



# Churn analysis for an Iranian mobile operator

Abbas Keramati <sup>a,\*</sup>, Seyed M.S. Ardabili <sup>b,1</sup>

<sup>a</sup> Industrial Engineering Department, Faculty of Engineering, University of Tehran, P.O. Box 11365–4563, Tehran, Iran

<sup>b</sup> Information Technology Group, University of Tehran, Iran

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## ABSTRACT

To survive in the challenging environment of a global market, organizations must recognize and analyze customer attitudes. To be competitive, organizations must recognize and forecast customer preferences and behaviors to maximize customer retention before their rivals do so. This research identifies factors that affect customer churn, the single most valuable of an organization's assets. One year's data from call log files relating to 3150 customers were selected randomly from an Iranian mobile operator call-center database. Binomial Logistic Regression was the method of analysis used in this research. The results of this research indicate that a customer's dissatisfaction, their amount of service usage and certain demographic characteristics have the most influence on their decision to remain or churn. The results also imply that customer status (active or inactive status) mediates the relationship between churn and the cause of churn. The Iranian government's current plan to privatize the telecommunications industry without deregulation leads to a non-square competition environment. Deregulation in favor of delegating more authorities of customer care is necessary in order to develop a square private competition environment in the Iranian mobile telecommunications industry.

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## 1. Introduction

In this information age, and relative to other segments, telecommunications industries clearly have a higher developing index. Among the different telecommunication and communication industries, one of the fastest growing is the mobile phone services industry, with its rapidly increasing share of daily communications. The mobile service market shows considerable and continued growth, which is attributed not only to market size, but also to the increasing variety of services offered and the intensive competition. Despite the infancy of the mobile phone services industry, the mode of competition has shifted from acquiring new subscribers to retaining existing customers. This has been achieved by engaging in heavy marketing efforts and by luring customers away from rival companies (Kim, Park, & Jeong, 2004; Kim & Yoon, 2004). The development of competition in the telecom market and reviews of mobile operators' strategies have been well documented (Valletti & Cave, 1998). Alternatively, studies have analyzed the effects of market structures and networks (Fullerton, 1998) on market performance in regional mobile markets.

Compared to the cost of retaining current customers, acquiring new customers is even more difficult and expensive (Coussement, Benoit, & Van den Poel, 2010). According to one survey, in 1995 it cost 300 dollars per account to acquire

\* Corresponding author. Tel.: +98 21 88021067; fax: +98 21 82084194.

E-mail addresses: [keramati@ut.ac.ir](mailto:keramati@ut.ac.ir) (A. Keramati), [m.seyedain@tanavob.com](mailto:m.seyedain@tanavob.com) (S.M.S. Ardabili).

<sup>1</sup> Tel.: +98 21 88021067; fax: +98 21 82084194.

new customers compared to 20 dollars to retain existing ones. On the other hand, in 2004, it cost 300 dollars per account to acquire new customers and 25 dollars to retain existing customers (Brown, 2004). According to a US telecommunication market survey, these costs were yet again determined to be 300 dollars and 20 dollars, respectively. This means that it was considerably more expensive (15 times more expensive) to acquire new customers than to retain existing ones (Seo, Ranganathan, & Babad, 2008). The higher costs associated with obtaining new customers is due to the efforts made by service providers in collecting and analyzing data about customers to gain valuable information and insight about their preferences and behaviors. In addition, in a mature market, acquiring additional subscribers often means taking them away from other service providers. Increasingly, such acquisitions require greater incentives in order to force the customers to switch. Thus, financially, it makes more sense for an organization to focus on retaining its existing customers. As a result, churn management is a major area of focus. In fact, the telecommunications industry experiences an average of 20–40 percent annual churn rate, and acquiring a new subscriber costs 5–10 times more than retaining an existing one (Barrett, 2003; Lu, 2002). The worldwide growth of competition in the telecommunications industry along with the maturation of the service market, have turned customer churn management into a main challenge within these industries.

In Iran, a mobile telephony service was launched by the government-owned, Iran Mobile Telecom in 1992. After 12 years, the entrance of new private operators (for instance Talia in 2004) ended a longstanding monopolistic market structure. In September 2005, Irancell, in a partnership with MTN (the largest mobile telephony operator currently in the Middle East and Africa), started its own mobile telephony service as a second operator. Currently, 15 international companies from countries that include Canada, Britain, Russia, China, Malaysia and the United Arab Emirates have announced their readiness to participate in developing a third mobile telephony operator. A third mobile telephony operator is predicted to support approximately 17 million subscribers and would enjoy a monopoly on the provision of third generation mobile telephony technology. Fifteen years since the introduction of mobile telephony into Iran, the mobile communications development index has a penetration rate of approximately 42%. Even when taking into account over-investment, excessive competition in similar markets worldwide, population growth or the increasing need for mobile communications, service operators' efforts to remain in the Iranian mobile telephony market and to obtain greater market share, is predictable. Indeed, in Iran, under General Law 44's rule policy, the privatization of mobile telephony systems is accelerating, and the Iranian mobile telephony market, which according to experts is experiencing fierce competition (especially in credit mobile telephony area), will enter into a more intensively competitive stage. The entire government-operated mobile telephony system will be handed over to private enterprise. With the impending loss of governmental support, managerial skills, technical expertise, and clever in-time marketing strategies will be necessary in order to assure the survival and success of this joint enterprise.

With fierce competition predicted in Iran, the ultimate winner will be the one who can not only acquire significant numbers of new customers but who can retain existing ones as well. In light of the current (as well as the predicted) state of the Iranian telecommunications market, along with the boom-like and challenging nature of the mobile telephony market, a case study of one of Iran's active mobile telephony companies has been conducted. This research was conducted in order to identify the determinants customer churn.

## 2. Literature review

In the first section of this paper's literature review, the significant tools and techniques associated with a churn analysis are summarized: a set of techniques applied by researchers for indicating the importance of Customer Relationship Management. The second section entails a brief review of field studies from different companies that survey customer behavior as a basis for churn analyses.

