

# Applying Data Mining to Insurance Customer Churn Management

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**Abstract.** According to competition in insurance industry in Iran in recent years and entrance of private sector, keeping customers has become more important for insurer companies and reasons of churning is challenging. Thus in this research, data mining methods is used for Customer churn management (CCM). In first step, customers with equal characteristics were selected by clustering K-means method and in the second step, using churn index and decision tree CART, reasons of customer churn were analyzed. Data mining process was done by Clementine software on set of data gathered from seven “Iran Insurance” branches in Anzali as population size. Customer clustering and knowing the reasons of churning by decision tree CART make company choose better policy to reduce that.

**Keywords:** data mining, customer churn management (CCM), k-means clustering, decision tree cart, insurance.

## 1. Introduction

Welcome New technology with wide competitive facilities has made Iran insurance market challenging and competitive mean while main selling factor, customer, has become more important. In this industry companies are service one and charge money due to service they provide. After 2002, in insurance industry of the country, entrance of private insurer companies and giving two governmental companies (Alborz and Asia insurance) to private section in 2010 lead to sever competition between companies[49]. Thus old companies try to keep their costumers because attracting new one cost 5-6 times more[52][47]. This problem is more obvious in saturated markets. All try to get new products or services in which attract more customers[52]. So pay attention to customer’s behavior patterns for keeping them is necessary for old companies.

As mentioned above, pay attention to customers in insurance industry has become more important in recent years. Some of the subjects about customers and marketing in insurance industry are as follows:

- Determining and selecting customers based on risk and by using clustering[18]
- Classify different customers and determining characteristics of each customer who tend to buy any of the policies[56].
- Determining probable churn customers based on their characteristics[38].

Losing customers or customer churn is one of the problems that companies may face[50]. Churn of good customers have irrecoverable disadvantages for a famous company. In this research we try to determine churn customers, churn rate and understanding the reasons. So we used useful data mining tool which is used in marketing and customers’ relations management fields, especially customers churn, for analyzing data due to large various software and algorithm. In first step, customers with equal characteristics were selected by

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clustering K-means method and in the second step, using churn index and decision tree CART, reasons of customer churn were analyzed and finally some strategies were suggested to reduce that and help companies for better policies.

## 2. Literature Review: Customer Churn Management With Data Mining

In today competitive market, old companies are trying to keep their customers because lack of customers must be recovered by new one[50] which has Its own problems (1)Attracting new customer is difficult and expensive.(2)High expenses of process which lead to service revoke.(3) Losing customer lead to income reduction and negative effects on company reputations[47].

With respect to these concepts, customers churn is very important. In every industries, small to large, pay attention to customers’ needs and their behavioral patterns is in order to understand them better and make more advantageous. A churn customer is one who is transiting from one provider to another[54], in other definition we can say that how much time a customer in a company is in value cycle[41]. There are two types of churn customers: mandatory and volunteer. Mandatory churn is in a case of services misuse or not paying bills by customer[4][20] but volunteer is by free will and is difficult to determine[4].

Customer churn management includes three steps include: determining churn customers[2][20][8], determining reasons[2][20][53] and deciding policies to decrease the rate of churn[20][45]. Data mining is a useful tool to extract and explore knowledge from data and has been used in recent decays for customer’s relation management, especially customer churn[12][23].

Generally data mining divided in two categories[50][37]. (1)Predictive data mining: in this method, models are used for expressing system which can help to predict performance of various variables. So the aim of Predictive data mining is producing a model that can estimate by using executive codes, i.e. ranking prediction. The example is regression.(2) Descriptive data mining: new data and performance describe the behavioral patterns of variables based on available data set. The aim is a comprehensive understanding of current system by using its hidden patterns and internal relations of data set. As an example, we can mention clustering. According to Tab.1, main researches in customer churn management filed are about determining and predicting the rate by various data mining methods. These researches are divided in two categories: those merely about customer churn rate and those use data mining methods the find the optimum one for determining customer churn. researches in determining customer churn have two categories: those merely using churn index to find reasons and those researches using customers determination and churn index to find reasons.

