# Multi-Linear Regression

## Example- Computer Dataset

## Target Variable is Price

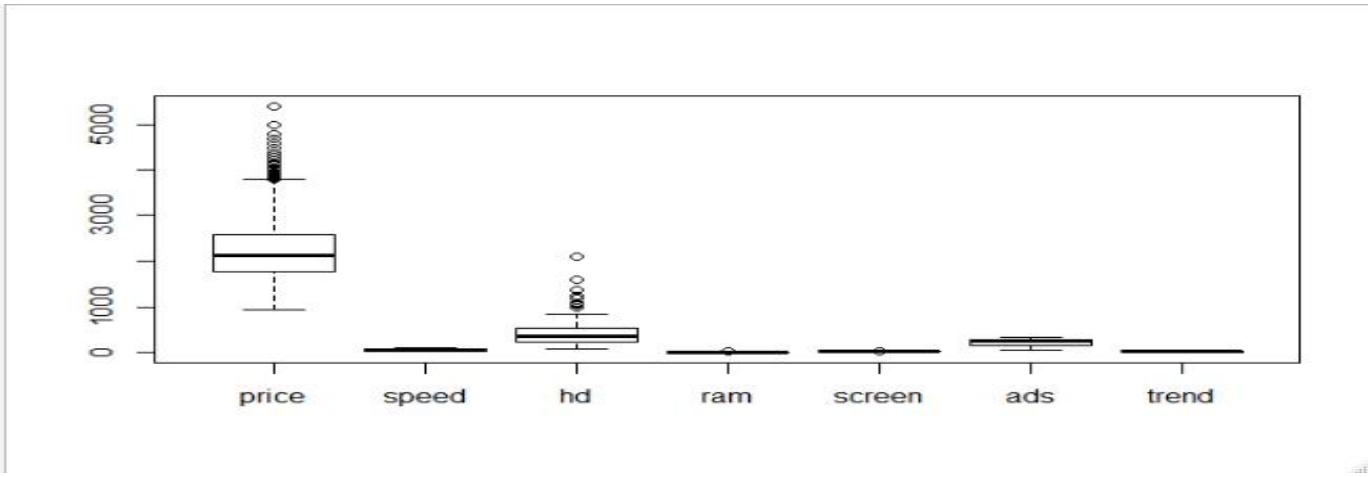
## Summary ➔

| X | price | speed | hd | ram | screen | ads | trend |
|---|---|---|---|---|---|---|---|
| Min. : 1 | Min. : 949 | Min. : 25.00 | Min. : 80.0 | Min. : 2.000 | Min. :14.00 | Min. : 39.0 | Min. : 1.00 |
| 1st Qu.:1566 | 1st Qu.:1794 | 1st Qu.: 33.00 | 1st Qu.: 214.0 | 1st Qu.: 4.000 | 1st Qu.:14.00 | 1st Qu.:162.5 | 1st Qu.:10.00 |
| Median:3130 | Median:2144 | Median :50.00 | Median :340.0 | Median :8.000 | Median:14.00 | Median:246.0 | Median:16.00 |
| Mean :3130 | Mean :2220 | Mean : 52.01 | Mean : 416.6 | Mean : 8.287 | Mean :14.61 | Mean :221.3 | Mean :15.93 |
| 3rd Qu.:4694 | 3rd Qu.:2595 | 3rd Qu.: 66.00 | 3rd Qu.: 528.0 | 3rd Qu.: 8.000 | 3rd Qu.:15.00 | 3rd Qu.:275.0 | 3rd Qu.:21.50 |
| Max. :6259 | Max. :5399 | Max. :100.00 | Max. :2100.0 | Max. :32.000 | Max. :17.00 | Max. :339.0 | Max. :35.00 |

| cd | multi | premium |
|---|---|---|
| no :3351 | no :5386 | no : 612 |
| yes:2908 | yes: 873 | yes:5647 |

