Employee_Atrittion_final_.R

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```
#Final Project
#Shivani Malandkar & Sojwal Shetye

#Cleaning
#No NAs in dataset
EmployeeAttrition=read.csv("C:\\Users\\Shiva\\Desktop\\employee_attrition_pre
diction-master\\HR-Employee-Attrition.csv")
summary(EmployeeAttrition)
```

```
##      ï..Age      Attrition            BusinessTravel   DailyRate
##  Min.   :18.00   No :1233   Non-Travel       : 150   Min.   : 102.0
##  1st Qu.:30.00   Yes: 237   Travel_Frequently: 277   1st Qu.: 465.0
##  Median :36.00              Travel_Rarely    :1043   Median : 802.0
##  Mean   :36.92                                       Mean   : 802.5
##  3rd Qu.:43.00                                       3rd Qu.:1157.0
##  Max.   :60.00                                       Max.   :1499.0
##
##                   Department  DistanceFromHome   Education
##  Human Resources       : 63   Min.   : 1.000   Min.   :1.000
##  Research & Development:961   1st Qu.: 2.000   1st Qu.:2.000
##  Sales                 :446   Median : 7.000   Median :3.000
##                               Mean   : 9.193   Mean   :2.913
##                               3rd Qu.:14.000   3rd Qu.:4.000
##                               Max.   :29.000   Max.   :5.000
##
##          EducationField EmployeeCount EmployeeNumber
##  Human Resources : 27    Min.   :1     Min.   :   1.0
##  Life Sciences   :606    1st Qu.:1     1st Qu.: 491.2
##  Marketing       :159    Median :1     Median :1020.5
##  Medical         :464    Mean   :1     Mean   :1024.9
##  Other           : 82    3rd Qu.:1     3rd Qu.:1555.8
##  Technical Degree:132    Max.   :1     Max.   :2068.0
##
##  EnvironmentSatisfaction    Gender      HourlyRate     JobInvolvement
##  Min.   :1.000           Female:588   Min.   : 30.00   Min.   :1.00
##  1st Qu.:2.000           Male  :882   1st Qu.: 48.00   1st Qu.:2.00
##  Median :3.000                        Median : 66.00   Median :3.00
##  Mean   :2.722                        Mean   : 65.89   Mean   :2.73
##  3rd Qu.:4.000                        3rd Qu.: 83.75   3rd Qu.:3.00
##  Max.   :4.000                        Max.   :100.00   Max.   :4.00
##
##     JobLevel                          JobRole    JobSatisfaction
```

```
##  Min.   :1.000   Sales Executive          :326   Min.   :1.000
##  1st Qu.:1.000   Research Scientist       :292   1st Qu.:2.000
##  Median :2.000   Laboratory Technician    :259   Median :3.000
##  Mean   :2.064   Manufacturing Director   :145   Mean   :2.729
##  3rd Qu.:3.000   Healthcare Representative:131   3rd Qu.:4.000
##  Max.   :5.000   Manager                  :102   Max.   :4.000
##                  (Other)                  :215
##   MaritalStatus MonthlyIncome    MonthlyRate    NumCompaniesWorked
##  Divorced:327   Min.   : 1009   Min.   : 2094   Min.   :0.000
##  Married :673   1st Qu.: 2911   1st Qu.: 8047   1st Qu.:1.000
##  Single  :470   Median : 4919   Median :14236   Median :2.000
##                 Mean   : 6503   Mean   :14313   Mean   :2.693
##                 3rd Qu.: 8379   3rd Qu.:20462   3rd Qu.:4.000
##                 Max.   :19999   Max.   :26999   Max.   :9.000
##
##  Over18   OverTime   PercentSalaryHike PerformanceRating
##  Y:1470   No :1054   Min.   :11.00     Min.   :3.000
##           Yes: 416   1st Qu.:12.00     1st Qu.:3.000
##                      Median :14.00     Median :3.000
##                      Mean   :15.21     Mean   :3.154
##                      3rd Qu.:18.00     3rd Qu.:3.000
##                      Max.   :25.00     Max.   :4.000
##
##  RelationshipSatisfaction StandardHours StockOptionLevel TotalWorkingYears
##  Min.   :1.000            Min.   :80    Min.   :0.0000   Min.   : 0.00
##  1st Qu.:2.000            1st Qu.:80    1st Qu.:0.0000   1st Qu.: 6.00
##  Median :3.000            Median :80    Median :1.0000   Median :10.00
##  Mean   :2.712            Mean   :80    Mean   :0.7939   Mean   :11.28
##  3rd Qu.:4.000            3rd Qu.:80    3rd Qu.:1.0000   3rd Qu.:15.00
##  Max.   :4.000            Max.   :80    Max.   :3.0000   Max.   :40.00
##
##  TrainingTimesLastYear WorkLifeBalance YearsAtCompany   YearsInCurrentRole
##  Min.   :0.000         Min.   :1.000   Min.   : 0.000   Min.   : 0.000
##  1st Qu.:2.000         1st Qu.:2.000   1st Qu.: 3.000   1st Qu.: 2.000
##  Median :3.000         Median :3.000   Median : 5.000   Median : 3.000
##  Mean   :2.799         Mean   :2.761   Mean   : 7.008   Mean   : 4.229
##  3rd Qu.:3.000         3rd Qu.:3.000   3rd Qu.: 9.000   3rd Qu.: 7.000
##  Max.   :6.000         Max.   :4.000   Max.   :40.000   Max.   :18.000
##
##  YearsSinceLastPromotion YearsWithCurrManager
##  Min.   : 0.000          Min.   : 0.000
##  1st Qu.: 0.000          1st Qu.: 2.000
##  Median : 1.000          Median : 3.000
##  Mean   : 2.188          Mean   : 4.123
##  3rd Qu.: 3.000          3rd Qu.: 7.000
##  Max.   :15.000          Max.   :17.000
##

#After looking into Summary ,We can see that there are no NA'S and Some varia
bles
```

```r
#such as Education,JobInvolvement..etc  which are factors are
##stored as integers ,so Converting these  continuos variables to Categorical
data##

names <- c('WorkLifeBalance' ,'StockOptionLevel','PerformanceRating','JobSati
sfaction',
           'RelationshipSatisfaction','JobLevel','JobInvolvement','Environmen
tSatisfaction','Education')
EmployeeAttrition[,names] <- lapply(EmployeeAttrition[,names],factor)
head(EmployeeAttrition)
```

```
##   ï..Age Attrition    BusinessTravel DailyRate              Department
## 1     41       Yes     Travel_Rarely      1102                   Sales
## 2     49        No Travel_Frequently       279 Research & Development
## 3     37       Yes     Travel_Rarely      1373 Research & Development
## 4     33        No Travel_Frequently      1392 Research & Development
## 5     27        No     Travel_Rarely       591 Research & Development
## 6     32        No Travel_Frequently      1005 Research & Development
##   DistanceFromHome Education EducationField EmployeeCount EmployeeNumber
## 1                1         2  Life Sciences             1              1
## 2                8         1  Life Sciences             1              2
## 3                2         2         Other             1              4
## 4                3         4  Life Sciences             1              5
## 5                2         1        Medical             1              7
## 6                2         2  Life Sciences             1              8
##   EnvironmentSatisfaction Gender HourlyRate JobInvolvement JobLevel
## 1                       2 Female         94              3        2
## 2                       3   Male         61              2        2
## 3                       4   Male         92              2        1
## 4                       4 Female         56              3        1
## 5                       1   Male         40              3        1
## 6                       4   Male         79              3        1
##                 JobRole JobSatisfaction MaritalStatus MonthlyIncome
## 1       Sales Executive               4        Single          5993
## 2    Research Scientist               2       Married          5130
## 3 Laboratory Technician               3        Single          2090
## 4    Research Scientist               3       Married          2909
## 5 Laboratory Technician               2       Married          3468
## 6 Laboratory Technician               4        Single          3068
##   MonthlyRate NumCompaniesWorked Over18 OverTime PercentSalaryHike
## 1       19479                  8      Y      Yes                11
## 2       24907                  1      Y       No                23
## 3        2396                  6      Y      Yes                15
## 4       23159                  1      Y      Yes                11
## 5       16632                  9      Y       No                12
## 6       11864                  0      Y       No                13
##   PerformanceRating RelationshipSatisfaction StandardHours
## 1                 3                       1            80
## 2                 4                       4            80
## 3                 3                       2            80
```

```
## 4                  3                         3            80
## 5                  3                         4            80
## 6                  3                         3            80
##   StockOptionLevel TotalWorkingYears TrainingTimesLastYear WorkLifeBalance
## 1                0                  8                     0               1
## 2                1                 10                     3               3
## 3                0                  7                     3               3
## 4                0                  8                     3               3
## 5                1                  6                     3               3
## 6                0                  8                     2               2
##   YearsAtCompany YearsInCurrentRole YearsSinceLastPromotion
## 1              6                  4                       0
## 2             10                  7                       1
## 3              0                  0                       0
## 4              8                  7                       3
## 5              2                  2                       2
## 6              7                  7                       3
##   YearsWithCurrManager
## 1                    5
## 2                    7
## 3                    0
## 4                    0
## 5                    2
## 6                    6
```

```
#Checking for missing value and removing non value attribute
apply(is.na(EmployeeAttrition),2,sum)
```

```
##                   ï..Age                 Attrition             BusinessTravel
##                        0                         0                          0
##                DailyRate                Department          DistanceFromHome
##                        0                         0                          0
##                Education             EducationField             EmployeeCount
##                        0                         0                          0
##           EmployeeNumber  EnvironmentSatisfaction                     Gender
##                        0                         0                          0
##               HourlyRate           JobInvolvement                   JobLevel
##                        0                         0                          0
##                  JobRole           JobSatisfaction              MaritalStatus
##                        0                         0                          0
##            MonthlyIncome               MonthlyRate         NumCompaniesWorked
##                        0                         0                          0
##                   Over18                 OverTime          PercentSalaryHike
##                        0                         0                          0
##        PerformanceRating RelationshipSatisfaction              StandardHours
##                        0                         0                          0
##         StockOptionLevel         TotalWorkingYears     TrainingTimesLastYear
##                        0                         0                          0
##          WorkLifeBalance             YearsAtCompany         YearsInCurrentRole
##                        0                         0                          0
```

```
##  YearsSinceLastPromotion     YearsWithCurrManager
##                        0                        0
```

```
EmployeeAttrition$EmployeeNumber=NULL
EmployeeAttrition$StandardHours=NULL
EmployeeAttrition$Over18=NULL
EmployeeAttrition$EmployeeCount=NULL
cat("Data Set has",dim(EmployeeAttrition)[1],"Rows and",dim(EmployeeAttrition
)[2],"Columns")
```

