Employee Churn Analytics

PROBLEM STATEMENT: Companies face the problem that their human resources on whom the company have invested time and money to train them, leave the company voluntarily. It is important for the management and stakeholders to know the variables responsible for employees quitting jobs and also have a prediction that which employees will be quitting their jobs in future.

Goal: To predict whether an employee will stay or leave the company within the next year.

```
# Load packages

library('ggplot2') # visualization

## Warning: package 'ggplot2' was built under R version 3.4.4

library('ggthemes') # visualization

## Warning: package 'ggthemes' was built under R version 3.4.4

library('scales') # visualization

## Warning: package 'scales' was built under R version 3.4.4

library('dplyr') # data manipulation

## Warning: package 'dplyr' was built under R version 3.4.3

## 
## 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('mice') # imputation

## Warning: package 'mice' was built under R version 3.4.4

## Loading required package: lattice

## 
## Attaching package: 'mice'
## The following objects are masked from 'package:base':
## 
##     cbind, rbind
```

```
library('randomForest') # classification algorithm
```

```
## Warning: package 'randomForest' was built under R version 3.4.4
```

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

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

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

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

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

```
dataNW<-read.csv("WA_Fn-UseC_-HR-Employee-Attrition.csv")
head(dataNW)
```

```
##   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
```

```
names(dataNW)[names(dataNW) == 'ï..Age'] <- 'Age'
```

```
dim(dataNW)
```

```
## [1] 1470   35
```

```
names(dataNW)
```

```
##  [1] "Age"                      "Attrition"
##  [3] "BusinessTravel"           "DailyRate"
##  [5] "Department"               "DistanceFromHome"
##  [7] "Education"                "EducationField"
##  [9] "EmployeeCount"            "EmployeeNumber"
## [11] "EnvironmentSatisfaction"  "Gender"
## [13] "HourlyRate"               "JobInvolvement"
## [15] "JobLevel"                 "JobRole"
## [17] "JobSatisfaction"          "MaritalStatus"
## [19] "MonthlyIncome"            "MonthlyRate"
## [21] "NumCompaniesWorked"       "Over18"
## [23] "OverTime"                 "PercentSalaryHike"
## [25] "PerformanceRating"        "RelationshipSatisfaction"
## [27] "StandardHours"            "StockOptionLevel"
## [29] "TotalWorkingYears"        "TrainingTimesLastYear"
## [31] "WorkLifeBalance"          "YearsAtCompany"
## [33] "YearsInCurrentRole"       "YearsSinceLastPromotion"
## [35] "YearsWithCurrManager"
```

```
str(data)
```

```
## function (..., list = character(), package = NULL, lib.loc = NULL,
##     verbose = getOption("verbose"), envir = .GlobalEnv)
```

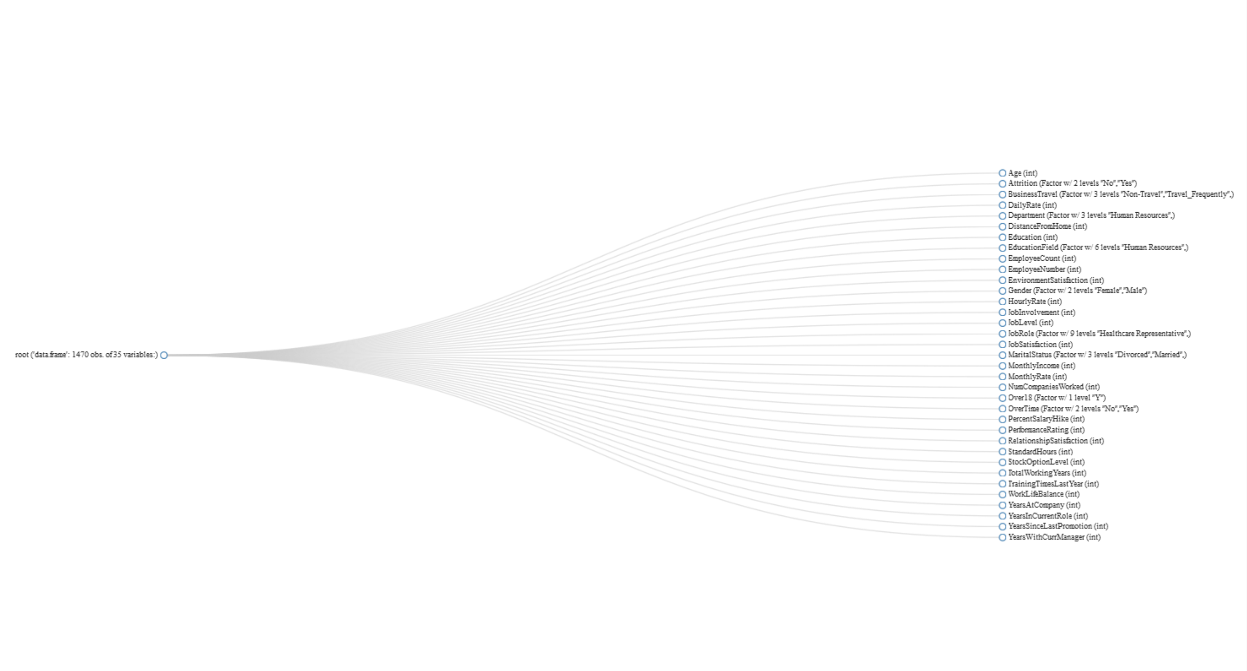
Checking the Missing values:

```
sapply(dataNW, function(x) sum(is.na(x)))
```

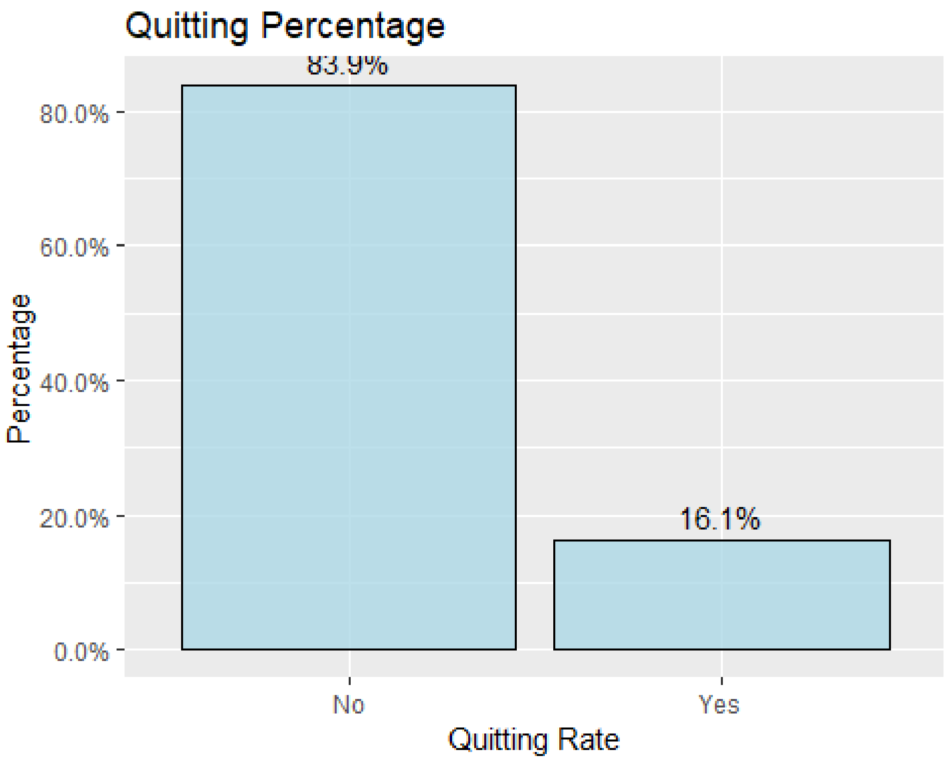
```
##                      Age                Attrition           BusinessTravel
##                        0                        0                        0
##                DailyRate               Department         DistanceFromHome
##                        0                        0                        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
```

Data Exploration

```
library(DataExplorer)
plot_str(dataNW)
```


root ('data.frame': 1470 obs. of35 variables:)
Age (int)
Attrition (Factor w/ 2 levels "No","Yes")
BusinessTravel (Factor w/ 3 levels "Non-Travel","Travel_Frequently",)
DailyRate (int)
Department (Factor w/ 3 levels "Human Resources",)
DistanceFromHome (int)
Education (int)
EducationField (Factor w/ 6 levels "Human Resources",)
EmployeeCount (int)
EmployeeNumber (int)
EnvironmentSatisfaction (int)
Gender (Factor w/ 2 levels "Female","Male")
HourlyRate (int)
JobInvolvement (int)
JobLevel (int)
JobRole (Factor w/ 9 levels "Healthcare Representative",)
JobSatisfaction (int)
MaritalStatus (Factor w/ 3 levels "Divorced","Married",)
MonthlyIncome (int)
MonthlyRate (int)
NumCompaniesWorked (int)
Over18 (Factor w/ 1 level "Y")
OverTime (Factor w/ 2 levels "No","Yes")
PercentSalaryHike (int)
PerformanceRating (int)
RelationshipSatisfaction (int)
StandardHours (int)
StockOptionLevel (int)
TotalWorkingYears (int)
TrainingTimesLastYear (int)
WorkLifeBalance (int)
YearsAtCompany (int)
YearsInCurrentRole (int)
YearsSinceLastPromotion (int)
YearsWithCurrManager (int)

```
Terminated<-as.factor(dataNW$Attrition)
summary(Terminated)

##   No  Yes 
## 1233  237

perc_attrition_rate<-sum(dataNW$Attrition/length(dataNW$Attrition))*100

## Warning in Ops.factor(dataNW$Attrition, length(dataNW$Attrition)): '/' not
## meaningful for factors

prop.table(table(dataNW$Attrition))

## 
##        No       Yes 
## 0.8387755 0.1612245

Terminated<- ggplot(dataNW, aes(x=Attrition)) +
  geom_bar(aes(y=(..count..)/sum(..count..)), alpha=0.8, fill="lightblue", 
color = "black") +
  scale_y_continuous(labels = scales::percent) +
  geom_text(aes(label = scales::percent((..count..)/sum(..count..)),
                y= (..count..)/sum(..count..) ), stat= "count", vjust = -0.5)
+
  ylab("Percentage") + xlab("Quitting Rate")+ ggtitle("Quitting Percentage")
Terminated
```



The Data is Unbalanced, where the minority class is only 16.1%

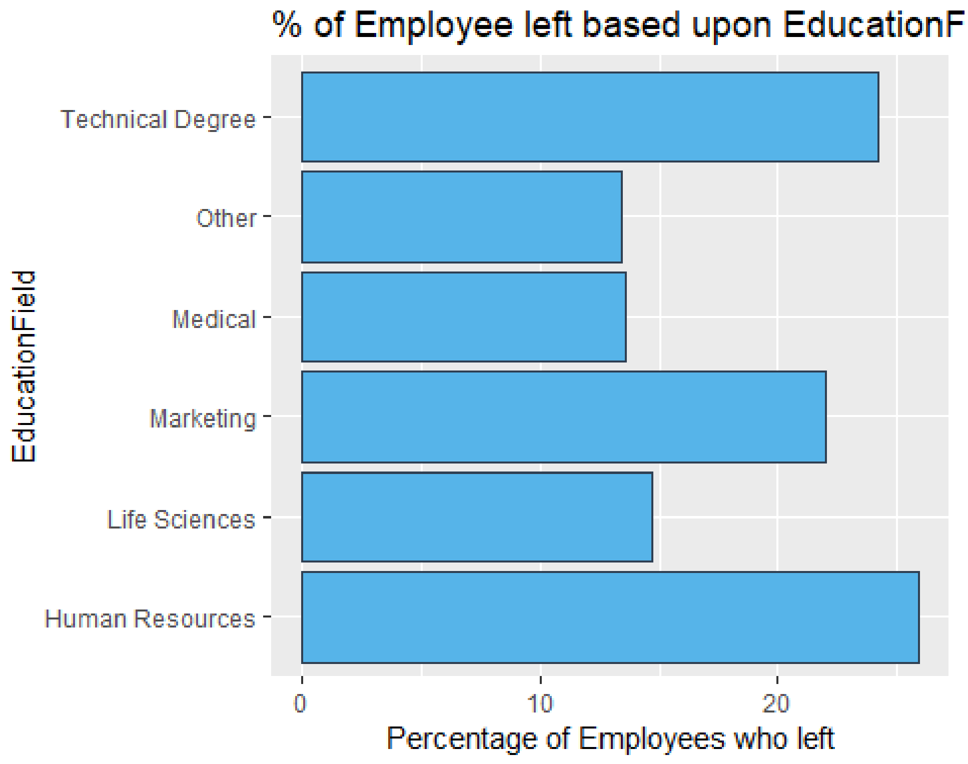
```
library(dplyr)
library(tidyr)

## Warning: package 'tidyr' was built under R version 3.4.3

##
## Attaching package: 'tidyr'

## The following object is masked from 'package:mice':
##
##     complete

#Transforming Termination Column to Factor with True and False values
dataNW$Attrition<-factor(dataNW$Attrition,labels=c('False',"True"))
SHdf<-dataNW %>% group_by(EducationField,Attrition) %>%
      summarise(count=n())

#replacing NA value with 0
SHdf[is.na(SHdf)]<-0
```

```
#making a data frame of Departments and the count of workers who left or not
SHdf<-spread(SHdf,Attrition,count)

SHdf<-transform(SHdf,Perleft=(True/(True+False))*100 ,
PerWork=(False/(True+False))*100)
SHdf
```

```
##     EducationField False True  Perleft  PerWork
## 1  Human Resources    20    7 25.92593 74.07407
## 2    Life Sciences   517   89 14.68647 85.31353
## 3        Marketing   124   35 22.01258 77.98742
## 4          Medical   401   63 13.57759 86.42241
## 5            Other    71   11 13.41463 86.58537
## 6 Technical Degree   100   32 24.24242 75.75758
```

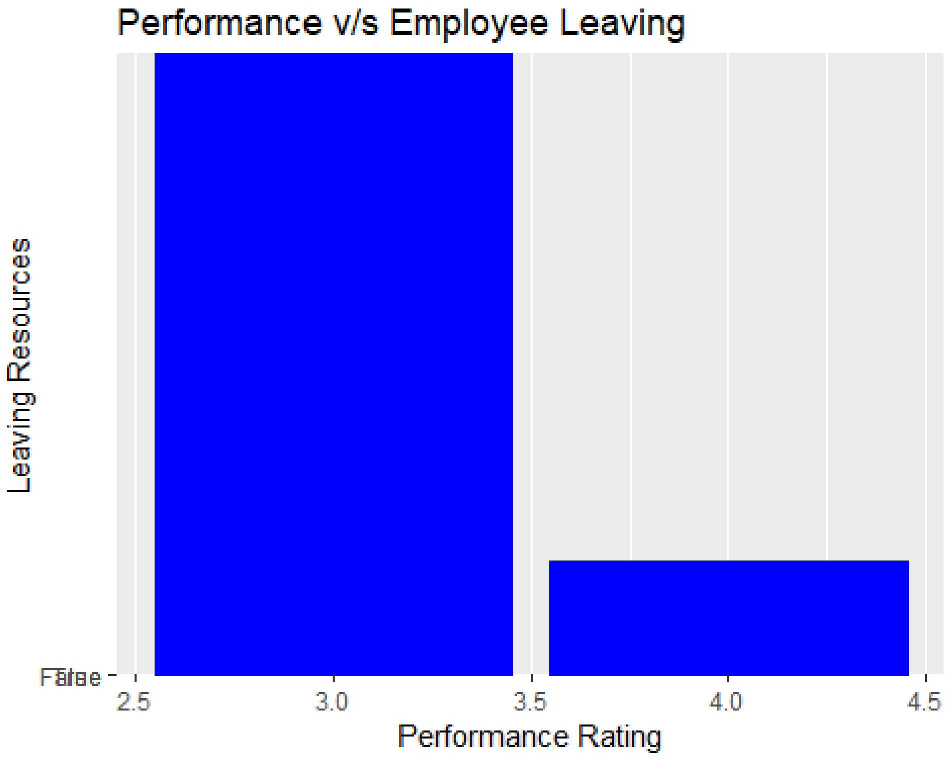
Percentage of employee who left and Employee who are working based upon Source.Of.Hire

```
#Plot of Department vs Percentage of Employees who left
ggplot(aes(x=EducationField, y = Perleft),data = SHdf) +
  geom_col(fill='#56B4E9',color='#2f3f52') +
  coord_flip()+
  xlab("EducationField") +
  ylab("Percentage of Employees who left") +
  labs(title="% of Employee left based upon EducationField")
```