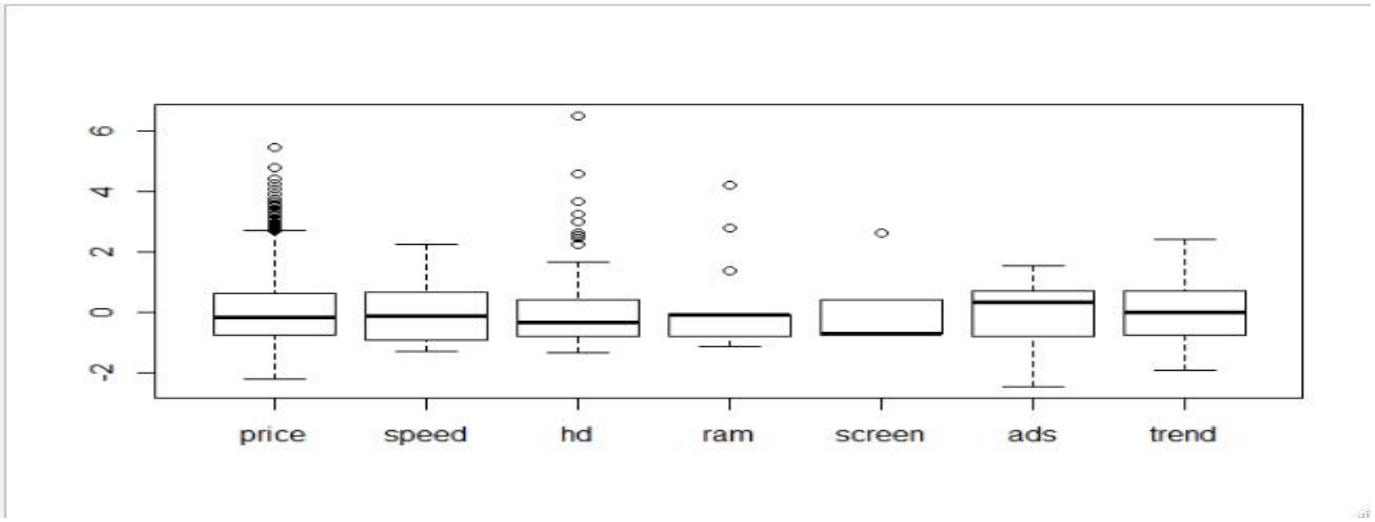
**From the above summary cd, multi and premium are factor type and rest all are in discrete type.**

