

# Churn Prediction in Banking Sector using Bayesian Neural Networks

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**Abstract-**To increase profitability and to sustain in current competitive business scenario any business, organization, especially banks, retention of existing customers is more important than the acquisition of new customers. The customer churn or customer attrition due to one or the other reason in a business organization is of grave concern and to address this is of paramount importance. To predict churn i.e. likelihood of losing the customer to a competitor or stoppage of service by customer is considered one of the important research areas in CRM. In this paper, the churn prediction model has been developed using Bayesian Neural Network. By implementing this data mining approach significant results with regard to better churn prediction has been obtained

**Index Terms** - Churn prediction, Data mining, CRM, Bayesian neural network.

## 1. INTRODUCTION

In present highly competitive and saturated market, the customer is the most important asset; customer churn prevention is one of the top challenges in banks today. Customer churn also known as customer defection or customer attrition is the term meaning loss of customers or stoppage of current services, termination of service from providers, subscriptions or complete switching of business to competitors. Churn has negative impact on business and incurs great losses to organizations as existing customers are an important part of the growth of business growth and customer retention is challenging yet important task for any business to sustain and grow. Moreover, the acquisition of new customers is much difficulty and number of times costlier than retention of existing customers and lifetime value of existing customers is higher. Hence, customer retention becomes critical. But, Churn can't be completely avoided, but if we can predict which customer is going to churn in the near future, efforts can be made to avoid or reduce the chances of churn to minimize losses. Here, churn prediction plays important role [11].

Customer retention is an important task in CRM (customer relationship management) and is possible only by holistic customer understanding [2]. CRM is a strategy that helps business to build long lasting relationships with their customers and increase their revenues and profits. [1]In current environment where customers are using multiple banking channels, predicting churn by detecting warning signs and

foreseeing behavioral changes of customers is very difficult. leveraging of complex banking data that is the result of customer interactions with banks across multiple channels i.e. internet banking, mobile banking, bank visits, ATM banking, kiosk banking, credit card transactions etc. can be done using data mining techniques .this actionable information can help in detecting potential churners .Churn prediction models can be used as tool to prevent customer attrition to some extent by taking corrective measures for prospective churn customers before it's too late. These models work by analyzing individual customers transactional activity data and historical data based on their profiles i.e. their demographic and behavioral data, customer interactions with bank, level of engagement in services or products of bank, or sensing inactivity of customers on some or all banking channels, their feedback through various channels, service usage information etc. and identify customers most likely t risk of leaving bank or stop using services of bank in near future i.e ;churn based on all these indicators. Prediction of churn follows by customer retention actions to prevent churn. Predictive analytics will also help in identification of retention strategy which will work best for specific customers. Success rate depends on retention strategies, retention campaigns, service improvements, customer support etc. Churn can be voluntarily or involuntarily i.e. customer change of job, location etc. can lead to un-subscription of service. Customer retention efforts can be compared with the help of churn prediction models. There are two types of targeted approaches to manage customer churn i.e. reactive and proactive. In reactive

approach, customers unsubscribe to banks service and bank offers the customer with incentive to retain him. While as in proactive approach bank tries to identify customers likely to churn in near future before they actually do so then the bank uses strategies or offers to prevent the. Bank can target customer likely to churn with potential efforts to prevent the customer from churning by identifying his needs, redressing his complaints and by making extra efforts to improve his experience with the bank or providing him incentives to retain the customer. Banks rely mainly on customers for profit generation and therefore customer relationship management (CRM) is an important task in banking business[2]. Data associated with behavior of customers and transactional data can be used and evaluated to assess the probability of customer churn and can be used for suggestive purposes in CRM thereby reducing the risk of losing customers. Churn is one of the most important factors in key performance indicators (KPI) of a product or service and indicates the success or failure of a particular strategy or offer in business whether its effect is positive or negative on the business. In churn identification, we analyze the behavior of user on temporal basis[3]. From data mining perspective churn prediction can be considered

as binary classification problem, where we can label customers as “churners” and “non-churners” on a particular frame of time. It is essential to monitor the predictive performance of the model. Frequency, usage intensity, response to offers, number of transactions are strongest indicators of churn.

The main objective of this paper is building these predictive models using data mining techniques. Data mining techniques can be used to build predictive churn models using classification technique by analyzing customers to belong to either of two classes i.e. ‘churn’ or ‘not churn’.

## 2. CONCEPTUAL FRAMEWORK

Churn prediction is a binary classification problem where output can be ‘yes’ or ‘no’ depending upon the value of churn indicators as illustrated in fig.1. Input of the predictive model will be customer and output will be YES or NO. i.e.: the customer will belong to ‘churn’ or ‘not churn’ category based on outcome of predictive churn model. To make this classification we need data of customer’s i.e. demographic, behavioral, historical and transactional data[4].

