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Full Length Article

# Modelling and evaluating customer loyalty using neural networks: Evidence from startup insurance companies

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## Abstract

The purpose of this study is to investigate the customer–service provider relationship in the insurance industry using artificial neural networks and linear regression. Using a sample of 389 customers from 10 different startup insurance companies, it was found that artificial neural networks are an efficient way to evaluate the factors affecting customer loyalty. The results indicated that customer satisfaction and perceived value are significant predictors of customer loyalty. Additionally, it was found that trust, perceived quality, and empathy have a significant impact on both customer satisfaction and perceived value. The results also showed that customer commitment to service provider is positively associated with customer satisfaction and loyalty. After comparing the performance of linear regression models with artificial neural networks, it was found that the use of neural networks is a better approach for analyzing the customer loyalty, satisfaction, and perceived value. The use of new techniques such as artificial neural networks for analyzing the customer behavior can be particularly beneficial for startup companies who aspire to gain competitive advantage over their strong and well-established rivals.

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**Keywords:** Startups; Customer loyalty; Relationship marketing; Artificial neural networks; Insurance companies

## 1. Introduction

In the past decade, startups have been in the spotlight in all countries; particularly in developing economies where they are considered as an important economic growth factor and a source of sustainable employment. Some experts believe that startups and emerging market economies can recover from the worldwide economic crises more rapidly compared to large companies and advanced market economies (Kose, Otrok, & Prasad, 2012). Therefore, startups can be considered as new engines of worldwide economic growth (Wälti, 2009). Previous studies showed that between one-fourth to approximately one-third of the variation in economic growth and development in many industrialized countries is due to the creation of new independent businesses (Carter, Gartner, Shaver, & Gatewood, 2003; Davidsson, Lindmark, & Olofsson, 1994; Reynolds, 1994; Reynolds & Maki, 1990; Reynolds, Hay, Bygrave, Camp, & Autio, 2000). According to U.S. Small Business Administration (SBA) (2014) about 50% of all new businesses survive five years or more and roughly one-third of them

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survive ten years or more. In addition to this, the level of competition among firms has moved from the local markets to the global markets (Nyaoga, Wang, & Magutu, 2015). In other words the business environment is experiencing excessive competition as customers have become more aware of the competing products and services and regularly search for new options. Therefore, it is easy to claim that no organization except monopolists can survive in this competitive business environment without having loyal customers (Afsar, 2010; Riasi, 2015). Therefore, customer loyalty is considered as the key to business success. Experts believe that customer loyalty is rapidly becoming the marketplace currency of the twenty-first century which indicates that the value of the firms can be determined by the degree of their customers' loyalty (Singh & Sirdeshmukh, 2000). Studies showed that increasing customer loyalty can affect the profitability of the firms and can lead to reduced marketing and customer acquisition costs (Gee, Coates, & Nicholson, 2008). The study of Reichheld (1992) indicated that depending on the particular industry, after a 5% reduction in customer migration it might be possible to increase the profitability by up to 60%. Therefore, it is easy to see that the retention of loyal customers can positively affect the long-term prosperity of the companies (Kuusik, 2007). For startups in financial services industry, customer loyalty is a more complicated issue and it is becoming significantly important. Insurance companies are an example of financial services firms which compete in a complicated and competitive business environment and should use their limited resources in order to increase their customers' loyalty. The high costs of new customer acquisition have made the initial stages of customer-provider relationship less profitable for the firms. Therefore, the relationship between firms and their new customers is only profitable in later stages after the customers become loyal and the firms become more cost efficient (Riasi & Pourmiri, 2015; Wang, Lo, & Hui, 2003).

According to Menelec and Jones (2015), small professional service businesses lack the business/marketing language which is necessary to articulate their approaches and values to their customers. Historically, the firms competing in Iranian insurance industry have not been very successful in constructing long-term relationships with their customers. As small private insurance companies (i.e., non-government owned and non-government sponsored insurance companies) entered this industry, competitiveness among firms significantly increased. As private insurance companies emerged in Iran, the customers' expectations from their service providers increased. Therefore in order to be successful in customer acquisition and customer retention, the Iranian insurance firms have to identify the factors affecting customer loyalty (Bahramzadeh & Shokati Moghareb, 2009) and should adjust their marketing strategies according to these factors. One purpose of this study is to identify the factors that affect the customer-service provider relationship in the insurance industry.

Traditional statistical analysis techniques for assessing the service quality, customer loyalty, and profitability include multiple regression with interactions, principal component regression (PCR), structural equation modeling (SEM), and partial least squares (PLS) (Lee, Rey, Mentele, & Garver, 2005). Recent developments in artificial intelligence and the use of innovative techniques for modelling the decision making process have led to the introduction of artificial neural networks. Artificial neural networks are a group of models used in machine learning which are inspired by biological neural networks and can be used to estimate or approximate various functions including those that depend on a large number of inputs and/or are generally unknown (Mirghafoori, Taheri, & Zareh Ahmadabadi, 2010). The significance of using artificial neural networks is underlined by the fact that about eighty percent of the Fortune 500 companies have heavily invested in neural networks in order to improve the quality of their data analyses (Johnston, 1991). The goal of this study is to use artificial neural networks to model the customer loyalty in startup insurance companies and it intends to answer the following questions: How artificial neural networks can model the process used by startup insurance companies to make their customers loyal? In what dimensions, can artificial neural networks be beneficial for the process of making customers loyal? What are the dimensions of the mechanism used by private insurance firms in order to make customers loyal? How different factors affect customer loyalty in the insurance industry?

## 2. Conceptual framework

### 2.1. Nascent organizations

Organizations and firms became important parts of the global economy after the industrial revolution. Nascent organizations or startups are a relatively new concept in the business environment. Startups are young firms which have been created in order to pursue a technological innovation or to target market demand for a specific product or service which have not been offered before or have not been adequately supplied by well-established companies in the industry. Startups attempt to use these opportunities to enter the market and sell their products or services.