## Box Plot ➔

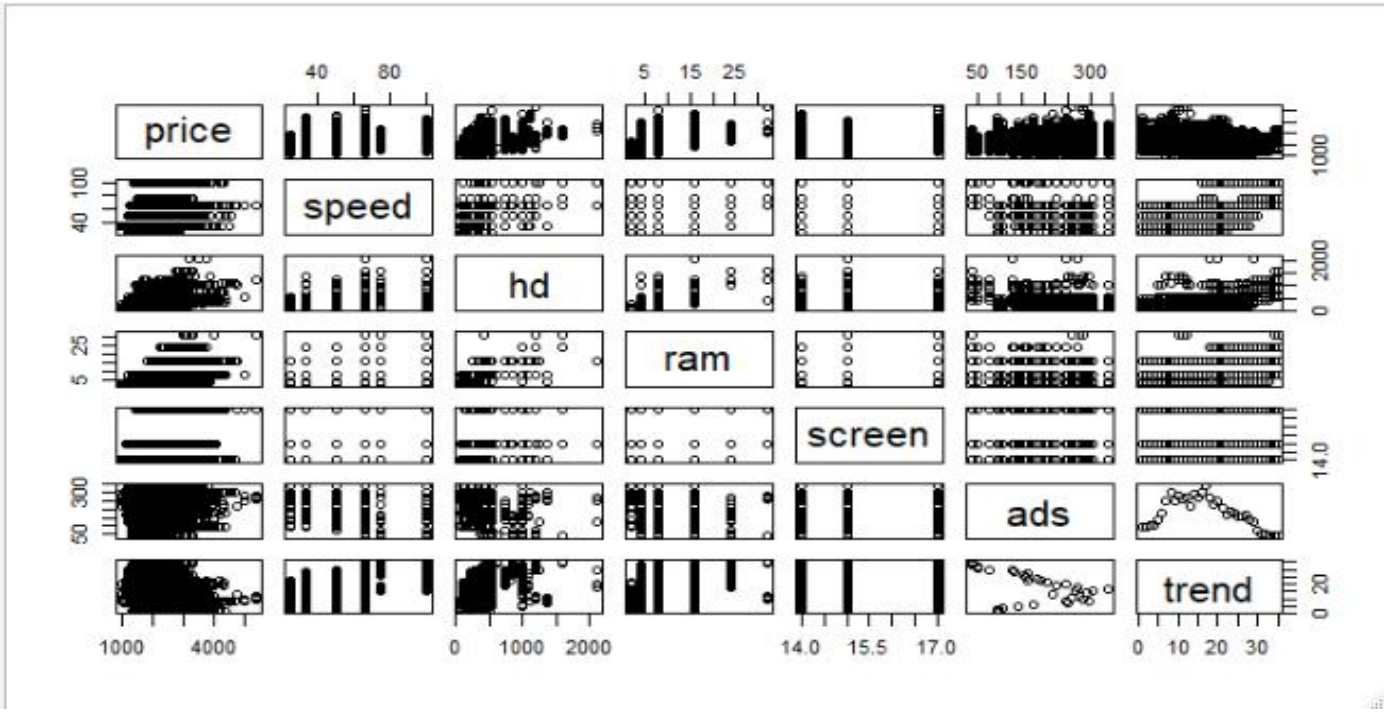



**From the above plot, so many outliers are present in variable price and hd.**

**Unitless and scale free box plot**




## Pairs Plot ➔



## Correlation ➔

| | price | speed | hd | ram | screen | ads | trend |
|---|---|---|---|---|---|---|---|
| price | 1 | 0.300976459 | 0.430257794 | 0.622748245 | 0.296041474 | 0.054540473 | -0.199986935 |
| speed | 0.300976459 | 1 | 0.372304101 | 0.234760496 | 0.189074122 | -0.21523206 | 0.405438333 |
| hd | 0.430257794 | 0.372304101 | 1 | 0.777726299 | 0.23280153 | -0.323222005 | 0.577790128 |
| ram | 0.622748245 | 0.234760496 | 0.777726299 | 1 | 0.20895374 | -0.181669713 | 0.276843843 |
| screen | 0.296041474 | 0.189074122 | 0.23280153 | 0.20895374 | 1 | -0.093919429 | 0.188614445 |
| ads | 0.054540473 | -0.21523206 | -0.323222005 | -0.181669713 | -0.093919429 | 1 | -0.318552508 |
| trend | -0.199986935 | 0.405438333 | 0.577790128 | 0.276843843 | 0.188614445 | -0.318552508 | 1 |

