CHURN PREDICTION BASED ON CUSTOMER PROFILING

A MINI PROJECT REPORT submitted in partial fulfillment of the requirements

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CERTIFICATE

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ABSTRACT

Delighted customer is the key to success for a company hence it becomes very important to keep the customers not just satisfied, but happy. A company must segment the market and select the one which seems the most profitable and where it gets the best results. This is done so as to not waste resources and time on segments that will not help the company grow. Data mining techniques are used for this purpose. Predict behaviour of a retain Telco customers & analyse all relevant customer data and develop focused customer retention programs using data mining . Data Mining is defined as the process of gaining knowledge from data, it is a technique to find out patterns that are not easily visible on the surface but are important.

key words : customer profiling , segments, Data mining.

Chapter 1

INTRODUCTION

'**Churn**' is a word derived from change and turn. It means the discontinuation of a contract. Here from telco customer data which consists of customer details try to predict the which customer is discontinuing and analyse the data so that company can take decisions to retain their customers.

Here we have to know "what is customer profiling"? Customer profiling is a method to create a portrait of customers, which includes their personal and transactional details. It helps companies make various customer-centered decisions regarding their business. Customer Profiles or Personas are created with the help of customer research. Understanding the customers is the secret of successful selling today, the customer is the king and must be treated so. It is easier to retain an existing customer than to get a new one. Hence the more you make them happy, the higher are the chances that they will stick to you.

1.1 Purpose

In order to predict the which customer is discontinuing and analyse the data so that company can take decisions to retain their customers. Predict behaviour of a retain Telco customers & analyse all relevant customer data and develop focused customer retention programs using data mining .

1.2 Scope

Understanding the audience is now more valuable to a business than it has ever been before. And, if the right approach is taken, more attainable than ever before. By following a few fundamental steps, creating a powerful and useful profile of your best and most valuable customers is within reach.

1.3 Motivation

However, the volume and complexity of data being generated and the sophistication of available analytical tools means that it is now possible to gain deeper and more detailed insights Importantly, consumers are now expecting organizations to utilize this type of analysis.

1.4 Existing System

Previously customer profiling is done manually and there are not as many as sources for the customer data. The only source is the data given by the customer on paper based

Demerits :