```
## Data Set has 1470 Rows and 31 Columns
```

```
sum(is.na(duplicated(EmployeeAttrition)))#No missing values and no duplicate
```

```
## [1] 0
```

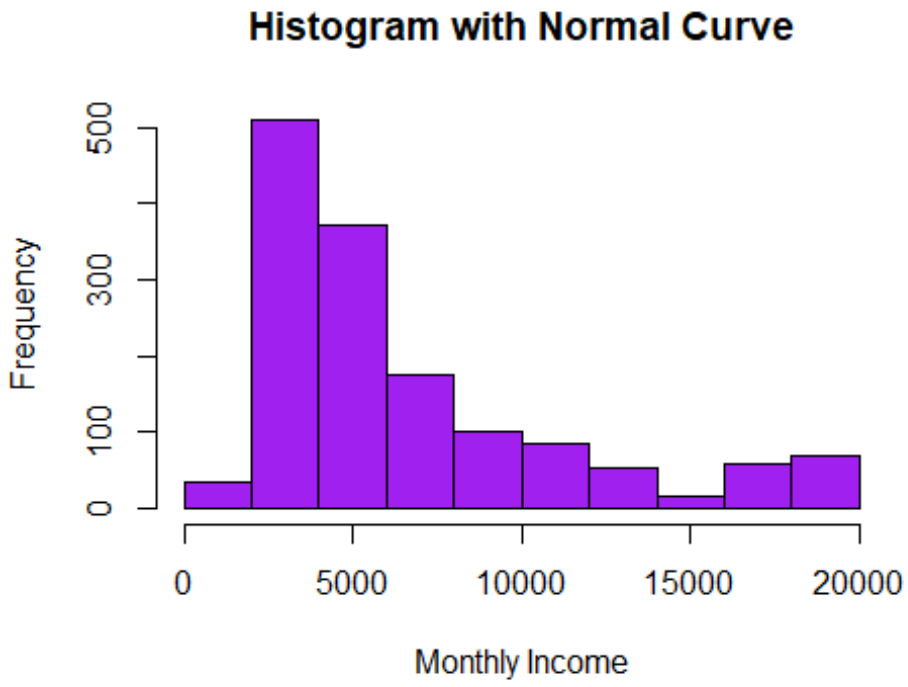
```
#Removing columns which have same value for all
cleaned_data=EmployeeAttrition[,-c(9,10,22,27)]
#replacing all blank cells with NA
cleaned_data[cleaned_data==""]=NA
#removing all rows with any blank cell
cleaned_data=cleaned_data[complete.cases(cleaned_data), ]
str(cleaned_data)
```

```
## 'data.frame':    1470 obs. of  27 variables:
##  $ ï..Age                  : int  41 49 37 33 27 32 59 30 38 36 ...
##  $ Attrition               : Factor w/ 2 levels "No","Yes": 2 1 2 1 1 1 1
1 1 1 ...
##  $ BusinessTravel          : Factor w/ 3 levels "Non-Travel","Travel_Frequ
ently",..: 3 2 3 2 3 2 3 3 2 3 ...
##  $ DailyRate               : int  1102 279 1373 1392 591 1005 1324 1358 21
6 1299 ...
##  $ Department              : Factor w/ 3 levels "Human Resources",..: 3 2
2 2 2 2 2 2 2 2 ...
##  $ DistanceFromHome        : int  1 8 2 3 2 2 3 24 23 27 ...
##  $ Education               : Factor w/ 5 levels "1","2","3","4",..: 2 1 2
4 1 2 3 1 3 3 ...
##  $ EducationField          : Factor w/ 6 levels "Human Resources",..: 2 2
5 2 4 2 4 2 2 4 ...
##  $ HourlyRate              : int  94 61 92 56 40 79 81 67 44 94 ...
##  $ JobInvolvement          : Factor w/ 4 levels "1","2","3","4": 3 2 2 3 3
3 4 3 2 3 ...
##  $ JobLevel                : Factor w/ 5 levels "1","2","3","4",..: 2 2 1
1 1 1 1 1 3 2 ...
##  $ JobRole                 : Factor w/ 9 levels "Healthcare Representative
",..: 8 7 3 7 3 3 3 3 5 1 ...
##  $ JobSatisfaction         : Factor w/ 4 levels "1","2","3","4": 4 2 3 3 2
4 1 3 3 3 ...
##  $ MaritalStatus           : Factor w/ 3 levels "Divorced","Married",..: 3
2 3 2 2 3 2 1 3 2 ...
##  $ MonthlyIncome           : int  5993 5130 2090 2909 3468 3068 2670 2693
```

```
9526 5237 ...
##  $ MonthlyRate             : int  19479 24907 2396 23159 16632 11864 9964
13335 8787 16577 ...
##  $ NumCompaniesWorked      : int  8 1 6 1 9 0 4 1 0 6 ...
##  $ OverTime                : Factor w/ 2 levels "No","Yes": 2 1 2 2 1 1 2
1 1 1 ...
##  $ PercentSalaryHike       : int  11 23 15 11 12 13 20 22 21 13 ...
##  $ RelationshipSatisfaction: Factor w/ 4 levels "1","2","3","4": 1 4 2 3 4
3 1 2 2 2 ...
##  $ StockOptionLevel        : Factor w/ 4 levels "0","1","2","3": 1 2 1 1 2
1 4 2 1 3 ...
##  $ TotalWorkingYears       : int  8 10 7 8 6 8 12 1 10 17 ...
##  $ TrainingTimesLastYear   : int  0 3 3 3 3 2 3 2 2 3 ...
##  $ YearsAtCompany          : int  6 10 0 8 2 7 1 1 9 7 ...
##  $ YearsInCurrentRole      : int  4 7 0 7 2 7 0 0 7 7 ...
##  $ YearsSinceLastPromotion : int  0 1 0 3 2 3 0 0 1 7 ...
##  $ YearsWithCurrManager    : int  5 7 0 0 2 6 0 0 8 7 ...

library(ggplot2)

library(tidyr)

library(dplyr)

##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union

library(corrplot)

## corrplot 0.84 loaded

library(miscset)

##
## Attaching package: 'miscset'

## The following object is masked from 'package:dplyr':
##
##     collapse

library(purrr)
require(gridExtra)

## Loading required package: gridExtra
```

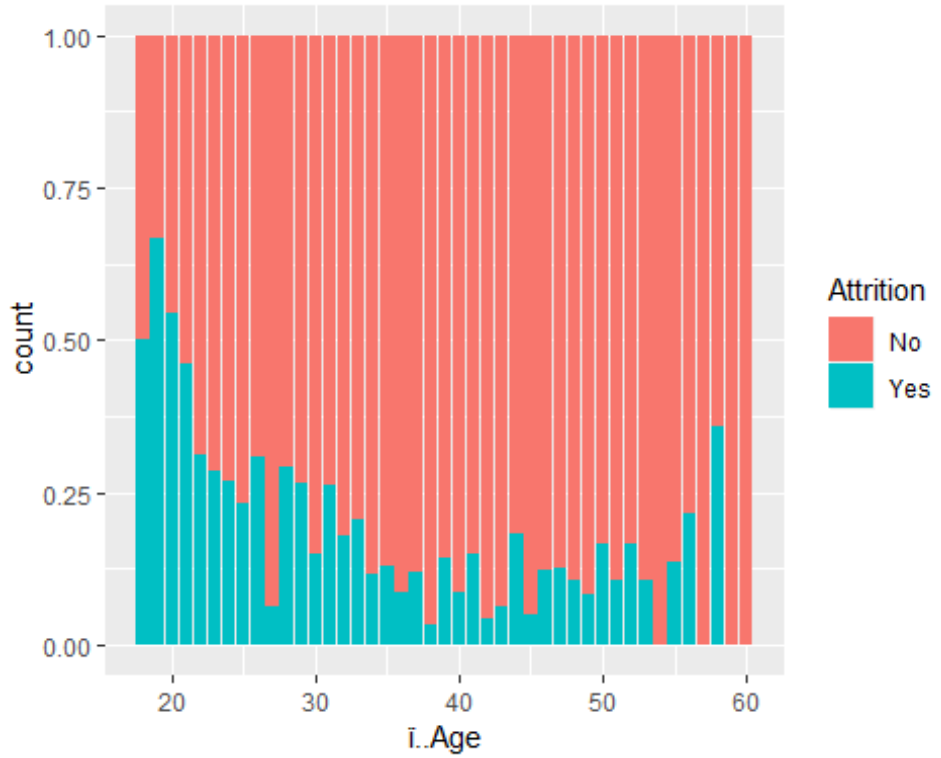
```
##
## Attaching package: 'gridExtra'

## The following object is masked from 'package:dplyr':
##
##     combine

library(caTools)


library(e1071)

library(glmnet)

## Loading required package: Matrix

##
## Attaching package: 'Matrix'

## The following object is masked from 'package:tidyr':
##
##     expand

## Loading required package: foreach

##
## Attaching package: 'foreach'

## The following objects are masked from 'package:purrr':
##
##     accumulate, when

## Loaded glmnet 2.0-16

#Exploring the data
dim(cleaned_data)

## [1] 1470   27

#performing cross validation, its important to maintain this turnover ratio
attrition<-as.factor(cleaned_data$Attrition)
summary(attrition)#We can see that 237 employees have been retained whereas 1
233 employees have been let go of.

