW

Customer Relationship Management (CRM) is a management effort to control business interaction with customers. In management of customer affairs, different tools and technologies is used for customer recognition [18]. In insurance company, customer relationship management has a very important role [27]. One of the advantages of CRM is to recognize customers with more profits by a tool named Customer Lifetime Value (CLV). Customer Lifetime Value is a scale with our life value that creates a weight for customer in order to allot resources to a specified customer [10]. Liu has identified a lifetime value for CRM that includes three stages: customer acquisition, customer relationship development and customer retention [19]. The expected value of next profits from customer purchasing during surveying time and the question that which customers are more profitable and how to divide resources between customers are some of the questions answered by customer lifetime value [11]. There are different patterns to calculate CLV like Carpenter [9], Berger and Nasr [9], Blattberg and Deighton [7]. Hwang and his colleagues presented another sample for calculating CLV in 2004. In this sample, three factors were examined that hasn't been considered in previous samples: acquired profits in the past, potential profit, probability of customer leaving [14],[17]. Pippers and his colleagues considered in creating deeper and closer relationship with customers as objective of management in order to increase CLV for the organization [25]. CRM is a process of exact management of customer information in order to background out customers loyalty [21]. Increasing customer retention and customer loyalty, profitability and creating values for them are advantages of CRM [15]. Increasing income by customer satisfaction, reducing selling and distribution costs, reducing customer supporting costs are other objectives of CRM. Profitable customer is a customer that amount of getting income on his side for the company increase with noticeable amount in a period of time. The usage of CLV is so extended [8]. Hwang and his colleagues used LTV model for clustering customers in wireless telecommunication industry in 2004. Their reason was that in order to have an effective CRM, having suitable information of customers is necessary [14]. Kim introduced a framework for analyzing customer value and clustering them based on amount of their values in 2006. Then he introduced suitable strategies with each cluster [20]. Creating and developing data models for hierarchical data base, network, and especially relative base in seventieth, cause to introduce implications as data organization and indexing and at the end creating question language, SQL, in early of eighteen decade. By this words, users can create required reports and information form [12].

Data mining is considered a tool for analyzing CRM. Data mining process was presented scientifically in nineties and was entered to science statistics in 1995. The first knowledge discovery magazine in data base was published in 1996. Researchers like Brachman and Anand explained and determine specifically primary steps of data mining process. Two main objectives of data mining technology are prediction and description. Predictive data mining: in this model, by using data collection, it creates models for explaining system that can predict operation of variable by using it. Descriptive data mining: creates new data based on available data collection that descript patterns of variable

[16]. Data mining process has six steps that includes: business understanding step, data understanding step, model creating step, model assessment and model deduction step, deployment step [6]. Available capabilities in data mining, makes CRM possible in a best way. The success key in CRM is having suitable data strategy, data warehouse and ability to analyze customer interactive data with business. Information like customer value, object customer, customer ranking and surveying customer behavior that are in organizations shows the ability of data mining in converting customer data to the related information [27].

The advantages of data mining are: fast and exact availability to the information, quality and data cleaning in order to omit repeated data, extraction and availability to data in order to analyze customer profitability, fast reaction to business environment changes and customer acquisition [22]. One of the tools in data mining is process of customer segmentation. The objective of segmentation is to create differences for marketing of these segments and getting most suitable marketing mix for each segment [29]. A skillful segmentation makes company to know profitable customer of their objects, understand requirement of their customers, to allot their resources suitably and be in front of their competitors [4]. Segmentation is divided to different parts. The process of data segmentation to clusters in a way that objects of a cluster be quite similar to each other and has the least similarity to objects of other clusters named clustering. Dividing heterogeneous population to homogeneous clusters without guidance that is necessary to calculate similarities of data [9]. Classification is one of the most well-known models of learning in data mining. The objective of this method is to create a model for predicting future behavior of customers by classifying database records to a number of determined classes based on specified criteria [2]. Classification figures every part of data based on differences between data to a collection of predetermined classification, while clustering divides data to different groups that are not specified formerly (it is based on similarities in clusters and differences out of clusters) [9].