1. Time for analysis is more.
2. The analysis may be true or may be false.

Not as many sources for data

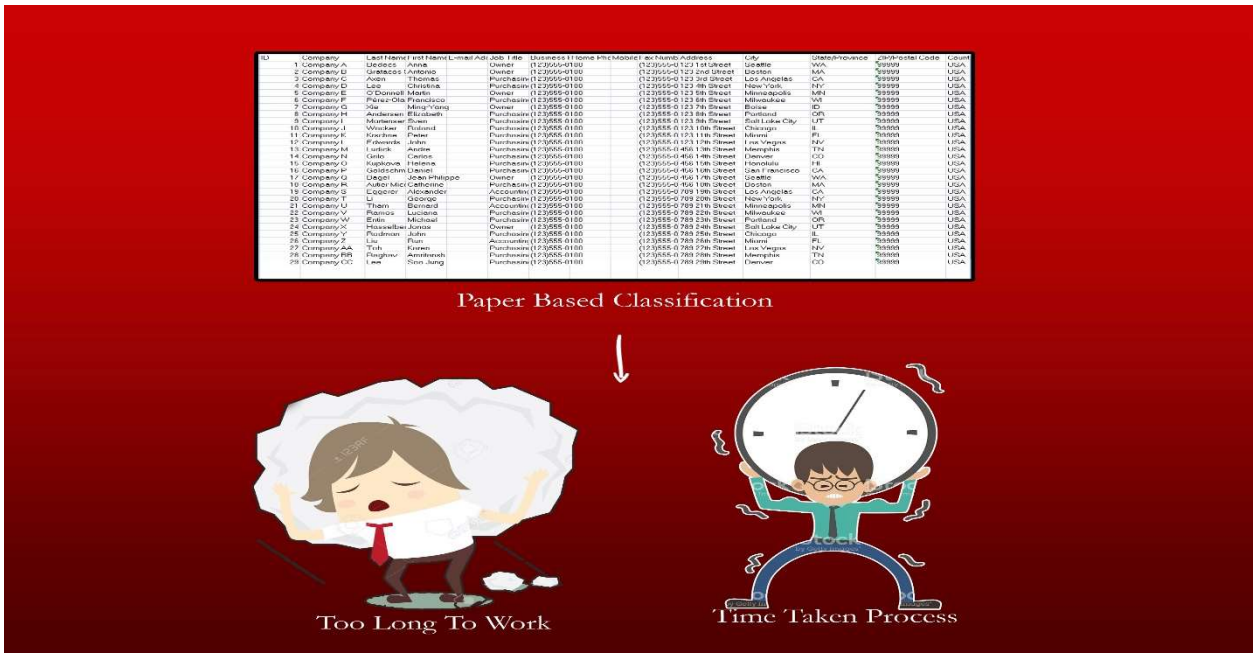

Fig.1.4.1 paper based classification

From the above diagram 1.4.1 at earlier times the data given by the customer is only on paper based. Hence this is known as paper based classification. Due to this it is very time taken process and have to do so much of work. Time for analysis is more. The analysis may be true or may be false.

CHAPTER 2

LITERATURE SURVEY

This paper reviews the different categories of customer data available in open datasets, predictive models and performance metrics used in the literature for churn prediction in telecom industry [1]. Customer Churn is the major issue that almost all the Telecommunication Industries in the world faces now. In telecommunication paradigm, Churn is defined to be the activity of customers leaving the company and discarding the services offered by it due to dissatisfaction of the services and/or due to better offering from other network providers within the affordable price tag of the customer [4]. It is necessary to identify those customers who are likely to leave the company in the near future in advance because losing them would results in significant loss of profit for the company. This process is called Churn prediction.

Data mining techniques are found to be more effective in predicting customer churn from the researches carried out during the past few years. Churn Prediction is a phenomenon which is used to identify the possible churners in advance before they leave the network [2]. This helps the CRM department to prevent subscribers who are likely to churn in future by taking the required retention policies to attract the likely churners and to retain them. Thereby, the potential loss of the company could be avoided. The input for this problem includes the data on past calls for each mobile subscriber, together with all personal and business information that is maintained by the service provider [6]. In addition, for the training phase, labels are provided in the form of a list of churners. After the model is trained with highest accuracy, the model must be able to predict the list of churners from the real dataset which does not include any churn label.

In the perspective of knowledge discovery process, this problem is categorized as predictive mining or predictive modelling [11]. There are a lot of researches being carried out in the area of customer churn prediction modeling. In this section, we survey some of the researches carried out in this area in the past few years. Authors of [1] depict phases of a general churn prediction model such as data collection, preparation, classification and prediction. It also describes that identifying the right grouping of variables has significant influence in improving the percentage of true predictions (TP). A churn prediction model was proposed by [1], which works in 5 steps: i) problem identification; ii) dataset

selection; iii) investigation of data set; iv) classification; v) clustering, and vi) using the knowledge. It seems to be a complete model.

Classification techniques are used for distinguishing Churners. Clustering is used for model evaluation. For classification, Decision tree, Support vector machine and Neural Network are used. And for clustering Simple K-Means was used. It concluded that SVM was the best among the three methods in distinguishing churners from non-churners. In this paper, initially, we introduced the churn prediction problem and the significance of using predictive modelling methods to overcome the problem of customer churn in telecom industry. We surveyed the existing churn prediction methods in detail and summarized them. Unlike other surveys, which primarily focused only on the prediction models and the accuracy of churn prediction, in this survey we presented the characteristics of the existing publicly available churn prediction datasets. Further, we focused on different customer related variables that are used for churn prediction and categorized them. Finally, we surveyed the list of the commonly used metrics proposed in the literature for evaluating the performance of various churn prediction methods.

Customer churn prediction is one of the most important problems in customer relationship management (CRM). Its aim is to retain valuable customers to maximize the profit of a company. To predict whether a customer will be a churner or non-churner, there are a number of data mining techniques applied for churn prediction, such as artificial neural networks, decision trees, and support vector machines. That is, highly competitive organizations have understood that retaining existing and valuable customers is their core managerial strategy to survive in their industries. However, to create and retain customers is difficult and costly in terms of marketing. Consequently, this leads to the importance of churn management [1, 2]. As customer churning will likely result in the loss of businesses, churn prediction has received increasing attention in the marketing and management literature over the past time. In addition, it shows that a small change in the retention rate can result in significant impact on businesses.

