

# **Profiling bank customers behaviour using cluster analysis for profitability**

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## **Abstract**

Analyzing information of bank's customers for Customer Behavior Modeling is a difficult problem since it is a multi dimensional problem. This study has been done in a bank at the analysis of customer's behavior that isn't limited to customer's benefit in their general uses of banking services and also is considered as channel's charges. In this study, used of k-means for customer segmentation according to important characteristic of customers and their behaviors in using a channel. The result of segmentation of customer's profile is according to their behavior which will help the bank for retention strategies of current customers and attracting new customers.

## **Keywords**

Customer behavior modeling, Analytical customer relationship management, segmentation, Classification

## **1. Introduction**

Bank's large databases and voluminous information contain customer's information and the history of their transactions. These databases could help them to increase profitability, since they need to use more and better ways for analyzing their customers and increase their profitability.

Analyzing databases and data mining are the basics of Customers Relationship management. Also segmenting and classification of customers according to Data mining techniques is one of the most profitable Applicable and actually the most practical affairs in analytical Customer Relationship Management. Special attention to these issues, in recent years is providing multiple and sometimes ingenious solutions in this field. Most activities done so far are based on customer's grade and their credibility and their analysis of customer is for the validity of customers to take on loan. Also some are trying to analyze customer behavior considering customer's RFM<sup>1</sup> factor in a year. But little studies have been done on the analysis of customer behavior according to their profitability. The major point in this research is profiling customers according to their profitability for bank. With the analysis of profiles we can answer to the questions that make banks successful in their business, the questions like targeting actual and potential customers, offering incentive programs for retaining customers and offering propaganda plans for attracting profitable customers.

## **2. Reviewing the literature**

Nowadays with the advancement of information technology, new systems have been generated that can help organizations at reducing internal costs, better interaction with the environment and ultimately can help them to profit. One of these tools is Customer Relationship Management (CRM). "CRM is a strategic approach that is

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<sup>1</sup> Recency , Frequency , Monetary

concerned with creating improved shareholder value through the development of appropriate relationship with Key customers and customer segments. CRM provides enhanced opportunities to use data and information to both understand customers and co-create value with them. This requires a cross-functional integration of processes, people, operations, and marketing capabilities that is enabled through information, technology and applications [6]. CRM has three categories of operational, analytical and Collaborative [14]. Since in this article has been used of data mining techniques for analytical customer relationship management, so in this section we review its literature.

## **2.1 Analytical Customer Relationship Management**

Analytical customer relationship management including activities such as capture, storage, extraction, processing, interpretation and reporting customer's data to the organized user that would analyze them according to their needs [7]. This advanced kind of CRM In addition to providing statistics about the situation of sales, marketing and support, would analyze level of satisfaction and loyalty of customers [3]. Necessary analytical tools must be able to provide rapidly and in the real-time various types of analysis of the gathered data requesting by banks operators [16]. Analytical CRM provides the capability to be able to understand client's needs through talking communication centers, catalogs and Web tools and after analyzing this information they would create the ability of useful movement for the company and customer [13]. In this type of CRM will use data mining methods and online processing for interpretation and production of information from the Data.

Xu and Walton [16] assert that the essential of acquiring customer knowledge is to know not only who they are (customer profiling and segmentation) but also how they behave and what pattern they follow. Customer knowledge acquisition should be considered as a continuous and dynamic process, to collect information about new customers, existing customers (internal) and defecting customers. Knowledge about prospective customers and customers who are loyal to competitors (external) should also be attained. Managers need to be aware of the power of analytical CRM systems and the strategic importance of gaining customer knowledge.

Xu and Walton [16] further state that retaining existing customers is perceived more important than acquiring new customers and turning external and prospective customers into the company's customer is often the battleground between competitors. The analytical CRM system offers the function of profiling and analyzing prospective customers which this requires data to be fed into it from both internal and external sources. Bolton [2] refers that in a bank's CRM system first should be well established banking processes like checks, withdrawals and transfers. Although in transactions directly has no concept of customer and its value. Bolton [2] refers to a bank's CRM system by suggesting that maintaining the processing of checks, withdrawals, transfers, etc. is well established.

