Project_Group_03

2025-06-24

```r
#Import dataset into R-studio
library(readxl)

Employee_Data <- read_xlsx("C:\\Users\\Clone\\Documents\\Campus\\3rd
year\\lab\\project\\employee_attrition_dataset_10000.xlsx")
head(Employee_Data)
```

```
## # A tibble: 6 × 28
##   Employee_ID   Age Gender Marital_Status Department Job_Role  Job_Level
##         <dbl> <dbl> <chr>  <chr>          <chr>      <chr>         <dbl>
## 1           1    58 Male   Single         Finance    Manager           5
## 2           2    48 Female Divorced       HR         Assistant         4
## 3           3    34 Female Married        Marketing  Manager           4
## 4           4    27 Female Divorced       HR         Manager           4
## 5           5    40 Male   Married        HR         Analyst           1
## 6           6    58 Male   Married        Finance    Executive         3
## # ℹ 21 more variables: Monthly_Income <dbl>, Hourly_Rate <dbl>,
## #   Years_at_Company <dbl>, Years_in_Current_Role <dbl>,
## #   Years_Since_Last_Promotion <dbl>, Work_Life_Balance <dbl>,
## #   Job_Satisfaction <dbl>, Perform <dbl>, Performance <chr>,
## #   Performance_Rating <dbl>, Training_Hours_Last_Year <dbl>, Overtime
<chr>,
## #   Project_Count <dbl>, Average_Hours_Worked_Per_Week <dbl>,
## #   Absenteeism <dbl>, Work_Environment_Satisfaction <dbl>, …
```

```r
#Identify missing values
missing_count <- sum(is.na(Employee_Data))
missing_count
```

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

```r
#Remove the Employee_ID,Performance_Rating,Perform columns from the dataset
Employee_Data$Employee_ID <- NULL
Employee_Data$Performance_Rating <- NULL
Employee_Data$Perform <- NULL
head(Employee_Data)
```

```
## # A tibble: 6 × 25
##     Age Gender Marital_Status Department Job_Role  Job_Level
Monthly_Income
##   <dbl> <chr>  <chr>          <chr>      <chr>         <dbl>
<dbl>
## 1    58 Male   Single         Finance    Manager           5
7332
```

```
## 2    48 Female Divorced       HR         Assistant         4
6069
## 3    34 Female Married        Marketing  Manager           4
11485
## 4    27 Female Divorced       HR         Manager           4
18707
## 5    40 Male   Married        HR         Analyst           1
16398
## 6    58 Male   Married        Finance    Executive         3
7305
## # ℹ 18 more variables: Hourly_Rate <dbl>, Years_at_Company <dbl>,
## #   Years_in_Current_Role <dbl>, Years_Since_Last_Promotion <dbl>,
## #   Work_Life_Balance <dbl>, Job_Satisfaction <dbl>, Performance <chr>,
## #   Training_Hours_Last_Year <dbl>, Overtime <chr>, Project_Count <dbl>,
## #   Average_Hours_Worked_Per_Week <dbl>, Absenteeism <dbl>,
## #   Work_Environment_Satisfaction <dbl>, Relationship_with_Manager <dbl>,
## #   Job_Involvement <dbl>, Distance_From_Home <dbl>, …
```

```
str(Employee_Data)
```

```
## tibble [10,000 × 25] (S3: tbl_df/tbl/data.frame)
##  $ Age                          : num [1:10000] 58 48 34 27 40 58 38 42 30
30 ...
##  $ Gender                       : chr [1:10000] "Male" "Female" "Female"
"Female" ...
##  $ Marital_Status               : chr [1:10000] "Single" "Divorced"
"Married" "Divorced" ...
##  $ Department                   : chr [1:10000] "Finance" "HR" "Marketing"
"HR" ...
##  $ Job_Role                     : chr [1:10000] "Manager" "Assistant"
"Manager" "Manager" ...
##  $ Job_Level                    : num [1:10000] 5 4 4 4 1 3 5 1 4 4 ...
##  $ Monthly_Income               : num [1:10000] 7332 6069 11485 18707
16398 ...
##  $ Hourly_Rate                  : num [1:10000] 81 55 65 28 92 63 63 41 95
53 ...
##  $ Years_at_Company             : num [1:10000] 24 18 6 12 3 25 3 16 17 16
...
##  $ Years_in_Current_Role        : num [1:10000] 12 7 4 9 9 2 3 8 10 14 ...
##  $ Years_Since_Last_Promotion   : num [1:10000] 3 5 3 1 1 3 4 0 2 4 ...
##  $ Work_Life_Balance            : num [1:10000] 1 1 4 1 3 4 4 2 2 1 ...
##  $ Job_Satisfaction             : num [1:10000] 3 2 5 1 4 5 3 4 3 4 ...
##  $ Performance                  : chr [1:10000] "Low" "Low" "Low" "Low"
...
##  $ Training_Hours_Last_Year     : num [1:10000] 74 24 63 4 62 84 98 75 51
45 ...
##  $ Overtime                     : chr [1:10000] "No" "Yes" "Yes" "No" ...
##  $ Project_Count                : num [1:10000] 9 9 3 9 1 1 1 3 8 6 ...
##  $ Average_Hours_Worked_Per_Week: num [1:10000] 48 57 55 53 54 42 58 45 42
41 ...
```

```
##  $ Absenteeism                  : num [1:10000] 16 10 1 2 11 11 16 9 4 12
...
##  $ Work_Environment_Satisfaction: num [1:10000] 4 4 1 3 1 2 3 2 3 4 ...
##  $ Relationship_with_Manager    : num [1:10000] 1 1 4 4 1 3 3 1 3 2 ...
##  $ Job_Involvement              : num [1:10000] 1 1 3 1 1 4 4 4 1 1 ...
##  $ Distance_From_Home           : num [1:10000] 49 25 21 46 43 4 33 3 39 1
...
##  $ Number_of_Companies_Worked   : num [1:10000] 3 1 1 2 4 3 1 2 4 4 ...
##  $ Attrition                    : chr [1:10000] "No" "No" "Yes" "No" ...
```

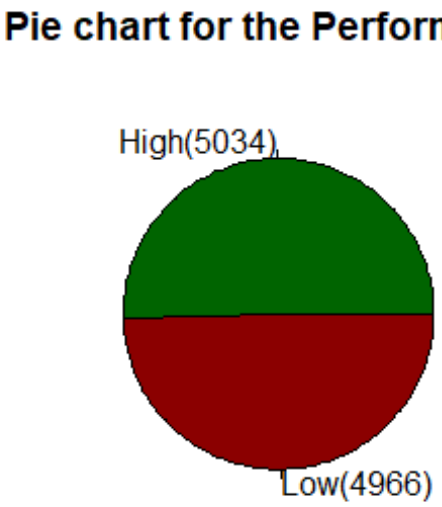
```
#Convert charctor variable into factor type
Employee_Data$Gender <- as.factor(Employee_Data$Gender)
Employee_Data$Performance <- as.factor(Employee_Data$Performance)
Employee_Data$Marital_Status <- as.factor(Employee_Data$Marital_Status)
Employee_Data$Department <- as.factor(Employee_Data$Department)
Employee_Data$Job_Role <- as.factor(Employee_Data$Job_Role)
Employee_Data$Overtime <- as.factor(Employee_Data$Overtime)
Employee_Data$Attrition<- as.factor(Employee_Data$Attrition)

str(Employee_Data)
```

```
## tibble [10,000 × 25] (S3: tbl_df/tbl/data.frame)
##  $ Age                          : num [1:10000] 58 48 34 27 40 58 38 42 30
30 ...
##  $ Gender                       : Factor w/ 2 levels "Female","Male": 2 1
1 1 2 2 2 1 1 2 ...
##  $ Marital_Status               : Factor w/ 3 levels
"Divorced","Married",..: 3 1 2 1 2 2 2 2 2 1 ...
##  $ Department                   : Factor w/ 5 levels "Finance","HR",..: 1
2 4 2 2 1 5 4 3 5 ...
##  $ Job_Role                     : Factor w/ 4 levels
"Analyst","Assistant",..: 4 2 4 4 1 3 3 3 1 2 ...
##  $ Job_Level                    : num [1:10000] 5 4 4 4 1 3 5 1 4 4 ...
##  $ Monthly_Income               : num [1:10000] 7332 6069 11485 18707
16398 ...
##  $ Hourly_Rate                  : num [1:10000] 81 55 65 28 92 63 63 41 95
53 ...
##  $ Years_at_Company             : num [1:10000] 24 18 6 12 3 25 3 16 17 16
...
##  $ Years_in_Current_Role        : num [1:10000] 12 7 4 9 9 2 3 8 10 14 ...
##  $ Years_Since_Last_Promotion   : num [1:10000] 3 5 3 1 1 3 4 0 2 4 ...
##  $ Work_Life_Balance            : num [1:10000] 1 1 4 1 3 4 4 2 2 1 ...
##  $ Job_Satisfaction             : num [1:10000] 3 2 5 1 4 5 3 4 3 4 ...
##  $ Performance                  : Factor w/ 2 levels "High","Low": 2 2 2 2
1 1 1 1 1 1 ...
##  $ Training_Hours_Last_Year     : num [1:10000] 74 24 63 4 62 84 98 75 51
45 ...
##  $ Overtime                     : Factor w/ 2 levels "No","Yes": 1 2 2 1 1
1 1 2 2 2 ...
##  $ Project_Count                : num [1:10000] 9 9 3 9 1 1 1 3 8 6 ...
```

```
##  $ Average_Hours_Worked_Per_Week: num [1:10000] 48 57 55 53 54 42 58 45 42
41 ...
##  $ Absenteeism                  : num [1:10000] 16 10 1 2 11 11 16 9 4 12
...
##  $ Work_Environment_Satisfaction: num [1:10000] 4 4 1 3 1 2 3 2 3 4 ...
##  $ Relationship_with_Manager    : num [1:10000] 1 1 4 4 1 3 3 1 3 2 ...
##  $ Job_Involvement              : num [1:10000] 1 1 3 1 1 4 4 4 1 1 ...
##  $ Distance_From_Home           : num [1:10000] 49 25 21 46 43 4 33 3 39 1
...
##  $ Number_of_Companies_Worked   : num [1:10000] 3 1 1 2 4 3 1 2 4 4 ...
##  $ Attrition                    : Factor w/ 2 levels "No","Yes": 1 1 2 1 1
2 2 1 1 1 ...
```

```
performance_table<-table(Employee_Data$Performance)
pie(performance_table,main="Pie chart for the
Performance",col=c("darkgreen","darkred"),labels =
paste(names(performance_table),"(",performance_table,")",sep=""))
```



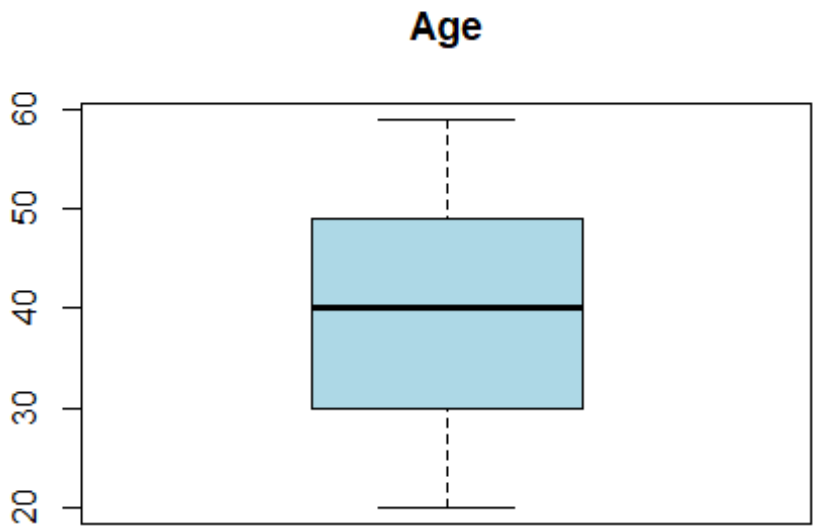

```
#summary(Employee_Data)
summary(Employee_Data)
```

```
##       Age           Gender      Marital_Status     Department
##  Min.   :20.00   Female:5042   Divorced:3330   Finance  :1990
##  1st Qu.:30.00   Male  :4958   Married :3375   HR       :1953
##  Median :40.00                 Single  :3295   IT       :1916
##  Mean   :39.56                                 Marketing:2133
##  3rd Qu.:49.00                                 Sales    :2008
```

```
##  Max.   :59.00
##       Job_Role      Job_Level     Monthly_Income   Hourly_Rate
##  Analyst  :2572   Min.   :1.000   Min.   : 3000   Min.   :15.00
##  Assistant:2538   1st Qu.:2.000   1st Qu.: 7182   1st Qu.:36.00
##  Executive:2476   Median :3.000   Median :11402   Median :57.00
##  Manager  :2414   Mean   :2.991   Mean   :11437   Mean   :57.03
##                   3rd Qu.:4.000   3rd Qu.:15680   3rd Qu.:78.00
##                   Max.   :5.000   Max.   :19999   Max.   :99.00
##  Years_at_Company Years_in_Current_Role Years_Since_Last_Promotion
##  Min.   : 1.00    Min.   : 1.000        Min.   :0.000
##  1st Qu.: 8.00    1st Qu.: 4.000        1st Qu.:2.000
##  Median :15.00    Median : 7.000        Median :4.000
##  Mean   :14.94    Mean   : 7.451        Mean   :4.472
##  3rd Qu.:22.00    3rd Qu.:11.000        3rd Qu.:7.000
##  Max.   :29.00    Max.   :14.000        Max.   :9.000
##  Work_Life_Balance Job_Satisfaction Performance Training_Hours_Last_Year
##  Min.   :1.000     Min.   :1.000    High:5034   Min.   : 0.00
##  1st Qu.:2.000     1st Qu.:2.000    Low :4966   1st Qu.:25.00
##  Median :2.000     Median :3.000                Median :49.00
##  Mean   :2.502     Mean   :3.038                Mean   :49.59
##  3rd Qu.:3.000     3rd Qu.:4.000                3rd Qu.:75.00
##  Max.   :4.000     Max.   :5.000                Max.   :99.00
##  Overtime   Project_Count   Average_Hours_Worked_Per_Week  Absenteeism
##  No :5103   Min.   :1.000   Min.   :30.00                 Min.   : 0.00
##  Yes:4897   1st Qu.:3.000   1st Qu.:37.00                 1st Qu.: 4.00
##             Median :5.000   Median :45.00                 Median : 9.00
##             Mean   :4.984   Mean   :44.47                 Mean   : 9.41
##             3rd Qu.:7.000   3rd Qu.:52.00                 3rd Qu.:14.00
##             Max.   :9.000   Max.   :59.00                 Max.   :19.00
##  Work_Environment_Satisfaction Relationship_with_Manager Job_Involvement
##  Min.   :1.000                 Min.   :1.000             Min.   :1.000
##  1st Qu.:1.000                 1st Qu.:1.000             1st Qu.:2.000
##  Median :2.000                 Median :2.000             Median :3.000
##  Mean   :2.493                 Mean   :2.491             Mean   :2.505
##  3rd Qu.:4.000                 3rd Qu.:3.000             3rd Qu.:3.000
##  Max.   :4.000                 Max.   :4.000             Max.   :4.000
##  Distance_From_Home Number_of_Companies_Worked Attrition
##  Min.   : 1.00      Min.   :1.000              No :8003
##  1st Qu.:13.00      1st Qu.:2.000              Yes:1997
##  Median :25.00      Median :2.000
##  Mean   :25.27      Mean   :2.517
##  3rd Qu.:37.00      3rd Qu.:4.000
##  Max.   :49.00      Max.   :4.000
```

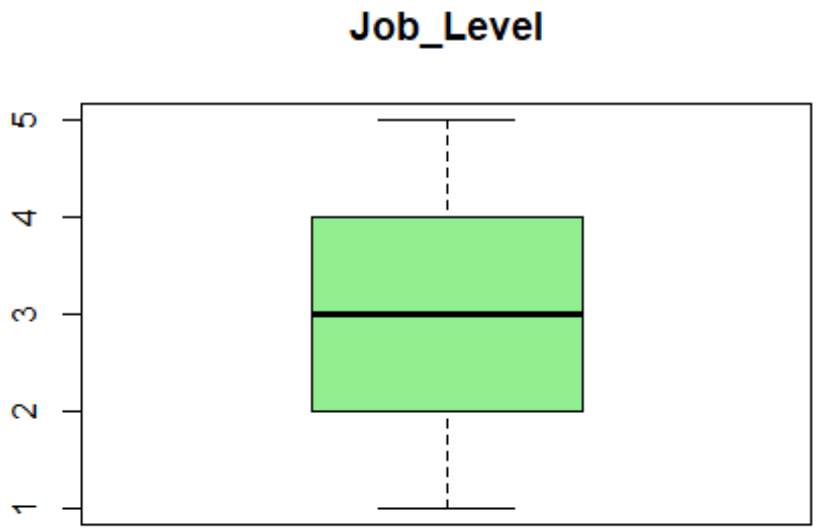
```
#Draw boxplot for the find outliers


boxplot(Employee_Data$Age, main = "Age",col="lightblue", sub =
paste("outliers:", boxplot.stats(Employee_Data$Age)$out))
```



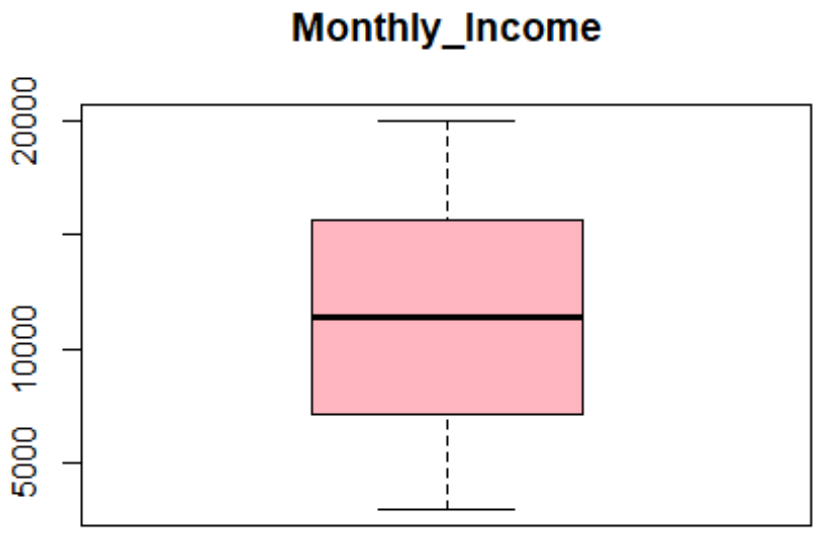
outliers:

```
boxplot(Employee_Data$Job_Level, main = "Job_Level",col="lightgreen", sub =
paste("outliers:", boxplot.stats(Employee_Data$Job_Level)$out))
```

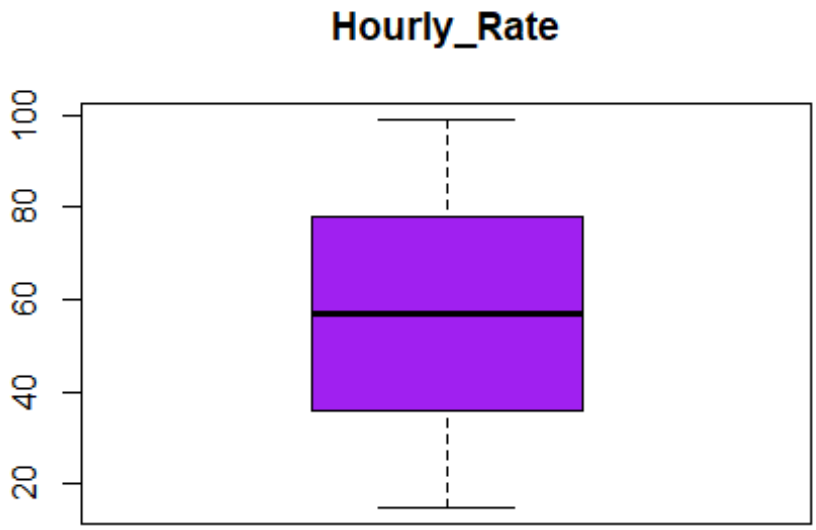


outliers:

```r
boxplot(Employee_Data$Monthly_Income, main =
"Monthly_Income",col="lightpink", sub = paste("outliers:",
boxplot.stats(Employee_Data$Monthly_Income)$out))
```

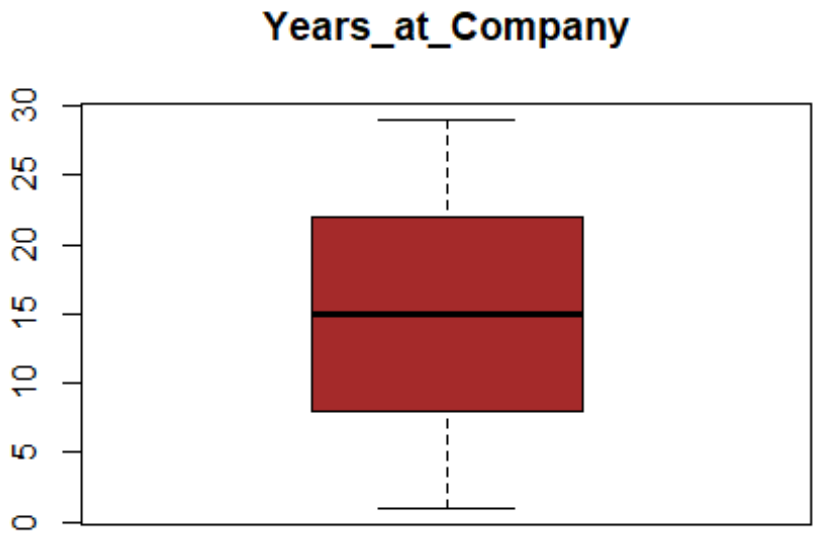



```r
boxplot(Employee_Data$Hourly_Rate, main = "Hourly_Rate", col="purple",sub =
paste("outliers:", boxplot.stats(Employee_Data$Hourly_Rate)$out))
```



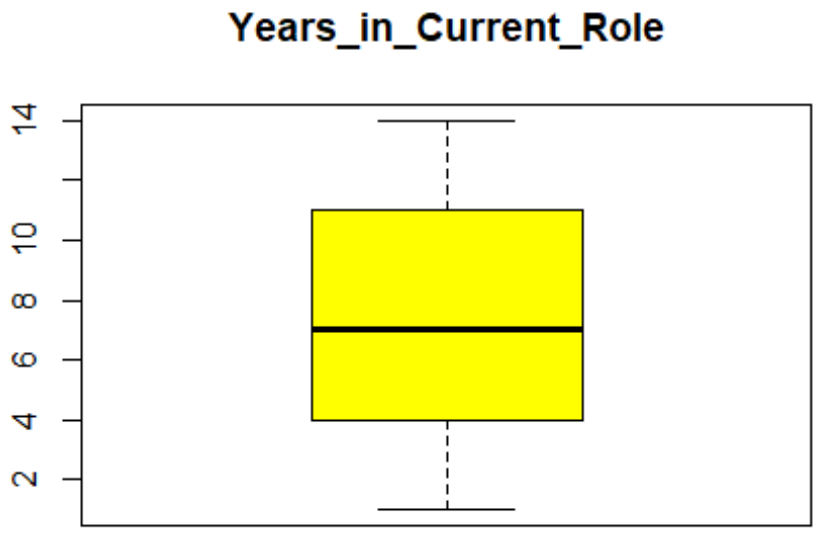
outliers:

```
boxplot(Employee_Data$Years_at_Company, main = "Years_at_Company",
col="brown",sub = paste("outliers:",
boxplot.stats(Employee_Data$Years_at_Company)$out))
```