Finally, the mining result is evaluated to examine whether the finding is useful for the business problem. 2.1.1. Data Pre-Processing the data in the real world is always incomplete, noisy, and inconsistent because of not applicable, human or computer error at data entry, errors in data transmission, or from different data sources, etc. Therefore, the major tasks in data pre-processing includes data cleaning, data integration, data transformation, data reduction, and data discretization [10]. Data cleaning is one of the three biggest problems in data warehousing (Kimball, 1996). In data cleaning process, some tasks may be to fill

in missing values, identify outliers, smooth out noisy data, correct inconsistent data, and resolve redundancy caused by data integration. Missing and noisy data are resolved by using attribute mean to fill in, or employing a regression function to find a fitted value. First, for the data pre-processing step, it is unknown that which feature selection method performs the best by selecting the most representative features to make prediction models provide the highest rate of accuracy. That is, there are a number of feature selection methods, which can be applied for churn prediction, such as principal component analysis, genetic algorithms, decision trees, stepwise, etc. [11]. Besides feature selection, outlier detection and removal is another important pre-processing task, which aims at filtering out bad/noisy data that can degrade the prediction performances [12].

CHAPTER 3

PROPOSED SYSTEM

The primary step is getting customer data from various sources available. Next step is to remove the inconsistent data because of inconsistent data, accurate analysis is not possible.

By Removing inconsistent data so that on pure data analysis can be done.

In this proposed system of churn prediction,

- The first major step is to collect the customer data which is in the form of inconsistent data i.e., missing data, redundant data, noisy data etc…
- The second major step was we have to prune the inconsistent data to make inconsistent data as consistent data.

3.1 Proposed system flow :

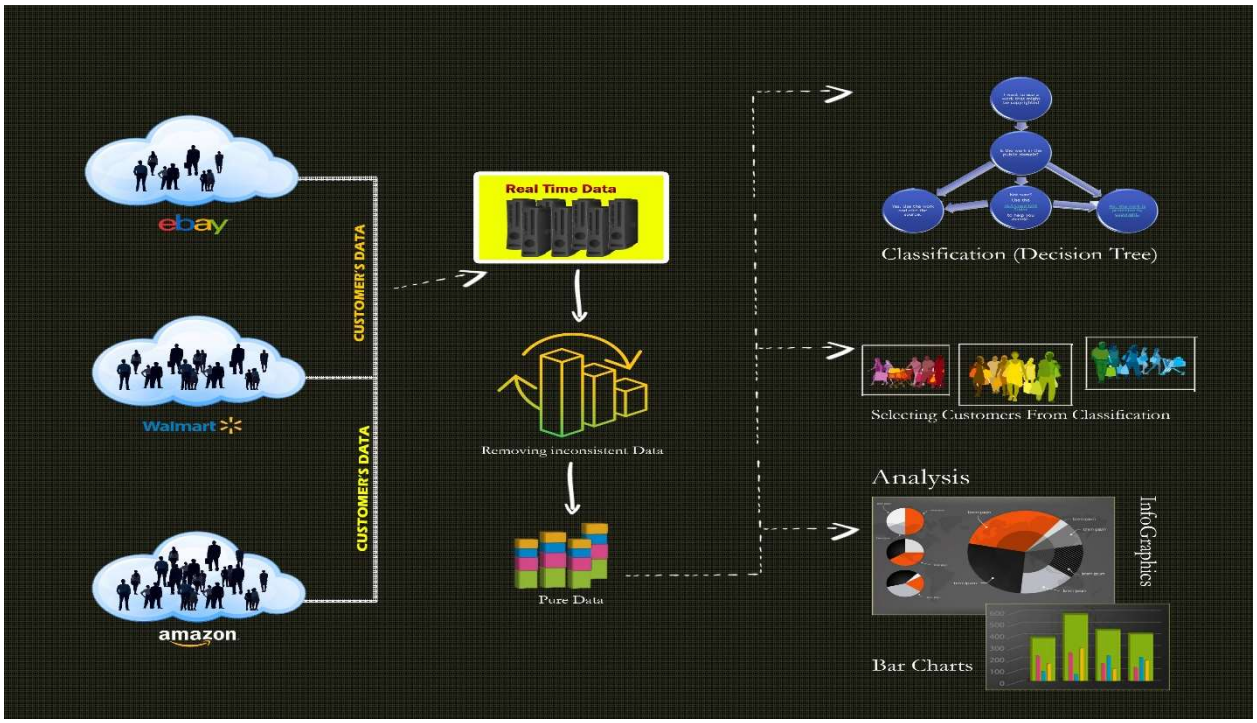

Fig.3.1.2 proposed system flow diagram

In that above flow diagram, we clearly known that first we have to collect customer data, the data which is real time data which consists of inconsistent data. We have to prune the data. After pruning inconsistent data becomes consistent data. Then we have to design decision

tree then after clustering and lastly production analysis which is in the form of bar and pie charts.