## **2.2 Profiling and Segmenting Customers**

In addition to identifying strategically significant customers, the analytical CRM system will help profile and segment existing customers. Customer profiling integrates several aspects of customers into a rational evaluation, such as customer details, historical records and contact details, customer attractiveness, or customer satisfaction [9]. Ferguson et al. (2004) reported such a system used in a financial service company that can profile customers and the service representative can instantly assist the customer by extracting the entire relevant customer's information. Even though customer profiling is oriented more towards the operational function than the analytical function, it does provide a broad view of each customer. This is the information required to understand the true value of the customer and gain insights to realize customer behavior [16].

Segmenting customers provides approaches to better understand their preferences and to more efficiently allocate resources based on the information. The benefit is twofold: First, it enables companies to differentiate themselves by providing appropriate and suitable services for their customers' needs; therefore, building up a competitive advantage. Second, it guides the companies to where their most valuable customers are located and helps allocate major capital, effort and time to generate the most profit [15]. Segmentation is a key method employed by banks to better understand and to service their customers in this increasingly competitive environment [5].

Market segmentation is one of the central concepts in marketing and customer profitability as a segmentation criterion is a newer phenomenon which has become increasingly prevalent in many industries, leading to differential treatment of customers [12].

One of the most important points for customer profiling is targeting valued customer and having special attention to them [11]. Xu and Walton [15] distinguished four criteria for segmenting customers: customer profitability score, retention score, satisfaction and loyalty score, response to promotion. PeopleSoft uses a customer scorecard to track key performance measurements and communicate progress against CRM-related goals. The key performance indicators (KPIs) delivered with the customer scorecard for an organization's financial goals (revenue, margins, profitability); customer goals (acquisition, retention, satisfaction); process goals (campaigns, sales, and support); for workforce goals (retention and competencies).The possible criteria to support customer segmentation are:

profitability by customer and distribution channel; cost to support by product and customer; average order value by customer; customer acquisition rate; customer defection rate; repeat customer rate; and customer satisfaction [16].

Also Gurau [8] further proposes that once the main customer's segments have been identified and their behavioral profile defined and the new customer is steered into the most appropriate customer segment. Gurau [8] recognized that the analysis and the definition of each customer segment in terms of profitability will depend on each firm's profile and strategic objectives. Sometimes the low value/loyal customers can become, in the future, highly profitable customers for the company, either through increased purchase or through positive referrals.

Segmentation according to profitability and profiling customers has different aspects. In this study besides noticing to bank's strategic objectives is considered to profitability according to different channels (such as branch, ATM, Terminal, Web) used to service customers and different costs for each of them. Of course utilizing of used channel standard alone cannot be a good criterion for segmentation, so used services of each channel in customer profitability has been considered too. Some services may cause increasing in the number of transactions although has no benefit for the bank and cause additional charges. Of course it is important to know that channel used for customer service belongs to that bank or is for the other bank, because it may cause changes in customer profitability. These comments haven't been studied at Segmentation according to profitability.

### 3. Research Methodology

#### 3.1 Framework of research implementation

For data mining projects, a framework is presented that according to it at first the necessary data for performing the project has been gathered. Then, based on customer behavior in the use of bank card, segmentation is done. Each segment has been labeled and each segment's customer has been known by that label. After that, for profiling customers, classification methods has been used that their variable target are customer's segment name. Figure 1 shows an Overview of research conducted within the framework.

This research has been done on the Saman bank card holders. Transaction and Data of customers are between the years of 2008 and 2009. Two SEMMA and CRISP\_DM methodologies, in addition to KDD traditional Methodology in Data mining are available for this study which are accepted and well-known [1]. But universal use of CRISP-DM Methodology made it the first choice for performing this research [10]. This Methodology contains six phases of business understanding, data understanding, data preparation, modeling, evaluation and deployment [4]. In the Business understanding phase business goals of data mining project were set with the help of bank's senior managers which include receiving a general perspective of bank's business and using that for marketing and targeting actual and potential customers. In the Understanding data phase, necessary information and concepts for achieving business goal has been received from Bank experts and saved in the database. In the phase of Database preparing, data were analyzed in terms of accuracy, validation of data and the volume of missing data and the necessary solutions for estimating missing data that were used. In the phase modeling (according to the data given in figure 1) customers have been segmented and classified. Then created models according to data segmentation were evaluated into two parts of training and test. In this research also has been used of Clementine Software and Oracle database manager system.

