A Detailed Review For Marketing Decision Making Support System In A Customer Churn Prediction

Mr. M. John Britto, Dr. R. Gobinath

Abstract: Churn prediction is one of the important issues in customer relationship management (CRM). It has become increasingly important to retain existing customer than acquiring new one. This paper presents a review of customer’s churn prediction in various domains like telecommunications, retail banking, e-banking, energy sectors, insurance, and so on. The study shows a huge number of attributes that were used to develop customer churn model by many researchers. It reveals various techniques that are used till date in churn prediction. Modelling techniques such as Logistic Regression, Neural Network Model, Random Forest, Decision Tree, Support Vector Machine and Rough set approach are implemented for the churn detection. The findings reveal that the customer churn prediction through predictive analytics will fetch more accurate outcomes while comparing with other similar approaches in prediction. There is large research scope in Customer churn prediction and Customer retention through predictive analytics.

Keywords: CRM, Churn, Predictive Analytics, Data Mining, Attrition.

1 INTRODUCTION
The digital media is one of the most favourite and powerful media that uses large amount of data in database which faces a problem of irrelevancy and some major problems in transactions. There is an essential need of large data repositories to store and manage these types of data. The immense challenge for such data transactions are due to the irrelevancy in data as well as due to missing values, which makes difficulty in extracting necessary information. Furthermore, with digital transaction of the banking industry, it is necessary for banks to keep customers in electronic channels like internet or mobile applications. Reason for this is that digital customer is more profitable than the traditional transaction customer. There is no need for a physical branch or a station for client service communication in transactions. Customer attrition in banking industry or electronic banking may lead to economic crisis and makes the situation worse. It is essential to predict the customer churn earlier and retaining methods should be implemented. In recent years there has been huge increase in the amount of data that is collected and processed to extract meaningful and valuable information across wide areas of business. The meaningful information that is obtained is then used by the companies for CRM [1]–[4]. Although there are many techniques that have been effectively applied in predicting customer churn like using SVM[5], [6], logistic regression [7], decision Trees [7], Naive Bayes and neural networks [4]8–[10] in the domain of airlines, banking, energy sector, telecommunication, retail banking and many more sectors, deep learning, predictive analytics approaches for this circumstances still have lots to be explored. However every customer can have more than one credit card more than one bank so there might be lot of chances for a customer to churn out of particular bank [11].

Hence it is the task of Bank Credit Card Account Management System (BCCAMS) to preserve the existing customers. Through highly efficient data mining systems and predictive analytics it is possible to predict churn out of particular bank based on various available attributes collected from the past history of old customers. Data mining methods such as decision tree, naive bayes, random forest, artificial neural networks, inductive rule learning, and support vector machine to find out the churn[1,3– 8]. All these techniques are implemented not only in banking but also in medical systems, insurance, telecommunication, gaming, automobile industries, retail marketing etc.,[12]–[15]. Previously customer retention technique in credit card churn prediction was done using supervised techniques. Later the research work in churn started to use unsupervised techniques[4,16,18]. But it could not end with better results. So, through hybrid Predictive analytics techniques we might bring better accuracy.

Data Mining
Data mining is an important component of every CRM framework that facilitates analysis of business problems, prepare data requirements, and build, validate and evaluate models for business problems [2], [3], [9]. The data mining process and algorithms enable firms to search, discover hidden patterns and correlations among data, and to extract relevant knowledge buried in commercial data warehouses, in order to gain broader understanding of business. Data mining uses sophisticated statistical data search algorithms to find, discover hidden patterns and relationships for extracting knowledge buried in corporate data warehouses.,[12] or information that visitors have dropped about their experience, most of which can lead to improvements in the understanding and use of the data in order to detect significant patterns and rules underlying consumer’s behaviours.

Related Work
Nowadays, there exists a plethora of machine learning approaches to customer data mining and retention modelling. It is ranging from classical regression to neural networks to random forests (e.g., see [12, 17, 18, and 20] for a general topic overview). The experiments in [10], [19], [20] showed that neural networks typically outperform

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logistic regression and decision trees in churn prediction. Applications of social network analysis to customer retention, however, are often limited due to poor availability of data on customer peer networks[13]. Most progress in this direction has been achieved in telecommunication industry, where social networks are naturally observed from the call and message records (e.g., see [1, 2, 13, 17, and 20]). Constructing networks of bank customers requires additional steps, such as targeted surveys [3], mining the databases of customers and their transactions [19], and, potentially, employing big data approaches[15], [21]–[23] for harnessing customer information from different sources, including online social media [22].Deep learning (DL) methods continue to attract increasing interest in customer churn prediction, while being a relatively new tool in customer analytics. DL concepts into customer churn prediction and retention models in retail banking with multi-layer feed-forward architecture, can effectively capture features of the underlying customer data [24].

