analysis.rmd

2025-12-02

```
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
Loading required package: carData

Attaching package: 'car'
The following object is masked from 'package:dplyr':

    recode
Loading required package: lattice

Attaching package: 'olsrr'
The following object is masked from 'package:datasets':

    rivers
```

```r
df <- read.csv("main.csv")
df <- na.omit(df)
head(df)
```

```
##                    Player Team  G   MP FG_pct  FTA  TRB  AST stocks  PTS
## 1 Shai Gilgeous-Alexander  OKC 76 34.2  0.519  8.8  5.0  6.4    2.7 32.7
## 2   Giannis Antetokounmpo  MIL 67 34.2  0.601 10.6 11.9  6.5    2.1 30.4
## 3            Nikola Jokić  DEN 70 36.7  0.576  6.4 12.7 10.2    2.4 29.6
## 5         Anthony Edwards  MIN 79 36.3  0.447  6.3  5.7  4.5    1.8 27.6
## 6            Jayson Tatum  BOS 72 36.4  0.452  6.1  8.7  6.0    1.6 26.8
## 7            Kevin Durant  PHO 62 36.5  0.527  5.8  6.0  4.2    2.0 26.6
##   Value_Billions awards_1 awards_2plus avg_salary_millions Age_22_26 Age_27_31
## 1           4.35        0            1             55.3591         1         0
## 2           4.30        0            1             58.4566         0         1
## 3           4.60        0            1             59.0331         0         1
## 5           3.60        0            1             50.6117         1         0
## 6           6.70        0            1             62.7867         1         0
## 7           5.43        1            0             54.7086         0         0
##   Age_32_34 Age_35_plus Pos_PF Pos_PG Pos_SF Pos_SG   Age    Awards
## 1         0           0      0      1      0      0 Age_1 2+ awards
## 2         0           0      1      0      0      0 Age_2 2+ awards
```

```
## 3         0           0      0      0      0      0 Age_2 2+ awards
## 5         0           0      0      0      0      1 Age_1 2+ awards
## 6         0           0      1      0      0      0 Age_1 2+ awards
## 7         0           1      1      0      0      0 Age_4   1 award
```

Initial Model Creation

```
initial_model <- lm(avg_salary_millions ~ MP + PTS + FG_pct + FTA + TRB + AST + stocks + Value_Billions
summary(initial_model)
```

```
##
## Call:
## lm(formula = avg_salary_millions ~ MP + PTS + FG_pct + FTA +
##     TRB + AST + stocks + Value_Billions + (PTS * FTA), data = df)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -30.1308  -5.2910   0.0091   4.4900  26.9012
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)     -2.32238    4.11447  -0.564  0.57290
## MP              -0.19778    0.16255  -1.217  0.22473
## PTS              1.44802    0.28750   5.037 8.45e-07 ***
## FG_pct         -10.02353    7.82553  -1.281  0.20129
## FTA             -2.07371    1.13461  -1.828  0.06865 .
## TRB              0.79491    0.30568   2.600  0.00980 **
## AST              1.06854    0.40188   2.659  0.00829 **
## stocks           3.12002    1.13606   2.746  0.00641 **
## Value_Billions   0.25564    0.25489   1.003  0.31675
## PTS:FTA          0.11387    0.04448   2.560  0.01099 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 8.269 on 283 degrees of freedom
## Multiple R-squared:  0.7495, Adjusted R-squared:  0.7415
## F-statistic: 94.07 on 9 and 283 DF,  p-value: < 2.2e-16
```

VIF Analysis

```
vif_values <- vif(initial_model)
```

```
## there are higher-order terms (interactions) in this model
## consider setting type = 'predictor'; see ?vif
```

```
print(vif_values)
```

```
##             MP            PTS         FG_pct            FTA            TRB
##       8.239128      16.765183       1.521308      19.180468       2.486230
##            AST         stocks Value_Billions        PTS:FTA
##       2.726504       2.127730       1.021384      21.624494
```

```r
# high vifs detected, remove
vif_less <- lm(avg_salary_millions ~ MP + PTS + FG_pct + FTA + TRB + AST + stocks + Value_Billions, data
print(vif(vif_less))
```

```
##             MP            PTS         FG_pct            FTA            TRB
##       7.020613      13.503046       1.500397       6.538584       2.477370
##            AST         stocks Value_Billions
##       2.670589       2.127717       1.013432
```