### 2.1. Significant churn analysis techniques

In order to survive in an increasingly competitive marketplace, many companies are turning to a wide range of methods for churn analysis. A number of studies have employed the following approaches to explore customer churn: balanced random forests (Xie, Li, Ngai, & Ying, 2009), customer lifetime value (Glady, Baesens, & Croux, 2009), neural networks (Tsai & Lu, 2009), decision tree analysis (Chu, Tsai, & Ho, 2007), regression techniques (Larivière & Van den Poel, 2005), support vector machine (Xia & Jin, 2008) and association rules (Tsai & Chen, 2010).

### 2.2. Investigating customer behavior and churn analysis

This section summarizes research dealing with behavior-oriented churn analysis of customers. Song and Kim (2001) used a simulation to evaluate change in the Korean mobile phone market structure that had resulted from customer churn. Choi, Lee, and Chung (2001) analyzed the impact of business strategies on customer loyalty at the five dominant mobile service providers in Korea. They argued that, overall, complete deregulation is necessary in order to enhance the competitiveness of the Korean mobile industry and to increase consumer welfare. Kim and Kwon (2003) studied the factors that customers take into account when choosing a mobile telephony operator. The results of their research showed the impact of inter-network call discounts and quality of connection on a customer's choice of mobile telephony operator. In addition, Kim and Yoon (2004) also surveyed 973 users of Korea's five main mobile telephony operators and identified

determinants of both churn and loyalty. They found that the probability that a customer will switch operators depends on his or her level of satisfaction with various (alternative-specific) service operator attributes (for instance call quality, tariff level, handsets, and brand image), income level and subscription duration. Factors such as call quality, handset type and brand value were shown to have significant explanatory power of user loyalty (i.e., measured by the intention to recommend the present carrier to others). Subscription duration was found to be negatively associated with churn probability but turns out to have no significant influence on loyal customers who were willing to recommend their present mobile operator to others. Therefore, a so-called “lock-in effect” was identified among non-loyal subscribers who, due to switching costs, remained with their present mobile operator.

Research on the German mobile communications market was conducted using data from a sample of 684 residential mobile communications users (Gerpott, Rams, & Schindler, 2001). The results suggested that customer satisfaction, customer loyalty and customer retention are strongly correlated. In addition, mobile service cost and perceptions of personal service benefit were found to have an effect on customer retention. The analysis supported a two-stage model where overall customer satisfaction significantly impacts customer loyalty, which in turn influences a customer's intention to terminate (or to continue) their relationship with his or her mobile telephony operator. Mobile service costs, personal perceptions of services and the transfer of phone numbers among operators were identified as supply-related factors with the strongest effects on customer satisfaction. This paper examines the differences and similarities between the constructs of “customer retention”, “customer loyalty”, and “customer satisfaction” as well as the supply-side factors that influence them both conceptually and empirically.

Previous surveys have focused mainly on finding specific determinants of user churn, such as customer dissatisfaction and loyalty. Such studies were performed in lieu of examining a more comprehensive model that incorporated relationships between alternative constructs like service usage, switching costs, usefulness of services and other customer related variables. Other weaknesses of previous surveys were associated with type of data and samples collected. Consequently, there was often an assumption that the consumers' perceptions of and intentions towards their service experiences remain constant over time. Comparing actual user transactions and billing data does not permit one to describe or estimate customers' actual future decisions. Due to the costly nature of survey-based research, most of these studies used small samples (less than 1000 respondents). This in turn decreased both the validity and the reliability of the research. Ahn, Han, and Lee (2006) tried to mitigate the shortcomings of earlier research. In particular, they conducted a study entitled, “Customer churn analysis: Churn determinants and mediation effects of partial defection in the Korean mobile telecommunications service industry”. Using a sample of 5789 actual customer transactions and billing data, this study investigated the factors that led to customer churn. User dissatisfaction, switching cost and service usage level were found to be among the major factors influencing customers' decisions to remain or churn. Relative to previous studies, this research has generated new findings by achieving several things: (1) the development and testing of a comprehensive churn model using a large sample of actual customer transactions and billing data (data that are directly related to actual customer churn decisions) and (2) the identification of both partial and total defections in a subscription-based telecommunications service industry. The majority of previous studies have focused on discovering the direct effect of independent variables on customer churn; however, this study suggests that customer status may mediate between churn determinants and customer churn. This would indicate that a customer's change in status is an early signal of total customer churn.

Another paper entitled, “Two-level model of customer retention in the US mobile telecommunications service market” (Seo et al., 2008) focused on factors that led to customer retention behavior (and understanding how they did so) by answering the following questions: (1) “How does switching costs and customer satisfaction (like length of association, service plan complexity and the quality of connectivity) drive customer retention behavior in the wireless telecommunications industry?” and (2) “How do demographic characteristics like age, gender, income, occupation, rural/urban, and others affect customers' decisions to whether or not to stay with their service provider?”. The more significant studies of customer churn and retention in the mobile telephony market were used in this research and are illustrated in Table 1a.

Moreover, a summary of recent work on customer churn analysis in the context of the telecommunication industry is presented in Table 1b. As shown in the table, Tsai and Chen (2010) applied association rules for customer churn prediction to one of the telecommunication companies in Taiwan. Xia and Jin (2008) applied support vector machine (SVM) on structural risk minimization to customer churn prediction of a home telecommunication carrier in California. Using a CRM dataset provided by American telecom, companies that focus on the task of customer churn prediction, Tsai and Lu (2009) considered two hybrid models that combined two different neural network techniques for churn prediction. By using a decision tree analysis, Chu et al. (2007) proposed a hybridized architecture for predicting churn probability and for proposing retention policies for a wireless subscriber in Taiwan.