Employee with Human Resource degree are leaving more.

```
ggplot(dataNW, aes(x = PerformanceRating, y = Attrition)) + geom_bar(stat =
"identity", fill = 'blue', colour = 'blue') + ggtitle("Performance v/s
Employee Leaving") + labs(y = "Leaving Resources", x =
"Performance Rating")
```



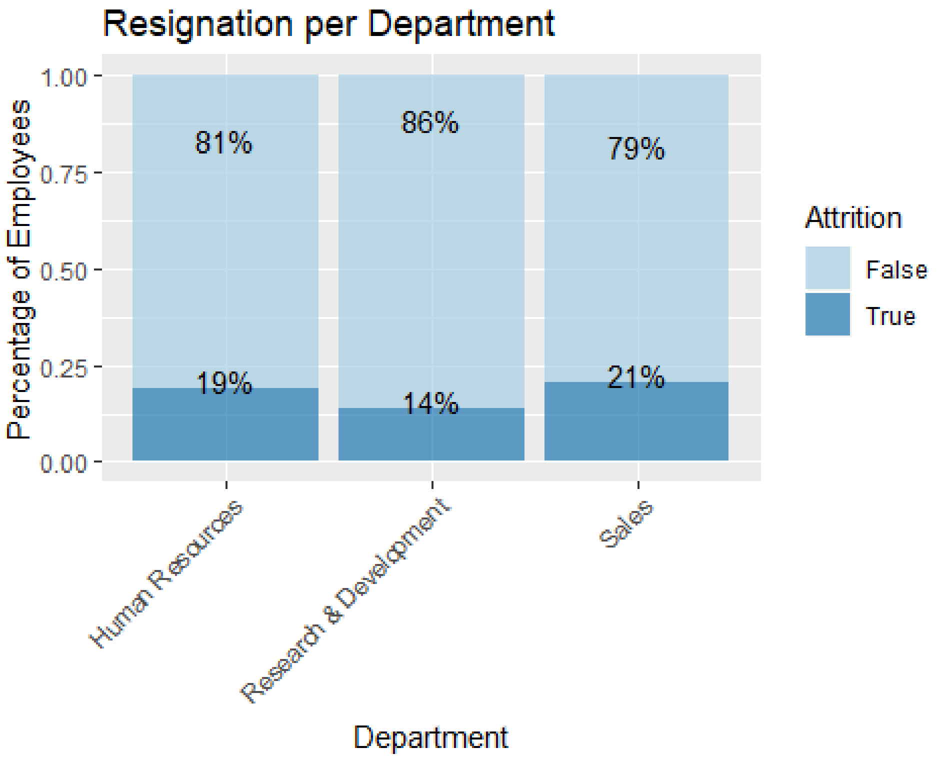
RESIGNATION PER DEPARTMENT:

```
dataNW$Attrition <- as.factor(dataNW$Attrition)

dataNW %>%
  select(Department,Attrition) %>%
  group_by(Department, Attrition) %>%
  summarise(count=n()) %>%
  mutate(dep_pct = count/sum(count)) %>%
  ggplot(aes(x=Department, y=dep_pct, fill = Attrition)) +
  geom_bar(stat="identity", alpha = 0.7) +
  geom_text(aes(label = paste0(round(dep_pct*100,0),"%"),
                y=dep_pct+0.02)) +
  scale_fill_brewer(palette="Paired")+
  ylab("Percentage of Employees") + xlab("Department") +
  ggtitle("Resignation per
Department")+theme(axis.text.x=element_text(angle=45,hjust=1))

## Warning: package 'bindrcpp' was built under R version 3.4.3
## Warning: `as_dictionary()` is soft-deprecated as of rlang 0.3.0.
## Please use `as_data_pronoun()` instead
## This warning is displayed once per session.
```

```
## Warning: `new_overscope()` is soft-deprecated as of rlang 0.2.0.
## Please use `new_data_mask()` instead
## This warning is displayed once per session.
```

```
## Warning: The `parent` argument of `new_data_mask()` is deprecated.
## The parent of the data mask is determined from either:
##
##   * The `env` argument of `eval_tidy()`
##   * Quosure environments when applicable
## This warning is displayed once per session.
```

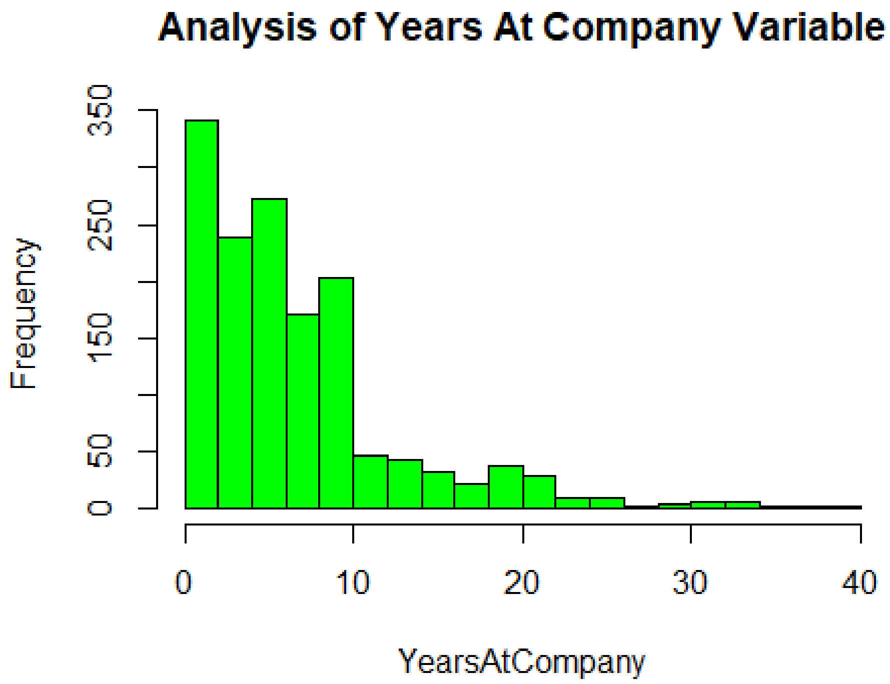
```
## Warning: `overscope_clean()` is soft-deprecated as of rlang 0.2.0.
## This warning is displayed once per session.
```



SALES DEPARTMENT ARE LEAVING MORE

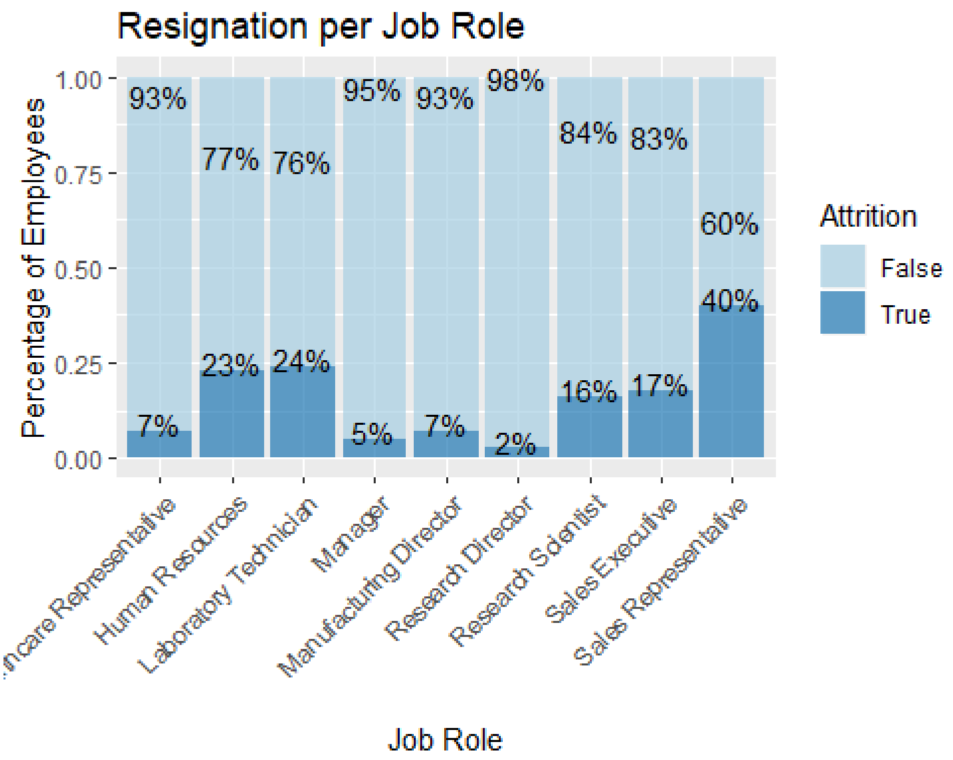
CHECKING THE EMPLOYEE TENURE IN THE COMPANY:

```
hist(dataNW$YearsAtCompany, breaks = 15, col = 'green', main = "Analysis of
Years At Company Variable", xlab = "YearsAtCompany")
```



RESIGNATION BASED UPON JOB ROLE

```
dataNW$Attrition <- as.factor(dataNW$Attrition)

dataNW %>%
  select(JobRole,Attrition) %>%
  group_by(JobRole, Attrition) %>%
  summarise(count=n()) %>%
  mutate(dep_pct = count/sum(count)) %>%
  ggplot(aes(x=JobRole, y=dep_pct, fill = Attrition)) +
  geom_bar(stat="identity", alpha = 0.7) +
  geom_text(aes(label = paste0(round(dep_pct*100,0),"%"),
                y=dep_pct+0.02)) +
  scale_fill_brewer(palette="Paired")+
  ylab("Percentage of Employees") + xlab("Job Role") +
  ggtitle("Resignation per Job
Role")+theme(axis.text.x=element_text(angle=45,hjust=1))
```



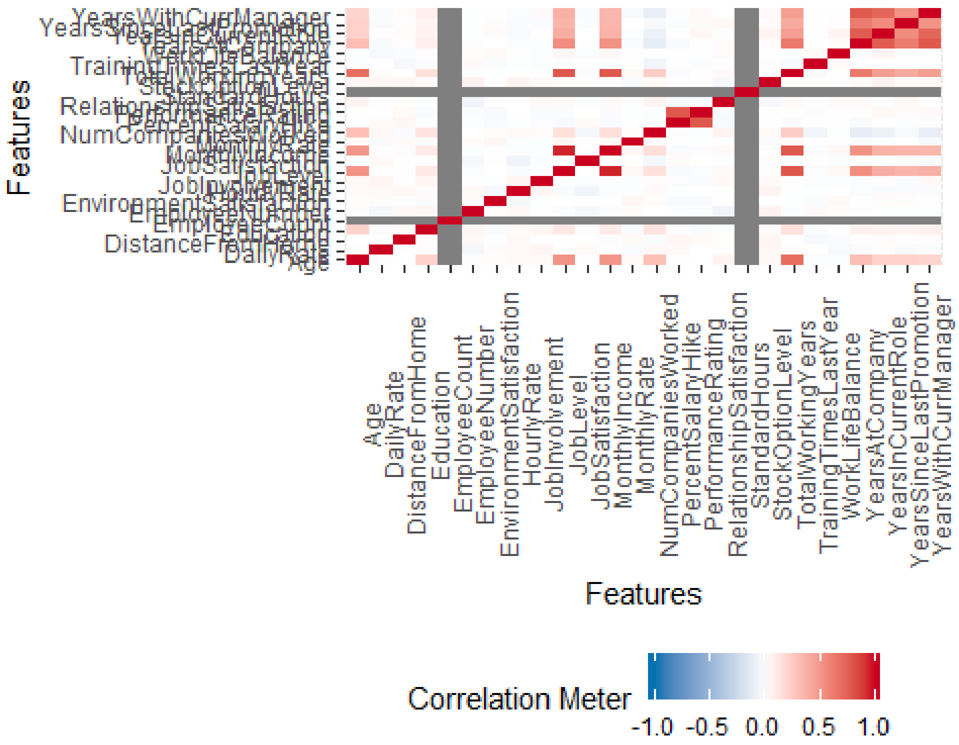
SALES REPRESENTATIVE TEND TO LEAVE MORE.

```
str(dataNW)

## 'data.frame':    1470 obs. of  35 variables:
##  $ Age                     : int  41 49 37 33 27 32 59 30 38 36 ...
##  $ Attrition               : Factor w/ 2 levels "False","True": 2 1 2 1 1
1 1 1 1 1 ...
##  $ BusinessTravel          : Factor w/ 3 levels "Non-
Travel","Travel_Frequently",..: 3 2 3 2 3 2 3 3 2 3 ...
##  $ DailyRate               : int  1102 279 1373 1392 591 1005 1324 1358
216 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               : int  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 ...
##  $ EmployeeCount           : int  1 1 1 1 1 1 1 1 1 1 ...
##  $ EmployeeNumber          : int  1 2 4 5 7 8 10 11 12 13 ...
##  $ EnvironmentSatisfaction : int  2 3 4 4 1 4 3 4 4 3 ...
##  $ Gender                  : Factor w/ 2 levels "Female","Male": 1 2 2 1 2
2 1 2 2 2 ...
##  $ HourlyRate              : int  94 61 92 56 40 79 81 67 44 94 ...
##  $ JobInvolvement          : int  3 2 2 3 3 3 4 3 2 3 ...
##  $ JobLevel                : int  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         : int  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 ...
##  $ Over18                  : Factor w/ 1 level "Y": 1 1 1 1 1 1 1 1 1 1
...
##  $ 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 ...
##  $ PerformanceRating       : int  3 4 3 3 3 3 4 4 4 3 ...
##  $ RelationshipSatisfaction: int  1 4 2 3 4 3 1 2 2 2 ...
##  $ StandardHours           : int  80 80 80 80 80 80 80 80 80 80 ...
##  $ StockOptionLevel        : int  0 1 0 0 1 0 3 1 0 2 ...
##  $ TotalWorkingYears       : int  8 10 7 8 6 8 12 1 10 17 ...
##  $ TrainingTimesLastYear   : int  0 3 3 3 3 2 3 2 2 3 ...
##  $ WorkLifeBalance         : int  1 3 3 3 3 2 2 3 3 2 ...
##  $ 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 ...

df1<-dataNW
```