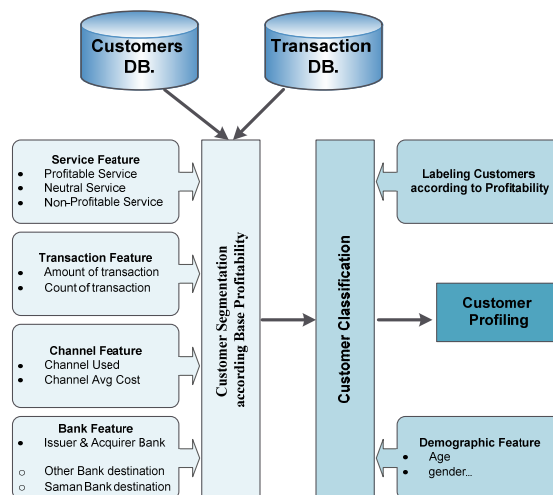


Figure 1: Framework of study

### 3.2 Selecting data base

Main Data of bank for studying are located in three database table. The table of customer's information includes their Demographic characteristics like age, gender, marital status and etc. Card table contains the data for card issuing and transaction table contains all the data of transactions of customers. Card table can be a junction between customer and transaction table. It means that customer's transactions can be accessed by card number and customer's number which are in card table. Approximately there are 900000 customers and they have almost 26 million transactions. Considering the count of missing data Fields has been chosen as the database for data mining.

### 3.3 Estimate missing data

Missing data contains the data of birthday, marital status, and birth place and residence town. Therefore with the logical analysis we know that the correct birthday couldn't be achieved from the other data. So only the wrong data resulting from the careless user would be corrected.

Data of marital status could be achieved from the other data. With regard to marital status as a target variable for existing data, various models have been achieved to estimate missing data of this variable. With regard to percent of correct estimation on testing data, neural network model has been selected as best model. Add to this that neural network model is a layer with 20 node. According to this model, importance of age is 66 percent, education 30 percent and gender 4 percent.

After that missing data of birth place and residence place has been studied. 46% data of birth place of customers has been missed. It should be noted that for a better and more valid modeling residence town province and birth place province have been used (After that provinces have been used instead of town). Variables used to estimate province are birth place, age, marital status and gender. According to performed modeling C 5.0 model is the best one for estimating that. Noticing this model, it will be understood that the only variable for predicting province of birth place is province of residence town.

### 3.4 Constructing customer behavior data

Noticing to the main goal of this study, it seems necessary that the required attributes of data transaction of customers be extracted. Important factors which are needed for classification and segmentation of customers according to their profitability are in the following:

- Type of channel (containing 7 channels)
- Type of Bank (containing 83 banks)
- Type of service (containing 26 services)
- Type of transactions, including the monetary and frequency of transactions

Because attributes of referring factors alone couldn't be useful for knowing customer profitability and a combination of them would be helpful for their profitability, they should be combined. But combining all these factors we reach to 30212 attributes for each customer that is too many. Factors have been classified according to their profitability that is referred in table 1.

Table 1: Factors and Classes defined for creating segmentation and profiling according to profitability

Factor Name	Number of Classes	Type of Class
Kind of Channel	3 Class	ATM, Terminal(Shop, Branch), Web
Kind of Bank	2 Class	Saman Bank destination, destination of other bank except Saman
Kind of Service	4 Class	Purchase, Withdrawal, Transfer and Bill, Services with charges
Kind of Transaction	1 Class	According to nature of service monetary or frequency is accounted

By using mentioned factors and classes, we reach to different Combinations. Noticing to the nature of combinations, we reach to the 19 feasible customer behavioral models that their full specifications have been mentioned in appendix A. For example the specification of combination 1 is "the amount of Withdrawal from the Saman Bank ATM by customer".