##   No  Yes
## 1233  237

#Exploratory data plots
# Histogram with normal curve for monthly income
# Histogram
histogram.curve <- hist(cleaned_data$MonthlyIncome, breaks = 10, col = "purpl
e", xlab = "Monthly Income", main = "Histogram with Normal Curve")
# Adding normal curve to the histogram
```

```r
xfit <- seq(min(cleaned_data[,19]), max(cleaned_data[,19]), length=40)
yfit <- dnorm(xfit, mean=mean(cleaned_data[,19]), sd=sd((cleaned_data[,19])))
yfit <- yfit*diff(histogram.curve$mids[1:2])*length(cleaned_data$MonthlyIncom
e)
lines(xfit, yfit, col ="black", lwd=2)
```

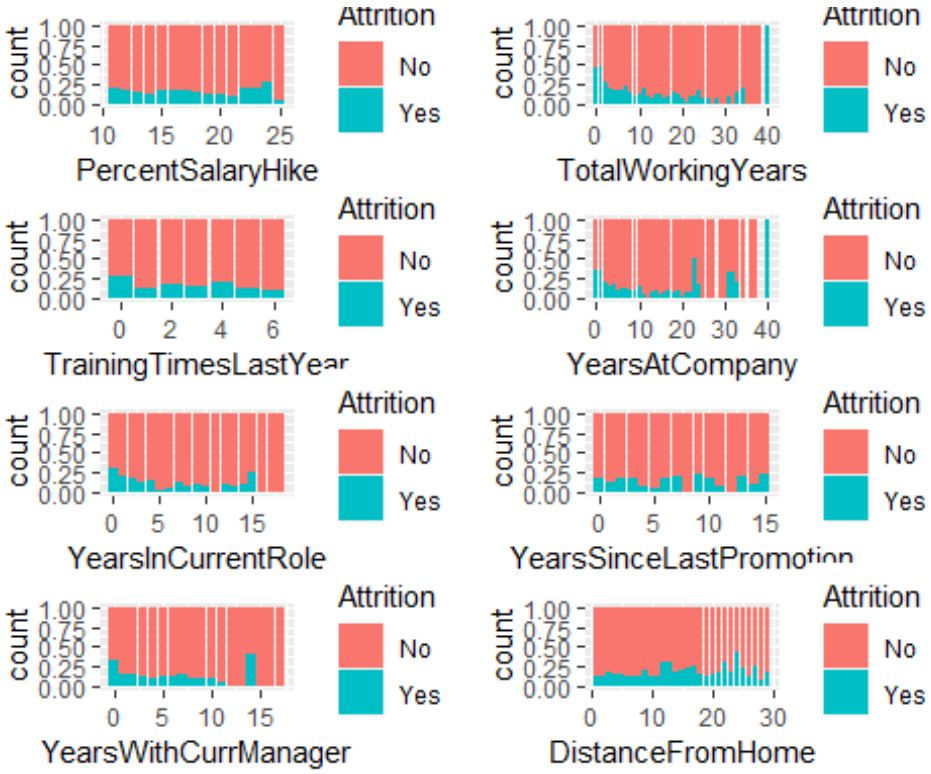



```r
# Plot showing relationships between employees leaving the company with respe
ct to monthly income, percent salary hike and job level
library(ggplot2)
pl <- ggplot(cleaned_data, aes(x=MonthlyIncome, y=PercentSalaryHike)) + geom_
point(shape=2)+ ggtitle("Effect of Job Level(1-5), PercentSalaryHike and Mont
hlyIncome on Attrition(Y/N)")
pl + facet_grid(Attrition ~ JobLevel)
```


```
ggplot(cleaned_data,aes(x = ï..Age ,fill = Attrition)) + geom_bar(position =
"fill")
```

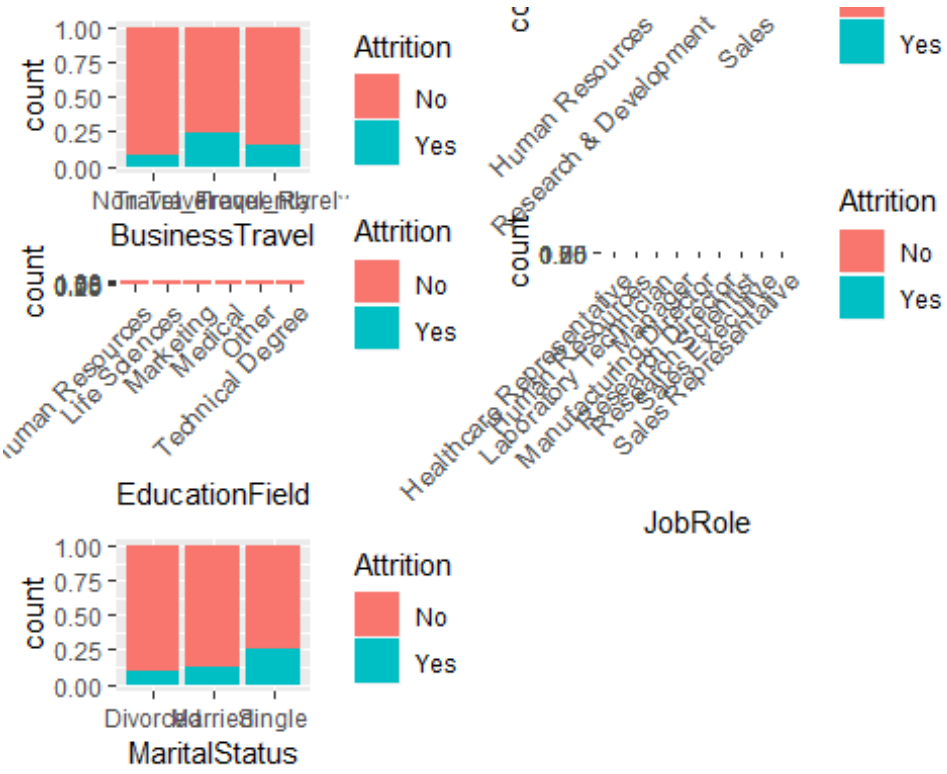


```r
co2 <- ggplot(cleaned_data,aes(x = PercentSalaryHike,fill = Attrition)) +
  geom_bar(position = "fill")

co3 <- ggplot(cleaned_data,aes(x = TotalWorkingYears,fill = Attrition)) +
  geom_bar(position = "fill")

co4 <- ggplot(cleaned_data,aes(x = TrainingTimesLastYear,fill = Attrition)) +
  geom_bar(position = "fill")

co5 <- ggplot(cleaned_data,aes(x = YearsAtCompany,fill = Attrition)) +
  geom_bar(position = "fill")

co6 <- ggplot(cleaned_data,aes(x = YearsInCurrentRole,fill = Attrition)) +
  geom_bar(position = "fill")

co7 <- ggplot(cleaned_data,aes(x = YearsSinceLastPromotion,fill = Attrition))
+
  geom_bar(position = "fill")

co8 <- ggplot(cleaned_data,aes(x = YearsWithCurrManager,fill = Attrition)) +
  geom_bar(position = "fill")

co9 <- ggplot(cleaned_data,aes(x = DistanceFromHome,fill = Attrition)) +
  geom_bar(position = "fill")

co10 <- ggplot()

grid.arrange(co2,co3,co4,co5,co6,co7,co8,co9,ncol=2)
```

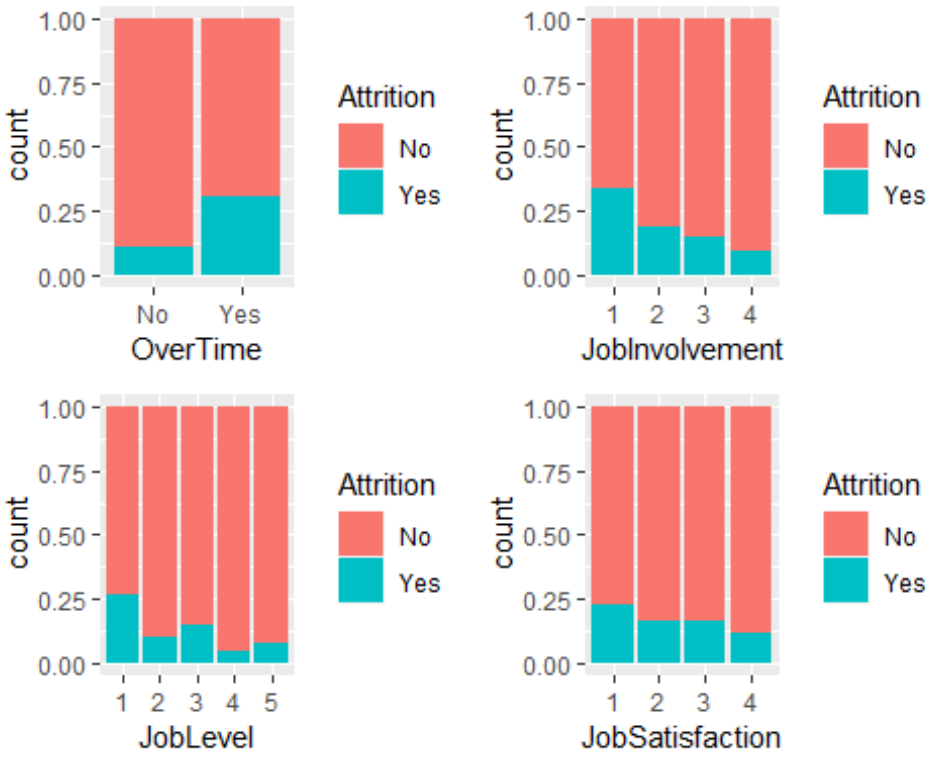



```
pc1 <- ggplot(cleaned_data,aes(x = BusinessTravel,..count..)) +
  geom_bar(aes(fill = Attrition),position = "fill")


pc2 <- ggplot(cleaned_data,aes(x = Department,..count..)) +
  geom_bar(aes(fill = Attrition),position = "fill") +
  theme(axis.text.x = element_text(size  = 10, angle = 45,hjust = 1,vjust = 1
))

pc3 <- ggplot(cleaned_data,aes(x = EducationField,..count..)) +
  geom_bar(aes(fill = Attrition),position = "fill") +
  theme(axis.text.x = element_text(size  = 10, angle = 45,hjust = 1,vjust = 1
))



pc5 <- ggplot(cleaned_data,aes(x = JobRole,..count..)) +
  geom_bar(aes(fill = Attrition),position = "fill") +
  theme(axis.text.x = element_text(size  = 10, angle = 45,hjust = 1,vjust = 1
))

pc6 <- ggplot(cleaned_data,aes(x = MaritalStatus,..count..)) +
  geom_bar(aes(fill = Attrition),position = "fill")

