DDS Analytics

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Business Objective

The leadership has identified predicting employee turnover as its first application of data science for talent management. Before investing in the project they would like an analysis of existing employee data.

Data

Data was provided by the client in form of a .csv file “CaseStudy2-data.xlsx”.

Basic Statistics

The data includes a total of 1470 current and terminated employee records with 35 variables.

	Data Records
Observations	1470
Variables	35

Summary of measures included in the data:

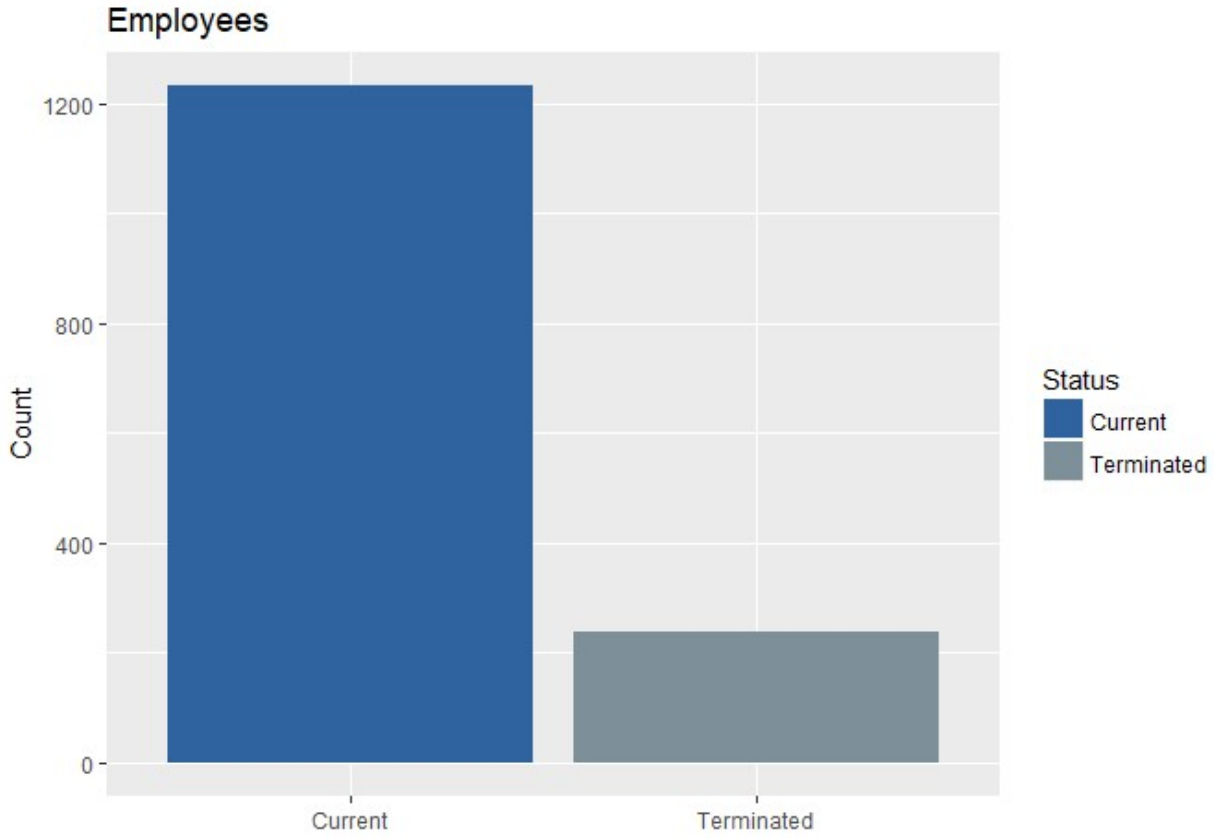
	DailyRate	Number of Companies Worked	Years at Company	Years with Manager	Distance From Home	Percent Salary Hike	Years in Current Role
Min.	102.0000	0.000000	0.000000	0.000000	1.000000	11.00000	0.000000
1st Qu.	465.0000	1.000000	3.000000	2.000000	2.000000	12.00000	2.000000
Median	802.0000	2.000000	5.000000	3.000000	7.000000	14.00000	3.000000
Mean	802.4857	2.693197	7.008163	4.123129	9.192517	15.20952	4.229252
3rd Qu.	1157.0000	4.000000	9.000000	7.000000	14.000000	18.00000	7.000000
Max.	1499.0000	9.000000	40.000000	17.000000	29.000000	25.00000	18.000000

Methodology

Attrition is the central theme of this analysis. We interpreted the value “Yes” in the data provided under attrition as an indicator that the employee is terminated.

We categorized each record as “Current” or “Terminated” and look for patterns in the variables that may explain why employees become terminated.