**CRM (Customer Relationship Management)**
The CRM covers the Cross-Selling, Up-Selling, Customer Retention, New Customer Acquiring module. The main focus of Customer retention is to retain current customer in an organization. The following are the reasons There is rare or no chance of the new customer in the telecommunication and banking Industries due to saturation. Acquiring of new customer is costly for a company due to various reasons. There is ten times increase in expenditure when acquiring a new customer related to the expenses of retaining the current existing customer[25].Churn prediction helps to identify expected churning customer, so that the companies could target only those customers instead of all customers for giving some incentives to retain them.

**Customer Churn Prediction**
The churn means those customers who will leave in near future. There is essential need to predict those customers on behalf of some parameter to initiate some suitable action to minimize their leaving. The most of the mobile phone companies invest under CRM (customer relationship management) technology.

**Types of Churners**
Churners are classified into two main categories that are voluntary and involuntary[25]. The voluntary churners are further more subdivided into deliberate and incidental churners. Involuntary churners are those customers removed from the list of customers due to their non-payment, fraud and so on. The voluntary churners are difficult to find due to that customers want to terminate from his services providers. The incidental churners come due to incident because the churners have no plan to leave but this one done due to some reasons like change of location, change in financial position etc.

**Modelling Techniques of Churn Prediction**
It is the basic need of the companies to develop an efficient and effective model to manage customers churn. There are so many modelling techniques that are used to predict customers churn in different organization. Here is the table of customer churn prediction models/techniques and various algorithms.

### Table 1: Various Algorithms for Churn Prediction.

<table>
<thead>
<tr>
<th>YEAR</th>
<th>AUTHOR</th>
<th>TITLE</th>
<th>DOMAIN</th>
<th>ALGORITHMS/ METHODOLOGIES</th>
<th>FEATURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>R. RajaMohamed, J. Manoharan</td>
<td>Improved credit card churn prediction based on rough clustering and supervised learning techniques</td>
<td>Credit card (e-banking)</td>
<td>Modified rough k-means algorithm</td>
<td>Precision, sensitivity, specification, accuracy and misclassification</td>
</tr>
<tr>
<td>2018</td>
<td>Nelson Rosa</td>
<td>Gauging and foreseeing customer churn in banking industry- A Neural Network Approach</td>
<td>Portuguese retail bank</td>
<td>A frame work with Neural Network approach. CRISP methodology And ANN.</td>
<td></td>
</tr>
<tr>
<td>2019</td>
<td>Sandeep Kumar Hegde, Monica R Mundada</td>
<td>Enhanced deep feed forward neural network model for the customer attrition analysis in banking sector</td>
<td>Banking</td>
<td>EDFPNN – Enhanced Deep Feed Forward Neural Network. ROC Curve, F1 Score, Recall, Precision and confusion matrix</td>
<td></td>
</tr>
<tr>
<td>2018</td>
<td>Fatemeh Safinejad, Elham Akhond Zadeh, Behrouz H. Far</td>
<td>A fuzzy dynamic model for customer churn prediction in retail banking</td>
<td>Retail Banking</td>
<td>Fuzzy dynamic model</td>
<td>LRFM is used as attributes.</td>
</tr>
<tr>
<td>2018</td>
<td>J. Vijaya, E. Sivasankar</td>
<td>Improved churn prediction based on Supervised and unsupervised hybrid data mining system</td>
<td>Telecommunication</td>
<td>Hybrid supervised and unsupervised techniques</td>
<td>Sensitivity, specificity, accuracy</td>
</tr>
<tr>
<td>2019</td>
<td>Sanjay Kumar, Manish Kumar</td>
<td>Predicting customer churn using Artificial Neural Network</td>
<td>Telecommunication</td>
<td>Multi layered ANN consists with 3 dense ANN</td>
<td>Precision, recall, accuracy are the evaluation measures used.</td>
</tr>
<tr>
<td>2017</td>
<td>Arash Barfar, Balaji Padmanabhan, et.</td>
<td>Applying Behavioral economics in predictive B2B</td>
<td></td>
<td>Behavioral economics concepts</td>
<td>Behavioral economics,</td>
</tr>
<tr>
<td>YEAR</td>
<td>AUTHOR</td>
<td>TITLE</td>
<td>DOMAIN</td>
<td>ALGORITHMS/ METHODOLOGIES</td>
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<tr>
<td>2018</td>
<td>Sandeep Yadav, Aman Jain, Deepthi Singh</td>
<td>Early prediction of employee attrition using data mining techniques</td>
<td>Hr Attrition dataset from Kaggle website</td>
<td>Logistic Regression, SVM, Random Forest,</td>
<td>HR Dataset, salary, promotion, satisfaction level.</td>
</tr>
<tr>
<td>2018</td>
<td>Erdem Kaya, Xiowen Dong, Yoshihiko Suhara, Selin Balciyoy, Alex Sandy</td>
<td>Behavioral attributes and financial churn prediction</td>
<td>Credit card sampling of OECD countries</td>
<td>SVM –SMOTE</td>
<td>Solving imbalance classification, spatio-temporal choice patterns are taken into account</td>
</tr>
<tr>
<td>2019</td>
<td>Abdelrahim Kasem Ahamed, Assef Jafer, KadanAljoumaa</td>
<td>Customer churn prediction in telecom using machine learning in Big Data platform</td>
<td>Telecommunication-Syria Tel.</td>
<td>XGBOOST algorithm</td>
<td>IMEI data are used</td>
</tr>
<tr>
<td>2018</td>
<td>Anderi Simion Constantinescu, Andrei Ionut Damian, Nicoae Tapus</td>
<td>Deep Neural pipeline for churn prediction</td>
<td>Pharmaceutical industry</td>
<td>Deep Neural pipeline</td>
<td>Balanced between High recall rate and precision rate</td>
</tr>
</tbody>
</table>