pc7 <- ggplot(cleaned_data,aes(x = OverTime,..count..)) +
  geom_bar(aes(fill = Attrition),position = "fill")
```

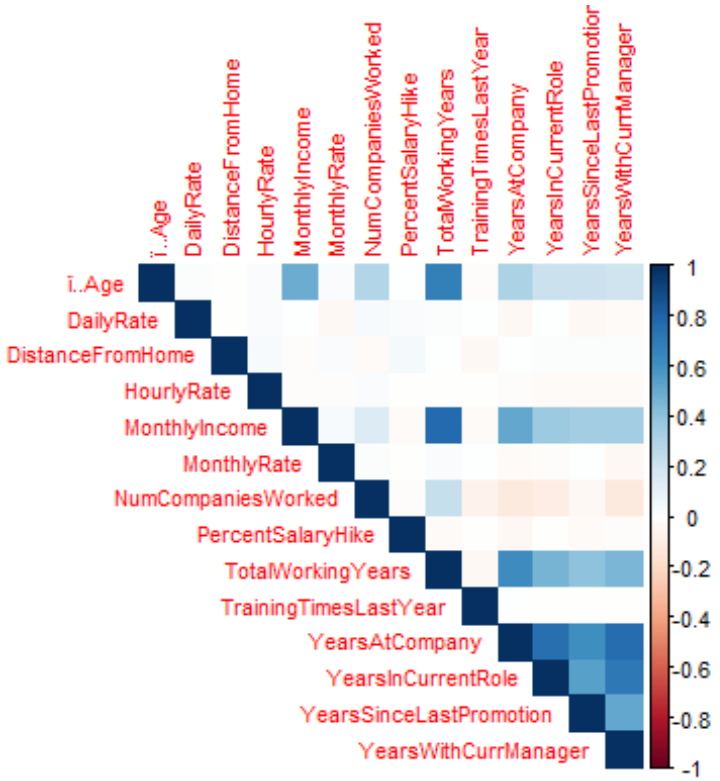
```
pc9 <- ggplot(cleaned_data,aes(x = JobInvolvement,..count..)) +
  geom_bar(aes(fill = Attrition),position = "fill")

pc10 <- ggplot(cleaned_data,aes(x = JobLevel,..count..)) +
  geom_bar(aes(fill = Attrition),position = "fill")

pc11 <- ggplot(cleaned_data,aes(x = JobSatisfaction,..count..)) +
  geom_bar(aes(fill = Attrition),position = "fill")

grid.arrange(pc1,pc2,pc3,pc5,pc6,ncol =2)
```




```
####From these graphs, we can Infer that Education and Performance Rating,Tra
ining times since
#last year  doesnot impact on Employee Attrition

grid.arrange(pc7,pc9,pc10,pc11,ncol =2)
```

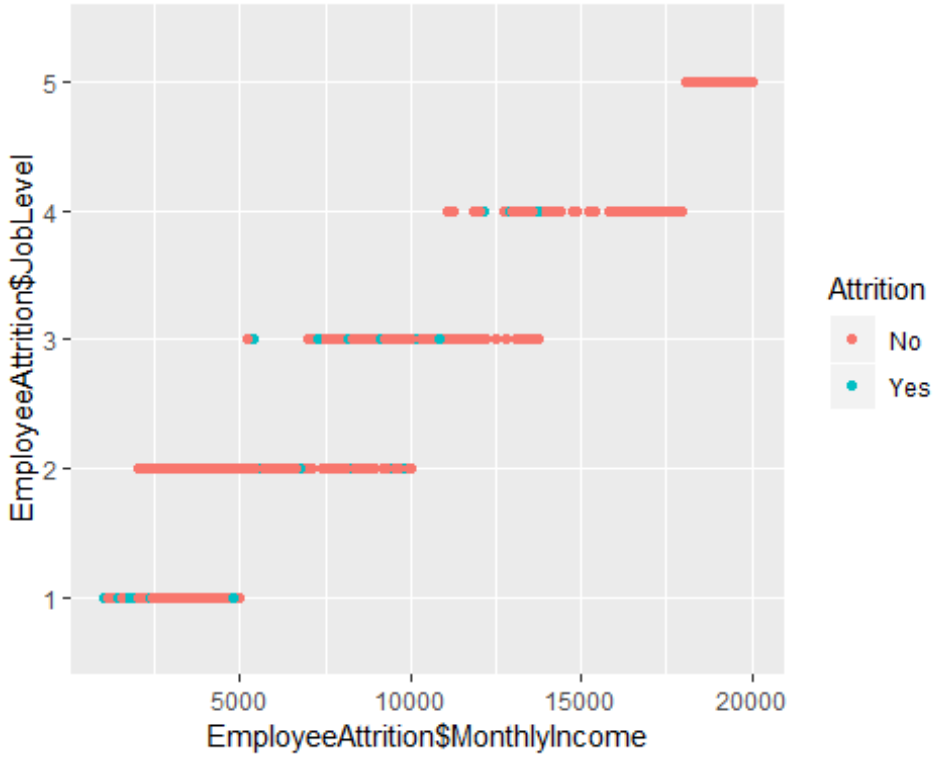



```
#From this ,We can infer that employees who  travel frequently will leave
#company when company when compared to Non-Travellers. More than 25% of Emplo
yees who work Overtime leave the company

#So, Education Field, Gender, Department ,Trainingtimessincelastyear, Perform
ance rating and
##Education Field are not strong predictors and I will not be including these
variables.


#Checking if there is Multi-Co linearity - High Correlation between
#ndependent variables
library(corrplot)
empn <- which(sapply(cleaned_data,is.numeric))
corrplot(cor(cleaned_data[empn]),type = "upper",method='color',tl.cex = .7,cl
.cex = .7,number.cex = 0.7)
```

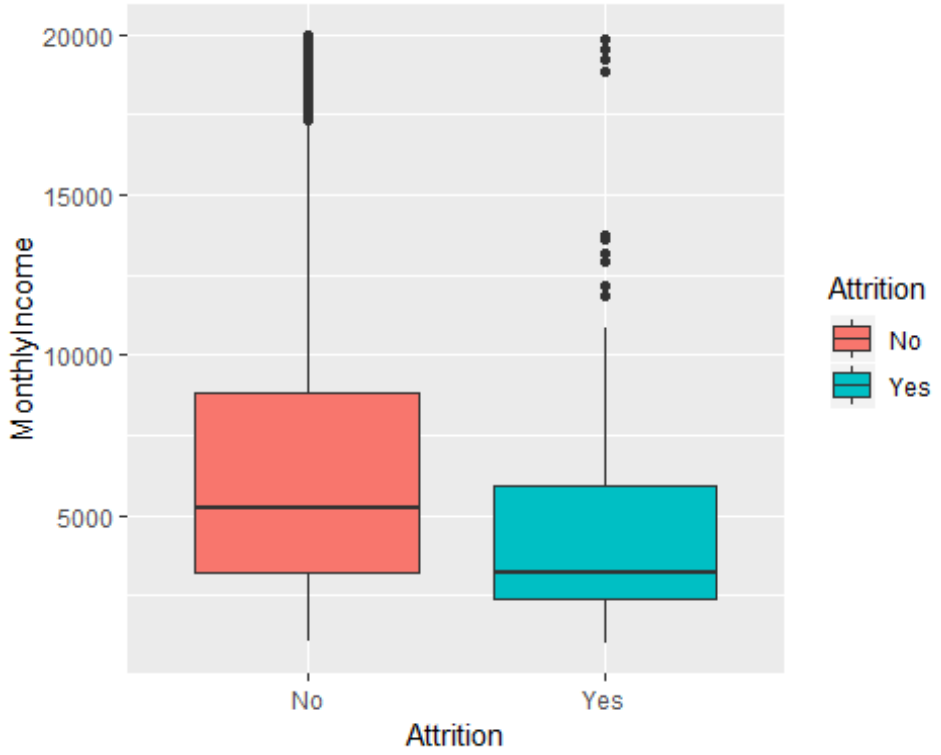



```
#scatter plot between monthly income, work life balance and attrition
ggplot(EmployeeAttrition,aes(EmployeeAttrition$MonthlyIncome,EmployeeAttritio
n$WorkLifeBalance, color=Attrition))+geom_point()
```

```
#scatter plot between monthly income, JobLevel and attrition
ggplot(EmployeeAttrition,aes(EmployeeAttrition$MonthlyIncome,EmployeeAttritio
n$JobLevel, color=Attrition))+geom_point()
```




```
#boxplot between monthly income and attrition
ggplot(cleaned_data,aes(Attrition,MonthlyIncome,fill=Attrition))+geom_boxplot
()
```

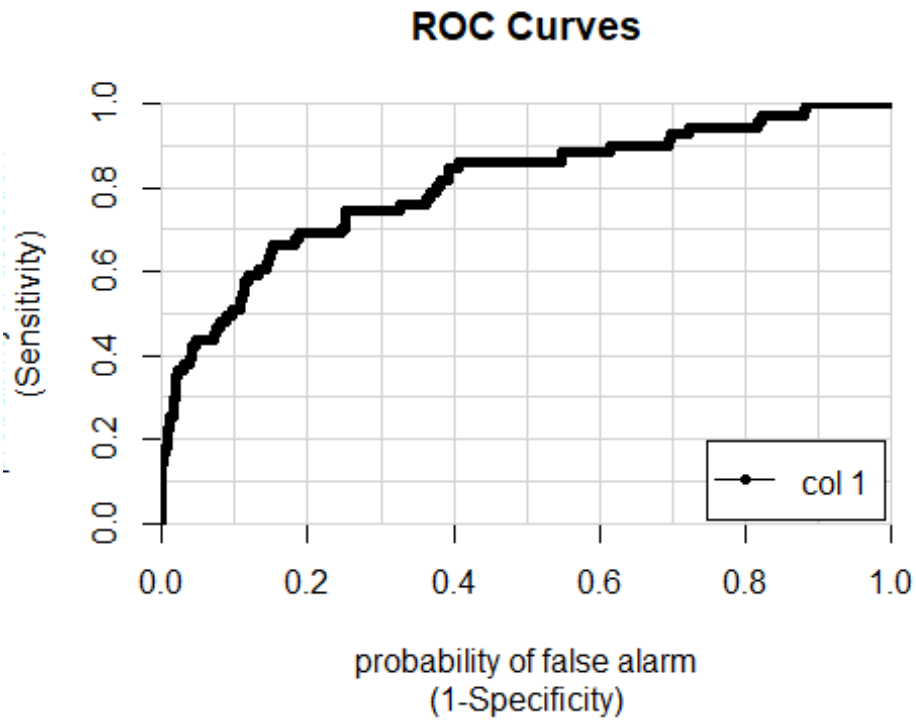



```
#Logistic Regression
#We split the data into two chunks: training and testing set. The training se
t will be used to fit our model.