## 4. Customer Behavior Modeling

### 4.1 Segmenting Customers according to profitability

For modeling are used of those customers' Data that haven't any missed data and also have at least one transaction in Database (71000 customers are in the modeling). Segmenting has been done according to K-Mean model that this segmenting has been done on 3 channels of ATM, Terminal and web. Essential Data for each segment contains customer Demographic characteristics and created combinations relating to that channel. With Segmenting and creating 2, 3, 4, 5, 6, 7 clusters of them and consulting with the experts, three segments for each channel have been known and three types of customers exist for each channel. Of course it has been suggested that before segmenting, neural network has been used to determine the importance of each feature and selecting important features [9]. Here, for each channel combination of properties (variable output), neural network was carried out separately and importance of demographic characteristic of customers (input variables) were measured and characteristics with less than 0.02 of importance haven't be used in segmentation. Each segment should have a name. For labeling them, complete analysis has been done on the value of combinations (in appendix B has been referred to some analysis). Table 2 shows the name of segments and the number of their customers.

Table 2: Naming of created segments according to Customer Profitability

Channel Name	Segment Name	Number of customers
ATM	Long term potential customers	44099
	Disloyal customers	14073
	Runaway customers	13305
Terminal	Hostage customers	43393
	Consumer customers	17744
	Official customers	10340
Web	Paying bill customers	23709
	Future customers	44973
	Good customers	17842

### 4.2 Classification and customer profiling

After segmentation, customer of each channel should be classified. Input variables for classification are their demographic characteristic variables and the target variable is customer's segment name. Various models have been used for classification .The best one for ATM channel is CRT model, for terminal channel is CHAID model and for Web channel is C5.0 model. It is important to know that in modeling has been noticed to balance of them. After classification the rule set of each model should be extracted. These rule set is customer's profile that shows customer's Demographic characteristic of each Segment. Following will be referred to the rules extracted from each channel's model and the number of customers covered by the rule.

- ATM channel rule set: The ATM channel rule set according to customer segment is as follows:

There are two rule sets in ATM channel rules for *long term potential* customers (first segment):

- Rule one of long term potential customers: The first rule is stated that customers are married men and their birthplaces are all provinces except three provinces of Khorasan. (Total 10,889 customers).
- Rule two of long term potential customers: the second rule stated that they are married women which have opened an account in a branch of Tehran province (Total 2023 customers).

ATM channel rules set for *disloyal* customers (second segment) are as follows:

- Rule one of disloyal customers: the customers are single and have opened their accounts in Khorasan Razavi province (Total 613 customers).
- Rule two of disloyal customers: the customers are married men and have opened their accounts in Khorasan Razavi province (Total 434 customers).
- Rule three of disloyal customers: the customers are married women (Total 5398 customers).
- Rule four of disloyal customers: the customers are married and have opened their accounts in three provinces of Khorasan or Sistan and Baluchistan province (Total 8097 customers).

ATM channel rule set for *runaway* customers (third segment) consist a rule as follows:

- Rule one of runaway customers: the customers are single (Total 13214 customers).

- Terminal channel rule set: Terminal channel rule set regarding to customer's segments is as follows:

Terminal channel rule set for *hostage* customers (first segment) consist a rule as follows:

- Rule one of hostage customers: the customers are married men (Total 10806 customers).

Terminal channel rule set for *consumer* customers (second segment) consist a rule as follows:

- Rule one of consumer customers: the customers are women (Total 10774 customers).

Terminal channel rule set for *official* customers (third segment) consist a rule as follows:

- Rule one of official customers: the customers are single men (Total 10339 customers).

- Web channel rule set. Web channel rule set regarding to customer's segments is as follows:

Web channel rule set for paying bill customers (first segment) are totally 4 rules:

- Rule three of paying bill customers (that have maximum number of customers): The customers are born in Tehran province (Total 5833 customers).

Web channel rule set for *future* customers (second segment) are totally 5 rules:

- Rule one of future customers: The customers are born in provinces except provinces of Gilan, Isfahan, Tehran, Qom, Golestan (Total 5599 customers).
- Rule two of future customers: The customers are born in Gilan province and live in Gilan, West Azerbaijan and Khuzestan province (Total 263 customers).
- Rule three of future customers: The customers are born in Khuzestan province and live in Gilan, and Khuzestan province (Total 692 customers).
- Rule four of future customers: The customers are born in Qom province and live in Mazandaran, East Azerbaijan, Khuzestan, Khorasan Razavi, Zanjan, Hormozgan, Ardabil, Qazvin provinces (Total 72 customers).
- Rule five of future customers: The customers are born in Golestan province and stayed there (Total 76 customers).