Following the definition used in the Panel Study of Entrepreneurial Dynamics (PSED) (Reynolds, 2000; Shaver, Carter, Gartner, & Reynolds, 2001; Gartner & Carter, 2003; Gartner, Shaver, Carter, & Reynolds, 2004; Reynolds, Carter, Gartner, & Greene, 2004) and in the Global Entrepreneurship Monitor (GEM) (Reynolds, Hay, & Camp, 1999, 2000; Reynolds, Camp, Bygrave, Autio, & Hay, 2001; Acs, Arenius, Hay, & Minniti, 2005), Wagner (2007) defined a nascent entrepreneur as: “a person who is now trying to start a new business, who expects to be the owner or part owner of the new firm, who has been active in trying to start the new firm in the past 12 months and whose start-up did not yet have a positive monthly cash flow that covers expenses and the owner-manager salaries for more than three month”. According to Reynolds and White (1997) and Reynolds (2000), four steps are required in order to start a new business, namely, conception, gestation, infancy, and adolescence. They believe that there are also three transition periods in this process (Reynolds & White, 1997; Reynolds, 2000). The first transition period is started as soon as one or more entrepreneurs start to commit their time and resources to founding a new company. According to Wagner (2007) these individuals are called nascent entrepreneurs only if they do so on their own and if their new business could be considered as an independent startup. Also if this new venture occurs within the context of an organization that already exists, then they can be called organizational nascent entrepreneurs. After the gestation process is complete and the firm starts either as an operating business, or after the nascent entrepreneurs exit the firm and a stillborn happens is when the second transition period occurs. Finally, the last transition period is when the venture moves from infancy to adolescence (Wagner, 2007).

## 2.2. *The concept of relationship marketing*

The term relationship marketing was first introduced by Berry (1983) and it was later used in a business-to-business context by Jackson (1985). This concept has been further developed through the works of various researchers including but not limited to Coviello and Brodie (1998), Grönroos (1989, 2004), Riasi and Shapiro (2016), Sheth and Parvatiyar (1995), and Mattsson (1997). According to Rashid (2003), relationship marketing is about identifying, establishing, maintaining, enhancing, and when necessary, terminating relationships with customers in order to satisfy the objectives of both the firm and its customers. Therefore, organizations should establish communication and interaction processes that facilitate their relationship with customers (Rashid, 2003). The concept of relationship marketing and relationship management have been previously studied in a variety of small entrepreneurial businesses (e.g., Chaudhry, 2007) and well-established firms (e.g., Gebert, Geib, Kolbe, & Brenner, 2003; MacKenzie & Hardy, 1996). The current study will focus on customer loyalty in startup insurance companies. Since relationship marketing is fundamentally linked to customer loyalty, this study will add to the current literature regarding relationship marketing in small entrepreneurial businesses.

## 2.3. *Customer loyalty and its dimensions*

Studies on customer loyalty initially focused on product orientation and brand loyalty, while loyalty to service providers was not widely discussed (Gremler & Brown, 1996). Various researchers discussed the links between customer satisfaction, customer loyalty, and firm's profitability (e.g., Anderson & Fornell, 1994; Heskett, Sasser, & Hart, 1990; Heskett & Schlesinger, 1994; Reicheld & Sasser, 1990; Storbacka, Strandvik, & Grönroos, 1994; Zeithaml, Parasuraman, & Berry, 1990); they proposed that customer satisfaction has an impact on customer loyalty, which in turn influences the firm's profitability (Hallowell, 1996; Jacoby & Chestnut, 1978)

Many researchers studied loyalty using a composite approach (e.g., Backman & Crompton, 1991; Dick & Basu, 1994; Li & Petrick, 2008; Morais, Dorsch, & Backman, 2004). Dick and Basu (1994) conceptualized customer loyalty as the relationship between relative attitude (also called the attitudinal dimension of loyalty) and repeat patronage (also called the behavioral dimension of loyalty). Day (1969) believed that loyalty is a two-dimensional concept and viewed brand loyalty as consistent purchase behavior which is a consequence of positive attitudes toward the brand. This conceptualization of loyalty suggested that attitudinal loyalty and behavioral loyalty should be considered simultaneously (Day, 1969; Li & Petrick, 2008). The study of Day (1969) had an important influence on the direction of loyalty research (Jacoby & Chestnut, 1978; Knox & Walker, 2001). There are various studies in which either the attitudinal dimension or behavioral dimension of loyalty have been investigated separately, but the fact is that in order to perform a comprehensive investigation of loyalty, both dimensions should be considered.

Therefore, in the current study, both aspects of customer loyalty (i.e. attitudinal and behavioral dimensions) are investigated by combining these two dimensions into a single construct.

In the past and even now, customer loyalty have been considered as the frequency or quantity of purchase from a specific brand. The current literature regarding customer loyalty has the problem of merely focusing on customers and not taking the psychological meaning of loyalty into account. Customer loyalty can be considered as a deliberate behavioral response formed over time by a decision maker (i.e., an individual, family, organization, etc.) in favor of a particular brand. Loyalty encompasses psychological processes in which the decision maker analyzes different product/service options based on disparate criteria before making the decision to purchase (Beerli, Martin, & Quintana, 2004). The most complete definition of loyalty is provided by Oliver (1999) who defines customer loyalty as: “deeply held commitment to rebuy or re-patronize a preferred product/service consistently in the future, thereby causing repetitive same-brand or same-brand set purchasing, despite situational influences and marketing efforts having the potential to cause switching behaviors”. In next section, factors affecting customer loyalty will be discussed. These factors can be considered as the input of the model which will be later created using artificial neural networks.