2. RESEARCH PROCESS

The presented model for customer segmentation and calculating customer lifetime value based on Liu and Shih [23] and the process of model performance is formed based on CRISP-DM [6] methodology. And it has changed due to restriction and specified objective. The model starts from business recognizing stage and continue to result showing stage. Figure 1 shows all stages of the model. After data collection in data preparation stage, sub collection of attributes are chosen ad data will be ready to enter modeling stage. In modeling stage, data are clustered by K-Means algorithm. Life time values of groups of customers are calculated and association rules for valuable cluster is extracted. For classification and prediction of new customer in cluster, decision tree algorithm is used at the end, the result of clustering, discovery of association rules and classification is evaluated. In general the model includes four phases: business understanding and data understanding, data preparation, modeling, evaluating and development. Performance of the model is explained continuously in subsections (3.1) to (3.4).
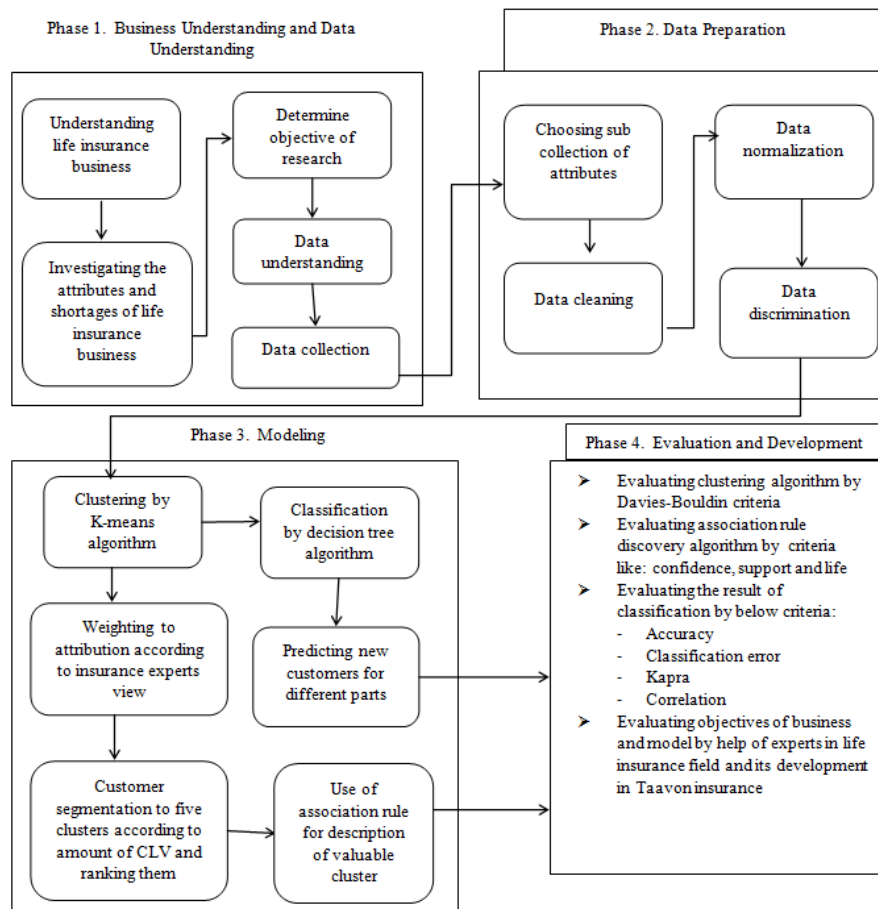
Figure 1. Recognition of valuable cluster in life insurance model

3.1 Business Understanding and Data Understanding

The first step is to understand scope of application and the problem relationship. This step is prerequisite of useful data extraction and choosing suitable data mining methods in third step according to usage objective and data nature [9]. It is impossible to present a solution or suggestion without knowing shortages and defects of business. Some parts of objective markets has not been recognized in life insurance. While these parts have potential customers that can add them to groups of customers by a marketing plan. Presenting the same services to all customers, causes wasting parts of these costs. We can abstract weaknesses of life insurance in lack of attention to CLV and CRM. According to the presented defects, our objective of performing this model is to implement CRM model, and in an exact view to implement a model for recognizing valuable life insurance customers. By presenting the model, values of groups of customers in life insurance field is evaluated. If a customer is being known as a low yields customer, it will be prevented from any company's budget payment. Instead they allocate company's budget for valuable customer retention

and acquisition of potential profitable customers. After recognition of available data in data base, required data like two data collection of insured attributes and insurance policy in life insurance field of Taavon Company was collected in a period of one year. It includes 2311 records that 647 data belongs to customers in 1392 and 1664 data belongs to customers in 1393.

