Computer Price Prediction using Stepwise Linear Regression & Feature Selection

libraries <- c('MASS','leaps', 'FNN') # install.packages(libraries)

Loading dataframe

```
c_prices <- read.csv("C:/Users/Arup/Documents/DS_ComputerConfigure.csv")
str(c_prices)
```

```
## 'data.frame':    6259 obs. of  11 variables:
##  $ X      : int  1 2 3 4 5 6 7 8 9 10 ...
##  $ price  : int  1499 1795 1595 1849 3295 3695 1720 1995 2225 2575 ...
##  $ speed  : int  25 33 25 25 33 66 25 50 50 50 ...
##  $ hd     : int  80 85 170 170 340 340 170 85 210 210 ...
##  $ ram    : int  4 2 4 8 16 16 4 2 8 4 ...
##  $ screen : int  14 14 15 14 14 14 14 14 14 15 ...
##  $ cd     : chr  "no" "no" "no" "no" ...
##  $ multi  : chr  "no" "no" "no" "no" ...
##  $ premium: chr  "yes" "yes" "yes" "no" ...
##  $ ads    : int  94 94 94 94 94 94 94 94 94 94 ...
##  $ trend  : int  1 1 1 1 1 1 1 1 1 1 ...
```

Numerizing the Dataset

```
c_prices<-c_prices[-1]

c_prices[which(c_prices$cd == "no"),]$cd <- 0;              c_prices[which(c_prices$cd ==
"yes"),]$cd <- 1
c_prices[which(c_prices$multi == "no"),]$multi <- 0;        c_prices[which(c_prices$multi
== "yes"),]$multi <- 1
c_prices[which(c_prices$premium == "no"),]$premium <- 0;
c_prices[which(c_prices$premium == "yes"),]$premium <- 1



c_prices$cd<-as.integer(c_prices$cd)
c_prices$multi<-as.integer(c_prices$multi)
c_prices$premium<-as.integer(c_prices$premium)

head(c_prices)
```

```
##   price speed  hd ram screen cd multi premium ads trend
## 1  1499    25  80   4     14  0     0       1  94     1
## 2  1795    33  85   2     14  0     0       1  94     1
## 3  1595    25 170   4     15  0     0       1  94     1
## 4  1849    25 170   8     14  0     0       0  94     1
## 5  3295    33 340  16     14  0     0       1  94     1
## 6  3695    66 340  16     14  0     0       1  94     1
```