#### 2.4. *Factors affecting customer loyalty*

Bahramzadeh and Shokati Moghareb (2009) studied the customers of banking services and found that satisfaction, trust, commitment, and perceived value are the most important factors that affect customer loyalty. In the current study, eight major factors affecting customer loyalty, namely, satisfaction, switching barriers, trust, commitment, perceived value, perceived quality, intuitive image and empathy are studied. According to Oliver (1999), customer satisfaction is one of the initial steps toward customer loyalty. Satisfaction is the customers’ perception of the degree to which their needs have been fulfilled. According to Kim, Park, and Jeong (2004) customers experiencing a high degree of satisfaction with products/services are very likely to remain with their current providers. Switching barriers or switching costs refer to the difficulties associated with switching to a new provider (Fornell, 1992; Kim, Kaplowitz, & Johnston, 2004). These difficulties are encountered by a customer who is dissatisfied with the current service/product, or they are related to the financial, social and psychological burdens experienced by a customer who is trying to change his/her provider (Fornell, 1992). Morgan and Hunt (1994) believe that trust is created when both parties have confidence in the honesty and commitment of each other. They describe commitment as an enduring desire to continue a relationship. A customer's psychological commitment to a product/service is best defined by his/her tendency to resist change (Pritchard, Havitz, & Howard, 1999). After purchasing a product/service customers tend to compare the benefits they received with the costs associated with their purchase. Customers’ perceived value is the perceived difference between the benefits received and the costs paid for receiving a service or purchasing a product. It is important to note that the value perceived by customers might be affected by external factors which are irrelevant to the service/product. Perceived quality is a customer's evaluation or judgment of the way the service is delivered by service providers (Gallan, Jarvis, Brown, & Bitner, 2013) or the way the product is offered by the producers and it is formed in the customer's mind during the service/product experience. Intuitive image refers to the customers’ intuitions about the firm and this type of visual identity is assumed to be an important aspect of corporate communications and customer–provider relationships (Bromley, 2001). Empathy is the power to share emotions and to understand the emotional state of the other party involved in the relationship. In other words, empathy is the perception of other party's needs and goals and it is an essential element that can make a customer–provider relationship stronger.

#### 2.5. *Artificial neural networks*

A neural network is a multilayer perceptron with simple connections between different components. In each layer, one or more processing unit(s) called artificial neurons or nodes are present which perform a simplified version of what human brain's neurons do. Gardner and Dorling (1998) define multilayer perceptron as: “a system of simple interconnected neurons, or nodes, which is a model representing a nonlinear mapping between an input vector and an output vector”. The role of neurons in human brain is to process and analyze the data and this task is simulated by using a mathematical processor in artificial neural networks. The behavior of the neural network depends on the relationships and connections among individual components of the network (Mirghafoori et al., 2010). There are three main neural layers in each neural network: The first layer which is called the input layer is where the data enters the network and is then transferred to the processors. The second layer is called hidden layer. This layer functions by receiving the inputs from the input layer and by considering

the weights of the relationships among different input units and hidden units. These weights determine when the hidden layer should be activated. The last layer is called the output layer. The functionality of this layer depends upon the activities of hidden layer and the weights between hidden units and output units. Multilayer perceptron uses backpropagation to classify instances, which is one of the most widely used neural network techniques in data analysis (Chauvin & Rumelhart, 1995; Rumelhart, Hinton, & Williams, 1986).

## 2.6. Conceptual model

The conceptual model of this study has three layers in order to replicate an artificial neural network. In the conceptual model, the input layer contains six of the eight factors affecting customer loyalty, namely, switching barriers, trust, commitment, perceived quality, intuitive image and empathy. The hidden layer contains the other two factors that affect customer loyalty, namely, satisfaction and perceived value. Finally, the output of the model is customer loyalty. The conceptual model of this study assumes that perceived quality is an antecedent to satisfaction and perceived value. This assumption is based on previous studies which found these relationships (e.g., Anderson & Sullivan, 1993; Churchill & Surprenant, 1982; Cronin & Taylor, 1992; De Ruyter, Bloemer, & Peeters, 1997; Fornell, 1992; Gallan et al., 2013; Oliver & DeSarbo, 1988; Ravald & Grönroos, 1996; Riasi & Shapiro, 2016; Tam, 2004). For instance Tam (2004) found that increasing customer perception of service quality can result in higher levels of customer satisfaction and perceived value. Additionally, Riasi and Shapiro (2016) in a study of customer–service provider relationship in financial services industry found that perceived service quality is a direct antecedent to customer satisfaction. Consistent with this literature, the conceptual model of this study is designed such that service quality precedes satisfaction. Yang and Peterson (2004) used a web-based survey of online service users, and found that companies striving for customer loyalty should focus primarily on customer satisfaction and perceived value. Based on the findings of Fornell (1992), Fornell and Wernerfelt (1987), Gallarza and Saura (2006), Kumar, Dalla Pozza, and Ganesh (2013), Parasuraman, Berry, and Zeithaml (1991), Reichheld and Sasser (1990), Reynolds and Beatty (1999), and Yang and Peterson (2004), perceived value and satisfaction were chosen as antecedents to customer loyalty in the conceptual model of this study.

Hojat et al. (2010) and Kim et al. (2004) found that higher degrees of empathy result in higher degrees of customer satisfaction and perceived value; therefore empathy is an antecedent to customer satisfaction and perceived value in the proposed conceptual model of this study. Bloemer and De Ruyter (1998), found that intuitive image directly affects satisfaction and perceived value. They also found that intuitive image indirectly affects loyalty through satisfaction and perceived value. Cameran, Moizer, and Pettinicchio (2010) also found a similar relationship using data from audit firms and suggested that intuitive image is an antecedent to customer satisfaction and perceived value. Balabanis, Reynolds, and Simintiras (2006) studied the relationship between perceived switching barriers and satisfaction and suggested that switching barriers are antecedents to customer satisfaction and perceived value. They also found that the impact of switching barriers on customer loyalty varies at different levels of customer satisfaction and perceived value. McLean and Andrew (1999) found that commitment is an antecedent to satisfaction and perceived value. Johnson, Sivadas, and Garbarino (2008) and Selnes (1998) also found that commitment has a positive influence on customer satisfaction and as a result it can be considered as one of its antecedents. Johnson and Grayson (2005) found that trust is an antecedent to sales effectiveness and they operationalized sales effectiveness as a formative construct comprising perceived value. Chiou and Droge (2006) also found that trust is an antecedent to customer satisfaction. They also found that trust affects customer loyalty through satisfaction. Fig. 1 depicts the conceptual model.