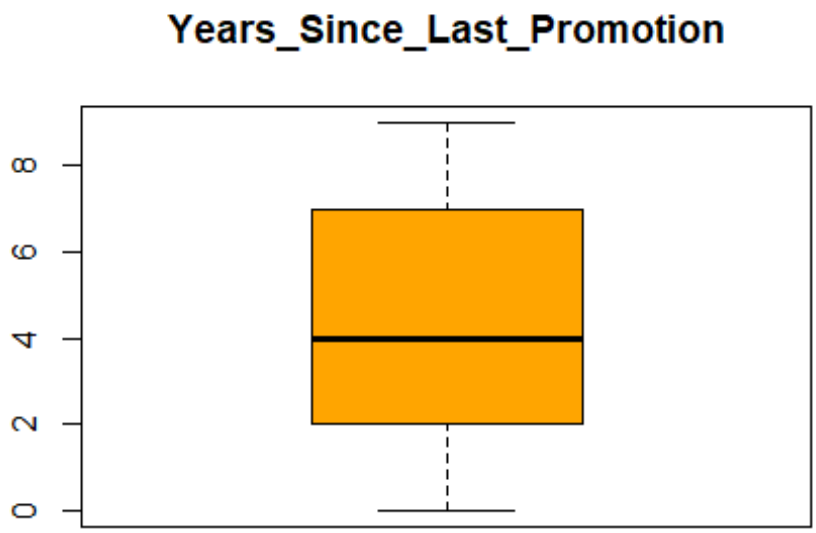
outliers:

```
boxplot(Employee_Data$Years_in_Current_Role, main =
"Years_in_Current_Role",col="yellow", sub = paste("outliers:",
boxplot.stats(Employee_Data$Years_in_Current_Role)$out))
```



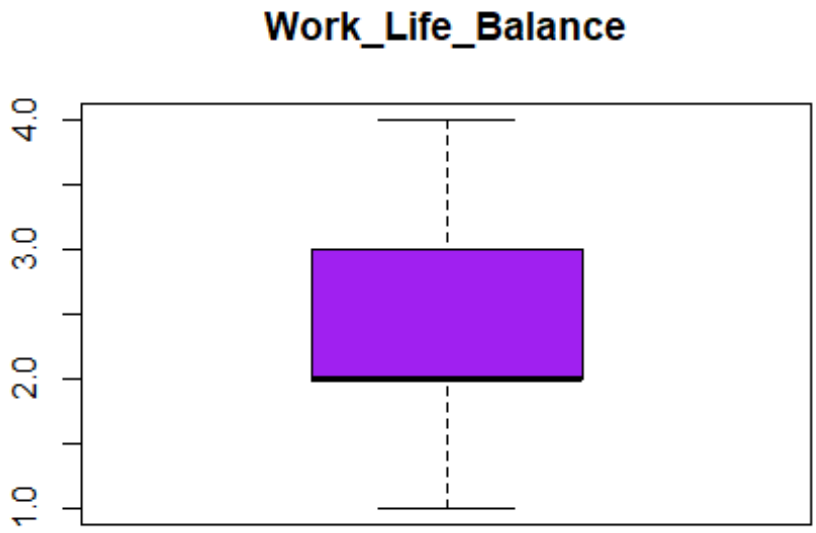
outliers:

```
boxplot(Employee_Data$Years_Since_Last_Promotion, main =
"Years_Since_Last_Promotion",col="orange", sub = paste("outliers:",
boxplot.stats(Employee_Data$Years_Since_Last_Promotion)$out))
```



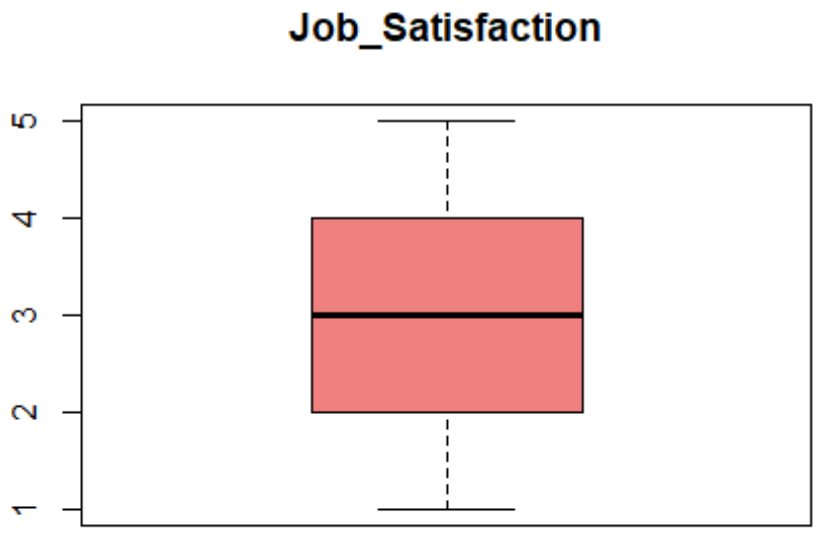
outliers:

```
boxplot(Employee_Data$Work_Life_Balance, main =
"Work_Life_Balance",col="purple", sub = paste("outliers:",
boxplot.stats(Employee_Data$Work_Life_Balance)$out))
```

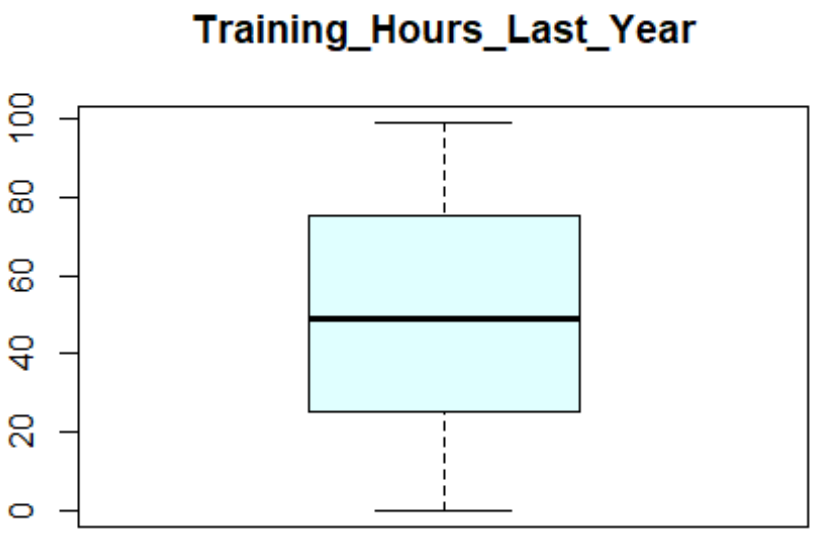


outliers:

```r
boxplot(Employee_Data$Job_Satisfaction, main = "Job_Satisfaction",
col="lightcoral",sub = paste("outliers:",
boxplot.stats(Employee_Data$Job_Satisfaction)$out))
```

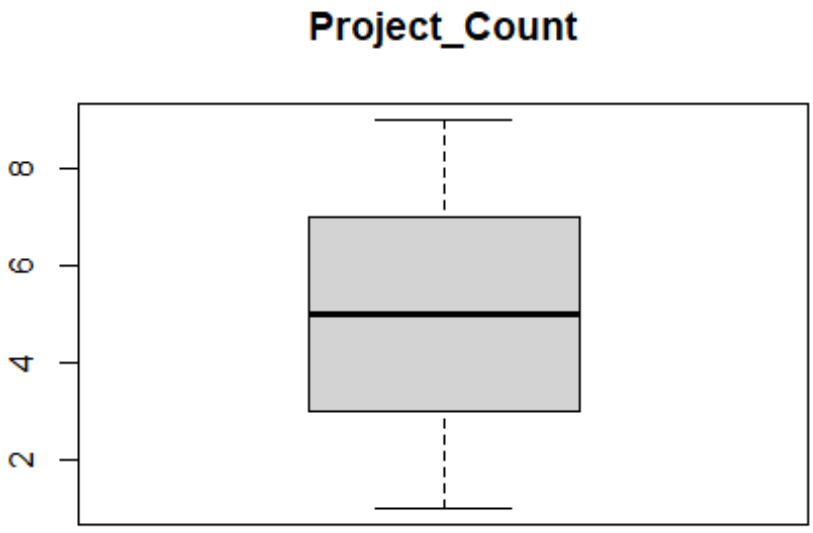



```r
boxplot(Employee_Data$Training_Hours_Last_Year, main =
"Training_Hours_Last_Year", col="lightcyan",sub = paste("outliers:",
boxplot.stats(Employee_Data$Training_Hours_Last_Year)$out))
```



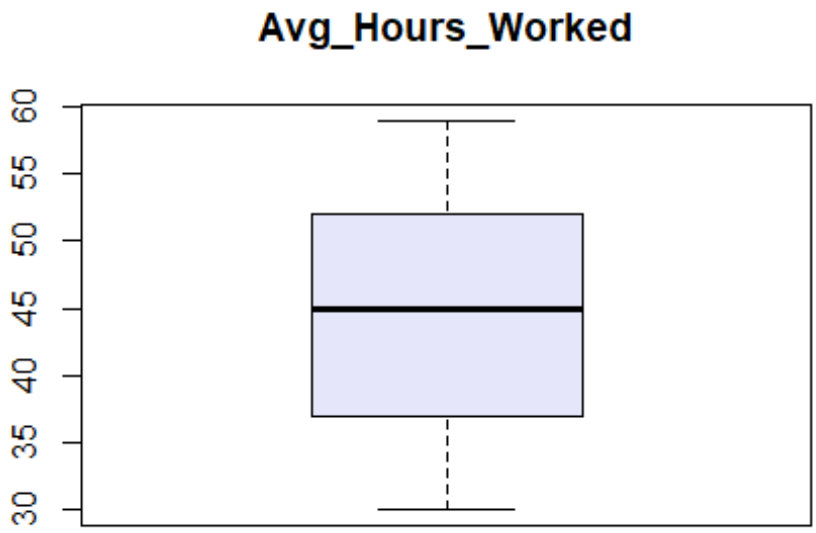
outliers:

```
boxplot(Employee_Data$Project_Count, main = "Project_Count",
col="lightgray",sub = paste("outliers:",
boxplot.stats(Employee_Data$Project_Count)$out))
```

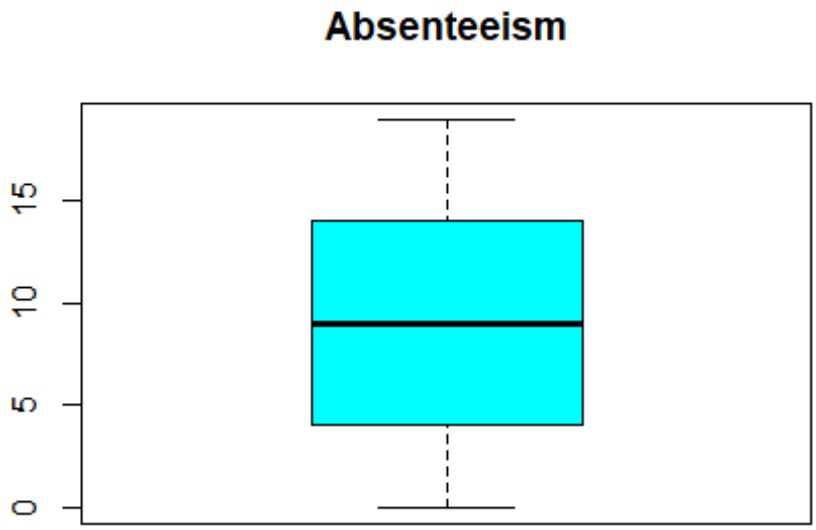


outliers:

```r
boxplot(Employee_Data$Average_Hours_Worked_Per_Week, main =
"Avg_Hours_Worked", col="lavender",sub = paste("outliers:",
boxplot.stats(Employee_Data$Average_Hours_Worked_Per_Week)$out))
```

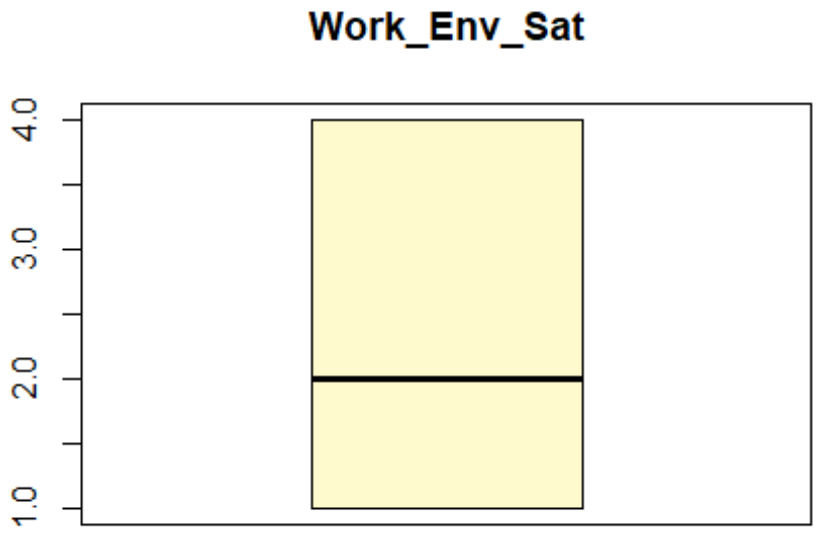



```r
boxplot(Employee_Data$Absenteeism, main = "Absenteeism",col="cyan", sub =
paste("outliers:", boxplot.stats(Employee_Data$Absenteeism)$out))
```



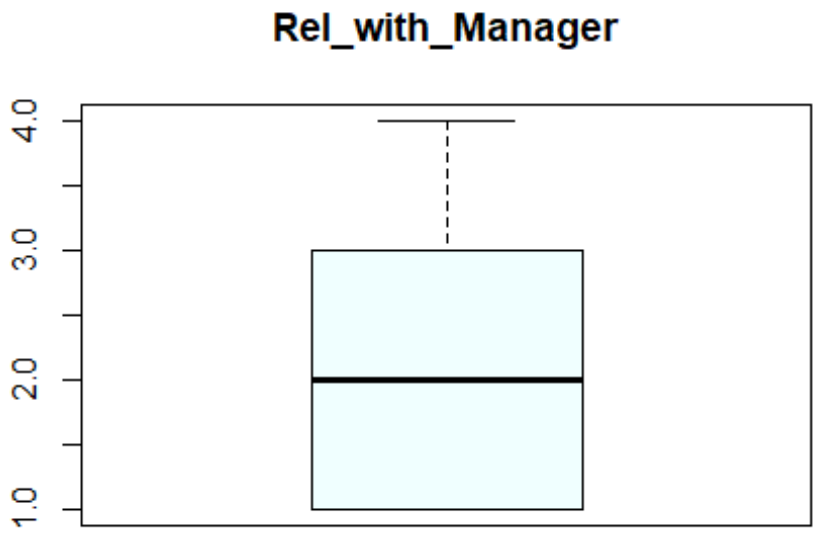
outliers:

```
boxplot(Employee_Data$Work_Environment_Satisfaction, main = "Work_Env_Sat",
col="lemonchiffon",sub = paste("outliers:",
boxplot.stats(Employee_Data$Work_Environment_Satisfaction)$out))
```

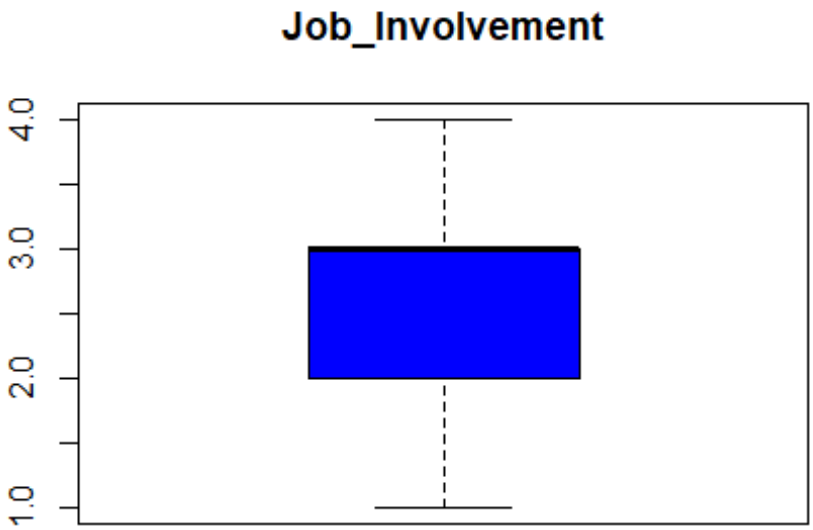


outliers:

```
boxplot(Employee_Data$Relationship_with_Manager, main =
"Rel_with_Manager",col="azure", sub = paste("outliers:",
boxplot.stats(Employee_Data$Relationship_with_Manager)$out))
```

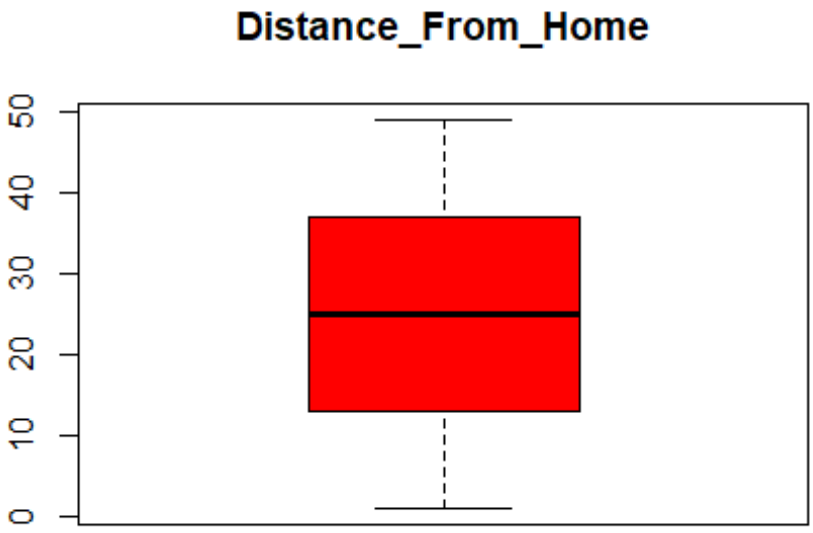



```
boxplot(Employee_Data$Job_Involvement, main = "Job_Involvement",
col="blue",sub = paste("outliers:",
boxplot.stats(Employee_Data$Job_Involvement)$out))
```



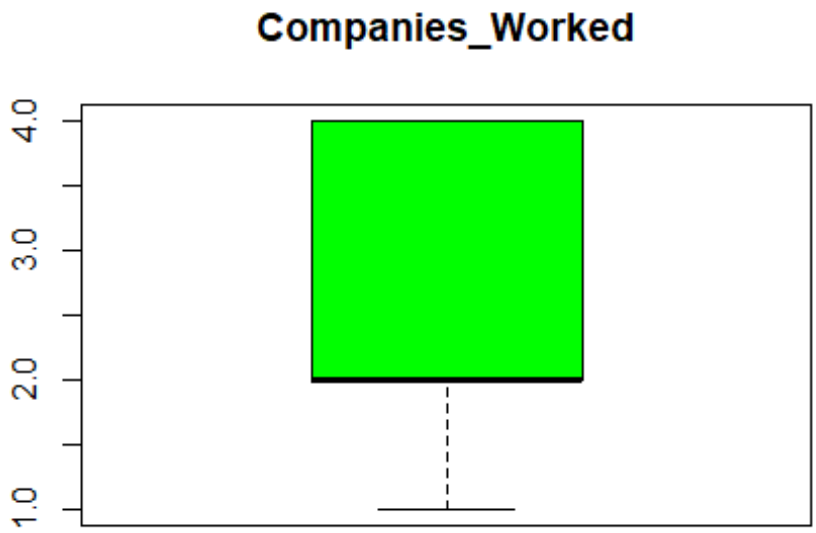
outliers:

```
boxplot(Employee_Data$Distance_From_Home, main =
"Distance_From_Home",col="red", sub = paste("outliers:",
boxplot.stats(Employee_Data$Distance_From_Home)$out))
```



outliers:

```r
boxplot(Employee_Data$Number_of_Companies_Worked, main = "Companies_Worked",
col="green",sub = paste("outliers:",
boxplot.stats(Employee_Data$Number_of_Companies_Worked)$out))
```




```r
# Pick numeric columns only
numeric_cols <- sapply(Employee_Data, is.numeric)

# Subset numeric data
numeric_data <- Employee_Data[, numeric_cols]

# Calculate mean and standard deviation for each numeric column
means <- sapply(numeric_data, mean)
sds <- sapply(numeric_data, sd)

# Print means and standard deviations
print(data.frame(variable = names(means), mean = means, sd = sds))
```

```
##                                                 variable       mean
## Age                                                  Age    39.5618
## Job_Level                                      Job_Level     2.9908
## Monthly_Income                            Monthly_Income 11436.7167
## Hourly_Rate                                  Hourly_Rate    57.0323
## Years_at_Company                        Years_at_Company    14.9362
## Years_in_Current_Role              Years_in_Current_Role     7.4513
## Years_Since_Last_Promotion    Years_Since_Last_Promotion     4.4719
## Work_Life_Balance                      Work_Life_Balance     2.5024
## Job_Satisfaction                        Job_Satisfaction     3.0380
```

```
## Training_Hours_Last_Year           Training_Hours_Last_Year    49.5889
## Project_Count                                 Project_Count     4.9844
## Average_Hours_Worked_Per_Week Average_Hours_Worked_Per_Week    44.4735
## Absenteeism                                     Absenteeism     9.4102
## Work_Environment_Satisfaction Work_Environment_Satisfaction     2.4931
## Relationship_with_Manager         Relationship_with_Manager     2.4914
## Job_Involvement                             Job_Involvement     2.5054
## Distance_From_Home                       Distance_From_Home    25.2720
## Number_of_Companies_Worked       Number_of_Companies_Worked     2.5166
##                                                        sd
## Age                                             11.454986
## Job_Level                                        1.410643
## Monthly_Income                                4926.528302
## Hourly_Rate                                     24.703261
## Years_at_Company                                 8.431657
## Years_in_Current_Role                            4.042903
## Years_Since_Last_Promotion                       2.891617
## Work_Life_Balance                                1.112348
## Job_Satisfaction                                 1.414764
## Training_Hours_Last_Year                        28.801393
## Project_Count                                    2.580043
## Average_Hours_Worked_Per_Week                    8.611662
## Absenteeism                                      5.760335
## Work_Environment_Satisfaction                    1.120927
## Relationship_with_Manager                        1.115101
## Job_Involvement                                  1.116018
## Distance_From_Home                              14.219474
## Number_of_Companies_Worked                       1.113934
```