Feature (Attribute) Selection using Forward Stepwise Regression

```
library(MASS) # stepwise regression
```

```r
full <- lm(price ~ speed + hd + ram + screen + cd + multi + premium + ads + trend,
data=c_prices)
null <- lm(price~1,data=c_prices)

stepF <- stepAIC(null, scope=list(lower=null, upper=full), direction= "forward",
trace=TRUE)
```

```
## Start:  AIC=79670.73
## price ~ 1
##
##           Df Sum of Sq        RSS   AIC
## + ram      1 818690431 1292340953 76601
## + hd       1 390797865 1720233519 78391
## + speed    1 191231639 1919799745 79078
## + screen   1 185011960 1926019424 79099
## + trend    1  84430224 2026601160 79417
## + cd       1  82212838 2028818546 79424
## + premium  1  13746829 2097284555 79632
## + ads      1   6279607 2104751777 79654
## <none>                 2111031384 79671
## + multi    1    585323 2110446061 79671
##
## Step:  AIC=76601.3
## price ~ ram
##
##           Df Sum of Sq        RSS   AIC
## + trend    1 317046568  975294385 74842
## + premium  1  90928941 1201412013 76147
## + ads      1  61377109 1230963845 76299
## + screen   1  60765788 1231575165 76302
## + speed    1  53523313 1238817640 76339
## + hd       1  15618983 1276721971 76527
## + cd       1  14990800 1277350154 76530
## + multi    1   4280755 1288060198 76583
## <none>                 1292340953 76601
##
## Step:  AIC=74841.57
## price ~ ram + trend
##
##           Df Sum of Sq       RSS   AIC
## + speed    1 219800193 755494193 73245
## + screen   1 107619693 867674692 74112
## + premium  1  95496579 879797806 74199
## + hd       1  70850709 904443676 74372
## + cd       1   9234744 966059642 74784
## + ads      1   8402231 966892154 74789
## + multi    1   2706117 972588268 74826
## <none>                 975294385 74842
##
## Step:  AIC=73245.23
## price ~ ram + trend + speed

##           Df Sum of Sq       RSS   AIC
## + premium  1 121458788 634035405 72150
## + screen   1  78678269 676815924 72559
```

```
## + hd       1  44107493 711386700 72871
## + ads      1  17590316 737903876 73100
## + cd       1   5471868 750022325 73202
## + multi    1   2685619 752808574 73225
## <none>                 755494193 73245
##
## Step:  AIC=72150.23
## price ~ ram + trend + speed + premium
##
##          Df Sum of Sq       RSS   AIC
## + screen  1  72874490 561160915 71388
## + hd      1  58613852 575421553 71545
## + cd      1  17368943 616666462 71978
## + multi   1   9176056 624859350 72061
## + ads     1   8152702 625882703 72071
## <none>                634035405 72150
##
## Step:  AIC=71388.02
## price ~ ram + trend + speed + premium + screen
##
##         Df Sum of Sq       RSS   AIC
## + hd     1  54901344 506259571 70746
## + cd     1  18110557 543050358 71185
## + multi  1  11282896 549878019 71263
## + ads    1   8883646 552277269 71290
## <none>               561160915 71388
##
## Step:  AIC=70745.61
## price ~ ram + trend + speed + premium + screen + hd
##
##         Df Sum of Sq       RSS   AIC
## + ads    1  16662799 489596771 70538
## + cd     1  14252137 492007433 70569
## + multi  1  14091100 492168471 70571
## <none>               506259571 70746
##
## Step:  AIC=70538.14
## price ~ ram + trend + speed + premium + screen + hd + ads
##
##         Df Sum of Sq       RSS   AIC
## + multi  1  12705685 476891087 70376
## + cd     1   9477678 480119093 70418
## <none>               489596771 70538
##
## Step:  AIC=70375.56
## price ~ ram + trend + speed + premium + screen + hd + ads + multi
##
##        Df Sum of Sq       RSS   AIC
## + cd    1   3107211 473783875 70337
## <none>              476891087 70376
##
## Step:  AIC=70336.65
## price ~ ram + trend + speed + premium + screen + hd + ads + multi +
##     cd

summary(stepF)
```

```
##
## Call:
## lm(formula = price ~ ram + trend + speed + premium + screen +
##     hd + ads + multi + cd, data = c_prices)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1093.77  -174.24   -11.49   146.49  2001.05
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)  307.98798   60.35341   5.103 3.44e-07 ***
## ram           48.25596    1.06608  45.265  < 2e-16 ***
## trend        -51.84958    0.62871 -82.470  < 2e-16 ***
## speed          9.32028    0.18506  50.364  < 2e-16 ***
## premium     -509.22473   12.34225 -41.259  < 2e-16 ***
## screen       123.08904    3.99950  30.776  < 2e-16 ***
## hd             0.78178    0.02761  28.311  < 2e-16 ***
## ads            0.65729    0.05132  12.809  < 2e-16 ***
## multi        104.32382   11.41268   9.141  < 2e-16 ***
## cd            60.91671    9.51559   6.402 1.65e-10 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 275.3 on 6249 degrees of freedom
## Multiple R-squared:  0.7756, Adjusted R-squared:  0.7752
## F-statistic:  2399 on 9 and 6249 DF,  p-value: < 2.2e-16
```