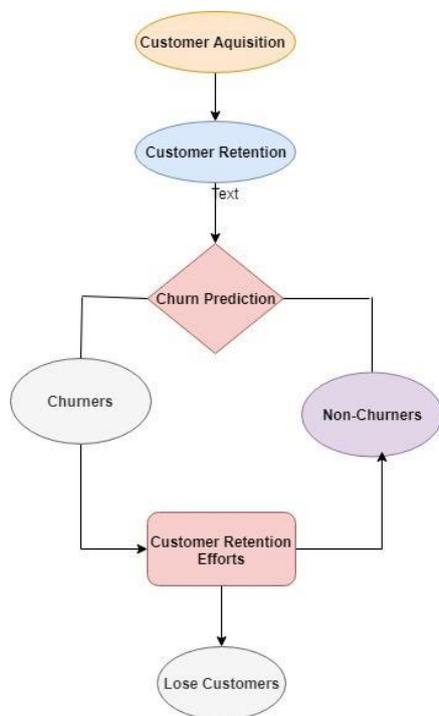


Fig.1. Churn Prediction and Customer Retention

Data Mining is the process of discovering useful knowledge by analyzing patterns and relationships in

existing large and complex data sets to solve different problems. This valuable knowledge can be put to use and has numerous applications in various fields[5]. Data mining is used by banking applications for different purposes like CRM management, Loan prediction, customer profiling and segmentation, detection of fraudulent transactions, loan risk categorization etc. Banks generate enormous data from daily transactions and data is valuable asset in banks but potential of this asset can be harnessed by use of data mining techniques[6]. bank data is unbalanced and dense so, without the use of proper tools the information derived can't be useful and actionable, as the information is critical to decision making and knowledge derived by manual process is inappropriate and error prone. Data mining can help in proactive, dynamic decision making and prediction of future events by analyzing historic trends of customers and identification of relationships between events thereby help in reducing losses faced by bank.

Classification is supervised learning technique and is one of the most widely used data mining techniques. The algorithms of classification include decision trees, artificial neural networks and so on. In which artificial neural networks are considered most useful technique

in business problems[3]. We are using Bayesian neural network for the churn prediction.

### Bayesian Neural Network

BNN are networks that consists of probabilistic model and neural network so that the resultant model combines strength of neural network and stochastic modeling[7]. In other words, Bayesian neural network is a neural network with probability distribution over its network weights. Conventional models are based on minimization of error function and suffer from deficiencies like determination of appropriate complexity level of mode, as the complexity of the model increases it can give better fits to training data but if model is too complex it can result in over fitting[8]. Stochastic models allow direct specification of model with known interaction between parameters to generate data. Neural Networks use MLE (Maximum Likelihood Estimation) for training purpose. MLE uses point estimate and Using MLE ignores any uncertainty that we have in proper weight values. Practically this type of training is often susceptible to over fitting, which is a common problem in neural networks. BNN is neural network with prior distribution on its weights, it use MCMC (long convergence, difficult to diagnose) or Laplace method (LC). BNN extends neural network with posterior inference[9]. BNN are useful in decision making systems where we care more about uncertainty or where uncertainty is high. BNN are useful for solving problems in domains where data is scarce as a way to prevent over fitting. With this approach we can address issues like; Regularization or over fitting, model selection or model comparison without need of cross validation of separate data sets[10]. Bayesian methods provide general and robust framework for dealing with model complexity issue and

### 3. CONCLUSION

Churn prediction is complex process and the churn prediction model should be effective, continuously evolving and highly adaptive to changes as banking environment is highly complex and dynamically changing. Moreover, false positives i.e. categorizing customers as churners when they are actually not should be minimized to avoid wastage of time and resources.

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regularization techniques arise naturally in BNN and is depicted in fig.2. For classification problems, conventional approaches make overconfident predictions and are not well designed to model the uncertainty associated with predictions[8]. BNN helps in realizing robust and optimal results in classification problems. Bayesian learning produces a probability distribution that expresses our beliefs how likely the different parameter values are:

Prior Distribution  $P(\theta)$

$$P(\theta | x(1), \dots, x(n)) = P(\theta | x(1), \dots, x(n) | \theta) P(\theta) / P(\theta | x(1), \dots, x(n)) \propto L(\theta | x(1), \dots, x(n)) P(\theta)$$

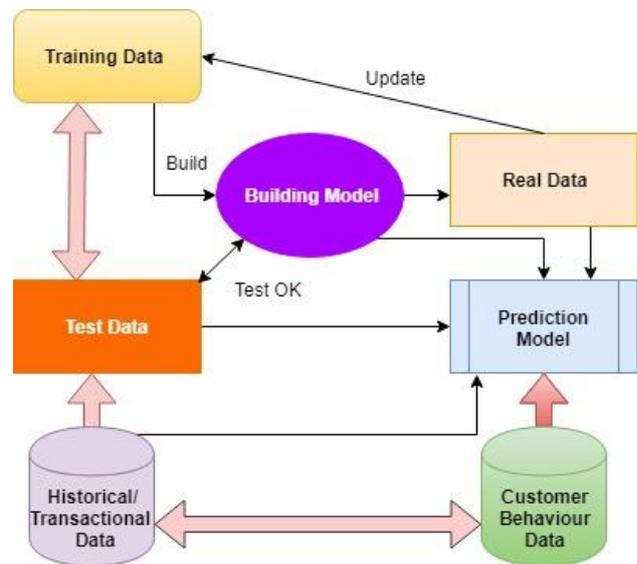


Fig. 2. Prediction Model using BNN

should be minimized to avoid wastage of time and resources.

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