Now we have consistent data 3 things are done

1. classification
2. segmenting of customers.
3. production analysis.

Classification :

Classification is a data mining technique that assigns categories to a collection of data in order to aide in more accurate predictions and analysis. Also called sometimes called a Decision Tree, classification is one of several methods intended to make the analysis of very large data sets effective. Here we have to make churn as an class label and we have to design Decision tree making churn as root node. By using decision tree rules are generated that done who are 'churning' from a product.

Clustering :

It is nothing but clustering. Grouping of similar objects. In telecom customer survey, the customer who is having same interest like interest on same plan, they should be in one cluster. This nothing but clustering or grouping of people with same interests or plans based on groups different strategies are applied to improve business.

Product analysis :

By doing product analysis we use to know to which product thus customers are interested more and this is shown in the form of a bar charts and pie charts. As this is shown in pie charts and bar charts we have good statistical analysis among the which customer is intrested in which aspect.

3.2 ALGORITHMS USED:

Classification : In classification Decision tree is used. In 'R' for decision tree is implemented by using 'CTREE'.

CTREE

Conditional Inference Trees

Recursive partitioning for continuous, censored, ordered, nominal and multivariate response variables in a conditional inference framework.

Keywords

tree

Usage

```
ctree(formula, data, weights, subset, na.action = na.pass,
control = ctree_control(...), ytrafo = NULL, scores = NULL, ...)
```

Formula a symbolic description of the model to be fit

Data a data frame containing the variables in the model.

Subset an optional vector specifying a subset of observations to be used in the fitting process.

Weights an optional vector of weights to be used in the fitting process. Only non-negative integer valued weights are allowed.

na.action a function which indicates what should happen when the data contain missing value.

Clustering : k Means algorithm. Along with k means we use 'cluster' package

k-means clustering aims to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean, serving as a

prototype of the cluster. This results in a partitioning of the data space into Veronesi cells.

K-means (Macqueen) is one of the simplest unsupervised learning algorithms that solve the well known clustering problem. The procedure follows a simple and easy way to classify a given data set through a certain number of clusters (assume k clusters) fixed a priori. The main idea is to define k centroids, one for each cluster. These centroids should be placed in a cunning way because of different location causes different result. So, the better choice is to place them as much as possible far away from each other. The next step is to take each point belonging to a given data set and associate it to the nearest centroid. When no point is pending, the first step is completed and an early groupage is done. At this point we need to re-calculate k new centroids as barycentre of the clusters resulting from the previous step. After we have these k new centroids, a new binding has to be done between the same data set points and the nearest new centroid. A loop has been generated. As a result of this loop we may notice that the k centroids change their location step by step until no more changes are done. In other words centroids do not move any more.
Finally, this algorithm aims at minimizing an *objective function*, in this case a squared error function. The objective function

$$J = \sum_{j=1}^{k} \sum_{i=1}^{n} \left\| x_i^{(j)} - c_j \right\|^2$$

where $\left\| x_i^{(j)} - c_j \right\|^2$ is a chosen distance measure between a data point $x_i^{(j)}$ and the cluster centre c_j, is an indicator of the distance of the *n* data points from their respective cluster centres

CHAPTER 4

RESULTS AND OBSERVATIONS

As discussed above in this system have three stages of implementation. Before going to implementation in fig (a) shows the dataset which contain approximately 12000 records.