Table. 1: Distribution of articles according to the proposed classification

Reference	Data mining techniques	CCM elements	CCM dimensions
[54][38][36][44]	Decision tree	just identified churn customers and determine of churn rate	Identifying churn customers and determining churn rate
[58][11][62]	Neural Networks		
[53][57][8]	Support vector machine		
[14]	k- nearest neighbour		
[48]	New Bayes		
[21]	Markov		
[6]	Random Forest		
[17][19][43][27]	logistic regression		
[45][38]	Clustering		
[9]	Apriori		
[28][23][34]	Decision tree	Evaluation of data mining methods to Identifying churn customers and determining churn rate	
[41][44][22]	Neural Networks		
[24][29][15]	Support vector machine		
[51]	k- nearest neighbour		

[43]	New Bayes		
[5]	Markov		
[12]	Random Forest		
[16][57]	logistic regression		
[10][40]	Decision tree	The results Identifying churn customers and determining churn rate	Identifying the reason of customer churn
[25]	Support vector machine		
[30][60]	Neural Networks		
[31]	Random Forest		
[13][59]	logistic regression		
[9]	Apriori	Only index churn	
[42]	Decision tree		
[46]	Genetic		
[26][39]	logistic regression	The results Identifying the reason of customer churn	Get reduction strategies against customer churn
[61]	Decision tree		
[3]	Support vector machine		
[33]	Neural Networks		
[35]	Apriori		

### 3. Research Methodology

Papers We have considered a framework for using data mining in customer churn management in insurance industry shown in Fig.1 and include Understanding the bussiness,Data Collect,Data preparation and normalization,Modeling and Evaluation

#### 3.1. Understanding the business

In recent decays Attracting new customers were the main policy of insurance companies but nowadays business policies are focused on keeping customers and their loyalty to insurance companies[49]. Permanent customers will increase their insurance shopping and as mentioned above, expenses of these customers are less than new ones. These customers introduce the insurance companies to others continuously. So we try to determine those customers who are going to leave the company and know their reasons, so keep them by choosing suitable approaches.

#### 3.2. Data collected

As many companies refuse to give their filtered data due to security reasons and at the same time gathered data from branches were not useful enough so we make our own questionnaire and for that purpose we use variables of churn modeling according to primary interviews of insurance industry reporters with churn customers. Thus against researches that use customers database, in this research with questionnaire, demographic and conceptual variables are used more in compare to behavioral and environmental factors.

Population includes customers who used third party policy in Anzali city of Guilan province in time interval of 23JUL-23SEP 2011 After primary setting of questionnaire and field survey, final version became ready and 7 Iran insurance branches were selected in Anzali and 150 questionnaires were given to any of them. Finally 300 questionnaires that customers had answered their key questions were selected

#### 3.3. Data preparation and normalization

As data gathering tool in this research is questionnaire and data are catalogue-like (very little- little-normal- much -too much) and numeral variable, but have no significant effect on other variables, so there is no need to normalization . The only factor is customer churn index which needs to be normalized by Min-Max method as follows  $X=(X-\text{Min}(X))/(\text{Max}(X)-\text{Min}(X))$  [32] .