#install.packages('caret')
#Load package
library(caret)

## Loading required package: lattice

##
## Attaching package: 'caret'

## The following object is masked from 'package:purrr':
##
##     lift

trainIndex = createDataPartition(cleaned_data$Attrition,
                                 p=0.7, list=FALSE,times=1)

train = cleaned_data[trainIndex,]
test = cleaned_data[-trainIndex,]

model <- glm(Attrition ~.,family=binomial(link='logit'),data=train)
summary(model)
```

```
##
## Call:
## glm(formula = Attrition ~ ., family = binomial(link = "logit"),
##     data = train)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.9126  -0.4269  -0.1948  -0.0514   3.5904
##
## Coefficients:
##                                  Estimate Std. Error z value Pr(>|z|)
## (Intercept)                    -1.261e+01  6.619e+02  -0.019 0.984795
## ï..Age                         -5.729e-02  1.834e-02  -3.124 0.001786
## BusinessTravelTravel_Frequently  1.232e+00  4.865e-01   2.532 0.011341
## BusinessTravelTravel_Rarely      2.529e-01  4.478e-01   0.565 0.572191
## DailyRate                      -2.902e-04  2.800e-04  -1.037 0.299926
## DepartmentResearch & Development 1.606e+01  6.619e+02   0.024 0.980640
## DepartmentSales                  1.459e+01  6.619e+02   0.022 0.982419
## DistanceFromHome                 6.011e-02  1.371e-02   4.384 1.16e-05
## Education2                       8.145e-01  4.304e-01   1.892 0.058451
## Education3                       4.570e-01  3.794e-01   1.205 0.228380
## Education4                       4.247e-01  4.161e-01   1.021 0.307394
## Education5                       4.888e-02  8.208e-01   0.060 0.952513
## EducationFieldLife Sciences    -1.753e+00  1.087e+00  -1.613 0.106667
## EducationFieldMarketing        -1.201e+00  1.144e+00  -1.050 0.293899
## EducationFieldMedical          -1.799e+00  1.088e+00  -1.653 0.098301
## EducationFieldOther            -1.939e+00  1.163e+00  -1.667 0.095502
## EducationFieldTechnical Degree -7.081e-01  1.112e+00  -0.637 0.524086
## HourlyRate                       1.123e-03  5.737e-03   0.196 0.844828
## JobInvolvement2                -1.230e+00  4.256e-01  -2.890 0.003854
## JobInvolvement3                -1.612e+00  4.029e-01  -4.001 6.31e-05
## JobInvolvement4                -1.840e+00  5.605e-01  -3.283 0.001029
## JobLevel2                      -2.022e+00  5.882e-01  -3.437 0.000587
## JobLevel3                      -2.488e-01  8.827e-01  -0.282 0.778075
## JobLevel4                      -1.823e+00  1.491e+00  -1.223 0.221424
## JobLevel5                        8.995e-01  1.949e+00   0.462 0.644412
## JobRoleHuman Resources           1.644e+01  6.619e+02   0.025 0.980182
## JobRoleLaboratory Technician     7.020e-01  7.216e-01   0.973 0.330589
## JobRoleManager                   7.329e-01  1.138e+00   0.644 0.519523
## JobRoleManufacturing Director    2.809e-01  7.002e-01   0.401 0.688278
## JobRoleResearch Director       -1.413e+00  1.583e+00  -0.892 0.372151
## JobRoleResearch Scientist      -4.255e-01  7.453e-01  -0.571 0.568113
## JobRoleSales Executive           3.032e+00  1.446e+00   2.097 0.036018
## JobRoleSales Representative      2.286e+00  1.548e+00   1.477 0.139785
## JobSatisfaction2               -7.109e-01  3.532e-01  -2.013 0.044123
## JobSatisfaction3               -4.475e-01  3.029e-01  -1.477 0.139629
## JobSatisfaction4               -1.393e+00  3.442e-01  -4.048 5.17e-05
## MaritalStatusMarried             3.674e-01  3.495e-01   1.051 0.293075
## MaritalStatusSingle              6.768e-01  5.043e-01   1.342 0.179623
## MonthlyIncome                  -7.064e-05  1.151e-04  -0.614 0.539414
```

```
## MonthlyRate                          1.506e-05  1.578e-05   0.954 0.339928
## NumCompaniesWorked                   2.403e-01  4.872e-02   4.932 8.15e-07
## OverTimeYes                          2.456e+00  2.584e-01   9.504  < 2e-16
## PercentSalaryHike                   -2.753e-03  3.100e-02  -0.089 0.929232
## RelationshipSatisfaction2           -9.808e-01  3.492e-01  -2.808 0.004978
## RelationshipSatisfaction3           -1.439e+00  3.228e-01  -4.457 8.32e-06
## RelationshipSatisfaction4           -1.439e+00  3.220e-01  -4.468 7.89e-06
## StockOptionLevel1                   -1.140e+00  3.970e-01  -2.871 0.004092
## StockOptionLevel2                   -1.042e+00  5.549e-01  -1.879 0.060285
## StockOptionLevel3                   -2.177e-01  5.991e-01  -0.363 0.716282
## TotalWorkingYears                   -1.873e-02  3.579e-02  -0.523 0.600780
## TrainingTimesLastYear               -2.565e-01  9.353e-02  -2.743 0.006097
## YearsAtCompany                       1.373e-01  5.266e-02   2.608 0.009119
## YearsInCurrentRole                  -1.964e-01  6.271e-02  -3.132 0.001736
## YearsSinceLastPromotion              9.630e-02  5.455e-02   1.765 0.077503
## YearsWithCurrManager                -1.509e-01  6.117e-02  -2.466 0.013644
##
## (Intercept)
## ï..Age                              **
## BusinessTravelTravel_Frequently     *
## BusinessTravelTravel_Rarely
## DailyRate
## DepartmentResearch & Development
## DepartmentSales
## DistanceFromHome                    ***
## Education2                          .
## Education3
## Education4
## Education5
## EducationFieldLife Sciences
## EducationFieldMarketing
## EducationFieldMedical               .
## EducationFieldOther                 .
## EducationFieldTechnical Degree
## HourlyRate
## JobInvolvement2                     **
## JobInvolvement3                     ***
## JobInvolvement4                     **
## JobLevel2                           ***
## JobLevel3
## JobLevel4
## JobLevel5
## JobRoleHuman Resources
## JobRoleLaboratory Technician
## JobRoleManager
## JobRoleManufacturing Director
## JobRoleResearch Director
## JobRoleResearch Scientist
## JobRoleSales Executive              *
## JobRoleSales Representative
```

```
## JobSatisfaction2                  *
## JobSatisfaction3
## JobSatisfaction4                  ***
## MaritalStatusMarried
## MaritalStatusSingle
## MonthlyIncome
## MonthlyRate
## NumCompaniesWorked                ***
## OverTimeYes                       ***
## PercentSalaryHike
## RelationshipSatisfaction2         **
## RelationshipSatisfaction3         ***
## RelationshipSatisfaction4         ***
## StockOptionLevel1                 **
## StockOptionLevel2                 .
## StockOptionLevel3
## TotalWorkingYears
## TrainingTimesLastYear             **
## YearsAtCompany                    **
## YearsInCurrentRole                **
## YearsSinceLastPromotion           .
## YearsWithCurrManager              *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 909.69  on 1029  degrees of freedom
## Residual deviance: 540.41  on  975  degrees of freedom
## AIC: 650.41
##
## Number of Fisher Scoring iterations: 15

# Predicting the results using testing dataset
LR_model.predict <- predict(model, test, type = "response")
length(LR_model.predict)

## [1] 440

length(test$Attrition)

## [1] 440

library(caTools)
colAUC(LR_model.predict,test$Attrition, plotROC=TRUE)
```



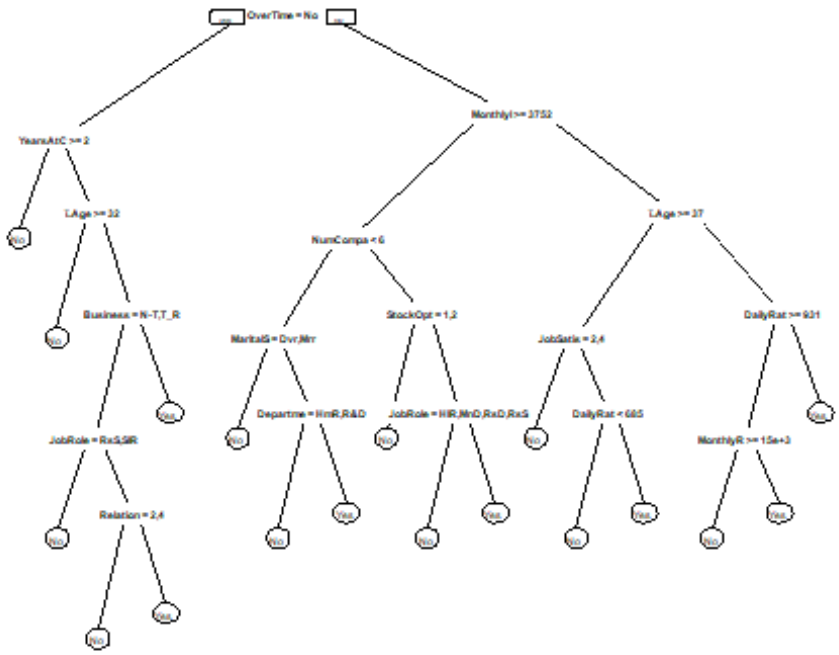

```
##                  [,1]
## No vs. Yes 0.8055269

#Column under ROC

#Make use of the confusion matrix
conf_mat = table(LR_model.predict,test$Attrition)

#To evaluate this model, we will use 10 repeats of 10-fold cross-validation a
nd use the 100 holdout samples to evaluate the overall accuracy of the model.
set.seed(123)

library(devtools)

library(caret)

# Define train control for k fold cross validation
train_control <- trainControl(method="cv", number=10)
# Fit Naive Bayes Model
model2 <- train(Attrition ~., data=cleaned_data, trControl=train_control, met
hod="glm",family=binomial())
# Summarise Results
summary(model2)