Current *meaning currently employed by the firm.*
Terminated *meaning left the firm (voluntarily or non-voluntarily)*



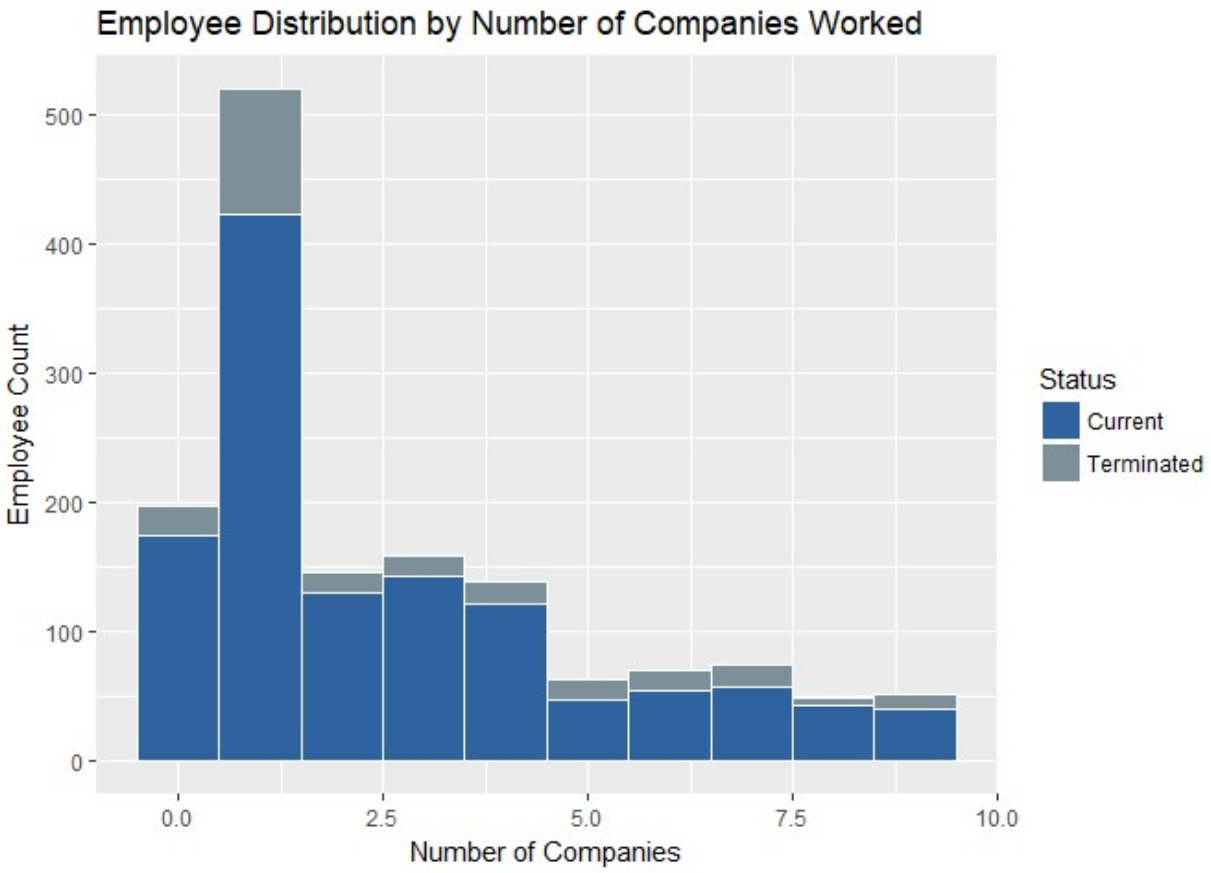
As requested employees under the age of 18 have been excluded from this analsyis. The table below shows the youngest age record included in the data:

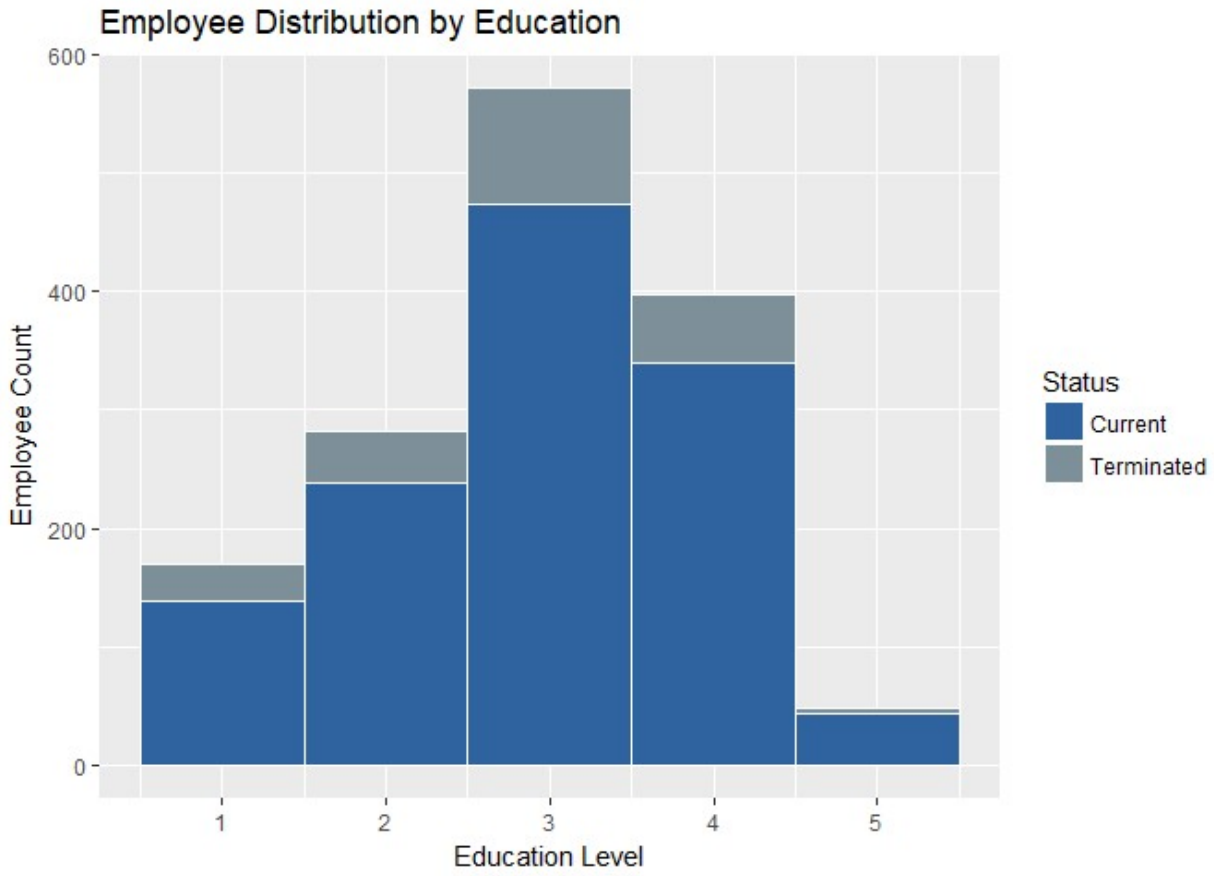
Youngest Age Record
18

Distributions

The following are the distributions of employees by various measures.

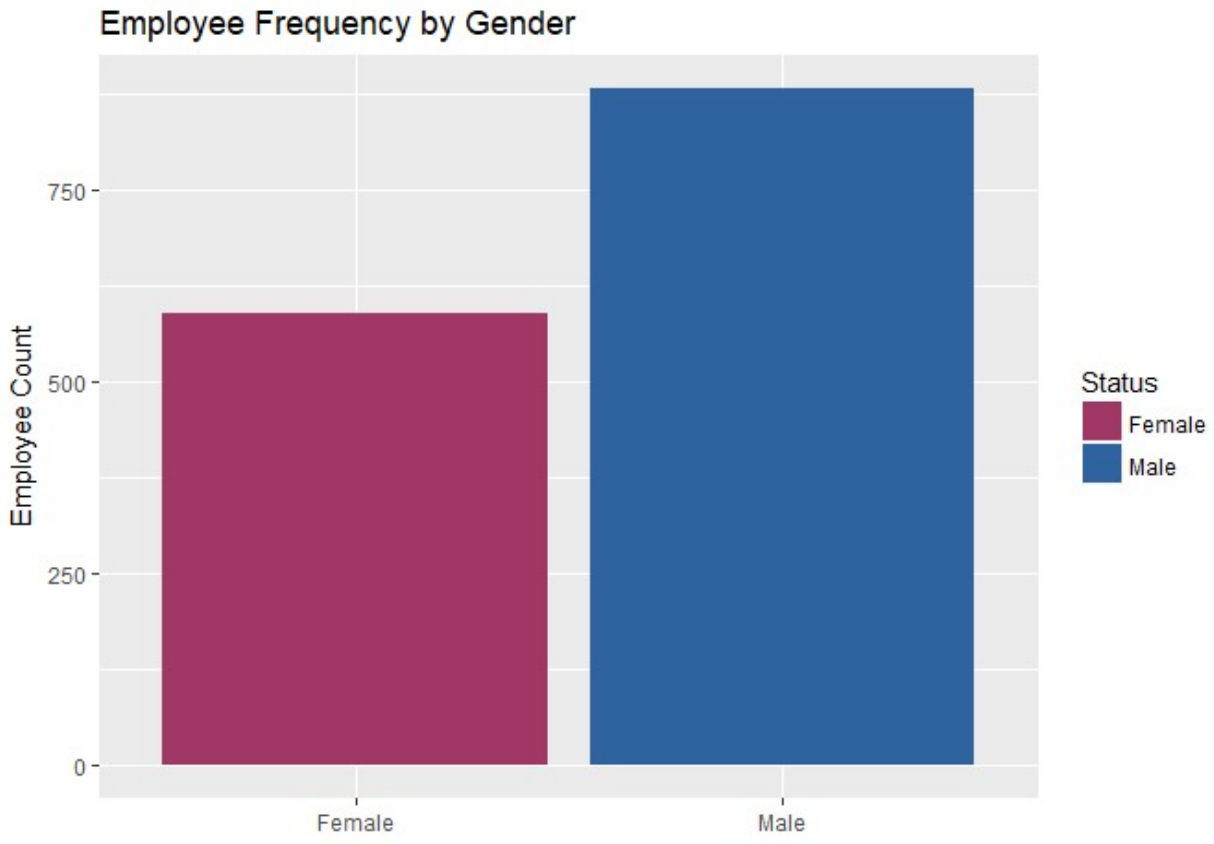

Employee Distribution by Hourly Rate
Employee Count
150
100
50
0
40
60
80
100
Hourly Rate
Status
Current
Terminated