customer	gender	SeniorCiti	Partner	Depender	tenure	PhoneSer	MultipleL	InternetS	OnlineSe	OnlineBa	DevicePrc	TechSupp	Streaming	Streaming	Contract	Paperless	Payment	MonthlyC	TotalChar	Churn
7590-VHV	Female	0	Yes	No	1	No	No phone	DSL	No	Yes	No	No	No	No	Month-to	Yes	Electronic	29.85	29.85	No
5575-GNV	Male	0	No	No	34	Yes	No	DSL	Yes	No	Yes	No	No	No	One year	No	Mailed ch	56.95	1889.5	No
3668-QPY	Male	0	No	No	2	Yes	No	DSL	Yes	Yes	No	No	No	No	Month-to	Yes	Mailed ch	53.85	108.15	Yes
7795-CFO	Male	0	No	No	45	No	No phone	DSL	Yes	No	Yes	Yes	No	No	One year	No	Bank trans	42.3	1840.75	No
9237-HQI	Female	0	No	No	2	Yes	No	Fiber opti	No	No	No	No	No	No	Month-to	Yes	Electronic	70.7	151.65	Yes
9305-CDS	Female	0	No	No	8	Yes	Yes	Fiber opti	No	No	Yes	No	Yes	Yes	Month-to	Yes	Electronic	99.65	820.5	Yes
1452-KIO	Male	0	No	Yes	22	Yes	Yes	Fiber opti	No	Yes	No	No	Yes	No	Month-to	Yes	Credit car	89.1	1949.4	No
6713-OKO	Female	0	No	No	10	No	No phone	DSL	Yes	No	No	No	No	No	Month-to	No	Mailed ch	29.75	301.9	No
7892-POO	Female	0	Yes	No	28	Yes	Yes	Fiber opti	No	No	Yes	Yes	Yes	Yes	Month-to	Yes	Electronic	104.8	3046.05	Yes
6388-TAB	Male	0	No	Yes	62	Yes	No	DSL	Yes	Yes	No	No	No	No	One year	No	Bank trans	56.15	3487.95	No
9763-GRS	Male	0	Yes	Yes	13	Yes	No	DSL	Yes	No	No	No	No	No	Month-to	Yes	Mailed ch	49.95	587.45	No

Fig 4.0 Dataset

4.1 Classification

In classification decision tree algorithms are used for implementation. R provides many packages here for implementing decision tree CTREE package is used. In the above section about CTREE is clearly discussed.

Here class label is ‘churn’

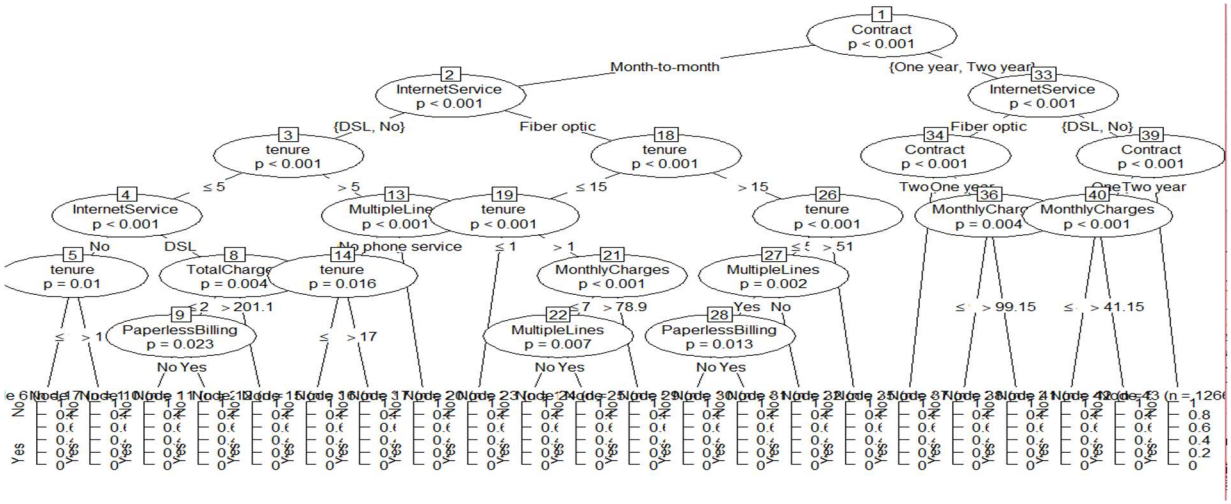

Fig 4.1.1 Overfitting Decision Tree

The above fig 4.1.1 shows the decision tree with covering all the attributes and classify the "churn" attribute. But in the tree you can observe that is over fitted some useless branches are added. In order to that overfitting should be avoided and tree with accuracy must be consider as best tree.