Stepwise

```r
ols_step_both_p(vif_less,p_ent=0.15,p_rem=0.15,details=T)
```

```
## Stepwise Selection Method
## -------------------------
##
## Candidate Terms:
##
## 1. MP
## 2. PTS
## 3. FG_pct
## 4. FTA
## 5. TRB
## 6. AST
## 7. stocks
## 8. Value_Billions
##
##
## Step   => 0
## Model  => avg_salary_millions ~ 1
## R2     => 0
##
## Initiating stepwise selection...
##
## Step      => 1
## Selected  => PTS
## Model     => avg_salary_millions ~ PTS
## R2        => 0.715
##
## Step      => 2
## Selected  => stocks
## Model     => avg_salary_millions ~ PTS + stocks
## R2        => 0.724
##
## Step      => 3
## Selected  => AST
## Model     => avg_salary_millions ~ PTS + stocks + AST
## R2        => 0.732
##
## Step      => 4
## Selected  => MP
## Model     => avg_salary_millions ~ PTS + stocks + AST + MP
## R2        => 0.736
```

```
##
## Step      => 5
## Selected  => TRB
## Model     => avg_salary_millions ~ PTS + stocks + AST + MP + TRB
## R2        => 0.74
##
## Step      => 6
## Selected  => FG_pct
## Model     => avg_salary_millions ~ PTS + stocks + AST + MP + TRB + FG_pct
## R2        => 0.742
##
##
## No more variables to be added or removed.
```

```
##
##
##                                Stepwise Summary
## ----------------------------------------------------------------------------
## Step    Variable        AIC         SBC         SBIC        R2       Adj. R2
## ----------------------------------------------------------------------------
##  0      Base Model    2468.817    2476.178    1634.766    0.00000    0.00000
##  1      PTS (+)       2102.890    2113.930    1271.095    0.71513    0.71415
##  2      stocks (+)    2095.460    2110.181    1263.711    0.72415    0.72225
##  3      AST (+)       2089.525    2107.925    1257.906    0.73152    0.72874
##  4      MP (+)        2086.670    2108.751    1255.187    0.73593    0.73227
##  5      TRB (+)       2083.963    2109.724    1252.676    0.74014    0.73562
##  6      FG_pct (+)    2083.664    2113.105    1252.524    0.74217    0.73677
## ----------------------------------------------------------------------------
##
## Final Model Output
## ------------------
##
##                          Model Summary
## ----------------------------------------------------------------
## R                       0.861       RMSE                 8.244
## R-Squared               0.742       MSE                 67.965
## Adj. R-Squared          0.737       Coef. Var           50.835
## Pred R-Squared          0.728       AIC               2083.664
## MAE                     6.429       SBC               2113.105
## ----------------------------------------------------------------
##  RMSE: Root Mean Square Error
##  MSE: Mean Square Error
##  MAE: Mean Absolute Error
##  AIC: Akaike Information Criteria
##  SBC: Schwarz Bayesian Criteria
##
##                                 ANOVA
## --------------------------------------------------------------------------
##                  Sum of
##                 Squares         DF    Mean Square       F         Sig.
## --------------------------------------------------------------------------
## Regression    57323.780          6       9553.963    137.213    0.0000
## Residual      19913.802        286         69.629
## Total         77237.582        292
```

```
## ------------------------------------------------------------------------
##
##                                 Parameter Estimates
## ----------------------------------------------------------------------------------------------
##       model       Beta    Std. Error    Std. Beta      t        Sig       lower     upper
## ----------------------------------------------------------------------------------------------
## (Intercept)     -1.223         3.979                -0.307    0.759     -9.055     6.609
##         PTS      1.844         0.164        0.781   11.221    0.000      1.520     2.167
##      stocks      3.045         1.137        0.116    2.679    0.008      0.808     5.283
##         AST      1.254         0.396        0.153    3.163    0.002      0.474     2.034
##          MP     -0.375         0.135       -0.197   -2.768    0.006     -0.641    -0.108
##         TRB      0.779         0.300        0.120    2.601    0.010      0.190     1.369
##      FG_pct    -11.749         7.827       -0.055   -1.501    0.134    -27.155     3.658
## ----------------------------------------------------------------------------------------------
```