3.2 Data Preparation

Data preparation for data mining is the art of compacting existed data and extracting valuable data, while data mining is the art of discovery meaning full patterns in data. Meaningfulness of pattern has relation to the problem. Preparation as a part of data mining depends on the problem and also tools and methods that we are going to use on data [9].

Choosing Sub Collection Of Attributes

In data mining operation, we don't work with all aspects of collected data. But those important and related aspects of data are chosen and unrelated and extra are omitted. Unrelated attributes are those that don't have information value for the problem, it cause just confusion and slowness data mining algorithm [28]. For choosing a sub collection of attributes we used method of interview with experts

and kept useful attributes. In recognizing groups of valuable customers and omitted other attributes. The selected attributes are in table 1. In selected data, there is no missing part.

Table 1. Insured and insurance policy attributes

	Attribute	Class	description
Insured attributes	Insured sex	Categorical – nominal	837 number of data are female and 1474 number of data are male
	Insured age	Numerical – rational	Age of insured is between (0-61) years old. Age frequency of insured before 2 years and until 18 years old is downward and after 18 to 29 years old is upward and then downward.
	Business level	Categorical – ordinal	408 number of people are in business first class, 1618 number of people are in business second class, 253 number of people are in business third class, 23 number of people are in business fourth class, 9 people are in fifth business class
Insurance policy attributes	Insurance policy period	Nominal – rational	The minimum period of insurance policy is 5 years, maximum is 78 years and average is 25 years
	Primitive insurance premium (yearly)	Nominal – rational	Minimum amount of insurance payment on that year is 1.400.000 Rials and maximum is 85.000.000 Rials and average is 5.847.905 Rials
	Death equity	Nominal – rational	The minimum of death equity is 10.000.000 Rials and maximum is 400.000.000 Rials and average is 102.029.532 Rials
	Payment of insurance premium	Categorical - ordinal	404 number of people would like to pay yearly, 415 number of people would like to pay every six month, 44 number of people would like to pay every four month, 576 number of people every three month, 215 number of people every 2 month, 616 number of people every month

Recognition of Outliers

One of the repeated problems of data is low quality. The operation of resolving quality problem is called data cleaning. One of the problems endangering data quality is outliers. In this research Rapid Miner6 software has been chosen for different operation of data mining. The reason of choosing this software is the effective superiority of this tool in comparison with other data mining tools in statistics [28]. These data are records that amount of their attributes are quite different than other records. This difference cause a very different place for outliers than other records in multi aspects attribute environment. In this software, for recognizing outliers, Detect Outlier (Distance) is used. This operation recognizes outliers in data collection with N number of records and based on their distance with K to their nearest neighbors. This operation discover outliers by searching basically. It's a statistic research method. This method start the research based on the distance with K nearest neighbor of a record and then arrange the results based on their placement to other neighbors. The objects that have most distance with K nearest of their neighbor will be recognized as outliers in existed data collection. Then based on the amount of distance of each object with K nearest neighbor a ranking will be done on all objects of the collection. According to it, user processing can consider highest degree as outliers of data collection from N records. This operation use Sin, Cos and Euclidean distance for calculating that is changeable by distance parameter [28].

Data Normalization

Normalization of changing data scale, is in a way that it will mapping out them to small and specified domain like distance between 0-1. For data transformation distribution function like maximum and minimum function is used. By normalization numerical data domain is transformed to 0-1 intervals [12]. For data normalization in software, normalize operation has been used. This operation normalize amount of attributes to a specific intervals.