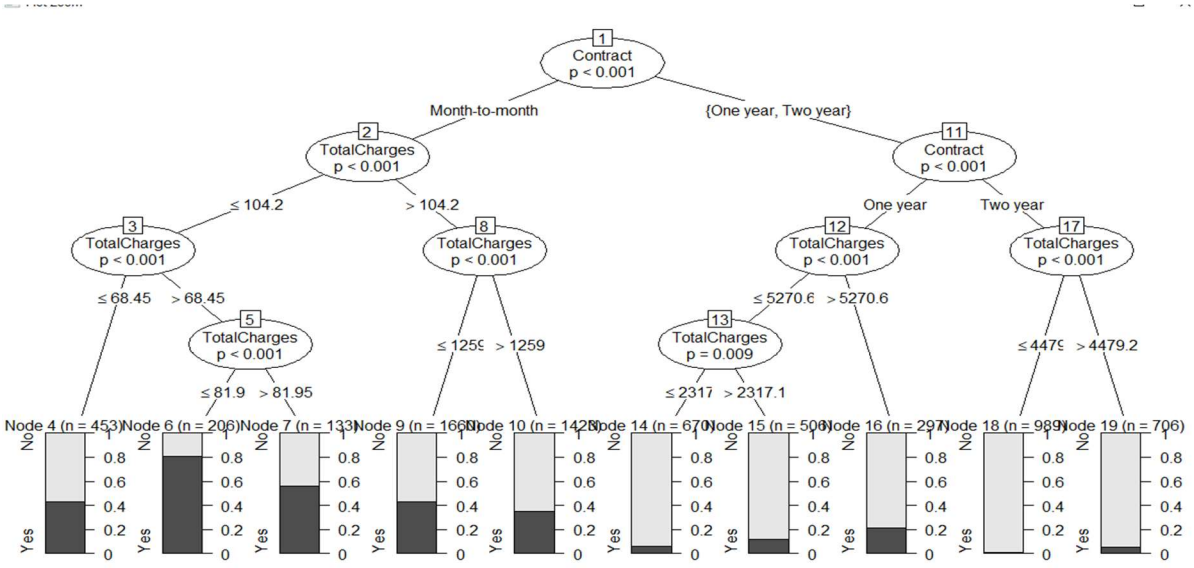

Fig 4.1.2 Best hypothesis tree

In fig 4.1.2 is the tree that which satisfy all the constraints. The tree is not over fitted and which reaches the best accuracy among the other hypothesis.

In the below fig 4.1.3 shows the rules that which are generated by the above decision tree. By using the set of rules only classification of customer is done.

```
1) Contract == {Month-to-month}; criterion = 1, statistic = 1184.428
  2) TotalCharges <= 104.2; criterion = 1, statistic = 46.517
    3) TotalCharges <= 68.45; criterion = 1, statistic = 37.867
      4)*  weights = 453
    3) TotalCharges > 68.45
      5) TotalCharges <= 81.95; criterion = 1, statistic = 17.027
        6)*  weights = 206
      5) TotalCharges > 81.95
        7)*  weights = 133
  2) TotalCharges > 104.2
    8) TotalCharges <= 1259; criterion = 1, statistic = 15.845
      9)*  weights = 1660
    8) TotalCharges > 1259
      10)*  weights = 1423
1) Contract == {One year, Two year}
  11) Contract == {One year}; criterion = 1, statistic = 89.051
    12) TotalCharges <= 5270.6; criterion = 1, statistic = 40.043
      13) TotalCharges <= 2317.1; criterion = 0.991, statistic = 8.736
        14)*  weights = 670
      13) TotalCharges > 2317.1
        15)*  weights = 506
    12) TotalCharges > 5270.6
      16)*  weights = 297
  11) Contract == {Two year}
    17) TotalCharges <= 4479.2; criterion = 1, statistic = 21.685
      18)*  weights = 989
    17) TotalCharges > 4479.2
      19)*  weights = 706
```

Fig 4.1.3 Rules Generated from Tree

In the below dig 4.1.4 shows the accuracy of the model i.e decision tree in the form of confusion matrix. Here below in the matrix the rate of YES YES and NO NO is more which states model accuracy is high.

```
Confusion Matrix and Statistics

          Reference
Prediction   No  Yes
       No  3238 1044
       Yes   65  155

               Accuracy : 0.7537
                 95% CI : (0.7408, 0.7662)
    No Information Rate : 0.7337
    P-Value [Acc > NIR] : 0.001184
```

Fig 4.1.4 Confusion matrix

4.2 Data Analysis

In data analysis first summarization is very important below fig 4.2.1 represents summary of monthly charges that which are paid by the customers.

```
> summary(data1$MonthlyCharges)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  18.75   45.85   73.25   66.40   88.88  117.40
```

Fig 4.2.1 summary of monthly charges

In fig 4.2.2 represents the summary of total charges i.e charges that are paid yearly by the customers with Min, Mean and Max ranges.

```
> summary(data1$TotalCharges)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  18.85  160.10  679.60 1369.00 2066.00 8062.00
```

Fig 4.2.2 summary of yearly charges

Here below fig 4.2.3 is Based on contract how many users are there in month to month, one year, two year. In below plot majority of users are month to month .