T-Test Quant Only

```
summary(vif_less)
```

```
##
## Call:
## lm(formula = avg_salary_millions ~ MP + PTS + FG_pct + FTA +
##     TRB + AST + stocks + Value_Billions, data = df)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -30.0240  -5.5008  -0.2633   4.8354  26.2877
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)     -2.6726     4.1522  -0.644  0.52032
## MP              -0.3578     0.1515  -2.362  0.01887 *
## PTS              1.7727     0.2605   6.804 6.02e-11 ***
## FG_pct         -12.3722     7.8472  -1.577  0.11599
## FTA              0.2843     0.6689   0.425  0.67111
## TRB              0.7482     0.3081   2.428  0.01579 *
## AST              1.2159     0.4016   3.028  0.00269 **
## stocks           3.1129     1.1471   2.714  0.00706 **
## Value_Billions   0.3132     0.2564   1.222  0.22282
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 8.349 on 284 degrees of freedom
## Multiple R-squared:  0.7437, Adjusted R-squared:  0.7364
## F-statistic:   103 on 8 and 284 DF,  p-value: < 2.2e-16
```

New Model as a Result of Test

```
quant <- lm(avg_salary_millions ~ MP + PTS + TRB + AST, data = df)
summary(quant)
```

```
##
```

```
## Call:
## lm(formula = avg_salary_millions ~ MP + PTS + TRB + AST, data = df)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -31.2415  -5.1619   0.0729   4.5430  28.4028
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -6.3780     1.6228  -3.930 0.000106 ***
## MP           -0.2091     0.1235  -1.693 0.091484 .
## PTS           1.7512     0.1627  10.761  < 2e-16 ***
## TRB           0.8646     0.2454   3.524 0.000495 ***
## AST           1.3825     0.3963   3.488 0.000562 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 8.434 on 288 degrees of freedom
## Multiple R-squared:  0.7347, Adjusted R-squared:  0.7311
## F-statistic: 199.4 on 4 and 288 DF,  p-value: < 2.2e-16
```

Adding Qualitative Predictors

```
quant_and_qual <- lm(avg_salary_millions ~ MP + PTS + TRB + AST + awards_1 + awards_2plus + Age_22_26 +
summary(quant_and_qual)
```

```
##
## Call:
## lm(formula = avg_salary_millions ~ MP + PTS + TRB + AST + awards_1 +
##     awards_2plus + Age_22_26 + Age_27_31 + Age_32_34 + Age_35_plus +
##     Pos_PF + Pos_PG + Pos_SF + Pos_SG, data = df)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -25.5348  -4.1983  -0.6067   5.0558  24.9099
##
## Coefficients: (1 not defined because of singularities)
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -4.114614   2.672790  -1.539  0.12483
## MP            0.009948   0.131089   0.076  0.93956
## PTS           1.453234   0.165701   8.770  < 2e-16 ***
## TRB          -0.084596   0.346047  -0.244  0.80705
## AST           1.544745   0.459850   3.359  0.00089 ***
## awards_1      4.356863   2.255561   1.932  0.05442 .
## awards_2plus 11.834128   2.472409   4.786 2.76e-06 ***
## Age_22_26     0.099894   2.080365   0.048  0.96174
## Age_27_31     4.190384   2.162765   1.938  0.05369 .
## Age_32_34     2.994712   2.505735   1.195  0.23305
## Age_35_plus         NA         NA      NA       NA
## Pos_PF        0.276624   1.592812   0.174  0.86225
## Pos_PG       -4.665921   2.340322  -1.994  0.04716 *
## Pos_SF       -3.381229   1.836950  -1.841  0.06673 .
## Pos_SG       -5.236117   1.980071  -2.644  0.00865 **
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 7.832 on 279 degrees of freedom
## Multiple R-squared:  0.7784, Adjusted R-squared:  0.7681
## F-statistic: 75.39 on 13 and 279 DF,  p-value: < 2.2e-16
```

ANOVA Test for reduced model (Awards)

```
reduced_awards <- lm(avg_salary_millions ~ MP + PTS + TRB + AST + Age_22_26 + Age_27_31 + Age_32_34 + Ag
anova(reduced_awards, quant_and_qual)
```

```
## Analysis of Variance Table
##
## Model 1: avg_salary_millions ~ MP + PTS + TRB + AST + Age_22_26 + Age_27_31 +
##     Age_32_34 + Age_35_plus + Pos_PF + Pos_PG + Pos_SF + Pos_SG
## Model 2: avg_salary_millions ~ MP + PTS + TRB + AST + awards_1 + awards_2plus +
##     Age_22_26 + Age_27_31 + Age_32_34 + Age_35_plus + Pos_PF +
##     Pos_PG + Pos_SF + Pos_SG
##   Res.Df   RSS Df Sum of Sq      F    Pr(>F)
## 1    281 18582
## 2    279 17116  2    1466.4 11.952 1.047e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

ANOVA Test for reduced model (Age)