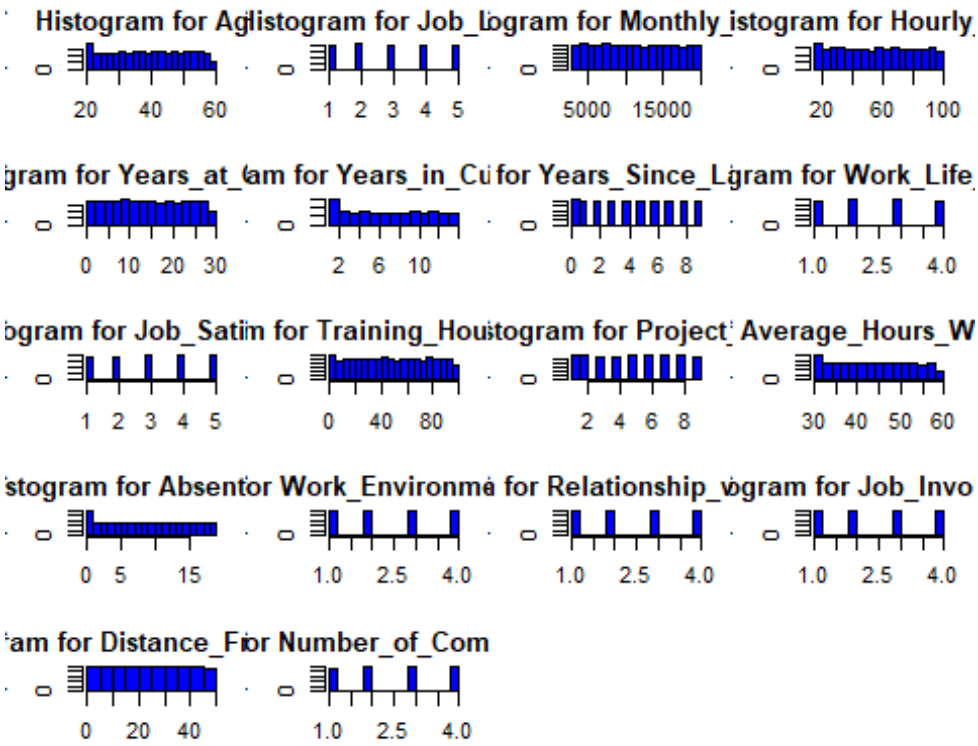
```r
# draw Histograms
# Select numeric columns
numeric_cols <- sapply(Employee_Data, is.numeric)

# Set up plotting window: adjust rows and cols based on number of variables
num_vars <- sum(numeric_cols)
rows <- ceiling(sqrt(num_vars))
cols <- ceiling(num_vars / rows)

par(mfrow = c(rows, cols), mar = c(3, 3, 2, 1))  # margins: bottom, left,
top, right

# Loop to plot histograms for each numeric variable
for (var_name in names(Employee_Data)[numeric_cols]) {
  hist(Employee_Data[[var_name]],
       main = paste("Histogram for", var_name),
       col = "blue",
       xlab = var_name)
}
```

```r
# Reset plotting layout to default
par(mfrow = c(1, 1))
```




```r
library(e1071)
continuous_vars<- c("Job_Level","Monthly_Income","Hourly_Rate",
"Years_in_Current_Role","Years_Since_Last_Promotion","Work_Life_Balance","Job
_Satisfaction","Training_Hours_Last_Year","Project_Count","Average_Hours_Work
ed_Per_Week","Absenteeism","Work_Environment_Satisfaction","Relationship_with
_Manager","Job_Involvement","Distance_From_Home","Number_of_Companies_Worked"
)

# Calculate skewness for each variable
skew_values <- sapply(Employee_Data[continuous_vars], skewness, na.rm = TRUE)

# Print skewness values
print(skew_values)
```

```
##                     Job_Level                Monthly_Income
##                   0.015217678                   0.015038630
##                   Hourly_Rate         Years_in_Current_Role
##                   0.007873296                   0.003241685
##    Years_Since_Last_Promotion             Work_Life_Balance
##                  -0.001873735                   0.001810751
##               Job_Satisfaction      Training_Hours_Last_Year
##                  -0.034540544                  -0.005605580
##                 Project_Count Average_Hours_Worked_Per_Week
##                  -0.008448485                  -0.003639286
```

```
##                   Absenteeism Work_Environment_Satisfaction
##                   0.030083060                   0.013832390
##     Relationship_with_Manager               Job_Involvement
##                   0.014011848                  -0.011169225
##            Distance_From_Home    Number_of_Companies_Worked
##                  -0.012448076                  -0.005456899

#all are closer to 0 ,so no need to apply transformation(fixed skewness)

# ---------------------- CATEGORICAL VARIABLES -----------------------

# Gender
chisq_gender <- chisq.test(table(Employee_Data$Performance,
Employee_Data$Gender))
print(chisq_gender)

##
##  Pearson's Chi-squared test with Yates' continuity correction
##
## data:  table(Employee_Data$Performance, Employee_Data$Gender)
## X-squared = 1.5734, df = 1, p-value = 0.2097

# Marital_Status
chisq_MaritalStatus <- chisq.test(table(Employee_Data$Performance,
Employee_Data$Marital_Status))
print(chisq_MaritalStatus)

##
##  Pearson's Chi-squared test
##
## data:  table(Employee_Data$Performance, Employee_Data$Marital_Status)
## X-squared = 0.4812, df = 2, p-value = 0.7862

# Department
chisq_Depaertment <- chisq.test(table(Employee_Data$Performance,
Employee_Data$Department))
print(chisq_Depaertment)

##
##  Pearson's Chi-squared test
##
## data:  table(Employee_Data$Performance, Employee_Data$Department)
## X-squared = 3.3905, df = 4, p-value = 0.4947

# Job_Role
chisq_JobRole <- chisq.test(table(Employee_Data$Performance,
Employee_Data$Job_Role))
print(chisq_JobRole)

##
##  Pearson's Chi-squared test
##
```

```
## data:  table(Employee_Data$Performance, Employee_Data$Job_Role)
## X-squared = 2.6129, df = 3, p-value = 0.4552

# Job_Level (numeric, but ordinal, so still categorical)
chisq_JobLevel <- chisq.test(table(Employee_Data$Performance,
Employee_Data$Job_Level))
print(chisq_JobLevel)

##
##  Pearson's Chi-squared test
##
## data:  table(Employee_Data$Performance, Employee_Data$Job_Level)
## X-squared = 10.68, df = 4, p-value = 0.03041

# Work_Life_Balance
chisq_WorklifeBalance <- chisq.test(table(Employee_Data$Performance,
Employee_Data$Work_Life_Balance))
print(chisq_WorklifeBalance)

##
##  Pearson's Chi-squared test
##
## data:  table(Employee_Data$Performance, Employee_Data$Work_Life_Balance)
## X-squared = 4.1495, df = 3, p-value = 0.2458

# Job_Satisfaction
chisq_Jobsatisfaction <- chisq.test(table(Employee_Data$Performance,
Employee_Data$Job_Satisfaction))
print(chisq_Jobsatisfaction)

##
##  Pearson's Chi-squared test
##
## data:  table(Employee_Data$Performance, Employee_Data$Job_Satisfaction)
## X-squared = 4.2625, df = 4, p-value = 0.3716

# Overtime
chisq_Overtime <- chisq.test(table(Employee_Data$Performance,
Employee_Data$Overtime))
print(chisq_Overtime)

##
##  Pearson's Chi-squared test with Yates' continuity correction
##
## data:  table(Employee_Data$Performance, Employee_Data$Overtime)
## X-squared = 0.20622, df = 1, p-value = 0.6497

# Work_Environment_Satisfaction
chisq_EnviromentSatisfaction <- chisq.test(table(Employee_Data$Performance,
Employee_Data$Work_Environment_Satisfaction))
print(chisq_EnviromentSatisfaction)
```

```
##
##  Pearson's Chi-squared test
##
## data:  table(Employee_Data$Performance,
Employee_Data$Work_Environment_Satisfaction)
## X-squared = 8.9978, df = 3, p-value = 0.02932

# Relationship_with_Manager
chisq_Relationwith_Manager <- chisq.test(table(Employee_Data$Performance,
Employee_Data$Relationship_with_Manager))
print(chisq_Relationwith_Manager)

##
##  Pearson's Chi-squared test
##
## data:  table(Employee_Data$Performance,
Employee_Data$Relationship_with_Manager)
## X-squared = 6.4532, df = 3, p-value = 0.09153

# Job_Involvement
chisq_JobInvolvement <- chisq.test(table(Employee_Data$Performance,
Employee_Data$Job_Involvement))
print(chisq_JobInvolvement)

##
##  Pearson's Chi-squared test
##
## data:  table(Employee_Data$Performance, Employee_Data$Job_Involvement)
## X-squared = 4.0665, df = 3, p-value = 0.2544

# Attrition
chisq_Attrition <- chisq.test(table(Employee_Data$Performance,
Employee_Data$Attrition))
print(chisq_Attrition)

##
##  Pearson's Chi-squared test with Yates' continuity correction
##
## data:  table(Employee_Data$Performance, Employee_Data$Attrition)
## X-squared = 2.7605, df = 1, p-value = 0.09662

library(dplyr)

##
## Attaching package: 'dplyr'

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

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

set.seed(250)
split_ratio <- 0.8
df1_bound <- ceiling(nrow(Employee_Data) * split_ratio)

train1 <- Employee_Data %>% slice_sample(n = df1_bound, replace = FALSE)
head(train1)

## # A tibble: 6 × 25
##     Age Gender Marital_Status Department Job_Role  Job_Level
Monthly_Income
##   <dbl> <fct>  <fct>          <fct>      <fct>         <dbl>
<dbl>
## 1    55 Male   Married        Sales      Assistant         4
3362
## 2    27 Female Divorced       IT         Executive         1
6217
## 3    23 Female Single         Marketing  Manager           1
3859
## 4    53 Male   Divorced       Sales      Executive         2
17808
## 5    49 Female Married        Marketing  Assistant         1
14551
## 6    27 Male   Divorced       IT         Manager           4
7732
## # ℹ 18 more variables: Hourly_Rate <dbl>, Years_at_Company <dbl>,
## #   Years_in_Current_Role <dbl>, Years_Since_Last_Promotion <dbl>,
## #   Work_Life_Balance <dbl>, Job_Satisfaction <dbl>, Performance <fct>,
## #   Training_Hours_Last_Year <dbl>, Overtime <fct>, Project_Count <dbl>,
## #   Average_Hours_Worked_Per_Week <dbl>, Absenteeism <dbl>,
## #   Work_Environment_Satisfaction <dbl>, Relationship_with_Manager <dbl>,
## #   Job_Involvement <dbl>, Distance_From_Home <dbl>, …

test1 <- Employee_Data[-as.numeric(rownames(train1)),]
head(test1)

## # A tibble: 6 × 25
##     Age Gender Marital_Status Department Job_Role  Job_Level
Monthly_Income
##   <dbl> <fct>  <fct>          <fct>      <fct>         <dbl>
<dbl>
## 1    54 Female Divorced       Finance    Executive         3
5064
## 2    53 Female Married        HR         Assistant         1
12679
## 3    57 Female Divorced       IT         Manager           3
5345
## 4    24 Male   Single         HR         Assistant         2
```

```
5640
## 5    37 Male   Divorced       HR         Executive         3
4050
## 6    35 Male   Single         HR         Executive         5
15470
## # ℹ 18 more variables: Hourly_Rate <dbl>, Years_at_Company <dbl>,
## #   Years_in_Current_Role <dbl>, Years_Since_Last_Promotion <dbl>,
## #   Work_Life_Balance <dbl>, Job_Satisfaction <dbl>, Performance <fct>,
## #   Training_Hours_Last_Year <dbl>, Overtime <fct>, Project_Count <dbl>,
## #   Average_Hours_Worked_Per_Week <dbl>, Absenteeism <dbl>,
## #   Work_Environment_Satisfaction <dbl>, Relationship_with_Manager <dbl>,
## #   Job_Involvement <dbl>, Distance_From_Home <dbl>, …
```

```
#Univariable logistic regression for each predictor
uni_Age <- glm(Performance ~ Age, data = train1, family = binomial)
summary(uni_Age)
```

```
##
## Call:
## glm(formula = Performance ~ Age, family = binomial, data = train1)
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept) -0.093734   0.080243  -1.168    0.243
## Age          0.002295   0.001949   1.177    0.239
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 11090  on 7999  degrees of freedom
## Residual deviance: 11089  on 7998  degrees of freedom
## AIC: 11093
##
## Number of Fisher Scoring iterations: 3
```

```
uni_Job_Level <- glm(Performance ~ Job_Level, data = train1, family =
binomial)
summary(uni_Job_Level)
```

```
##
## Call:
## glm(formula = Performance ~ Job_Level, family = binomial, data = train1)
##
## Coefficients:
##             Estimate Std. Error z value Pr(>|z|)
## (Intercept) -0.05235    0.05229  -1.001    0.317
## Job_Level    0.01655    0.01585   1.044    0.296
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 11090  on 7999  degrees of freedom
## Residual deviance: 11089  on 7998  degrees of freedom
```

```
## AIC: 11093
##
## Number of Fisher Scoring iterations: 3
```

```
uni_Monthly_Income <- glm(Performance ~ Monthly_Income, data = train1, family
= binomial)
summary(uni_Monthly_Income)
```

```
##
## Call:
## glm(formula = Performance ~ Monthly_Income, family = binomial,
##     data = train1)
##
## Coefficients:
##                  Estimate Std. Error z value Pr(>|z|)
## (Intercept)    -2.793e-02  5.657e-02  -0.494    0.621
## Monthly_Income  2.179e-06  4.541e-06   0.480    0.631
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 11090  on 7999  degrees of freedom
## Residual deviance: 11090  on 7998  degrees of freedom
## AIC: 11094
##
## Number of Fisher Scoring iterations: 3
```

```
uni_Hourly_Rate <- glm(Performance ~ Hourly_Rate, data = train1, family =
binomial)
summary(uni_Hourly_Rate)
```

```
##
## Call:
## glm(formula = Performance ~ Hourly_Rate, family = binomial, data = train1)
##
## Coefficients:
##                Estimate Std. Error z value Pr(>|z|)
## (Intercept) -0.0306141  0.0563093  -0.544    0.587
## Hourly_Rate  0.0004842  0.0009062   0.534    0.593
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 11090  on 7999  degrees of freedom
## Residual deviance: 11090  on 7998  degrees of freedom
## AIC: 11094
##
## Number of Fisher Scoring iterations: 3
```

```
uni_Years_at_Company <- glm(Performance ~ Years_at_Company, data = train1,
family = binomial)
summary(uni_Years_at_Company)
```

```
##
## Call:
## glm(formula = Performance ~ Years_at_Company, family = binomial,
##     data = train1)
##
## Coefficients:
##                   Estimate Std. Error z value Pr(>|z|)
## (Intercept)       0.037142   0.045346   0.819    0.413
## Years_at_Company -0.002696   0.002649  -1.018    0.309
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 11090  on 7999  degrees of freedom
## Residual deviance: 11089  on 7998  degrees of freedom
## AIC: 11093
##
## Number of Fisher Scoring iterations: 3
```

```
uni_Years_in_Current_Role <- glm(Performance ~ Years_in_Current_Role, data =
train1, family = binomial)
summary(uni_Years_in_Current_Role)
```

```
##
## Call:
## glm(formula = Performance ~ Years_in_Current_Role, family = binomial,
##     data = train1)
##
## Coefficients:
##                        Estimate Std. Error z value Pr(>|z|)
## (Intercept)           -0.029259   0.046813  -0.625    0.532
## Years_in_Current_Role  0.003523   0.005518   0.638    0.523
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 11090  on 7999  degrees of freedom
## Residual deviance: 11090  on 7998  degrees of freedom
## AIC: 11094
##
## Number of Fisher Scoring iterations: 3
```

```
uni_Years_Since_Last_Promotion <- glm(Performance ~
Years_Since_Last_Promotion, data = train1, family = binomial)
summary(uni_Years_Since_Last_Promotion)
```

```
##
## Call:
## glm(formula = Performance ~ Years_Since_Last_Promotion, family = binomial,
##     data = train1)
##
## Coefficients:
##                             Estimate Std. Error z value Pr(>|z|)
```

```
## (Intercept)                0.005775   0.041282   0.140    0.889
## Years_Since_Last_Promotion -0.001959   0.007749  -0.253    0.800
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 11090  on 7999  degrees of freedom
## Residual deviance: 11090  on 7998  degrees of freedom
## AIC: 11094
##
## Number of Fisher Scoring iterations: 3
```

```
uni_Work_Life_Balance <- glm(Performance ~ Work_Life_Balance, data = train1,
family = binomial)
summary(uni_Work_Life_Balance)
```

```
##
## Call:
## glm(formula = Performance ~ Work_Life_Balance, family = binomial,
##     data = train1)
##
## Coefficients:
##                    Estimate Std. Error z value Pr(>|z|)
## (Intercept)       -0.025843   0.055150  -0.469    0.639
## Work_Life_Balance  0.009102   0.020088   0.453    0.650
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 11090  on 7999  degrees of freedom
## Residual deviance: 11090  on 7998  degrees of freedom
## AIC: 11094
##
## Number of Fisher Scoring iterations: 3
```

```
uni_Job_Satisfaction <- glm(Performance ~ Job_Satisfaction, data = train1,
family = binomial)
summary(uni_Job_Satisfaction)
```

```
##
## Call:
## glm(formula = Performance ~ Job_Satisfaction, family = binomial,
##     data = train1)
##
## Coefficients:
##                   Estimate Std. Error z value Pr(>|z|)
## (Intercept)       0.023761   0.052951   0.449    0.654
## Job_Satisfaction -0.008812   0.015805  -0.558    0.577
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 11090  on 7999  degrees of freedom
## Residual deviance: 11090  on 7998  degrees of freedom
```

```
## AIC: 11094
##
## Number of Fisher Scoring iterations: 3
```

```
uni_Training_Hours_Last_Year <- glm(Performance ~ Training_Hours_Last_Year,
data = train1, family = binomial)
summary(uni_Training_Hours_Last_Year)
```

```
##
## Call:
## glm(formula = Performance ~ Training_Hours_Last_Year, family = binomial,
##     data = train1)
##
## Coefficients:
##                             Estimate Std. Error z value Pr(>|z|)
## (Intercept)                0.0782021  0.0446381   1.752   0.0798 .
## Training_Hours_Last_Year -0.0016329  0.0007768  -2.102   0.0356 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 11090  on 7999  degrees of freedom
## Residual deviance: 11086  on 7998  degrees of freedom
## AIC: 11090
##
## Number of Fisher Scoring iterations: 3
```

```
uni_Project_Count <- glm(Performance ~ Project_Count, data = train1, family =
binomial)
summary(uni_Project_Count)
```

```
##
## Call:
## glm(formula = Performance ~ Project_Count, family = binomial,
##     data = train1)
##
## Coefficients:
##                Estimate Std. Error z value Pr(>|z|)
## (Intercept)   -0.035685   0.048790  -0.731    0.465
## Project_Count  0.006528   0.008660   0.754    0.451
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 11090  on 7999  degrees of freedom
## Residual deviance: 11090  on 7998  degrees of freedom
## AIC: 11094
##
## Number of Fisher Scoring iterations: 3
```

```r
uni_Average_Hours_Worked_Per_Week <- glm(Performance ~
Average_Hours_Worked_Per_Week, data = train1, family = binomial)
summary(uni_Average_Hours_Worked_Per_Week)
```

```
##
## Call:
## glm(formula = Performance ~ Average_Hours_Worked_Per_Week, family =
binomial,
##     data = train1)
##
## Coefficients:
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                  -0.084926   0.118128  -0.719    0.472
## Average_Hours_Worked_Per_Week  0.001839   0.002603   0.706    0.480
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 11090  on 7999  degrees of freedom
## Residual deviance: 11090  on 7998  degrees of freedom
## AIC: 11094
##
## Number of Fisher Scoring iterations: 3
```

```r
uni_Absenteeism <- glm(Performance ~ Absenteeism, data = train1, family =
binomial)
summary(uni_Absenteeism)
```

```
##
## Call:
## glm(formula = Performance ~ Absenteeism, family = binomial, data = train1)
##
## Coefficients:
##               Estimate Std. Error z value Pr(>|z|)
## (Intercept) -0.0050472  0.0431001  -0.117    0.907
## Absenteeism  0.0002164  0.0038944   0.056    0.956
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 11090  on 7999  degrees of freedom
## Residual deviance: 11090  on 7998  degrees of freedom
## AIC: 11094
##
## Number of Fisher Scoring iterations: 3
```

```r
uni_Work_Environment_Satisfaction <- glm(Performance ~
Work_Environment_Satisfaction, data = train1, family = binomial)
summary(uni_Work_Environment_Satisfaction)
```

```
##
## Call:
## glm(formula = Performance ~ Work_Environment_Satisfaction, family =
```

```
binomial,
##     data = train1)
##
## Coefficients:
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                  -0.10901    0.05456  -1.998   0.0457 *
## Work_Environment_Satisfaction  0.04245    0.01993   2.130   0.0331 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 11090  on 7999  degrees of freedom
## Residual deviance: 11086  on 7998  degrees of freedom
## AIC: 11090
##
## Number of Fisher Scoring iterations: 3
```

```
uni_Relationship_with_Manager <- glm(Performance ~ Relationship_with_Manager,
data = train1, family = binomial)
summary(uni_Relationship_with_Manager)
```

```
##
## Call:
## glm(formula = Performance ~ Relationship_with_Manager, family = binomial,
##     data = train1)
##
## Coefficients:
##                            Estimate Std. Error z value Pr(>|z|)
## (Intercept)                 0.07794    0.05476   1.423    0.155
## Relationship_with_Manager -0.03238    0.02000  -1.619    0.105
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 11090  on 7999  degrees of freedom
## Residual deviance: 11088  on 7998  degrees of freedom
## AIC: 11092
##
## Number of Fisher Scoring iterations: 3
```

```
uni_Job_Involvement <- glm(Performance ~ Job_Involvement, data = train1,
family = binomial)
summary(uni_Job_Involvement)
```

```
##
## Call:
## glm(formula = Performance ~ Job_Involvement, family = binomial,
##     data = train1)
##
## Coefficients:
##                 Estimate Std. Error z value Pr(>|z|)
```

```
## (Intercept)      0.10558    0.05513   1.915   0.0555 .
## Job_Involvement -0.04324    0.02007  -2.155   0.0312 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 11090  on 7999  degrees of freedom
## Residual deviance: 11086  on 7998  degrees of freedom
## AIC: 11090
##
## Number of Fisher Scoring iterations: 3
```

```
uni_Distance_From_Home <- glm(Performance ~ Distance_From_Home, data =
train1, family = binomial)
summary(uni_Distance_From_Home)
```

```
##
## Call:
## glm(formula = Performance ~ Distance_From_Home, family = binomial,
##     data = train1)
##
## Coefficients:
##                      Estimate Std. Error z value Pr(>|z|)
## (Intercept)        -0.047147   0.045649  -1.033    0.302
## Distance_From_Home  0.001748   0.001576   1.109    0.267
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 11090  on 7999  degrees of freedom
## Residual deviance: 11089  on 7998  degrees of freedom
## AIC: 11093
##
## Number of Fisher Scoring iterations: 3
```

```
uni_Number_of_Companies_Worked <- glm(Performance ~
Number_of_Companies_Worked, data = train1, family = binomial)
summary(uni_Number_of_Companies_Worked)
```

```
##
## Call:
## glm(formula = Performance ~ Number_of_Companies_Worked, family = binomial,
##     data = train1)
##
## Coefficients:
##                             Estimate Std. Error z value Pr(>|z|)
## (Intercept)                -0.021307   0.055193  -0.386    0.699
## Number_of_Companies_Worked  0.007261   0.020014   0.363    0.717
##
## (Dispersion parameter for binomial family taken to be 1)
##
```

```
##     Null deviance: 11090  on 7999  degrees of freedom
## Residual deviance: 11090  on 7998  degrees of freedom
## AIC: 11094
##
## Number of Fisher Scoring iterations: 3
```

```
#Fitting binary logistic regression using "glm" function

data<-train1

model1<-glm(Performance ~.,data=data,family="binomial"(link=logit))

summary(model1)
```

```
##
## Call:
## glm(formula = Performance ~ ., family = binomial(link = logit),
##     data = data)
##
## Coefficients:
##                                Estimate Std. Error z value Pr(>|z|)
## (Intercept)                  -1.632e-01  2.414e-01  -0.676   0.4991
## Age                           2.085e-03  1.957e-03   1.065   0.2869
## GenderMale                    4.921e-02  4.491e-02   1.096   0.2732
## Marital_StatusMarried        -7.768e-02  5.488e-02  -1.416   0.1569
## Marital_StatusSingle         -5.179e-02  5.520e-02  -0.938   0.3481
## DepartmentHR                  3.610e-02  7.165e-02   0.504   0.6144
## DepartmentIT                 -5.269e-02  7.186e-02  -0.733   0.4634
## DepartmentMarketing           3.234e-02  6.996e-02   0.462   0.6438
## DepartmentSales               6.882e-02  7.104e-02   0.969   0.3327
## Job_RoleAssistant             3.899e-02  6.292e-02   0.620   0.5354
## Job_RoleExecutive             4.652e-02  6.317e-02   0.736   0.4615
## Job_RoleManager              -9.540e-04  6.361e-02  -0.015   0.9880
## Job_Level                     1.829e-02  1.591e-02   1.149   0.2504
## Monthly_Income                2.753e-06  4.560e-06   0.604   0.5461
## Hourly_Rate                   4.592e-04  9.094e-04   0.505   0.6136
## Years_at_Company             -2.677e-03  2.659e-03  -1.007   0.3140
## Years_in_Current_Role         3.481e-03  5.540e-03   0.628   0.5298
## Years_Since_Last_Promotion   -2.701e-03  7.775e-03  -0.347   0.7283
## Work_Life_Balance             9.211e-03  2.017e-02   0.457   0.6480
## Job_Satisfaction             -9.868e-03  1.587e-02  -0.622   0.5339
## Training_Hours_Last_Year     -1.625e-03  7.804e-04  -2.083   0.0373 *
## OvertimeYes                  -4.915e-03  4.489e-02  -0.109   0.9128
## Project_Count                 7.024e-03  8.697e-03   0.808   0.4193
## Average_Hours_Worked_Per_Week 1.635e-03  2.613e-03   0.626   0.5314
## Absenteeism                   4.713e-04  3.908e-03   0.121   0.9040
## Work_Environment_Satisfaction 3.980e-02  2.000e-02   1.989   0.0466 *
## Relationship_with_Manager    -3.302e-02  2.009e-02  -1.644   0.1002
## Job_Involvement              -4.342e-02  2.013e-02  -2.157   0.0310 *
## Distance_From_Home            1.801e-03  1.582e-03   1.138   0.2551
```

```
## Number_of_Companies_Worked     6.459e-03  2.009e-02   0.321   0.7479
## AttritionYes                  -1.027e-01  5.635e-02  -1.822   0.0685 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 11090  on 7999  degrees of freedom
## Residual deviance: 11056  on 7969  degrees of freedom
## AIC: 11118
##
## Number of Fisher Scoring iterations: 3
```

```
library(car)
```

```
## Loading required package: carData
```