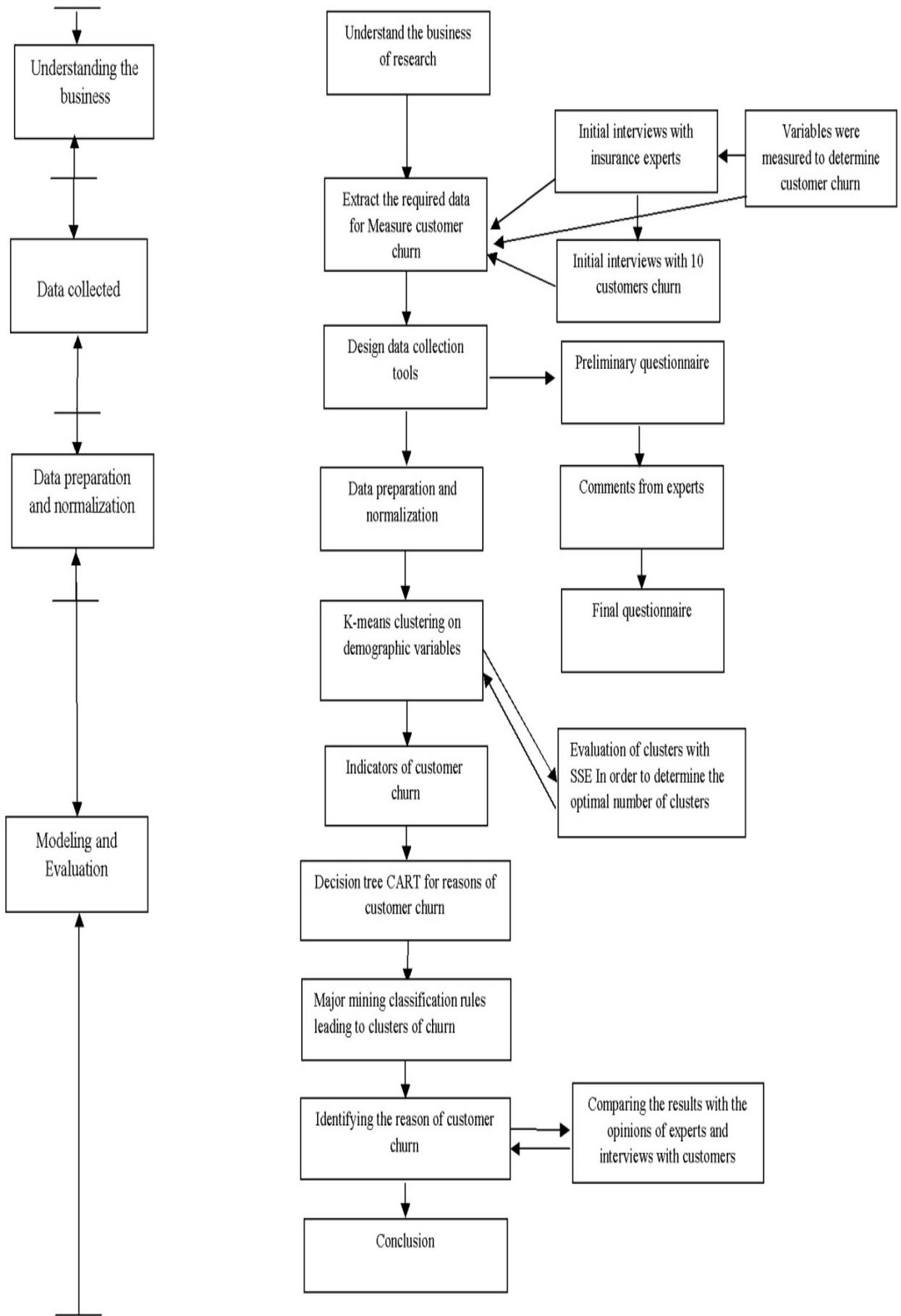


Fig. 1: Research methodology

### **3.4. Modelling and evaluation**

#### **K-Means clustering**

The most famous and applicable method of clustering is K-Means which introduced by Mc. Queen in 1967. K-Mean Clustering steps are as follows: First, it randomly selects K of the objects, each of which initially represents a cluster mean or center. For each of the remaining objects, an object is assigned to the cluster to which it is the most similar, based on the distance between the object and the cluster mean. It then computes the new mean for each cluster. This process iterates until the criterion function converges. Typically, the square-error criterion is used for cluster evaluation [1]. One of the important subjects in K-Means clustering is determining number of optimum clusters. Measuring Euclid distance is one of the benchmarks for determining. The algorithm continues until the other cluster centers do not change or in other words, the elements in each cluster does not move in the other iterations And if the convergence criteria to a predetermined threshold is reached, the algorithm ends. One of these criteria, the Sum squared errors or SSE. The SSE represents the best clustering (optimal number of clusters)[32].