CORRELATION MATRIX

```
plot_correlation(df1, type = 'continuous')

## Warning in cor(x = structure(list(Age = c(41L, 49L, 37L, 33L, 27L, 32L, :
## the standard deviation is zero
```



```
names(df1)
```

```
##  [1] "Age"                      "Attrition"
##  [3] "BusinessTravel"           "DailyRate"
##  [5] "Department"               "DistanceFromHome"
##  [7] "Education"                "EducationField"
##  [9] "EmployeeCount"            "EmployeeNumber"
## [11] "EnvironmentSatisfaction"  "Gender"
## [13] "HourlyRate"               "JobInvolvement"
## [15] "JobLevel"                 "JobRole"
## [17] "JobSatisfaction"          "MaritalStatus"
## [19] "MonthlyIncome"            "MonthlyRate"
## [21] "NumCompaniesWorked"       "Over18"
## [23] "OverTime"                 "PercentSalaryHike"
## [25] "PerformanceRating"        "RelationshipSatisfaction"
## [27] "StandardHours"            "StockOptionLevel"
## [29] "TotalWorkingYears"        "TrainingTimesLastYear"
## [31] "WorkLifeBalance"          "YearsAtCompany"
## [33] "YearsInCurrentRole"       "YearsSinceLastPromotion"
## [35] "YearsWithCurrManager"
```

DIVIDING THE DATASET INTO TRAIN AND TEST SET

```
library(caTools)
```

```
## Warning: package 'caTools' was built under R version 3.4.3
```

```
#Splitting the data
set.seed(123)
indices = sample.split(df1$Attrition, SplitRatio = 0.7)
train = df1[indices,]
validation = df1[!(indices),]
```

MODEL1

LOGISTIC REGRESSION

```
colnames(train)

##  [1] "Age"                      "Attrition"
##  [3] "BusinessTravel"           "DailyRate"
##  [5] "Department"               "DistanceFromHome"
##  [7] "Education"                "EducationField"
##  [9] "EmployeeCount"            "EmployeeNumber"
## [11] "EnvironmentSatisfaction"  "Gender"
## [13] "HourlyRate"               "JobInvolvement"
## [15] "JobLevel"                 "JobRole"
## [17] "JobSatisfaction"          "MaritalStatus"
## [19] "MonthlyIncome"            "MonthlyRate"
## [21] "NumCompaniesWorked"       "Over18"
## [23] "OverTime"                 "PercentSalaryHike"
## [25] "PerformanceRating"        "RelationshipSatisfaction"
## [27] "StandardHours"            "StockOptionLevel"
## [29] "TotalWorkingYears"        "TrainingTimesLastYear"
## [31] "WorkLifeBalance"          "YearsAtCompany"
## [33] "YearsInCurrentRole"       "YearsSinceLastPromotion"
## [35] "YearsWithCurrManager"

#Build the first model using all variables
model_1 = glm(Attrition ~ Age
+BusinessTravel+DailyRate+Department+DistanceFromHome+Education+EducationFiel
d+EnvironmentSatisfaction+Gender+HourlyRate+JobInvolvement+JobLevel+JobRole+J
obSatisfaction+MaritalStatus+MonthlyIncome+MonthlyRate+NumCompaniesWorked+Ove
rTime+PercentSalaryHike+PerformanceRating+RelationshipSatisfaction+StandardHo
urs+StockOptionLevel+TotalWorkingYears+TrainingTimesLastYear+WorkLifeBalance+
YearsAtCompany+YearsInCurrentRole+YearsSinceLastPromotion+YearsWithCurrManage
r, data = train, family = "binomial")
summary(model_1)

##
## Call:
## glm(formula = Attrition ~ Age + BusinessTravel + DailyRate +
##     Department + DistanceFromHome + Education + EducationField +
##     EnvironmentSatisfaction + Gender + HourlyRate + JobInvolvement +
##     JobLevel + JobRole + JobSatisfaction + MaritalStatus + MonthlyIncome +
##     MonthlyRate + NumCompaniesWorked + OverTime + PercentSalaryHike +
##     PerformanceRating + RelationshipSatisfaction + StandardHours +
##     StockOptionLevel + TotalWorkingYears + TrainingTimesLastYear +
##     WorkLifeBalance + YearsAtCompany + YearsInCurrentRole +
YearsSinceLastPromotion +
##     YearsWithCurrManager, family = "binomial", data = train)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.6681  -0.4819  -0.2502  -0.0908   3.4600
##
## Coefficients: (1 not defined because of singularities)
##                                    Estimate Std. Error z value Pr(>|z|)
## (Intercept)                      -1.059e+01  7.008e+02  -0.015 0.987940
## Age                              -1.804e-02  1.582e-02  -1.140 0.254165
## BusinessTravelTravel_Frequently   1.989e+00  5.396e-01   3.687 0.000227
## BusinessTravelTravel_Rarely       1.037e+00  5.100e-01   2.034 0.041932
## DailyRate                        -1.839e-04  2.630e-04  -0.699 0.484450
## DepartmentResearch & Development  1.348e+01  7.008e+02   0.019 0.984649
## DepartmentSales                   1.423e+01  7.008e+02   0.020 0.983796
## DistanceFromHome                  4.144e-02  1.302e-02   3.184 0.001454
## Education                         2.685e-02  1.075e-01   0.250 0.802788
## EducationFieldLife Sciences      -9.295e-01  1.073e+00  -0.866 0.386263
## EducationFieldMarketing          -7.117e-01  1.123e+00  -0.634 0.526292
## EducationFieldMedical            -1.368e+00  1.069e+00  -1.279 0.200766
## EducationFieldOther              -1.014e+00  1.131e+00  -0.896 0.370034
## EducationFieldTechnical Degree   -2.719e-01  1.098e+00  -0.248 0.804510
## EnvironmentSatisfaction          -4.078e-01  9.939e-02  -4.103 4.09e-05
## GenderMale                        3.583e-01  2.204e-01   1.625 0.104058
## HourlyRate                        9.030e-04  5.231e-03   0.173 0.862952
## JobInvolvement                   -4.798e-01  1.496e-01  -3.207 0.001343
## JobLevel                          6.848e-02  3.702e-01   0.185 0.853224
## JobRoleHuman Resources            1.503e+01  7.008e+02   0.021 0.982884
## JobRoleLaboratory Technician      2.157e+00  6.548e-01   3.294 0.000987
## JobRoleManager                    7.738e-01  1.121e+00   0.690 0.490189
## JobRoleManufacturing Director     8.420e-01  7.104e-01   1.185 0.235910
## JobRoleResearch Director         -8.839e-01  1.338e+00  -0.661 0.508748
## JobRoleResearch Scientist         8.761e-01  6.704e-01   1.307 0.191231
## JobRoleSales Executive            8.892e-01  1.314e+00   0.676 0.498732
## JobRoleSales Representative       1.985e+00  1.373e+00   1.446 0.148235
## JobSatisfaction                  -4.100e-01  9.862e-02  -4.157 3.22e-05
## MaritalStatusMarried              3.086e-01  3.209e-01   0.962 0.336192
## MaritalStatusSingle               9.227e-01  4.069e-01   2.268 0.023357
## MonthlyIncome                    -2.048e-05  9.401e-05  -0.218 0.827550
## MonthlyRate                       1.907e-05  1.519e-05   1.255 0.209312
## NumCompaniesWorked                1.672e-01  4.741e-02   3.528 0.000419
## OverTimeYes                       1.887e+00  2.354e-01   8.014 1.11e-15
## PercentSalaryHike                -2.948e-02  4.652e-02  -0.634 0.526186
## PerformanceRating                -3.232e-01  5.014e-01  -0.645 0.519218
## RelationshipSatisfaction         -2.236e-01  9.700e-02  -2.305 0.021171
## StandardHours                            NA         NA      NA       NA
## StockOptionLevel                 -2.891e-01  1.925e-01  -1.502 0.133094
## TotalWorkingYears                -6.822e-02  3.474e-02  -1.964 0.049547
## TrainingTimesLastYear            -1.188e-01  8.587e-02  -1.384 0.166388
## WorkLifeBalance                  -5.179e-01  1.491e-01  -3.473 0.000515
## YearsAtCompany                    6.794e-02  4.760e-02   1.427 0.153494
## YearsInCurrentRole               -1.445e-01  5.601e-02  -2.581 0.009861
## YearsSinceLastPromotion           1.391e-01  5.060e-02   2.750 0.005968
## YearsWithCurrManager             -8.400e-02  5.929e-02  -1.417 0.156520
##
## (Intercept)
## Age
## BusinessTravelTravel_Frequently  ***
## BusinessTravelTravel_Rarely      *
## DailyRate
## DepartmentResearch & Development
## DepartmentSales
## DistanceFromHome                 **
## Education
## EducationFieldLife Sciences
## EducationFieldMarketing
## EducationFieldMedical
## EducationFieldOther
## EducationFieldTechnical Degree
## EnvironmentSatisfaction          ***
## GenderMale
## HourlyRate
## JobInvolvement                   **
## JobLevel
## JobRoleHuman Resources
## JobRoleLaboratory Technician     ***
## JobRoleManager
## JobRoleManufacturing Director
## JobRoleResearch Director
## JobRoleResearch Scientist
## JobRoleSales Executive
## JobRoleSales Representative
## JobSatisfaction                  ***
## MaritalStatusMarried
## MaritalStatusSingle              *
## MonthlyIncome
## MonthlyRate
## NumCompaniesWorked               ***
## OverTimeYes                      ***
## PercentSalaryHike
## PerformanceRating
## RelationshipSatisfaction         *
## StandardHours
## StockOptionLevel
## TotalWorkingYears                *
## TrainingTimesLastYear
## WorkLifeBalance                  ***
## 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: 909.34  on 1028  degrees of freedom
## Residual deviance: 602.56  on  984  degrees of freedom
## AIC: 692.56
##
## Number of Fisher Scoring iterations: 15
```

Using stepAIC for variable selection, which is a iterative process of adding or removing variables, in order to get a subset of variables that gives the best performing model.

```
library(MASS)
```

```
##
## Attaching package: 'MASS'
```