### 3. A customer churn analysis framework

The usefulness of a theory depends on its capacity to contribute to knowledge and thus on its capacity for replication, development and generalization (Santhanam & Hartono, 2003). After a review of the literature in the field of customer churn and after examining many of the contemporary models employed within it, Ahn et al. (2006) comprehensive model was selected as a framework for developing this study. According to the Ahn et al. (2006) model, certain factors can affect

**Table 1a**

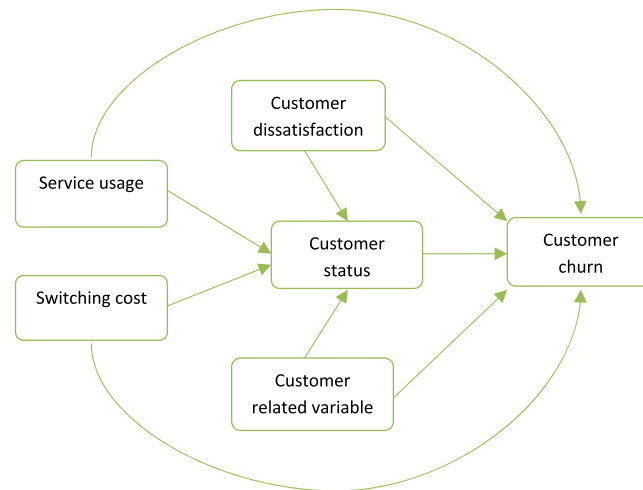
Significant studies on customer churn and retention in the mobile telephony market used in this research.

| Researcher and survey year          | Independent variables |                      |                          |               | Part of study |             |                   |        | Research methodology |                 |                       |                |                 |               |                                                                                                                             |
|-------------------------------------|-----------------------|----------------------|--------------------------|---------------|---------------|-------------|-------------------|--------|----------------------|-----------------|-----------------------|----------------|-----------------|---------------|-----------------------------------------------------------------------------------------------------------------------------|
|                                     |                       |                      |                          |               |               |             |                   |        | Dependent variables  |                 | Independent variables |                | Data collection |               | Techniques                                                                                                                  |
|                                     | Customer behavior     | Customer expectation | Customer characteristics | Environmental | Financial     | Retail sale | Telecommunication | Others | Stochastic           | Time/stochastic | Time independent      | Time dependent | Data warehouse  | Questionnaire |                                                                                                                             |
| Kim and Yoon (2004)                 | x                     |                      | x                        |               |               |             | X                 |        | x                    |                 |                       | x              |                 | x             | Binomial Logic Model                                                                                                        |
| Gerpott, Rams, and Schindler (2001) | x                     | x                    | x                        |               |               |             | X                 |        |                      | x               | x                     | x              |                 | x             | Casual Analysis                                                                                                             |
| Ahn, Han, and Lee (2006)            | x                     |                      | x                        |               |               |             | X                 |        | x                    |                 | x                     | x              | x               |               | Multinomial Regression and Binary logistic Regression<br>Binary logistic Regression and Two level hierarchical linear model |
| Seo, Ranganathan, and Babad (2008)  | x                     |                      | x                        |               |               |             | X                 |        | x                    |                 | x                     | x              | x               |               |                                                                                                                             |

**Table 1b**

Summary of recent related works.

| Reference                | Technique                 | Data source                                        |
|--------------------------|---------------------------|----------------------------------------------------|
| Tsai and Chen (2010)     | Association rules         | One of the telecommunication companies in Taiwan   |
| Xia and Jin (2008)       | Support vector machine    | A home telecommunication carry in California       |
| Tsai and Lu (2009)       | Neural network techniques | CRM dataset provided by American telecom companies |
| Chu, Tsai, and Ho (2007) | Decision tree             | A wireless subscriber in Taiwan                    |

**Fig. 1.** A conceptual model for customer churn with mediation effects.

customer churn. These factors are shown in Fig. 1. Four major constructs are hypothesized as affecting customer churn while customer status is understood to mediate (or indirectly affect) customer churn.

### 3.1. Customer dissatisfaction

In nearly all of the research reviewed, customer dissatisfaction was identified as a main customer churn factor. The level of satisfaction was measured with respect to the customers' evaluation of major service attributes (that are, call quality, tariff level, billing, value-added services, customer services and handset), their income levels and their subscription durations (Kim & Yoon, 2004).

Marketing theorists hold a variety of definitions and perceptions of customer satisfaction. Some definitions consider customer satisfaction as a degree to which a company's performance will meet customer expectations (for instance, if company performance does not meet customer requirements then customers will not be content). Other definitions express customer satisfaction as the result of comparing customer pre-conceptions with actual performance (Beerli, Martin, & Quintana, 2004). In customer information based studies, customer satisfaction is an experience-based assessment that stems from the degree to which customer expectations about characteristics of the service (or its overall functionality) has been fulfilled. In addition, high network quality, low charges and the degree to which a customer benefits from their mobile services also affect customer satisfaction (Gerpott et al., 2001). Regarding actual data-based approaches, call and network quality were both determined to be significant factors in customer satisfaction. Determinants such as the number of calls dropped and call failures are known to affect customer satisfaction (Ahn et al., 2006). In a US telecommunications service market survey, the principal customer satisfaction factors were connectivity and length of customer association (Seo et al., 2008).

