# Final project: Investigate the impact of a number of automobile engine factors

2022-11-15

**installing packages and utilizing them in the code:**

```
install.packages("tinytex", repos = "http://cran.us.r-project.org")
```

```
## Installing package into 'C:/Users/vkoyya/AppData/Local/R/win-library/4.2'
## (as 'lib' is unspecified)

## package 'tinytex' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
##  C:\Users\vkoyya\AppData\Local\Temp\RtmpiG2xtU\downloaded_packages
```

```
install.packages("dplyr", repos = "http://cran.us.r-project.org")
```

```
## Installing package into 'C:/Users/vkoyya/AppData/Local/R/win-library/4.2'
## (as 'lib' is unspecified)

## package 'dplyr' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
##  C:\Users\vkoyya\AppData\Local\Temp\RtmpiG2xtU\downloaded_packages
```

```
install.packages("tidyr", repos = "http://cran.us.r-project.org")
```

```
## Installing package into 'C:/Users/vkoyya/AppData/Local/R/win-library/4.2'
## (as 'lib' is unspecified)

## package 'tidyr' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
##  C:\Users\vkoyya\AppData\Local\Temp\RtmpiG2xtU\downloaded_packages
```

```
install.packages("magrittr", repos = "http://cran.us.r-project.org")
```

```
## Installing package into 'C:/Users/vkoyya/AppData/Local/R/win-library/4.2'
## (as 'lib' is unspecified)
```

```
## package 'magrittr' successfully unpacked and MD5 sums checked

## Warning: cannot remove prior installation of package 'magrittr'

## Warning in file.copy(savedcopy, lib, recursive = TRUE):
## problem copying C:\Users\vkoyya\AppData\Local\R\win-
## library\4.2\00LOCK\magrittr\libs\x64\magrittr.dll to C:
## \Users\vkoyya\AppData\Local\R\win-library\4.2\magrittr\libs\x64\magrittr.dll:
## Permission denied

## Warning: restored 'magrittr'

##
## The downloaded binary packages are in
##  C:\Users\vkoyya\AppData\Local\Temp\RtmpiG2xtU\downloaded_packages
```

```
install.packages("knitr", repos = "http://cran.us.r-project.org")
```

```
## Installing package into 'C:/Users/vkoyya/AppData/Local/R/win-library/4.2'
## (as 'lib' is unspecified)

##
##   There is a binary version available but the source version is later:
##       binary source needs_compilation
## knitr   1.40   1.41             FALSE

## installing the source package 'knitr'
```

```
install.packages("glmnet", repos = "http://cran.us.r-project.org")
```

```
## Installing package into 'C:/Users/vkoyya/AppData/Local/R/win-library/4.2'
## (as 'lib' is unspecified)

## package 'glmnet' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
##  C:\Users\vkoyya\AppData\Local\Temp\RtmpiG2xtU\downloaded_packages
```

```
install.packages("leaps", repos = "http://cran.us.r-project.org")
```

```
## Installing package into 'C:/Users/vkoyya/AppData/Local/R/win-library/4.2'
## (as 'lib' is unspecified)

## package 'leaps' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
##  C:\Users\vkoyya\AppData\Local\Temp\RtmpiG2xtU\downloaded_packages
```

```
install.packages("gvlma", repos = "http://cran.us.r-project.org")
```

```
## Installing package into 'C:/Users/vkoyya/AppData/Local/R/win-library/4.2'
## (as 'lib' is unspecified)

## package 'gvlma' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
##  C:\Users\vkoyya\AppData\Local\Temp\RtmpiG2xtU\downloaded_packages
```

```
install.packages("psych", repos = "http://cran.us.r-project.org")
```

```
## Installing package into 'C:/Users/vkoyya/AppData/Local/R/win-library/4.2'
## (as 'lib' is unspecified)

## package 'psych' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
##  C:\Users\vkoyya\AppData\Local\Temp\RtmpiG2xtU\downloaded_packages
```

```
install.packages("latticeExtra", repos = "http://cran.us.r-project.org")
```

```
## Installing package into 'C:/Users/vkoyya/AppData/Local/R/win-library/4.2'
## (as 'lib' is unspecified)

## package 'latticeExtra' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
##  C:\Users\vkoyya\AppData\Local\Temp\RtmpiG2xtU\downloaded_packages
```

```
install.packages("caret", repos = "http://cran.us.r-project.org")
```

```
## Installing package into 'C:/Users/vkoyya/AppData/Local/R/win-library/4.2'
## (as 'lib' is unspecified)

## package 'caret' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
##  C:\Users\vkoyya\AppData\Local\Temp\RtmpiG2xtU\downloaded_packages
```

```
library(knitr)
library(magrittr)
```

```
## Warning: package 'magrittr' was built under R version 4.2.2
```

```
library(leaps)
```

```
## Warning: package 'leaps' was built under R version 4.2.2
```

```
library(gvlma)
library(glmnet)
```

```
## Warning: package 'glmnet' was built under R version 4.2.2
```

```
## Loading required package: Matrix
```

```
## Loaded glmnet 4.1-4
```

```
library(psych)
```

```
## Warning: package 'psych' was built under R version 4.2.2
```

```
library(caret)
```

```
## Warning: package 'caret' was built under R version 4.2.2
```

```
## Loading required package: ggplot2
```

```
##
## Attaching package: 'ggplot2'
```

```
## The following objects are masked from 'package:psych':
##
##     %+%, alpha
```

```
## Loading required package: lattice
```

```
library(latticeExtra)
```

```
## Warning: package 'latticeExtra' was built under R version 4.2.2
```

```
##
## Attaching package: 'latticeExtra'
```

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

```
library(dplyr)
```

```
## Warning: package 'dplyr' was built under R version 4.2.2
```

```
##
## Attaching package: 'dplyr'
```

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

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

```
library(tidyr)
```

```
## Warning: package 'tidyr' was built under R version 4.2.2
```

```
##
## Attaching package: 'tidyr'

## The following objects are masked from 'package:Matrix':
##
##     expand, pack, unpack

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

##Main input auto-mpg.csv file read:

```
mpgcoredf =  read.csv("C:/Users/Public/Project510/auto-mpg.csv")
str(mpgcoredf)
```

```
## 'data.frame':    398 obs. of  9 variables:
##  $ mpg         : num  18 15 18 16 17 15 14 14 14 15 ...
##  $ cylinder    : int  8 8 8 8 8 8 8 8 8 8 ...
##  $ displacement: num  307 350 318 304 302 429 454 440 455 390 ...
##  $ horsepower  : chr  "130" "165" "150" "150" ...
##  $ weight      : int  3504 3693 3436 3433 3449 4341 4354 4312 4425 3850 ...
##  $ acceleration: num  12 11.5 11 12 10.5 10 9 8.5 10 8.5 ...
##  $ model.year  : int  70 70 70 70 70 70 70 70 70 70 ...
##  $ origin      : int  1 1 1 1 1 1 1 1 1 1 ...
##  $ car.name    : chr  "chevrolet chevelle malibu" "buick skylark 320" "plymouth satellite" "amc rebel
```

##remodifying of the pandas dataframe

```
names(mpgcoredf) = c("mpg","cylinder","displacement","horsepower","weight","acceleration","model_year",
head(mpgcoredf)
```

```
##   mpg cylinder displacement horsepower weight acceleration model_year origin
## 1  18        8          307        130   3504         12.0         70      1
## 2  15        8          350        165   3693         11.5         70      1
## 3  18        8          318        150   3436         11.0         70      1
## 4  16        8          304        150   3433         12.0         70      1
## 5  17        8          302        140   3449         10.5         70      1
```

```
## 6  15        8          429        198   4341         10.0         70      1
##                   car_name
## 1 chevrolet chevelle malibu
## 2         buick skylark 320
## 3        plymouth satellite
## 4             amc rebel sst
## 5               ford torino
## 6          ford galaxie 500
```