## 3. Methodology and results

### 3.1. Sample and measure validation

Based on its objective, this study can be classified as a quantitative survey research. In order to collect the data, surveys were distributed among customers of Iranian insurance industry. The sample included the customers of 10 startup insurance firms operating in Iran. In order to be qualified as a startup insurance firm the companies were required to be less than 5 years old. The choice of this sample was appropriate because customers of financial services industry and particularly customers of insurance companies vary in their complexity and other

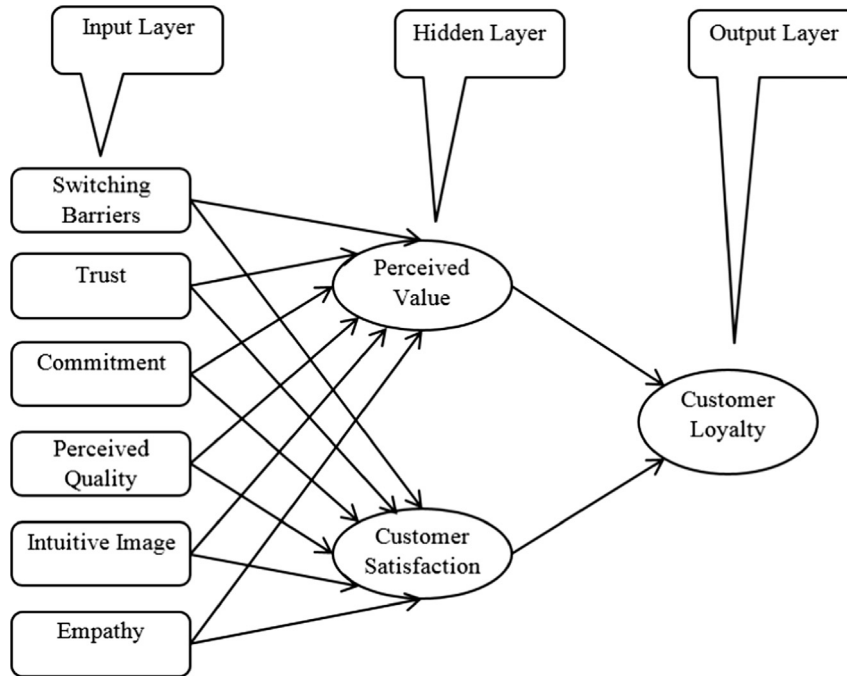


Fig. 1. Conceptual model.

characteristics, allowing for the breadth of the relationships to be accounted for (Riasi & Shapiro, 2016). Since in random sampling, each member of the population has equal opportunity of being selected, the current study used this method in order to select the survey respondents. Additionally, due to the representativeness of a sample which is obtained by using random sampling, using this sampling technique was beneficial for generalization of the findings in a reasonable way. Initially, a preliminary study was performed using a sample of 30 customers. Based on the variance of the initial sample (variance=0.52), and using the 95% confidence level (error=0.05), the sample size for the main study was calculated to be 416 using Eq. (1).

$$n = \frac{z_{\alpha/2}^2 * \sigma^2}{E^2} \quad (1)$$

The surveys were distributed among the sample and a total of 389 completed surveys were collected. Demographic characteristics of the survey respondents are summarized in Fig. 2.

In order to design the survey items for each construct in the conceptual model, theoretical and conceptual definitions of the constructs were examined. The survey items for measuring perceived quality and customer satisfaction were designed by extracting relevant survey items from the studies of Gallan et al. (2013), Han and Hyun (2015), Oliver and DeSarbo (1988), Riasi and Shapiro (2016), and Tam (2004). The items for measuring commitment, trust, and switching barriers were designed by examining the constructs used in previous studies by Balabanis et al. (2006), Chiou and Droge (2006), Han and Hyun (2015), Johnson et al. (2008), Johnson and Grayson (2005), Ranaweera and Prabhu (2003), and Selnes (1998). In order to measure empathy and intuitive image, survey items were obtained from previous studies that measured these two constructs, including but not limited to the studies of Cameran et al. (2010), Hojat et al. (2010), and Kim et al. (2004). Finally, customer loyalty and perceived value were measured after the studies by Chiou and Droge (2006), Floh, Zauner, Koller, and Rusch (2014), Gallarza and Saura (2006), Kumar et al. (2013), and Yang and Peterson (2004) were examined and related survey items were extracted. The respondents were asked to rate the items in the survey on a seven-point Likert scale ranging from “completely disagree” (1) to “completely agree” (7), unless otherwise indicated. The content validity of the surveys were approved by a group of marketing professors and financial services experts. In order to test the reliability and internal consistency of the measures, Cronbach's alpha was calculated for each construct using IBM SPSS. The Cronbach's alphas for all scales were above 0.82 which exceeds the recommended 0.70 cutoff value (Nunnally &