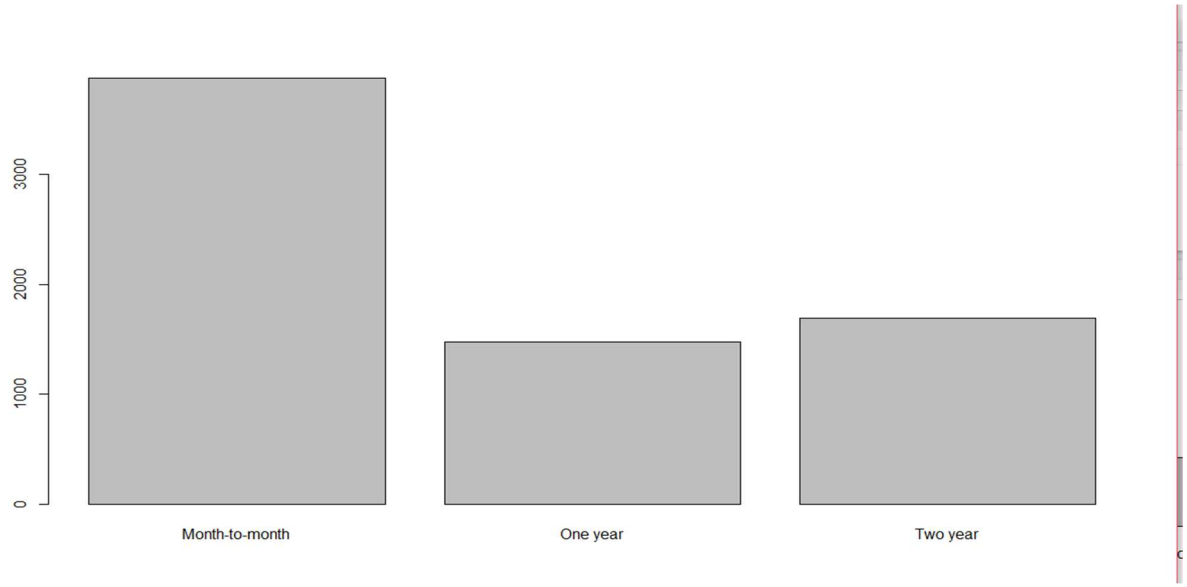

Fig 4.2.3 Bar plot on contract of customers

4.3 Clustering

Finally Clustering in done on customer charges so that a validate plan can be prepared based on that. Here k-means algorithm is used and divided into 3 clusters.