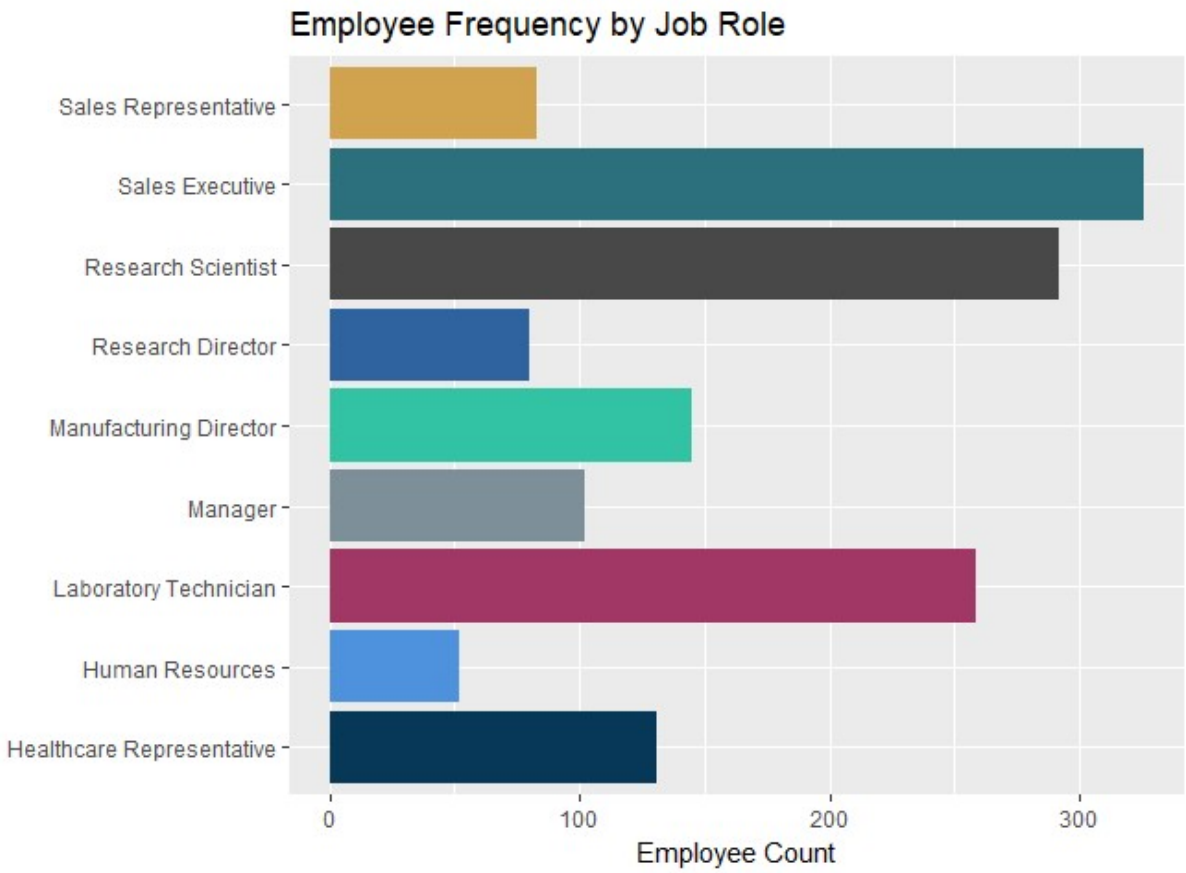

Employee Distribution by Number of Companies Worked
Employee Count
500
400
300
200
100
0
0.0
2.5
5.0
7.5
10.0
Number of Companies
Status
Current
Terminated