Web channel rule set for *good* customers (third segment) are totally 2 rules:

- Rule one of good customers: The customers are born in the province of Isfahan (Total 5584 customers).
- Rule two of good customers: The customers are born in Golestan province and live in Isfahan province (Total 2 customers).

## 5. Conclusion and Suggestion

The ultimate goal of this study was to obtain customer profitability profile. For customer profiling two main operations of segmenting and classification have been done. One of the important matters that bank's expert notice is segmenting based on customer profitability, according to the rate of usage of different channels and various services. So each service in the various channels, according to the bank that channel is belongs may be profitable, neutral or may have charges. Various methods have been used for Classification customers that their best ones have been used for creating rule set and profiling customers. According to the analysis done on the rule set, bank can plan its future strategy in these ways:

**ATM channel:** Most single men customers have a little loyalty to the use of Saman Bank's ATM. Also customers of three provinces of Khorasan are not reliable. The most significant rule is related to married women that have opened their Accounts in Tehran, so bank could try to attract them. Also it is better that bank focus its propaganda plan on married people.

**Web Channel:** Bank can invest on the paying bill services for the customers that have been born in Tehran province and offer them incentive programs. Also Bank should have special attention to customers of Esfahan Province.

**Terminal channel:** Bank should invest on female customers for using terminals and increase the number of these customers, because they have the most profit for the bank. Also the bank should note the fact that single men have a large tendency to pay bills or transfer money by using Saman Bank terminal and they come to bank for withdrawal of money more than the other customers.

The following suggestions are provided for the future studies:

- Noticing to the high cost of installation of bank Terminals, with the analysis of merchant behavior and regarding to merchant transactions, can offer the strategy for the place of Terminal Installation.
- Using the RFM models can be one of the important aspects for ranking of customers. With offering these points to customers, incentive programs like giving prizes can be implemented.
- Using time series to predict the time of transactions. So a plan can be offered in portable services like using portable ATM and installation of additional terminals in order to give better services to customers.

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17. **Appendix A:**

Table 3: Table of Construct Data for each Customer

Combination Name	Channel	Type of Service	Bank of Channel Owner	Type of Transaction
1	ATM	Bill Payment, Bill payment by other acquire Bank, Transfer	Saman	Amount
2	ATM	Withdrawal	Saman	Amount
3	ATM	Balance inquiry(Card/account), Customer Profile, Account List, Statement, Pin Change	Saman	Count
4	Terminal	Balance inquiry, Statement	Saman	Count
5	Terminal	Bill Payment, Bill payment by other acquire Bank, Transfer	Saman	Amount
6	Terminal	E-shopping	Saman	Amount
7	Terminal	Withdrawal	Saman	Amount
8	WEB	Internet Purchasing	Saman	Amount
9	WEB	Refund goods	Saman	Amount
10	WEB	Bill payment	Saman	Amount
11	WEB	Balance inquiry, Customer detail, Statement, Pin Change	Saman	Count
12	ATM	Bill Payment, Bill payment by other acquire Bank, Transfer	Other Bank	Amount
13	ATM	Withdrawal	Other Bank	Amount
14	ATM	Balance inquiry, Customer Profile, Statement, Pin Change	Other Bank	Count
15	Terminal	Balance inquiry, Statement	Other Bank	Count
16	Terminal	Bill Payment, Bill payment by other acquire Bank, Transfer	Other Bank	Amount
17	Terminal	E-Shopping	Other Bank	Amount
18	Terminal	Withdrawal	Other Bank	Infeasible
19	WEB	Internet Purchasing	Other Bank	Amount
20	Terminal	Refund goods	Other Bank	Infeasible
21	Terminal	Bill payment	Other Bank	Infeasible
22	WEB	Balance Inquiry, Viewing profile, Pin change	Other Bank	Count



**Appendix B.1** : Features of ATM channel segments

*Segment 1-Long Term potential Customers:*

- Customers who have the most number of transactions (transfer, withdrawal, balance inquiry, pin change).
- They Use transfer and bill payment services of Saman Bank more than the other services.
- They use more withdrawal service of the other bank (70 percent).
- They use balance inquiry, statement, and PIN change services of Saman Bank more than the other banks (1.19 times more than the other banks).
- They use withdrawal more in Saman Bank than the other segments (1.73 times more).
- More withdrawals in segments are for paying bill and transfer between segments (0.19 more).
- They use more, segment of receiving service of Saman bank than the other segments.