#### **CART decision tree**

CART decision tree in 1984 by a group of statistical classification and regression was developed. The above algorithm for a comprehensive study on decision trees, providing technical innovations, debate on a complex data structure tree and a strong management on large sample theory for trees is important. CART decision tree and a recursive binary segmentation procedure is capable of processing particular attributes with continuous and discrete values. The data are managed in a row and need not be binary operations. Trees without any law to the greatest extent possible, grown and then by the algorithm, the cost-complexity to root pruning are two-dimensional case, pruning is placed divide that the overall performance of the tree on the data to test the least role play. More than one division at a time may be removed by this operation. The overall goal of this algorithm produces a series of nested trees, and pruning trees, each of which has been optimized and are candidates. Tree of appropriate size by calculating the predicted performance of each tree in the pruning process is determined up. Tree performance on independent test data are evaluated and selected based on the best tree after the evaluation is not performed. The cross validation test continues. If there are no test data are necessary to determine the best tree in one step, this algorithm will not be able to [55][4].

Measures of performance that we can verify it with the CART decision tree classification method to assess the evaluation criteria that is mentioned in the following: Overall accuracy: Percentage of records that have been correctly predicted records. Profit: function of a set of coefficients revenue costs associated with weight coefficients is made. A good model this function must be started from zero to a maximum point and come back and modeling in a weak form of the line of ascending, descending or direct to be seen. ROC curve: ROC curve is an indicator for measuring the performance of a model of the area under the curve is more accurate indication. Index Lift: Sample rate depending on the sort of confidence, predict the parameters of the basic units of society as a whole shows Lift [33].

## **4. Implementation Model**

As noted above, because our data collection instrument was a questionnaire of demographic variables, customer perception and the behavioral variables were used. Clustering method to identify characteristics of customers and toward determining churn rate and understand reasons customer churn, we used the CART decision tree.

### **4.1. K-Means clustering implementation**

Clustering to our data, the demographic variables that are more descriptive aspects of our data, it is also the K-Means clustering due to the ease of application we used. The clustering of the K-Means, the number of clusters is of great importance and will affect the results of our optimal. Therefore, the SSE criterion for evaluating the quality of clustering is to evaluate the number of clusters. Given the low volume of data to

compare the number of clusters to 2 clusters, we start. As we see from Tab.2 clustering with 4 clusters of less than SSE Materials cluster with cluster 2,3,5 and 6, are, in fact, will show better performance. After the K-means clustering with four clusters, we used.

Table. 2: SSE parameter is the rate per number of clusters

SSE rate	Number of clusters
2.198561	2
2.156033	3
1.859767	4
1.908669	5
1.933044	6

Reconstructing A characteristic of each cluster is as follows: Cluster 1: a cluster of customers or employees, mostly engineers And the level of monthly income between 5 to 10 million Rial, with an average age between 30 to 40 years (more than 97 %), Cluster 2: Customer educated (82 % or higher degree) And high income between 10 to 20 million Rial (95 %) and employee jobs, medical markets, Cluster 3: consumers, workers or farmers (with more than 78 %) and having income between 2.50 to million Rial (about 95%) are mostly high school graduates and school education (90 %), Cluster 4: The customer has the job market (95 %) with age between 30 to 40 years), about 72% and education diploma (91%) and income between 5 to 1 million Rial (over 81%)

#### 4.2. CART decision tree implementation

We need to determine why customers churn have a target variable, for this is because we use questionnaires to collect data. And lack of access rates churn customers to find rates possible, the criteria for calculating the index of the label Churn has been used, we therefore require normalization of data is that the variables of the normalization Min-Max we used.

Y1: Having insurance in other companies (if you have other insurance in an insurance company 1 and otherwise 0), Y2 : Satisfaction with the services of other insurance companies (toward normalization satisfaction and convert the data to range between 0 and 1, instead of simply very little = 0, little = 0.25, normal = 0.5, much = 0.75, too much=1), Y3: Satisfaction with overall services provided by insurance companies (in the normalization satisfaction and convert the data to range between 0 and 1, instead of simply very little = 1, little = 0.75, normal = 0.5, much =0.25, too much= 0), Y4: Possibility of renewing the insurance policy (in the normalization satisfaction and convert the data to range between 0 and 1, instead of simply very little = 1, little = 0.75, normal = 0.5, much =0.25, too much = 0), Y5: Recommended rate Iran Insurance Others (in the normalization satisfaction and convert the data to range between 0 and 1, instead of simply very little = 1, little = 0.75, normal = 0.5, much =0.25, too much = 0), Y6: May terminate the insurance policy in Iran, before spending the period (toward normalization satisfaction and convert the data to range between 0 and 1, instead of simply very little = 0, little = 0.25, normal = 0.5, much = 0.75 , too much=1) It varies according to the indices customer churn with the following formula is calculated  $churn = (Y1 * Y2 + Y3 + Y4 + Y5 + Y6) / 5$ . Customers have a high rate of 0.5 as customers churn and customers with lower rates of 0.5 customers are not supposed to churn.