Frequencies

The following are frequencies by Gender and Job Roles



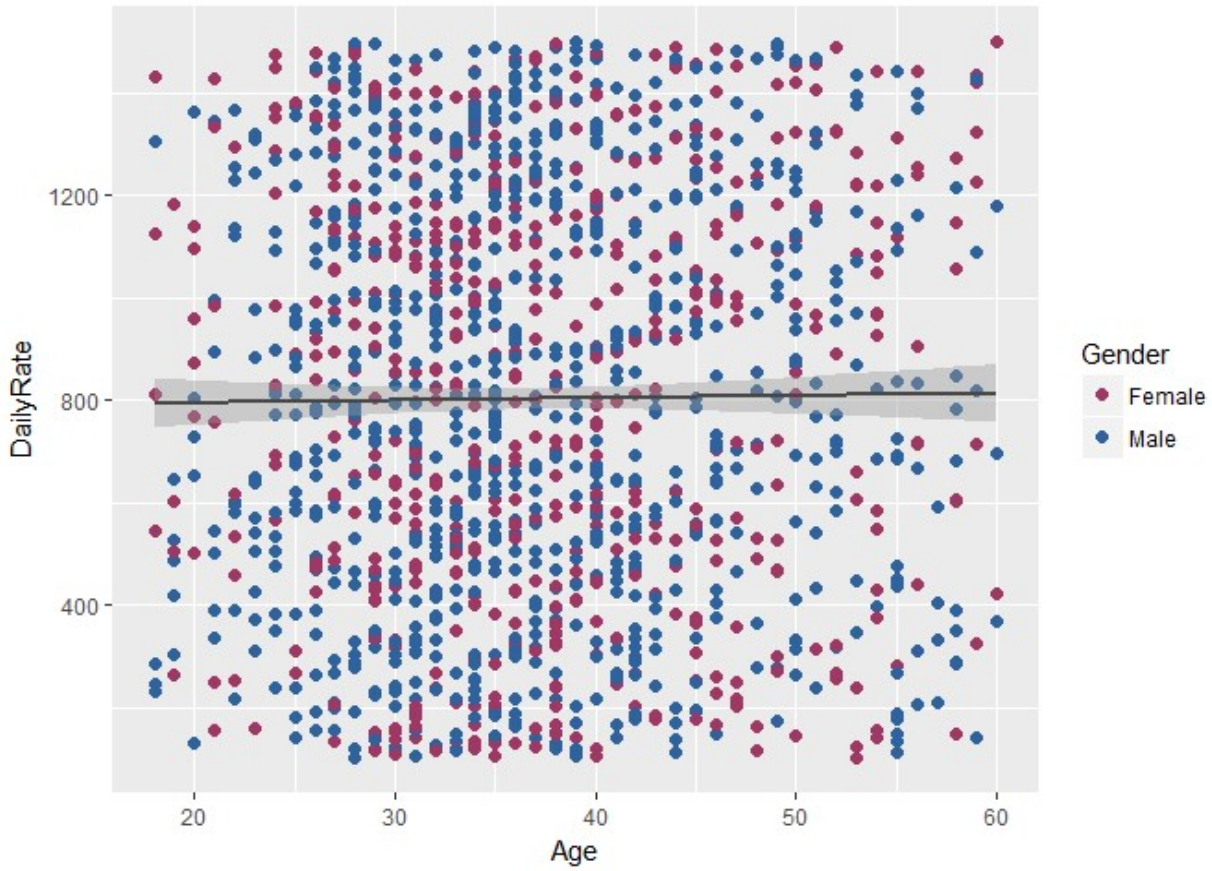


As requested we have captured the counts of management positions in the table below:

	Count
Sales Executives	326
Manufacturing Directors	145
Managers	102
Research Directors	80

Is there a relationship between Age and Income?

There's no apparent relationship between Age and Income. The plot below shows a very slight upward incline as age increases but is relatively insignificant.



What are the top 3 factors that lead to attrition?

Using the Stepwise Variable selction method we have determined that the most effective predictors of years with the company are Years with Current Manager, Training Times Last Year, Years In CurrentRole, Years Since Last Promotion, Number of Companies Worked, Age, Monthly Income, Job Involvement, Percent Salary Hike and DailyRate.

These factors can be used to predict how long in years an employee will stay with the company using a statistical formula.

We advise caution be used in decision making based on the following variables for ethical or even legal reasons:

- Gender
- Marital Status
- Relationship Satisfaction
- Total Working Years
- Age

Our model actually only uses one of these factors (Age) which if used as a factor in decision making could be considered discriminatory therefore this analysis should be used with caution.

Inference can only be drawn to the employees in our dataset and not an larger external population.

The top 3 factors that predict how long an employee will stay with the company in years are Years With Current Manager, Training Times Last Year and YearsInCurrentRole

Though this analysis is significant it is merely a proof of concept; higher quality results can be achieved wiht additional time and resources for analyzing the data.