```
mpgcoredf$horsepower[mpgcoredf$horsepower=="?"] = NA
mpgcoredf$horsepower = as.numeric(mpgcoredf$horsepower)
mpgcoredf$cylinder = as.numeric(mpgcoredf$cylinder)
str(mpgcoredf)
```

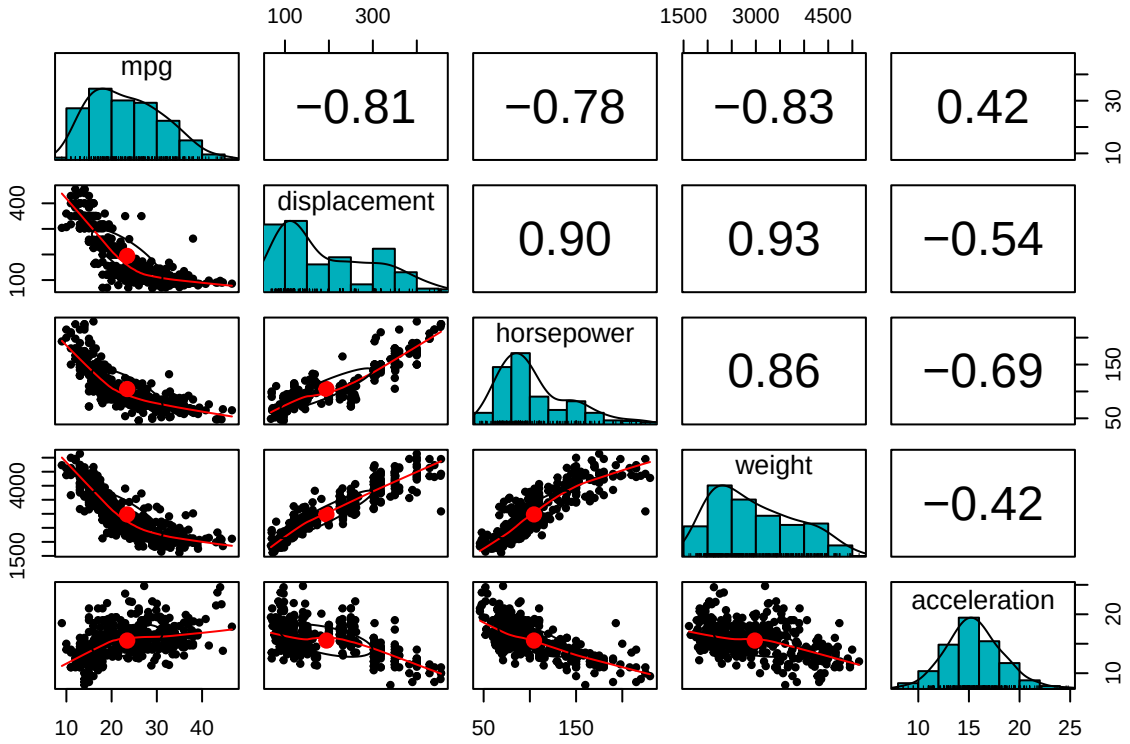
```
## 'data.frame':    398 obs. of  9 variables:
##  $ mpg         : num  18 15 18 16 17 15 14 14 14 15 ...
##  $ cylinder    : num  8 8 8 8 8 8 8 8 8 8 ...
##  $ displacement: num  307 350 318 304 302 429 454 440 455 390 ...
##  $ horsepower  : num  130 165 150 150 140 198 220 215 225 190 ...
##  $ weight      : int  3504 3693 3436 3433 3449 4341 4354 4312 4425 3850 ...
##  $ acceleration: num  12 11.5 11 12 10.5 10 9 8.5 10 8.5 ...
##  $ model_year  : int  70 70 70 70 70 70 70 70 70 70 ...
##  $ origin      : int  1 1 1 1 1 1 1 1 1 1 ...
##  $ car_name    : chr  "chevrolet chevelle malibu" "buick skylark 320" "plymouth satellite" "amc rebe
```

##selecting out the actual data which is used for trasformation:

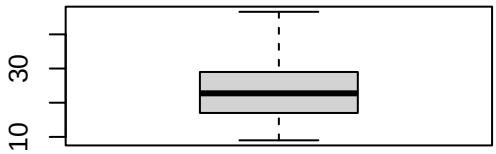
```
actual_df = select(mpgcoredf,mpg,displacement,horsepower,weight,acceleration)
actual_df = na.omit(actual_df)
kable(summary(actual_df),row.names = FALSE)
```

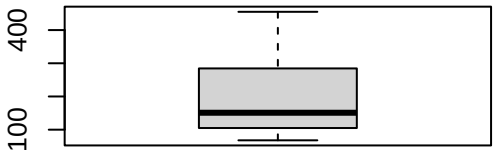
| mpg | displacement | horsepower | weight | acceleration |
|---|---|---|---|---|
| Min. : 9.00 | Min. : 68.0 | Min. : 46.0 | Min. :1613 | Min. : 8.00 |
| 1st Qu.:17.00 | 1st Qu.:105.0 | 1st Qu.: 75.0 | 1st Qu.:2225 | 1st Qu.:13.78 |
| Median :22.75 | Median :151.0 | Median : 93.5 | Median :2804 | Median :15.50 |
| Mean :23.45 | Mean :194.4 | Mean :104.5 | Mean :2978 | Mean :15.54 |
| 3rd Qu.:29.00 | 3rd Qu.:275.8 | 3rd Qu.:126.0 | 3rd Qu.:3615 | 3rd Qu.:17.02 |
| Max. :46.60 | Max. :455.0 | Max. :230.0 | Max. :5140 | Max. :24.80 |

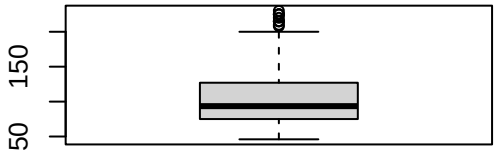
```
#Overall charts and  plots of a dataframe :
pairs.panels(actual_df,method = "pearson",hist.col ="#00AFBB" ,density = TRUE,ellipses = TRUE)
```

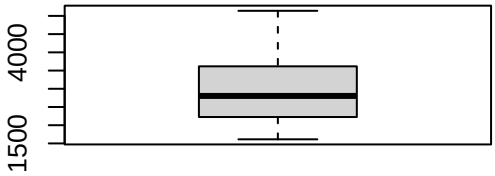


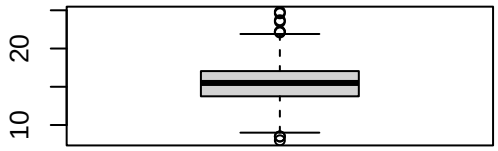

```
par(mfrow=c(2,2))
for (i in names(actual_df)) {
   boxplot(actual_df[,i], names = "names(actual_df[,i])")
}
```


10
30


100
400


50
150


1500
4000




##In the first case, there were 300 split records, while there were 98 last records in the second case:

```
fcase.thrhnd = actual_df[1:300,]
scase.niteit = na.omit(actual_df[301:398,])
```

##Finding displacement model for first case:

```
fcasmdl1.dis = lm(mpg~displacement, data=fcase.thrhnd)
summary(fcasmdl1.dis)
```

```
##
## Call:
## lm(formula = mpg ~ displacement, data = fcase.thrhnd)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -9.9282 -2.0043 -0.5401  1.9737 16.1501
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)  31.352035   0.435875   71.93   <2e-16 ***
## displacement -0.048913   0.001809  -27.04   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3.412 on 298 degrees of freedom
```

```
## Multiple R-squared:  0.7104, Adjusted R-squared:  0.7094
## F-statistic: 731.1 on 1 and 298 DF,  p-value: < 2.2e-16
```

```
ffcasck1_dis = summary(fcasmdl1.dis)
ffcasck1_dis$r.squared
```

```
## [1] 0.7104182
```

```
ffcasck1_dis$adj.r.squared
```

```
## [1] 0.7094464
```

```
coef(ffcasck1_dis)
```

```
##                 Estimate  Std. Error   t value      Pr(>|t|)
## (Intercept)  31.35203522 0.435875376  71.92890 2.258211e-190
## displacement -0.04891259 0.001809011 -27.03831  3.483733e-82
```

```
coef(fcasmdl1.dis)
```

```
##  (Intercept) displacement
##  31.35203522  -0.04891259
```

##Finding horsepower model for first case:

```
fcasmdl1.hrp = lm(mpg~horsepower, data=fcase.thrhnd)
summary(fcasmdl1.hrp)
```

```
##
## Call:
## lm(formula = mpg ~ horsepower, data = fcase.thrhnd)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -10.8442  -2.7816  -0.3376   2.4948  14.2360
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 34.903508   0.648037   53.86   <2e-16 ***
## horsepower  -0.125824   0.005455  -23.07   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3.8 on 298 degrees of freedom
## Multiple R-squared:  0.641,  Adjusted R-squared:  0.6397
## F-statistic:   532 on 1 and 298 DF,  p-value: < 2.2e-16
```

```
ffcsechk1_hrp = summary(fcasmdl1.hrp)
ffcsechk1_hrp$r.squared
```

```
## [1] 0.6409527
```

```
ffcsechk1_hrp$adj.r.squared
```

```
## [1] 0.6397479
```

```
coef(ffcsechk1_hrp)
```

```
##               Estimate  Std. Error   t value      Pr(>|t|)
## (Intercept) 34.9035083 0.648036714  53.86039 1.252684e-155
## horsepower  -0.1258239 0.005455289 -23.06457  3.004974e-68
```

```
coef(fcasmdl1.hrp)
```

```
## (Intercept)  horsepower
##  34.9035083  -0.1258239
```

##Finding acceleration model for first case:

```
fcasmdl1.acc = lm(mpg~acceleration, data=fcase.thrhnd)
summary(fcasmdl1.acc)
```

```
##
## Call:
## lm(formula = mpg ~ acceleration, data = fcase.thrhnd)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -15.202  -4.126  -1.012   3.268  16.154
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    5.0012     1.8352   2.725  0.00681 **
## acceleration   1.0379     0.1183   8.770  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 5.654 on 298 degrees of freedom
## Multiple R-squared:  0.2052, Adjusted R-squared:  0.2025
## F-statistic: 76.91 on 1 and 298 DF,  p-value: < 2.2e-16
```

```
ffcaschk1_acc = summary(fcasmdl1.acc)
ffcaschk1_acc$r.squared
```

```
## [1] 0.2051531
```

```
ffcaschk1_acc$adj.r.squared
```

```
## [1] 0.2024858
```

```
coef(ffcaschk1_acc)
```

```
##              Estimate Std. Error  t value     Pr(>|t|)
## (Intercept)  5.001162  1.8351855 2.725153 6.807164e-03
## acceleration 1.037865  0.1183411 8.770118 1.397098e-16
```

```
coef(fcasmdl1.acc)
```

```
##  (Intercept) acceleration
##     5.001162     1.037865
```

##Finding Weight model for first case:

```
fcasmdl1.wght = lm(mpg~weight, data=fcase.thrhnd)
summary(fcasmdl1.wght)
```

```
##
## Call:
## lm(formula = mpg ~ weight, data = fcase.thrhnd)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -9.2011 -1.9157 -0.0812  1.7341 15.0246
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept) 40.5619792  0.6461532   62.77   <2e-16 ***
## weight      -0.0062905  0.0001984  -31.71   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3.032 on 298 degrees of freedom
## Multiple R-squared:  0.7714, Adjusted R-squared:  0.7706
## F-statistic:  1005 on 1 and 298 DF,  p-value: < 2.2e-16
```

```
ffcaschk1_wght = summary(fcasmdl1.wght)
ffcaschk1_wght$r.squared
```

```
## [1] 0.7713783
```

```
ffcaschk1_wght$adj.r.squared
```

```
## [1] 0.7706111
```

```
coef(ffcaschk1_wght)
```

```
##                 Estimate   Std. Error   t value      Pr(>|t|)
## (Intercept) 40.561979247 0.6461531581  62.77456 7.613401e-174
## weight      -0.006290453 0.0001983804 -31.70904  1.693958e-97
```

```
coef(fcasmdl1.wght)
```

```
##  (Intercept)       weight
## 40.561979247 -0.006290453
```

##Finding multiple linear regression model for first case:

```
fcasmlrchkfi = lm(mpg ~ displacement + horsepower + weight + acceleration,data = fcase.thrhnd)
fincasemlrchk = summary(fcasmlrchkfi)
fincasemlrchk$r.squared
```