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

```
model_2<- stepAIC(model_1, direction="both")
```

```
## Start:  AIC=692.56
## Attrition ~ Age + BusinessTravel + DailyRate + Department + 
DistanceFromHome + 
##     Education + EducationField + EnvironmentSatisfaction + Gender + 
##     HourlyRate + JobInvolvement + JobLevel + JobRole + JobSatisfaction + 
##     MaritalStatus + MonthlyIncome + MonthlyRate + NumCompaniesWorked + 
##     OverTime + PercentSalaryHike + PerformanceRating + 
RelationshipSatisfaction + 
##     StandardHours + StockOptionLevel + TotalWorkingYears + 
TrainingTimesLastYear + 
##     WorkLifeBalance + YearsAtCompany + YearsInCurrentRole + 
YearsSinceLastPromotion + 
##     YearsWithCurrManager
##
##
## Step:  AIC=692.56
## Attrition ~ Age + BusinessTravel + DailyRate + Department + 
DistanceFromHome + 
##     Education + EducationField + EnvironmentSatisfaction + Gender + 
##     HourlyRate + JobInvolvement + JobLevel + JobRole + JobSatisfaction + 
##     MaritalStatus + MonthlyIncome + MonthlyRate + NumCompaniesWorked + 
##     OverTime + PercentSalaryHike + PerformanceRating + 
RelationshipSatisfaction + 
##     StockOptionLevel + TotalWorkingYears + TrainingTimesLastYear +
##     WorkLifeBalance + YearsAtCompany + YearsInCurrentRole +
YearsSinceLastPromotion +
##     YearsWithCurrManager
##
##                            Df Deviance    AIC
## - Department                2   604.10 690.10
## - HourlyRate                1   602.59 690.59
## - JobLevel                  1   602.59 690.59
## - MonthlyIncome             1   602.60 690.60
## - Education                 1   602.62 690.62
## - PercentSalaryHike         1   602.96 690.96
## - PerformanceRating         1   602.97 690.97
## - DailyRate                 1   603.05 691.05
## - Age                       1   603.88 691.88
## - EducationField            5   612.11 692.11
## - MonthlyRate               1   604.14 692.14
## - TrainingTimesLastYear     1   604.50 692.50
## - YearsWithCurrManager      1   604.54 692.54
## <none>                          602.56 692.56
## - YearsAtCompany            1   604.58 692.58
## - StockOptionLevel          1   604.89 692.89
## - Gender                    1   605.24 693.24
## - MaritalStatus             2   608.52 694.52
## - TotalWorkingYears         1   606.58 694.58
## - RelationshipSatisfaction  1   607.91 695.91
## - YearsInCurrentRole        1   609.19 697.19
## - YearsSinceLastPromotion   1   610.31 698.31
## - DistanceFromHome          1   612.63 700.63
## - JobInvolvement            1   612.95 700.95
## - NumCompaniesWorked        1   614.75 702.75
## - WorkLifeBalance           1   614.77 702.77
## - JobRole                   8   632.01 706.01
## - EnvironmentSatisfaction   1   619.91 707.91
## - JobSatisfaction           1   620.43 708.43
## - BusinessTravel            2   624.80 710.80
## - OverTime                  1   673.26 761.26
##
## Step:  AIC=690.1
## Attrition ~ Age + BusinessTravel + DailyRate + DistanceFromHome +
##     Education + EducationField + EnvironmentSatisfaction + Gender +
##     HourlyRate + JobInvolvement + JobLevel + JobRole + JobSatisfaction +
##     MaritalStatus + MonthlyIncome + MonthlyRate + NumCompaniesWorked +
##     OverTime + PercentSalaryHike + PerformanceRating +
RelationshipSatisfaction +
##     StockOptionLevel + TotalWorkingYears + TrainingTimesLastYear +
##     WorkLifeBalance + YearsAtCompany + YearsInCurrentRole +
YearsSinceLastPromotion +
##     YearsWithCurrManager
##
```

```
##                             Df Deviance    AIC
## - JobLevel                   1   604.12 688.12
## - HourlyRate                 1   604.14 688.14
## - MonthlyIncome              1   604.15 688.15
## - Education                  1   604.15 688.15
## - PercentSalaryHike          1   604.45 688.45
## - PerformanceRating          1   604.53 688.53
## - DailyRate                  1   604.56 688.56
## - Age                        1   605.49 689.49
## - MonthlyRate                1   605.73 689.73
## - TrainingTimesLastYear      1   605.91 689.91
## - YearsWithCurrManager       1   605.96 689.96
## - EducationField             5   614.03 690.03
## <none>                          604.10 690.10
## - YearsAtCompany             1   606.12 690.12
## - StockOptionLevel           1   606.61 690.61
## - Gender                     1   606.72 690.72
## - MaritalStatus              2   609.96 691.96
## - TotalWorkingYears          1   608.00 692.00
## + Department                 2   602.56 692.56
## - RelationshipSatisfaction   1   609.53 693.53
## - YearsInCurrentRole         1   610.79 694.79
## - YearsSinceLastPromotion    1   611.87 695.87
## - DistanceFromHome           1   613.88 697.88
## - JobInvolvement             1   615.14 699.14
## - WorkLifeBalance            1   616.16 700.16
## - NumCompaniesWorked         1   616.50 700.50
## - EnvironmentSatisfaction    1   621.45 705.45
## - JobSatisfaction            1   622.01 706.01
## - BusinessTravel             2   626.34 708.34
## - JobRole                    8   642.99 712.99
## - OverTime                   1   676.05 760.05
## 
## Step:  AIC=688.12
## Attrition ~ Age + BusinessTravel + DailyRate + DistanceFromHome + 
##     Education + EducationField + EnvironmentSatisfaction + Gender + 
##     HourlyRate + JobInvolvement + JobRole + JobSatisfaction + 
##     MaritalStatus + MonthlyIncome + MonthlyRate + NumCompaniesWorked + 
##     OverTime + PercentSalaryHike + PerformanceRating + 
RelationshipSatisfaction + 
##     StockOptionLevel + TotalWorkingYears + TrainingTimesLastYear + 
##     WorkLifeBalance + YearsAtCompany + YearsInCurrentRole + 
YearsSinceLastPromotion + 
##     YearsWithCurrManager
## 
##                             Df Deviance    AIC
## - MonthlyIncome              1   604.15 686.15
## - HourlyRate                 1   604.16 686.16
## - Education                  1   604.17 686.17
## - PercentSalaryHike          1   604.48 686.48
## - PerformanceRating         1   604.55 686.55
## - DailyRate                 1   604.59 686.59
## - Age                       1   605.51 687.51
## - MonthlyRate               1   605.78 687.78
## - TrainingTimesLastYear     1   605.93 687.93
## - YearsWithCurrManager      1   605.98 687.98
## <none>                          604.12 688.12
## - EducationField            5   614.16 688.16
## - YearsAtCompany            1   606.27 688.27
## - StockOptionLevel          1   606.63 688.63
## - Gender                    1   606.75 688.75
## - MaritalStatus             2   610.06 690.06
## + JobLevel                  1   604.10 690.10
## - TotalWorkingYears         1   608.11 690.11
## + Department                2   602.59 690.59
## - RelationshipSatisfaction  1   609.58 691.58
## - YearsInCurrentRole        1   611.00 693.00
## - YearsSinceLastPromotion   1   611.87 693.87
## - DistanceFromHome          1   614.01 696.01
## - JobInvolvement            1   615.14 697.14
## - WorkLifeBalance           1   616.17 698.17
## - NumCompaniesWorked        1   616.54 698.54
## - EnvironmentSatisfaction   1   621.49 703.49
## - JobSatisfaction           1   622.03 704.03
## - BusinessTravel            2   626.40 706.40
## - JobRole                   8   643.05 711.05
## - OverTime                  1   676.05 758.05
## 
## Step:  AIC=686.15
## Attrition ~ Age + BusinessTravel + DailyRate + DistanceFromHome + 
##     Education + EducationField + EnvironmentSatisfaction + Gender + 
##     HourlyRate + JobInvolvement + JobRole + JobSatisfaction + 
##     MaritalStatus + MonthlyRate + NumCompaniesWorked + OverTime + 
##     PercentSalaryHike + PerformanceRating + RelationshipSatisfaction + 
##     StockOptionLevel + TotalWorkingYears + TrainingTimesLastYear + 
##     WorkLifeBalance + YearsAtCompany + YearsInCurrentRole + 
YearsSinceLastPromotion + 
##     YearsWithCurrManager
## 
##                              Df Deviance    AIC
## - HourlyRate                1   604.18 684.18
## - Education                 1   604.20 684.20
## - PercentSalaryHike         1   604.51 684.51
## - PerformanceRating         1   604.57 684.57
## - DailyRate                 1   604.62 684.62
## - Age                       1   605.54 685.54
## - MonthlyRate               1   605.80 685.80
## - TrainingTimesLastYear     1   605.96 685.96
## - YearsWithCurrManager      1   605.98 685.98
## <none>                          604.15 686.15
## - EducationField            5   614.17 686.17
## - YearsAtCompany            1   606.27 686.27
## - StockOptionLevel          1   606.66 686.66
## - Gender                    1   606.76 686.76
## - MaritalStatus             2   610.06 688.06
## + MonthlyIncome             1   604.12 688.12
## + JobLevel                  1   604.15 688.15
## + Department                2   602.61 688.61
## - TotalWorkingYears         1   609.14 689.14
## - RelationshipSatisfaction  1   609.58 689.58
## - YearsInCurrentRole        1   611.01 691.01
## - YearsSinceLastPromotion   1   611.88 691.88
## - DistanceFromHome          1   614.05 694.05
## - JobInvolvement            1   615.15 695.15
## - WorkLifeBalance           1   616.25 696.25
## - NumCompaniesWorked        1   616.55 696.55
## - EnvironmentSatisfaction   1   621.59 701.59
## - JobSatisfaction           1   622.14 702.14
## - BusinessTravel            2   626.40 704.40
## - JobRole                   8   648.20 714.20
## - OverTime                  1   676.05 756.05
##
## Step:  AIC=684.18
## Attrition ~ Age + BusinessTravel + DailyRate + DistanceFromHome +
##     Education + EducationField + EnvironmentSatisfaction + Gender +
##     JobInvolvement + JobRole + JobSatisfaction + MaritalStatus +
##     MonthlyRate + NumCompaniesWorked + OverTime + PercentSalaryHike +
##     PerformanceRating + RelationshipSatisfaction + StockOptionLevel +
##     TotalWorkingYears + TrainingTimesLastYear + WorkLifeBalance +
##     YearsAtCompany + YearsInCurrentRole + YearsSinceLastPromotion +
##     YearsWithCurrManager
##
##                            Df Deviance    AIC
## - Education                 1   604.23 682.23
## - PercentSalaryHike         1   604.54 682.54
## - PerformanceRating         1   604.61 682.61
## - DailyRate                 1   604.65 682.65
## - Age                       1   605.56 683.56
## - MonthlyRate               1   605.85 683.85
## - TrainingTimesLastYear     1   606.02 684.02
## - YearsWithCurrManager      1   606.03 684.03
## <none>                          604.18 684.18
## - EducationField            5   614.29 684.29
## - YearsAtCompany            1   606.35 684.35
## - StockOptionLevel          1   606.69 684.69
## - Gender                    1   606.77 684.77
## - MaritalStatus             2   610.10 686.10
## + HourlyRate                1   604.15 686.15
## + MonthlyIncome             1   604.16 686.16
## + JobLevel                  1   604.18 686.18
## + Department                2   602.64 686.64
## - TotalWorkingYears         1   609.19 687.19
## - RelationshipSatisfaction  1   609.63 687.63
## - YearsInCurrentRole        1   611.07 689.07
## - YearsSinceLastPromotion   1   611.89 689.89
## - DistanceFromHome          1   614.12 692.12
## - JobInvolvement            1   615.21 693.21
## - WorkLifeBalance           1   616.30 694.30
## - NumCompaniesWorked        1   616.56 694.56
## - EnvironmentSatisfaction   1   621.62 699.62
## - JobSatisfaction           1   622.31 700.31
## - BusinessTravel            2   626.41 702.41
## - JobRole                   8   648.22 712.22
## - OverTime                  1   676.10 754.10
## 
## Step:  AIC=682.23
## Attrition ~ Age + BusinessTravel + DailyRate + DistanceFromHome + 
##     EducationField + EnvironmentSatisfaction + Gender + JobInvolvement + 
##     JobRole + JobSatisfaction + MaritalStatus + MonthlyRate + 
##     NumCompaniesWorked + OverTime + PercentSalaryHike + PerformanceRating 
+ 
##     RelationshipSatisfaction + StockOptionLevel + TotalWorkingYears + 
##     TrainingTimesLastYear + WorkLifeBalance + YearsAtCompany + 
##     YearsInCurrentRole + YearsSinceLastPromotion + YearsWithCurrManager
## 
##                            Df Deviance    AIC
## - PercentSalaryHike         1   604.58 680.58
## - PerformanceRating         1   604.67 680.67
## - DailyRate                 1   604.71 680.71
## - Age                       1   605.56 681.56
## - MonthlyRate               1   605.86 681.86
## - TrainingTimesLastYear     1   606.09 682.09
## - YearsWithCurrManager      1   606.10 682.10
## <none>                          604.23 682.23
## - EducationField            5   614.40 682.40
## - YearsAtCompany            1   606.41 682.41
## - StockOptionLevel          1   606.70 682.70
## - Gender                    1   606.79 682.79
## + Education                 1   604.18 684.18
## + HourlyRate                1   604.20 684.20
## + MonthlyIncome             1   604.21 684.21
## - MaritalStatus             2   610.21 684.21
## + JobLevel                  1   604.23 684.23
## + Department                2   602.69 684.69
## - TotalWorkingYears         1   609.22 685.22
## - RelationshipSatisfaction  1   609.64 685.64
## - YearsInCurrentRole        1   611.08 687.08
## - YearsSinceLastPromotion   1   611.96 687.96
## - DistanceFromHome          1   614.31 690.31
## - JobInvolvement            1   615.22 691.22
## - WorkLifeBalance           1   616.32 692.32
## - NumCompaniesWorked        1   616.69 692.69
## - EnvironmentSatisfaction   1   621.66 697.66
## - JobSatisfaction           1   622.33 698.33
## - BusinessTravel            2   626.49 700.49
## - JobRole                   8   648.32 710.32
## - OverTime                  1   676.19 752.19
##
## Step:  AIC=680.58
## Attrition ~ Age + BusinessTravel + DailyRate + DistanceFromHome +
##     EducationField + EnvironmentSatisfaction + Gender + JobInvolvement +
##     JobRole + JobSatisfaction + MaritalStatus + MonthlyRate +
##     NumCompaniesWorked + OverTime + PerformanceRating +
RelationshipSatisfaction +
##     StockOptionLevel + TotalWorkingYears + TrainingTimesLastYear +
##     WorkLifeBalance + YearsAtCompany + YearsInCurrentRole +
YearsSinceLastPromotion +
##     YearsWithCurrManager
##
##                            Df Deviance    AIC
## - DailyRate                 1   605.07 679.07
## - Age                       1   605.96 679.96
## - MonthlyRate               1   606.06 680.06
## - YearsWithCurrManager      1   606.44 680.44
## - TrainingTimesLastYear     1   606.46 680.46
## <none>                          604.58 680.58
## - YearsAtCompany            1   606.73 680.73
## - EducationField            5   614.92 680.92
## - Gender                    1   607.12 681.12
## - StockOptionLevel          1   607.13 681.13
## - PerformanceRating         1   607.29 681.29
## + PercentSalaryHike         1   604.23 682.23
## + Education                 1   604.54 682.54
## + HourlyRate                1   604.55 682.55
## + MonthlyIncome             1   604.55 682.55
## - MaritalStatus             2   610.56 682.56
## + JobLevel                  1   604.58 682.58
## + Department                2   603.09 683.09
## - TotalWorkingYears         1   609.51 683.51
## - RelationshipSatisfaction  1   610.08 684.08
## - YearsInCurrentRole        1   611.35 685.35
## - YearsSinceLastPromotion   1   612.42 686.42
## - DistanceFromHome          1   614.53 688.53
## - JobInvolvement            1   615.55 689.55
## - WorkLifeBalance           1   616.44 690.44
## - NumCompaniesWorked        1   617.00 691.00
## - EnvironmentSatisfaction   1   621.77 695.77
## - JobSatisfaction           1   622.63 696.63
## - BusinessTravel            2   626.92 698.92
## - JobRole                   8   648.61 708.61
## - OverTime                  1   677.31 751.31
##
## Step:  AIC=679.07
## Attrition ~ Age + BusinessTravel + DistanceFromHome + EducationField +
##     EnvironmentSatisfaction + Gender + JobInvolvement + JobRole +
##     JobSatisfaction + MaritalStatus + MonthlyRate + NumCompaniesWorked +
##     OverTime + PerformanceRating + RelationshipSatisfaction +
##     StockOptionLevel + TotalWorkingYears + TrainingTimesLastYear +
##     WorkLifeBalance + YearsAtCompany + YearsInCurrentRole +
YearsSinceLastPromotion +
##     YearsWithCurrManager
##
##                            Df Deviance    AIC
## - Age                       1   606.56 678.56
## - MonthlyRate               1   606.59 678.59
## - YearsWithCurrManager      1   606.85 678.85
## - TrainingTimesLastYear     1   606.94 678.94
## <none>                          605.07 679.07
## - YearsAtCompany            1   607.24 679.24
## - Gender                    1   607.63 679.63
## - StockOptionLevel          1   607.64 679.64
## - EducationField            5   615.71 679.71
## - PerformanceRating         1   607.88 679.88
## + DailyRate                 1   604.58 680.58
## + PercentSalaryHike         1   604.71 680.71
## + Education                 1   605.01 681.01
## + MonthlyIncome             1   605.04 681.04
## + HourlyRate                1   605.05 681.05
## + JobLevel                  1   605.07 681.07
## - MaritalStatus             2   611.19 681.19
## + Department                2   603.62 681.62
## - TotalWorkingYears         1   610.13 682.13
## - RelationshipSatisfaction  1   610.70 682.70
## - YearsInCurrentRole        1   612.13 684.13
## - YearsSinceLastPromotion   1   613.29 685.29
## - DistanceFromHome          1   615.28 687.28
## - JobInvolvement            1   616.21 688.21
## - WorkLifeBalance           1   616.84 688.84
## - NumCompaniesWorked        1   617.62 689.62
## - EnvironmentSatisfaction   1   622.20 694.20
## - JobSatisfaction           1   623.24 695.24
## - BusinessTravel            2   627.76 697.76
## - JobRole                   8   649.00 707.00
## - OverTime                  1   677.82 749.82
##
## Step:  AIC=678.56
## Attrition ~ BusinessTravel + DistanceFromHome + EducationField +
##     EnvironmentSatisfaction + Gender + JobInvolvement + JobRole +
##     JobSatisfaction + MaritalStatus + MonthlyRate + NumCompaniesWorked +
##     OverTime + PerformanceRating + RelationshipSatisfaction +
##     StockOptionLevel + TotalWorkingYears + TrainingTimesLastYear +
##     WorkLifeBalance + YearsAtCompany + YearsInCurrentRole +
YearsSinceLastPromotion +
##     YearsWithCurrManager
##
##                             Df Deviance    AIC
## - YearsWithCurrManager      1   608.11 678.11
## - MonthlyRate               1   608.17 678.17
## <none>                          606.56 678.56
## - TrainingTimesLastYear     1   608.62 678.62
## - YearsAtCompany            1   608.88 678.88
## - Gender                    1   608.91 678.91
## - EducationField            5   617.02 679.02
## - StockOptionLevel          1   609.06 679.06
## + Age                       1   605.07 679.07
## - PerformanceRating         1   609.39 679.39
## + DailyRate                 1   605.96 679.96
## + PercentSalaryHike         1   606.14 680.14
## + MonthlyIncome             1   606.53 680.53
## + Education                 1   606.55 680.55
## + HourlyRate                1   606.55 680.55
## + JobLevel                  1   606.55 680.55
## + Department                2   605.03 681.03
## - MaritalStatus             2   613.09 681.09
## - RelationshipSatisfaction  1   612.51 682.51
## - YearsInCurrentRole        1   613.61 683.61
## - YearsSinceLastPromotion   1   614.49 684.49
## - DistanceFromHome          1   616.56 686.56
## - TotalWorkingYears         1   617.49 687.49
## - WorkLifeBalance           1   617.92 687.92
## - JobInvolvement            1   617.93 687.93
## - NumCompaniesWorked        1   618.15 688.15
## - EnvironmentSatisfaction   1   623.84 693.84
## - JobSatisfaction           1   625.31 695.31
## - BusinessTravel            2   629.84 697.84
## - JobRole                   8   650.35 706.35
## - OverTime                  1   678.86 748.86
##
## Step:  AIC=678.11
## Attrition ~ BusinessTravel + DistanceFromHome + EducationField +
##     EnvironmentSatisfaction + Gender + JobInvolvement + JobRole +
##     JobSatisfaction + MaritalStatus + MonthlyRate + NumCompaniesWorked +
##     OverTime + PerformanceRating + RelationshipSatisfaction +
##     StockOptionLevel + TotalWorkingYears + TrainingTimesLastYear +
##     WorkLifeBalance + YearsAtCompany + YearsInCurrentRole +
YearsSinceLastPromotion
##
##                             Df Deviance    AIC
## - YearsAtCompany            1   609.28 677.28
## - MonthlyRate               1   609.87 677.87
## - TrainingTimesLastYear     1   610.09 678.09
## <none>                          608.11 678.11
## + YearsWithCurrManager      1   606.56 678.56
## - Gender                    1   610.60 678.60
## - EducationField            5   618.78 678.78
## - StockOptionLevel          1   610.84 678.84
## + Age                       1   606.85 678.85
## - PerformanceRating         1   611.05 679.05
## + DailyRate                 1   607.60 679.60
## + PercentSalaryHike         1   607.70 679.70
## + Education                 1   608.08 680.08
## + JobLevel                  1   608.10 680.10
## + HourlyRate                1   608.10 680.10
## + MonthlyIncome             1   608.10 680.10
## - MaritalStatus             2   614.37 680.37
## + Department                2   606.70 680.70
## - RelationshipSatisfaction  1   614.08 682.08
## - YearsSinceLastPromotion   1   615.36 683.36
## - YearsInCurrentRole        1   617.34 685.34
## - DistanceFromHome          1   618.00 686.00
## - WorkLifeBalance           1   619.03 687.03
## - TotalWorkingYears         1   619.43 687.43
## - NumCompaniesWorked        1   620.12 688.12
## - JobInvolvement            1   620.20 688.20
## - EnvironmentSatisfaction   1   625.21 693.21
## - JobSatisfaction           1   626.50 694.50
## - BusinessTravel            2   631.09 697.09
## - JobRole                   8   652.03 706.03
## - OverTime                  1   680.54 748.54
## 
## Step:  AIC=677.28
## Attrition ~ BusinessTravel + DistanceFromHome + EducationField + 
##     EnvironmentSatisfaction + Gender + JobInvolvement + JobRole + 
##     JobSatisfaction + MaritalStatus + MonthlyRate + NumCompaniesWorked + 
##     OverTime + PerformanceRating + RelationshipSatisfaction + 
##     StockOptionLevel + TotalWorkingYears + TrainingTimesLastYear + 
##     WorkLifeBalance + YearsInCurrentRole + YearsSinceLastPromotion
## 
##                            Df Deviance    AIC
## - MonthlyRate               1   610.89 676.89
## - TrainingTimesLastYear     1   611.24 677.24
## <none>                          609.28 677.28
## - EducationField            5   619.36 677.36
## - Gender                    1   611.75 677.75
## + Age                       1   607.82 677.82
## - StockOptionLevel          1   611.97 677.97
## + YearsAtCompany            1   608.11 678.11
## - PerformanceRating         1   612.24 678.24
## + DailyRate                 1   608.71 678.71
## + YearsWithCurrManager      1   608.88 678.88
## + PercentSalaryHike         1   608.89 678.89
## + JobLevel                  1   609.18 679.18
## + HourlyRate                1   609.25 679.25
## + Education                 1   609.26 679.26
## + MonthlyIncome             1   609.27 679.27
## - MaritalStatus             2   615.65 679.65
## + Department                2   607.78 679.78
## - RelationshipSatisfaction  1   615.21 681.21
## - YearsInCurrentRole        1   618.06 684.06
## - DistanceFromHome          1   618.92 684.92
## - TotalWorkingYears         1   619.59 685.59
## - YearsSinceLastPromotion   1   620.11 686.11
## - WorkLifeBalance           1   620.15 686.15
## - NumCompaniesWorked        1   620.19 686.19
## - JobInvolvement            1   621.64 687.64
## - EnvironmentSatisfaction   1   626.61 692.61
## - JobSatisfaction           1   627.56 693.56
## - BusinessTravel            2   632.66 696.66
## - JobRole                   8   652.61 704.61
## - OverTime                  1   681.53 747.53
## 
## Step:  AIC=676.89
## Attrition ~ BusinessTravel + DistanceFromHome + EducationField + 
##     EnvironmentSatisfaction + Gender + JobInvolvement + JobRole + 
##     JobSatisfaction + MaritalStatus + NumCompaniesWorked + OverTime + 
##     PerformanceRating + RelationshipSatisfaction + StockOptionLevel + 
##     TotalWorkingYears + TrainingTimesLastYear + WorkLifeBalance + 
##     YearsInCurrentRole + YearsSinceLastPromotion
## 
##                             Df Deviance    AIC
## - EducationField            5   620.88 676.88
## <none>                          610.89 676.89
## - TrainingTimesLastYear     1   612.98 676.98
## - Gender                    1   613.20 677.20
## + MonthlyRate               1   609.28 677.28
## + Age                       1   609.37 677.37
## + YearsAtCompany            1   609.87 677.87
## - StockOptionLevel          1   613.88 677.88
## - PerformanceRating         1   614.18 678.18
## + DailyRate                 1   610.31 678.31
## + YearsWithCurrManager      1   610.38 678.38
## + PercentSalaryHike         1   610.65 678.65
## + JobLevel                  1   610.75 678.75
## + HourlyRate                1   610.85 678.85
## + MonthlyIncome             1   610.88 678.88
## + Education                 1   610.89 678.89
## - MaritalStatus             2   617.20 679.20
## + Department                2   609.39 679.39
## - RelationshipSatisfaction  1   616.90 680.90
## - YearsInCurrentRole        1   620.03 684.03
## - TotalWorkingYears         1   621.06 685.06
## - DistanceFromHome          1   621.17 685.17
## - YearsSinceLastPromotion   1   621.51 685.51
## - NumCompaniesWorked        1   621.77 685.77
## - WorkLifeBalance           1   621.78 685.78
## - JobInvolvement            1   623.11 687.11
## - EnvironmentSatisfaction   1   627.65 691.65
## - JobSatisfaction           1   629.19 693.19
## - BusinessTravel            2   634.18 696.18
## - JobRole                   8   653.70 703.70
## - OverTime                  1   683.35 747.35
##
## Step:  AIC=676.88
## Attrition ~ BusinessTravel + DistanceFromHome + EnvironmentSatisfaction +
##     Gender + JobInvolvement + JobRole + JobSatisfaction + MaritalStatus +
##     NumCompaniesWorked + OverTime + PerformanceRating +
RelationshipSatisfaction +
##     StockOptionLevel + TotalWorkingYears + TrainingTimesLastYear +
##     WorkLifeBalance + YearsInCurrentRole + YearsSinceLastPromotion
##
##                            Df Deviance    AIC
## <none>                          620.88 676.88
## + EducationField            5   610.89 676.89
## + MonthlyRate               1   619.36 677.36
## - Gender                    1   623.45 677.45
## - TrainingTimesLastYear     1   623.53 677.53
## + Age                       1   619.59 677.59
## + YearsWithCurrManager      1   620.00 678.00
## + DailyRate                 1   620.03 678.03
## - StockOptionLevel          1   624.17 678.17
## - PerformanceRating         1   624.23 678.23
## + YearsAtCompany            1   620.38 678.38
## + PercentSalaryHike         1   620.46 678.46
## + JobLevel                  1   620.48 678.48
## - MaritalStatus             2   626.66 678.66
## + HourlyRate                1   620.77 678.77
## + MonthlyIncome             1   620.78 678.78
## + Education                 1   620.85 678.85
## + Department                2   619.24 679.24
## - RelationshipSatisfaction  1   626.95 680.95
## - YearsInCurrentRole        1   629.24 683.24
## - WorkLifeBalance           1   630.94 684.94
## - YearsSinceLastPromotion   1   630.98 684.98
## - DistanceFromHome          1   631.00 685.00
## - TotalWorkingYears         1   631.27 685.27
## - NumCompaniesWorked        1   631.67 685.67
## - JobInvolvement            1   633.48 687.48
## - EnvironmentSatisfaction   1   636.69 690.69
## - JobSatisfaction           1   639.04 693.04
## - BusinessTravel            2   644.84 696.84
## - JobRole                    8   671.13 711.13
## - OverTime                   1   692.20 746.20
```

```r
summary(model_2)
```

```
##
## Call:
## glm(formula = Attrition ~ BusinessTravel + DistanceFromHome +
##     EnvironmentSatisfaction + Gender + JobInvolvement + JobRole +
##     JobSatisfaction + MaritalStatus + NumCompaniesWorked + OverTime +
##     PerformanceRating + RelationshipSatisfaction + StockOptionLevel +
##     TotalWorkingYears + TrainingTimesLastYear + WorkLifeBalance +
##     YearsInCurrentRole + YearsSinceLastPromotion, family = "binomial",
##     data = train)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.7010  -0.4917  -0.2623  -0.0993   3.8093
##
## Coefficients:
##                                   Estimate Std. Error z value Pr(>|z|)
## (Intercept)                        2.00424    1.48474   1.350 0.177051
## BusinessTravelTravel_Frequently    2.04122    0.53275   3.831 0.000127 ***
## BusinessTravelTravel_Rarely        1.09637    0.50460   2.173 0.029800 *
## DistanceFromHome                   0.04036    0.01265   3.190 0.001422 **
## EnvironmentSatisfaction           -0.37848    0.09630  -3.930 8.49e-05 ***
## GenderMale                         0.34154    0.21435   1.593 0.111076
## JobInvolvement                    -0.51003    0.14446  -3.531 0.000414 ***
## JobRoleHuman Resources             1.94824    0.75083   2.595 0.009465 **
## JobRoleLaboratory Technician       2.10220    0.59416   3.538 0.000403 ***
## JobRoleManager                     1.15109    0.81172   1.418 0.156165
## JobRoleManufacturing Director      0.76195    0.70332   1.083 0.278646
## JobRoleResearch Director          -0.65599    1.21877  -0.538 0.590413
## JobRoleResearch Scientist          0.86667    0.60489   1.433 0.151919
## JobRoleSales Executive             1.77094    0.58694   3.017 0.002551 **
## JobRoleSales Representative        2.82936    0.65114   4.345 1.39e-05 ***
## JobSatisfaction                   -0.40153    0.09558  -4.201 2.66e-05 ***
## MaritalStatusMarried               0.27415    0.31461   0.871 0.383545
## MaritalStatusSingle                0.86616    0.39500   2.193 0.028323 *
## NumCompaniesWorked                 0.14774    0.04445   3.324 0.000887 ***
## OverTimeYes                        1.86137    0.23053   8.074 6.79e-16 ***
## PerformanceRating                 -0.58703    0.33093  -1.774 0.076083 .
## RelationshipSatisfaction          -0.23271    0.09473  -2.456 0.014031 *
## StockOptionLevel                  -0.32569    0.18334  -1.776 0.075664 .
## TotalWorkingYears                 -0.07367    0.02384  -3.090 0.001999 **
## TrainingTimesLastYear             -0.13615    0.08428  -1.615 0.106218
## WorkLifeBalance                   -0.45746    0.14461  -3.163 0.001559 **
## YearsInCurrentRole                -0.12571    0.04450  -2.825 0.004730 **
## YearsSinceLastPromotion            0.14330    0.04499   3.185 0.001446 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 909.34  on 1028  degrees of freedom
## Residual deviance: 620.88  on 1001  degrees of freedom
## AIC: 676.88
##
## Number of Fisher Scoring iterations: 6
```