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

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

```
print(vif(model1))
```

```
##                                 GVIF Df GVIF^(1/(2*Df))
## Age                         1.004510  1        1.002253
## Gender                      1.003941  1        1.001969
## Marital_Status              1.005901  2        1.001472
## Department                  1.011895  4        1.001479
## Job_Role                    1.014737  3        1.002441
## Job_Level                   1.003363  1        1.001680
## Monthly_Income              1.004296  1        1.002145
## Hourly_Rate                 1.002746  1        1.001372
## Years_at_Company            1.002920  1        1.001459
## Years_in_Current_Role       1.003898  1        1.001947
## Years_Since_Last_Promotion  1.002473  1        1.001236
## Work_Life_Balance           1.004363  1        1.002179
## Job_Satisfaction            1.003548  1        1.001773
## Training_Hours_Last_Year    1.005468  1        1.002730
## Overtime                    1.002513  1        1.001256
## Project_Count               1.004298  1        1.002147
## Average_Hours_Worked_Per_Week 1.003357  1        1.001677
## Absenteeism                 1.002704  1        1.001351
## Work_Environment_Satisfaction 1.004086  1        1.002041
## Relationship_with_Manager   1.005147  1        1.002570
## Job_Involvement             1.002396  1        1.001197
## Distance_From_Home          1.004135  1        1.002066
## Number_of_Companies_Worked  1.003903  1        1.001950
## Attrition                   1.003702  1        1.001849
```

```r
step_model <- step(model1, direction = "both")
```

```
## Start:  AIC=11118.24
## Performance ~ Age + Gender + Marital_Status + Department + Job_Role +
##     Job_Level + Monthly_Income + Hourly_Rate + Years_at_Company +
##     Years_in_Current_Role + Years_Since_Last_Promotion + Work_Life_Balance
+
##     Job_Satisfaction + Training_Hours_Last_Year + Overtime +
##     Project_Count + Average_Hours_Worked_Per_Week + Absenteeism +
##     Work_Environment_Satisfaction + Relationship_with_Manager +
##     Job_Involvement + Distance_From_Home + Number_of_Companies_Worked +
##     Attrition
##
##                                 Df Deviance   AIC
## - Job_Role                       3    11057 11113
## - Department                     4    11060 11114
## - Overtime                       1    11056 11116
## - Absenteeism                    1    11056 11116
## - Marital_Status                 2    11058 11116
## - Number_of_Companies_Worked     1    11056 11116
## - Years_Since_Last_Promotion     1    11056 11116
## - Work_Life_Balance              1    11056 11116
## - Hourly_Rate                    1    11056 11116
## - Monthly_Income                 1    11057 11117
## - Job_Satisfaction               1    11057 11117
## - Average_Hours_Worked_Per_Week  1    11057 11117
## - Years_in_Current_Role          1    11057 11117
## - Project_Count                  1    11057 11117
## - Years_at_Company               1    11057 11117
## - Age                            1    11057 11117
## - Gender                         1    11057 11117
## - Distance_From_Home             1    11058 11118
## - Job_Level                      1    11058 11118
## <none>                                11056 11118
## - Relationship_with_Manager      1    11059 11119
## - Attrition                      1    11060 11120
## - Work_Environment_Satisfaction  1    11060 11120
## - Training_Hours_Last_Year       1    11061 11121
## - Job_Involvement                1    11061 11121
##
## Step:  AIC=11113.18
## Performance ~ Age + Gender + Marital_Status + Department + Job_Level +
##     Monthly_Income + Hourly_Rate + Years_at_Company +
Years_in_Current_Role +
##     Years_Since_Last_Promotion + Work_Life_Balance + Job_Satisfaction +
##     Training_Hours_Last_Year + Overtime + Project_Count +
Average_Hours_Worked_Per_Week +
##     Absenteeism + Work_Environment_Satisfaction +
Relationship_with_Manager +
##     Job_Involvement + Distance_From_Home + Number_of_Companies_Worked +
```

```
##     Attrition
##
##                                  Df Deviance   AIC
## - Department                      4    11060 11108
## - Overtime                        1    11057 11111
## - Absenteeism                     1    11057 11111
## - Number_of_Companies_Worked      1    11057 11111
## - Marital_Status                  2    11059 11111
## - Years_Since_Last_Promotion      1    11057 11111
## - Work_Life_Balance               1    11057 11111
## - Hourly_Rate                     1    11057 11111
## - Monthly_Income                  1    11058 11112
## - Job_Satisfaction                1    11058 11112
## - Average_Hours_Worked_Per_Week   1    11058 11112
## - Years_in_Current_Role           1    11058 11112
## - Project_Count                   1    11058 11112
## - Years_at_Company                1    11058 11112
## - Age                             1    11058 11112
## - Gender                          1    11058 11112
## - Job_Level                       1    11058 11112
## - Distance_From_Home              1    11058 11112
## <none>                                 11057 11113
## - Relationship_with_Manager       1    11060 11114
## - Attrition                       1    11060 11114
## - Work_Environment_Satisfaction   1    11061 11115
## - Training_Hours_Last_Year        1    11061 11115
## - Job_Involvement                 1    11062 11116
## + Job_Role                        3    11056 11118
##
## Step:  AIC=11108.47
## Performance ~ Age + Gender + Marital_Status + Job_Level + Monthly_Income +
##     Hourly_Rate + Years_at_Company + Years_in_Current_Role +
##     Years_Since_Last_Promotion + Work_Life_Balance + Job_Satisfaction +
##     Training_Hours_Last_Year + Overtime + Project_Count +
Average_Hours_Worked_Per_Week +
##     Absenteeism + Work_Environment_Satisfaction +
Relationship_with_Manager +
##     Job_Involvement + Distance_From_Home + Number_of_Companies_Worked +
##     Attrition
##
##                                  Df Deviance   AIC
## - Absenteeism                     1    11060 11106
## - Overtime                        1    11060 11106
## - Marital_Status                  2    11062 11106
## - Number_of_Companies_Worked      1    11061 11107
## - Years_Since_Last_Promotion      1    11061 11107
## - Work_Life_Balance               1    11061 11107
## - Hourly_Rate                     1    11061 11107
## - Monthly_Income                  1    11061 11107
## - Job_Satisfaction                1    11061 11107
```

```
## - Years_in_Current_Role           1    11061 11107
## - Average_Hours_Worked_Per_Week   1    11061 11107
## - Project_Count                   1    11061 11107
## - Years_at_Company                1    11062 11108
## - Age                             1    11062 11108
## - Job_Level                       1    11062 11108
## - Gender                          1    11062 11108
## - Distance_From_Home              1    11062 11108
## <none>                                 11060 11108
## - Relationship_with_Manager       1    11063 11109
## - Attrition                       1    11064 11110
## - Work_Environment_Satisfaction   1    11064 11110
## - Training_Hours_Last_Year        1    11065 11111
## - Job_Involvement                 1    11065 11111
## + Department                      4    11057 11113
## + Job_Role                        3    11060 11114
##
## Step:  AIC=11106.48
## Performance ~ Age + Gender + Marital_Status + Job_Level + Monthly_Income +
##     Hourly_Rate + Years_at_Company + Years_in_Current_Role +
##     Years_Since_Last_Promotion + Work_Life_Balance + Job_Satisfaction +
##     Training_Hours_Last_Year + Overtime + Project_Count +
Average_Hours_Worked_Per_Week +
##     Work_Environment_Satisfaction + Relationship_with_Manager +
##     Job_Involvement + Distance_From_Home + Number_of_Companies_Worked +
##     Attrition
##
##                                  Df Deviance   AIC
## - Overtime                        1    11060 11104
## - Marital_Status                  2    11062 11104
## - Number_of_Companies_Worked      1    11061 11105
## - Years_Since_Last_Promotion      1    11061 11105
## - Work_Life_Balance               1    11061 11105
## - Hourly_Rate                     1    11061 11105
## - Monthly_Income                  1    11061 11105
## - Job_Satisfaction                1    11061 11105
## - Years_in_Current_Role           1    11061 11105
## - Average_Hours_Worked_Per_Week   1    11061 11105
## - Project_Count                   1    11061 11105
## - Years_at_Company                1    11062 11106
## - Age                             1    11062 11106
## - Job_Level                       1    11062 11106
## - Gender                          1    11062 11106
## - Distance_From_Home              1    11062 11106
## <none>                                 11060 11106
## - Relationship_with_Manager       1    11063 11107
## - Attrition                       1    11064 11108
## + Absenteeism                     1    11060 11108
## - Work_Environment_Satisfaction   1    11064 11108
## - Training_Hours_Last_Year        1    11065 11109
```

```
## - Job_Involvement                1    11065 11109
## + Department                     4    11057 11111
## + Job_Role                       3    11060 11112
##
## Step:  AIC=11104.5
## Performance ~ Age + Gender + Marital_Status + Job_Level + Monthly_Income +
##     Hourly_Rate + Years_at_Company + Years_in_Current_Role +
##     Years_Since_Last_Promotion + Work_Life_Balance + Job_Satisfaction +
##     Training_Hours_Last_Year + Project_Count +
Average_Hours_Worked_Per_Week +
##     Work_Environment_Satisfaction + Relationship_with_Manager +
##     Job_Involvement + Distance_From_Home + Number_of_Companies_Worked +
##     Attrition
##
##                                 Df Deviance   AIC
## - Marital_Status                 2    11062 11102
## - Number_of_Companies_Worked     1    11061 11103
## - Years_Since_Last_Promotion     1    11061 11103
## - Work_Life_Balance              1    11061 11103
## - Hourly_Rate                    1    11061 11103
## - Monthly_Income                 1    11061 11103
## - Job_Satisfaction               1    11061 11103
## - Years_in_Current_Role          1    11061 11103
## - Average_Hours_Worked_Per_Week  1    11061 11103
## - Project_Count                  1    11061 11103
## - Years_at_Company               1    11062 11104
## - Age                            1    11062 11104
## - Job_Level                      1    11062 11104
## - Gender                         1    11062 11104
## - Distance_From_Home             1    11062 11104
## <none>                                11060 11104
## - Relationship_with_Manager      1    11063 11105
## - Attrition                      1    11064 11106
## + Overtime                       1    11060 11106
## + Absenteeism                    1    11060 11106
## - Work_Environment_Satisfaction  1    11064 11106
## - Training_Hours_Last_Year       1    11065 11107
## - Job_Involvement                1    11065 11107
## + Department                     4    11057 11109
## + Job_Role                       3    11060 11110
##
## Step:  AIC=11102.51
## Performance ~ Age + Gender + Job_Level + Monthly_Income + Hourly_Rate +
##     Years_at_Company + Years_in_Current_Role + Years_Since_Last_Promotion
+
##     Work_Life_Balance + Job_Satisfaction + Training_Hours_Last_Year +
##     Project_Count + Average_Hours_Worked_Per_Week +
Work_Environment_Satisfaction +
##     Relationship_with_Manager + Job_Involvement + Distance_From_Home +
##     Number_of_Companies_Worked + Attrition
```

```
##
##                                 Df Deviance   AIC
## - Number_of_Companies_Worked     1    11063 11101
## - Years_Since_Last_Promotion     1    11063 11101
## - Work_Life_Balance              1    11063 11101
## - Hourly_Rate                    1    11063 11101
## - Job_Satisfaction               1    11063 11101
## - Monthly_Income                 1    11063 11101
## - Years_in_Current_Role          1    11063 11101
## - Average_Hours_Worked_Per_Week  1    11063 11101
## - Project_Count                  1    11063 11101
## - Years_at_Company               1    11064 11102
## - Age                            1    11064 11102
## - Job_Level                      1    11064 11102
## - Gender                         1    11064 11102
## - Distance_From_Home             1    11064 11102
## <none>                                11062 11102
## - Relationship_with_Manager      1    11065 11103
## - Attrition                      1    11066 11104
## + Marital_Status                 2    11060 11104
## + Overtime                       1    11062 11104
## + Absenteeism                    1    11062 11104
## - Work_Environment_Satisfaction  1    11066 11104
## - Training_Hours_Last_Year       1    11067 11105
## - Job_Involvement                1    11067 11105
## + Department                     4    11059 11107
## + Job_Role                       3    11062 11108
##
## Step:  AIC=11100.61
## Performance ~ Age + Gender + Job_Level + Monthly_Income + Hourly_Rate +
##     Years_at_Company + Years_in_Current_Role + Years_Since_Last_Promotion
+
##     Work_Life_Balance + Job_Satisfaction + Training_Hours_Last_Year +
##     Project_Count + Average_Hours_Worked_Per_Week +
Work_Environment_Satisfaction +
##     Relationship_with_Manager + Job_Involvement + Distance_From_Home +
##     Attrition
##
##                                 Df Deviance   AIC
## - Years_Since_Last_Promotion     1    11063 11099
## - Work_Life_Balance              1    11063 11099
## - Hourly_Rate                    1    11063 11099
## - Job_Satisfaction               1    11063 11099
## - Monthly_Income                 1    11063 11099
## - Years_in_Current_Role          1    11063 11099
## - Average_Hours_Worked_Per_Week  1    11063 11099
## - Project_Count                  1    11063 11099
## - Years_at_Company               1    11064 11100
## - Age                            1    11064 11100
## - Job_Level                      1    11064 11100
```

```
## - Gender                            1    11064 11100
## - Distance_From_Home                1    11064 11100
## <none>                                   11063 11101
## - Relationship_with_Manager         1    11065 11101
## - Attrition                         1    11066 11102
## + Number_of_Companies_Worked        1    11062 11102
## + Marital_Status                    2    11061 11103
## + Overtime                          1    11063 11103
## + Absenteeism                       1    11063 11103
## - Work_Environment_Satisfaction     1    11067 11103
## - Training_Hours_Last_Year          1    11067 11103
## - Job_Involvement                   1    11067 11103
## + Department                        4    11059 11105
## + Job_Role                          3    11062 11106
##
## Step:  AIC=11098.73
## Performance ~ Age + Gender + Job_Level + Monthly_Income + Hourly_Rate +
##     Years_at_Company + Years_in_Current_Role + Work_Life_Balance +
##     Job_Satisfaction + Training_Hours_Last_Year + Project_Count +
##     Average_Hours_Worked_Per_Week + Work_Environment_Satisfaction +
##     Relationship_with_Manager + Job_Involvement + Distance_From_Home +
##     Attrition
##
##                                   Df Deviance   AIC
## - Work_Life_Balance                1    11063 11097
## - Hourly_Rate                      1    11063 11097
## - Job_Satisfaction                 1    11063 11097
## - Monthly_Income                   1    11063 11097
## - Years_in_Current_Role            1    11063 11097
## - Average_Hours_Worked_Per_Week    1    11063 11097
## - Project_Count                    1    11063 11097
## - Years_at_Company                 1    11064 11098
## - Age                              1    11064 11098
## - Job_Level                        1    11064 11098
## - Gender                           1    11064 11098
## - Distance_From_Home               1    11064 11098
## <none>                                  11063 11099
## - Relationship_with_Manager        1    11066 11100
## - Attrition                        1    11066 11100
## + Years_Since_Last_Promotion       1    11063 11101
## + Number_of_Companies_Worked       1    11063 11101
## + Marital_Status                   2    11061 11101
## + Overtime                         1    11063 11101
## + Absenteeism                      1    11063 11101
## - Work_Environment_Satisfaction    1    11067 11101
## - Training_Hours_Last_Year         1    11067 11101
## - Job_Involvement                  1    11067 11101
## + Department                       4    11060 11104
## + Job_Role                         3    11062 11104
##
```

```
## Step:  AIC=11096.94
## Performance ~ Age + Gender + Job_Level + Monthly_Income + Hourly_Rate +
##     Years_at_Company + Years_in_Current_Role + Job_Satisfaction +
##     Training_Hours_Last_Year + Project_Count +
Average_Hours_Worked_Per_Week +
##     Work_Environment_Satisfaction + Relationship_with_Manager +
##     Job_Involvement + Distance_From_Home + Attrition
##
##                                 Df Deviance   AIC
## - Hourly_Rate                    1    11063 11095
## - Monthly_Income                 1    11063 11095
## - Job_Satisfaction               1    11063 11095
## - Years_in_Current_Role          1    11063 11095
## - Average_Hours_Worked_Per_Week  1    11063 11095
## - Project_Count                  1    11064 11096
## - Years_at_Company               1    11064 11096
## - Age                            1    11064 11096
## - Job_Level                      1    11064 11096
## - Gender                         1    11064 11096
## - Distance_From_Home             1    11064 11096
## <none>                                11063 11097
## - Relationship_with_Manager      1    11066 11098
## - Attrition                      1    11066 11098
## + Work_Life_Balance              1    11063 11099
## + Years_Since_Last_Promotion     1    11063 11099
## + Number_of_Companies_Worked     1    11063 11099
## + Marital_Status                 2    11061 11099
## + Overtime                       1    11063 11099
## + Absenteeism                    1    11063 11099
## - Work_Environment_Satisfaction  1    11067 11099
## - Training_Hours_Last_Year       1    11067 11099
## - Job_Involvement                1    11068 11100
## + Department                     4    11060 11102
## + Job_Role                       3    11062 11102
##
## Step:  AIC=11095.18
## Performance ~ Age + Gender + Job_Level + Monthly_Income + Years_at_Company
+
##     Years_in_Current_Role + Job_Satisfaction + Training_Hours_Last_Year +
##     Project_Count + Average_Hours_Worked_Per_Week +
Work_Environment_Satisfaction +
##     Relationship_with_Manager + Job_Involvement + Distance_From_Home +
##     Attrition
##
##                                 Df Deviance   AIC
## - Job_Satisfaction               1    11064 11094
## - Monthly_Income                 1    11064 11094
## - Years_in_Current_Role          1    11064 11094
## - Average_Hours_Worked_Per_Week  1    11064 11094
## - Project_Count                  1    11064 11094
```

```
## - Years_at_Company                1    11064 11094
## - Age                             1    11064 11094
## - Job_Level                       1    11064 11094
## - Gender                          1    11064 11094
## - Distance_From_Home              1    11064 11094
## <none>                                 11063 11095
## - Relationship_with_Manager       1    11066 11096
## - Attrition                       1    11066 11096
## + Hourly_Rate                     1    11063 11097
## + Work_Life_Balance               1    11063 11097
## + Years_Since_Last_Promotion      1    11063 11097
## + Number_of_Companies_Worked      1    11063 11097
## + Marital_Status                  2    11061 11097
## + Overtime                        1    11063 11097
## + Absenteeism                     1    11063 11097
## - Work_Environment_Satisfaction   1    11067 11097
## - Training_Hours_Last_Year        1    11068 11098
## - Job_Involvement                 1    11068 11098
## + Department                      4    11060 11100
## + Job_Role                        3    11062 11100
##
## Step:  AIC=11093.52
## Performance ~ Age + Gender + Job_Level + Monthly_Income + Years_at_Company
+