Data Discrimination

The objective of data discrimination is to transform rates and interval attributes to nominal attributes. This is done in complicated problems that includes data with different attributes and also many records and attributes to reduce difficulty of problem by data discrimination and provides a suitable place for more effective performance of model learning algorithm

[12]. Discrimination is one of the steps of data preprocessing. Discrimination is performed in software by use of Discritize by frequency operation.

3.3 Modeling

After data preprocessing in data mining process, data are ready to apply in learning step of model. In learning step of model, the discipline in preprocessing data is recognized according to data researching model. The produced model is transformed to the next step that is evaluation and interpretation of model [9]. In this research, three useful methods of data mining has been used that are clustering, association rule discovery and classification.

Customers Clustering

Clustering is a method that use no labels for records and records will be classifying to a collection of cluster based on the introduced similarities. Lack of labels makes every clustering algorithm regarded as an algorithm without supervisor. In without supervisor method, the algorithm doesn't have steps as teaching and evaluation and at the end of clustering; the produced model is presented with its usage as extraction. Clustering algorithm of K-means is one of the simplest and most famous of learning algorithm without supervisor [28]. The source of customer classification in this research is based on attributes of customers' insurance policy. The attributes of insurance policy are:

- Yearly insurance premium
- Insurance policy period
- Dying investment
- Payment of insurance premium

In this research K-means algorithm is used. For clustering with K-means algorithm it is necessary to determine optimized number of clusters. As number of clusters from experts view is limited between 2-10 clusters, it was decided to perform this algorithm for each cluster and get optimized number of clusters. To calculate the distance between data, Euclidean distance is used. Last result to get optimized number of clusters with Davies-Bouldin criteria is in table 2 & figure 2.

Table 2. Amount of Davies-Bouldin criteria

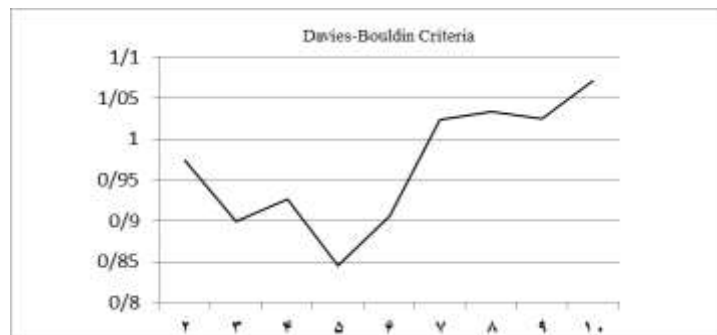| Number of clusters	2	3	4	5	6	7	8	9	10
Davies-Bouldin criteria	0.98	0.90	0.93	0.85	0.91	1.02	1.03	1.03	1.07

Figure 2. Linear chart of Davies-Bouldin Criteria

According to experts view and also evaluation criteria, five clusters was considered for customer clustering. Data distribution in clusters is based on table 3. Most numbers are in second cluster and least numbers are in first cluster.

Table 3. Data distribution in clusters

Cluster	Number of insured	Percentage
First cluster	235	12%
Second cluster	624	32%
Third cluster	421	22%
Fourth cluster	359	18%
Fifth cluster	310	16%
total	1949	100%

Presenting Specified Model

As presented in last part, there are many mathematical models for estimating customer life insurance value. But the most important note is that we should choose the model according to the requisite and specific attributes of each organization and specify it for organization in order to qualify operation of the model. Firstly based on experts' view weighting to attributes was done. All attributes with their weights are in table 4.

Table 4. Attributes weights

Life insurance period	Yearly insurance premium	Payment of insurance policy	Death equity	Insured sex	Insured business class	Insured age	attributes
0.064	0.107	0.129	0.15	0.161	0.172	0.215	weight

To calculate amount of CLV, equation (1) has been used [23].

$$CLV = C_1W_1 + C_2W_2 + C_3W_3 + \dots \qquad (1)$$

C= insurers and insured attributes

W= weight of each attributes

For estimating CLV, we should get normal amount of clusters and multiply it in weight of each one and by use of above formula, calculate CLV of each cluster. Customers were ranked according to amount of customer lifetime value in each cluster. To analyze clusters, the result of customer clustering and distribution in each cluster was analyzed based on clustering and ranking criteria with calculating amount of CLV and these results were confirmed by experts. To analyze clusters, for variables like insurance premium, insurance policy period, death equity and payment of insurance policy we should calculate average of clusters to interpret the cluster, by its help. The amount of CLV and their ranking are in table 5.