```
reduced_age <- lm(avg_salary_millions ~ MP + PTS + TRB + AST + awards_1 + awards_2plus + Pos_PF + Pos_P
anova(reduced_age, quant_and_qual)
```

```
## Analysis of Variance Table
##
## Model 1: avg_salary_millions ~ MP + PTS + TRB + AST + awards_1 + awards_2plus +
##     Pos_PF + Pos_PG + Pos_SF + Pos_SG
## Model 2: avg_salary_millions ~ MP + PTS + TRB + AST + awards_1 + awards_2plus +
##     Age_22_26 + Age_27_31 + Age_32_34 + Age_35_plus + Pos_PF +
##     Pos_PG + Pos_SF + Pos_SG
##   Res.Df   RSS Df Sum of Sq      F   Pr(>F)
## 1    282 18105
## 2    279 17116  3    988.97 5.3736 0.001306 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

ANOVA Test for reduced model (Pos)

```
reduced_pos <- lm(avg_salary_millions ~ MP + PTS + TRB + AST + awards_1 + awards_2plus + Age_22_26 + Ag
anova(reduced_pos, quant_and_qual)
```

```
## Analysis of Variance Table
##
## Model 1: avg_salary_millions ~ MP + PTS + TRB + AST + awards_1 + awards_2plus +
```

```
##     Age_22_26 + Age_27_31 + Age_32_34 + Age_35_plus
## Model 2: avg_salary_millions ~ MP + PTS + TRB + AST + awards_1 + awards_2plus +
##     Age_22_26 + Age_27_31 + Age_32_34 + Age_35_plus + Pos_PF +
##     Pos_PG + Pos_SF + Pos_SG
##   Res.Df   RSS Df Sum of Sq      F   Pr(>F)
## 1    283 17960
## 2    279 17116  4    844.26 3.4405 0.009149 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Confidence Intervals

```
conf <- confint(quant_and_qual, level = 0.95)
conf
```

```
##                    2.5 %      97.5 %
## (Intercept)  -9.37600976  1.14678214
## MP           -0.24810170  0.26799800
## PTS           1.12705068  1.77941713
## TRB          -0.76579043  0.59659941
## AST           0.63952979  2.44996070
## awards_1     -0.08321464  8.79694141
## awards_2plus  6.96718419 16.70107227
## Age_22_26    -3.99531150  4.19509932
## Age_27_31    -0.06702517  8.44779358
## Age_32_34    -1.93783492  7.92725821
## Age_35_plus           NA          NA
## Pos_PF       -2.85883188  3.41207906
## Pos_PG       -9.27285233 -0.05899061
## Pos_SF       -6.99727148  0.23481320
## Pos_SG       -9.13389344 -1.33833995
```

K-Fold Cross Validation

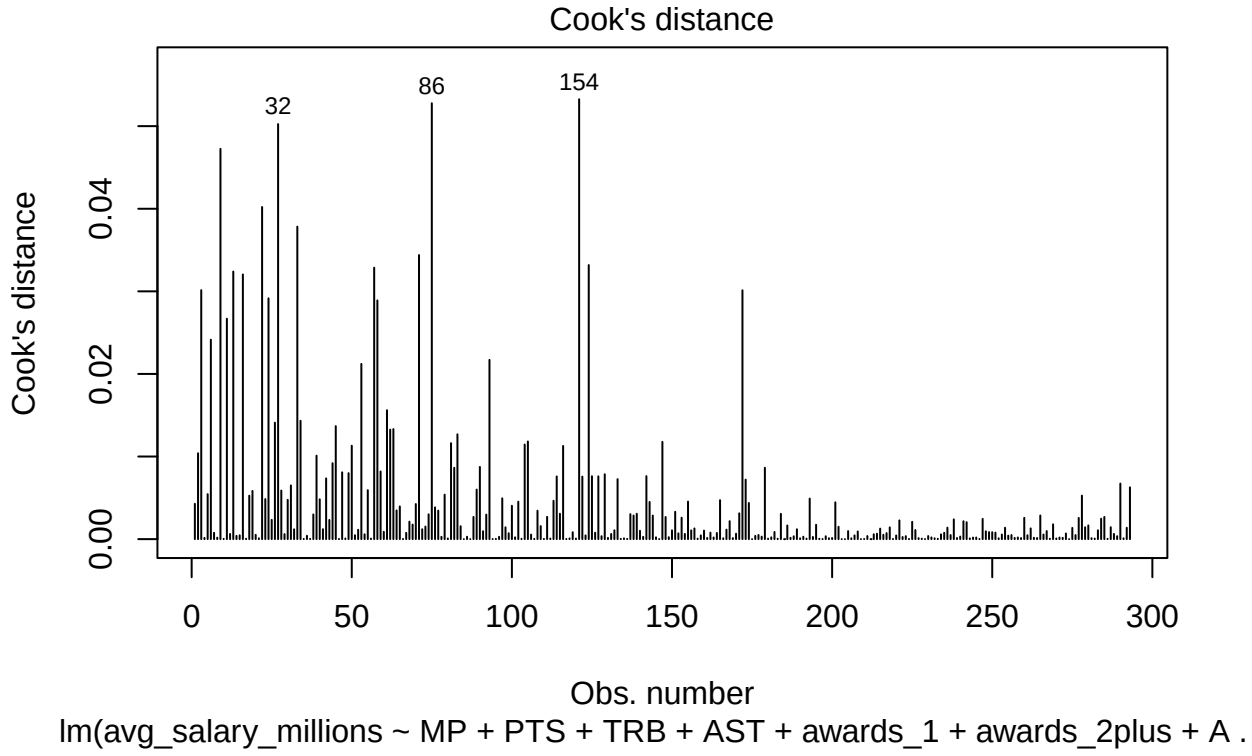
```
cv_model <- train(
  avg_salary_millions ~ MP + PTS + TRB + AST + awards_1 + awards_2plus + Age_22_26 + Age_27_31 +   Age_3
  method = "lm",
  trControl = trainControl(method = "cv", number = 5)
)