VIF:

We can use variance inflation factor (vif) to get rid of redundant predictors or the variables that have high multicollinearity between them. Multicollinearity exists when two or more predictor variables are highly related to each other and then it becomes difficult to understand the impact of an independent variable on the dependent variable. The Variance Inflation Factor(VIF) is used to measure the multicollinearity between predictor variables in a model. A predictor having a VIF of 5 or less is generally considered safe and it can be assumed that it is not correlated with other predictor variables. Higher the VIF, greater is the correlation of the predictor variable w.r.t other predictor variables. However, Predictors with high VIF may have high p-value(or highly significant), hence, we need to see the significance of the Predictor variable before removing it from our model.

```
library(car)
```

```
##
## Attaching package: 'car'
```

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

```
vif(model_2)
```

```
##                              GVIF Df GVIF^(1/(2*Df))
## BusinessTravel           1.159661  2        1.037726
## DistanceFromHome         1.109299  1        1.053232
## EnvironmentSatisfaction  1.058276  1        1.028726
## Gender                   1.038340  1        1.018990
## JobInvolvement           1.028626  1        1.014212
## JobRole                  2.056495  8        1.046093
## JobSatisfaction          1.066460  1        1.032696
## MaritalStatus            2.032717  2        1.194041
## NumCompaniesWorked       1.260061  1        1.122524
## OverTime                 1.240102  1        1.113598
## PerformanceRating        1.037761  1        1.018706
## RelationshipSatisfaction 1.072754  1        1.035738
## StockOptionLevel         1.928597  1        1.388739
## TotalWorkingYears        2.257093  1        1.502363
## TrainingTimesLastYear    1.062476  1        1.030765
## WorkLifeBalance          1.074822  1        1.036736
## YearsInCurrentRole       1.789946  1         1.337889
## YearsSinceLastPromotion  1.816638  1         1.347827
```

```
final_model <- model_2
```

Accuracy

```
prob_pred=predict(final_model,type='response', newdata = validation[-2])
y_pred = ifelse(prob_pred>0.5,"Yes","No")


accuracy <- table(y_pred, validation[,"Attrition"])
accuracy
```

```
##
## y_pred False True
##    No    364   42
##    Yes     6   29
```

```
sum(diag(accuracy))/sum(accuracy)
```

```
## [1] 0.8911565
```

```
res=predict(final_model,train, type="response")
```

```
library(ROCR)
```

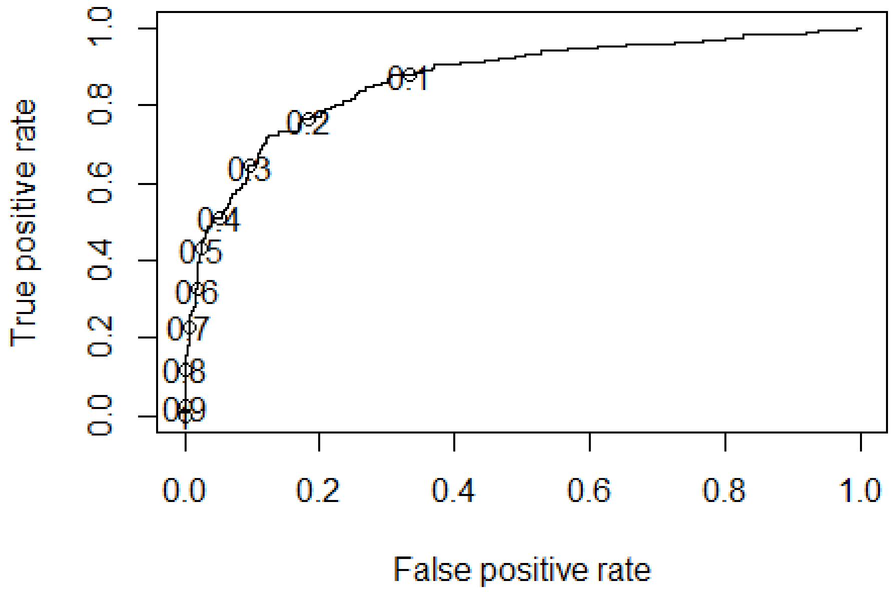
```
## Warning: package 'ROCR' was built under R version 3.4.3
```

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

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

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

```
ROCRPred = prediction(res,train$Attrition)
ROCRPref<- performance(ROCRPred,"tpr","fpr")
plot(ROCRPref, colorsize=TRUE,print.cutoffs.at=seq(0.1, by=0.1))
```



```
prob_pred1=predict(final_model,type='response', newdata = validation[-2])
y_pred1 = ifelse(prob_pred1>0.2,"Yes","No")

accuracy1 <- table(y_pred1, validation[,"Attrition"])
accuracy1

##
## y_pred1 False True
##      No    306   18
##      Yes    64   53

sum(diag(accuracy1))/sum(accuracy1)

## [1] 0.814059
```