##     Years_in_Current_Role + Training_Hours_Last_Year + Project_Count +
##     Average_Hours_Worked_Per_Week + Work_Environment_Satisfaction +
##     Relationship_with_Manager + Job_Involvement + Distance_From_Home +
##     Attrition
##
##                                  Df Deviance   AIC
## - Monthly_Income                  1    11064 11092
## - Years_in_Current_Role           1    11064 11092
## - Average_Hours_Worked_Per_Week   1    11064 11092
## - Project_Count                   1    11064 11092
## - Years_at_Company                1    11065 11093
## - Age                             1    11065 11093
## - Job_Level                       1    11065 11093
## - Gender                          1    11065 11093
## - Distance_From_Home              1    11065 11093
## <none>                                 11064 11094
## - Relationship_with_Manager       1    11066 11094
## - Attrition                       1    11067 11095
## + Job_Satisfaction                1    11063 11095
## + Hourly_Rate                     1    11063 11095
## + Work_Life_Balance               1    11063 11095
## + Years_Since_Last_Promotion      1    11063 11095
## + Number_of_Companies_Worked      1    11063 11095
## + Marital_Status                  2    11062 11096
## + Overtime                        1    11064 11096
## + Absenteeism                     1    11064 11096
```

```
## - Work_Environment_Satisfaction  1    11068 11096
## - Training_Hours_Last_Year       1    11068 11096
## - Job_Involvement                1    11068 11096
## + Department                     4    11060 11098
## + Job_Role                       3    11063 11099
##
## Step:  AIC=11091.84
## Performance ~ Age + Gender + Job_Level + Years_at_Company +
Years_in_Current_Role +
##     Training_Hours_Last_Year + Project_Count +
Average_Hours_Worked_Per_Week +
##     Work_Environment_Satisfaction + Relationship_with_Manager +
##     Job_Involvement + Distance_From_Home + Attrition
##
##                                 Df Deviance   AIC
## - Years_in_Current_Role          1    11064 11090
## - Average_Hours_Worked_Per_Week  1    11064 11090
## - Project_Count                  1    11064 11090
## - Years_at_Company               1    11065 11091
## - Age                            1    11065 11091
## - Job_Level                      1    11065 11091
## - Gender                         1    11065 11091
## - Distance_From_Home             1    11065 11091
## <none>                                11064 11092
## - Relationship_with_Manager      1    11067 11093
## - Attrition                      1    11067 11093
## + Monthly_Income                 1    11064 11094
## + Job_Satisfaction               1    11064 11094
## + Hourly_Rate                    1    11064 11094
## + Work_Life_Balance              1    11064 11094
## + Years_Since_Last_Promotion     1    11064 11094
## + Number_of_Companies_Worked     1    11064 11094
## + Marital_Status                 2    11062 11094
## + Overtime                       1    11064 11094
## + Absenteeism                    1    11064 11094
## - Work_Environment_Satisfaction  1    11068 11094
## - Training_Hours_Last_Year       1    11068 11094
## - Job_Involvement                1    11068 11094
## + Department                     4    11061 11097
## + Job_Role                       3    11063 11097
##
## Step:  AIC=11090.21
## Performance ~ Age + Gender + Job_Level + Years_at_Company +
Training_Hours_Last_Year +
##     Project_Count + Average_Hours_Worked_Per_Week +
Work_Environment_Satisfaction +
##     Relationship_with_Manager + Job_Involvement + Distance_From_Home +
##     Attrition
##
##                                 Df Deviance   AIC
```

```
## - Average_Hours_Worked_Per_Week  1    11065 11089
## - Project_Count                  1    11065 11089
## - Years_at_Company               1    11065 11089
## - Age                            1    11065 11089
## - Job_Level                      1    11065 11089
## - Gender                         1    11066 11090
## - Distance_From_Home             1    11066 11090
## <none>                                11064 11090
## - Relationship_with_Manager      1    11067 11091
## - Attrition                      1    11067 11091
## + Years_in_Current_Role          1    11064 11092
## + Job_Satisfaction               1    11064 11092
## + Monthly_Income                 1    11064 11092
## + Hourly_Rate                    1    11064 11092
## + Work_Life_Balance              1    11064 11092
## + Years_Since_Last_Promotion     1    11064 11092
## + Number_of_Companies_Worked     1    11064 11092
## + Marital_Status                 2    11062 11092
## + Absenteeism                    1    11064 11092
## + Overtime                       1    11064 11092
## - Work_Environment_Satisfaction  1    11068 11092
## - Training_Hours_Last_Year       1    11069 11093
## - Job_Involvement                1    11069 11093
## + Department                     4    11061 11095
## + Job_Role                       3    11063 11095
##
## Step:  AIC=11088.67
## Performance ~ Age + Gender + Job_Level + Years_at_Company +
Training_Hours_Last_Year +
##     Project_Count + Work_Environment_Satisfaction +
Relationship_with_Manager +
##     Job_Involvement + Distance_From_Home + Attrition
##
##                                 Df Deviance   AIC
## - Project_Count                  1    11065 11087
## - Years_at_Company               1    11066 11088
## - Job_Level                      1    11066 11088
## - Gender                         1    11066 11088
## - Age                            1    11066 11088
## - Distance_From_Home             1    11066 11088
## <none>                                11065 11089
## - Relationship_with_Manager      1    11067 11089
## - Attrition                      1    11068 11090
## + Average_Hours_Worked_Per_Week  1    11064 11090
## + Years_in_Current_Role          1    11064 11090
## + Monthly_Income                 1    11064 11090
## + Job_Satisfaction               1    11064 11090
## + Hourly_Rate                    1    11064 11090
## + Work_Life_Balance              1    11064 11090
## + Years_Since_Last_Promotion     1    11065 11091
```

```
## + Number_of_Companies_Worked     1    11065 11091
## + Absenteeism                    1    11065 11091
## + Overtime                       1    11065 11091
## + Marital_Status                 2    11063 11091
## - Work_Environment_Satisfaction  1    11069 11091
## - Training_Hours_Last_Year       1    11069 11091
## - Job_Involvement                1    11069 11091
## + Department                     4    11062 11094
## + Job_Role                       3    11064 11094
##
## Step:  AIC=11087.25
## Performance ~ Age + Gender + Job_Level + Years_at_Company +
Training_Hours_Last_Year +
##     Work_Environment_Satisfaction + Relationship_with_Manager +
##     Job_Involvement + Distance_From_Home + Attrition
##
##                                 Df Deviance   AIC
## - Years_at_Company               1    11066 11086
## - Job_Level                      1    11066 11086
## - Gender                         1    11066 11086
## - Age                            1    11066 11086
## - Distance_From_Home             1    11067 11087
## <none>                                11065 11087
## - Relationship_with_Manager      1    11068 11088
## - Attrition                      1    11068 11088
## + Project_Count                  1    11065 11089
## + Average_Hours_Worked_Per_Week  1    11065 11089
## + Years_in_Current_Role          1    11065 11089
## + Monthly_Income                 1    11065 11089
## + Job_Satisfaction               1    11065 11089
## + Hourly_Rate                    1    11065 11089
## + Work_Life_Balance              1    11065 11089
## + Number_of_Companies_Worked     1    11065 11089
## + Years_Since_Last_Promotion     1    11065 11089
## + Marital_Status                 2    11063 11089
## + Overtime                       1    11065 11089
## + Absenteeism                    1    11065 11089
## - Work_Environment_Satisfaction  1    11069 11089
## - Training_Hours_Last_Year       1    11070 11090
## - Job_Involvement                1    11070 11090
## + Department                     4    11062 11092
## + Job_Role                       3    11064 11092
##
## Step:  AIC=11086.32
## Performance ~ Age + Gender + Job_Level + Training_Hours_Last_Year +
##     Work_Environment_Satisfaction + Relationship_with_Manager +
##     Job_Involvement + Distance_From_Home + Attrition
##
##                                 Df Deviance   AIC
## - Job_Level                      1    11068 11086
```

```
## - Gender                            1    11068 11086
## - Age                               1    11068 11086
## - Distance_From_Home                1    11068 11086
## <none>                                   11066 11086
## - Relationship_with_Manager         1    11069 11087
## + Years_at_Company                  1    11065 11087
## - Attrition                         1    11069 11087
## + Project_Count                     1    11066 11088
## + Average_Hours_Worked_Per_Week     1    11066 11088
## + Years_in_Current_Role             1    11066 11088
## + Monthly_Income                    1    11066 11088
## + Job_Satisfaction                  1    11066 11088
## + Hourly_Rate                       1    11066 11088
## + Work_Life_Balance                 1    11066 11088
## + Number_of_Companies_Worked        1    11066 11088
## + Years_Since_Last_Promotion        1    11066 11088
## + Marital_Status                    2    11064 11088
## + Overtime                          1    11066 11088
## + Absenteeism                       1    11066 11088
## - Work_Environment_Satisfaction     1    11070 11088
## - Training_Hours_Last_Year          1    11071 11089
## - Job_Involvement                   1    11071 11089
## + Department                        4    11063 11091
## + Job_Role                          3    11065 11091
##
## Step:  AIC=11085.52
## Performance ~ Age + Gender + Training_Hours_Last_Year +
Work_Environment_Satisfaction +
##     Relationship_with_Manager + Job_Involvement + Distance_From_Home +
##     Attrition
##
##                                   Df Deviance   AIC
## - Gender                           1    11069 11085
## - Age                              1    11069 11085
## - Distance_From_Home               1    11069 11085
## <none>                                  11068 11086
## - Relationship_with_Manager        1    11070 11086
## + Job_Level                        1    11066 11086
## + Years_at_Company                 1    11066 11086
## - Attrition                        1    11071 11087
## + Project_Count                    1    11067 11087
## + Average_Hours_Worked_Per_Week    1    11067 11087
## + Years_in_Current_Role            1    11067 11087
## + Monthly_Income                   1    11067 11087
## + Job_Satisfaction                 1    11067 11087
## + Hourly_Rate                      1    11067 11087
## + Work_Life_Balance                1    11067 11087
## + Number_of_Companies_Worked       1    11067 11087
## + Years_Since_Last_Promotion       1    11067 11087
## + Overtime                         1    11068 11088
```

```
## + Absenteeism                     1    11068 11088
## + Marital_Status                  2    11066 11088
## - Work_Environment_Satisfaction   1    11072 11088
## - Training_Hours_Last_Year        1    11072 11088
## - Job_Involvement                 1    11072 11088
## + Department                      4    11064 11090
## + Job_Role                        3    11066 11090
##
## Step:  AIC=11084.72
## Performance ~ Age + Training_Hours_Last_Year +
Work_Environment_Satisfaction +
##     Relationship_with_Manager + Job_Involvement + Distance_From_Home +
##     Attrition
##
##                                  Df Deviance   AIC
## - Age                             1    11070 11084
## - Distance_From_Home              1    11070 11084
## <none>                                 11069 11085
## - Relationship_with_Manager       1    11071 11085
## + Gender                          1    11068 11086
## + Job_Level                       1    11068 11086
## + Years_at_Company                1    11068 11086
## - Attrition                       1    11072 11086
## + Project_Count                   1    11068 11086
## + Average_Hours_Worked_Per_Week   1    11068 11086
## + Years_in_Current_Role           1    11068 11086
## + Job_Satisfaction                1    11068 11086
## + Monthly_Income                  1    11068 11086
## + Hourly_Rate                     1    11068 11086
## + Work_Life_Balance               1    11069 11087
## + Number_of_Companies_Worked      1    11069 11087
## + Years_Since_Last_Promotion      1    11069 11087
## + Absenteeism                     1    11069 11087
## + Overtime                        1    11069 11087
## + Marital_Status                  2    11067 11087
## - Work_Environment_Satisfaction   1    11073 11087
## - Training_Hours_Last_Year        1    11073 11087
## - Job_Involvement                 1    11073 11087
## + Department                      4    11066 11090
## + Job_Role                        3    11068 11090
##
## Step:  AIC=11083.95
## Performance ~ Training_Hours_Last_Year + Work_Environment_Satisfaction +
##     Relationship_with_Manager + Job_Involvement + Distance_From_Home +
##     Attrition
##
##                                  Df Deviance   AIC
## - Distance_From_Home              1    11071 11083
## <none>                                 11070 11084
## - Relationship_with_Manager       1    11073 11085
```

```
## + Age                              1    11069 11085
## + Gender                           1    11069 11085
## + Job_Level                        1    11069 11085
## + Years_at_Company                 1    11069 11085
## - Attrition                        1    11073 11085
## + Project_Count                    1    11069 11085
## + Average_Hours_Worked_Per_Week    1    11069 11085
## + Years_in_Current_Role            1    11070 11086
## + Job_Satisfaction                 1    11070 11086
## + Monthly_Income                   1    11070 11086
## + Hourly_Rate                      1    11070 11086
## + Work_Life_Balance                1    11070 11086
## + Number_of_Companies_Worked       1    11070 11086
## + Years_Since_Last_Promotion       1    11070 11086
## + Absenteeism                      1    11070 11086
## + Overtime                         1    11070 11086
## + Marital_Status                   2    11068 11086
## - Work_Environment_Satisfaction    1    11074 11086
## - Training_Hours_Last_Year         1    11074 11086
## - Job_Involvement                  1    11074 11086
## + Department                       4    11067 11089
## + Job_Role                         3    11069 11089
##
## Step:  AIC=11083.24
## Performance ~ Training_Hours_Last_Year + Work_Environment_Satisfaction +
##     Relationship_with_Manager + Job_Involvement + Attrition
##
##                                  Df Deviance   AIC
## <none>                                11071 11083
## - Relationship_with_Manager       1    11074 11084
## + Distance_From_Home              1    11070 11084
## + Age                             1    11070 11084
## + Gender                          1    11070 11084
## + Job_Level                       1    11070 11084
## - Attrition                       1    11074 11084
## + Years_at_Company                1    11070 11084
## + Project_Count                   1    11071 11085
## + Average_Hours_Worked_Per_Week   1    11071 11085
## + Years_in_Current_Role           1    11071 11085
## + Job_Satisfaction                1    11071 11085
## + Monthly_Income                  1    11071 11085
## + Hourly_Rate                     1    11071 11085
## + Work_Life_Balance               1    11071 11085
## + Number_of_Companies_Worked      1    11071 11085
## + Years_Since_Last_Promotion      1    11071 11085
## + Absenteeism                     1    11071 11085
## + Overtime                        1    11071 11085
## + Marital_Status                  2    11069 11085
## - Work_Environment_Satisfaction   1    11076 11086
## - Job_Involvement                 1    11076 11086
```

```
## - Training_Hours_Last_Year       1    11076 11086
## + Department                     4    11068 11088
## + Job_Role                       3    11070 11088

cat("\nFinal model after stepwise selection:\n")

##
## Final model after stepwise selection:

summary(step_model)

##
## Call:
## glm(formula = Performance ~ Training_Hours_Last_Year +
Work_Environment_Satisfaction +
##     Relationship_with_Manager + Job_Involvement + Attrition,
##     family = binomial(link = logit), data = data)
##
## Coefficients:
##                                Estimate Std. Error z value Pr(>|z|)
## (Intercept)                   0.1815903  0.0988512   1.837   0.0662 .
## Training_Hours_Last_Year     -0.0016465  0.0007777  -2.117   0.0342 *
## Work_Environment_Satisfaction  0.0417642  0.0199487   2.094   0.0363 *
## Relationship_with_Manager    -0.0327912  0.0200212  -1.638   0.1015
## Job_Involvement              -0.0422470  0.0200911  -2.103   0.0355 *
## AttritionYes                 -0.0957194  0.0562007  -1.703   0.0885 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 11090  on 7999  degrees of freedom
## Residual deviance: 11071  on 7994  degrees of freedom
## AIC: 11083
##
## Number of Fisher Scoring iterations: 3

Significant_model <- glm(Performance ~ Training_Hours_Last_Year +
                         Work_Environment_Satisfaction +
                         Job_Involvement,
                         data = train1, family = binomial(link = "logit"))
summary(Significant_model)

##
## Call:
## glm(formula = Performance ~ Training_Hours_Last_Year +
Work_Environment_Satisfaction +
##     Job_Involvement, family = binomial(link = "logit"), data = train1)
##
## Coefficients:
##                                Estimate Std. Error z value Pr(>|z|)
```

```
## (Intercept)                    0.0788169  0.0836515   0.942   0.3461
## Training_Hours_Last_Year      -0.0016385  0.0007774  -2.108   0.0351 *
## Work_Environment_Satisfaction  0.0424220  0.0199398   2.128   0.0334 *
## Job_Involvement               -0.0423240  0.0200819  -2.108   0.0351 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 11090  on 7999  degrees of freedom
## Residual deviance: 11077  on 7996  degrees of freedom
## AIC: 11085
##
## Number of Fisher Scoring iterations: 3
```

```
model_interactions <- glm(Performance ~ Training_Hours_Last_Year +
                          Work_Environment_Satisfaction * Job_Involvement,
                          data = train1, family = binomial)

summary(model_interactions)
```

```
##
## Call:
## glm(formula = Performance ~ Training_Hours_Last_Year +
Work_Environment_Satisfaction *
##     Job_Involvement, family = binomial, data = train1)
##
## Coefficients:
##                                              Estimate Std. Error z
value
## (Intercept)                                 0.0534053  0.1406421
0.380
## Training_Hours_Last_Year                   -0.0016372  0.0007774  -
2.106
## Work_Environment_Satisfaction               0.0525211  0.0491603
1.068
## Job_Involvement                            -0.0322270  0.0492064  -
0.655
## Work_Environment_Satisfaction:Job_Involvement -0.0040326  0.0179419  -
0.225
##                                             Pr(>|z|)
## (Intercept)                                   0.7041
## Training_Hours_Last_Year                      0.0352 *
## Work_Environment_Satisfaction                 0.2854
## Job_Involvement                               0.5125
## Work_Environment_Satisfaction:Job_Involvement   0.8222
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
```

```
##
##     Null deviance: 11090  on 7999  degrees of freedom
## Residual deviance: 11077  on 7995  degrees of freedom
## AIC: 11087
##
## Number of Fisher Scoring iterations: 3
```

```
library(pROC)
```