After identifying the customer and the purpose of seeking to understand the reasons for customer churn CART decision tree technique we use. The results obtained from the above rules, we can conclude the following: first cluster (customers or employees, mostly engineers): Churn largest in this group of customers that although more activity is now in Iran Insurance. But degree of dissatisfaction with the answer to problems is more important and will encourage them to transition from. second cluster (customers educated): For this group of customers is more important than the amount the insurer. third cluster (our farmers and workers): For this group of little interest to customers who have insurance, Currently, the company's obligations to pay compensation And duration of insurance other than the insurer is very important. Four

clusters (consumer market) :For this group of customers, the major. Current level of mutual trust and reputation and is recognized This group of customers and generally do not tend to change in future influencing the choice of insurer If it be the satisfaction of other insurance companies What insurance company and willingness to work as a factor in this group of customers churn.

CART decision tree method is evaluated according to evaluation criteria category, Indicates the overall accuracy of 99.66, a profit of 215, the area under the curve index Lift 3.33 and ROC curve1. Evaluation criterion indicates the proper method to determine the reasons for its star turn trust the results of customer churn.

## **5. Analyzing Results of the Model in Compare to Reporters and Churn Customers**

At the first part of research, a list of interview by reporters, insurers and churn customers were presented as possible reasons. Main point for the insurer is to reduce risk, i.e customers with lower level of risk. At the same time main point for insurer and reporters is reducing insurance rate and getting the damage recovery at the right time and finally for customers important factors were insurer behavior, giving clear information, paying insurance bill on time by insurer himself so that customer don't lose anything.

While checking principles of decision tree CART, we notice that most of churn customers are officers or engineers. Most of their activity is in Iran Insurance but are not satisfy with services provided and eager to churn. In educated group, the main reason for churning was the behavior of insurer and for those who work in market, reputation of insurer and well-knowing was very important. In worker group with lower tendency toward insurance, time intervals of policy and insurer commitments are important factors. Results show that factors which are important for reporters and insurer are less important churn customers.

## **6. Reduction Strategies**

After Some suitable strategies for reducing churn customers are as follows:

- (1) Providing electronic services to reduce time and process of registration
- (2) Providing information about services and facilities of policies
- (3) Providing more services with higher prices and considering high priority for special customers
- (4) Providing information for customers for getting loss recovery payment in order to satisfy them
- (5) Paying insurance bill by insurer himself for some customers in order to prevent them lose anything.

This seems value less but is the most hidden factor that customers continue to work with the company. In other words, this is some kind of private-making for some value able customers.

## **7. Conclusion**

Churn customers are important factors for insurance companies in competitive markets of today. Due to lack of suitable data, a questionnaire was used to collect data, most of the variables include demographic, conceptual and less environmental and behavioral. Seven branches of "Iran Insurance" in Anzali were selected. First of all, determining customers were done by clustering, then goal index were selected by a pre-determined one and patterns were extracted by decision tree and show that most churn customers are in officers or engineers. Most of their activity is in Iran Insurance but are not satisfy with services provided and eager to churn. In educated group, the main reason for churning was the behavior of insurer and for those who work in market, reputation of insurer and well-knowing was very important. In worker group with lower tendency toward insurance, time intervals of policy and insurer commitments are important factors. Comparing these results with insurer and churn customers being interview show close relation. And finally reduction strategies for reducing churn customers are presented. Results make it possible for managers and

marketing professionals to make decision and choose suitable strategies to prevent churn of customers and let them go to other companies.

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