##
## Call:
## NULL
```

```
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.6752  -0.4701  -0.2239  -0.0696   3.3655
##
## Coefficients:
##                                   Estimate Std. Error z value Pr(>|z|)
## (Intercept)                     -1.227e+01  6.221e+02  -0.020 0.984261
## ï..Age                          -3.197e-02  1.389e-02  -2.302 0.021322
## BusinessTravelTravel_Frequently  1.893e+00  4.237e-01   4.467 7.94e-06
## BusinessTravelTravel_Rarely      9.106e-01  3.928e-01   2.318 0.020437
## DailyRate                       -3.578e-04  2.238e-04  -1.599 0.109834
## `DepartmentResearch & Development`  1.440e+01  6.221e+02   0.023 0.981537
## DepartmentSales                  1.372e+01  6.221e+02   0.022 0.982409
## DistanceFromHome                 4.774e-02  1.110e-02   4.301 1.70e-05
## Education2                       3.803e-01  3.378e-01   1.126 0.260242
## Education3                       3.276e-01  2.983e-01   1.098 0.272166
## Education4                       4.048e-01  3.231e-01   1.253 0.210357
## Education5                       1.603e-01  6.274e-01   0.255 0.798380
## `EducationFieldLife Sciences`   -1.023e+00  8.737e-01  -1.171 0.241668
## EducationFieldMarketing         -5.524e-01  9.171e-01  -0.602 0.546937
## EducationFieldMedical           -1.108e+00  8.736e-01  -1.268 0.204805
## EducationFieldOther             -1.237e+00  9.437e-01  -1.311 0.189905
## `EducationFieldTechnical Degree`  -3.008e-02  8.913e-01  -0.034 0.973078
## HourlyRate                       2.728e-03  4.553e-03   0.599 0.549026
## JobInvolvement2                 -1.296e+00  3.546e-01  -3.655 0.000257
## JobInvolvement3                 -1.588e+00  3.354e-01  -4.734 2.20e-06
## JobInvolvement4                 -2.184e+00  4.722e-01  -4.625 3.74e-06
## JobLevel2                       -1.563e+00  4.570e-01  -3.421 0.000624
## JobLevel3                       -3.139e-02  7.075e-01  -0.044 0.964610
## JobLevel4                       -1.083e+00  1.211e+00  -0.895 0.370821
## JobLevel5                        1.734e+00  1.605e+00   1.080 0.280122
## `JobRoleHuman Resources`         1.463e+01  6.221e+02   0.024 0.981239
## `JobRoleLaboratory Technician`   6.411e-01  5.812e-01   1.103 0.270021
## JobRoleManager                  -1.693e-01  1.080e+00  -0.157 0.875388
## `JobRoleManufacturing Director`  1.457e-01  5.484e-01   0.266 0.790418
## `JobRoleResearch Director`      -2.033e+00  1.182e+00  -1.719 0.085532
## `JobRoleResearch Scientist`     -4.554e-01  5.983e-01  -0.761 0.446556
## `JobRoleSales Executive`         1.909e+00  1.204e+00   1.585 0.112865
## `JobRoleSales Representative`    1.484e+00  1.285e+00   1.154 0.248306
## JobSatisfaction2                -6.826e-01  2.790e-01  -2.447 0.014399
## JobSatisfaction3                -6.138e-01  2.461e-01  -2.494 0.012616
## JobSatisfaction4                -1.209e+00  2.618e-01  -4.618 3.88e-06
## MaritalStatusMarried             2.664e-01  2.833e-01   0.940 0.346969
## MaritalStatusSingle              3.858e-01  3.990e-01   0.967 0.333540
## MonthlyIncome                   -1.073e-04  9.193e-05  -1.168 0.242978
## MonthlyRate                      6.241e-06  1.268e-05   0.492 0.622727
## NumCompaniesWorked               2.039e-01  3.944e-02   5.169 2.35e-07
## OverTimeYes                      1.946e+00  1.961e-01   9.925  < 2e-16
## PercentSalaryHike               -6.061e-03  2.525e-02  -0.240 0.810315
```

```
## RelationshipSatisfaction2          -8.947e-01  2.908e-01  -3.077 0.002091
## RelationshipSatisfaction3          -9.475e-01  2.570e-01  -3.688 0.000226
## RelationshipSatisfaction4          -9.498e-01  2.574e-01  -3.689 0.000225
## StockOptionLevel1                  -1.277e+00  3.132e-01  -4.077 4.57e-05
## StockOptionLevel2                  -1.221e+00  4.394e-01  -2.780 0.005440
## StockOptionLevel3                  -5.425e-01  4.642e-01  -1.169 0.242572
## TotalWorkingYears                  -3.835e-02  2.897e-02  -1.324 0.185606
## TrainingTimesLastYear              -1.994e-01  7.438e-02  -2.681 0.007336
## YearsAtCompany                      1.050e-01  4.020e-02   2.612 0.009014
## YearsInCurrentRole                 -1.545e-01  4.879e-02  -3.166 0.001544
## YearsSinceLastPromotion             1.336e-01  4.245e-02   3.147 0.001649
## YearsWithCurrManager               -1.358e-01  4.824e-02  -2.815 0.004880
##
## (Intercept)
## ï..Age                             *
## BusinessTravelTravel_Frequently    ***
## BusinessTravelTravel_Rarely        *
## DailyRate
## `DepartmentResearch & Development`
## DepartmentSales
## DistanceFromHome                   ***
## Education2
## Education3
## Education4
## Education5
## `EducationFieldLife Sciences`
## EducationFieldMarketing
## EducationFieldMedical
## EducationFieldOther
## `EducationFieldTechnical Degree`
## HourlyRate
## JobInvolvement2                    ***
## JobInvolvement3                    ***
## JobInvolvement4                    ***
## JobLevel2                          ***
## JobLevel3
## JobLevel4
## JobLevel5
## `JobRoleHuman Resources`
## `JobRoleLaboratory Technician`
## JobRoleManager
## `JobRoleManufacturing Director`
## `JobRoleResearch Director`         .
## `JobRoleResearch Scientist`
## `JobRoleSales Executive`
## `JobRoleSales Representative`
## JobSatisfaction2                   *
## JobSatisfaction3                   *
## JobSatisfaction4                   ***
## MaritalStatusMarried
```

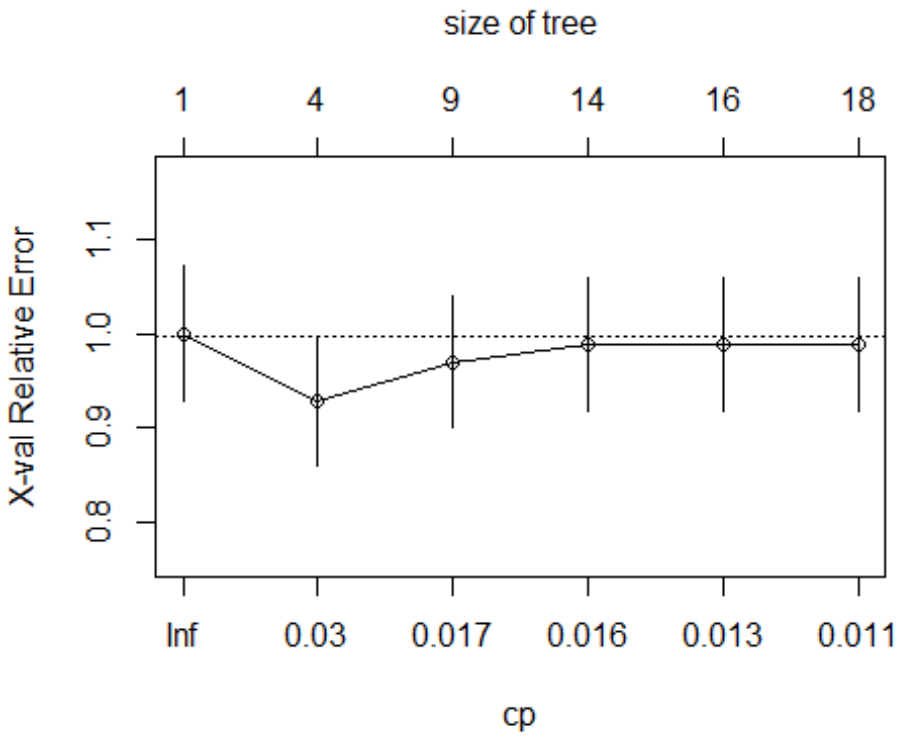
```
## MaritalStatusSingle
## MonthlyIncome
## MonthlyRate
## NumCompaniesWorked                ***
## OverTimeYes                       ***
## PercentSalaryHike
## RelationshipSatisfaction2         **
## RelationshipSatisfaction3         ***
## RelationshipSatisfaction4         ***
## StockOptionLevel1                 ***
## StockOptionLevel2                 **
## StockOptionLevel3
## TotalWorkingYears
## TrainingTimesLastYear             **
## YearsAtCompany                    **
## YearsInCurrentRole                **
## YearsSinceLastPromotion           **
## YearsWithCurrManager              **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 1298.58  on 1469  degrees of freedom
## Residual deviance:  831.16  on 1415  degrees of freedom
## AIC: 941.16
##
## Number of Fisher Scoring iterations: 15

print(model2)

## Generalized Linear Model
##
## 1470 samples
##   26 predictor
##    2 classes: 'No', 'Yes'
##
## No pre-processing
## Resampling: Cross-Validated (10 fold)
## Summary of sample sizes: 1323, 1323, 1323, 1322, 1323, 1323, ...
## Resampling results:
##
##   Accuracy   Kappa
##   0.8680586  0.4339151

#decision tree
# Load CART packages
library(rpart)
## Warning: package 'rpart' was built under R version 3.3.3
library(rpart.plot)
```

```
## Warning: package 'rpart.plot' was built under R version 3.3.3
decisiontree = rpart(Attrition ~ ., data=train, method="class")


#Plot the model

prp(decisiontree)
```

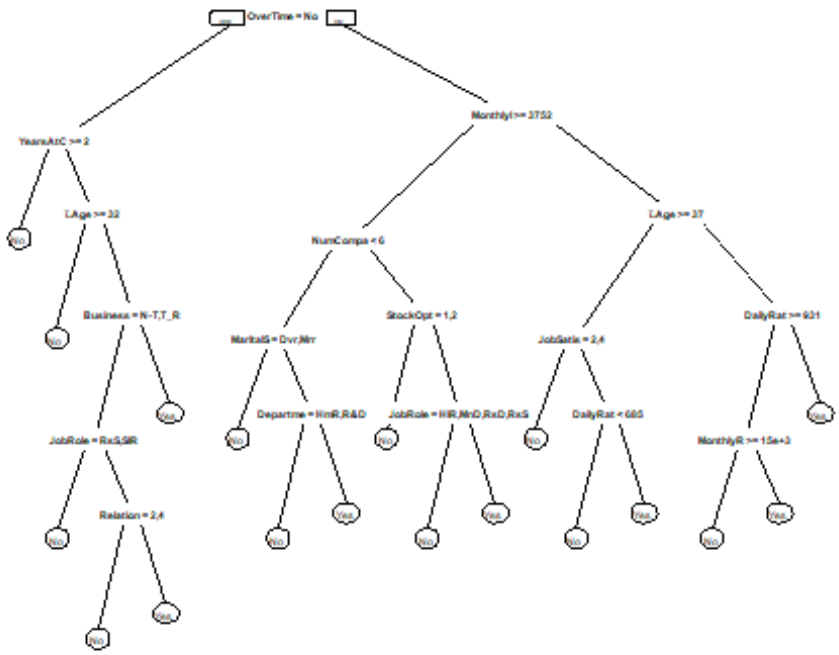



```
#Predict on the test data
prediction <- predict(decisiontree, newdata=test, type="class")
#Baseline Accuracy vs CART Accuracy


table(test$Attrition)

##
##  No Yes
## 369  71

369/nrow(test)

## [1] 0.8386364

#Confusion matrix
table(test$Attrition, prediction)
```

```
##      prediction
##        No Yes
##   No  348  21
##   Yes  51  20

#CART model accuracy
(336+23)/nrow(test)

## [1] 0.8159091

#Baseline Accuracy - If we just predict attrition as "No" for every observati
on, we will get an accuracy of 83.8%. Model Accuracy - The model gave us an a
ccuracy of 84%, an improvement of approx. 1% over the baseline accuracy.