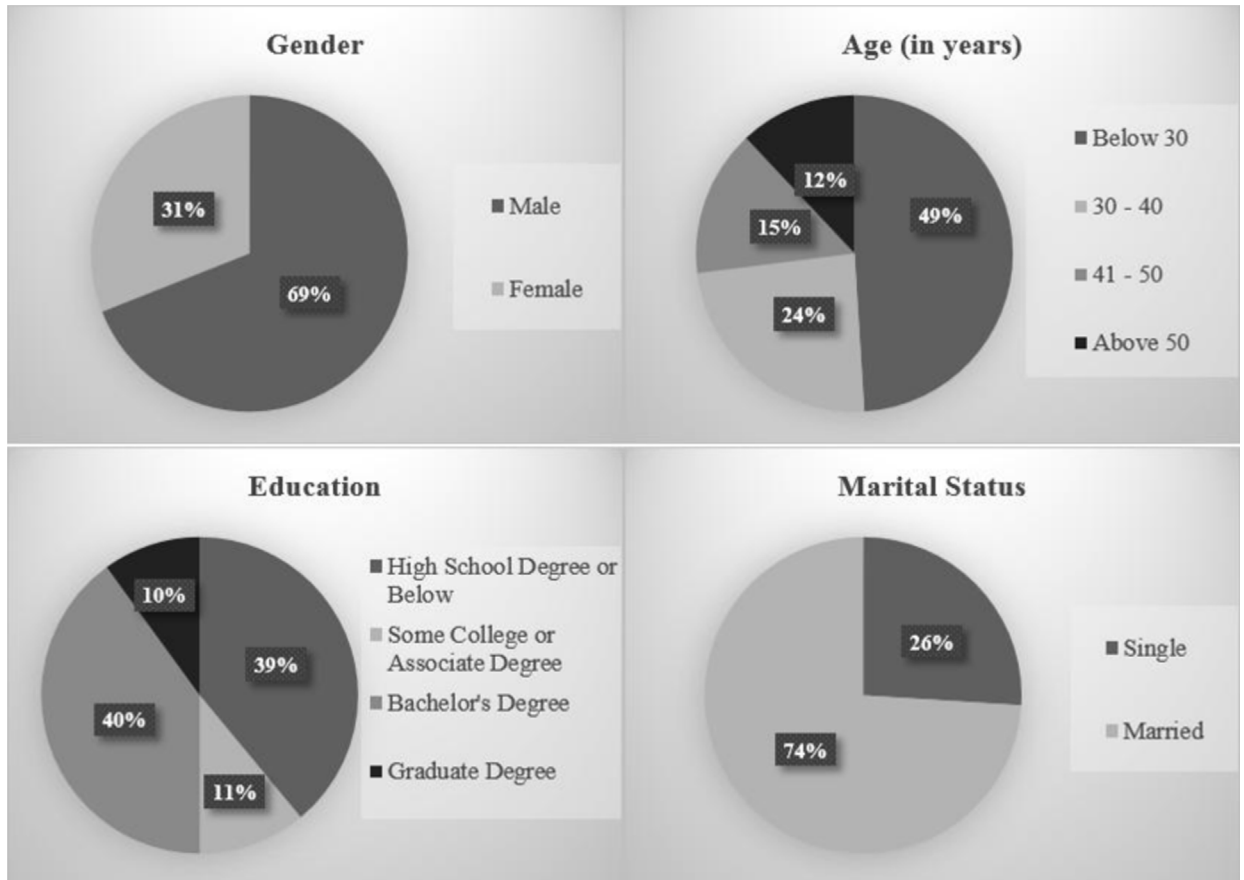


Fig. 2. Demographic characteristics of the survey respondents.

Bernstein, 1994); indicating very high reliability and internal consistency of the scales. Additionally, confirmatory factor analyses were performed in order to make sure that the survey items designed to measure each construct do in fact load together. The confirmatory factor analyses revealed that all the scales which were designed for measuring customer satisfaction, switching barriers, trust, commitment, perceived value, perceived quality, intuitive image, empathy, and loyalty were acceptable.

### 3.2. Data analysis using linear regression

In order to perform the data analysis, linear regression and artificial neural networks were used. To study the significance of the model, analysis of variance (ANOVA) was used. The ANOVA results are displayed in Table 1. According to Table 1, the  $p$ -value is smaller than 0.05, thus it can be concluded that the  $F$  value is significant indicating that the linear model is also significant.

Three different regression models were tested in this study (see Fig. 3). The dependent variable for the first model was perceived value, the dependent variable for the second model was customer satisfaction, and finally for the last model the dependent variable was customer loyalty. It was found that Durbin–Watson statistics for all 3 models were close to 2 indicating that the models were significant. As it can be seen in Table 2, the values of  $R$ -squared and adjusted  $R$ -squared were very close to each other in all 3 models, which again confirms the significance of the models.

Regression analysis using perceived value as the dependent variable (model 1) revealed that trust, perceived quality, and empathy have a significant impact on perceived value. Using stepwise regression it was found that the

Table 1  
ANOVA results.

Model	Sum of squares	Degrees of freedom	Mean square	F value	p-Value
Regression	1110.961	3	370.204	276.118	< 0.001
Total	1551.72	332			

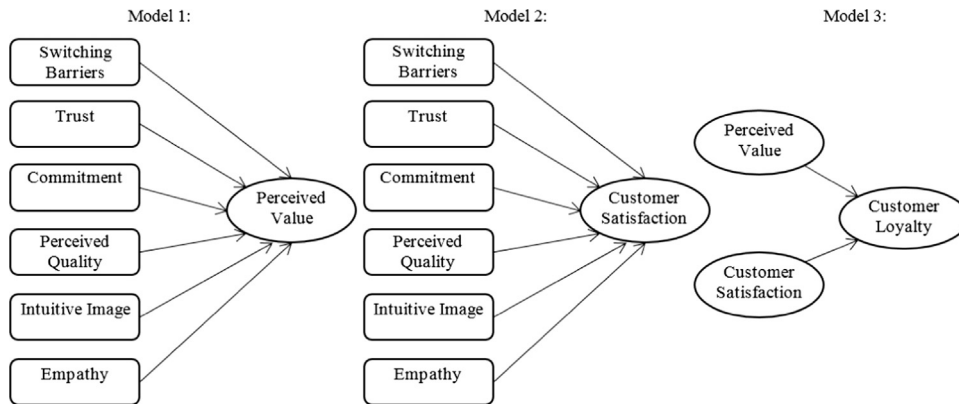


Fig. 3. Models used for regression analysis.

linear regression equation for predicting the degree of customer perceived value is

$$Y = 0.5X_1 + 0.446X_2 + 0.345X_3 \quad (2)$$

where  $X_1$  represents customer trust,  $X_2$  represents perceived quality, and  $X_3$  represents empathy. It is clear that among these three independent variables, customer trust ( $B=0.5$ ,  $p < 0.001$ ) had the largest impact on customer perceived value. Additionally the intercept of this model was not significant and therefore it was not included in the regression equation. The coefficients and  $p$ -values for all three predictor variables are displayed in Table 3.