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

```
##
## Attaching package: 'pROC'
```

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

```
# Predict on test set
prob_step_model_test <- predict(Significant_model, newdata = test1, type =
"response")
prob_interaction_test <- predict(model_interactions, newdata = test1, type =
"response")

# Generate ROC curves
roc_step_model_test <- roc(test1$Performance, prob_step_model_test)
```

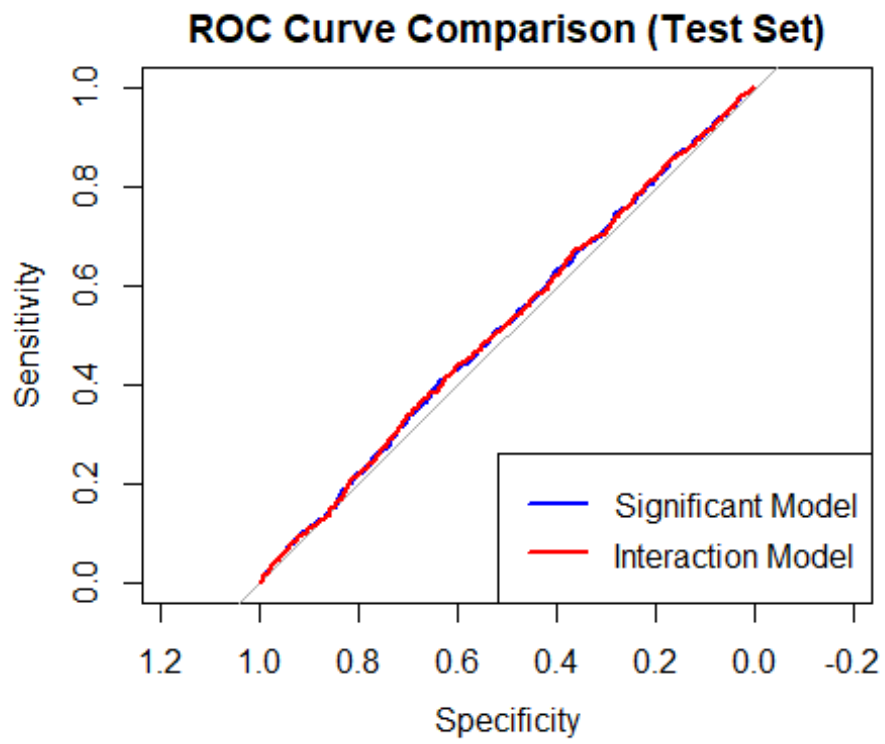
```
## Setting levels: control = High, case = Low
```

```
## Setting direction: controls < cases
```

```
roc_interaction_test <- roc(test1$Performance, prob_interaction_test)
```

```
## Setting levels: control = High, case = Low
## Setting direction: controls < cases
```

```
# Plot
plot(roc_step_model_test, col = "blue", main = "ROC Curve Comparison (Test
Set)")
lines(roc_interaction_test, col = "red")
legend("bottomright", legend = c("Significant Model", "Interaction Model"),
       col = c("blue", "red"), lwd = 2)
```




```
# Print AUCs
auc(roc_step_model_test)

## Area under the curve: 0.5177

auc(roc_interaction_test)

## Area under the curve: 0.518

library(car)
cat("\nVariance Inflation Factors (VIF):\n")

##
## Variance Inflation Factors (VIF):

##
## Variance Inflation Factors (VIF):
#Check the multicollinearity
print(vif(Significant_model))

##      Training_Hours_Last_Year Work_Environment_Satisfaction
##                      1.000231                      1.000312
##                Job_Involvement
##                      1.000220

exp(coef(Significant_model))

##                   (Intercept)      Training_Hours_Last_Year
##                     1.0820062                     0.9983629
```

```
## Work_Environment_Satisfaction                Job_Involvement
##                     1.0433347                     0.9585591

#fit <- model2$fitted

#Attrion_num<-as.numeric(as.character(Employee_Data$Attrition))

#r <- (Employee_Data$Attrion_num - fit)/(sqrt(fit*(1-fit))) # Pearson
residuals
#sum(r^2) # Pearson Chi-Square statistic

library(ResourceSelection)

## ResourceSelection 0.3-6   2023-06-27

#Goodness of fit

#Null hypothesis (H0): The model fits the data well.
#Alternative hypothesis (Ha): The model does not fit the data well.
hoslem <- hoslem.test(as.numeric(train1$Performance)-1,
fitted(Significant_model))
print(hoslem)

##
##  Hosmer and Lemeshow goodness of fit (GOF) test
##
## data:  as.numeric(train1$Performance) - 1, fitted(Significant_model)
## X-squared = 3.9359, df = 8, p-value = 0.8629

#Model Evaluation
predictions <- predict(Significant_model, newdata = test1, type = "response")
print(predictions)

##         1         2         3         4         5         6         7
8
## 0.5053961 0.4899660 0.4968591 0.4861433 0.5042322 0.4695014 0.4712231
0.4956548
##         9        10        11        12        13        14        15
16
## 0.4829429 0.4850537 0.4985466 0.4698851 0.5240820 0.5036641 0.5122638
0.4727674
##        17        18        19        20        21        22        23
24
## 0.5201073 0.4997063 0.5116077 0.5343317 0.5070545 0.4879434 0.4809867
0.5143105
##        25        26        27        28        29        30        31
32
## 0.4727186 0.4613927 0.5065557 0.4825985 0.5164502 0.4832787 0.5327006
0.5177222
##        33        34        35        36        37        38        39
40
```

```
## 0.5176287 0.5143349 0.4940856 0.4866261 0.5250372 0.4703621 0.5087617
0.5213585
##        41        42        43        44        45        46        47
48
## 0.5196293 0.5030523 0.5444639 0.4875786 0.4719707 0.5334718 0.4883082
0.4951560
##        49        50        51        52        53        54        55
56
## 0.4866462 0.4899459 0.5037333 0.5200628 0.5160611 0.5136300 0.5094669
0.4793953
##        57        58        59        60        61        62        63
64
## 0.4943325 0.4818494 0.4748300 0.4960644 0.5038024 0.4841460 0.4993168
0.5139702
##        65        66        67        68        69        70        71
72
## 0.5156764 0.4830076 0.5046662 0.5177222 0.4973624 0.4874894 0.4780796
0.4687742
##        73        74        75        76        77        78        79
80
## 0.4931528 0.4788484 0.4617755 0.5172195 0.5078534 0.5115386 0.5033683
0.5159028
##        81        82        83        84        85        86        87
88
## 0.4533044 0.5001850 0.5160165 0.5147197 0.4840971 0.4992520 0.5233781
0.5278721
##        89        90        91        92        93        94        95
96
## 0.5038024 0.4923092 0.4752185 0.4792817 0.4699540 0.4830076 0.5237178
0.4993658
##        97        98        99       100       101       102       103
104
## 0.5073503 0.5021640 0.5069407 0.4821002 0.5025045 0.5028449 0.5298444
0.5042120
##       105       106       107       108       109       110       111
112
## 0.4988625 0.4613927 0.5061663 0.5412110 0.4985912 0.4944707 0.5197919
0.4911253
##       113       114       115       116       117       118       119
120
## 0.5144486 0.5065312 0.5041429 0.5144486 0.5054609 0.4760559 0.5044833
0.4480312
##       121       122       123       124       125       126       127
128
## 0.4752185 0.5295296 0.4942878 0.4997308 0.5103060 0.4886931 0.5020949
0.4955612
##       129       130       131       132       133       134       135
136
## 0.5037578 0.5028694 0.5185159 0.5012310 0.4751940 0.4585194 0.5022331
0.4602157
```

```
##       137       138       139       140       141       142       143
144
## 0.4822584 0.4956303 0.4825985 0.5045971 0.5229694 0.5045525 0.5171304
0.4923092
##       145       146       147       148       149       150       151
152
## 0.5327250 0.5074395 0.4768733 0.5045078 0.4899012 0.5063045 0.4866016
0.5127869
##       153       154       155       156       157       158       159
160
## 0.5069854 0.4780551 0.4825295 0.5266713 0.5318403 0.5123574 0.4939229
0.4826676
##       161       162       163       164       165       166       167
168
## 0.5033237 0.5127667 0.5253078 0.4984328 0.4699984 0.4906511 0.5160410
0.4830076
##       169       170       171       172       173       174       175
176
## 0.4898278 0.4968390 0.4780307 0.4968836 0.5099210 0.4904000 0.5274881
0.5062800
##       177       178       179       180       181       182       183
184
## 0.5128358 0.4814403 0.4830076 0.5004809 0.5152671 0.4980188 0.4918997
0.5119681
##       185       186       187       188       189       190       191
192
## 0.4712231 0.4808486 0.4944016 0.4906021 0.5302526 0.5016607 0.5030034
0.5351714
##       193       194       195       196       197       198       199
200
## 0.4952251 0.4744458 0.5091957 0.5127869 0.4967943 0.5154936 0.5289836
0.4723791
##       201       202       203       204       205       206       207
208
## 0.5126285 0.4703176 0.5351026 0.5372087 0.5074439 0.5391761 0.4904000
0.5197429
##       209       210       211       212       213       214       215
216
## 0.4629974 0.4960644 0.4938783 0.4739439 0.5229449 0.5128113 0.4695903
0.4804640
##       217       218       219       220       221       222       223
224
## 0.5156764 0.5000468 0.4702688 0.4796216 0.4760803 0.4976783 0.5083277
0.5229694
##       225       226       227       228       229       230       231
232
## 0.5028896 0.4585437 0.5164257 0.5229248 0.5473071 0.4967943 0.4891025
0.5094914
##       233       234       235       236       237       238       239
240
```

```
## 0.4887377 0.4752185 0.4959506 0.5106507 0.5135811 0.4883283 0.5110601
0.4911297
##       241       242       243       244       245       246       247
248
## 0.5497417 0.4879880 0.4972687 0.5209252 0.4802132 0.4723346 0.4683662
0.4822584
##       249       250       251       252       253       254       255
256
## 0.5049174 0.4903064 0.5046216 0.4805331 0.4910605 0.5368013 0.5017789
0.4936516
##       257       258       259       260       261       262       263
264
## 0.4899459 0.4976337 0.4973624 0.4972932 0.5005010 0.4690933 0.4959261
0.4927432
##       265       266       267       268       269       270       271
272
## 0.5232646 0.5078289 0.5229248 0.4977475 0.4924230 0.4944952 0.4988380
0.4695458
##       273       274       275       276       277       278       279
280
## 0.4938783 0.4780997 0.5266713 0.4593331 0.5062354 0.5032545 0.4755782
0.5099455
##       281       282       283       284       285       286       287
288
## 0.5323171 0.4723590 0.4822584 0.5090329 0.4829185 0.4920379 0.4985667
0.5489304
##       289       290       291       292       293       294       295
296
## 0.5033438 0.5073748 0.4740129 0.4878988 0.5081693 0.5067141 0.5071035
0.4935825
##       297       298       299       300       301       302       303
304
## 0.4836879 0.5098965 0.4764200 0.5050758 0.5119436 0.5054653 0.5163566
0.5046216
##       305       306       307       308       309       310       311
312
## 0.5070991 0.5033482 0.5017544 0.4984976 0.4610299 0.5054609 0.4948803
0.5293918
##       313       314       315       316       317       318       319
320
## 0.5074395 0.5176977 0.4997509 0.4984328 0.4878297 0.5083277 0.4956303
0.4903553
##       321       322       323       324       325       326       327
328
## 0.5124020 0.5184713 0.4956548 0.5094669 0.5053471 0.4959261 0.4715868
0.4593574
##       329       330       331       332       333       334       335
336
## 0.4975646 0.4850781 0.4659191 0.5012310 0.4650593 0.5197919 0.4805331
0.5065758
```

```
##       337       338       339       340       341       342       343
344
## 0.5061216 0.5066205 0.5156318 0.5102858 0.4914657 0.4977720 0.4952452
0.4924230
##       345       346       347       348       349       350       351
352
## 0.5009596 0.5044833 0.4956793 0.5164502 0.4939229 0.5245596 0.5330640
0.5287131
##       353       354       355       356       357       358       359
360
## 0.4955612 0.4980433 0.5103103 0.4916039 0.5106708 0.5034173 0.5314768
0.5184958
##       361       362       363       364       365       366       367
368
## 0.5140393 0.4654670 0.5241955 0.5444639 0.4828940 0.5303459 0.5262140
0.4830076
##       369       370       371       372       373       374       375
376
## 0.4899012 0.4952899 0.4830076 0.5131962 0.4796706 0.5058748 0.4898523
0.4854629
##       377       378       379       380       381       382       383
384
## 0.4561482 0.5090329 0.4622515 0.4902617 0.5008905 0.5091266 0.5005702
0.4924028
##       385       386       387       388       389       390       391
392
## 0.4984774 0.4808486 0.4975891 0.4723791 0.4907158 0.4826676 0.5180622
0.5012511
##       393       394       395       396       397       398       399
400
## 0.5042567 0.5286643 0.4769423 0.5185159 0.4976783 0.4577745 0.5071035
0.5131761
##       401       402       403       404       405       406       407
408
## 0.5038226 0.4837569 0.5189249 0.4699296 0.4613683 0.5119235 0.5016406
0.4865771
##       409       410       411       412       413       414       415
416
## 0.4609855 0.5171304 0.4956303 0.4601470 0.5127423 0.5355789 0.5234025
0.5017054
##       417       418       419       420       421       422       423
424
## 0.4911253 0.4727674 0.4993413 0.4980433 0.5087372 0.5278276 0.4915838
0.4638123
##       425       426       427       428       429       430       431
432
## 0.5025491 0.4854183 0.4932219 0.4748099 0.4866217 0.5193584 0.4918306
0.5388377
##       433       434       435       436       437       438       439
440
```

```
## 0.4980923 0.4809176 0.4609855 0.4895810 0.5070099 0.4800551 0.4961335
0.4969283
##       441       442       443       444       445       446       447
448
## 0.4903308 0.5322482 0.4816422 0.5189249 0.4666658 0.4906712 0.5286198
0.5213341
##       449       450       451       452       453       454       455
456
## 0.5191758 0.4983838 0.4622071 0.4789418 0.5261939 0.4609855 0.5017990
0.4903107
##       457       458       459       460       461       462       463
464
## 0.4753075 0.4947910 0.4908094 0.4956102 0.5262140 0.5274192 0.4808730
0.5196293
##       465       466       467       468       469       470       471
472
## 0.4789418 0.5041674 0.5253524 0.5020502 0.4922847 0.5086235 0.5135163
0.4895810
##       473       474       475       476       477       478       479
480
## 0.5155627 0.5180176 0.5154936 0.5054163 0.5200383 0.4690689 0.5017990
0.5327250
##       481       482       483       484       485       486       487
488
## 0.5175395 0.4561482 0.5021395 0.4753075 0.5383618 0.5062153 0.5025290
0.5388377
##       489       490       491       492       493       494       495
496
## 0.4906511 0.4985667 0.4928570 0.4862124 0.5408728 0.4911944 0.4899660
0.5201073
##       497       498       499       500       501       502       503
504
## 0.5282560 0.4638811 0.4976337 0.5143349 0.4691822 0.5119235 0.4902171
0.5102614
##       505       506       507       508       509       510       511
512
## 0.4886485 0.5010043 0.5200829 0.5185159 0.4690445 0.5028896 0.5302081
0.4871002
##       513       514       515       516       517       518       519
520
## 0.5209008 0.4951516 0.5057121 0.5037333 0.4866217 0.4843043 0.4918997
0.4874894
##       521       522       523       524       525       526       527
528
## 0.5225850 0.5033482 0.5152225 0.4792127 0.4791883 0.4924230 0.4768733
0.5505527
##       529       530       531       532       533       534       535
536
## 0.5151290 0.4820758 0.5298444 0.4858276 0.4866908 0.5241510 0.4829386
0.5000223
```

```
##       537       538       539       540       541       542       543
544
## 0.5012756 0.4883283 0.4976827 0.5074194 0.5086033 0.5040982 0.4930836
0.5253969
##       545       546       547       548       549       550       551
552
## 0.5034173 0.5122192 0.5187667 0.4698851 0.4793508 0.4853737 0.5229248
0.4980232
##       553       554       555       556       557       558       559
560
## 0.5066896 0.4863060 0.4727674 0.4873958 0.4874448 0.4638367 0.5115141
0.5026427
##       561       562       563       564       565       566       567
568
## 0.4964740 0.4887622 0.4735599 0.5045971 0.4756716 0.5481189 0.4922847
0.4601714
##       569       570       571       572       573       574       575
576
## 0.4598087 0.4714935 0.4911253 0.4935133 0.5481189 0.4935868 0.4719952
0.4919242
##       577       578       579       580       581       582       583
584
## 0.5395832 0.4792127 0.4944952 0.5127624 0.5062109 0.5005255 0.4859413
0.4993413
##       585       586       587       588       589       590       591
592
## 0.5204918 0.4800996 0.5154936 0.5124265 0.4736044 0.5172440 0.5045971
0.5086479
##       593       594       595       596       597       598       599
600
## 0.5302526 0.4816667 0.4707014 0.5278031 0.4938783 0.4891270 0.5241955
0.4675503
##       601       602       603       604       605       606       607
608
## 0.5095360 0.5208806 0.5180378 0.4740373 0.4918306 0.5269864 0.4711786
0.5062800
##       609       610       611       612       613       614       615
616
## 0.4914902 0.4662824 0.5347394 0.4789418 0.4565547 0.5177222 0.5057812
0.4866261
##       617       618       619       620       621       622       623
624
## 0.4874894 0.5086724 0.4597644 0.4915593 0.5278276 0.5070790 0.4877807
0.4476260
##       625       626       627       628       629       630       631
632
## 0.4883283 0.4812576 0.5189739 0.4686853 0.4931081 0.5028449 0.4952452
0.5095115
##       633       634       635       636       637       638       639
640
```

```
## 0.4699296 0.4825539 0.4871247 0.5229004 0.5432445 0.4922847 0.4792616
0.5250128
##       641       642       643       644       645       646       647
648
## 0.5232646 0.5073503 0.5057812 0.5477130 0.5278721 0.4842151 0.5150844
0.4699984
##       649       650       651       652       653       654       655
656
## 0.5070790 0.4988625 0.4873713 0.5310687 0.5159028 0.5245596 0.4947464
0.5334718
##       657       658       659       660       661       662       663
664
## 0.5298889 0.5396276 0.4833521 0.5160611 0.5016161 0.4898321 0.4557418
0.5327250
##       665       666       667       668       669       670       671
672
## 0.5286643 0.4805532 0.5005500 0.5283048 0.5095605 0.4911944 0.5208562
0.5237178
##       673       674       675       676       677       678       679
680
## 0.5195848 0.4895566 0.5033928 0.4650349 0.5355789 0.5128113 0.5327006
0.5049174
##       681       682       683       684       685       686       687
688
## 0.5033237 0.4870109 0.5351714 0.5144486 0.4796461 0.4842597 0.5351470
0.4744013
##       689       690       691       692       693       694       695
696
## 0.4569613 0.5136300 0.5026182 0.4764200 0.5071481 0.5049822 0.5192649
0.4946974
##       697       698       699       700       701       702       703
704
## 0.4907202 0.5103305 0.5029386 0.4808730 0.5032992 0.5257854 0.4752630
0.4946974
##       705       706       707       708       709       710       711
712
## 0.4723346 0.5001605 0.4853248 0.5225850 0.5033237 0.4862168 0.4825985
0.4792372
##       713       714       715       716       717       718       719
720
## 0.5303215 0.5221273 0.5314323 0.5160856 0.4761248 0.5082586 0.5083277
0.5152916
##       721       722       723       724       725       726       727
728
## 0.4609855 0.4918752 0.4751940 0.5021150 0.4992275 0.5295052 0.5022086
0.5070099
##       729       730       731       732       733       734       735
736
## 0.4695214 0.5147643 0.5073949 0.5034130 0.5131962 0.4488417 0.5347394
0.5241265
```

```
##       737       738       739       740       741       742       743
744
## 0.4476260 0.5257164 0.5079182 0.5217674 0.4914902 0.4561482 0.5024800
0.5034620
##       745       746       747       748       749       750       751
752
## 0.4765336 0.5069407 0.4967453 0.4926942 0.5118098 0.5062153 0.4858722
0.4922646
##       753       754       755       756       757       758       759
760
## 0.5172685 0.4480312 0.5179486 0.5197919 0.4874448 0.5041184 0.5095360
0.4919443
##       761       762       763       764       765       766       767
768
## 0.4773511 0.4858276 0.5298000 0.5013448 0.4993413 0.5229449 0.5164948
0.5184713
##       769       770       771       772       773       774       775
776
## 0.4911498 0.5082384 0.4838951 0.4820513 0.5058503 0.5132207 0.4858276
0.4769423
##       777       778       779       780       781       782       783
784
## 0.5012310 0.5193340 0.4674815 0.4798043 0.4924028 0.4951070 0.4610299
0.5102167
##       785       786       787       788       789       790       791
792
## 0.5229938 0.5075576 0.5168593 0.4992722 0.5029832 0.5237178 0.5066939
0.4804396
##       793       794       795       796       797       798       799
800
## 0.5008660 0.4719507 0.4927677 0.4922891 0.5115587 0.4806222 0.4492471
0.4727430
##       801       802       803       804       805       806       807
808
## 0.4732203 0.4715624 0.5367770 0.4887622 0.4943569 0.5147888 0.5004564
0.4955857
##       809       810       811       812       813       814       815
816
## 0.5017054 0.5091957 0.5114896 0.4997308 0.5016852 0.4814403 0.5016406
0.4816422
##       817       818       819       820       821       822       823
824
## 0.5075130 0.4984976 0.5074640 0.4939027 0.5128358 0.4797151 0.5036886
0.4739683
##       825       826       827       828       829       830       831
832
## 0.5122638 0.5216740 0.5094871 0.4642198 0.4597644 0.5189048 0.4690689
0.4760803
##       833       834       835       836       837       838       839
840
```

```
## 0.4934687 0.5176085 0.4817113 0.5180867 0.4894183 0.4800795 0.5224916
0.5464951
##       841       842       843       844       845       846       847
848
## 0.4723791 0.4751940 0.5274192 0.5180867 0.5346949 0.5269419 0.4617755
0.4617999
##       849       850       851       852       853       854       855
856
## 0.4833276 0.5053716 0.5140393 0.5196739 0.5241510 0.4833477 0.5147643
0.5197185
##       857       858       859       860       861       862       863
864
## 0.4828695 0.5114695 0.4922891 0.4784395 0.5270553 0.4923092 0.5180867
0.5000914
##       865       866       867       868       869       870       871
872
## 0.4931974 0.5189739 0.5026182 0.4956548 0.4818048 0.4753075 0.5359177
0.4980188
##       873       874       875       876       877       878       879
880
## 0.4919933 0.4931773 0.5051003 0.4851227 0.5375473 0.5091021 0.4926741
0.4903107
##       881       882       883       884       885       886       887
888
## 0.5008415 0.5025938 0.5299377 0.4793953 0.4740373 0.4975891 0.5299133
0.4841705
##       889       890       891       892       893       894       895
896
## 0.4833521 0.5448703 0.4821693 0.5323171 0.5278276 0.4870556 0.4914902
0.5192448
##       897       898       899       900       901       902       903
904
## 0.4923538 0.5144040 0.4996371 0.5343317 0.5278276 0.4830321 0.5099700
0.4752630
##       905       906       907       908       909       910       911
912
## 0.4597400 0.5199937 0.4702932 0.5119480 0.5020257 0.5177222 0.4816422
0.4744904
##       913       914       915       916       917       918       919
920
## 0.4940611 0.4687742 0.5208562 0.5327006 0.4801442 0.4935825 0.5171750
0.5059195
##       921       922       923       924       925       926       927
928
## 0.4992275 0.4885995 0.5440575 0.4961091 0.4910116 0.4682973 0.5004564
0.4776707
##       929       930       931       932       933       934       935
936