```
## [1] 0.7806338
```

```
fincasemlrchk$adj.r.squared
```

```
## [1] 0.7776593
```

```
summary(fcasmlrchkfi)$coefficient
```

```
##                   Estimate   Std. Error    t value     Pr(>|t|)
## (Intercept)  40.585172043 2.0191187112 20.1004388 3.314915e-57
## displacement -0.005887596 0.0051269341 -1.1483658 2.517479e-01
## horsepower   -0.027012390 0.0124165089 -2.1755222 3.038476e-02
## weight       -0.004642193 0.0006082628 -7.6318876 3.223717e-13
## acceleration -0.059386923 0.1032311890 -0.5752808 5.655399e-01
```

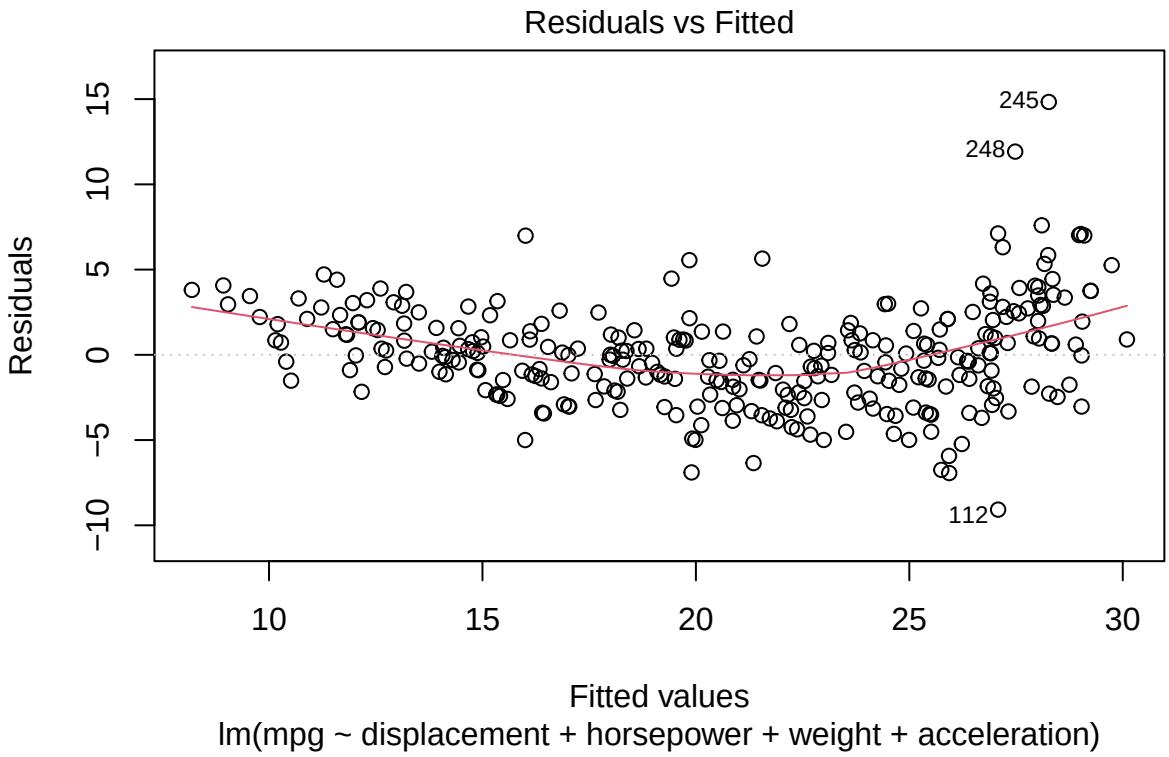
```
confint(fcasmlrchkfi)
```

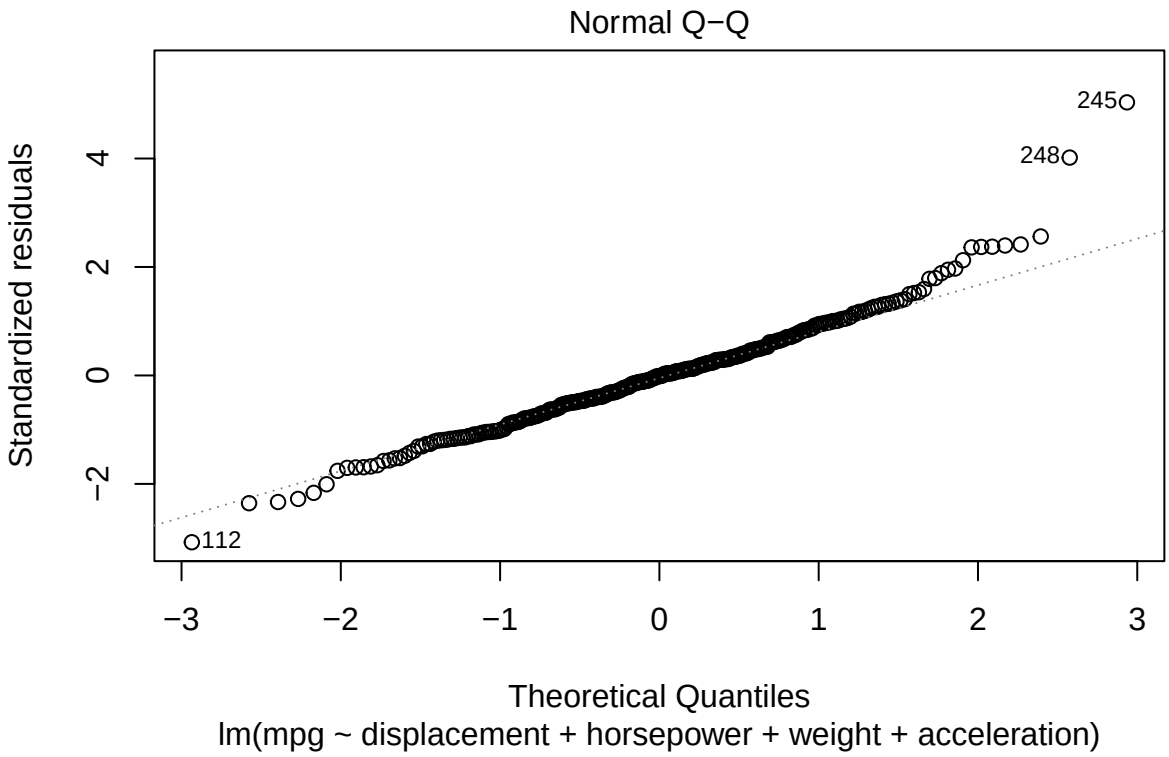
```
##                     2.5 %       97.5 %
## (Intercept)  36.611469461 44.558874625
## displacement -0.015977597  0.004202406
## horsepower   -0.051448553 -0.002576227
## weight       -0.005839278 -0.003445109
## acceleration -0.262549838  0.143775992
```

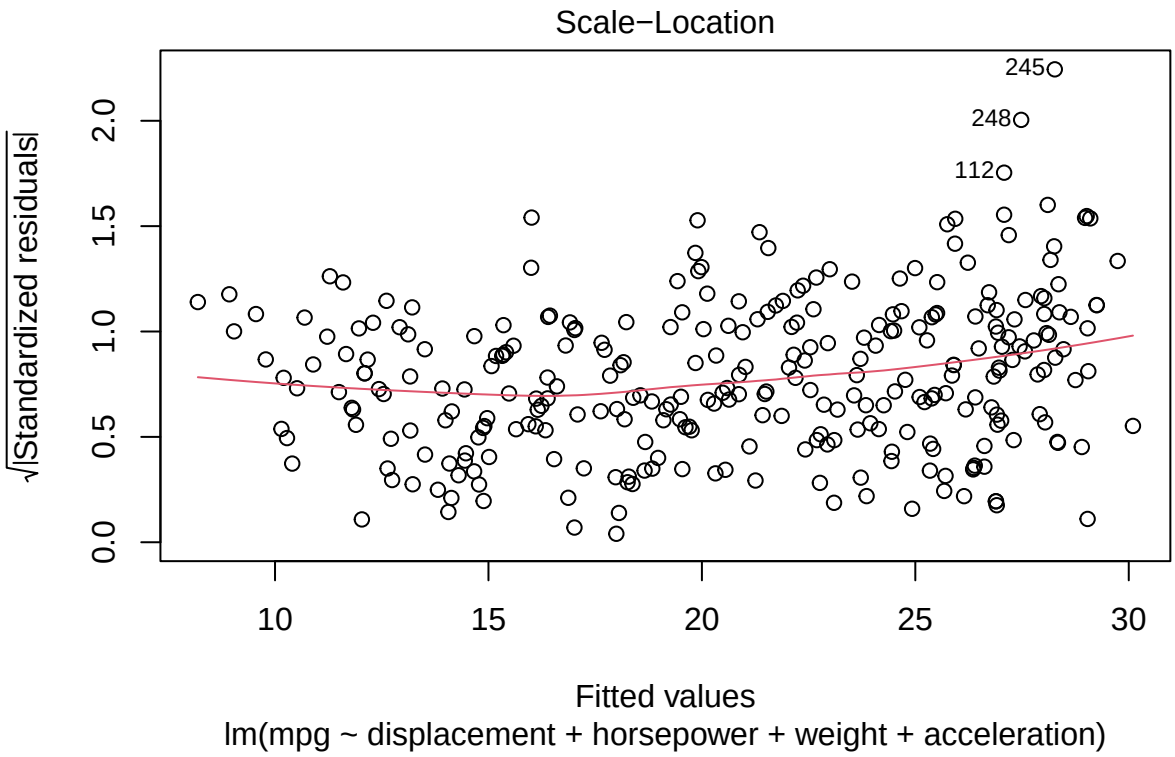
```
print(fcasmlrchkfi)
```

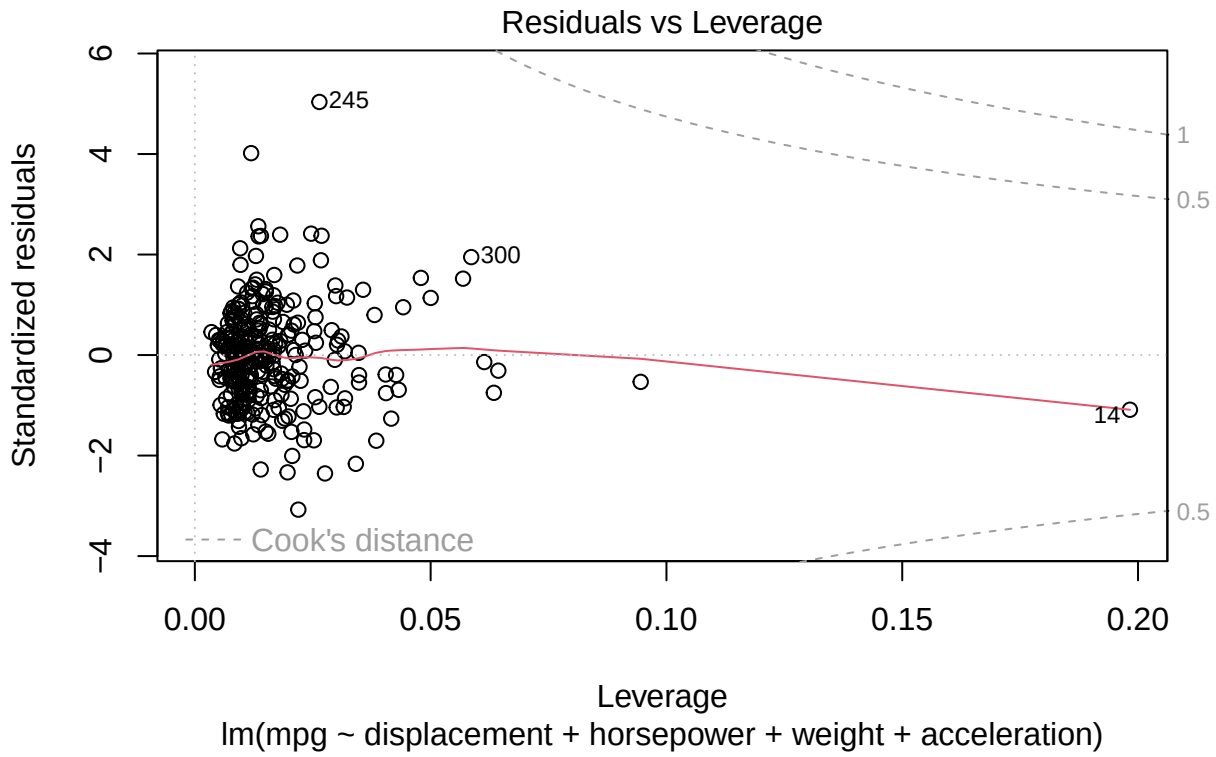
```
##
## Call:
## lm(formula = mpg ~ displacement + horsepower + weight + acceleration,
##     data = fcase.thrhnd)
##
## Coefficients:
##  (Intercept)  displacement    horsepower        weight  acceleration
##    40.585172     -0.005888     -0.027012     -0.004642     -0.059387
```