Regression analysis using satisfaction as the dependent variable (model 2) indicated that trust, perceived quality, empathy, and commitment have a significant impact on customer satisfaction. Using stepwise regression it was found that the linear regression equation for predicting the degree of customer satisfaction is

$$Y = 0.631 + 0.425X_1 + 0.282X_2 + 0.349X_3 + 0.119X_4 \quad (3)$$

where  $X_1$  represents customer trust,  $X_2$  represents perceived quality,  $X_3$  represents empathy, and  $X_4$  represents commitment. It is obvious that trust ( $B=0.425$ ,  $p < 0.001$ ) had the largest impact on satisfaction. The coefficients and  $p$ -values for all predictor variables are displayed in Table 4.

Finally, regression analysis using loyalty as the dependent variable (model 3) showed that customer satisfaction and perceived value have a significant impact on customer loyalty. Using stepwise regression it was found that the linear regression equation for predicting the degree of customer loyalty is

$$Y = 1.253 + 0.697X_1 + 0.324X_2 \quad (4)$$

where  $X_1$  represents customer satisfaction, and  $X_2$  represents perceived value. Results showed that customer satisfaction ( $B=0.697$ ,  $p < 0.001$ ) had a stronger impact on customer loyalty compared to perceived value ( $B=0.324$ ,  $p < 0.001$ ). The coefficients and  $p$ -values for both predictor variables are displayed in Table 5.

In order to calculate and compare the estimation errors of each model, mean squared error (MSE) and root mean squared error (RMSE) were calculated. It was found that model 1 (i.e., perceived value as dependent variable) had the lowest MSE and RMSE while model 3 (i.e., customer loyalty as dependent variable) had the highest error rates. As MSE decreases the value of  $R$ -squared increases, indicating a better performance. The MSE and RMSE of all 3 regression models are displayed in Table 6.



Table 2  
Model summary.

Model	R	R <sup>2</sup>	Adjusted R <sup>2</sup>
1	0.753	0.566	0.565
2	0.834	0.696	0.694
3	0.845	0.716	0.713

Table 3  
Coefficients for the first model.

Variables	Unstandardized coefficients		Standardized coefficients	t-Statistic	p-Value
	B	Std. error			
Intercept	0.070	0.353		0.314	0.754
Trust	0.500	0.049	0.415	10.240	< 0.001
Perceived Quality	0.446	0.025	0.325	7.660	< 0.001
Empathy	0.345	0.031	0.228	4.781	< 0.001

Table 4  
Coefficients for the second model.

Variables	Unstandardized coefficients		Standardized coefficients	t-Statistic	p-value
	B	Std. error			
Intercept	0.631	0.225		2.087	0.038
Trust	0.425	0.040	0.390	7.022	< 0.001
Perceived quality	0.282	0.420	0.177	3.980	< 0.001
Empathy	0.349	0.320	0.311	4.745	< 0.001
Commitment	0.119	0.340	0.259	3.172	0.002

### 3.3. Data analysis using artificial neural networks

As mentioned earlier, multilayer perceptron was used in order to model the data using artificial neural networks. Artificial neural networks were created by using MATLAB. In order to find the best neural networks, disparate possible networks were tested and it was concluded that neural networks with a single input layer, a single hidden layer, and a single output layer were the best option for this study. Previous studies have found that using neural networks with a single input layer, a single hidden layer, and a single output layer is advantageous. [Sheela and Deepa \(2013\)](#), believe that as the number of neurons or the number of layers of a neural network increase, the training error also increases due to the overfitting. According to [Goyal, Deolia, and Sharma \(2015\)](#) and [Hinton et al. \(2012\)](#), training neural networks with many layers is computationally intensive. Therefore it is clear that using a single input layer, a single hidden layer, and a single output layer in the neural network will help to decrease the probability of overfitting and will require relatively lower computational time. One of the most salient considerations in the construction of artificial neural networks is choosing activation functions for hidden and output layers that are differentiable. The results showed that in this study, a hyperbolic tangent activation function should be used for the single hidden layer of the model and linear activation function should be used for the output layer.

Based on the conceptual model presented in [Fig. 1](#), six factors including: trust, perceived quality, empathy, switching barriers, commitment, and intuitive image might affect customer satisfaction and perceived value. In this study three different neural networks are presented. The first neural network, captures the effect of the 6 input variables on perceived value, the second neural network investigates the effect of these 6 input variables on customer satisfaction, and finally the last neural network studies the effect of perceived value and customer satisfaction on

Table 5  
Coefficients for the third model.

Variables	Unstandardized coefficients		Standardized coefficients Beta	t-Statistic	p-value
	B	Std. error			
Intercept	1.253	0.438		4.318	< 0.001
Satisfaction	0.697	0.067	0.593	10.310	< 0.001
Perceived value	0.324	0.075	0.224	3.898	< 0.001

Table 6  
Error rates for regression models.