# display results
print(cv_model)
```

```
## Linear Regression
##
## 293 samples
##  14 predictor
##
## No pre-processing
## Resampling: Cross-Validated (5 fold)
## Summary of sample sizes: 234, 233, 234, 236, 235
## Resampling results:
##
```

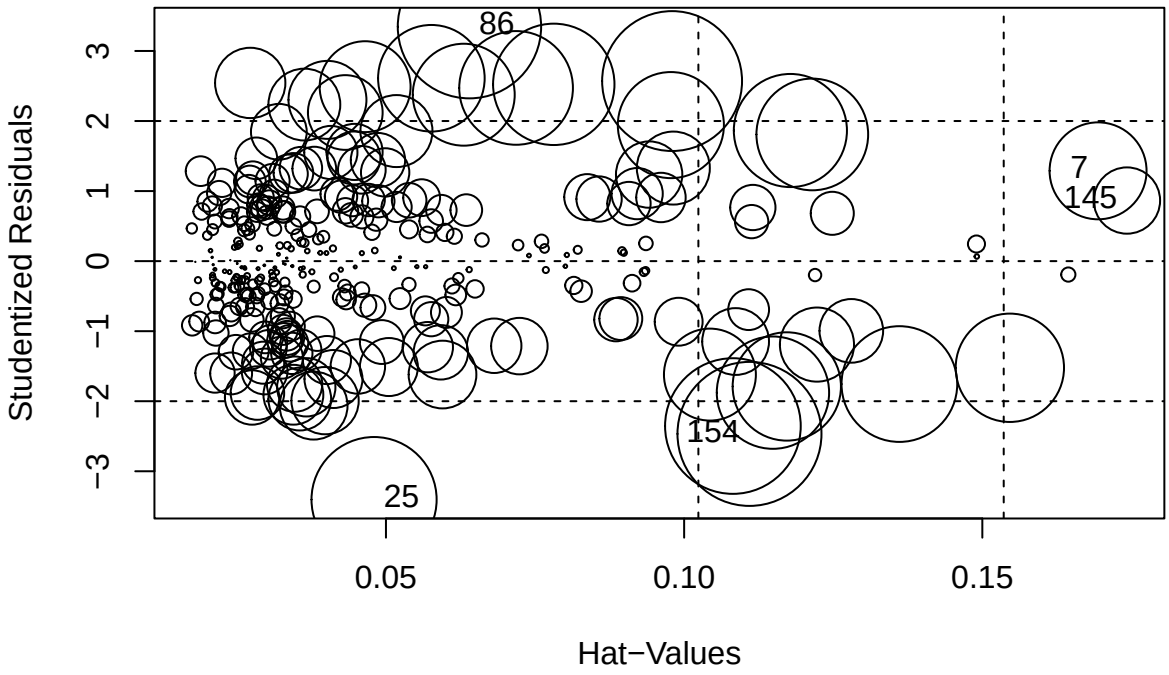
```
##   RMSE      Rsquared   MAE
##   8.051693  0.7608791  6.300267
##
## Tuning parameter 'intercept' was held constant at a value of TRUE
```

Residual Analysis