**From the above table it is seen that none of the variables are strongly correlated.**

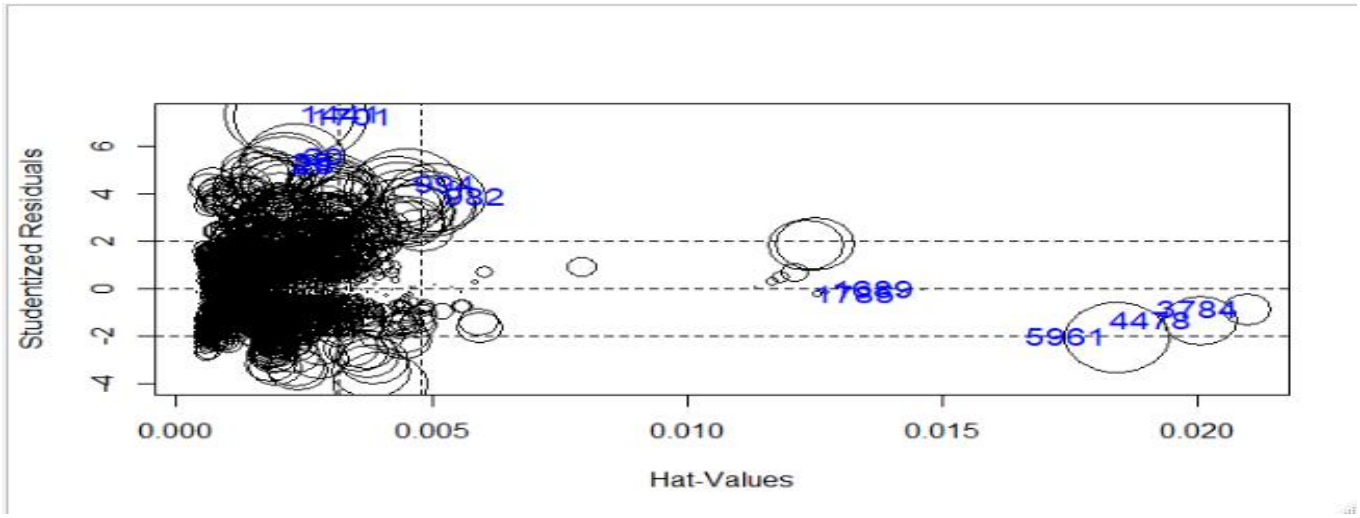
## Model-1 ➔

```
model_Comp_1 <-lm(price~speed+hd+ram+screen+cd+multi+premium+ads+trend,data =
df_comp)
```

```
Multiple R-squared:  0.7756,   Adjusted R-squared:  0.7752
```