	Model 1	Model 2	Model 3
MSE	1.412	1.426	1.725
RMSE	1.188	1.194	1.313

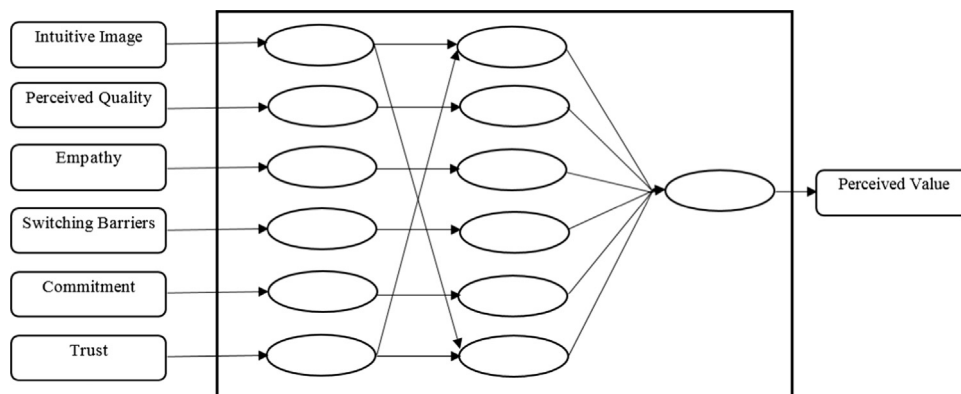


Fig. 4. Neural network 1.

customer loyalty. After using trust, perceived quality, empathy, switching barriers, commitment, and intuitive image as independent variables and perceived value as the dependent variable, it was found that the first neural network had 6 neurons in the input layer, 6 neurons in the hidden layer, and 1 neuron in the output layer. Fig. 4 depicts the first neural network.

After using trust, perceived quality, empathy, switching barriers, commitment, and intuitive image as independent variables and customer satisfaction as the dependent variable, it was found that the second neural network had 6 neurons in the input layer, 6 neurons in the hidden layer, and 1 neuron in the output layer. Fig. 5 depicts the second neural network.

Finally, after using perceived value and customer satisfaction as independent variables and customer loyalty as the dependent variable, it was found that the third neural network had 2 neurons in the input layer, 3 neurons in the hidden layer, and 1 neuron in the output layer. Fig. 6 depicts the third neural network.

In all 3 neural networks, resilient backpropagation (Rprop), was used for learning. Rprop is a first-order optimization algorithm which is used as a learning heuristic for supervised learning in feedforward artificial neural networks.

In order to calculate and compare the estimation errors of each neural network, MSE and RMSE were calculated. It was found that network 1 (i.e., perceived value as dependent variable) had the lowest MSE and RMSE while network 3 (i.e., customer loyalty as dependent variable) had the highest error rates. These results are consistent with those obtained from regression models. As MSE decreases the value of R-squared increases, indicating a better performance. The MSE and RMSE of all 3 neural networks are displayed in Table 7.

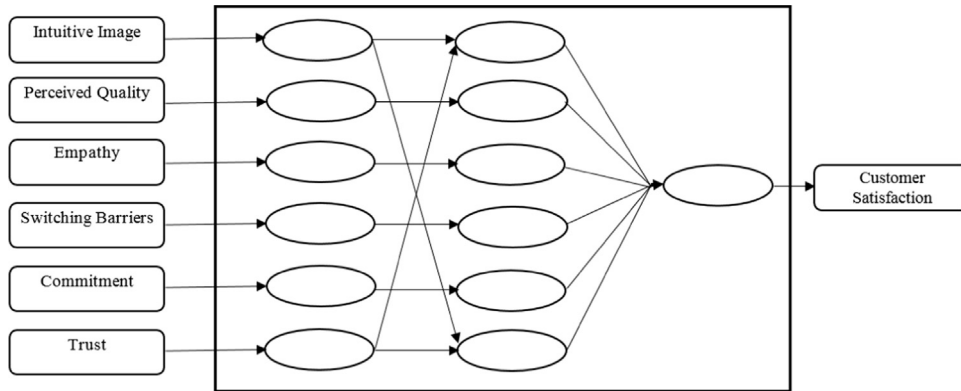


Fig. 5. Neural network 2.

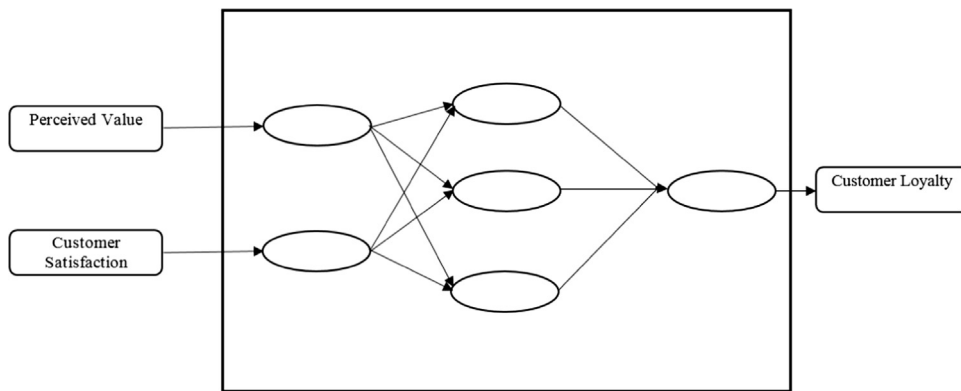


Fig. 6. Neural network 3.

Comparing the error rates of regression models (Table 6) with those of the neural networks (Table 7) indicates that artificial neural networks have lower estimation errors, hence, they can be considered as a stronger approach toward predicting the customer behavior compared to linear regression models.