Table 5. Amount of customer life time value and ranking

Cluster's name	ranking	Amount of CLV	Payment condition	Death equity	Period of insurance policy	Insurance premium	Number of insured	cluster
Golden	Rank 1	1.397	5.461	165,777,419	27.158	7,871,935	310	Fifth cluster
Valuable	Rank 2	0.861	5.515	48,959,619	24.831	3,066,508	421	Third cluster
favorable	Rank 3	0.809	1.659	144,126,602	25.128	6,994,359	624	Second cluster
Less valuable favorable	Rank 4	0.548	3.008	52,075,208	23.632	3,647,921	359	Fourth cluster
Less valuable	Rank 5	0.387	1.132	52,400,000	23.417	6,027,574	235	First cluster

Fifth cluster (golden customers): according to this research it was determined that fifth cluster was the most valuable cluster. 16% of total insured includes this cluster. Number of insured are 310people. Amount of CLV for fifth cluster is 1.397 that is more than other clusters. Average amount of insurance premium is 7.871.935 Rials and the period of their insurance policy is 27 years that is more than other clusters and payment condition of most customers of this cluster is outright and yearly.

Third cluster (valuable customers): 22% of total insured includes this cluster. Number of insured are 421 people and amount of CLV for third cluster is 0.861. Although the average of insurance premium for this cluster is 3,066,508 Rials and it is less than other clusters, but because of payment condition of insurance premium in total یکجا and yearly, so amount of CLV for this cluster is more than first, second and fourth cluster. Because in yearly and outright payment of insurance premium, liquidity is done sooner. In this way the probability of cancellation and redemption of insurance policy is less and its stableness is more.

Second cluster (favorable customers): 32% of total insured includes this cluster. Number of insured are 624 people that have the most amount in all other clusters. The amount of CLV for second cluster is 0.809. Average amount of insurance premium for this cluster is 6,994,359 Rials that is more than first, third and fourth cluster. Payment condition of insurance premium for more customer of this cluster is every two months.

Fourth cluster (less valuable favorable customers): 18% of total insured includes this cluster. Number of insured is 359 people. Amount of CLV for fourth cluster is 0.548. Average amount of

insurance premium is 3,647,911 Rials. Average period of their insurance policy is 23 years that is less than more clusters. In this cluster, most of insurers like to pay every 3 months.

First cluster (less valuable customers): the amount of CLV for this cluster is 0.387 that is less than other clusters and s regarded as the least valuable cluster. It includes 12% of total volume of cluster. Number of insured is 235 people. It has the least volume of clusters. The average amount of insurance premium is 6,027,574 Rials that is less than second and fifth clusters. Time period of their insurance policy is 25 years. Because of monthly payment, customers of this cluster are as less valuable customers. Because customer cash payment of this cluster is later and also the probability of cancellation and redemption of insurance policy is more possible among these customers.

Discovery of Association Rules

Extracting association rules is that kind of data mining that researches for finding the relation between attributes of data collection. In other language, association analyzing is the study of attributes or specifications that accompany with each other accompany with each other and look for rules among these specifications [9]. For discovery of association rules, Fp-Growth algorithm is used. This algorithm increases the speed of producing repeated object by making Fp-Tree. This part look for extracting rules in order to make a quantitative relation between two or more specification.

Association rules introduced in IF and THEN form and with three criteria as Lift, Support and Confidence [28].

By discovery of association rules, valuable cluster is described. For producing of association rules, insured variable has been used, that are:

- Insured sex
- Insured age
- Insurers business class

For recognizing valuable customers the behavior of customers is described firstly by help of these rules. In table 6 some samples of extracted rules are presented that describes only fifth cluster that is most valuable cluster and has been estimated by Lift, Support and Confidence criteria. Some samples of rules of most valuable cluster are as below:

- If insured sex be male and his age be between (5-17.5) , then it will be in fifth cluster.
- If insurers business class be class one and insured age be between (33.5-61) years, then it is in fifth cluster.
- If insured sex be male and insurers' business class be second class and insured age be between (5-17.5) years, then it is in fifth cluster.
- If insurers' business class be second class and insured age be between (17.5-25.5) years, then it is in fifth cluster.