Selecting the best combination of the 4 Features / Attributes

```
library(leaps) # all subsets regression
```

```
## Warning: package 'leaps' was built under R version 4.1.3
```

```
subsets<-regsubsets(price ~ speed + hd + ram + screen + cd + multi + premium + ads +
trend, data=c_prices, nbest=1,)
sub.sum <- summary(subsets)
as.data.frame(sub.sum$outmat)
```

```
##          speed hd ram screen cd multi premium ads trend
## 1  ( 1 )            *
## 2  ( 1 )            *                                 *
## 3  ( 1 )     *      *                                 *
## 4  ( 1 )     *      *                         *       *
## 5  ( 1 )     *      *      *                  *       *
## 6  ( 1 )     *  *   *      *                  *       *
## 7  ( 1 )     *  *   *      *                  *   *   *
## 8  ( 1 )     *  *   *      *        *         *   *   *
```

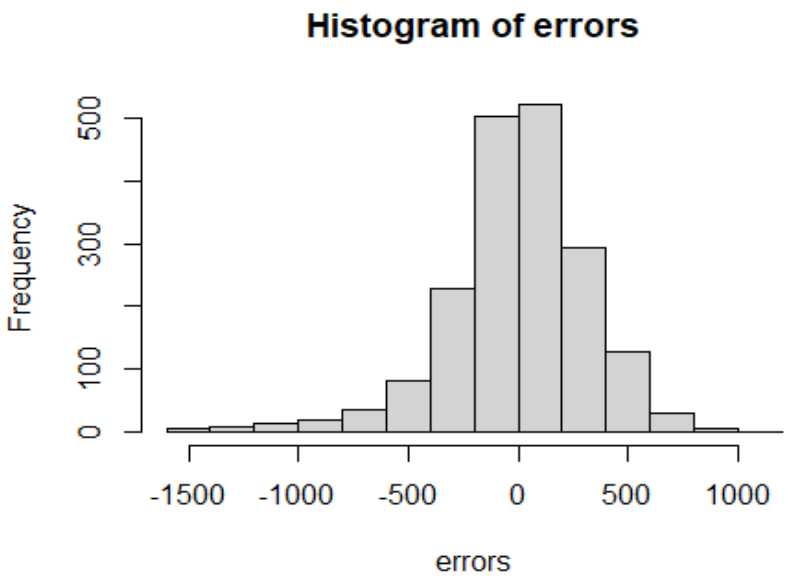
Modelling Dataset

```
rn_train <- sample(nrow(c_prices), floor(nrow(c_prices)*0.7))

# Modelling with Only Top four Significant Features (Cloumn 4,10,2,8)
train <- c_prices[rn_train,c("price","ram","trend","speed", "premium")]
test <- c_prices[-rn_train,c("price","ram","trend","speed", "premium")]
```

```
model_ulm <- lm(price ~ ram + trend + speed + premium, data=train)
prediction <- predict(model_ulm, interval="prediction", newdata =test)

errors <- prediction[,"fit"] - test$price
hist(errors)
```



Calculation of Root Mean Square Error & Percentage of cases that has less than 25% Error

```
rmse <- sqrt(sum((prediction[,"fit"] - test$price)^2)/nrow(test))
rel_change <- 1 - ((test$price - abs(errors)) / test$price)
pred25 <- table(rel_change<0.25)["TRUE"] / nrow(test)
paste("RMSE:", round(rmse,2))
```

```
## [1] "RMSE: 324.21"
```

```
paste("PRED(25):", round(100*pred25,2), "%")
```

```
## [1] "PRED(25): 90.89 %"
```

Predicting the Price of a new Product

```
library(FNN)

dataset <- rbind(c_prices, c(0,32,90,8,15,0,0,1,200,2))

dataset.numeric <- as.data.frame(dataset)
prediction <- knn.reg(dataset.numeric[1:nrow(c_prices),-1],
              test = dataset.numeric[nrow(c_prices)+1,-1],
              dataset.numeric[1:nrow(c_prices),]$price, k = 7 , algorithm="kd_tree")

paste("New Computer Price: $", prediction$pred)
```

```
## [1] "New Computer Price: $ 1601"
```