```
# Cooks Distance Thresholds
plot(quant_and_qual,which=4)
```

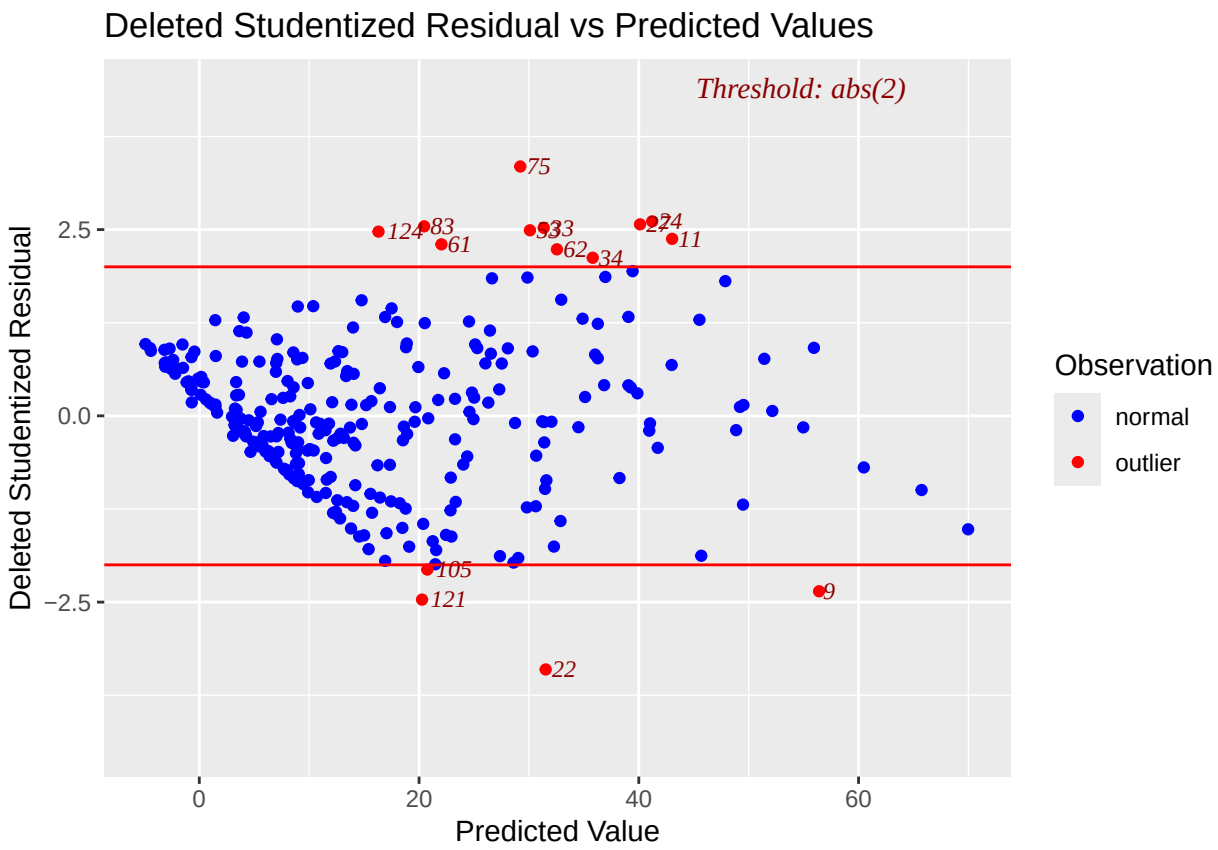



```
# Leverage vs Studentized Residuals
influencePlot(quant_and_qual,fill=F)
```




```
##        StudRes        Hat      CookD
## 7    1.2889804 0.16940188 0.02414702
## 25  -3.4041183 0.04800574 0.04021274
## 86   3.3468310 0.06400243 0.05277950
## 145  0.8648404 0.17424756 0.01128375
## 154 -2.4664804 0.11095420 0.05326048
```

```
# Deleted Studentized Residuals vs Predicted values
ols_plot_resid_stud_fit(quant_and_qual)
```



remove obs 86 and 154

```
df <- df[-c(86, 154), ]
```