As the data analysis for this study is primarily based on data mining, it is only possible to analyze customer behavior with data from a company's own data warehouse. A customer's personal perceptions about the services they received are not directly accessible in this study. A company's data warehouse may be classified into two types: customer internal data and customer contact records (Lu, 2002). Of the factors investigated in previous research, those that fell into either of these two types were selected. The following are factors obtained from previous literature that were associated with customer dissatisfaction: service failure rates (number of unsuccessful attempts to place a call), call drop rates (number of dropped calls), number of complaints (number of customer contacts to call center for trouble-shooting or complaints) and length of customer association. Customer satisfaction can be determined by three operator-attributed factors (i.e., service failure rate, number of complaints, and length of customer association). However, more than 97 percent of subscribers with

complaints had only one record of a complaint. Therefore, the “number of complaints” factor was given a binary value and expressed as whether or not a subscriber had ever complained. A zero value meant that the subscriber had never complained before, whereas a one value meant that at least a single complaint was recorded for the subscriber in the operator’s call center data warehouse. Thus, the following are hypotheses related to customer dissatisfaction:

**H1a.** Service failures rates are positively associated with customer churn probability.

**H1b.** Length of customer association is negatively associated with customer churn probability.

**H1c.** Customer complaints are positively associated with customer churn probability.

### 3.2. Level of service usage

The following are service usage factors found in previous studies: monthly charge, bill amount, unpaid balances, minutes of monthly use, number of calls and number of distinct calls by the subscriber. Among these factors, bill amount, unpaid balances, minutes of monthly use, number of calls and number of distinct calls were chosen for this study. In addition, a factor reflecting the number of short messages sent was also employed, while the monthly charge factor was changed to incorporate the amount of credit (due to operator supplied credit charge). The following are hypotheses related to level of service usage:

**H2a.** Amount of credit is negatively associated with customer churn probability.

**H2b.** Minutes of monthly use is negatively associated with customer churn probability.

**H2c.** Number of calls is negatively associated with customer churn probability.

**H2d.** Number of short messages sent is negatively associated with customer churn probability.

**H2e.** Number of distinct calls is negatively associated with customer churn probability.

### 3.3. Switching costs

Because the act of churning usually entails the costs of switching (e.g., change of phone number, the purchase of a new handset), in order to avoid them, customers may decide not to churn. These costs tend to vary with the different strategies employed by service providers (e.g., the exemption of entry fees, the implementation of handset subsidies). Costs also vary with respect to the different policies that can be implemented, such as mandatory number portability (Kim & Yoon, 2004). There is a relationship between customer satisfaction and switching costs. If switching costs are very high, customers will be reluctant to switch, even if they are not fully satisfied with services. However, if service quality is unacceptable, customers are likely to switch their service provider, regardless of switching costs (Seo et al., 2008). Switching costs are classified according to the following three types: learning, artificial (or contractual) and transaction. These three types of switching costs are defined as follows:

1. Learning costs refer to the costs of a subscriber’s efforts to achieve the same level of comfort and facility with the new product or service that they had had with the original. This kind of switching cost in the mobile telephony market is associated with cell-phones and often granted to customers as an enticement by operators. However, because this incentive is not offered by operators in the Iranian mobile telephony market, it is not considered in this study.
2. Artificial, or contractual, costs are those deliberately created by the service provider. For example, many providers employ penalties for ending a contract early. However, the Iranian mobile telephony market is a competitive market, and while there are a number of operators providing customers with the same level of services, none of the operators are prepared to risk alienating potential customers who have not already signed a contract. Therefore, mobile telephony users in Iran would not encounter such switching costs.
3. Transaction costs are financial costs incurred by a customer when he or she ends a relationship with one provider and begins a new relationship with another. In the Iranian mobile telephony market, the following are the only costs that might circumvent customer churn: transaction costs, certain tariffs (charge and service) or privileges granted to specific groups of customers as encouragement (i.e. loyal customers). Because of the research limitations mentioned above, the following factors were determined to be associated with customer switching costs in Iran:
  - *Membership in loyalty programs*: Number of loyalty programs that a customer has participated in (in cases where there were such programs).
  - *Complexity of service plans*: Of the service plans available to the customer, which ones do they use (in cases where there is diversity in the service plans offered)?

Among these factors, those related to loyalty programs were discarded, as operators were not themselves involved in them. In addition, the study was limited with respect to the service plans available. The Internet service plan was

**Table 2**  
Age group classification.

| Age group | Age interval      |
|-----------|-------------------|
| 1         | Less than 15      |
| 2         | Between 15 and 30 |
| 3         | Between 30 and 45 |
| 4         | Between 45 and 60 |
| 5         | Between 60 and 75 |

represented by a “1” when a customer had subscribed to it and a “2” when a customer had not subscribed to it. Thus the following hypothesis related to switching costs was defined:

**H3.** Type of service is positively associated with probability of subscriber churn.

### 3.4. Customer demographic variable

Previous research has identified several customer demographic variables as factors; these include gender, age, method of payment, and customer rank (in cases where operators rank customers). All of these are compatible with this research type. Due to the limitations of the dataset employed, this study only examines age as a multi-level variable. It takes values as shown in Table 2.

Hypothesis related to the customer demographic variable is defined as follows:

**H4.** Customer age is positively associated with customer churn probability.

Next, the impacts of mediation on customer churn are investigated. The monthly customer status before data collection is assumed have a mediating effect. This factor classifies customers in terms of billing status and calls. It takes into account whether a customer is likely to churn. Operators view customers as falling into one of the following categories:

- *Inactive status:* Customers who have not increased their account in two sequential months while having had less than 30 min worth of calls in the last month. These customers are expected to churn in the near future.
- *Active status:* Customers who have not demonstrated inactive conditions.

Investigating mediation effects entails examining the possibility that defection is partially due to the effect of some other determinant. Therefore, secondary hypotheses related to mediation effects are defined as follows:

**H1a'.** The effect of service failure rates on customer churn is mediated by a customer's change in status.

**H1b'.** The effect of length of customer association on customer churn is mediated by a customer's change in status.

**H1c'.** The effect of customer complaints on customer churn is mediated by a customer's change in status.

**H2a'.** The effect of amount of credit on customer churn is mediated by a customer's change in status.

**H2b'.** The effect of minutes of monthly use on customer churn is mediated by a customer's change in status.

**H2c'.** The effect of number of calls on customer churn is mediated by a customer's change in status.

**H2d'.** The effect of number of sent short messages on customer churn is mediated by a customer's status change.

**H2e'.** The effect of number of distinct calls on customer churn is mediated by a customer's change in status.

**H3'.** The effect of type of service plan on customer churn is mediated by a customer's change in status.

**H4'.** The effect of customer age on customer churn is mediated by a customer's change in status.

## 4. Research methodology

To identify factors that affect customer churn, a dataset of customer call-log files from an Iranian mobile operator's call center have randomly selected. Moreover, the effects of direct and mediating factors that cause mobile customers to churn out are identified. In this section, the method of data selection and analysis employed in this study will be discussed.