Here is a list of those attributes that affect churning process and help us to predict the churners. Customer demographics data, Customer data, Complaint data, Bill info, Payment info, Customer age, Fault report, Payment type, Consumption level rates, Area of customer, Quality of services, Purchases history, Survey report, and Demographic details. The techniques that are used to predict the Customer attrition are as follows.

**Artificial Neural Networks (ANN)**
The Neural Networks Model (NNM) is used to elaborate functionality like non-linear. The model holds the capability to learn due to its comparable data processing structure. These techniques provide successful results after applying on many problems like classification [9][26]. The model is dissimilar to classification model as well as decision tree due to its likely hood prediction. The neural network has several techniques having merits and demerits. The researcher suggests deep neural network is better than decision tree and regression analysis model of churn prediction [27].

**Linear Regression Model (LRM)**
To predict customer satisfaction and customer churn the regression analysis model technique can also be implemented which is a supervised learning model. In this model a data set of past observation is used to see future values of explanatory and numerical targeted variable.

**Decision Tree (DT)**
The decision tree is the most prominent predictive model that is used for the purpose of classification of upcoming trial. The decision tree consists of two steps, tree building and tree pruning. In tree building the training set data is recursively partitioned in accordance with the values of the attributes[28]. This process goes on until there is no one partition is left to have identical values. During this process noisy data and outliers are removed. The largest estimated error rate branches are selected and then removed in pruning. Pruning technique is used to reduce the size of a tree and thus complexity of the decision is reduced which in turns reflects on accuracy of customer churn prediction.

**Support Vector Machine (SVM)**
The SVM classifier deals with linear permutation of subset of the training set by finding a maximum edge over energized plane. The SVM plots the data into high dimensional features space closing to infinite with the help of most important part if vectors are non-linearly divisible input features and then categorize the data by the highest scope hyper-plane

**Fuzzy Logic Algorithm**
A fuzzy logic technique is very simple to understand due to its very simple mathematical concepts and fuzzy reasons. Fuzzy logic has the property of flexibility, tolerant of indefinite data. The function of random data can be implemented in this model. Evolutionary Learning Data Mining Techniques (DMEL) Data mining by evolutionary learning techniques is inherited classification technique. Such type of genetic algorithms has some set of rules for
DMEL technique[29]. The DMEL applies these rules on some given dataset that provide decision making results.