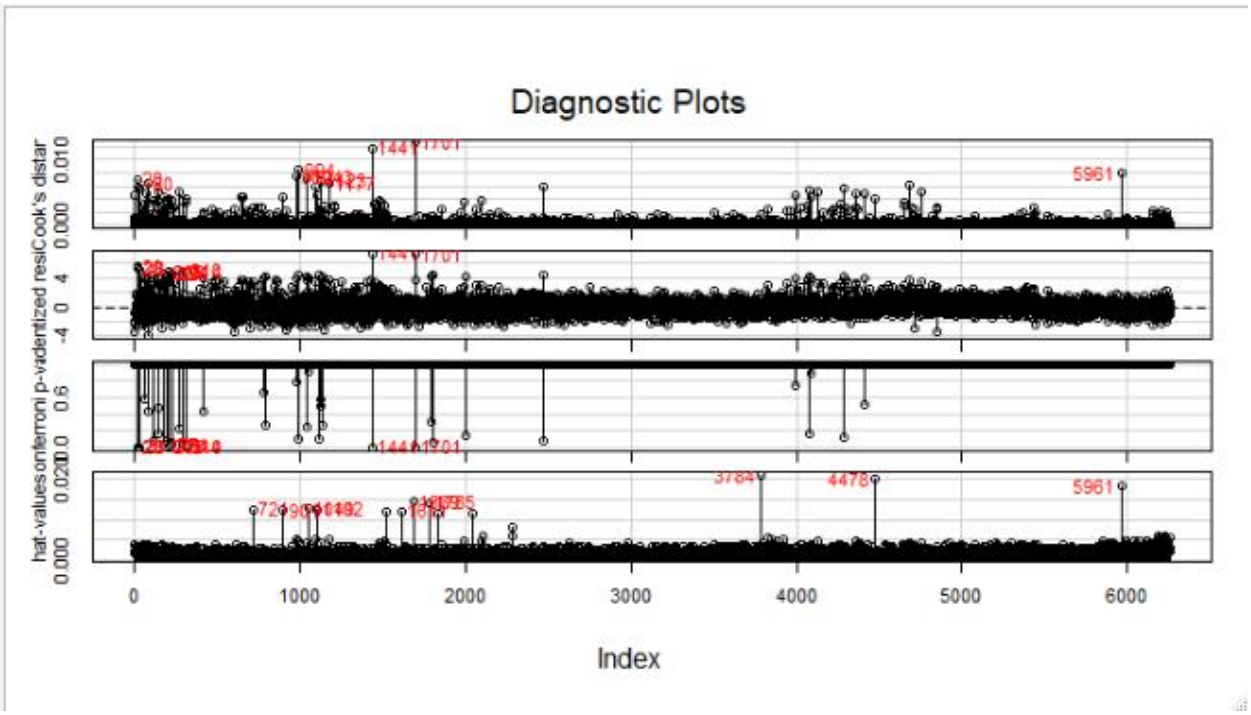
```
Correlation is 0.8806631
```

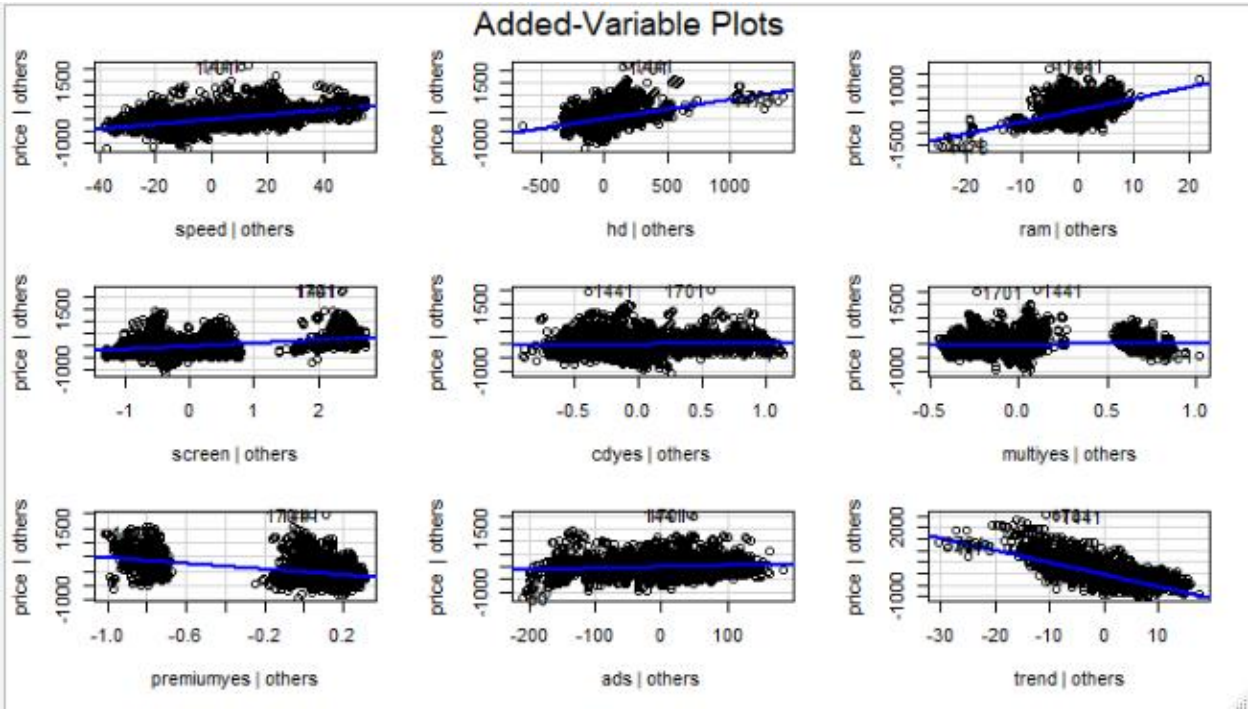
```
rmse = 275.1298
```




**From the above plot we can see dispersion of the points**

**Large number of influencing observations available in our model.**



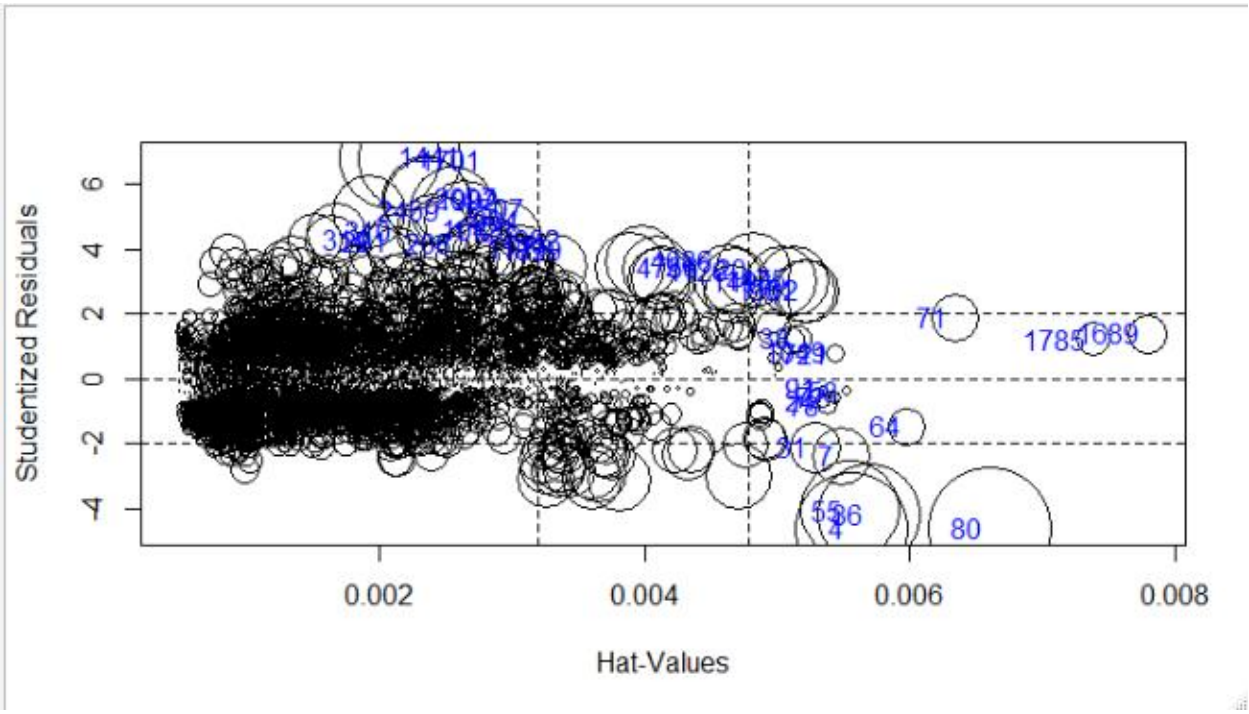




**Now we will make data scale free and unitless for next model.**

## Model-2 ➔

```
df_comp2 <- data.frame(scale(log(Comp[,-c(1,2,7,8,9)])),"price" = df_comp$price,"cd" = df_comp$cd,"premium" = df_comp$premium,"multi" = df_comp$multi)

model_Comp_2 <- lm(price~.,data=df_comp2)
```

```
Multiple R-squared:  0.7426,   Adjusted R-squared:  0.7422
```