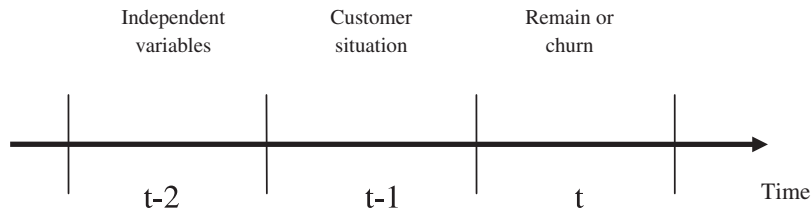


Fig. 2. Rational schedule for recording variable in 1-year period.

#### 4.1. Research data

The data necessary for a group of 3150 customers were collected randomly from an operator call-center's database over a 12-month period (from September 2006 to September 2007). To remove the unwanted effects of missing data, customers selected from the group had no churn in the first 2 months. Therefore, the churn observed relates to a 10-month period. When investigating the effect of direct and mediating factors on customer churn, and to comply with a rational observation consequence (as shown in Fig. 2), 2 months of observations of independent factors and a month of observations of customer status are recorded. The end of the observation period for each customer is the month in which the customer churns (i.e., sell or cedes SIM privilege to another person).

#### 4.2. Methods of analysis

The effect of direct factors (i.e., number of failed calls, subscription length, customer complaints, amount of charge, length of all calls, number of calls, frequency of SMS, number of distinct calls, type of service, group age) on customer churn was investigated using a binomial logistic regression model. Customer churn was entered in the model as the dependent variable, whereas the other factors (including number of failed calls, subscription length, customer complaints, amount of charge, length of all calls, number of calls, frequency of SMS, number of distinct calls, type of service, group age) were entered as independent variables.

According to Howitt and Cramer (2005) a binomial logistic regression is a form of multiple regression applied in cases where the dependent variable is dichotomous (i.e., has only two possible values). A set of predictors is identified which assesses the likelihood that a particular case falls into one of the two nominal categories. The predictor variables may be any type of variable. As in multiple regression, different ways of entering predictor variables are available. Like other forms of regression, logistic regressions generate *B*-weights (or slopes) and a constant. However, these are then used to calculate something known as logits rather than scores. The logit is the natural logarithm of the odds for a category. As in all multivariate forms of regression, the final regression calculation provides information about a set of significant predictors among those examined.

The mediating effect of customer status (active or inactive customer) on the relationship between independent variables and customer churn is also analyzed using a regression analysis. According to Judd and Kenny (1981), a series of regression models provides the best test of a mediating effect. To establish mediation, the following conditions must hold:

1. The independent variable must affect the mediator [Eq. (1)].
2. The independent variable must affect the dependent variable [Eq. (2)].
3. The mediator must affect the dependent variable [Eq. (3)].
4. If these conditions hold, then the effect of the independent variable on the dependent variable must be less in Eq. (3) than in Eq. (2).

The results of both the binomial logistic regression and the tests for the mediating effect of customer status (using a series of regression equations) are presented in the next section.

### 5. Results

As a first step in testing for the direct impact of an independent variable on customer churn, a binomial logistic regression was conducted using SPSS software. In this test, customer churn was used as the dependent variable while a set of others factors were used as independent variables. The  $\chi^2$  of the model in the general coefficient table examined the effectiveness of the independent variables on the dependent variables. A high  $\chi^2$  (1345.484 with 13 degrees of freedom) with a low *p*-value (zero) demonstrated the effectiveness of independent variables within the model. The summary output table provides three statistics for analyzing the data conformity with the model (or final fitting). Indeed a 2-log likelihood, or 2-LL statistic, tests model fitness. Smaller 2-Log statistics show better fitness. Unfortunately in the model, this statistic was 1394.396. Nagelkerke R Square and Cox & Snell R Square statistics are equivalent to the determination coefficient and



have the values of .598 and .348, respectively. A superior determination coefficient is more likely to approach 1. A determination coefficient less than 1 is not acceptable. The first result was determined to be acceptable, and the second one was good as well. In addition, data conformity was also accepted in this model (Hair, Anderson, Tatham, & Black, 1995). Finally, Table 3 includes the results of direct tests on customer satisfaction of a variety of factors. Using Table 2, main hypotheses shown in Table 4 can either be rejected or accepted.

The second step in the model analysis entailed investigating the status factor as a mediator between the dependent variables and the independent variable. In the following equations,  $X$  is the independent variable,  $Y$  the dependent variable and  $M$  the mediator:

$$M = aX \quad (1)$$

$$Y = cX \quad (2)$$

$$Y = bM + c'X \quad (3)$$

The results of these equations are interpreted as follows:

- (1) If  $a, b, c \neq 0$  and  $c' = 0$  then there is Full Mediation in the model. This means that the given independent variable has no direct effect on the dependent variable, and its effect is attributed fully to the mediator variable.
- (2) If  $a, b, c, c' \neq 0$  and  $|c| \geq |c'|$  then there is Partial Mediation in the model. This means that some of the independent variable's effect on the dependent variable is due to the mediator variable, while the rest of the effect is due to the independent variables.
- (3) If  $a = 0$  and  $b = 0$ , then there is no mediator in the model (Baron & Kenny, 1986).

By combining Eqs. (1) and (3), the results are reflected in Table 5.

The results from testing the secondary hypotheses are represented in Table 5. First, coefficients related to particular variables should be significant, and second, conditions for variable mediation (as mentioned above) should be evident. The results are represented in Table 6.