```
plot(fcasmlrchkfi)
```


Residuals vs Fitted
Residuals
Fitted values
lm(mpg ~ displacement + horsepower + weight + acceleration)
245
248
112
15
10
5
0
−5
−10
10
15
20
25
30


Normal Q−Q
Standardized residuals
Theoretical Quantiles
lm(mpg ~ displacement + horsepower + weight + acceleration)
245
248
112
−3
−2
−1
0
1
2
3
−2
0
2
4


Scale−Location
√|Standardized residuals|
0.0
0.5
1.0
1.5
2.0
245
248
112
10
15
20
25
30
Fitted values
lm(mpg ~ displacement + horsepower + weight + acceleration)




##Predictions for second case of MLR model:

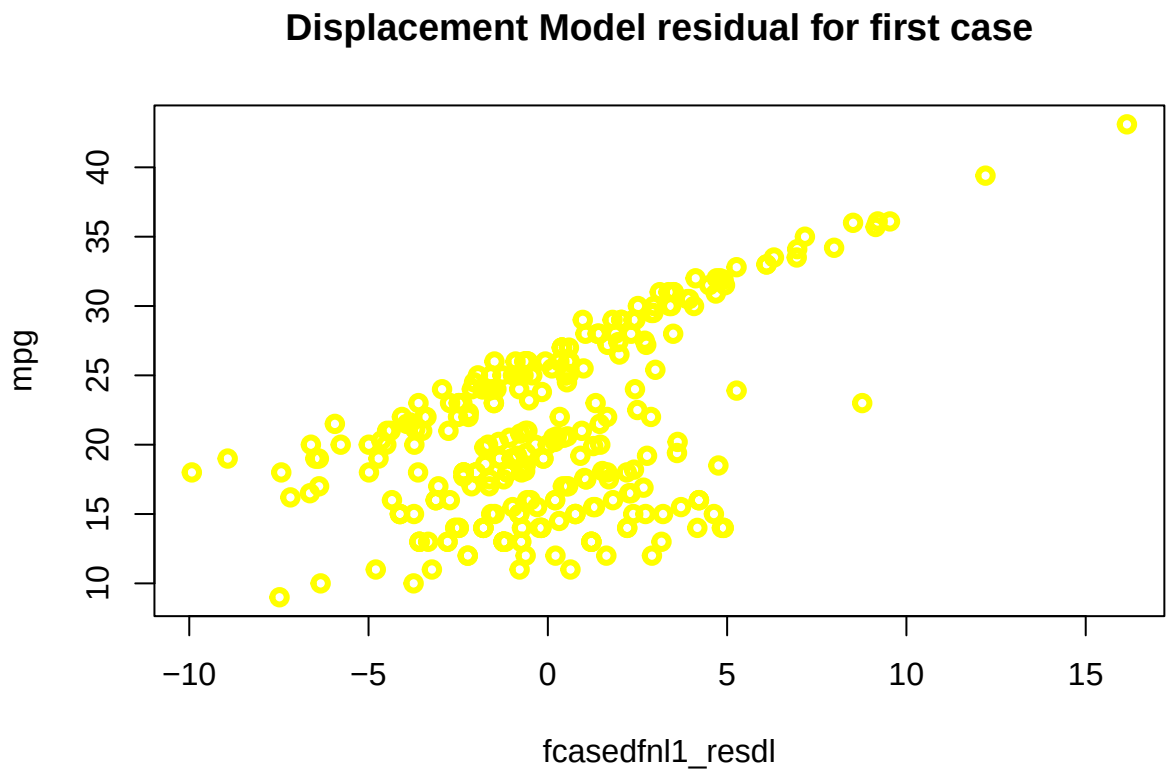
```
scpdt_f = fcasmlrchkfi %>% predict(scase.niteit)
data.frame( R2 = R2(scpdt_f, scase.niteit$mpg),
            RMSE = RMSE(scpdt_f, scase.niteit$mpg),
            MAE = MAE(scpdt_f, scase.niteit$mpg))
```

```
##          R2     RMSE     MAE
## 1 0.5261588 8.005138 6.84897
```

###Predictions Report for second case MLR model: Even if the outlier is taken out, the assumptions of the linear model are not met, according to the predictions report for the MLR model. However, if the outliers are eliminated, the model does perform better, with an adjusted R-squared ranging from 77% to 80%. This automobile data might perform better with a nonlinear model, in our opinion.

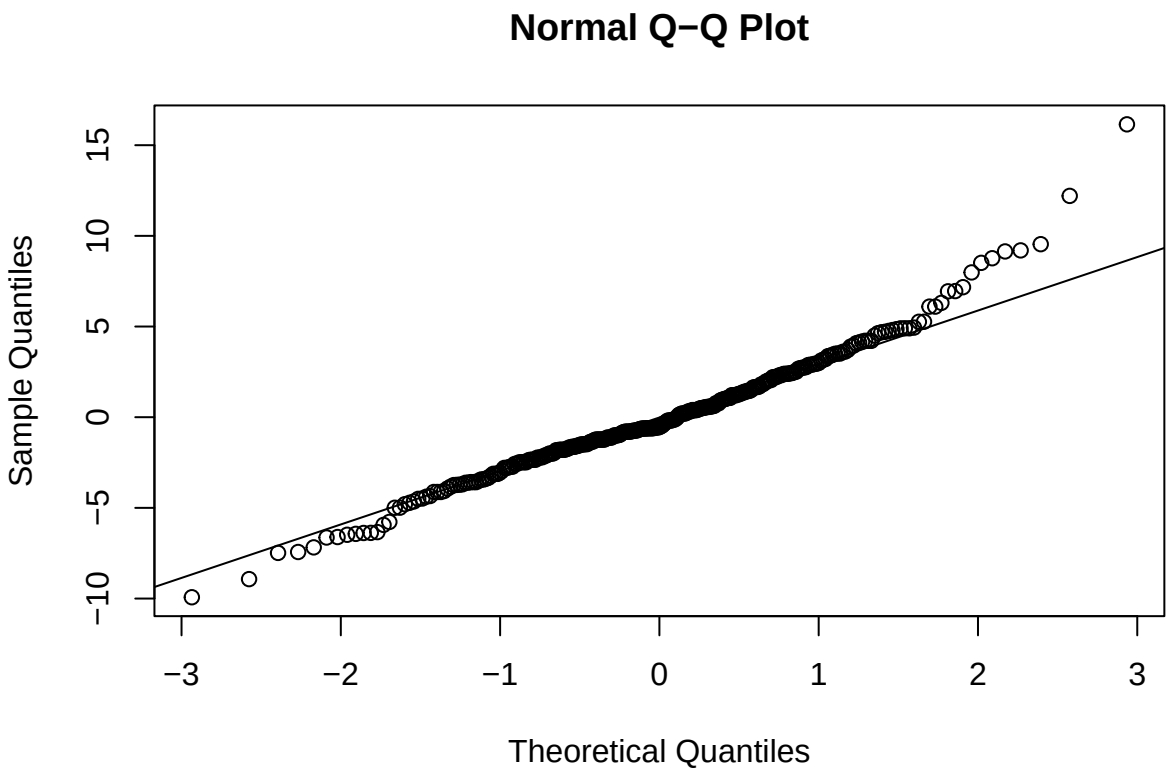
##Finding displacement model residual for first case:

```
disfcase1.dist = lm(mpg~displacement, data=fcase.thrhnd)
fcasedfnl1_resdl = disfcase1.dist$residuals
plot(fcase.thrhnd$mpg~fcasedfnl1_resdl ,lwd=3, col="yellow",main="Displacement Model residual for first
```

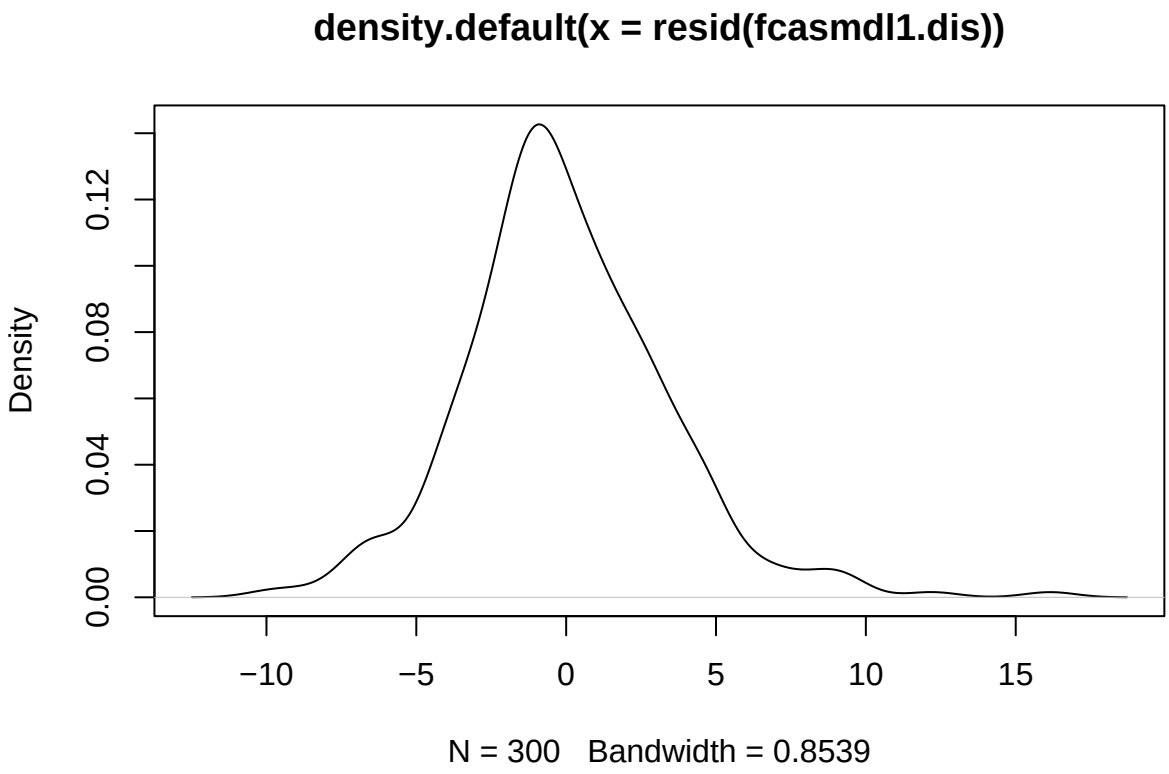



##Finding linear model residual of displacement for first case:

```
qqnorm(resid(fcasmdl1.dis))
qqline(resid(fcasmdl1.dis))
```

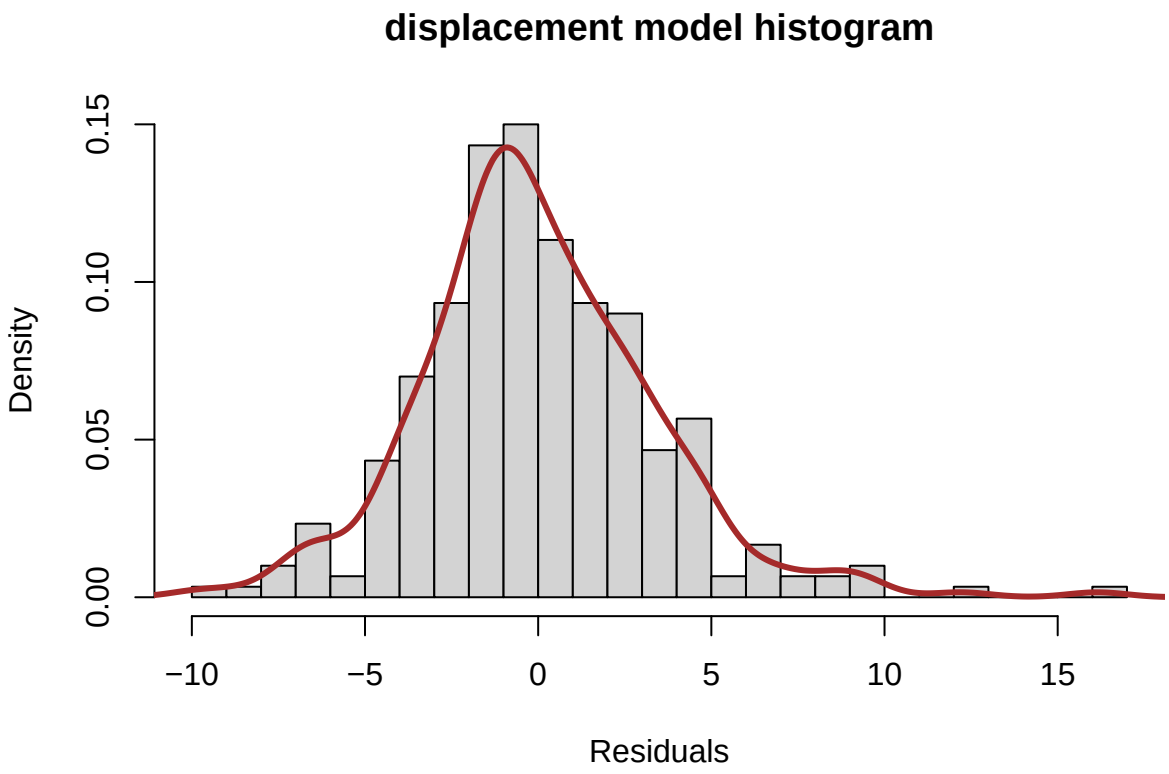



```
plot(density(resid(fcasmdl1.dis)))
```




##Finding Histogram of model displacement for first case:

```
hist(fcasedfnl1_resdl ,prob=T,breaks=20,main="displacement model histogram",xlab="Residuals")
lines(density(fcasedfnl1_resdl ),col="brown",lwd=3)
```




##Predicting displacement model for second case:

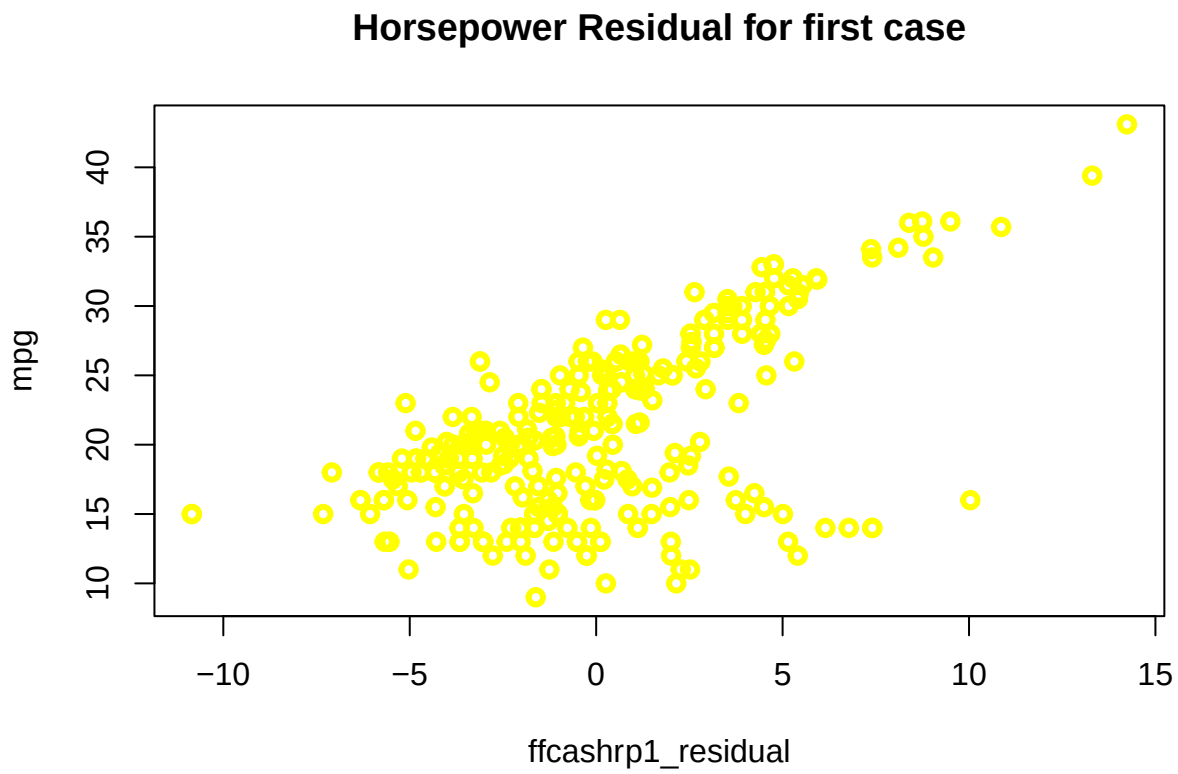
```
scaspdt_dis1 = fcasmdl1.dis %>% predict(scase.niteit)
data.frame( Prediction_DISPLACEMENT_R2 = R2(scaspdt_dis1, scase.niteit$mpg),Prediction_DISPLACEMENT_RMSE
```

```
##   Prediction_DISPLACEMENT_R2 Prediction_DISPLACEMENT_RMSE
## 1                   0.370789                     8.371337
##   Prediction_DISPLACEMENT_MAE
## 1                    7.050203
```

##A DISPLACEMENT MODEL IS USED IN THIS PREDICTION REPORT: Each estimated value in this output is statistically significant with a p-value of 2.2e-16. It is shown that the MPG vs. displacement plot is not linear and that there is some kind of relationship between the variable and the residual. This model is undoubtedly inadequate. The following data points are outliers, adding up to a total of 112,245,248 on the diagnostic plot. The R square states that only 38% of displacement may account for MPG.

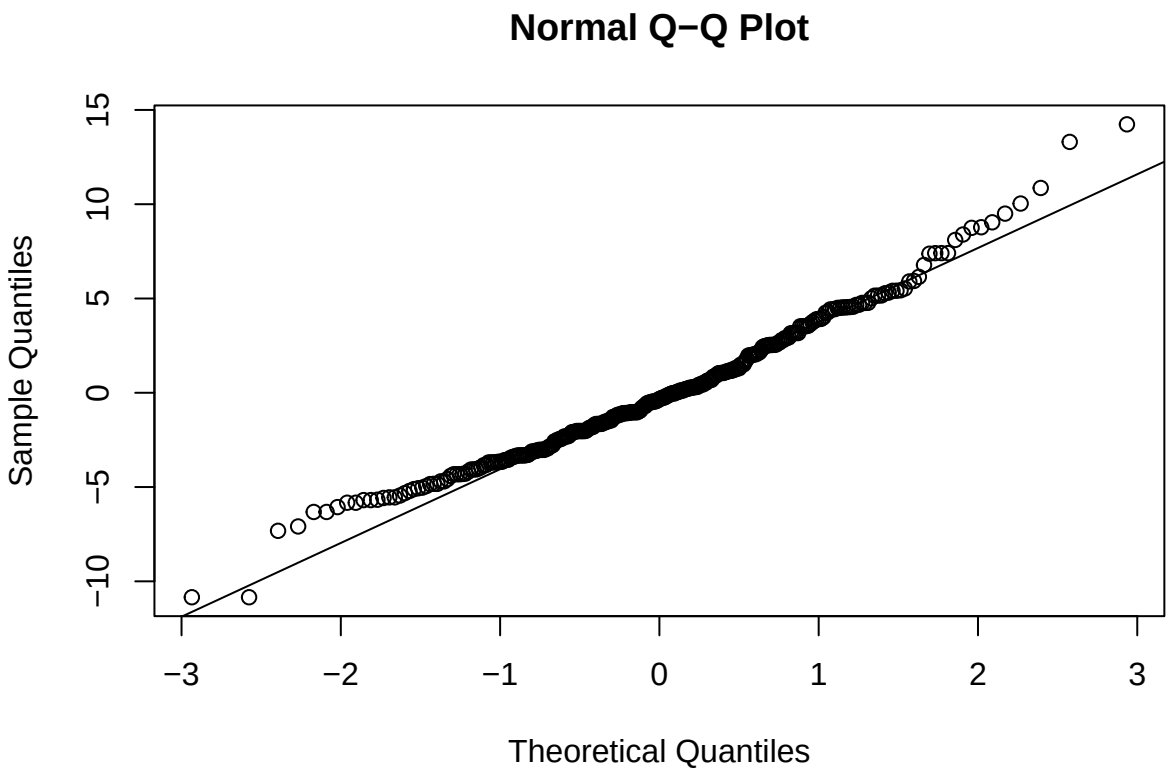
##Finding Model of Horsepower Residual for first case:

```
ffcashrp1_residual = fcasmdl1.hrp$residuals
plot(fcase.thrhnd$mpg~ffcashrp1_residual ,lwd=3, col="yellow",main="Horsepower Residual for first case"
```

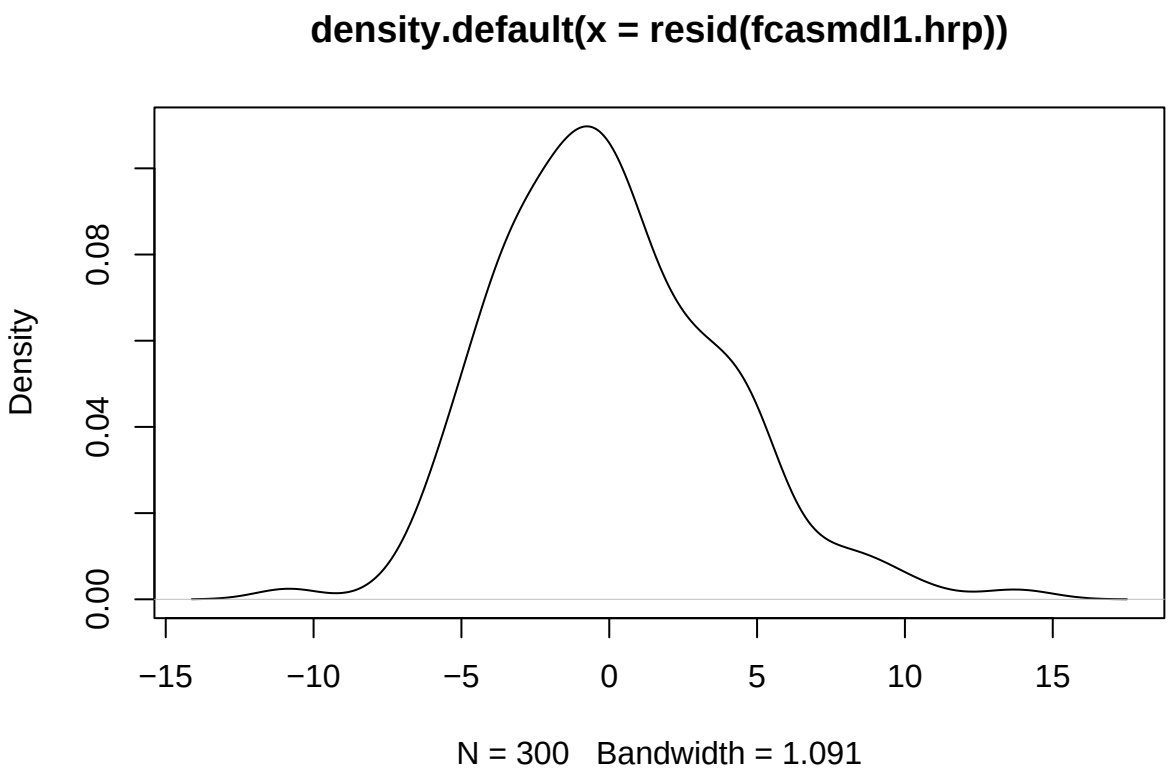



##Finding linear horsepower models for first case:

```
qqnorm(resid(fcasmdl1.hrp))
qqline(resid(fcasmdl1.hrp))
```

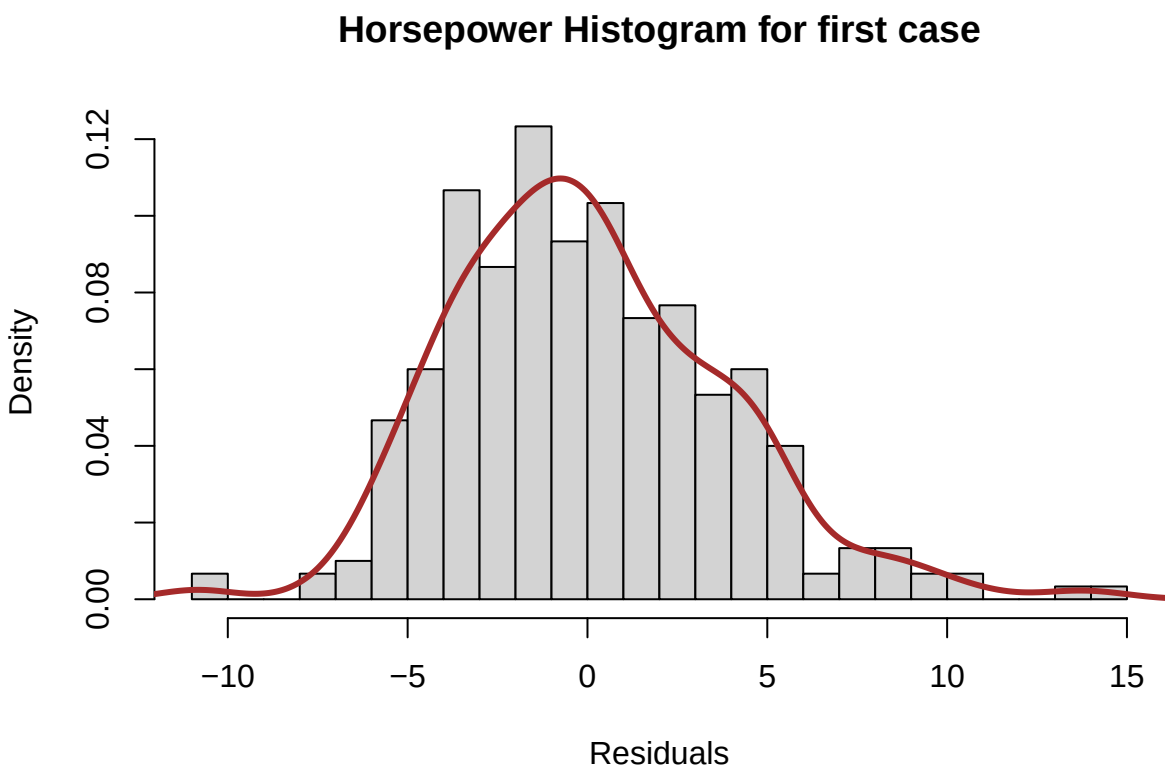



```
plot(density(resid(fcasmdl1.hrp)))
```




##Finding the horsepower models histogram for first case:

```
hist(ffcashrp1_residual ,prob=T,breaks=20,main="Horsepower Histogram for first case",xlab="Residuals")
lines(density(ffcashrp1_residual ),col="brown",lwd=3)
```




##Predictions the horsepower model for second case:

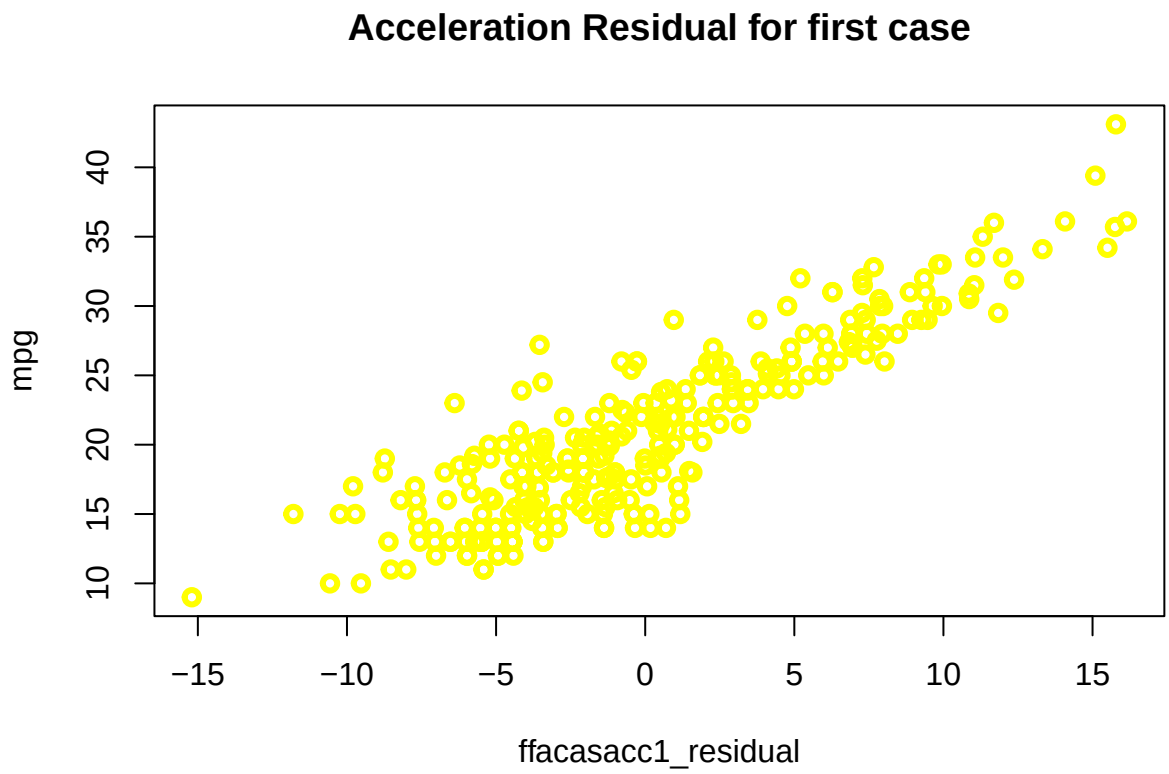
```
scaspdt1_hrp = fcasmdl1.hrp %>% predict(scase.niteit)
data.frame( Prediction_HORSEPOWER_R2 = R2(scaspdt1_hrp, scase.niteit$mpg),Prediction_HORSEPOWER_RMSE = R
```

```
##   Prediction_HORSEPOWER_R2 Prediction_HORSEPOWER_RMSE Prediction_HORSEPOWER_MAE
## 1                0.4483999                   8.592932                  7.508721
```

##FOR THE POWER MODEL PROJECT REPORT: The R square after correction is 0.225. This demonstrates that the strategy is incorrect because just 22.5% of horsepower contributes to mpg. Nevertheless, we were able to assess its significance using a p-value of 2.2e-16. HP and MPg have an unbalanced relationship.

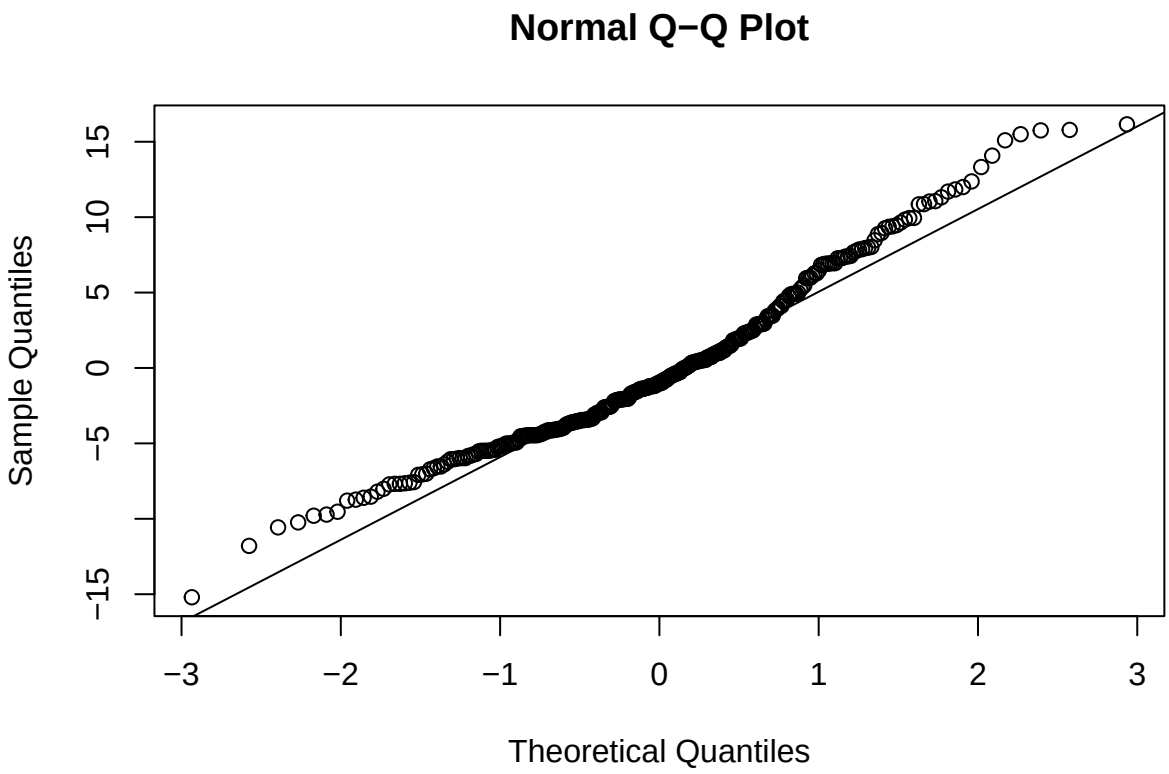
##Finding the worth of acceleration residual model for first case:

```
ffacasacc1_residual = fcasmdl1.acc$residuals
plot(fcase.thrhnd$mpg~ffacasacc1_residual ,lwd=3, col="yellow",main="Acceleration Residual for first cas
```

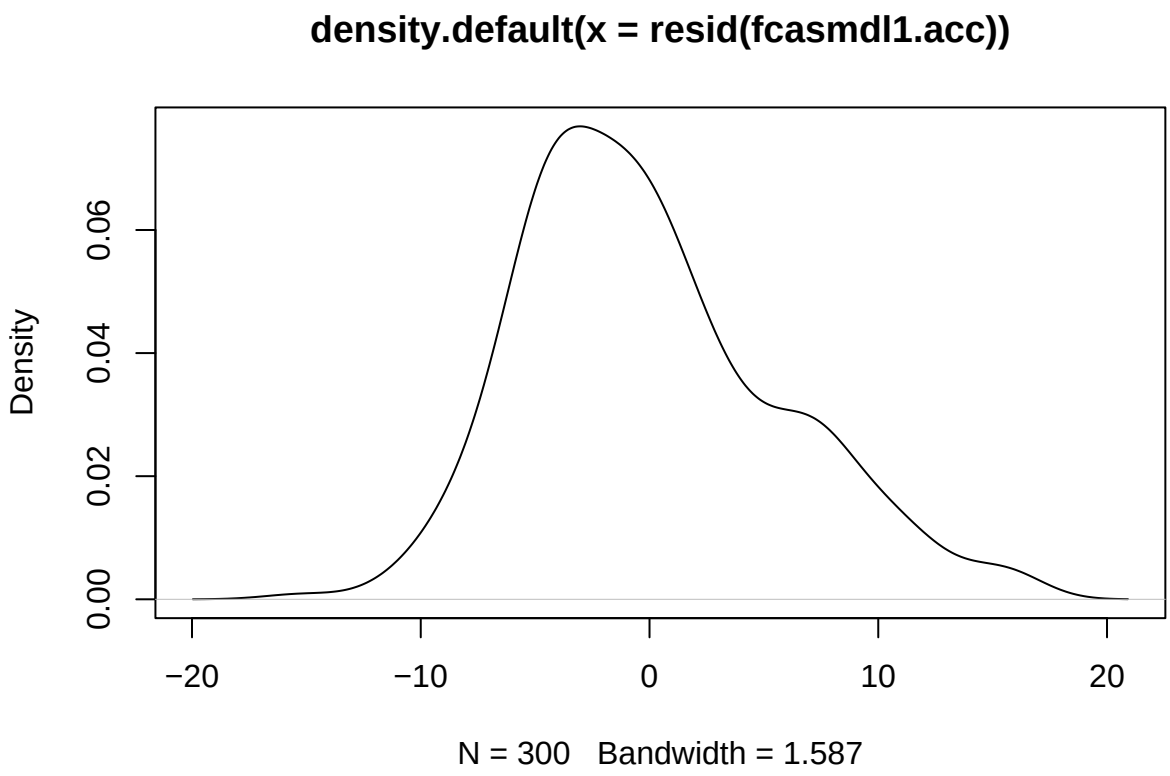



##Finding the linear acceleration residual model for first case:

```
qqnorm(resid(fcasmdl1.acc))
qqline(resid(fcasmdl1.acc))
```

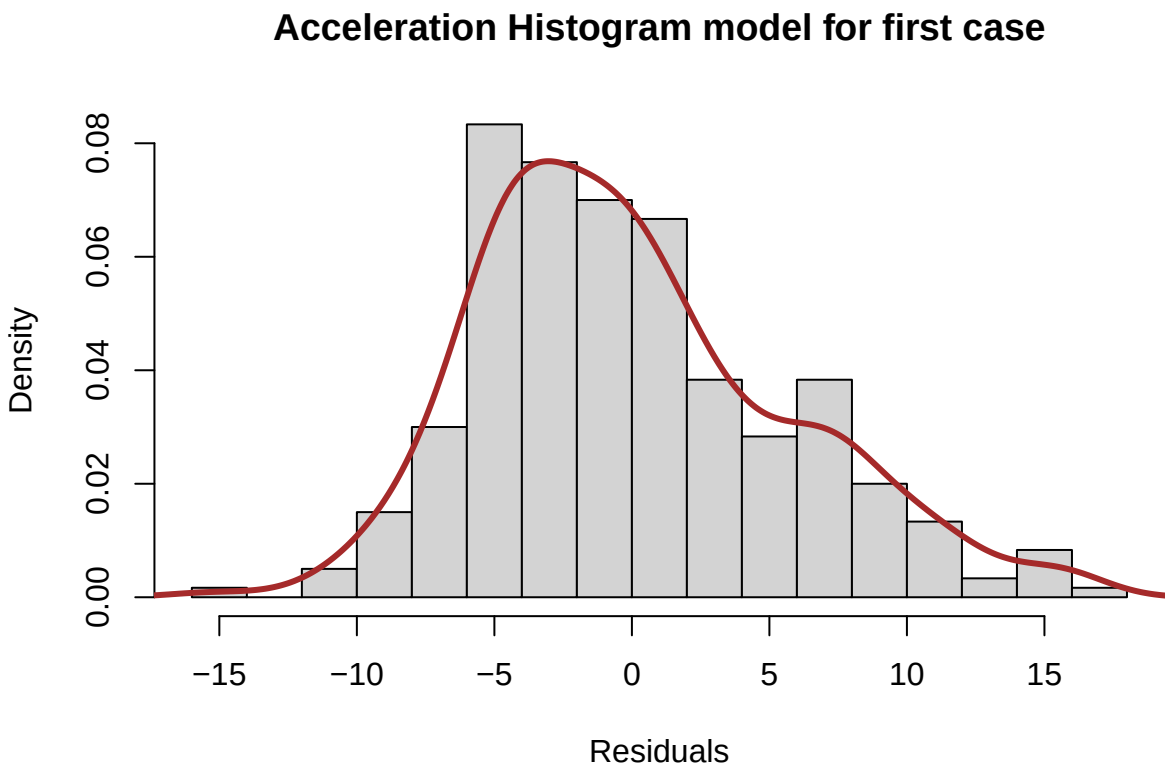



```
plot(density(resid(fcasmdl1.acc)))
```




##Finding a model of the acceleration histogram for first case:

```
hist(ffacasacc1_residual ,prob=T,breaks=20,main="Acceleration Histogram model for first case",xlab="Resi
lines(density(ffacasacc1_residual ),col="brown",lwd=3)
```




##Finding predictions from a model of acceleration for second case:

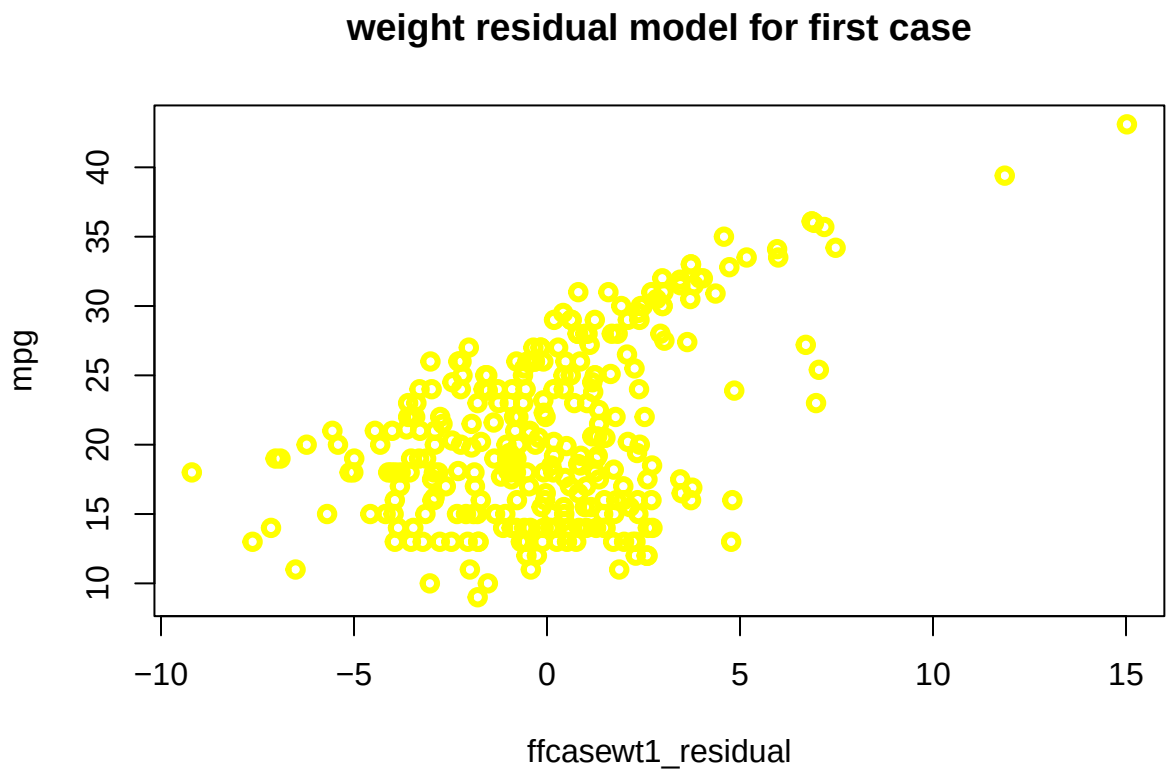
```
scasepdtctf1_acc = fcasmdl1.acc %>% predict(scase.niteit)
data.frame( Prediction_ACCELERATION_R2 = R2(scasepdtctf1_acc, scase.niteit$mpg),Prediction_ACCELERATION_
```