Table 6. Sample of extracted rules of valuable cluster

NO	premises	conclusion	lift	support	confidence
391	Insured sex=1, insured age= range 1 (5-17.5)	Business class= second class, cluster= cluster_5	1.877	0.017	0.185
520	Business class= first class, insured age= range 5 (35.5-61)	cluster= cluster_5	1.610	0.012	0.268
302	Insured age= range 1 (5-17.5)	Business class= second class, cluster= cluster_5	1.494	0.030	0.147
434	Business class= third class	cluster= cluster_5	1.232	0.026	0.205
409	Business class= first class, insured age= range four (29.5-35.5)	cluster= cluster_5	1.166	0.012	0.194
396	Business class= second class, insured sex=1, insured age= range 1 (5-17.5)	cluster= cluster_5	1.128	0.017	0.188
392	Insured age= range 5 (35.5-61)	cluster= cluster_5	1.122	0.033	0.187
390	Insured sex= 1, insured age= range 1 (5-17.5)	cluster= cluster_5	1.112	0.017	0.185
384	Insured age= range 4 (29.5-35.5)	cluster= cluster_5	1.097	0.036	0.182
380	Business class= second class, insured age= range 4 (29.5-35.5)	cluster= cluster_5	1.094	0.017	0.182
372	Business class= first class	cluster= cluster_5	1.077	0.039	0.179
361	Business class= second class, insured age= range 2 (17.5-25.5)	cluster= cluster_5	1.048	0.023	0.174

Customer Classification

Classification is one of the methods that for each records of researched data collection, there is a label showing a truth in problem. This label cause to consider every classification algorithm as an algorithm with supervisor. Classification and prediction are two operations for data analyzing and extracting model in order to describe important classification of data, understanding and predicting of their future behavior. Classification model is used in analyzing categorical and discriminated data [28]. In order to use classification operation we need to create a field as class field. So we add a field on data as cluster number and data is classified, in order to predict the placement of new customers when entering to organization. So for classifying, insured variable is used. These variables are:

- Insured sex
- Insured age
- Insurer's business class

Table 7. Amount of evaluation for classification

Accuracy	Classification_Error	Kappa	Correlation
61.30%	38.97%	0.012%	0.024%

3.4 Evaluation and Development

After modeling, now we should evaluate results of model. The result of evaluation improve model and make it usable. In this phase the value of model is investigated and a report of evaluation is presented. In this stage first of all clustering algorithm is evaluated by use of Davies-Bouldin criteria. After evaluation of algorithm association rule discovery was performed by Confidence, Lift and Support criteria.

Evaluation of classification result was done by accuracy, classification error, Kappa and Correlation criteria and evaluation of business objectives and model was performed by experts in life insurance field. The model that created by data mining technique is for Taavon insurance company, life insurance part and also other insurance fields.

3. CONCLUSION

In this research, we were looking for presenting a data mining based on customer, life period value in life insurance to investigate customer ponderable value. Beside customers were classifying to help jobs, business and service retails especially insurance companies. It is also possible to evaluate the real operation of management relation with customer. Clustering process based on specification of insurance policy, customer classifying to five clusters and weighting to recognize factors based on experts' view, calculating CLV, ranking them, rule association discovery and customer classification based on insured specification are the result of this research. Next research suggestions are:

1- Centralizing marketing research on potential customers that have more probability for purchasing and relating life insurance data with all other insurance fields.

2- Ranking customer churn (in life insurance redemption) to present effective plan for customer retention

3- Predicting and analyzing the preference of customer to choosing insurance products and suggesting products to customer

4- Presenting model of customer life time value for all other insurance field

5- For rating in life insurance field, life table of France in last 20 years was used. Suggestion for next research is to provide a life table by researchers

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