#As a fully grown tree is prone to overfitting, lets prune the tree and see i
f we can improve the model.
printcp(decisiontree)

##
## Classification tree:
## rpart(formula = Attrition ~ ., data = train, method = "class")
##
## Variables actually used in tree construction:
##  [1] BusinessTravel           DailyRate
##  [3] Department               ï..Age
##  [5] JobRole                  JobSatisfaction
##  [7] MaritalStatus            MonthlyIncome
##  [9] MonthlyRate              NumCompaniesWorked
## [11] OverTime                 RelationshipSatisfaction
## [13] StockOptionLevel         YearsAtCompany
##
## Root node error: 166/1030 = 0.16117
##
## n= 1030
##
##         CP nsplit rel error  xerror     xstd
## 1 0.048193      0   1.00000 1.00000 0.071086
## 2 0.018072      3   0.85542 0.92771 0.068942
## 3 0.016064      8   0.76506 0.96988 0.070210
## 4 0.015060     13   0.66867 0.98795 0.070738
## 5 0.012048     15   0.63855 0.98795 0.070738
## 6 0.010000     17   0.61446 0.98795 0.070738

plotcp(decisiontree)
```



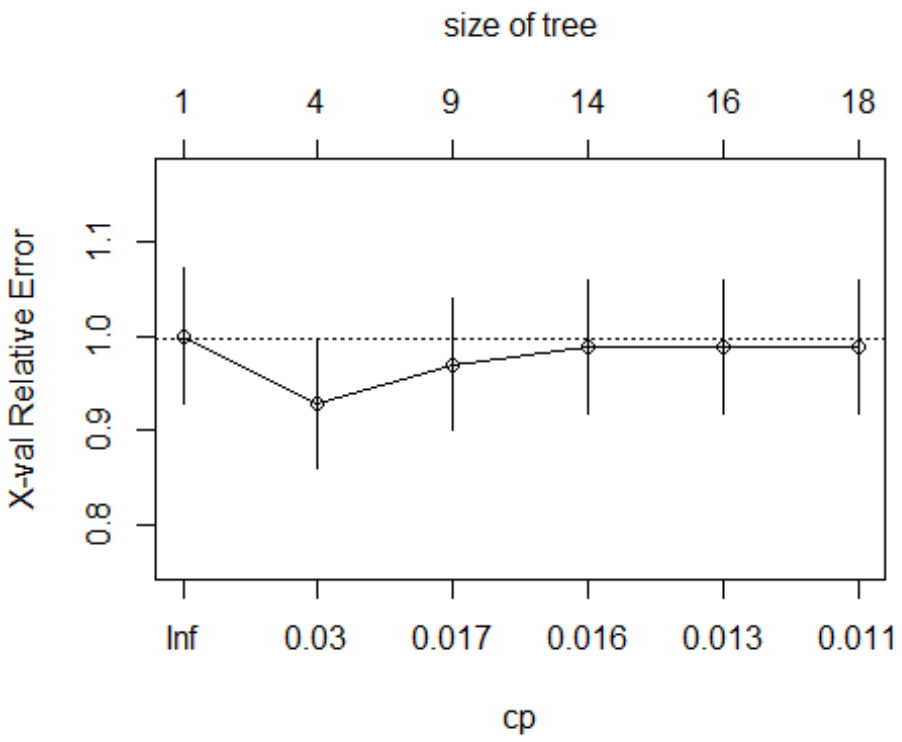

```
bestcp <- decisiontree$Attrition[which.min(decisiontree$Attrition[,"xerror"])
,"CP"]
prunedModel <-prune(decisiontree, cp= bestcp)
prp(prunedModel)
```




```
printcp(prunedModel)
```

```
##
## Classification tree:
## rpart(formula = Attrition ~ ., data = train, method = "class")
##
## Variables actually used in tree construction:
##  [1] BusinessTravel           DailyRate
##  [3] Department               ï..Age
##  [5] JobRole                  JobSatisfaction
##  [7] MaritalStatus            MonthlyIncome
##  [9] MonthlyRate              NumCompaniesWorked
## [11] OverTime                 RelationshipSatisfaction
## [13] StockOptionLevel         YearsAtCompany
##
## Root node error: 166/1030 = 0.16117
##
## n= 1030
##
##         CP nsplit rel error  xerror     xstd
## 1 0.048193      0   1.00000 1.00000 0.071086
## 2 0.018072      3   0.85542 0.92771 0.068942
## 3 0.016064      8   0.76506 0.96988 0.070210
## 4 0.015060     13   0.66867 0.98795 0.070738
## 5 0.012048     15   0.63855 0.98795 0.070738
## 6 0.010000     17   0.61446 0.98795 0.070738
```

```
plotcp(prunedModel)
```




```
#Predict on the test data
prediction_pm <- predict(prunedModel, newdata=test, type="class")
table(test$Attrition, prediction_pm)
```

```
##      prediction_pm
##        No Yes
##   No  348  21
##   Yes  51  20
```

```
(336+23)/nrow(test)
```

```
## [1] 0.8159091
```

```
#So the pruning does not improve the model accuracy
library(ROCR)
```

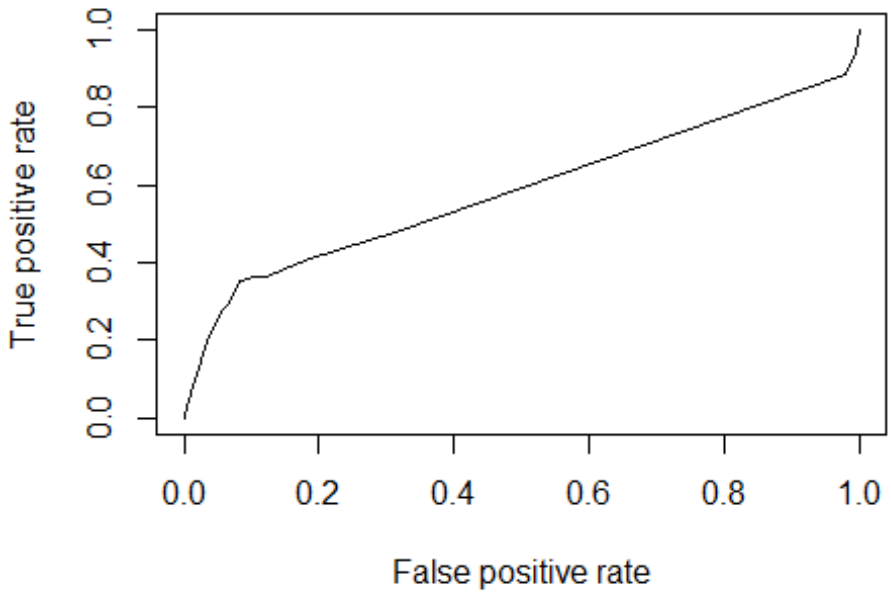
```
## Loading required package: gplots
```

```
##
## Attaching package: 'gplots'
```

```
## The following object is masked from 'package:stats':
##
##     lowess
```

```
prediction_ROC <- predict(prunedModel, newdata=test)
pred = prediction(prediction_ROC[,2], test$Attrition)
```

```
perf = performance(pred, "tpr", "fpr")
plot(perf)
```




```
#Area under the curve
as.numeric(performance(pred, "auc")@y.values)
```

```
## [1] 0.5865873
```

```
#Random Forest


library(randomForest)
```

```
## randomForest 4.6-14
```

```
## Type rfNews() to see new features/changes/bug fixes.
```

```
##
## Attaching package: 'randomForest'
```

```
## The following object is masked from 'package:gridExtra':
##
##     combine
```

```
## The following object is masked from 'package:dplyr':
##
##     combine
```

```
## The following object is masked from 'package:ggplot2':
##
##     margin

randomForestModel <- randomForest(Attrition~.,data=train,ntree=100,mtry=5, im
portance=TRUE)
print(randomForestModel)

##
## Call:
##  randomForest(formula = Attrition ~ ., data = train, ntree = 100,      mtr
y = 5, importance = TRUE)
##                Type of random forest: classification
##                      Number of trees: 100
## No. of variables tried at each split: 5
##
##         OOB estimate of  error rate: 14.56%
## Confusion matrix:
##      No Yes class.error
## No  854  10  0.01157407
## Yes 140  26  0.84337349

plot(randomForestModel, main="")
legend("topright", c("OOB", "0", "1"), text.col=1:6, lty=1:3, col=1:3)
title(main="Error Rates Random Forest")
```

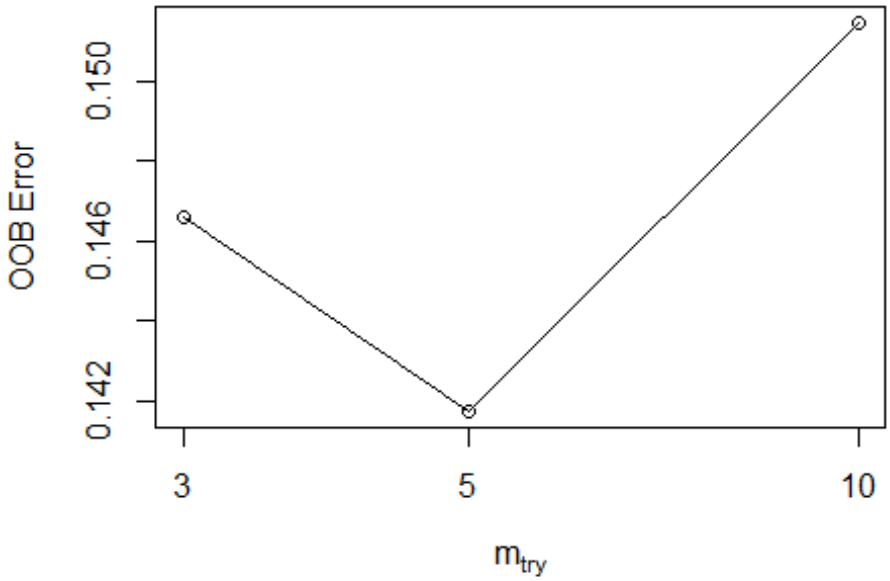
```r
## List the importance of the variables.
impVar <- round(randomForest::importance(randomForestModel), 2)
impVar[order(impVar[,3], decreasing=TRUE),]
```