**Table 3**  
Coefficients of logistic regression equations.

|                      | <i>B</i> | S.E.    | Wald    | df | Sig. | Exp( <i>B</i> ) |
|----------------------|----------|---------|---------|----|------|-----------------|
| Call failure         | .157     | .017    | 83.719  | 1  | .000 | 1.169           |
| Complaints(1)        | −4.150   | .284    | 210.559 | 1  | .000 | .016            |
| Subscription length  | .002     | .009    | .067    | 1  | .796 | 1.002           |
| Charge amount        | −.608    | .117    | 27.035  | 1  | .000 | .544            |
| Seconds of use       | .000     | .000    | 10.835  | 1  | .001 | 1.000           |
| Frequency of use     | −.058    | .008    | 51.302  | 1  | .000 | .944            |
| Frequency of SMS     | −.016    | .003    | 26.982  | 1  | .000 | .984            |
| Distinct call number | −.012    | .009    | 1.830   | 1  | .176 | .988            |
| Age group            |          |         | 13.306  | 4  | .010 |                 |
| Age group(1)         | −15.676  | 3423.86 | .000    | 1  | .996 | .000            |
| Age group(2)         | 3.043    | .862    | 12.469  | 1  | .000 | 20.968          |
| Age group(3)         | 2.913    | .856    | 11.569  | 1  | .001 | 18.403          |
| Age group(4)         | 3.095    | .866    | 12.772  | 1  | .000 | 22.086          |
| Tariff Plan(1)       | −1.058   | .699    | 2.292   | 1  | .130 | .347            |
| Constant             | 1.626    | 1.111   | 2.143   | 1  | .143 | 5.085           |

**Table 4**  
Results of main hypotheses.

| Dependent variable | Independent variable                                                                       | Result | Hypothesis |
|--------------------|--------------------------------------------------------------------------------------------|--------|------------|
| Customer churn     | Number of failed call                                                                      | Accept | H1a        |
|                    | Subscription length (duration of the relationship between a customer and service provider) | Reject | H1b        |
|                    | Customer complaint                                                                         | Accept | H1c        |
|                    | Amount of charge                                                                           | Accept | H2a        |
|                    | Length of all calls                                                                        | Accept | H2b        |
|                    | Number of calls                                                                            | Accept | H2c        |
|                    | Frequency of SMS                                                                           | Accept | H2d        |
|                    | Number of distinct calls                                                                   | Reject | H2e        |
|                    | Type of service                                                                            | Reject | H3         |
|                    | Group age                                                                                  | Accept | H4         |

**Table 5**

Coefficient compression in three equations.

| Variable                | $M=aX$  |     | $Y=bM+c'X$ |     | $Y=cX$  |     |
|-------------------------|---------|-----|------------|-----|---------|-----|
|                         | $B=a$   | Sig | $B=c'$     | Sig | $B=c$   | Sig |
| Call failure            | .258    | 0   | .131       | 0   | .157    | 0   |
| Complaints(1)           | −3.522  | 0   | −4.016     | 0   | −4.15   | 0   |
| Subscription length     | .203    | 0   | −.02       | .04 | .002    | .8  |
| Charge amount           | −83.954 | .91 | −.463      | 0   | −.608   | 0   |
| Seconds of use          | −.002   | 0   | 0          | 0   | 0       | 0   |
| Frequency of use        | .002    | .87 | −.053      | 0   | −.058   | 0   |
| Frequency of SMS        | −.014   | 0   | −.015      | 0   | −.016   | 0   |
| Distinct called numbers | −.023   | .01 | −.01       | .29 | −.012   | .18 |
| Age group(1)            | 2.456   | 1   | −15.512    | 1   | −15.676 | 1   |
| Age group(2)            | 21.206  | .99 | 2.793      | 0   | 3.043   | 0   |
| Age group(3)            | 22.051  | .99 | 2.693      | 0   | 2.913   | 0   |
| Age group(4)            | 22.341  | .99 | 2.725      | 0   | 3.095   | 0   |
| Tariff plan(1)          | 6.146   | .62 | −.925      | .16 | −1.058  | .13 |

**Table 6**

Results of secondary hypotheses tests.

| Independent variable     | Result | Hypothesis | Sig. |
|--------------------------|--------|------------|------|
| Failed call frequency    | Accept | H1a        | x    |
| Subscription length      | Reject | H1b        |      |
| Customer complaint       | Accept | H1c        | x    |
| Amount of charge         | Accept | H2a        |      |
| Length of all calls      | Accept | H2b        |      |
| Number of calls          | Accept | H2c        |      |
| Frequency of SMS         | Accept | H2d        | x    |
| Distinct calls frequency | Reject | H2e        |      |
| Type of service          | Reject | H3         |      |
| Group age                | Accept | H4         |      |

## 6. Results analysis

### 6.1. Customer dissatisfaction

Tests of the hypotheses indicate that among the determinants of customer dissatisfaction, the numbers of service failures and customer complaints are found to have an effect on customer churn. Moreover, the actual coefficients for these factors show that customer complaints has a larger influence on churn than number of service failures. What becomes evident from these results is that submitting a complaint (even if only just once) will increase customer churn probability up to 62 percent. As established by previous studies, customer complaints have a large influence on churn. However, the absence of any significant relationship between customer churn and length of customer association contrasts with previous studies (Kim & Yoon, 2004; Seo et al., 2008). Indeed results show that customer churn probabilities do not differ between new and existing customers. The fact that both existing and new customers are equivalent with respect to churn is bad news for operator managers. This suggests that operators have not offered any advantages or loyalty awards to existing (or longstanding) customers. The results of this study are in line with previous research, essentially confirming that customer dissatisfaction affects the probability of churn. Among all of the factors discussed, customer complaint has the most significant effect on increasing a customer's churn probability.