## 0.4894918 0.4984284 0.5115587 0.4870800 0.5139458 0.5042365 0.4894428
0.5302770
```

```
##       937       938       939       940       941       942       943
944
## 0.4927879 0.4845998 0.4891471 0.4829631 0.4956347 0.5093978 0.4829185
0.5103103
##       945       946       947       948       949       950       951
952
## 0.5069854 0.5266469 0.4808241 0.5368013 0.4922891 0.5069854 0.4984328
0.5265779
##       953       954       955       956       957       958       959
960
## 0.4724035 0.5061461 0.5216294 0.4866908 0.4735354 0.5173375 0.4699095
0.5152427
##       961       962       963       964       965       966       967
968
## 0.5367326 0.4670736 0.4870354 0.5058950 0.5009351 0.4841215 0.4898523
0.4727186
##       969       970       971       972       973       974       975
976
## 0.5185159 0.5029386 0.4512749 0.4984083 0.4878542 0.5179932 0.5208116
0.4968836
##       977       978       979       980       981       982       983
984
## 0.5029832 0.5053716 0.5046907 0.4480312 0.5372087 0.5302081 0.5225606
0.4959708
##       985       986       987       988       989       990       991
992
## 0.5001360 0.4841705 0.5085788 0.4927677 0.5278477 0.4899214 0.5244906
0.4989317
##       993       994       995       996       997       998       999
1000
## 0.5034620 0.5248993 0.4764890 0.5046662 0.4874649 0.4706770 0.5071236
0.4808975
##      1001      1002      1003      1004      1005      1006      1007
1008
## 0.5017097 0.5220828 0.4753075 0.5099210 0.5066248 0.4878297 0.5155627
0.5440575
##      1009      1010      1011      1012      1013      1014      1015
1016
## 0.4944016 0.4858075 0.4646273 0.4793263 0.5144731 0.5306851 0.5302081
0.4809421
##      1017      1018      1019      1020      1021      1022      1023
1024
## 0.5278477 0.5160856 0.4622071 0.4902617 0.5184914 0.5001850 0.5106262
0.4837368
##      1025      1026      1027      1028      1029      1030      1031
1032
## 0.4699095 0.5274881 0.4894183 0.4922401 0.4638123 0.4821693 0.4902416
0.4886931
##      1033      1034      1035      1036      1037      1038      1039
1040
```

```
## 0.5176977 0.4940410 0.5436510 0.5042322 0.4715423 0.5078736 0.5147643
0.5009553
##      1041      1042      1043      1044      1045      1046      1047
1048
## 0.4952006 0.4857830 0.4912189 0.5049174 0.5062354 0.4826230 0.4973379
0.5042322
##      1049      1050      1051      1052      1053      1054      1055
1056
## 0.5053716 0.4655114 0.5033482 0.5156519 0.4732649 0.4732203 0.5013894
0.4484364
##      1057      1058      1059      1060      1061      1062      1063
1064
## 0.5163811 0.5062800 0.4972486 0.4881901 0.5135365 0.5213096 0.5273503
0.5159474
##      1065      1066      1067      1068      1069      1070      1071
1072
## 0.5176977 0.5380233 0.4764890 0.4565547 0.5111983 0.5428379 0.5306851
0.5050513
##      1073      1074      1075      1076      1077      1078      1079
1080
## 0.5045280 0.5144486 0.5233537 0.5063290 0.4874649 0.5050758 0.4850781
0.4719952
##      1081      1082      1083      1084      1085      1086      1087
1088
## 0.4760113 0.4940611 0.4821693 0.4980923 0.4904000 0.4967943 0.4976092
0.5029141
##      1089      1090      1091      1092      1093      1094      1095
1096
## 0.5168349 0.4776707 0.5111047 0.4833276 0.4930592 0.4658503 0.5014139
0.4874203
##      1097      1098      1099      1100      1101      1102      1103
1104
## 0.4655114 0.4829185 0.4911944 0.4899660 0.4977720 0.5070790 0.5464951
0.5204027
##      1105      1106      1107      1108      1109      1110      1111
1112
## 0.5306851 0.5058258 0.4780997 0.4813957 0.4987934 0.5164012 0.4752185
0.5266224
##      1113      1114      1115      1116      1117      1118      1119
1120
## 0.4857585 0.4951070 0.5376161 0.4944952 0.4655114 0.4557418 0.4959751
0.4784884
##      1121      1122      1123      1124      1125      1126      1127
1128
## 0.5130825 0.4858031 0.4712231 0.5404416 0.5347394 0.5169284 0.4866261
0.5020704
##      1129      1130      1131      1132      1133      1134      1135
1136
## 0.5024353 0.5061663 0.5290725 0.4674815 0.4891716 0.5266713 0.4728564
0.5017789
```

```
##      1137      1138      1139      1140      1141      1142      1143
1144
## 0.5363939 0.5400589 0.5183577 0.4663268 0.5216740 0.4948155 0.4816667
0.4691822
##      1145      1146      1147      1148      1149      1150      1151
1152
## 0.4943123 0.5302971 0.4914657 0.5221072 0.4952251 0.5017054 0.5168593
0.4878743
##      1153      1154      1155      1156      1157      1158      1159
1160
## 0.5184023 0.5089883 0.5038471 0.5139947 0.5139458 0.5283048 0.5119480
0.4944261
##      1161      1162      1163      1164      1165      1166      1167
1168
## 0.4825539 0.5493361 0.4601714 0.4573679 0.5069854 0.5197185 0.4846444
0.4845552
##      1169      1170      1171      1172      1173      1174      1175
1176
## 0.4960198 0.4861678 0.5176977 0.5509581 0.4789864 0.4764646 0.5123329
0.4508692
##      1177      1178      1179      1180      1181      1182      1183
1184
## 0.5111493 0.5371400 0.5193584 0.5025938 0.5114004 0.4903553 0.4838951
0.5005702
##      1185      1186      1187      1188      1189      1190      1191
1192
## 0.4847135 0.5509581 0.5126976 0.4805532 0.4788484 0.4955612 0.5157008
0.4923538
##      1193      1194      1195      1196      1197      1198      1199
1200
## 0.4985019 0.4955410 0.4732649 0.4969283 0.5205163 0.4809176 0.5220382
0.4915838
##      1201      1202      1203      1204      1205      1206      1207
1208
## 0.5139012 0.4655114 0.4883283 0.5026427 0.5246286 0.4926942 0.5294363
0.4727875
##      1209      1210      1211      1212      1213      1214      1215
1216
## 0.4977273 0.4976582 0.4969081 0.4545228 0.4932219 0.4837569 0.5367326
0.5021193
##      1217      1218      1219      1220      1221      1222      1223
1224
## 0.5091467 0.5004809 0.5008415 0.4936314 0.4877807 0.5221518 0.5087171
0.5049376
##      1225      1226      1227      1228      1229      1230      1231
1232
## 0.5090574 0.5436510 0.5000914 0.4698607 0.4943325 0.5111292 0.5016161
0.4699984
##      1233      1234      1235      1236      1237      1238      1239
1240
```

```
## 0.5164012 0.5185403 0.5094669 0.5036886 0.4809867 0.5266023 0.5115832
0.4707703
##      1241      1242      1243      1244      1245      1246      1247
1248
## 0.4932420 0.5469011 0.5126732 0.4829429 0.5053918 0.5363939 0.4618443
0.4808932
##      1249      1250      1251      1252      1253      1254      1255
1256
## 0.4946974 0.4870354 0.5270108 0.4813267 0.5008415 0.4924028 0.5030034
0.5163811
##      1257      1258      1259      1260      1261      1262      1263
1264
## 0.5168795 0.4866261 0.5074640 0.5057567 0.4756472 0.4759869 0.5118990
0.5135854
##      1265      1266      1267      1268      1269      1270      1271
1272
## 0.5323171 0.4858276 0.4524924 0.4963847 0.4646517 0.5293918 0.5131717
0.4825295
##      1273      1274      1275      1276      1277      1278      1279
1280
## 0.4907158 0.5168349 0.4940410 0.5030279 0.5146751 0.4841661 0.5290969
0.4858031
##      1281      1282      1283      1284      1285      1286      1287
1288
## 0.4866016 0.5160611 0.4719707 0.5066003 0.4654670 0.5024353 0.5160165
0.4622071
##      1289      1290      1291      1292      1293      1294      1295
1296
## 0.4678894 0.4871693 0.4834413 0.4605784 0.5054163 0.5062153 0.4760113
0.4886240
##      1297      1298      1299      1300      1301      1302      1303
1304
## 0.5033482 0.5185403 0.4940611 0.5368013 0.5368013 0.4968635 0.5025981
0.4797597
##      1305      1306      1307      1308      1309      1310      1311
1312
## 0.4798043 0.5107154 0.5163811 0.4691822 0.4763956 0.5041429 0.5152225
0.5126285
##      1313      1314      1315      1316      1317      1318      1319
1320
## 0.5173375 0.5144731 0.4935868 0.4939920 0.4679582 0.4691378 0.5395832
0.5273948
##      1321      1322      1323      1324      1325      1326      1327
1328
## 0.5201318 0.5090574 0.5132452 0.4849155 0.5229694 0.4842151 0.5359864
0.4768043
##      1329      1330      1331      1332      1333      1334      1335
1336
## 0.4915838 0.4769423 0.5013448 0.5183577 0.4890334 0.4869620 0.4967453
0.4964294
```

```
##      1337      1338      1339      1340      1341      1342      1343
1344
## 0.4842597 0.5148133 0.5017990 0.4947219 0.4829429 0.5156318 0.5041429
0.4992477
##      1345      1346      1347      1348      1349      1350      1351
1352
## 0.4793508 0.5225606 0.5123574 0.4989072 0.5041630 0.5083522 0.4784884
0.5066939
##      1353      1354      1355      1356      1357      1358      1359
1360
## 0.5209252 0.4752185 0.5098764 0.5005702 0.4964049 0.5090128 0.4802132
0.5107154
##      1361      1362      1363      1364      1365      1366      1367
1368
## 0.5065758 0.4634048 0.4891025 0.5071035 0.4883082 0.4793062 0.5066003
0.4922401
##      1369      1370      1371      1372      1373      1374      1375
1376
## 0.4545228 0.5179932 0.4863060 0.5086235 0.4646517 0.5290725 0.5331328
0.5008905
##      1377      1378      1379      1380      1381      1382      1383
1384
## 0.4915593 0.4989562 0.4912189 0.5040982 0.5359177 0.5124020 0.4492471
0.4797597
##      1385      1386      1387      1388      1389      1390      1391
1392
## 0.5004319 0.5054653 0.4524924 0.4944016 0.5371400 0.5073748 0.5204717
0.4735354
##      1393      1394      1395      1396      1397      1398      1399
1400
## 0.5144241 0.5151981 0.4878542 0.4667346 0.4642886 0.5050758 0.4772131
0.5322927
##      1401      1402      1403      1404      1405      1406      1407
1408
## 0.5079182 0.4968390 0.5159028 0.4883283 0.5497417 0.4731959 0.4756472
0.5046662
##      1409      1410      1411      1412      1413      1414      1415
1416
## 0.5200628 0.5193584 0.5045726 0.5179932 0.4936314 0.5079225 0.5192649
0.4708148
##      1417      1418      1419      1420      1421      1422      1423
1424
## 0.4918997 0.4927634 0.4879434 0.4589949 0.5033683 0.5383618 0.5460890
0.4915348
##      1425      1426      1427      1428      1429      1430      1431
1432
## 0.5335162 0.4824604 0.4476260 0.5132452 0.5028449 0.4679138 0.4804842
0.4910605
##      1433      1434      1435      1436      1437      1438      1439
1440
```

```
## 0.4837814 0.4849645 0.4812576 0.5205407 0.5053025 0.5062153 0.4964985
0.4789864
##      1441      1442      1443      1444      1445      1446      1447
1448
## 0.4816667 0.5371400 0.5139947 0.5351470 0.5310243 0.5201318 0.4837569
0.5384306
##      1449      1450      1451      1452      1453      1454      1455
1456
## 0.4711341 0.4993168 0.5213096 0.5090776 0.5050067 0.4707258 0.5082831
0.5187667
##      1457      1458      1459      1460      1461      1462      1463
1464
## 0.4804842 0.5106708 0.4923092 0.4901926 0.5339240 0.4931729 0.5318403
0.4813511
##      1465      1466      1467      1468      1469      1470      1471
1472
## 0.5066450 0.5384062 0.5025736 0.4992967 0.4951516 0.5061216 0.5021395
0.4727186
##      1473      1474      1475      1476      1477      1478      1479
1480
## 0.4723590 0.5302971 0.4830767 0.5372087 0.5319091 0.4890579 0.4691822
0.5245797
##      1481      1482      1483      1484      1485      1486      1487
1488
## 0.5363696 0.4891716 0.4858967 0.4727430 0.4818494 0.5008214 0.4662580
0.5233537
##      1489      1490      1491      1492      1493      1494      1495
1496
## 0.5444639 0.5086235 0.4979742 0.4928570 0.4634048 0.4796461 0.5067386
0.5379990
##      1497      1498      1499      1500      1501      1502      1503
1504
## 0.4813022 0.5032545 0.5403972 0.4972932 0.5306607 0.4936516 0.4927634
0.5343317
##      1505      1506      1507      1508      1509      1510      1511
1512
## 0.4801442 0.5123329 0.4906266 0.4820513 0.4846243 0.5172886 0.5199937
0.5160165
##      1513      1514      1515      1516      1517      1518      1519
1520
## 0.5030034 0.5351470 0.4825985 0.4911052 0.5160165 0.4698851 0.5017544
0.4858276
##      1521      1522      1523      1524      1525      1526      1527
1528
## 0.5025491 0.5126732 0.5197429 0.4634048 0.4939719 0.5164257 0.5148133
0.4859413
##      1529      1530      1531      1532      1533      1534      1535
1536
## 0.5054609 0.4928325 0.5236733 0.5152671 0.4964495 0.4870311 0.4919242
0.4924028
```

```
##      1537      1538      1539      1540      1541      1542      1543
1544
## 0.5087862 0.5033683 0.4910605 0.5029342 0.5071236 0.4989317 0.5150844
0.5224470
##      1545      1546      1547      1548      1549      1550      1551
1552
## 0.5048929 0.4789864 0.4940165 0.5026427 0.5070344 0.5098519 0.4557418
0.5017544
##      1553      1554      1555      1556      1557      1558      1559
1560
## 0.4723346 0.4943368 0.4808730 0.5205407 0.5070300 0.5440575 0.4955857
0.4638123
##      1561      1562      1563      1564      1565      1566      1567
1568
## 0.4861923 0.5157008 0.5061216 0.5069652 0.5009596 0.4768532 0.4813712
0.4894673
##      1569      1570      1571      1572      1573      1574      1575
1576
## 0.5071481 0.4846243 0.5032992 0.5265334 0.5017990 0.4898278 0.5070545
0.4853248
##      1577      1578      1579      1580      1581      1582      1583
1584
## 0.5074395 0.4703377 0.5185159 0.4846444 0.4936516 0.5041630 0.5102412
0.5057366
##      1585      1586      1587      1588      1589      1590      1591
1592
## 0.5070099 0.5295052 0.5237624 0.5070344 0.4955166 0.5013448 0.5083320
0.5040737
##      1593      1594      1595      1596      1597      1598      1599
1600
## 0.5278477 0.5204473 0.4711542 0.4939474 0.4838951 0.4804151 0.5164502
0.4748300
##      1601      1602      1603      1604      1605      1606      1607
1608
## 0.4980880 0.4865527 0.5388134 0.4951560 0.4800551 0.5030034 0.4951070
0.5375473
##      1609      1610      1611      1612      1613      1614      1615
1616
## 0.5177222 0.4629974 0.5140149 0.5059195 0.5118990 0.5169039 0.4960889
0.5412110
##      1617      1618      1619      1620      1621      1622      1623
1624
## 0.5238113 0.4812821 0.4944952 0.4989317 0.5135163 0.4800752 0.5053270
0.5057366
##      1625      1626      1627      1628      1629      1630      1631
1632
## 0.5199937 0.4936070 0.4756027 0.5143349 0.4606228 0.4988870 0.4944952
0.4702688
##      1633      1634      1635      1636      1637      1638      1639
1640
```

```
## 0.4861923 0.4837613 0.4679582 0.5094669 0.5208562 0.5265334 0.5293918
0.5066450
##      1641      1642      1643      1644      1645      1646      1647
1648
## 0.4772821 0.5148579 0.4862124 0.4883082 0.5400589 0.5034375 0.4816422
0.4792127
##      1649      1650      1651      1652      1653      1654      1655
1656
## 0.5106262 0.4817113 0.5086926 0.5041630 0.5078534 0.5078980 0.4899459
0.4980923
##      1657      1658      1659      1660      1661      1662      1663
1664
## 0.4931773 0.5093978 0.5151535 0.4968145 0.4976092 0.5179486 0.4601470
0.4804640
##      1665      1666      1667      1668      1669      1670      1671
1672
## 0.4849846 0.4793062 0.5029386 0.5371400 0.4977028 0.5030077 0.5106708
0.4992520
##      1673      1674      1675      1676      1677      1678      1679
1680
## 0.5241955 0.4707014 0.5172685 0.5367770 0.5310243 0.4736288 0.4832787
0.4711786
##      1681      1682      1683      1684      1685      1686      1687
1688
## 0.4956303 0.4939920 0.4748300 0.5118544 0.4919688 0.5314323 0.5078980
0.5331328
##      1689      1690      1691      1692      1693      1694      1695
1696
## 0.4979742 0.5140149 0.5290969 0.4581369 0.5302770 0.4736733 0.5062844
0.4545228
##      1697      1698      1699      1700      1701      1702      1703
1704
## 0.4793508 0.5070344 0.4904000 0.4712231 0.4984774 0.4904000 0.4887622
0.4870109
##      1705      1706      1707      1708      1709      1710      1711
1712
## 0.4866261 0.4951761 0.5197228 0.4867599 0.5061908 0.4812821 0.5229694
0.5026427
##      1713      1714      1715      1716      1717      1718      1719
1720
## 0.4846243 0.4956793 0.4690445 0.4992477 0.5448703 0.4857585 0.5086033
0.4813511
##      1721      1722      1723      1724      1725      1726      1727
1728
## 0.4906021 0.5042120 0.5017097 0.4902372 0.5144486 0.5030523 0.5315012
0.5314323
##      1729      1730      1731      1732      1733      1734      1735
1736
## 0.4589949 0.4989072 0.5343561 0.5094871 0.5021885 0.4708148 0.4862614
0.5295052
```

```
##      1737      1738      1739      1740      1741      1742      1743
1744
## 0.5228558 0.5130825 0.5119681 0.5037534 0.5180823 0.4842151 0.5310687
0.5375917
##      1745      1746      1747      1748      1749      1750      1751
1752
## 0.4826676 0.4838951 0.5128113 0.4642442 0.5070991 0.4977720 0.4687053
0.5327006
##      1753      1754      1755      1756      1757      1758      1759
1760
## 0.4952006 0.4903107 0.5034173 0.4955857 0.5077843 0.5168593 0.4670736
0.4926942
##      1761      1762      1763      1764      1765      1766      1767
1768
## 0.4719262 0.4776707 0.4739439 0.4996126 0.4993212 0.5187667 0.4948601
0.5269864
##      1769      1770      1771      1772      1773      1774      1775
1776
## 0.4838059 0.4854428 0.4898278 0.4932420 0.4837123 0.5179486 0.5265334
0.5115343
##      1777      1778      1779      1780      1781      1782      1783
1784
## 0.5033683 0.4744458 0.4651037 0.4817156 0.5152671 0.4862614 0.4931729
0.5054609
##      1785      1786      1787      1788      1789      1790      1791
1792
## 0.5159474 0.4830767 0.4736288 0.4715624 0.4796216 0.5241265 0.4589262
0.5041674
##      1793      1794      1795      1796      1797      1798      1799
1800
## 0.4927432 0.4907158 0.4621828 0.5028449 0.5135163 0.5155828 0.5069854
0.4800752
##      1801      1802      1803      1804      1805      1806      1807
1808
## 0.4736288 0.4903308 0.5074640 0.4867153 0.5412110 0.5171994 0.4979742
0.4955655
##      1809      1810      1811      1812      1813      1814      1815
1816
## 0.4808486 0.5148334 0.5099700 0.4866217 0.4760803 0.4980678 0.4776218
0.5041184
##      1817      1818      1819      1820      1821      1822      1823
1824
## 0.4869865 0.4984529 0.4931974 0.4768532 0.5009798 0.5302526 0.5016607
0.4837569
##      1825      1826      1827      1828      1829      1830      1831
1832
## 0.5298444 0.4706770 0.4585194 0.4804151 0.4821247 0.5127178 0.4818048
0.5042365
##      1833      1834      1835      1836      1837      1838      1839
1840
```

```
## 0.4946974 0.4752386 0.5371400 0.5090329 0.4658746 0.5020704 0.5016161
0.4760803
##      1841      1842      1843      1844      1845      1846      1847
1848
## 0.5005010 0.5021640 0.5044833 0.5127178 0.4855320 0.4732649 0.4979987
0.5143105
##      1849      1850      1851      1852      1853      1854      1855
1856
## 0.4845552 0.4927634 0.5359177 0.4914211 0.4948357 0.4609612 0.5274393
0.5237423
##      1857      1858      1859      1860      1861      1862      1863
1864
## 0.4928325 0.4670980 0.5086724 0.5071481 0.4887176 0.4936516 0.4784395
0.4985466
##      1865      1866      1867      1868      1869      1870      1871
1872
## 0.5062109 0.4675503 0.4788484 0.4981124 0.4804842 0.4585194 0.5164257
0.5225850
##      1873      1874      1875      1876      1877      1878      1879
1880
## 0.4683217 0.4853492 0.5299133 0.5432445 0.5040982 0.5346949 0.5111493
0.4837613
##      1881      1882      1883      1884      1885      1886      1887
1888
## 0.4964539 0.5054408 0.4918795 0.5135811 0.5050067 0.4904000 0.5032545
0.5041184
##      1889      1890      1891      1892      1893      1894      1895
1896
## 0.5065758 0.4926942 0.5095360 0.5269864 0.5164948 0.5036641 0.5270553
0.4886240
##      1897      1898      1899      1900      1901      1902      1903
1904
## 0.5001605 0.5090329 0.5318403 0.5151736 0.4977475 0.4904000 0.4862815
0.4845753
##      1905      1906      1907      1908      1909      1910      1911
1912
## 0.4911253 0.5224916 0.4822584 0.4764445 0.4776218 0.5030034 0.5237868
0.5306851
##      1913      1914      1915      1916      1917      1918      1919
1920
## 0.5093978 0.4805776 0.5004117 0.5323171 0.5139012 0.4821693 0.4878542
0.4923582
##      1921      1922      1923      1924      1925      1926      1927
1928
## 0.5176531 0.5452766 0.4744214 0.5184713 0.4699095 0.5049822 0.4957240
0.4757162
##      1929      1930      1931      1932      1933      1934      1935
1936
## 0.5028694 0.5189739 0.5175395 0.5181557 0.4801687 0.5131271 0.4813022
0.4825295
```

```
##      1937      1938      1939      1940      1941      1942      1943
1944
## 0.5310243 0.4727430 0.5452766 0.4826230 0.5106953 0.4808486 0.5143105
0.4512749
##      1945      1946      1947      1948      1949      1950      1951
1952
## 0.4699984 0.4561482 0.5001605 0.4955166 0.4963602 0.5091467 0.4952452
0.5138565
##      1953      1954      1955      1956      1957      1958      1959
1960
## 0.5005457 0.5399903 0.4841661 0.4638367 0.4944952 0.4959506 0.4894183
0.4849889
##      1961      1962      1963      1964      1965      1966      1967
1968
## 0.5099009 0.4801442 0.5059195 0.5172641 0.5185403 0.5058748 0.5152427
0.4617999
##      1969      1970      1971      1972      1973      1974      1975
1976
## 0.4820513 0.4924475 0.4891270 0.5192448 0.4992030 0.5228558 0.5163566
0.4816667
##      1977      1978      1979      1980      1981      1982      1983
1984
## 0.5266469 0.5050312 0.5253524 0.5079225 0.4791883 0.4907158 0.4890334
0.4488417