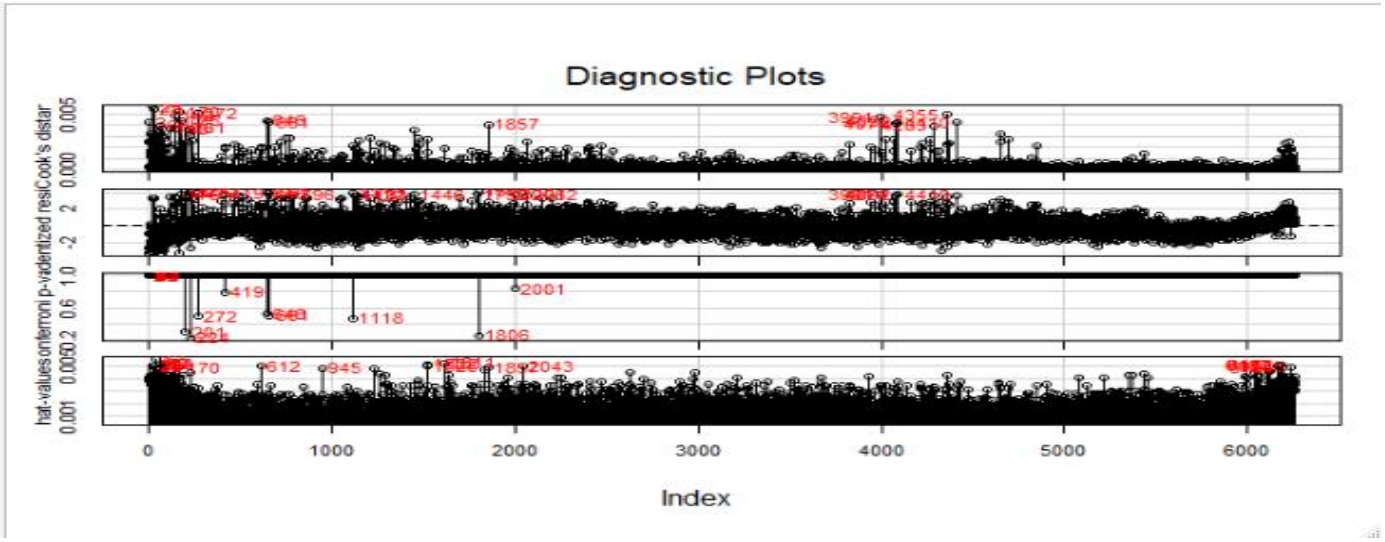

**After standardizing the whole data and log transformation we are getting coeffi cient of determination 0.742 which is less than previous model.**

**So, we are removing influencing index for our next model.**

**Model-3 ➔**

**influ_comp <- as.integer(rownames(influencePlot(model_Comp_2,id = list(n=20, col="blue"))))**

```
df_comp3 <- df_comp2[-c(influ_comp),]#head(df_comp2)
> model_Comp_3 <- lm(price~.,data=df_comp3)
Multiple R-squared:  0.7508,   Adjusted R-squared:  0.7504
Correlation is 0.8664749
rmse = 281.3819
```