**K-means clustering**

In K mean cluster in approach, in the first step we select k objects that have their centre (mean). In this method the remaining objects are not selected yet are assigned to cluster with respect to the similarity of the object with cluster. These similarities are measured on the behalf of the distance between cluster mean and object to get the new centre point. These steps are repeated until the required function is achieved. In k mean clustering, the most important point is to find the numbers of clusters that is optimum as well as the distance between cluster mean and objects. The algorithm works until no new cluster element leave a cluster and enter into other cluster and no new centre point is set for any cluster. When this target is achieved the algorithm is stopped. Here is the table of customer churn prediction models/techniques based on behavioral economics and Deep Learning.

**Table2: Behavioral economics, Deep Learning concepts for customer churn prediction.**

<table>
<thead>
<tr>
<th>S.no</th>
<th>Author</th>
<th>Topic</th>
<th>Methodologies/Techniques used</th>
<th>Description</th>
<th>Future scope</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Erdem Kaya, Xiwen Dong, Yoshihiko Suhara, Selim Balcisoy, Alex Sandy[2018]</td>
<td>Behavioral attributes and financial churn prediction</td>
<td>SVM –SMOTE</td>
<td>Solving imbalance classification, spatio-temporal choice patterns are taken into account</td>
<td>Behavioral features might be combined with other advanced characteristics such as customers purchase and search history and feedbacks in social media.</td>
</tr>
<tr>
<td></td>
<td>V.Umayaparvathi, K. lyakutti[2017]</td>
<td>Automated Feature Selection and Churn Prediction using Deep Learning Models.</td>
<td>Three deep neural network Learning Models.</td>
<td>Three deep neural network architecture were created. It eliminates manual feature engineering process</td>
<td>Behavioral economics can be taken into account with these three deep neural network architecture for predicting domain independent customer churn</td>
</tr>
<tr>
<td></td>
<td>Sandeep Kumar Hegde, Monica R Mundada [2019]</td>
<td>Enhanced deep feed forward neural network model for the customer attrition analysis in banking sector</td>
<td>EDFFNN – Enhanced Deep Feed Forward Neural Network, Tukey outlier algorithm</td>
<td>It is five layer Deep neural Network model with six nodes in each layer. It has been implemented using optimized data pre-processing, data exploration, feature scaling, and Adam optimizer algorithms for churn prediction</td>
<td>It can be implemented with other parameters with rough set approach for churn prediction</td>
</tr>
<tr>
<td></td>
<td>Uzair Ahmed, Asitullah Khan, Yeon Soo Lee[2017]</td>
<td>Transfer learning and meta classification based deep churn prediction for telecom industry</td>
<td>TL-DeepE</td>
<td>Integration of information from Transfer learning with GP-Adaboost ensemble improves churn prediction accuracy</td>
<td>Unsupervised learning technique can be used for customer churn prediction</td>
</tr>
<tr>
<td></td>
<td>Andei Simion Constantineseu, Andrei Ionut Damian, Nicolae Tapus [2018]</td>
<td>Deep Neural pipeline for churn prediction</td>
<td>Deep Neural pipeline</td>
<td>Balanced between High recall rate and precision rate used to find accuracy in finding churning customers.</td>
<td>Behavioral economic concepts can be used for independent domain customer churn prediction</td>
</tr>
</tbody>
</table>

**Behavioral Economics**

Customers’ spatio-temporal behaviour can be considered for churn prediction. Applying Behavioral economics will fetch better results in predicting customer attrition and also helps to predict domain independent churn prediction. The dynamic spatio-temporal Behavioral features such as diversity, loyalty, and regularity can be included in predicting customer churn[30]. It fills the gap between domain specific pattern and Behavioral pattern of customer. Behavioral economics can inspire feature engineering and helps to build parsimonious models for domain independent customer churn prediction.
CONCLUSION
The churn prediction done in recent years are mostly concentrated on unsupervised learning with few measurements which makes an effective way of extracting useful information in CRM. There are various ways to predict churns in a customer system. Behavioral economics of customers can be used for domain independent customer churn prediction. Deep learning techniques are also implemented for predicting customer churn in various areas such as behavioural economics, demographic, transaction, segmentation. Many researchers concentrate on developing solution for customer churn detection using forecast model with various large number of attributes which includes segmentation, account information, payment information, complaint information, and services information. This paper examines various exhibiting techniques such as LR, NNM, DT, FL, SVM and DME for the domain based churning detection purpose in different domains such as online gaming, online retail banking, insurance, energy sector, and telecommunication and so on. A framework can be examined for domain independent customer churn prediction using deep neural network techniques.

REFERENCE


[23]. H. Sayed, M. A. Abdel-Fattah, and S. Kholief,