Appendix

```
## Stepwise Selection Method
## ---------------------------
##
## Candidate Terms:
##
## 1. Age
## 2. DailyRate
## 3. DistanceFromHome
## 4. Education
## 5. EnvironmentSatisfaction
## 6. HourlyRate
## 7. JobInvolvement
## 8. JobLevel
## 9. JobSatisfaction
## 10. MonthlyIncome
## 11. MonthlyRate
## 12. NumCompaniesWorked
## 13. PercentSalaryHike
## 14. PerformanceRating
## 15. RelationshipSatisfaction
## 16. StockOptionLevel
## 17. TotalWorkingYears
## 18. TrainingTimesLastYear
## 19. WorkLifeBalance
## 20. YearsInCurrentRole
## 21. YearsSinceLastPromotion
## 22. YearsWithCurrManager
##
## We are selecting variables based on p value...
##
## Variables Entered/Removed:
##
## - YearsWithCurrManager added
## - TrainingTimesLastYear added
## - YearsInCurrentRole added
## - YearsSinceLastPromotion added
## - NumCompaniesWorked added
## - Age added
## - MonthlyIncome added
## - JobInvolvement added
## - PercentSalaryHike added
## - DailyRate added
##
## No more variables to be added/removed.
##
##
## Final Model Output
## ------------------
##
##                         Model Summary
## ----------------------------------------------------------------
## R                       0.884       RMSE                2.877
```

```
## R-Squared               0.781       Coef. Var          41.051
## Adj. R-Squared          0.779       MSE                 8.277
## Pred R-Squared          0.775       MAE                 1.897
## ----------------------------------------------------------------
##  RMSE: Root Mean Square Error
##  MSE: Mean Square Error
##  MAE: Mean Absolute Error
##
##                                 ANOVA
## --------------------------------------------------------------------------
##                  Sum of
##                 Squares          DF    Mean Square       F         Sig.
## --------------------------------------------------------------------------
## Regression    43062.379          10       4306.238    520.292    0.0000
## Residual      12075.523        1459          8.277
## Total         55137.902        1469
## --------------------------------------------------------------------------
##
##                                      Parameter Estimate
s
## ------------------------------------------------------------------------------
-------------------
##                   model      Beta    Std. Error    Std. Beta      t        Si
g      lower     upper
## ------------------------------------------------------------------------------
-------------------
##             (Intercept)     2.117         0.563                 3.756    0.00
0     1.011     3.222
##    YearsWithCurrManager     0.563         0.032        0.328    17.770    0.00
0     0.500     0.625
##   TrainingTimesLastYear     0.240         0.020        0.305    12.143    0.00
0     0.202     0.279
##      YearsInCurrentRole     0.468         0.032        0.277    14.780    0.00
0     0.406     0.530
## YearsSinceLastPromotion     0.310         0.029        0.163    10.714    0.00
0     0.254     0.367
##      NumCompaniesWorked    -0.286         0.033       -0.117    -8.769    0.00
0    -0.350    -0.222
##                     Age    -0.030         0.012       -0.045    -2.589    0.01
0    -0.053    -0.007
##           MonthlyIncome     0.000         0.000        0.047     2.443    0.01
5     0.000     0.000
##          JobInvolvement    -0.191         0.106       -0.022    -1.807    0.07
1    -0.399     0.016
##       PercentSalaryHike    -0.036         0.021       -0.021    -1.742    0.08
2    -0.076     0.005
##              DailyRate     0.000         0.000       -0.021    -1.716    0.08
6    -0.001     0.000
## ------------------------------------------------------------------------------
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```
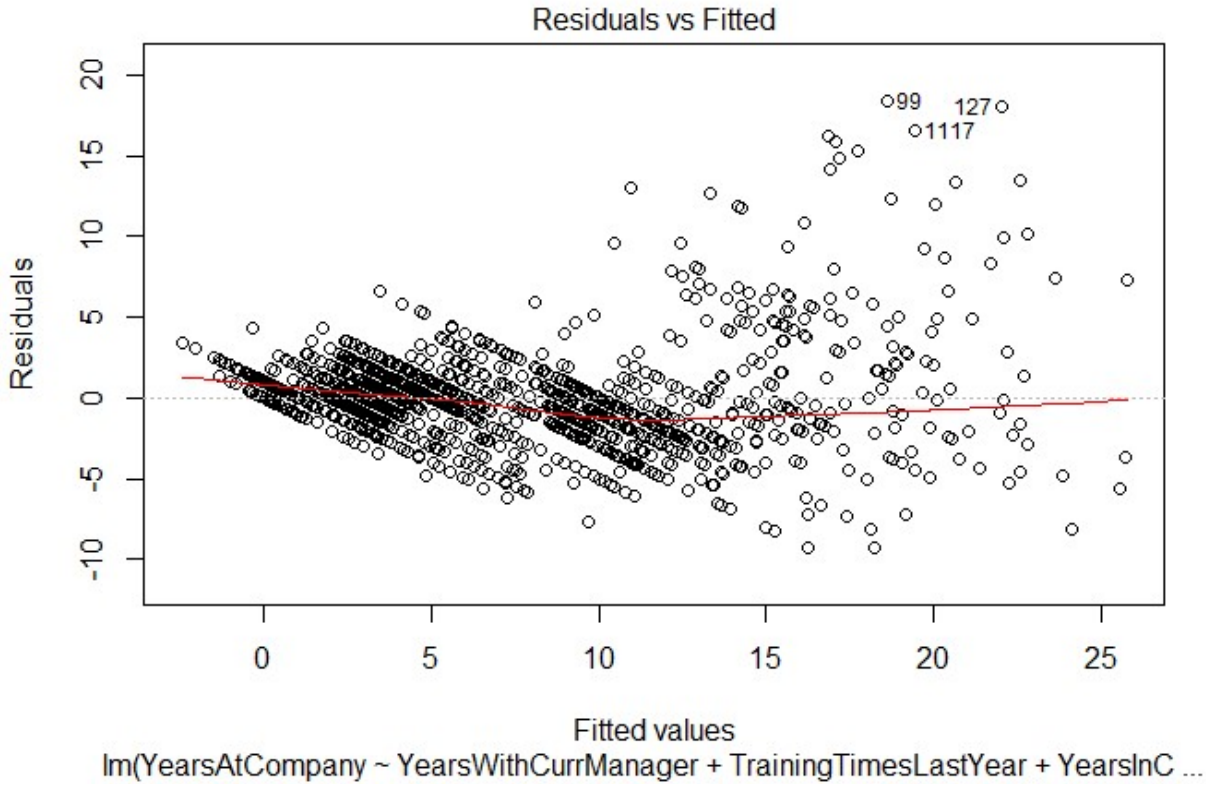
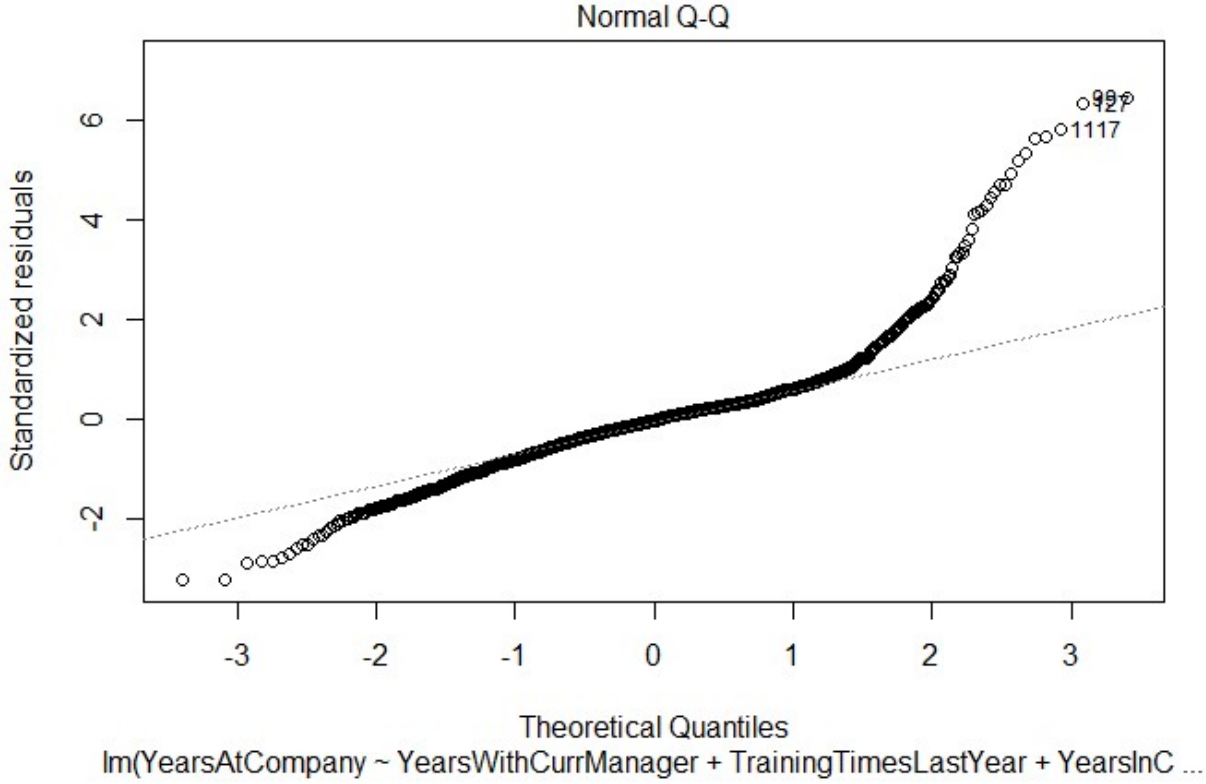
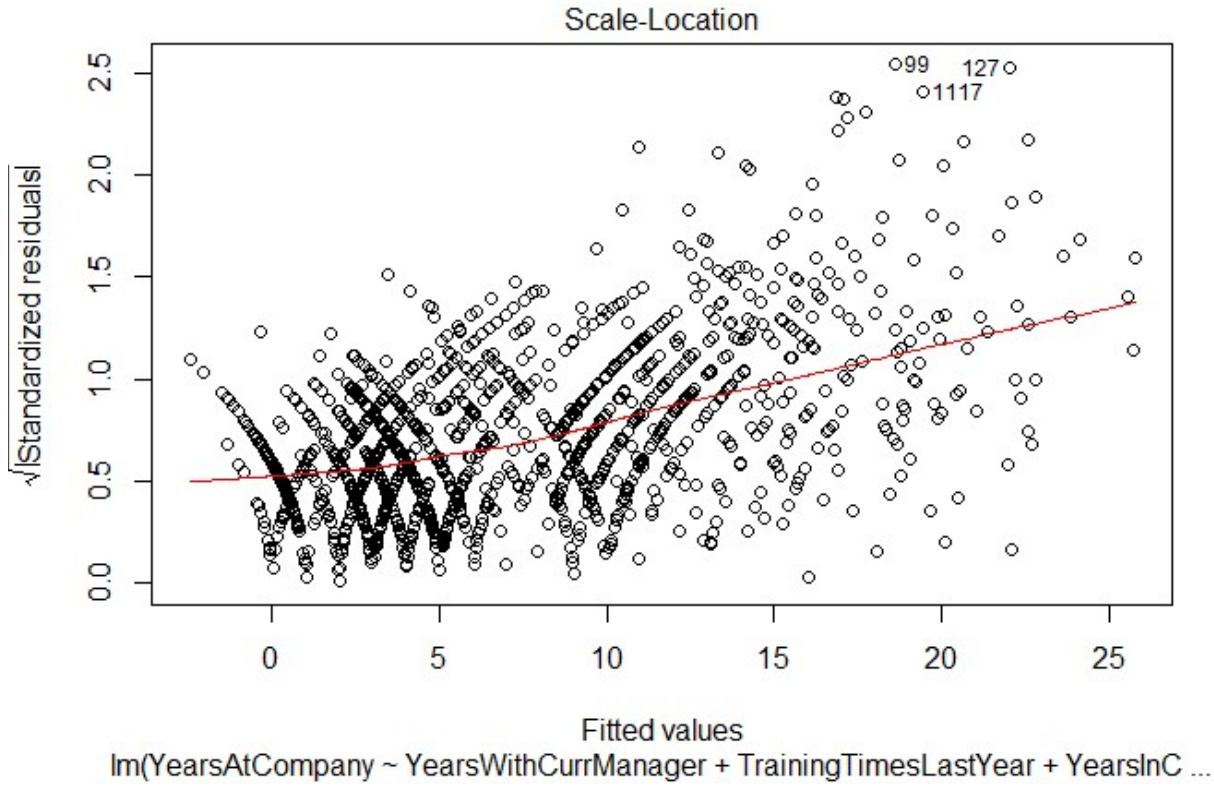
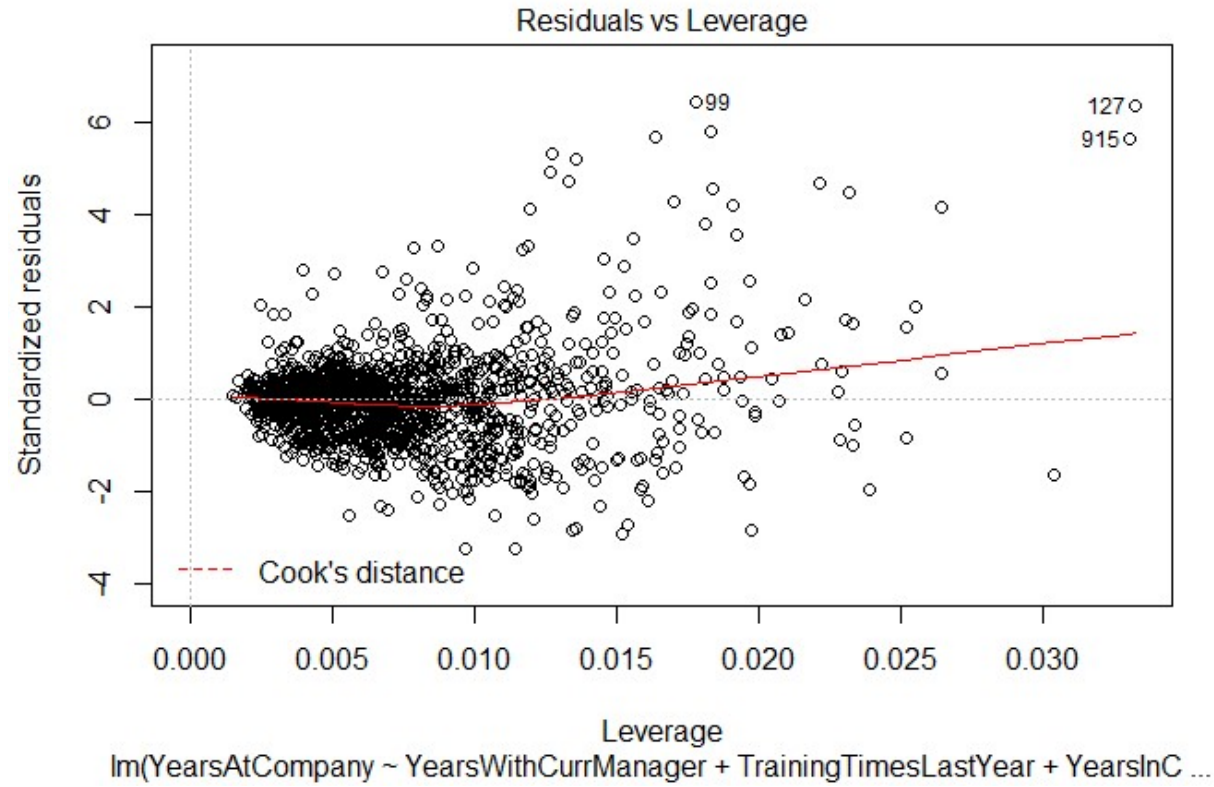