```
##                             No   Yes MeanDecreaseAccuracy MeanDecreaseGini
## OverTime                  7.25 12.08                11.29             20.27
## JobLevel                  2.95  3.46                 4.30              7.79
## JobRole                   3.64  2.11                 4.18             14.56
## ï..Age                   2.87  3.47                 3.90             18.68
## StockOptionLevel          4.04  1.45                 3.85              7.58
## NumCompaniesWorked        2.40  3.09                 3.71             10.58
## TotalWorkingYears         2.55  2.26                 3.21             12.17
## BusinessTravel            2.75  1.52                 2.89              5.07
## YearsInCurrentRole        1.64  1.76                 2.28              7.31
## MaritalStatus             0.55  2.94                 1.95              5.30
## YearsAtCompany            1.46  1.05                 1.82             11.94
## MonthlyIncome             0.71  2.39                 1.76             22.99
## YearsWithCurrManager      1.99  0.03                 1.69              7.88
## Education                 1.73 -0.19                 1.35              8.52
## Department                0.85  0.68                 1.14              2.54
## DailyRate                 0.95  0.42                 1.02             16.35
## YearsSinceLastPromotion   0.65  0.66                 0.92              5.69
## EducationField            0.94  0.05                 0.86              9.36
## JobSatisfaction           0.85  0.23                 0.82              8.02
## JobInvolvement            0.56  0.56                 0.75              8.26
## DistanceFromHome          0.15 -0.14                 0.08             14.29
## PercentSalaryHike        -0.20  0.28                -0.05              9.97
## RelationshipSatisfaction -0.91  1.06                -0.16              7.59
## HourlyRate               -0.19 -1.54                -0.78             13.82
## TrainingTimesLastYear    -1.87  1.08                -1.00              8.35
## MonthlyRate              -1.25 -0.80                -1.34             13.93
```

```r
# Tuning Random Forest
tunedRf <- tuneRF(x = train[,-2],
                  y=as.factor(train$Attrition),
                  mtryStart = 5,
                  ntreeTry=60,
                  stepFactor = 2,
                  improve = 0.001,
                  trace=TRUE,
                  plot = TRUE,
                  doBest = TRUE,
                  nodesize = 5,
                  importance=TRUE
)
```

```
## mtry = 5  OOB error = 14.17%
## Searching left ...
## mtry = 3     OOB error = 14.66%
## -0.03424658 0.001
```

```
## Searching right ...
## mtry = 10    OOB error = 15.15%
## -0.06849315 0.001
```




```
impvarTunedRf <- tunedRf$importance
impvarTunedRf[order(impvarTunedRf[,3], decreasing=TRUE),]
```

```
##                                   No           Yes MeanDecreaseAccuracy
## OverTime                1.377459e-02  0.0533664396         2.007451e-02
## JobRole                 7.077975e-03  0.0162950444         8.541189e-03
## TotalWorkingYears       6.181258e-03  0.0042048676         5.821248e-03
## MonthlyIncome           3.817357e-03  0.0138375883         5.430112e-03
## JobLevel                3.823750e-03  0.0120692742         5.118708e-03
## ï..Age                  3.200071e-03  0.0145132197         4.987702e-03
## YearsAtCompany          2.878657e-03  0.0087114865         3.832346e-03
## StockOptionLevel        2.491679e-03  0.0078103703         3.358959e-03
## MaritalStatus           1.539545e-03  0.0073896916         2.474629e-03
## YearsWithCurrManager    2.104689e-03  0.0021166493         2.074422e-03
## NumCompaniesWorked      1.839176e-03  0.0029870870         1.999315e-03
## JobSatisfaction         1.551516e-03  0.0020640963         1.632495e-03
## BusinessTravel          9.187148e-04  0.0042861021         1.457197e-03
## DistanceFromHome        7.747187e-04  0.0024571642         1.040680e-03
## YearsInCurrentRole      3.294178e-05  0.0063852817         1.038146e-03
## JobInvolvement          4.470828e-04  0.0038400568         9.753700e-04
## DailyRate               4.595290e-04  0.0036028798         9.330698e-04
## Department              3.451766e-04  0.0023788559         6.619648e-04
## YearsSinceLastPromotion 9.828311e-04 -0.0012371754         6.129680e-04
```

```
## HourlyRate                 5.999602e-04 -0.0001240287         4.610962e-04
## RelationshipSatisfaction  1.044515e-04  0.0020617046         4.258636e-04
## EducationField             9.650671e-04 -0.0026416780         3.580265e-04
## Education                  3.853383e-04  0.0001330482         3.447229e-04
## TrainingTimesLastYear      1.038326e-04 -0.0003210152         4.211951e-05
## PercentSalaryHike          3.327802e-05 -0.0014661764        -1.890161e-04
## MonthlyRate               -1.336967e-04 -0.0011267225        -2.822954e-04
##                          MeanDecreaseGini
## OverTime                        19.251275
## JobRole                         14.083064
## TotalWorkingYears               10.591924
## MonthlyIncome                   17.003264
## JobLevel                         7.062155
## ï..Age                          15.252457
## YearsAtCompany                   9.537282
## StockOptionLevel                 7.354336
## MaritalStatus                    5.115712
## YearsWithCurrManager             6.630427
## NumCompaniesWorked               8.765131
## JobSatisfaction                  7.350888
## BusinessTravel                   4.370969
## DistanceFromHome                11.200321
## YearsInCurrentRole               5.121905
## JobInvolvement                   6.177443
## DailyRate                       13.834251
## Department                       2.284567
## YearsSinceLastPromotion          4.261893
## HourlyRate                       9.667634
## RelationshipSatisfaction         7.273940
## EducationField                   7.657382
## Education                        6.556013
## TrainingTimesLastYear            5.127803
## PercentSalaryHike                7.224265
## MonthlyRate                     10.800101
```

```
predictionRf <- predict(tunedRf, test, type="class")
```

```
#RandomForest Accuracy
#Confusion matrix

t2 <- table(test$Attrition, predictionRf)
t2
```

```
##      predictionRf
##        No Yes
##   No  365   4
##   Yes  55  16
```

```r
#RandomForest model accuracy
(t2[1]+t2[4])/(nrow(test))
```

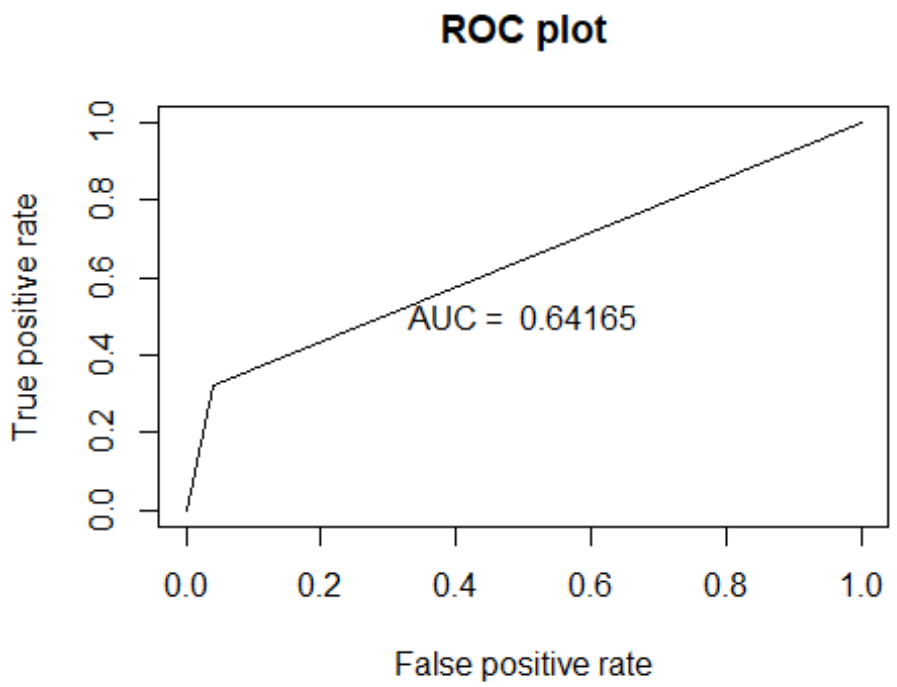
```
## [1] 0.8659091
```

```r
#Xtreme Gradient Boosting


library(caret)
library(xgboost)
```

```
##
## Attaching package: 'xgboost'
```

```
## The following object is masked from 'package:dplyr':
##
##     slice
```

```r
control <- trainControl(method="repeatedcv", number=5)
set.seed(123)
model_xgb <- train(as.factor(Attrition)~., data=train, method="xgbTree",  trC
ontrol=control)
#Output Prediction
pred_xgb <- predict(model_xgb, newdata=test)

library(ROCR)
ROCRpred <- prediction(as.numeric(pred_xgb), as.numeric(test$Attrition))
ROCRpref <- performance(ROCRpred,"auc")
auc_xgb <- as.numeric(ROCRpref@y.values)
perf_ROC <- performance(ROCRpred,"tpr","fpr") #plot the actual ROC curve
plot(perf_ROC, main="ROC plot")
text(0.5,0.5,paste("AUC = ",format(auc_xgb, digits=5, scientific=FALSE)))
```




```
#Confusion Matrix
confusionMatrix(pred_xgb, test$Attrition)
```

```
## Confusion Matrix and Statistics
##
##           Reference
## Prediction  No Yes
##        No  354  48
##        Yes  15  23
##
##                Accuracy : 0.8568
##                  95% CI : (0.8206, 0.8882)
##     No Information Rate : 0.8386
##     P-Value [Acc > NIR] : 0.1657
##
##                   Kappa : 0.3487
##  Mcnemar's Test P-Value : 5.539e-05
##
##             Sensitivity : 0.9593
##             Specificity : 0.3239
##          Pos Pred Value : 0.8806
##          Neg Pred Value : 0.6053
##              Prevalence : 0.8386
##          Detection Rate : 0.8045
##    Detection Prevalence : 0.9136
##       Balanced Accuracy : 0.6416
##
```

```
##         'Positive' Class : No
##
```