*Segment 2- Disloyal Customers:*

- Customers that have the least count of transactions (transfer, bill payment) in cluster one that of course most of them are done by Saman Channels (58 percent).
- They have the most withdrawal in the other banks ATM (73 percent that is the most in 3 clusters).
- They use the least services (balance inquiry, statement, and pin change) of cluster 3 that of course 40 percent of them are done by Saman bank ATM.
- Customers of this segment cannot be a good customer for bank because of highest rate of withdrawal in comparison to pay bills and transfer of money and also the minimum use of Saman Bank ATM for withdrawal service.

*Segment 3 – Runaway Customers:*

- They use more from services of other banks.
- They have the least count of transactions.
- In transactions of cluster 3 (services with charges) they are in second grade.
- They have more pay bills and transfer than the second cluster.
- The difference between them and the second cluster is that they use other bank's ATM.
- Because of using other bank's ATM and the high Count of balance inquiry, they are called Runaway Customers.

**Appendix B.2** : Features of Terminal channel segments

*Segment 1 – Hostage Customers:*

- They have the most quantity of balance inquiry and account statement; they frequently use Saman Bank's (78 percent).
- They have balance inquiry two times more than customers of cluster 3 and six times more than customers of cluster 2.
- Customers of this segment are in grade 2 between these 3 segments at bill payment often by Saman Bank (82 percent).
- They have the highest purchasing costs, of course only in 33% of them they use Saman bank Terminals.
- They have the highest amount of withdrawal from the branches.
- Because of the least use of Saman Bank terminals considering to the amount of purchase, they were called hostage customers.

*Segment 2- Consumer Customers:*

- Customers who have the least sum of transactions than other customers.
- They have the least amount of withdrawal service in comparison to the customers of other segments.
- They have the least use of services with cost (Combination 4 and 15) and this decreasing rate is significant.
- They have the least amount of purchasing goods, but often use Saman bank terminals for this (42 percent).
- The ratio of purchasing goods is 25 times more than bill payment and transfer which is the most between the other segments and so are called consumer customers.
- In this segment, 95% sum of customer's transactions is allocated to purchasing goods.
- The customers can have the most profit for the bank and the bank should have special attention to them.

*Segment 3- Official Customers:*

- They have the second grade at sum of transactions in Terminal services.
- Customers have the most use of bill payment and transferring services (90% use Saman Bank).
- Customers have the most use of withdrawal from the branches.
- Customers use more for their services from banking card.
- Customers use so much of services that have charges (Combination 4 and 15).
- These customers are called official customers because of doing more their banking operations like bill payment and transfer and withdrawal with bank, in comparison to the customers of the other segments (1.2 more than customers of segment one and 4.2 more than customers of segment two)

**Appendix B.3** : Features of Web channel segments

*Segment 1- Bill payer customers:*

- Customers of this segment have the least sum of transaction (Of course 91% of them done in Saman bank Web site).
- The most bill payment is done by these customers (12% of the sum of transactions).
- They have the most amounts in refund of goods.
- They cause charges since the high amount of refund and the least number of transactions.
- Bank should think of a strategy for them at their bill payment.

*Segment 2- Long term potential customers:*

- Customers of this segment have the second grade in sum of transactions.
- Important thing about them is using Saman port for purchasing goods (15 times more used Saman) that could show purchases from guilds that Saman bank only has contract with them.
- They are customers have done most of their transactions with Saman Bank.
- They aren't so different in their bill payment with customers of segment 3.
- They aren't so different in refund of goods with customers of segment 1.
- Bank should invest on these customers.

*Segment 3- Valued customers:*

- Customers of this segment have the first grade in sum of transactions (3.7 more than customers of segment one and 2.84 more than customers of segment two).
- They have the least amount of refund of goods.
- Bank should try so much in retaining these customers.

It is important to know that customers of all three segments used almost equally services of Combinations 11.