```
##   Prediction_ACCELERATION_R2 Prediction_ACCELERATION_RMSE
## 1                  0.03597167                     11.51665
##   Prediction_ACCELERATION_MAE
## 1                    10.16914
```

##ACCELERATION MODEL PREDICTION REPORT: Each estimated value in this output is statistically significant with a p-value of 2.2e-16. It has been shown that there is no conclusive evidence linking these two variables. It seems as though the residual vs. acceleration figure is in fine shape. In the future, we'll remark on stories of similar nature.

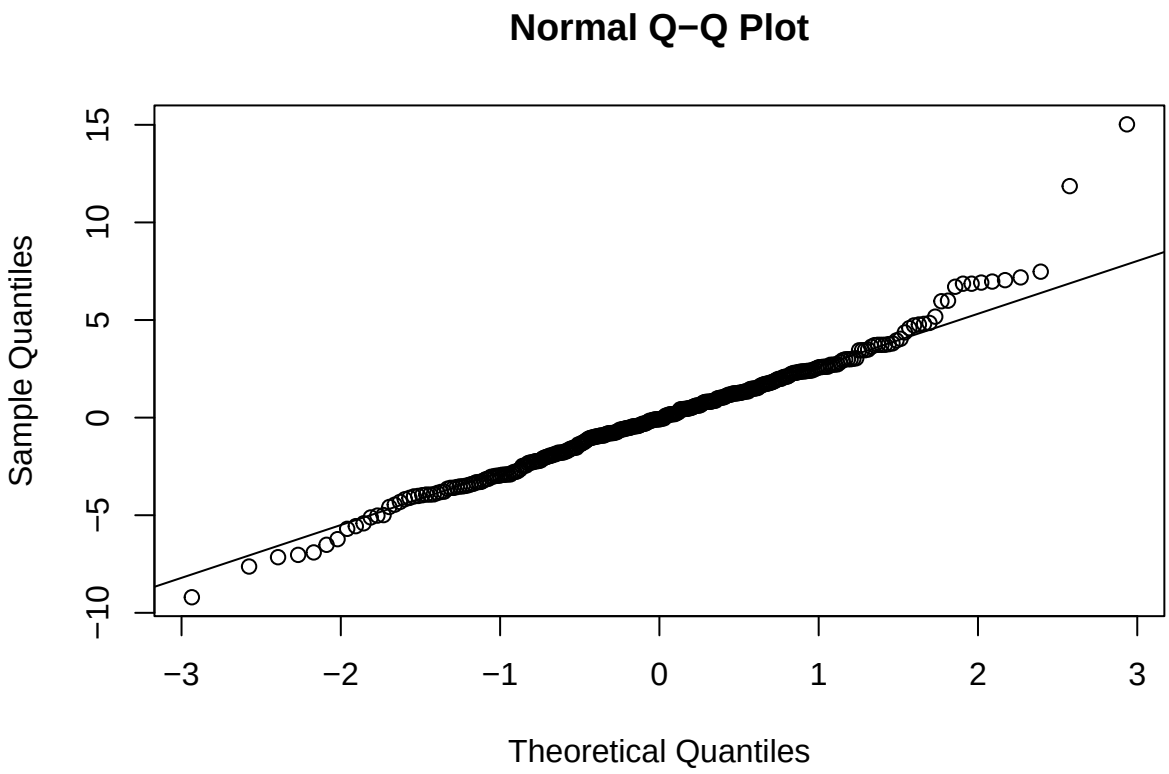
##Finding a weight residual model for first case:

```
ffcasewt1_residual = fcasmdl1.wght$residuals
plot(fcase.thrhnd$mpg~ffcasewt1_residual ,lwd=3, col="yellow",main="weight residual model for first cas
```

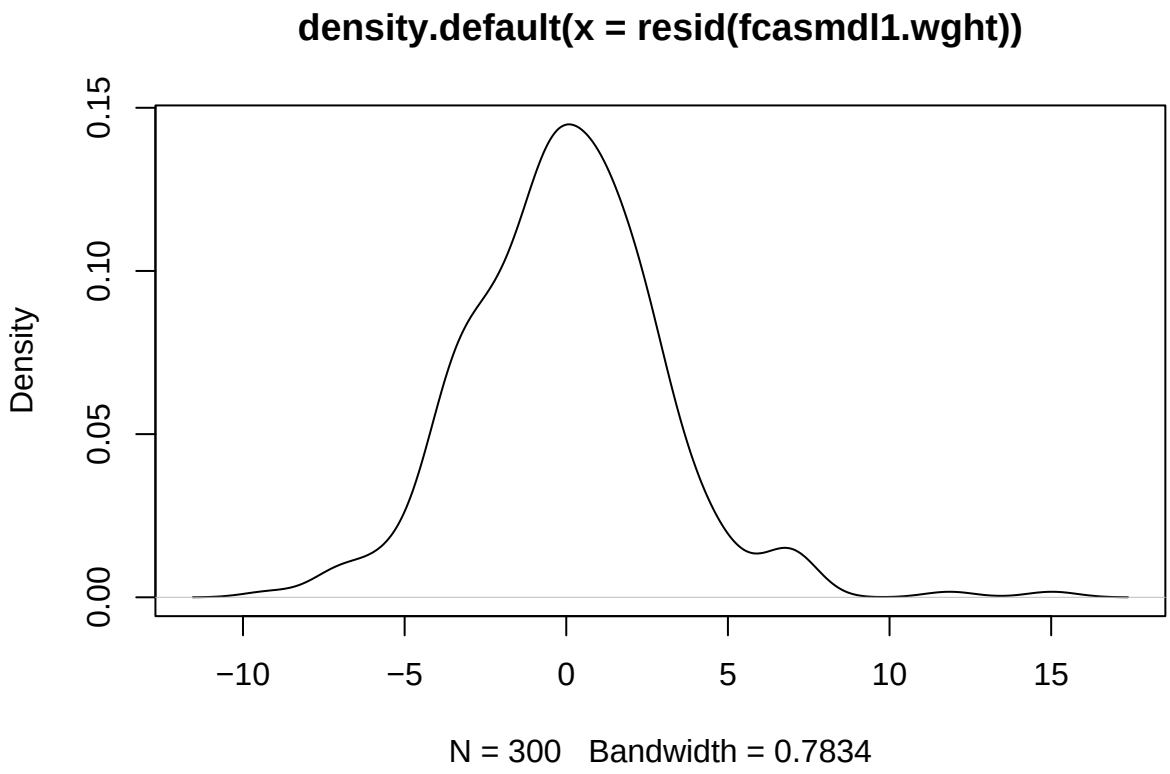



##Finding a linear Weight Models for first case:

```
qqnorm(resid(fcasmdl1.wght))
qqline(resid(fcasmdl1.wght))
```

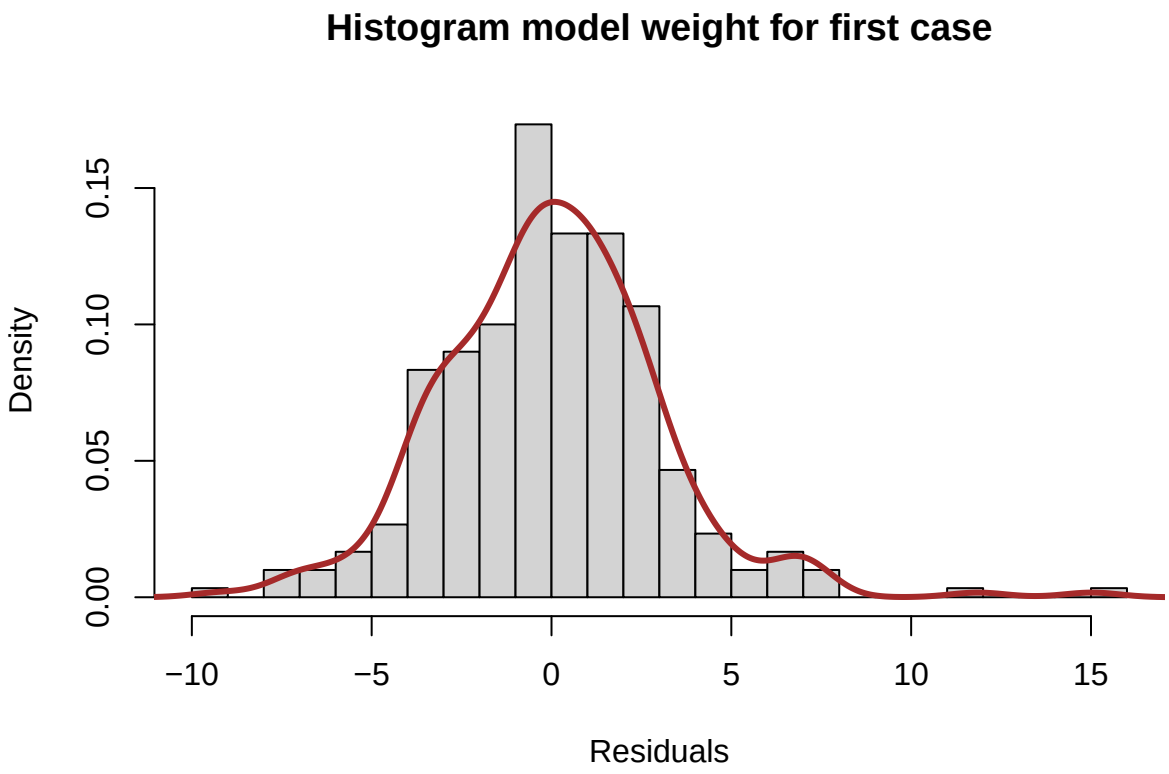



```
plot(density(resid(fcasmdl1.wght)))
```




##Finding a histogram model weight for first case:

```
hist(ffcasewt1_residual ,prob=T,breaks=20,main="Histogram model weight for first case",xlab="Residuals"
lines(density(ffcasewt1_residual ),col="brown",lwd=3)
```




##Finding predicted model weights for second case:

```
fscasepdit1_wght = fcasmdl1.wght %>% predict(scase.niteit)
data.frame( Prediction_WEIGHTMODEL_R2 = R2(fscasepdit1_wght, scase.niteit$mpg),Prediction_WEIGHTMODEL_RI
```

```
##   Prediction_WEIGHTMODEL_R2 Prediction_WEIGHTMODEL_RMSE
## 1                 0.5006516                    8.157758
##   Prediction_WEIGHTMODEL_MAE
## 1                   6.983514
```

##Report on the Weight Model Projections: The regression findings unequivocally show that our model is sound. It uses a 5% P-value of 2.2e-16. The coefficient of the model is statistically significant in explaining the mpg as a result. This model is the best option because it has the greatest R squared (0.7733) of the available models. Weight accounts for 77.33% of the mpg, per this Rsquared. In order to get the best regression at this point, we compared the R squared adjusted (0.7733>0.7129>0.2127), and we selected the model with the greatest R squared adjusted.