### 6.2. Amount of service used by customer

Results of this study substantiated the effectiveness of all service-usage factors (except for number of distinct calls). This study shows that the amount of use positively influences customer retention which is entirely in line with previous studies. Thus, as low-level users are more likely to churn, there are a number of managerial actions that should be taken to avoid this outcome. Low-level users should not be disregarded but provided a variety of services so as to encourage them to increase their level of usage. Among the factors tested in this study, monthly charge had the most influence on churn reduction probability (about 2 times more than next factor). The following factors are listed in the order of their influence on churn probability: the number of short messages sent, the number of calls and finally the length of time for all calls. With respect to their effectiveness, these factors are essentially equivalent.

### 6.3. Switching costs

Seo et al. (2008) have shown the preventive effect of switching costs on customer churn. In this study, a strong relationship between variety of services offered and customer retention was confirmed. But as the results of this study also revealed, operator switching cost and variety of services offered has no effect on customer retention. By setting just two kinds of tariffs and services (with internet services (GPRS) and without) it could be inferred that the operators have not been successful in setting efficient switching costs. The reason for this may simply be the infancy of GPRS service adoption among Iranian users, and thus it cannot be considered a switching cost for most of them.

### 6.4. Customer characteristics

The results of a previous study by Seo et al. (2008) reveal how demographics such as age and gender can indirectly affect customer retention behavior. This suggests that each customer age group has its own evaluation and expectation of an operator. The only age group not found to have a significant relationship with churn is the under-15 age group. The dependency of these customers upon their families and their adherence to parental decisions likely explains this fact.

### 6.5. Mediation effect

Among the 10 hypotheses employed for investigating the mediation effect of customer status on customer churn, seven were rejected, and three were accepted. One of the accepted hypotheses confirms the mediator effect of customer status between number of SMS sent and customer churn. Two of the other accepted hypotheses related to customer satisfaction: customer status mediates between number of service failures and customer churn and it mediates between customer complaints and customer churn. This suggests that a change in customer status (from active to inactive) is indicative of customer dissatisfaction. If operator performance fails to meet customer needs and expectations, customer satisfaction and their amount of usage will decrease gradually until it reaches an inactive status. Inactive status has a direct relationship on customer churn; so preventive actions (returning customer to active status) should be done quickly to avoid them. In addition, attention to factors that lead to a change in customer status (active to inactive) is necessary. Equation coefficients described in the previous section indicate that the numbers of service failures, customer complaints, and short messages sent are effective in increasing customer churn.

## 7. Conclusion and future research

### 7.1. Contribution of study

This study investigated contemporary customer churn models, integrating those elements that were held in common, while developing and testing one based mainly on the work of Ahn et al. (2006). In applying this framework to operators in Iran, it was first necessary to review the methods, determinants and variables that would be needed. This customization was developed utilizing literature from both academic and industrial experts. One difference between this study and similar research, is the method of analysis employed. A survey of customer churn in the Iranian mobile market was performed for the first time. Other research has focused primarily on permanent SIM card users, while this research investigated the churn of credit SIM card users. Additionally, the use of data mining together with Binomial Logistic Regression, while it has been employed in a few research endeavors, represents a new method for mobile telephony service research. Another theoretical contribution of this study lies in defining new criteria for the measurement of the research determinant. In conformity with the statistical method used and in contrast with previous research, customer complaints were represented by a categorical variable (taking values of 0 and 1). In addition, “Number of short messages sent” as a proxy for “amount of service usage”, and “variety in service plans” as a proxy for “switching cost” along with customer age were introduced as new measures. Indeed the results obtained have revealed their utility.

### 7.2. Public policy considerations

As mentioned earlier, according to General Law 44's rule policy, Iran's mobile telephony industry is privatizing. Consequently, the Iranian mobile telephony market is experiencing a competitive environment. Although the government-operated mobile telephony company is being transformed into a private enterprise, existing laws and regulations do not support the privatization process. The Government's plan for privatizing the Telecommunications Industry without deregulation leads to a non-square competition environment. Deregulation that delegates more authorities of customer care strategies is necessary. Delegating authorities for pricing strategies, providing discounts, awards and other incentives leads to the development of a square private competitive environment in the Iran mobile telephony industry and encourages customers to use more services.

### 7.3. Managerial implications

Applying these research findings can be beneficial to an organization's business development. Clarifying certain aspects of customer behavior can make the estimation of future customer behavior possible and may result in the implementation of new methods to successfully reduce customer churn for mobile telephony operators. Possible approaches for the organization manager based upon the test results from the hypotheses are proposed below.

#### 7.3.1. Approaches to avoiding customer churn due to dissatisfaction

- Establish new ways to generate customer satisfaction.
- Conduct direct and indirect polling to determine customer expectations and perceptions about operator services.
- Segment reasons for customer dissatisfaction to improve analysis.
- Further develop the network technically and improve the diagnosis of problems.
- Try to improve network coverage.
- Consider programs for rewarding long-term customers as lucrative assets of the organization.

#### 7.3.2. Approaches to increasing retention opportunity through customer usage

- Provide a variety of services that reinforce the customer's tendency to use more.
- Encourage customers to use more services by providing discounts, awards and other incentives.
- Cluster customers based on their usage level and set discounts and services proportional to each cluster.

#### 7.3.3. Approaches to avoiding customer churn through the use of switching cost

- Create a variety of switching cost by providing innovative and pioneer services.
- Establish a ranking system for loyal customers.
- Encourage grouping of customers recommending the operator to others and attracting new customers.
- Provide discounts and extra services to like customers acting as a group. Allow a family or an organization to choose the operator to be their provider of choice. As an example, most of the significant operators in the world do not charge for intra-group calls.

#### 7.3.4. Approaches for increasing tendency for retention by age group characteristics

- Consider age group in customer relationship management.
- Recognize needs and preferences as different age group motivators to keep relationship active.

#### 7.3.5. Approaches for using customer status as an alarm to churn potential

- Monitor the change in customer status as an alarm to churn potential.
- Provide special offers and services to customer with inactive status.
- Identify factors that make the customer status inactive and try to avoid them.
- Define multiple and more accurate customer status levels indicative of negative effects of particular actions. This makes preventive actions more responsive and more goal-oriented.