MODEL BUILDING 2 Decision Tree- Splits the data into multiple sets and each set is further split into subsets to arrive at a tree like structure and make a decision. Homogeneity is the basic concept that helps to determine the attribute on which a split should be made. A split that results into the most homogenous subset is often considered better and step by step each attribute is choosen that maximizes the homogeneity of each subset. Further, this homogeneity is measured using different ways such as Gini Index, Entropy and Information Gain. Hide

```
set.seed(123)
df1$Attrition <- as.factor(df1$Attrition)
indices = sample.split(df1$Attrition, SplitRatio = 0.7)
train = df1[indices,]
```

```r
validation = df1[!(indices),]
head(validation)
```

```
##    Age Attrition    BusinessTravel DailyRate             Department
## 2   49     False Travel_Frequently       279 Research & Development
## 3   37      True     Travel_Rarely      1373 Research & Development
## 5   27     False     Travel_Rarely       591 Research & Development
## 11  35     False     Travel_Rarely       809 Research & Development
## 13  31     False     Travel_Rarely       670 Research & Development
## 14  34     False     Travel_Rarely      1346 Research & Development
##    DistanceFromHome Education EducationField EmployeeCount EmployeeNumber
## 2                 8         1  Life Sciences             1              2
## 3                 2         2          Other             1              4
## 5                 2         1        Medical             1              7
## 11               16         3        Medical             1             14
## 13               26         1  Life Sciences             1             16
## 14               19         2        Medical             1             18
##    EnvironmentSatisfaction Gender HourlyRate JobInvolvement JobLevel
## 2                        3   Male         61              2        2
## 3                        4   Male         92              2        1
## 5                        1   Male         40              3        1
## 11                       1   Male         84              4        1
## 13                       1   Male         31              3        1
## 14                       2   Male         93              3        1
##                  JobRole JobSatisfaction MaritalStatus MonthlyIncome
## 2     Research Scientist               2       Married          5130
## 3  Laboratory Technician               3        Single          2090
## 5  Laboratory Technician               2       Married          3468
## 11 Laboratory Technician               2       Married          2426
## 13    Research Scientist               3      Divorced          2911
## 14 Laboratory Technician               4      Divorced          2661
##    MonthlyRate NumCompaniesWorked Over18 OverTime PercentSalaryHike
## 2        24907                  1      Y       No                23
## 3         2396                  6      Y      Yes                15
## 5        16632                  9      Y       No                12
## 11       16479                  0      Y       No                13
## 13       15170                  1      Y       No                17
## 14        8758                  0      Y       No                11
##    PerformanceRating RelationshipSatisfaction StandardHours
## 2                  4                        4            80
## 3                  3                        2            80
## 5                  3                        4            80
## 11                 3                        3            80
## 13                 3                        4            80
## 14                 3                        3            80
##    StockOptionLevel TotalWorkingYears TrainingTimesLastYear
## 2                 1                10                     3
## 3                 0                 7                     3
## 5                 1                 6                     3
## 11                1                 6                     5
## 13                1                 5                     1
## 14                1                 3                     2
##    WorkLifeBalance YearsAtCompany YearsInCurrentRole
## 2                3             10                  7
## 3                3              0                  0
## 5                3              2                  2
## 11               3              5                  4
## 13               2              5                  2
## 14               3              2                  2
##    YearsSinceLastPromotion YearsWithCurrManager
## 2                        1                    7
## 3                        0                    0
## 5                        2                    2
## 11                       0                    3
## 13                       4                    3
## 14                       1                    2
```

```r
options(repr.plot.width = 10, repr.plot.height = 8)
library(rpart)
library(rpart.plot)
```

```
## Warning: package 'rpart.plot' was built under R version 3.4.4
```

```r
#Training
Dtree = rpart(Attrition ~., data = train, method = "class")
summary(Dtree)
```

```
## Call:
## rpart(formula = Attrition ~ ., data = train, method = "class")
##   n= 1029
## 
##           CP nsplit rel error   xerror       xstd
## 1 0.03614458      0 1.0000000 1.000000 0.07107939
## 2 0.03012048      3 0.8915663 1.012048 0.07142339
## 3 0.02409639      4 0.8614458 1.006024 0.07125184
## 4 0.01807229      7 0.7891566 1.066265 0.07292739
## 5 0.01000000     13 0.6807229 1.090361 0.07357350
## 
## Variable importance
##                  JobRole           MonthlyIncome       TotalWorkingYears
##                       12                      12                      10
##                 OverTime                JobLevel           MaritalStatus
##                        9                       8                       6
##                      Age               DailyRate              Department
##                        6                       6                       5
##         StockOptionLevel   TrainingTimesLastYear          BusinessTravel
##                        4                       4                       3
##         DistanceFromHome          EmployeeNumber EnvironmentSatisfaction
##                        2                       2                       2
##           YearsAtCompany       PercentSalaryHike          JobInvolvement
##                        2                       2                       1
##              HourlyRate             MonthlyRate         JobSatisfaction
##                       1                       1                       1
##          EducationField       PerformanceRating      NumCompaniesWorked
##                       1                       1                       1
##
## Node number 1: 1029 observations,    complexity param=0.03614458
##   predicted class=False  expected loss=0.1613217  P(node) =1
##     class counts:   863   166
##    probabilities: 0.839 0.161
##   left son=2 (747 obs) right son=3 (282 obs)
##   Primary splits:
##       OverTime          splits as  LR,          improve=14.48644, (0
missing)
##       JobRole           splits as  LLRLLLLLR,   improve=13.92655, (0
missing)
##       MonthlyIncome     < 2802    to the right, improve=13.85877, (0
missing)
##       TotalWorkingYears < 1.5     to the right, improve=13.53070, (0
missing)
##       JobLevel          < 1.5     to the right, improve=12.38312, (0
missing)
##   Surrogate splits:
##       EmployeeNumber < 22.5    to the right, agree=0.729, adj=0.011, (0
split)
##       DailyRate      < 104.5   to the right, agree=0.727, adj=0.004, (0
split)
##       MonthlyRate    < 26923.5 to the left,  agree=0.727, adj=0.004, (0
split)
##       YearsAtCompany < 26.5    to the left,  agree=0.727, adj=0.004, (0
split)
##
## Node number 2: 747 observations,    complexity param=0.01807229
##   predicted class=False  expected loss=0.1097724  P(node) =0.7259475
##     class counts:   665    82
##    probabilities: 0.890 0.110
##   left son=4 (675 obs) right son=5 (72 obs)
##   Primary splits:
##       TotalWorkingYears    < 2.5     to the right, improve=7.964730, (0
missing)
##       YearsAtCompany       < 2.5     to the right, improve=7.802820, (0
missing)
##       YearsWithCurrManager < 0.5     to the right, improve=7.364425, (0
missing)
##       MonthlyIncome        < 2059.5  to the right, improve=6.199431, (0
missing)
##       JobRole              splits as  LLRLLLLLR,   improve=5.979504, (0
missing)
##   Surrogate splits:
##       MonthlyIncome < 2009.5  to the right, agree=0.933, adj=0.306, (0
split)
```

```
##       Age           < 21.5    to the right, agree=0.926, adj=0.236, (0
split)
##
## Node number 3: 282 observations,    complexity param=0.03614458
##   predicted class=False  expected loss=0.2978723  P(node) =0.2740525
##     class counts:   198    84
##    probabilities: 0.702 0.298
##   left son=6 (189 obs) right son=7 (93 obs)
##   Primary splits:
##       MonthlyIncome     < 3751.5  to the right, improve=15.953690, (0
missing)
##       JobLevel          < 1.5     to the right, improve=14.774430, (0
missing)
##       JobRole           splits as  LRRLLLLLR,   improve=12.439970, (0
missing)
##       TotalWorkingYears < 1.5     to the right, improve= 7.851383, (0
missing)
##       Age               < 26.5    to the right, improve= 6.737057, (0
missing)
##   Surrogate splits:
##       JobLevel          < 1.5     to the right, agree=0.933, adj=0.796, (0
split)
##       JobRole           splits as  LRRLLLRLR,   agree=0.865, adj=0.591, (0
split)
##       TotalWorkingYears < 3.5     to the right, agree=0.780, adj=0.333, (0
split)
##       YearsAtCompany    < 2.5     to the right, agree=0.723, adj=0.161, (0
split)
##       Age               < 23.5    to the right, agree=0.716, adj=0.140, (0
split)
##
## Node number 4: 675 observations
##   predicted class=False  expected loss=0.08592593  P(node) =0.6559767
##     class counts:   617    58
##    probabilities: 0.914 0.086
##
## Node number 5: 72 observations,    complexity param=0.01807229
##   predicted class=False  expected loss=0.3333333  P(node) =0.06997085
##     class counts:    48    24
##    probabilities: 0.667 0.333
##   left son=10 (62 obs) right son=11 (10 obs)
##   Primary splits:
##       BusinessTravel splits as  LRL,         improve=5.058065, (0 missing)
##       JobRole        splits as  -RR---L-R,   improve=4.500000, (0 missing)
##       HourlyRate     < 58.5    to the right, improve=4.266667, (0 missing)
##       DailyRate      < 258.5   to the right, improve=4.254945, (0 missing)
##       MaritalStatus  splits as  LLR,         improve=2.427245, (0 missing)
##   Surrogate splits:
##       EmployeeNumber < 1901.5  to the left,  agree=0.889, adj=0.2, (0
split)
```

```
##       MonthlyRate    < 26306.5 to the left,  agree=0.875, adj=0.1, (0
split)
## 
## Node number 6: 189 observations,    complexity param=0.02409639
##   predicted class=False  expected loss=0.1798942  P(node) =0.1836735
##     class counts:   155    34
##    probabilities: 0.820 0.180 
##   left son=12 (114 obs) right son=13 (75 obs)
##   Primary splits:
##       JobRole          splits as  LLRLLLLRL,   improve=4.881582, (0
missing)
##       MaritalStatus    splits as  LLR,         improve=4.654420, (0
missing)
##       StockOptionLevel < 0.5     to the right, improve=4.562328, (0
missing)
##       Department       splits as  LLR,         improve=3.841677, (0
missing)
##       EducationField   splits as  LLRLLL,      improve=3.565686, (0
missing)
##   Surrogate splits:
##       Department        splits as  LLR,         agree=0.884, adj=0.707, (0
split)
##       EducationField    splits as  LLRLLL,      agree=0.698, adj=0.240, (0
split)
##       Age               < 28.5    to the right, agree=0.651, adj=0.120, (0
split)
##       MonthlyIncome     < 5841.5  to the right, agree=0.646, adj=0.107, (0
split)
##       TotalWorkingYears < 8.5     to the right, agree=0.640, adj=0.093, (0
split)
## 
## Node number 7: 93 observations,    complexity param=0.03614458
##   predicted class=True   expected loss=0.4623656  P(node) =0.09037901
##     class counts:    43    50
##    probabilities: 0.462 0.538 
##   left son=14 (47 obs) right son=15 (46 obs)
##   Primary splits:
##       JobRole                 splits as  -LR---L-R,   improve=4.545532, (0
missing)
##       EnvironmentSatisfaction < 1.5     to the right, improve=4.398897, (0
missing)
##       Age                     < 33.5    to the right, improve=3.185902, (0
missing)
##       MonthlyIncome           < 2124    to the right, improve=2.876944, (0
missing)
##       NumCompaniesWorked      < 0.5     to the left,  improve=2.626303, (0
missing)
##   Surrogate splits:
##       Department        splits as  LLR,         agree=0.699, adj=0.391, (0
split)
```

```
##       EmployeeNumber    < 674     to the right, agree=0.624, adj=0.239, (0
split)
##       TotalWorkingYears < 1.5     to the right, agree=0.624, adj=0.239, (0
split)
##       Age               < 25      to the right, agree=0.591, adj=0.174, (0
split)
##       DailyRate         < 1285    to the left,  agree=0.591, adj=0.174, (0
split)
## 
## Node number 10: 62 observations,    complexity param=0.01807229
##   predicted class=False  expected loss=0.2580645  P(node) =0.06025267
##     class counts:    46    16
##    probabilities: 0.742 0.258 
##   left son=20 (51 obs) right son=21 (11 obs)
##   Primary splits:
##       DailyRate        < 343.5   to the right, improve=3.827497, (0
missing)
##       HourlyRate       < 58.5    to the right, improve=3.021843, (0
missing)
##       JobRole          splits as  -RR---L-R,   improve=2.391058, (0
missing)
##       StockOptionLevel < 0.5     to the right, improve=2.391058, (0
missing)
##       MaritalStatus    splits as  LLR,         improve=2.341935, (0
missing)
##   Surrogate splits:
##       MonthlyIncome < 1162.5  to the right, agree=0.839, adj=0.091, (0
split)
## 
## Node number 11: 10 observations
##   predicted class=True   expected loss=0.2  P(node) =0.009718173
##     class counts:     2     8
##    probabilities: 0.200 0.800 
## 
## Node number 12: 114 observations
##   predicted class=False  expected loss=0.0877193  P(node) =0.1107872
##     class counts:   104    10
##    probabilities: 0.912 0.088 
## 
## Node number 13: 75 observations,    complexity param=0.02409639
##   predicted class=False  expected loss=0.32  P(node) =0.0728863
##     class counts:    51    24
##    probabilities: 0.680 0.320 
##   left son=26 (49 obs) right son=27 (26 obs)
##   Primary splits:
##       MaritalStatus    splits as  LLR,         improve=8.870769, (0
missing)
##       StockOptionLevel < 0.5     to the right, improve=6.518571, (0
missing)
##       MonthlyIncome    < 5234.5  to the left,  improve=3.681667, (0
missing)
##       DistanceFromHome < 23.5    to the left,  improve=3.332308, (0
missing)
##       Gender           splits as  LR,          improve=2.182735, (0
missing)
##   Surrogate splits:
##       StockOptionLevel      < 0.5     to the right, agree=0.880,
adj=0.654, (0 split)
##       HourlyRate            < 82.5    to the left,  agree=0.720,
adj=0.192, (0 split)
##       EmployeeNumber        < 68      to the right, agree=0.693,
adj=0.115, (0 split)
##       NumCompaniesWorked    < 7.5     to the left,  agree=0.693,
adj=0.115, (0 split)
##       TrainingTimesLastYear < 1.5     to the right, agree=0.693,
adj=0.115, (0 split)
##
## Node number 14: 47 observations,    complexity param=0.03012048
##   predicted class=False  expected loss=0.3829787  P(node) =0.04567541
##     class counts:    29    18
##    probabilities: 0.617 0.383
##   left son=28 (40 obs) right son=29 (7 obs)
##   Primary splits:
##       DistanceFromHome        < 16      to the left,  improve=3.698480, (0
missing)
##       EnvironmentSatisfaction < 1.5     to the right, improve=3.470076, (0
missing)
##       BusinessTravel          splits as  -RL,         improve=2.693285, (0
missing)
##       MonthlyRate             < 5384    to the right, improve=2.597381, (0
missing)
##       MonthlyIncome           < 2469.5  to the right, improve=2.183675, (0
missing)
##   Surrogate splits:
##       DailyRate < 159.5   to the right, agree=0.894, adj=0.286, (0 split)
##
## Node number 15: 46 observations,    complexity param=0.01807229
##   predicted class=True   expected loss=0.3043478  P(node) =0.0447036
##     class counts:    14    32
##    probabilities: 0.304 0.696
##   left son=30 (20 obs) right son=31 (26 obs)
##   Primary splits:
##       Age                     < 33.5    to the right, improve=4.270569, (0
missing)
##       TotalWorkingYears       < 11      to the right, improve=3.846682, (0
missing)
##       EducationField          splits as  -RRLRR,      improve=2.871118, (0
missing)
##       YearsSinceLastPromotion < 2.5     to the right, improve=2.774964, (0
missing)
```

```
##       DailyRate               < 1104    to the right, improve=2.263975, (0
missing)
##   Surrogate splits:
##       TotalWorkingYears < 9       to the right, agree=0.783, adj=0.50, (0
split)
##       DailyRate         < 1315    to the right, agree=0.674, adj=0.25, (0
split)
##       PercentSalaryHike < 19.5    to the right, agree=0.674, adj=0.25, (0
split)
##       PerformanceRating < 3.5     to the right, agree=0.674, adj=0.25, (0
split)
##       StockOptionLevel  < 0.5     to the right, agree=0.674, adj=0.25, (0
split)
##
## Node number 20: 51 observations
##   predicted class=False  expected loss=0.1764706  P(node) =0.04956268
##     class counts:    42     9
##    probabilities: 0.824 0.176
##
## Node number 21: 11 observations
##   predicted class=True   expected loss=0.3636364  P(node) =0.01068999
##     class counts:     4     7
##    probabilities: 0.364 0.636
##
## Node number 26: 49 observations
##   predicted class=False  expected loss=0.1428571  P(node) =0.04761905
##     class counts:    42     7
##    probabilities: 0.857 0.143
##
## Node number 27: 26 observations,    complexity param=0.02409639
##   predicted class=True   expected loss=0.3461538  P(node) =0.02526725
##     class counts:     9    17
##    probabilities: 0.346 0.654
##   left son=54 (8 obs) right son=55 (18 obs)
##   Primary splits:
##       TrainingTimesLastYear   < 2.5     to the right, improve=3.769231, (0
missing)
##       MonthlyIncome           < 5791    to the left,  improve=3.211655, (0
missing)
##       JobLevel                < 2.5     to the left,  improve=2.769231, (0
missing)
##       YearsSinceLastPromotion < 2.5     to the left,  improve=2.295547, (0
missing)
##       DistanceFromHome        < 6.5     to the left,  improve=1.054945, (0
missing)
##   Surrogate splits:
##       Department      splits as  -LR,         agree=0.808, adj=0.375, (0
split)
##       JobRole         splits as  --L----R-,   agree=0.808, adj=0.375, (0
split)
```

```
##       JobInvolvement  < 1.5     to the left,  agree=0.769, adj=0.250, (0
split)
##       JobSatisfaction < 1.5     to the left,  agree=0.769, adj=0.250, (0
split)
##       MonthlyIncome   < 5052    to the left,  agree=0.769, adj=0.250, (0
split)
##
## Node number 28: 40 observations,    complexity param=0.01807229
##   predicted class=False  expected loss=0.3  P(node) =0.03887269
##     class counts:    28    12
##    probabilities: 0.700 0.300
##   left son=56 (33 obs) right son=57 (7 obs)
##   Primary splits:
##       EnvironmentSatisfaction < 1.5     to the right, improve=2.912554, (0
missing)
##       MonthlyRate             < 5384    to the right, improve=2.912554, (0
missing)
##       DailyRate               < 527.5   to the right, improve=2.190313, (0
missing)
##       BusinessTravel          splits as  -RL,         improve=1.828213, (0
missing)
##       Gender                  splits as  LR,          improve=1.609524, (0
missing)
##   Surrogate splits:
##       MonthlyRate          < 3251.5  to the right, agree=0.875, adj=0.286,
(0 split)
##       DistanceFromHome     < 12      to the left,  agree=0.850, adj=0.143,
(0 split)
##       JobSatisfaction      < 1.5     to the right, agree=0.850, adj=0.143,
(0 split)
##       StockOptionLevel     < 1.5     to the left,  agree=0.850, adj=0.143,
(0 split)
##       YearsWithCurrManager < 4       to the left,  agree=0.850, adj=0.143,
(0 split)
##
## Node number 29: 7 observations
##   predicted class=True   expected loss=0.1428571  P(node) =0.006802721
##     class counts:     1     6
##    probabilities: 0.143 0.857
##
## Node number 30: 20 observations,    complexity param=0.01807229
##   predicted class=False  expected loss=0.45  P(node) =0.01943635
##     class counts:    11     9
##    probabilities: 0.550 0.450
##   left son=60 (10 obs) right son=61 (10 obs)
##   Primary splits:
##       DailyRate               < 1121    to the right, improve=2.500000, (0
missing)
##       YearsSinceLastPromotion < 0.5     to the right, improve=2.500000, (0
missing)
```

```
##       PercentSalaryHike       < 14.5    to the right, improve=2.400000, (0 
missing)
##       EducationField          splits as  -RRLRL,      improve=2.031868, (0 
missing)
##       MaritalStatus           splits as  RLR,         improve=1.697980, (0 
missing)
##   Surrogate splits:
##       MaritalStatus         splits as  RLL,         agree=0.85, adj=0.7, 
(0 split)
##       PercentSalaryHike     < 17      to the right, agree=0.80, adj=0.6, 
(0 split)
##       TrainingTimesLastYear < 2.5     to the right, agree=0.80, adj=0.6, 
(0 split)
##       Department            splits as  -RL,         agree=0.70, adj=0.4, 
(0 split)
##       JobInvolvement        < 2.5     to the right, agree=0.70, adj=0.4, 
(0 split)
## 
## Node number 31: 26 observations
##   predicted class=True   expected loss=0.1153846  P(node) =0.02526725
##     class counts:     3    23
##    probabilities: 0.115 0.885 
## 
## Node number 54: 8 observations
##   predicted class=False  expected loss=0.25  P(node) =0.007774538
##     class counts:     6     2
##    probabilities: 0.750 0.250 
## 
## Node number 55: 18 observations
##   predicted class=True   expected loss=0.1666667  P(node) =0.01749271
##     class counts:     3    15
##    probabilities: 0.167 0.833 
## 
## Node number 56: 33 observations
##   predicted class=False  expected loss=0.2121212  P(node) =0.03206997
##     class counts:    26     7
##    probabilities: 0.788 0.212 
## 
## Node number 57: 7 observations
##   predicted class=True   expected loss=0.2857143  P(node) =0.006802721
##     class counts:     2     5
##    probabilities: 0.286 0.714 
## 
## Node number 60: 10 observations
##   predicted class=False  expected loss=0.2  P(node) =0.009718173
##     class counts:     8     2
##    probabilities: 0.800 0.200 
## 
## Node number 61: 10 observations
##   predicted class=True   expected loss=0.3  P(node) =0.009718173
##     class counts:     3     7
##    probabilities: 0.300 0.700

#Predicting
DTPred <- predict(Dtree,type = "class", newdata = validation[,-2])

library(caret)

## Warning: package 'caret' was built under R version 3.4.4

confusionMatrix(validation$Attrition, DTPred)

## Confusion Matrix and Statistics
##
##           Reference
## Prediction False True
##      False   352   18
##      True     48   23
##
##                Accuracy : 0.8503
##                  95% CI : (0.8136, 0.8823)
##     No Information Rate : 0.907
##     P-Value [Acc > NIR] : 0.9999501
##
##                   Kappa : 0.332
##  Mcnemar's Test P-Value : 0.0003575
##
##             Sensitivity : 0.8800
##             Specificity : 0.5610
##          Pos Pred Value : 0.9514
##          Neg Pred Value : 0.3239
##              Prevalence : 0.9070
##          Detection Rate : 0.7982
##    Detection Prevalence : 0.8390
##       Balanced Accuracy : 0.7205
##
##        'Positive' Class : False
##
```