#### 4. Discussion

The prosperity of a business whose objective is to increase its revenues and profits is strongly dependent on customer loyalty. The importance of customer loyalty is more apparent in service settings, where businesses have a closer relationship with their customers. Service managers always seek models that enable them to better understand their customers' needs. Although traditional regression techniques are widely used in studies of customer behavior, they are not a very effective method for analyzing data sets with high degrees of multi-collinearity and missing information (Wray, Palmer, & Bejou, 1994). Relatively newer techniques such as artificial neural networks can be a helpful way to analyze the customer behavior. Artificial neural networks are statistically-based learning procedures which are modelled using the workings of the human brain and are able to quantify the relationship between input and output variables through an intermediate hidden layer which is analogous to human brain (Wray et al., 1994). In this study, artificial neural networks were used in order to predict the degree of customer loyalty and it was found that artificial neural networks are an effective tool for modelling the customer behavior. Particularly, the results indicated that artificial neural networks have lower estimation error rates compared to traditional regression models when used for predicting customer loyalty, satisfaction, and perceived value. These findings are consistent with the results of Behara, Fisher, and Lemmink (2002) who used neural networks to evaluate service quality and Wray et al. (1994) who evaluated buyer–seller relationships using this methodology. Additionally the results of the current study indicated that customer satisfaction is positively associated with customer loyalty which is consistent with previous

Table 7  
Error rates for artificial neural networks.

	Network 1	Network 2	Network 3
MSE	1.016	1.204	1.611
RMSE	1.008	1.097	1.269

studies by Fornell (1992), Fornell and Wernerfelt (1987), Gallarza and Saura (2006), Kumar et al. (2013), Parasuraman et al. (1991), Reichheld and Sasser (1990), and Reynolds and Beatty (1999). This finding is also consistent with previous studies that conceptualized satisfaction as an antecedent to customer loyalty (Bitner, 1990; Dick and Basu, 1994; Fornell, Johnson, Anderson, Cha, & Bryant, 1996; Macintosh & Lockshin, 1997; Oliva, Oliver, & MacMillan, 1992). Further, the positive relationship found between customer commitment and customer loyalty is consistent with the findings of Hur et al. (2010, 2011), and Kumar et al. (2013). Also, in consistence with Gallarza and Saura (2006), Pura (2005), and Yang and Peterson (2004), it was found that perceived value is positively associated with customer loyalty. The current study has two main contributions to the existing literature. First, this study is the first study that uses artificial neural networks to predict the customer loyalty in financial services industry. Studying the relationship between customers and service providers in the insurance industry was appropriate to test the conceptual model because customers of this industry vary in their complexity and needs, allowing for the breadth of the relationships to be accounted for. Therefore, the authors believe that the pattern of relationships observed in this study can be extended to other service settings in financial services industry and even to the customer–service provider interactions in other industries. Second, this study investigated the concept of customer loyalty and its antecedents in startup insurance companies, which have not been investigated in previous service marketing studies. The results of this study revealed that the pattern of relationships observed in startup insurance companies is not different from more mature companies.

## 5. Conclusions and practical implications

The conceptual model of the study suggested that satisfaction and perceived value are direct antecedents of customer loyalty. Data from customers of startup insurance companies were collected in order to test this relationship. By using linear regression analysis and artificial neural networks, it was found that as customers' satisfaction and perceived value increase, their degree of loyalty also increases. Since one of the main objectives of the startup firms is to acquire new customers and retain their existing customers in order to be able to grow and become competitive in the marketplace, it is recommended that managers of financial services companies pay more attention to these two important determinants of customer loyalty. Moreover, the findings indicated that although satisfaction and perceived value are both positively associated with customer loyalty, they impact the degree of loyalty with different magnitudes. Specifically, it was found that customer satisfaction has a stronger impact on customer loyalty compared to perceived value. Therefore, it is recommended that company managers and marketing strategists allocate more resources to strategies that lead to augmented degrees of customer satisfaction and relatively less resources to strategies that are focused on improving the customers' perceived value.

Another practical importance of this research is that the findings can be used by managers of financial services firms to identify the key factors that can affect customer loyalty through increasing satisfaction and perceived value. Since the findings indicated that trust, perceived quality, empathy, and commitment have a significant impact on customer satisfaction, it is recommended that marketing managers try to target these salient factors in order to indirectly increase their degree of customer loyalty. Based on the findings, it is also suggested that marketing managers target customer trust, perceived quality, and empathy in order to indirectly enhance customer loyalty through improving the perceived value. Having a better understanding of these factors can help the managers to design their strategies more effectively in order to achieve higher levels of customer satisfaction, perceived value and loyalty. The results of this study can also be used by managers to prioritize different factors affecting customer loyalty and to adjust the weight of these factors in their marketing strategies.

Since the results of this study showed that artificial neural networks have an impressive ability in analyzing customer satisfaction, perceived value, and loyalty, it is recommended that companies use this state of the art data

analytics technique in order to analyze customer behavior and to make better decisions. In addition to their high performance in predicting customer loyalty, artificial neural networks are very flexible and can be easily manipulated in order to include more or fewer factors. In linear regression, the performance of the model can be improved only by adding additional variables, but artificial neural networks can be enhanced even by changing the relationships between the existing variables. Although regression models are very popular, but their limitations can negatively affect the quality of statistical data analysis, therefore, it is suggested to use neural networks in order to obtain more accurate and interpretable results. Using efficient data analysis techniques is considered as an important factor in today's competitive business environment (Reddy, 2015). The use of new techniques such as artificial neural networks for analyzing the customer behavior can be particularly beneficial for startup companies who aspire to gain competitive advantage over their strong and well-established rivals.

## 6. Directions for future research

Despite the advantages of using artificial neural networks for studying the customer behavior, there are also various limitations. For instance in order to test an artificial neural network a relatively large data set is required. Additionally, designing an optimal neural network can be a time consuming process. Future studies can test the proposed conceptual model of this research in other service settings in order to examine the robustness of the observed relationships. It is also believed that the proposed artificial neural networks of this study can be manipulated in order to take additional factors that affect customer loyalty into account. The authors suggest future researchers to use fuzzy logic in order to create the surveys or combine neural networks with genetic algorithms to see whether any improvements could be achieved.

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