### 7.4. Limitation and future research

Absence of impact factors compression especially between multiple operators is the main limitation of this study, for example service costs recount as an important factor of customer churn. Due to impossibilities of compression service costs between multiple operators in Iran it leaves to future research. Operator's reluctance to contribute, accounts for this limitation in study. Overcoming these limitations can be done in future research. Having multiple service providers could be very useful for understanding customer retention behavior more thoroughly. Also, customer probable churn time could be considered in future research. Using time series methods can be useful in extracting churn prediction function and calculating customer churn probability in certain time interval.

### References

- Ahn, J.-H., Han, S.-P., & Lee, Y.-S. (2006). Customer churn analysis: Churn determinants and mediation effects of partial defection in the Korean mobile telecommunications service industry. *Telecommunications Policy*, 30, 552–568.

- Baron, R., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic and statistical considerations. *Journal of Personality and Social Psychology*, 51(6), 1173–1182.
- Barrett, J. (2003). *US mobile market intelligence*. Dallas, TX: Parks Associates.
- Beerli, A., Martin, J. D., & Quintana, A. (2004). A model of customer loyalty in the retail banking market. *European Journal of Marketing*, 38(1–2), 253–275.
- Brown, K. (2004). Holding onto customers. *Wireless Week*, 15, 6.
- Choi, S.-K., Lee, M. H., & Chung, G.-H. (2001). Competition in Korean mobile telecommunications market: Business strategy and regulatory environment. *Telecommunications Policy*, 25, 125–138.
- Chu, B.-H., Tsai, M. S., & Ho, C. S. (2007). Toward a hybrid data mining model for customer retention. *Knowledge-Based Systems*, 20(8), 703–718, doi:10.1016/j.knosys.2006.10.003.
- Coussement, K., Benoit, D. F., & Van den Poel, E. (2010). Improved marketing decision making in a customer churn prediction context using generalized additive models. *Expert Systems with Application*, 37(3), 2132–2143, doi:10.1016/j.eswa.2009.07.029.
- Fullerton, H. (1998). Duopoly and competition: The case of the American cellular telephone. *Telecommunications Policy*, 22, 593–607.
- Gerpott, T. J., Rams, W., & Schindler, A. (2001). Customer retention, loyalty, and satisfaction in the German mobile cellular telecommunications market. *Telecommunications Policy*, 25, 249–269.
- Gladly, N., Baesens, B., & Croux, C. (2009). Modeling churn using customer lifetime value. *European Journal of Operational Research*, 197(1), 402–411.
- Hair, J. F., Jr., Anderson, R. E., Tatham, R. L., & Black, W. C. (1995). *Multivariate data analysis (4th ed.): With readings*. Upper Saddle River, NJ: Prentice-Hall, Inc.
- Howitt, D., & Cramer, D. (2005). *An introduction to statistics in psychology* (3rd ed.). Harlow: Pearson.
- Judd, C. M., & Kenny, D. A. (1981). Process analysis: Estimating mediation in treatment evaluations. *Evaluation Review*, 5(5), 602–619.
- Kim, H. S., & Kwon, N. (2003). The advantage of network size in acquiring new subscribers: A conditional logit analysis of the Korean mobile telephony market. *Information Economics and Policy*, 15(1), 17–33.
- Kim, H. S., & Yoon, C. H. (2004). Determinants of subscriber churn and customer loyalty in the Korean mobile telephony market. *Telecommunications Policy*, 28, 751–765.
- Kim, M. K., Park, M. C., & Jeong, D.-H. (2004). The effects of customer satisfaction and switching barrier on customer loyalty in Korean mobile telecommunication services. *Telecommunications Policy*, 28, 145–159.
- Larivière, B., & Van den Poel, E. (2005). Predicting customer retention and profitability by using random forests and regression forests techniques. *Expert Systems with Application*, 29(2), 472–484, doi:10.1016/j.eswa.2005.04.043.
- Lu, J. (2002). Predicting customer churn in the telecommunications industry—An application of survival analysis modeling using SAS®. In *Proceedings of the twenty-seventh annual SAS® users group international conference*, Orlando, FL. Retrieved from <http://www2.sas.com/proceedings/sugi27/p114-27.pdf>.
- Santhanam, R., & Hartono, E. (2003). Issues in linking information technology capability to firm performance. *MIS Quarterly*, 27(1), 125–153.
- Seo, D., Ranganathan, C., & Babad, Y. (2008). Two-level model of customer retention in the US mobile telecommunications service market. *Telecommunications Policy*, 32(3–4), 182–196.
- Song, J. D., & Kim, J.-C. (2001). Is five too many? Simulation analysis of profitability and cost structure in the Korean mobile telephone industry. *Telecommunications Policy*, 25(1–2), 101–123.
- Tsai, C. F., & Chen, M.-Y. (2010). Variable selection by association rules for customer churn prediction of multimedia on demand. *Expert Systems Application*, 37(3), 2006–2015, doi:10.1016/j.eswa.2009.06.076.
- Tsai, C. F., & Lu, Y.-H. (2009). Customer churn prediction by hybrid neural networks. *Expert Systems Application*, 36(10), 12547–12553, doi:10.1016/j.eswa.2009.05.032.
- Valletti, T. M., & Cave, M. (1998). Competition in UK mobile communications. *Telecommunications Policy*, 22, 109–131.
- Xia, G. E., & Jin, W. D. (2008). Model of customer churn prediction on support vector machine. *Systems Engineering—Theory & Practice*, 28(1), 71–77.
- Xie, Y., Li, X., Ngai, E. W. T., & Ying, W. (2009). Customer churn prediction using improved balanced random forests. *Expert Systems Application*, 36(3), 5445–5449, doi:10.1016/j.eswa.2008.06.121.