```
##
##                                     Stepwise Selection Summar
y
## ------------------------------------------------------------------------------
----------------------
##                                   Added/                   Ad
j.
## Step           Variable            Removed     R-Square    R-Square      C
(p)          AIC        RMSE
## ------------------------------------------------------------------------------
----------------------
##    1     YearsWithCurrManager      addition       0.592       0.591    1244.358
0    8189.0915    3.9161
##    2     TrainingTimesLastYear     addition       0.687       0.687     610.605
0    7798.1456    3.4274
##    3      YearsInCurrentRole       addition       0.744       0.744     234.642
0    7504.4996    3.1005
##    4    YearsSinceLastPromotion    addition       0.764       0.763     107.830
0    7390.4311    2.9815
##    5      NumCompaniesWorked       addition       0.777       0.777      19.568
0    7305.2675    2.8954
##    6              Age              addition       0.779       0.778      13.486
0    7299.2046    2.8885
##    7         MonthlyIncome         addition       0.780       0.779       9.275
0    7294.9777    2.8833
##    8        JobInvolvement         addition       0.780       0.779       7.847
0    7293.5298    2.8810
##    9       PercentSalaryHike       addition       0.781       0.779       6.683
0    7292.3412    2.8788
##   10           DailyRate           addition       0.781       0.779       5.751
0    7291.3789    2.8769
## ------------------------------------------------------------------------------
----------------------
```