##      1985      1986      1987      1988      1989      1990      1991
1992
## 0.5114896 0.5147197 0.5318847 0.4887622 0.5030279 0.4992275 0.4846689
0.4939474
##      1993      1994      1995      1996      1997      1998      1999
2000
## 0.4968145 0.5008415 0.4715179 0.4996616 0.5001404 0.5270108 0.5074194
0.5293918
```

```
predictions_category <- ifelse(predictions >= 0.5, "1","0")
print( predictions_category )
```

```
##    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15
16
##  "1"  "0"  "0"  "0"  "1"  "0"  "0"  "0"  "0"  "0"  "0"  "0"  "1"  "1"  "1"
"0"
##   17   18   19   20   21   22   23   24   25   26   27   28   29   30   31
32
##  "1"  "0"  "1"  "1"  "1"  "0"  "0"  "1"  "0"  "0"  "1"  "0"  "1"  "0"  "1"
"1"
##   33   34   35   36   37   38   39   40   41   42   43   44   45   46   47
48
##  "1"  "1"  "0"  "0"  "1"  "0"  "1"  "1"  "1"  "1"  "1"  "0"  "0"  "1"  "0"
"0"
##   49   50   51   52   53   54   55   56   57   58   59   60   61   62   63
64
```

```
##  "0"  "0"  "1"  "1"  "1"  "1"  "1"  "0"  "0"  "0"  "0"  "0"  "1"  "0"  "0"
"1"
##   65   66   67   68   69   70   71   72   73   74   75   76   77   78   79
80
##  "1"  "0"  "1"  "1"  "0"  "0"  "0"  "0"  "0"  "0"  "0"  "1"  "1"  "1"  "1"
"1"
##   81   82   83   84   85   86   87   88   89   90   91   92   93   94   95
96
##  "0"  "1"  "1"  "1"  "0"  "0"  "1"  "1"  "1"  "0"  "0"  "0"  "0"  "0"  "1"
"0"
##   97   98   99  100  101  102  103  104  105  106  107  108  109  110  111
112
##  "1"  "1"  "1"  "0"  "1"  "1"  "1"  "1"  "0"  "0"  "1"  "1"  "0"  "0"  "1"
"0"
##  113  114  115  116  117  118  119  120  121  122  123  124  125  126  127
128
##  "1"  "1"  "1"  "1"  "1"  "0"  "1"  "0"  "0"  "1"  "0"  "0"  "1"  "0"  "1"
"0"
##  129  130  131  132  133  134  135  136  137  138  139  140  141  142  143
144
##  "1"  "1"  "1"  "1"  "0"  "0"  "1"  "0"  "0"  "0"  "0"  "1"  "1"  "1"  "1"
"0"
##  145  146  147  148  149  150  151  152  153  154  155  156  157  158  159
160
##  "1"  "1"  "0"  "1"  "0"  "1"  "0"  "1"  "1"  "0"  "0"  "1"  "1"  "1"  "0"
"0"
##  161  162  163  164  165  166  167  168  169  170  171  172  173  174  175
176
##  "1"  "1"  "1"  "0"  "0"  "0"  "1"  "0"  "0"  "0"  "0"  "0"  "1"  "0"  "1"
"1"
##  177  178  179  180  181  182  183  184  185  186  187  188  189  190  191
192
##  "1"  "0"  "0"  "1"  "1"  "0"  "0"  "1"  "0"  "0"  "0"  "0"  "1"  "1"  "1"
"1"
##  193  194  195  196  197  198  199  200  201  202  203  204  205  206  207
208
##  "0"  "0"  "1"  "1"  "0"  "1"  "1"  "0"  "1"  "0"  "1"  "1"  "1"  "1"  "0"
"1"
##  209  210  211  212  213  214  215  216  217  218  219  220  221  222  223
224
##  "0"  "0"  "0"  "0"  "1"  "1"  "0"  "0"  "1"  "1"  "0"  "0"  "0"  "0"  "1"
"1"
##  225  226  227  228  229  230  231  232  233  234  235  236  237  238  239
240
##  "1"  "0"  "1"  "1"  "1"  "0"  "0"  "1"  "0"  "0"  "0"  "1"  "1"  "0"  "1"
"0"
##  241  242  243  244  245  246  247  248  249  250  251  252  253  254  255
256
##  "1"  "0"  "0"  "1"  "0"  "0"  "0"  "0"  "1"  "0"  "1"  "0"  "0"  "1"  "1"
"0"
```

```
##  257  258  259  260  261  262  263  264  265  266  267  268  269  270  271
272
##  "0"  "0"  "0"  "0"  "1"  "0"  "0"  "0"  "1"  "1"  "1"  "0"  "0"  "0"  "0"
"0"
##  273  274  275  276  277  278  279  280  281  282  283  284  285  286  287
288
##  "0"  "0"  "1"  "0"  "1"  "1"  "0"  "1"  "1"  "0"  "0"  "1"  "0"  "0"  "0"
"1"
##  289  290  291  292  293  294  295  296  297  298  299  300  301  302  303
304
##  "1"  "1"  "0"  "0"  "1"  "1"  "1"  "0"  "0"  "1"  "0"  "1"  "1"  "1"  "1"
"1"
##  305  306  307  308  309  310  311  312  313  314  315  316  317  318  319
320
##  "1"  "1"  "1"  "0"  "0"  "1"  "0"  "1"  "1"  "1"  "0"  "0"  "0"  "1"  "0"
"0"
##  321  322  323  324  325  326  327  328  329  330  331  332  333  334  335
336
##  "1"  "1"  "0"  "1"  "1"  "0"  "0"  "0"  "0"  "0"  "0"  "1"  "0"  "1"  "0"
"1"
##  337  338  339  340  341  342  343  344  345  346  347  348  349  350  351
352
##  "1"  "1"  "1"  "1"  "0"  "0"  "0"  "0"  "1"  "1"  "0"  "1"  "0"  "1"  "1"
"1"
##  353  354  355  356  357  358  359  360  361  362  363  364  365  366  367
368
##  "0"  "0"  "1"  "0"  "1"  "1"  "1"  "1"  "1"  "0"  "1"  "1"  "0"  "1"  "1"
"0"
##  369  370  371  372  373  374  375  376  377  378  379  380  381  382  383
384
##  "0"  "0"  "0"  "1"  "0"  "1"  "0"  "0"  "0"  "1"  "0"  "0"  "1"  "1"  "1"
"0"
##  385  386  387  388  389  390  391  392  393  394  395  396  397  398  399
400
##  "0"  "0"  "0"  "0"  "0"  "0"  "1"  "1"  "1"  "1"  "0"  "1"  "0"  "0"  "1"
"1"
##  401  402  403  404  405  406  407  408  409  410  411  412  413  414  415
416
##  "1"  "0"  "1"  "0"  "0"  "1"  "1"  "0"  "0"  "1"  "0"  "0"  "1"  "1"  "1"
"1"
##  417  418  419  420  421  422  423  424  425  426  427  428  429  430  431
432
##  "0"  "0"  "0"  "0"  "1"  "1"  "0"  "0"  "1"  "0"  "0"  "0"  "0"  "1"  "0"
"1"
##  433  434  435  436  437  438  439  440  441  442  443  444  445  446  447
448
##  "0"  "0"  "0"  "0"  "1"  "0"  "0"  "0"  "0"  "1"  "0"  "1"  "0"  "0"  "1"
"1"
##  449  450  451  452  453  454  455  456  457  458  459  460  461  462  463
464
```

```
##  "1"  "0"  "0"  "0"  "1"  "0"  "1"  "0"  "0"  "0"  "0"  "0"  "1"  "1"  "0"
"1"
##  465  466  467  468  469  470  471  472  473  474  475  476  477  478  479
480
##  "0"  "1"  "1"  "1"  "0"  "1"  "1"  "0"  "1"  "1"  "1"  "1"  "1"  "0"  "1"
"1"
##  481  482  483  484  485  486  487  488  489  490  491  492  493  494  495
496
##  "1"  "0"  "1"  "0"  "1"  "1"  "1"  "1"  "0"  "0"  "0"  "0"  "1"  "0"  "0"
"1"
##  497  498  499  500  501  502  503  504  505  506  507  508  509  510  511
512
##  "1"  "0"  "0"  "1"  "0"  "1"  "0"  "1"  "0"  "1"  "1"  "1"  "0"  "1"  "1"
"0"
##  513  514  515  516  517  518  519  520  521  522  523  524  525  526  527
528
##  "1"  "0"  "1"  "1"  "0"  "0"  "0"  "0"  "1"  "1"  "1"  "0"  "0"  "0"  "0"
"1"
##  529  530  531  532  533  534  535  536  537  538  539  540  541  542  543
544
##  "1"  "0"  "1"  "0"  "0"  "1"  "0"  "1"  "1"  "0"  "0"  "1"  "1"  "1"  "0"
"1"
##  545  546  547  548  549  550  551  552  553  554  555  556  557  558  559
560
##  "1"  "1"  "1"  "0"  "0"  "0"  "1"  "0"  "1"  "0"  "0"  "0"  "0"  "0"  "1"
"1"
##  561  562  563  564  565  566  567  568  569  570  571  572  573  574  575
576
##  "0"  "0"  "0"  "1"  "0"  "1"  "0"  "0"  "0"  "0"  "0"  "0"  "1"  "0"  "0"
"0"
##  577  578  579  580  581  582  583  584  585  586  587  588  589  590  591
592
##  "1"  "0"  "0"  "1"  "1"  "1"  "0"  "0"  "1"  "0"  "1"  "1"  "0"  "1"  "1"
"1"
##  593  594  595  596  597  598  599  600  601  602  603  604  605  606  607
608
##  "1"  "0"  "0"  "1"  "0"  "0"  "1"  "0"  "1"  "1"  "1"  "0"  "0"  "1"  "0"
"1"
##  609  610  611  612  613  614  615  616  617  618  619  620  621  622  623
624
##  "0"  "0"  "1"  "0"  "0"  "1"  "1"  "0"  "0"  "1"  "0"  "0"  "1"  "1"  "0"
"0"
##  625  626  627  628  629  630  631  632  633  634  635  636  637  638  639
640
##  "0"  "0"  "1"  "0"  "0"  "1"  "0"  "1"  "0"  "0"  "0"  "1"  "1"  "0"  "0"
"1"
##  641  642  643  644  645  646  647  648  649  650  651  652  653  654  655
656
##  "1"  "1"  "1"  "1"  "1"  "0"  "1"  "0"  "1"  "0"  "0"  "1"  "1"  "1"  "0"
"1"
```

```
##  657  658  659  660  661  662  663  664  665  666  667  668  669  670  671
672
##  "1"  "1"  "0"  "1"  "1"  "0"  "0"  "1"  "1"  "0"  "1"  "1"  "1"  "0"  "1"
"1"
##  673  674  675  676  677  678  679  680  681  682  683  684  685  686  687
688
##  "1"  "0"  "1"  "0"  "1"  "1"  "1"  "1"  "1"  "0"  "1"  "1"  "0"  "0"  "1"
"0"
##  689  690  691  692  693  694  695  696  697  698  699  700  701  702  703
704
##  "0"  "1"  "1"  "0"  "1"  "1"  "1"  "0"  "0"  "1"  "1"  "0"  "1"  "1"  "0"
"0"
##  705  706  707  708  709  710  711  712  713  714  715  716  717  718  719
720
##  "0"  "1"  "0"  "1"  "1"  "0"  "0"  "0"  "1"  "1"  "1"  "1"  "0"  "1"  "1"
"1"
##  721  722  723  724  725  726  727  728  729  730  731  732  733  734  735
736
##  "0"  "0"  "0"  "1"  "0"  "1"  "1"  "1"  "0"  "1"  "1"  "1"  "1"  "0"  "1"
"1"
##  737  738  739  740  741  742  743  744  745  746  747  748  749  750  751
752
##  "0"  "1"  "1"  "1"  "0"  "0"  "1"  "1"  "0"  "1"  "0"  "0"  "1"  "1"  "0"
"0"
##  753  754  755  756  757  758  759  760  761  762  763  764  765  766  767
768
##  "1"  "0"  "1"  "1"  "0"  "1"  "1"  "0"  "0"  "0"  "1"  "1"  "0"  "1"  "1"
"1"
##  769  770  771  772  773  774  775  776  777  778  779  780  781  782  783
784
##  "0"  "1"  "0"  "0"  "1"  "1"  "0"  "0"  "1"  "1"  "0"  "0"  "0"  "0"  "0"
"1"
##  785  786  787  788  789  790  791  792  793  794  795  796  797  798  799
800
##  "1"  "1"  "1"  "0"  "1"  "1"  "1"  "0"  "1"  "0"  "0"  "0"  "1"  "0"  "0"
"0"
##  801  802  803  804  805  806  807  808  809  810  811  812  813  814  815
816
##  "0"  "0"  "1"  "0"  "0"  "1"  "1"  "0"  "1"  "1"  "1"  "0"  "1"  "0"  "1"
"0"
##  817  818  819  820  821  822  823  824  825  826  827  828  829  830  831
832
##  "1"  "0"  "1"  "0"  "1"  "0"  "1"  "0"  "1"  "1"  "1"  "0"  "0"  "1"  "0"
"0"
##  833  834  835  836  837  838  839  840  841  842  843  844  845  846  847
848
##  "0"  "1"  "0"  "1"  "0"  "0"  "1"  "1"  "0"  "0"  "1"  "1"  "1"  "1"  "0"
"0"
##  849  850  851  852  853  854  855  856  857  858  859  860  861  862  863
864
```

```
##  "0"  "1"  "1"  "1"  "1"  "0"  "1"  "1"  "0"  "1"  "0"  "0"  "1"  "0"  "1"
"1"
##  865  866  867  868  869  870  871  872  873  874  875  876  877  878  879
880
##  "0"  "1"  "1"  "0"  "0"  "0"  "1"  "0"  "0"  "0"  "1"  "0"  "1"  "1"  "0"
"0"
##  881  882  883  884  885  886  887  888  889  890  891  892  893  894  895
896
##  "1"  "1"  "1"  "0"  "0"  "0"  "1"  "0"  "0"  "1"  "0"  "1"  "1"  "0"  "0"
"1"
##  897  898  899  900  901  902  903  904  905  906  907  908  909  910  911
912
##  "0"  "1"  "0"  "1"  "1"  "0"  "1"  "0"  "0"  "1"  "0"  "1"  "1"  "1"  "0"
"0"
##  913  914  915  916  917  918  919  920  921  922  923  924  925  926  927
928
##  "0"  "0"  "1"  "1"  "0"  "0"  "1"  "1"  "0"  "0"  "1"  "0"  "0"  "0"  "1"
"0"
##  929  930  931  932  933  934  935  936  937  938  939  940  941  942  943
944
##  "0"  "0"  "1"  "0"  "1"  "1"  "0"  "1"  "0"  "0"  "0"  "0"  "0"  "1"  "0"
"1"
##  945  946  947  948  949  950  951  952  953  954  955  956  957  958  959
960
##  "1"  "1"  "0"  "1"  "0"  "1"  "0"  "1"  "0"  "1"  "1"  "0"  "0"  "1"  "0"
"1"
##  961  962  963  964  965  966  967  968  969  970  971  972  973  974  975
976
##  "1"  "0"  "0"  "1"  "1"  "0"  "0"  "0"  "1"  "1"  "0"  "0"  "0"  "1"  "1"
"0"
##  977  978  979  980  981  982  983  984  985  986  987  988  989  990  991
992
##  "1"  "1"  "1"  "0"  "1"  "1"  "1"  "0"  "1"  "0"  "1"  "0"  "1"  "0"  "1"
"0"
##  993  994  995  996  997  998  999 1000 1001 1002 1003 1004 1005 1006 1007
1008
##  "1"  "1"  "0"  "1"  "0"  "0"  "1"  "0"  "1"  "1"  "0"  "1"  "1"  "0"  "1"
"1"
## 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023
1024
##  "0"  "0"  "0"  "0"  "1"  "1"  "1"  "0"  "1"  "1"  "0"  "0"  "1"  "1"  "1"
"0"
## 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039
1040
##  "0"  "1"  "0"  "0"  "0"  "0"  "0"  "0"  "1"  "0"  "1"  "1"  "0"  "1"  "1"
"1"
## 1041 1042 1043 1044 1045 1046 1047 1048 1049 1050 1051 1052 1053 1054 1055
1056
##  "0"  "0"  "0"  "1"  "1"  "0"  "0"  "1"  "1"  "0"  "1"  "1"  "0"  "0"  "1"
"0"
```

```
## 1057 1058 1059 1060 1061 1062 1063 1064 1065 1066 1067 1068 1069 1070 1071
1072
##  "1"  "1"  "0"  "0"  "1"  "1"  "1"  "1"  "1"  "1"  "0"  "0"  "1"  "1"  "1"
"1"
## 1073 1074 1075 1076 1077 1078 1079 1080 1081 1082 1083 1084 1085 1086 1087
1088
##  "1"  "1"  "1"  "1"  "0"  "1"  "0"  "0"  "0"  "0"  "0"  "0"  "0"  "0"  "0"
"1"
## 1089 1090 1091 1092 1093 1094 1095 1096 1097 1098 1099 1100 1101 1102 1103
1104
##  "1"  "0"  "1"  "0"  "0"  "0"  "1"  "0"  "0"  "0"  "0"  "0"  "0"  "1"  "1"
"1"
## 1105 1106 1107 1108 1109 1110 1111 1112 1113 1114 1115 1116 1117 1118 1119
1120
##  "1"  "1"  "0"  "0"  "0"  "1"  "0"  "1"  "0"  "0"  "1"  "0"  "0"  "0"  "0"
"0"
## 1121 1122 1123 1124 1125 1126 1127 1128 1129 1130 1131 1132 1133 1134 1135
1136
##  "1"  "0"  "0"  "1"  "1"  "1"  "0"  "1"  "1"  "1"  "1"  "0"  "0"  "1"  "0"
"1"
## 1137 1138 1139 1140 1141 1142 1143 1144 1145 1146 1147 1148 1149 1150 1151
1152
##  "1"  "1"  "1"  "0"  "1"  "0"  "0"  "0"  "0"  "1"  "0"  "1"  "0"  "1"  "1"
"0"
## 1153 1154 1155 1156 1157 1158 1159 1160 1161 1162 1163 1164 1165 1166 1167
1168
##  "1"  "1"  "1"  "1"  "1"  "1"  "1"  "0"  "0"  "1"  "0"  "0"  "1"  "1"  "0"
"0"
## 1169 1170 1171 1172 1173 1174 1175 1176 1177 1178 1179 1180 1181 1182 1183
1184
##  "0"  "0"  "1"  "1"  "0"  "0"  "1"  "0"  "1"  "1"  "1"  "1"  "1"  "0"  "0"
"1"
## 1185 1186 1187 1188 1189 1190 1191 1192 1193 1194 1195 1196 1197 1198 1199
1200
##  "0"  "1"  "1"  "0"  "0"  "0"  "1"  "0"  "0"  "0"  "0"  "0"  "1"  "0"  "1"
"0"
## 1201 1202 1203 1204 1205 1206 1207 1208 1209 1210 1211 1212 1213 1214 1215
1216
##  "1"  "0"  "0"  "1"  "1"  "0"  "1"  "0"  "0"  "0"  "0"  "0"  "0"  "0"  "1"
"1"
## 1217 1218 1219 1220 1221 1222 1223 1224 1225 1226 1227 1228 1229 1230 1231
1232
##  "1"  "1"  "1"  "0"  "0"  "1"  "1"  "1"  "1"  "1"  "1"  "0"  "0"  "1"  "1"
"0"
## 1233 1234 1235 1236 1237 1238 1239 1240 1241 1242 1243 1244 1245 1246 1247
1248
##  "1"  "1"  "1"  "1"  "0"  "1"  "1"  "0"  "0"  "1"  "1"  "0"  "1"  "1"  "0"
"0"
## 1249 1250 1251 1252 1253 1254 1255 1256 1257 1258 1259 1260 1261 1262 1263
1264
```

```
##  "0"  "0"  "1"  "0"  "1"  "0"  "1"  "1"  "1"  "0"  "1"  "1"  "0"  "0"  "1"
"1"
## 1265 1266 1267 1268 1269 1270 1271 1272 1273 1274 1275 1276 1277 1278 1279
1280
##  "1"  "0"  "0"  "0"  "0"  "1"  "1"  "0"  "0"  "1"  "0"  "1"  "1"  "0"  "1"
"0"
## 1281 1282 1283 1284 1285 1286 1287 1288 1289 1290 1291 1292 1293 1294 1295
1296
##  "0"  "1"  "0"  "1"  "0"  "1"  "1"  "0"  "0"  "0"  "0"  "0"  "1"  "1"  "0"
"0"
## 1297 1298 1299 1300 1301 1302 1303 1304 1305 1306 1307 1308 1309 1310 1311
1312
##  "1"  "1"  "0"  "1"  "1"  "0"  "1"  "0"  "0"  "1"  "1"  "0"  "0"  "1"  "1"
"1"
## 1313 1314 1315 1316 1317 1318 1319 1320 1321 1322 1323 1324 1325 1326 1327
1328
##  "1"  "1"  "0"  "0"  "0"  "0"  "1"  "1"  "1"  "1"  "1"  "0"  "1"  "0"  "1"
"0"
## 1329 1330 1331 1332 1333 1334 1335 1336 1337 1338 1339 1340 1341 1342 1343
1344
##  "0"  "0"  "1"  "1"  "0"  "0"  "0"  "0"  "0"  "1"  "1"  "0"  "0"  "1"  "1"
"0"
## 1345 1346 1347 1348 1349 1350 1351 1352 1353 1354 1355 1356 1357 1358 1359
1360
##  "0"  "1"  "1"  "0"  "1"  "1"  "0"  "1"  "1"  "0"  "1"  "1"  "0"  "1"  "0"
"1"
## 1361 1362 1363 1364 1365 1366 1367 1368 1369 1370 1371 1372 1373 1374 1375
1376
##  "1"  "0"  "0"  "1"  "0"  "0"  "1"  "0"  "0"  "1"  "0"  "1"  "0"  "1"  "1"
"1"
## 1377 1378 1379 1380 1381 1382 1383 1384 1385 1386 1387 1388 1389 1390 1391
1392
##  "0"  "0"  "0"  "1"  "1"  "1"  "0"  "0"  "1"  "1"  "0"  "0"  "1"  "1"  "1"
"0"
## 1393 1394 1395 1396 1397 1398 1399 1400 1401 1402 1403 1404 1405 1406 1407
1408
##  "1"  "1"  "0"  "0"  "0"  "1"  "0"  "1"  "1"  "0"  "1"  "0"  "1"  "0"  "0"
"1"
## 1409 1410 1411 1412 1413 1414 1415 1416 1417 1418 1419 1420 1421 1422 1423
1424
##  "1"  "1"  "1"  "1"  "0"  "1"  "1"  "0"  "0"  "0"  "0"  "0"  "1"  "1"  "1"
"0"
## 1425 1426 1427 1428 1429 1430 1431 1432 1433 1434 1435 1436 1437 1438 1439
1440
##  "1"  "0"  "0"  "1"  "1"  "0"  "0"  "0"  "0"  "0"  "0"  "1"  "1"  "1"  "0"
"0"
## 1441 1442 1443 1444 1445 1446 1447 1448 1449 1450 1451 1452 1453 1454 1455
1456
##  "0"  "1"  "1"  "1"  "1"  "1"  "0"  "1"  "0"  "0"  "1"  "1"  "1"  "0"  "1"
"1"
```

```
## 1457 1458 1459 1460 1461 1462 1463 1464 1465 1466 1467 1468 1469 1470 1471
1472
##  "0"  "1"  "0"  "0"  "1"  "0"  "1"  "0"  "1"  "1"  "1"  "0"  "0"  "1"  "1"
"0"
## 1473 1474 1475 1476 1477 1478 1479 1480 1481 1482 1483 1484 1485 1486 1487
1488
##  "0"  "1"  "0"  "1"  "1"  "0"  "0"  "1"  "1"  "0"  "0"  "0"  "0"  "1"  "0"
"1"
## 1489 1490 1491 1492 1493 1494 1495 1496 1497 1498 1499 1500 1501 1502 1503
1504
##  "1"  "1"  "0"  "0"  "0"  "0"  "1"  "1"  "0"  "1"  "1"  "0"  "1"  "0"  "0"
"1"
## 1505 1506 1507 1508 1509 1510 1511 1512 1513 1514 1515 1516 1517 1518 1519
1520
##  "0"  "1"  "0"  "0"  "0"  "1"  "1"  "1"  "1"  "1"  "0"  "0"  "1"  "0"  "1"
"0"
## 1521 1522 1523 1524 1525 1526 1527 1528 1529 1530 1531 1532 1533 1534 1535
1536
##  "1"  "1"  "1"  "0"  "0"  "1"  "1"  "0"  "1"  "0"  "1"  "1"  "0"  "0"  "0"
"0"
## 1537 1538 1539 1540 1541 1542 1543 1544 1545 1546 1547 1548 1549 1550 1551
1552
##  "1"  "1"  "0"  "1"  "1"  "0"  "1"  "1"  "1"  "0"  "0"  "1"  "1"  "1"  "0"
"1"
## 1553 1554 1555 1556 1557 1558 1559 1560 1561 1562 1563 1564 1565 1566 1567
1568
##  "0"  "0"  "0"  "1"  "1"  "1"  "0"  "0"  "0"  "1"  "1"  "1"  "1"  "0"  "0"
"0"
## 1569 1570 1571 1572 1573 1574 1575 1576 1577 1578 1579 1580 1581 1582 1583
1584
##  "1"  "0"  "1"  "1"  "1"  "0"  "1"  "0"  "1"  "0"  "1"  "0"  "0"  "1"  "1"
"1"
## 1585 1586 1587 1588 1589 1590 1591 1592 1593 1594 1595 1596 1597 1598 1599
1600
##  "1"  "1"  "1"  "1"  "0"  "1"  "1"  "1"  "1"  "1"  "0"  "0"  "0"  "0"  "1"
"0"
## 1601 1602 1603 1604 1605 1606 1607 1608 1609 1610 1611 1612 1613 1614 1615
1616
##  "0"  "0"  "1"  "0"  "0"  "1"  "0"  "1"  "1"  "0"  "1"  "1"  "1"  "1"  "0"
"1"
## 1617 1618 1619 1620 1621 1622 1623 1624 1625 1626 1627 1628 1629 1630 1631
1632
##  "1"  "0"  "0"  "0"  "1"  "0"  "1"  "1"  "1"  "0"  "0"  "1"  "0"  "0"  "0"
"0"
## 1633 1634 1635 1636 1637 1638 1639 1640 1641 1642 1643 1644 1645 1646 1647
1648
##  "0"  "0"  "0"  "1"  "1"  "1"  "1"  "1"  "0"  "1"  "0"  "0"  "1"  "1"  "0"
"0"
## 1649 1650 1651 1652 1653 1654 1655 1656 1657 1658 1659 1660 1661 1662 1663
1664
```

```
##  "1"  "0"  "1"  "1"  "1"  "1"  "0"  "0"  "0"  "1"  "1"  "0"  "0"  "1"  "0"
"0"
## 1665 1666 1667 1668 1669 1670 1671 1672 1673 1674 1675 1676 1677 1678 1679
1680
##  "0"  "0"  "1"  "1"  "0"  "1"  "1"  "0"  "1"  "0"  "1"  "1"  "1"  "0"  "0"
"0"
## 1681 1682 1683 1684 1685 1686 1687 1688 1689 1690 1691 1692 1693 1694 1695
1696
##  "0"  "0"  "0"  "1"  "0"  "1"  "1"  "1"  "0"  "1"  "1"  "0"  "1"  "0"  "1"
"0"
## 1697 1698 1699 1700 1701 1702 1703 1704 1705 1706 1707 1708 1709 1710 1711
1712
##  "0"  "1"  "0"  "0"  "0"  "0"  "0"  "0"  "0"  "0"  "1"  "0"  "1"  "0"  "1"
"1"
## 1713 1714 1715 1716 1717 1718 1719 1720 1721 1722 1723 1724 1725 1726 1727
1728
##  "0"  "0"  "0"  "0"  "1"  "0"  "1"  "0"  "0"  "1"  "1"  "0"  "1"  "1"  "1"
"1"
## 1729 1730 1731 1732 1733 1734 1735 1736 1737 1738 1739 1740 1741 1742 1743
1744
##  "0"  "0"  "1"  "1"  "1"  "0"  "0"  "1"  "1"  "1"  "1"  "1"  "1"  "0"  "1"
"1"
## 1745 1746 1747 1748 1749 1750 1751 1752 1753 1754 1755 1756 1757 1758 1759
1760
##  "0"  "0"  "1"  "0"  "1"  "0"  "0"  "1"  "0"  "0"  "1"  "0"  "1"  "1"  "0"
"0"
## 1761 1762 1763 1764 1765 1766 1767 1768 1769 1770 1771 1772 1773 1774 1775
1776
##  "0"  "0"  "0"  "0"  "0"  "1"  "0"  "1"  "0"  "0"  "0"  "0"  "0"  "1"  "1"
"1"
## 1777 1778 1779 1780 1781 1782 1783 1784 1785 1786 1787 1788 1789 1790 1791
1792
##  "1"  "0"  "0"  "0"  "1"  "0"  "0"  "1"  "1"  "0"  "0"  "0"  "0"  "1"  "0"
"1"
## 1793 1794 1795 1796 1797 1798 1799 1800 1801 1802 1803 1804 1805 1806 1807
1808
##  "0"  "0"  "0"  "1"  "1"  "1"  "1"  "0"  "0"  "0"  "1"  "0"  "1"  "1"  "0"
"0"
## 1809 1810 1811 1812 1813 1814 1815 1816 1817 1818 1819 1820 1821 1822 1823
1824
##  "0"  "1"  "1"  "0"  "0"  "0"  "0"  "1"  "0"  "0"  "0"  "0"  "1"  "1"  "1"
"0"
## 1825 1826 1827 1828 1829 1830 1831 1832 1833 1834 1835 1836 1837 1838 1839
1840
##  "1"  "0"  "0"  "0"  "0"  "1"  "0"  "1"  "0"  "0"  "1"  "1"  "0"  "1"  "1"
"0"
## 1841 1842 1843 1844 1845 1846 1847 1848 1849 1850 1851 1852 1853 1854 1855
1856
##  "1"  "1"  "1"  "1"  "0"  "0"  "0"  "1"  "0"  "0"  "1"  "0"  "0"  "0"  "1"
"1"
```

```
## 1857 1858 1859 1860 1861 1862 1863 1864 1865 1866 1867 1868 1869 1870 1871
1872
##  "0"  "0"  "1"  "1"  "0"  "0"  "0"  "0"  "1"  "0"  "0"  "0"  "0"  "0"  "1"
"1"
## 1873 1874 1875 1876 1877 1878 1879 1880 1881 1882 1883 1884 1885 1886 1887
1888
##  "0"  "0"  "1"  "1"  "1"  "1"  "1"  "0"  "0"  "1"  "0"  "1"  "1"  "0"  "1"
"1"
## 1889 1890 1891 1892 1893 1894 1895 1896 1897 1898 1899 1900 1901 1902 1903
1904
##  "1"  "0"  "1"  "1"  "1"  "1"  "1"  "0"  "1"  "1"  "1"  "1"  "0"  "0"  "0"
"0"
## 1905 1906 1907 1908 1909 1910 1911 1912 1913 1914 1915 1916 1917 1918 1919
1920
##  "0"  "1"  "0"  "0"  "0"  "1"  "1"  "1"  "1"  "0"  "1"  "1"  "1"  "0"  "0"
"0"
## 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934 1935
1936
##  "1"  "1"  "0"  "1"  "0"  "1"  "0"  "0"  "1"  "1"  "1"  "1"  "0"  "1"  "0"
"0"
## 1937 1938 1939 1940 1941 1942 1943 1944 1945 1946 1947 1948 1949 1950 1951
1952
##  "1"  "0"  "1"  "0"  "1"  "0"  "1"  "0"  "0"  "0"  "1"  "0"  "0"  "1"  "0"
"1"
## 1953 1954 1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965 1966 1967
1968
##  "1"  "1"  "0"  "0"  "0"  "0"  "0"  "0"  "1"  "0"  "1"  "1"  "1"  "1"  "1"
"0"
## 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983
1984
##  "0"  "0"  "0"  "1"  "0"  "1"  "1"  "0"  "1"  "1"  "1"  "1"  "0"  "0"  "0"
"0"
## 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999
2000
##  "1"  "1"  "1"  "0"  "1"  "0"  "0"  "0"  "0"  "1"  "0"  "0"  "1"  "1"  "1"
"1"
```

```r
# Creating a confusion matrix (to see how well your model performed on the
test set)

confusion_matrix <- table(test1$Performance, predictions_category)
print(confusion_matrix)
```

```
##       predictions_category
##          0   1
##   High 516 484
##   Low  487 513
```

```r
accuracy <- (sum(diag(confusion_matrix))/ sum(confusion_matrix))
accuracy
```

```
## [1] 0.5145
```