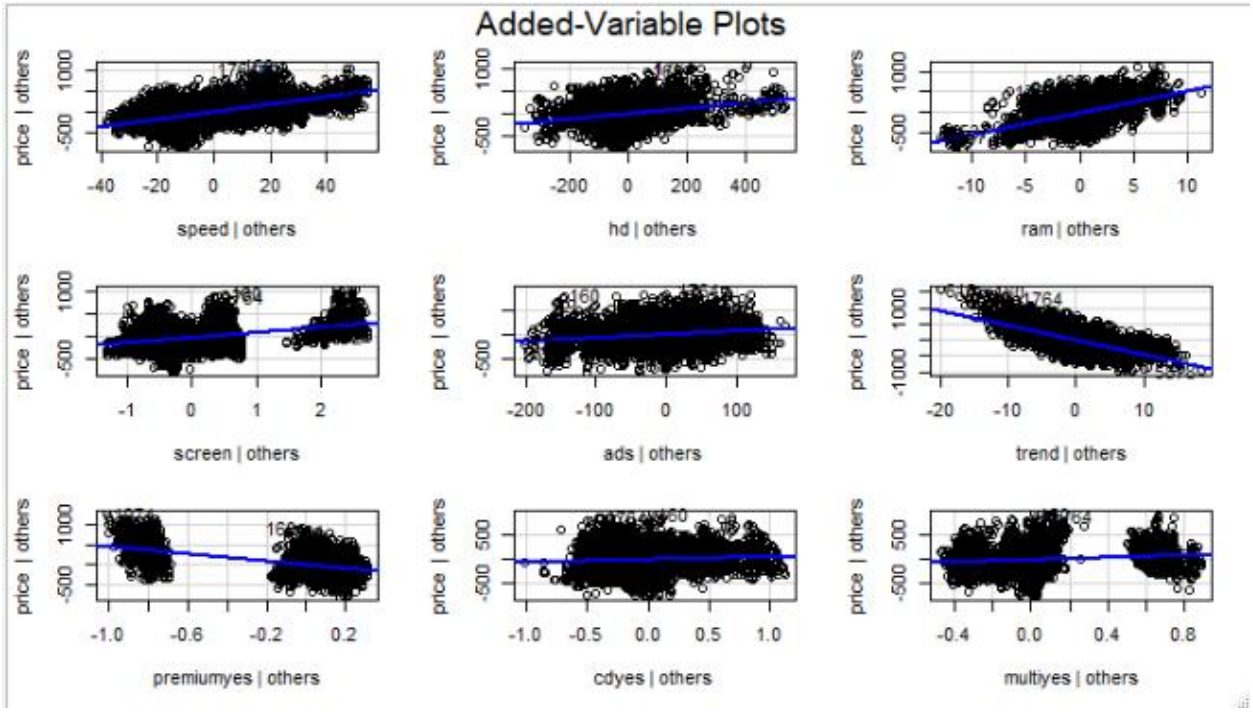



**In mode-3 we have removed 20 influencing observations , so there is only slight improvement coefficient of determination, RMSE, and correlation .**

**But our dataset contain still more influencing index with count 291, so now we will remove 3% of data in our next model.**

## Model-4 ➔

```
nfluencing_obs <- length(which(rowSums(influence.measures(model_Comp_1)$is.in
f) > 0));influencing_obs

# These are the influencing observations
[1] 294

influence_obs <- as.integer(rownames(influencePlot(model_Comp_1,id=list(n=90,
col="red"))))

> length(influence_obs)
[1] 186

df_Comp_scale <- data.frame(df_comp[,-c(6,7,8)],"premium"=df_comp$premium,"cd
"=df_comp$cd,"multi"=df_comp$multi)#,"cd"=df_comp3$cd,"multi"=df_comp3$multi

> df_Comp_scale <- df_Comp_scale[-c(influence_obs),]

model_Comp_4 <- lm(price~.,data=df_Comp_scale)

Multiple R-squared:  0.804,    Adjusted R-squared:  0.8037

Correlation is 0.879

rmse = 238.0004
```




**In model-4 without influencing factor we are getting good results with less RMSE compared with other models.**

## Comparison ➔

| Model No | Modeled with | Predicted With | Transformation | R^2 | RMSE | cor |
|---|---|---|---|---|---|---|
| Model-1 | All Observations | All Observations | NA | 0.7756 | 275.1298 | 0.880663 |
| Model-2 | All Observations | All Observations | NA | 0.7426 | - | - |
| Model-3 | 99.4 % data | 99.4 % data | log | 0.7508 | 281.3819 | 0.86647 |
| Model-4 | 97.02% data | All Observations | NA | 0.804 | 238.0004 | 0.879204 |

**From the above comparison we can infer that Model-4 is good model with 80% of variation in our target variable due to observations along with least RMSE.**