MODEL BUILDING 3: RANDOM FOREST- Often known as an ensemble of a large number of Decision Trees, that uses bootstrapped aggregation technique to choose random samples from a dataset to train each tree in the forest. The final prediction in a RandomForest is an aggregation of prediction of individual trees. One of the advantages of RandomForest is that, it gives out-of-bag(OOB) error estimates, which is the mean prediction error on a training sample, using the trees that do not have that training sample in their bootstrap sample. It may act as a cross validation error and eliminate the need of using test/validation data, thereby increasing the training the data. However, I am still going to use train and validation concept here as well, like I did in the above two Models. Hide

```
library(randomForest)
set.seed(123)
```

```
df1$Attrition <- as.factor(df1$Attrition)
indices = sample.split(df1$Attrition, SplitRatio = 0.7)
train = df1[indices,]
validation = df1[!(indices),]

#Training the RandomForest Model
model.rf <- randomForest(Attrition ~ ., data=train,
proximity=FALSE,importance = FALSE,
                        ntree=500,mtry=4, do.trace=FALSE)
model.rf
```

```
##
## Call:
##  randomForest(formula = Attrition ~ ., data = train, proximity = FALSE,
importance = FALSE, ntree = 500, mtry = 4, do.trace = FALSE)
##                Type of random forest: classification
##                      Number of trees: 500
## No. of variables tried at each split: 4
##
##         OOB estimate of  error rate: 15.26%
## Confusion matrix:
##       False True class.error
## False   858    5 0.005793743
## True    152   14 0.915662651
```

```
#Predicting on the validation set and checking the Confusion Matrix.
testPred <- predict(model.rf, newdata=validation[,-2])
table(testPred, validation$Attrition)
```

```
##
## testPred False True
##    False   368   62
##    True      2    9
```

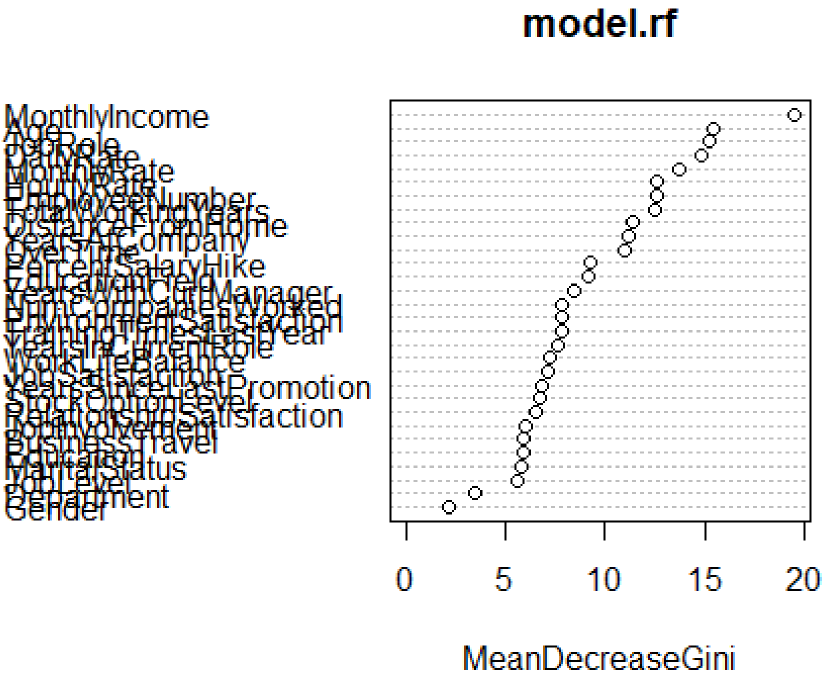
```
confusionMatrix(validation$Attrition, testPred)
```

```
## Confusion Matrix and Statistics
##
##           Reference
## Prediction False True
##      False   368    2
##      True     62    9
##
##                Accuracy : 0.8549
##                  95% CI : (0.8185, 0.8864)
##     No Information Rate : 0.9751
##     P-Value [Acc > NIR] : 1
##
##                   Kappa : 0.1843
##  Mcnemar's Test P-Value : 1.643e-13
##
```

```
##             Sensitivity : 0.8558
##             Specificity : 0.8182
##          Pos Pred Value : 0.9946
##          Neg Pred Value : 0.1268
##              Prevalence : 0.9751
##          Detection Rate : 0.8345
##    Detection Prevalence : 0.8390
##       Balanced Accuracy : 0.8370
##
##        'Positive' Class : False
##
```

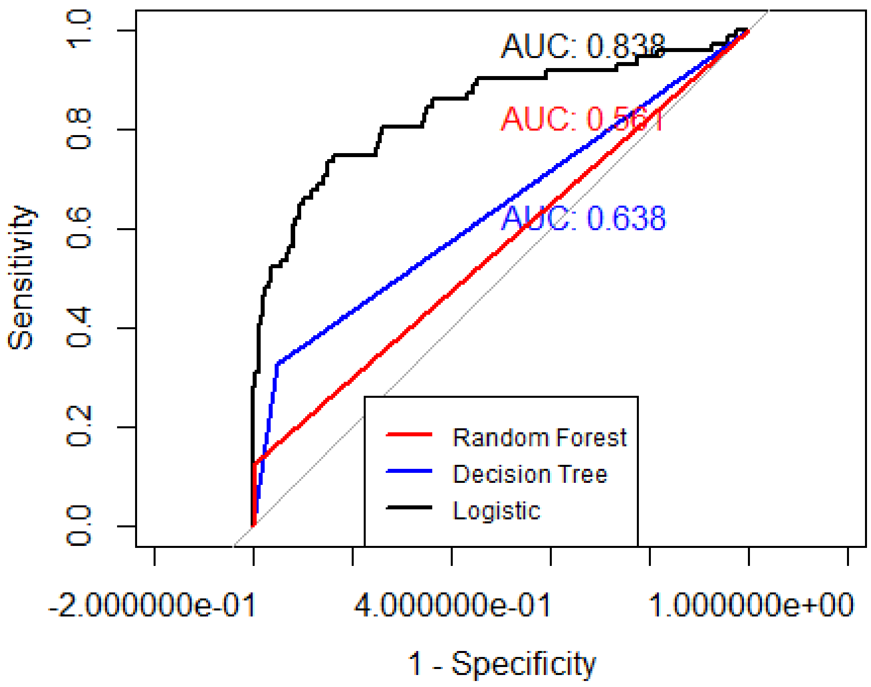
Variable Importance Plot: Below is the variable importance plot, that shows the most significant attribute in decreasing order by mean decrease in Gini. The Mean decrease Gini measures how pure the nodes are at the end of the tree. Higher the Gini Index, better is the homogeneity. Hide

```
#Checking the variable Importance Plot
varImpPlot(model.rf)
```



```
library(pROC)

## Warning: package 'pROC' was built under R version 3.4.4

## Type 'citation("pROC")' for a citation.

##
## Attaching package: 'pROC'
## The following objects are masked from 'package:stats':
##
##     cov, smooth, var
```

```
options(repr.plot.width =10, repr.plot.height = 8)
glm.roc <- roc(response = validation$Attrition, predictor =
as.numeric(prob_pred1))
DT.roc <- roc(response = validation$Attrition, predictor, predictor =
as.numeric(DTPred))

rf.roc <- roc(response = validation$Attrition, predictor =
as.numeric(testPred))
plot(glm.roc,      legacy.axes = TRUE, print.auc.y = 1.0, print.auc = TRUE)
plot(DT.roc, col = "blue", add = TRUE, print.auc.y = 0.65, print.auc = TRUE)


plot(rf.roc, col = "red" , add = TRUE, print.auc.y = 0.85, print.auc = TRUE)
legend("bottom", c("Random Forest", "Decision Tree","Logistic"),
       lty = c(1,1), lwd = c(2, 2), col = c("red", "blue","black"), cex =
0.75)
```



```
library(ROSE)
```