```
##
## Call:
## lm(formula = YearsAtCompany ~ YearsWithCurrManager + TrainingTimesLastYear +
##     YearsInCurrentRole + YearsSinceLastPromotion + NumCompaniesWorked +
##     Age + MonthlyIncome + JobInvolvement + PercentSalaryHike +
##     DailyRate, data = MyPredictionData)
##
## Coefficients:
##             (Intercept)     YearsWithCurrManager    TrainingTimesLastYear
##               2.117e+00                5.626e-01                2.404e-01
##      YearsInCurrentRole  YearsSinceLastPromotion       NumCompaniesWorked
##               4.678e-01                3.104e-01               -2.857e-01
##                     Age            MonthlyIncome           JobInvolvement
##              -2.995e-02                6.177e-05               -1.914e-01
##       PercentSalaryHike               DailyRate
##              -3.578e-02               -3.204e-04
```


Residuals vs Fitted
Residuals
Fitted values
lm(YearsAtCompany ~ YearsWithCurrManager + TrainingTimesLastYear + YearsInC ...
99
127
1117
-10
-5
0
5
10
15
20
0
5
10
15
20
25


Normal Q-Q
Standardized residuals
Theoretical Quantiles
lm(YearsAtCompany ~ YearsWithCurrManager + TrainingTimesLastYear + YearsInC ...
99
127
1117
-2
0
2
4
6
-3
-2
-1
0
1
2
3


Scale-Location
99
127
1117
√|Standardized residuals|
0.0
0.5
1.0
1.5
2.0
2.5
0
5
10
15
20
25
Fitted values
lm(YearsAtCompany ~ YearsWithCurrManager + TrainingTimesLastYear + YearsInC ...


Residuals vs Leverage
99
127
915
Standardized residuals
6
4
2
0
-2
-4
Cook's distance
0.000
0.005
0.010
0.015
0.020
0.025
0.030
Leverage
lm(YearsAtCompany ~ YearsWithCurrManager + TrainingTimesLastYear + YearsInC ...