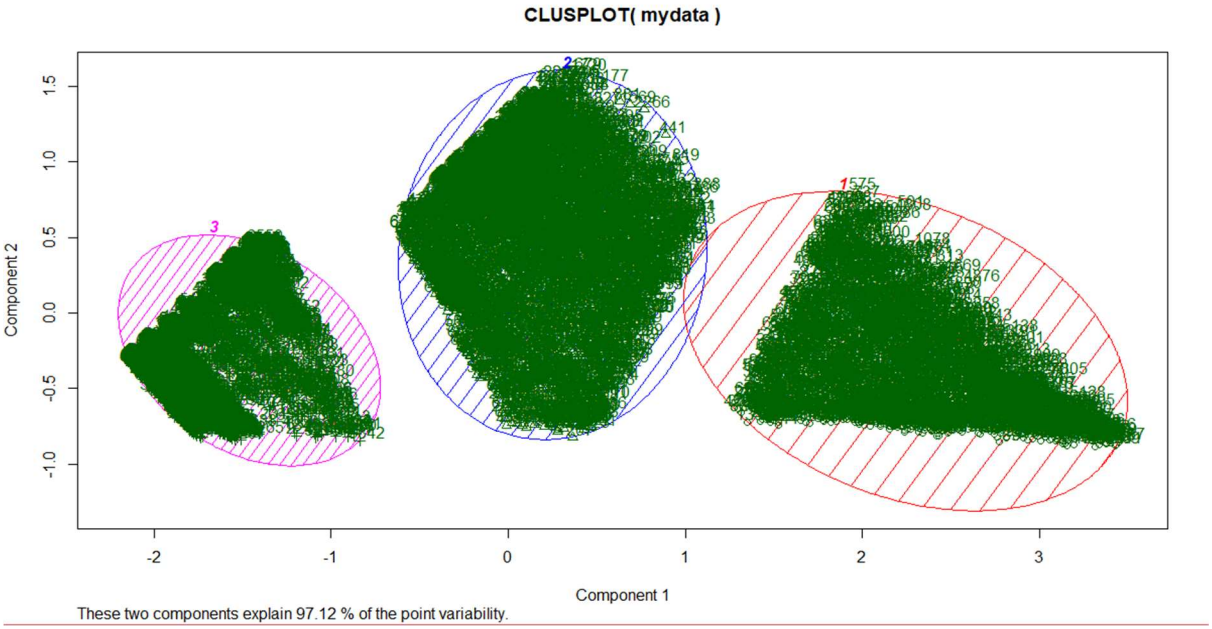

Fig 4.3.1 clustering using k-means algorithm

In the above fig 4.3.1 shows the clustering of customers based on their charges. By using that model company can offer different offers to different users.

CHAPTER 5

CONCLUSIONS AND FUTURE WORK

So Predicting behaviour of a Telco customers & analyse all relevant customer data and develop focused customer retention is done by using below steps

- From decision tree rules are generated by which a model is built in order to avoid customer churn.
- Clustering part customers are divided into groups so that set of group we can prepare some model based on their interest so that they are more satisfied with services.
- Finally from analysis plots and summarizing of data is done in order to know the insights of the business.

Future work :

Customer retention is the major aspect for any business and vast improvement in technology there is continuous generation of customer data day by day from different forms. In the above model R is applied over some set of records.

In order to overcome the present challenges **Big Data** concept comes into existence. By using **Hadoop** ecosystem storing the customers data which is continuously generating and now applying R programming for analysis Which will improve the customer retention that will ultimately leads to growth in the business.

APPENDIX

A. Classification code :

```
getwd()
setwd("C:/Users/LELLA HEMANTH/Desktop/mini")
data<-read.csv("customer.csv")
attach(data)
head(data)
library(party)
output <-ctree(Churn ~ +TotalCharges +gender + Contract ,data = data )
output1 <-ctree(Churn ~ + gender +TotalCharges+MonthlyCharges+PaperlessBilling
        +InternetService+tenure+MultipleLines+ Contract ,data = data )
print(output)
plot(output)
plot(output1)
dev.off()
data1<-read.csv("test2.csv")
library(caret)
pred<-predict(output,newdata=data1)
confusionMatrix(pred,data1$Churn)
```

B. Analysis code :

```
data<-read.csv("customer.csv")
getwd()
setwd("C:/Users/LELLA HEMANTH/Desktop/mini")
attach(data)
plot(gender)
y<-plot(InternetService)
plot(Contract)
plot(PhoneService)
data1<-data[Contract=="Month-to-month",]
plot(data1$gender)
```

```
plot(data1$InternetService)
summary(data1$MonthlyCharges)
summary(data1$TotalCharges)
plot(data1$PhoneService)
plot(MonthlyCharges)
```

C. Clustering code :

```
mydata<-read.csv("cluster.csv")
mydata = na.omit(mydata) #deletion of missing
mydata = scale(mydata) #standarize variables
wss <- (nrow(mydata)-1)*sum(apply(mydata,2,var))
for (i in 2:15) wss[i] <- sum(kmeans(mydata,
                              centers=i)$withinss)
plot(1:15, wss, type="b", xlab="Number of Clusters",
    ylab="Within groups sum of squares")
# check out the plot
fit <- kmeans(mydata, 3) # 5 cluster solution
# get cluster means
aggregate(mydata,by=list(fit$cluster),FUN=mean)
# append cluster assignment
mydata <- data.frame(mydata, fit$cluster)
a<-fit$cluster
a
mydata$cluster<-NA
mydata$cluster<-a
mydata

#visualize the clustering results
library(cluster)
clusplot(mydata, fit$cluster, color=TRUE, shade=TRUE, labels=2, lines=0
```

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