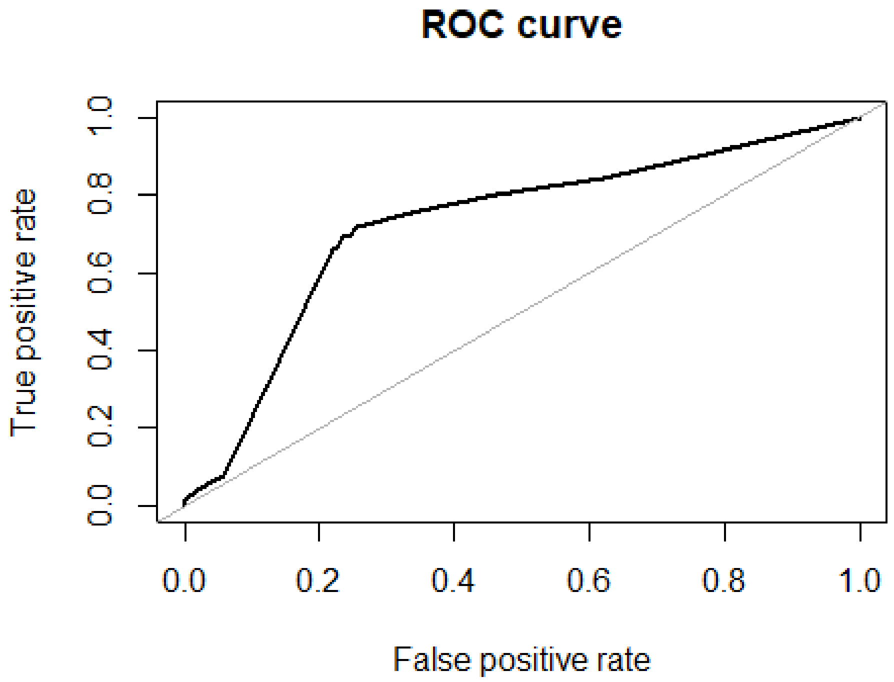
```
## Warning: package 'ROSE' was built under R version 3.4.4
```

```
## Loaded ROSE 0.0-3
```

```r
data.rose<-ROSE(Attrition~., data=train,seed=1)$data
table(data.rose$Attrition)
```

```
##
## False  True
##   533   496
```

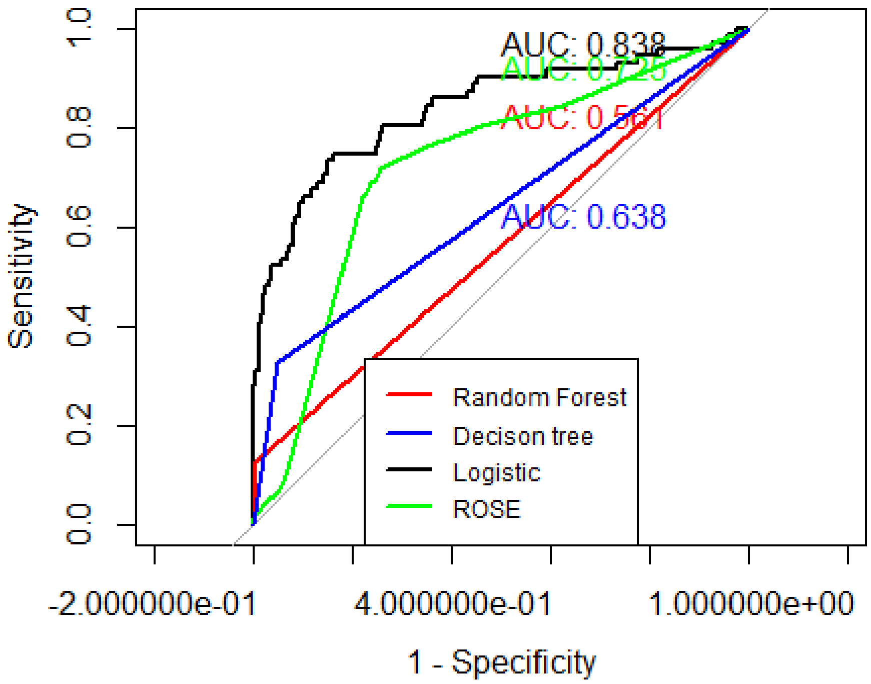
```r
library(rpart)
tree.rose <- rpart(Attrition ~ ., data = data.rose)
pred.tree.rose <- predict(tree.rose, newdata = validation)
roc.curve(validation$Attrition, pred.tree.rose[,2])
```



```
## Area under the curve (AUC): 0.725
```

```r
library(pROC)
options(repr.plot.width =10, repr.plot.height = 8)
glm.roc <- roc(response = validation$Attrition, predictor =
as.numeric(prob_pred1))
rf.roc <- roc(response = validation$Attrition, predictor =
as.numeric(testPred))
rose.roc<-roc(response = validation$Attrition, predictor =
as.numeric(pred.tree.rose[,2]))
plot(glm.roc,      legacy.axes = TRUE, print.auc.y = 1.0, print.auc = TRUE)
DT.roc <- roc(response = validation$Attrition, predictor, predictor =
as.numeric(DTPred))
```

```
plot(rf.roc, col = "red" , add = TRUE, print.auc.y = 0.85, print.auc = TRUE)
plot(rose.roc, col = "green" , add = TRUE, print.auc.y = 0.95, print.auc =
TRUE)
plot(DT.roc, col = "blue", add = TRUE, print.auc.y = 0.65, print.auc = TRUE)



legend("bottom", c("Random Forest","Decison tree" ,"Logistic","ROSE"),
       lty = c(1,1), lwd = c(2, 2), col = c("red", "blue", "black","green"),
cex = 0.75)
```



So we can see here ROSE(oversampling) on decision tree increases the performance when compared to normal decision tree but still Logistic regression wins the race by best AUC value.

SURVIVAL PROBABILITY:

```
library(survival)

##
## Attaching package: 'survival'

## The following object is masked from 'package:caret':
##
##     cluster
```

```
dataNW$YearsAtCompany=as.numeric(dataNW$YearsAtCompany)
dataNW$Attrition=as.numeric(dataNW$Attrition)
dataNW$Age=as.numeric(dataNW$Age)
```

Assigning the time and event

```
time = dataNW$YearsAtCompany
event= dataNW$Attrition

mySurv<-Surv(time,event)
class(mySurv)

## [1] "Surv"

head(mySurv,20) # plus sign means censored data- there is no informaton

##  [1]  6  10+  0   8+  2+  7+  1+  1+  9+  7+  5+  9+  5+  2+  4  10+  6+
## [18]  1+ 25+  3+

myfit<-survfit(mySurv~dataNW$OverTime)
myfit

## Call: survfit(formula = mySurv ~ dataNW$OverTime)
##
##                         n events median 0.95LCL 0.95UCL
## dataNW$OverTime=No  1054    110     40      32      NA
## dataNW$OverTime=Yes  416    127     24      16      NA
```

Median survival days for employees who does overtime is less(24) than employee who do not.

```
survdiff(mySurv~dataNW$OverTime)

## Call:
## survdiff(formula = mySurv ~ dataNW$OverTime)
##
##                         N Observed Expected (O-E)^2/E (O-E)^2/V
## dataNW$OverTime=No  1054      110    171.4      22.0      81.7
## dataNW$OverTime=Yes  416      127     65.6      57.5      81.7
##
##  Chisq= 81.7  on 1 degrees of freedom, p= 0

summary(myfit)

## Call: survfit(formula = mySurv ~ dataNW$OverTime)
##
##                 dataNW$OverTime=No
##  time n.risk n.event survival std.err lower 95% CI upper 95% CI
##     0   1054       6    0.994 0.00232        0.990        0.999
##     1   1024      31    0.964 0.00578        0.953        0.976
##     2    908      12    0.951 0.00677        0.938        0.965
##     3    816       6    0.944 0.00730        0.930        0.959
##     4    728      11    0.930 0.00836        0.914        0.947
##     5    648       7    0.920 0.00909        0.902        0.938
##     6    509       4    0.913 0.00971        0.894        0.932
##     7    457       3    0.907 0.01025        0.887        0.927
##     8    388       3    0.900 0.01094        0.879        0.922
##     9    332       6    0.884 0.01260        0.859        0.909
##    10    269       8    0.857 0.01527        0.828        0.888
##    11    181       1    0.853 0.01590        0.822        0.884
##    13    146       2    0.841 0.01770        0.807        0.876
##    14    126       2    0.828 0.01978        0.790        0.867
##    17     89       1    0.818 0.02163        0.777        0.862
##    18     82       1    0.808 0.02356        0.763        0.856
##    20     65       1    0.796 0.02627        0.746        0.849
##    22     35       1    0.773 0.03397        0.709        0.843
##    23     24       1    0.741 0.04532        0.657        0.835
##    32      8       1    0.648 0.09528        0.486        0.865
##    33      6       1    0.540 0.12663        0.341        0.855
##    40      1       1    0.000     NaN           NA           NA
## 
##                 dataNW$OverTime=Yes 
##  time n.risk n.event survival std.err lower 95% CI upper 95% CI
##     0    416      10    0.976 0.00751        0.961        0.991
##     1    402      28    0.908 0.01423        0.881        0.936
##     2    347      15    0.869 0.01684        0.836        0.902
##     3    312      14    0.830 0.01903        0.793        0.868
##     4    272       8    0.805 0.02034        0.766        0.846
##     5    242      14    0.759 0.02265        0.716        0.804
##     6    185       5    0.738 0.02383        0.693        0.786
##     7    161       8    0.702 0.02593        0.653        0.754
##     8    140       6    0.672 0.02757        0.620        0.728
##     9    116       2    0.660 0.02829        0.607        0.718
##    10     97      10    0.592 0.03254        0.531        0.659
##    11     65       1    0.583 0.03329        0.521        0.652
##    15     50       1    0.571 0.03460        0.507        0.643
##    16     43       1    0.558 0.03626        0.491        0.634
##    19     32       1    0.540 0.03909        0.469        0.623
##    21     22       1    0.516 0.04437        0.436        0.611
##    24     13       1    0.476 0.05595        0.378        0.599
##    31      7       1    0.408 0.07916        0.279        0.597
```

```
library(ggplot2)
require("survival")
library(survival)
library(survminer)
```

```
## Warning: package 'survminer' was built under R version 3.4.4
```

```
## Loading required package: ggpubr
```

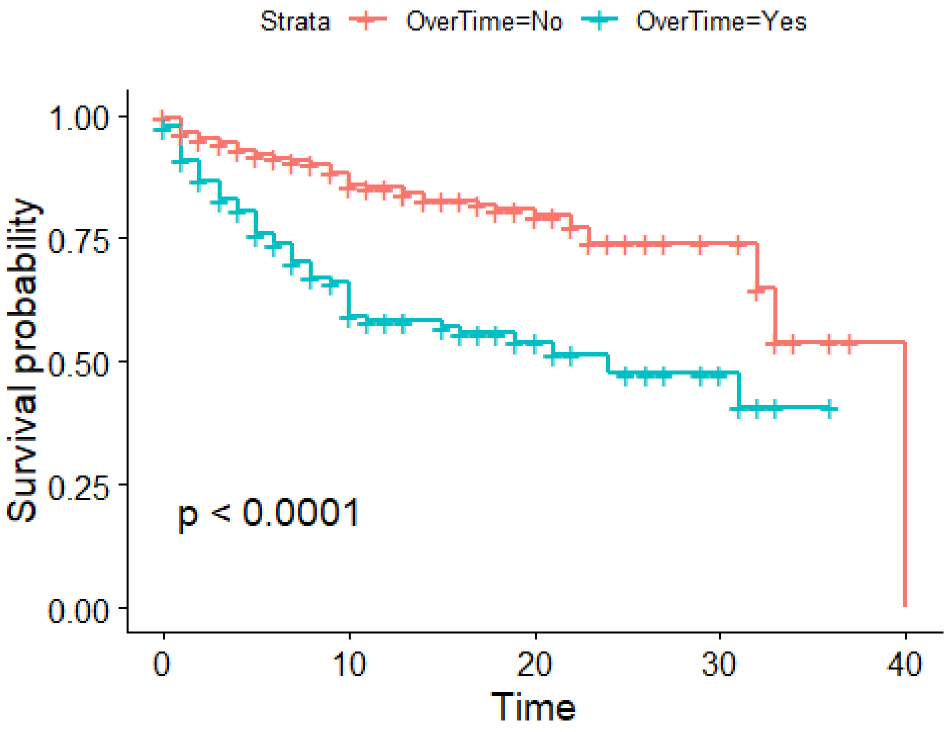
```
## Warning: package 'ggpubr' was built under R version 3.4.4
```

```
## Loading required package: magrittr
```

```
##
## Attaching package: 'magrittr'

## The following object is masked from 'package:tidyr':
##
##     extract
```

```
fit1 <- survfit(mySurv ~ dataNW$OverTime)
summary(fit1)
```

```
## Call: survfit(formula = mySurv ~ dataNW$OverTime)
##
##                 dataNW$OverTime=No
##  time n.risk n.event survival std.err lower 95% CI upper 95% CI
##     0   1054       6    0.994 0.00232        0.990        0.999
##     1   1024      31    0.964 0.00578        0.953        0.976
##     2    908      12    0.951 0.00677        0.938        0.965
##     3    816       6    0.944 0.00730        0.930        0.959
##     4    728      11    0.930 0.00836        0.914        0.947
##     5    648       7    0.920 0.00909        0.902        0.938
##     6    509       4    0.913 0.00971        0.894        0.932
##     7    457       3    0.907 0.01025        0.887        0.927
##     8    388       3    0.900 0.01094        0.879        0.922
##     9    332       6    0.884 0.01260        0.859        0.909
##    10    269       8    0.857 0.01527        0.828        0.888
##    11    181       1    0.853 0.01590        0.822        0.884
##    13    146       2    0.841 0.01770        0.807        0.876
##    14    126       2    0.828 0.01978        0.790        0.867
##    17     89       1    0.818 0.02163        0.777        0.862
##    18     82       1    0.808 0.02356        0.763        0.856
##    20     65       1    0.796 0.02627        0.746        0.849
##    22     35       1    0.773 0.03397        0.709        0.843
##    23     24       1    0.741 0.04532        0.657        0.835
##    32      8       1    0.648 0.09528        0.486        0.865
##    33      6       1    0.540 0.12663        0.341        0.855
##    40      1       1    0.000     NaN           NA           NA
##
##                 dataNW$OverTime=Yes
##  time n.risk n.event survival std.err lower 95% CI upper 95% CI
##     0    416      10    0.976 0.00751        0.961        0.991
##     1    402      28    0.908 0.01423        0.881        0.936
##     2    347      15    0.869 0.01684        0.836        0.902
##     3    312      14    0.830 0.01903        0.793        0.868
##     4    272       8    0.805 0.02034        0.766        0.846
##     5    242      14    0.759 0.02265        0.716        0.804
##     6    185       5    0.738 0.02383        0.693        0.786
##     7    161       8    0.702 0.02593        0.653        0.754
##     8    140       6    0.672 0.02757        0.620        0.728
##     9    116       2    0.660 0.02829        0.607        0.718
##    10     97      10    0.592 0.03254        0.531        0.659
##    11      65        1    0.583 0.03329        0.521        0.652
##    15      50        1    0.571 0.03460        0.507        0.643
##    16      43        1    0.558 0.03626        0.491        0.634
##    19      32        1    0.540 0.03909        0.469        0.623
##    21      22        1    0.516 0.04437        0.436        0.611
##    24      13        1    0.476 0.05595        0.378        0.599
##    31       7        1    0.408 0.07916        0.279        0.597

ggsurvplot(fit1, data = dataNW, pval = TRUE)
```



After 20 days the survival propability rate for employee who does overtime is 55% and employee who do overtime is 80%