Homework#2

Arinjay Jain

```
library(class)

data <-read.table(file = "C:/Arinjay_Personal/Statistical Learning/Homework#2/Grocery.txt",
                  header = FALSE, sep = "\t")


dataFrame <- data.frame(data)
names(dataFrame) <- c("Y","X1", "X2", "X3")

fitModel <- lm(Y ~ X1+X2+factor(X3),data = dataFrame)
summary(fitModel)
```

```
##
## Call:
## lm(formula = Y ~ X1 + X2 + factor(X3), data = dataFrame)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -264.05 -110.73  -22.52   79.29  295.75
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)  4.150e+03  1.956e+02  21.220  < 2e-16 ***
## X1           7.871e-04  3.646e-04   2.159   0.0359 *
## X2          -1.317e+01  2.309e+01  -0.570   0.5712
## factor(X3)1  6.236e+02  6.264e+01   9.954 2.94e-13 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 143.3 on 48 degrees of freedom
## Multiple R-squared:  0.6883, Adjusted R-squared:  0.6689
## F-statistic: 35.34 on 3 and 48 DF,  p-value: 3.316e-12
```

```
coefficients<-fitModel$coefficients
std_Dev<- coef(summary(fitModel))[, "Std. Error"]
z_Score<- coef(summary(fitModel))[, "t value"]
p_Values<- coef(summary(fitModel))[, "Pr(>|t|)"]
fitModel_Table<-cbind(coefficients, std_Dev, z_Score, p_Values)
print(fitModel_Table)
```

```
##              coefficients      std_Dev    z_Score     p_Values
## (Intercept)  4.149887e+03 1.955654e+02 21.2199453 4.902653e-26
## X1           7.870804e-04 3.645540e-04  2.1590228 3.587650e-02
```

```
## X2          -1.316602e+01 2.309173e+01 -0.5701616 5.712274e-01
## factor(X3)1  6.235545e+02 6.264095e+01  9.9544230 2.940869e-13
```

```
estimation_SigmaSquare<- (sum((fitModel$residuals)^2))/fitModel$df.residual

cat("estimation sigma_SigmaSquare:", estimation_SigmaSquare)
```

```
## estimation sigma_SigmaSquare: 20531.87
```

```
y_Hat<- predict(fitModel)
```

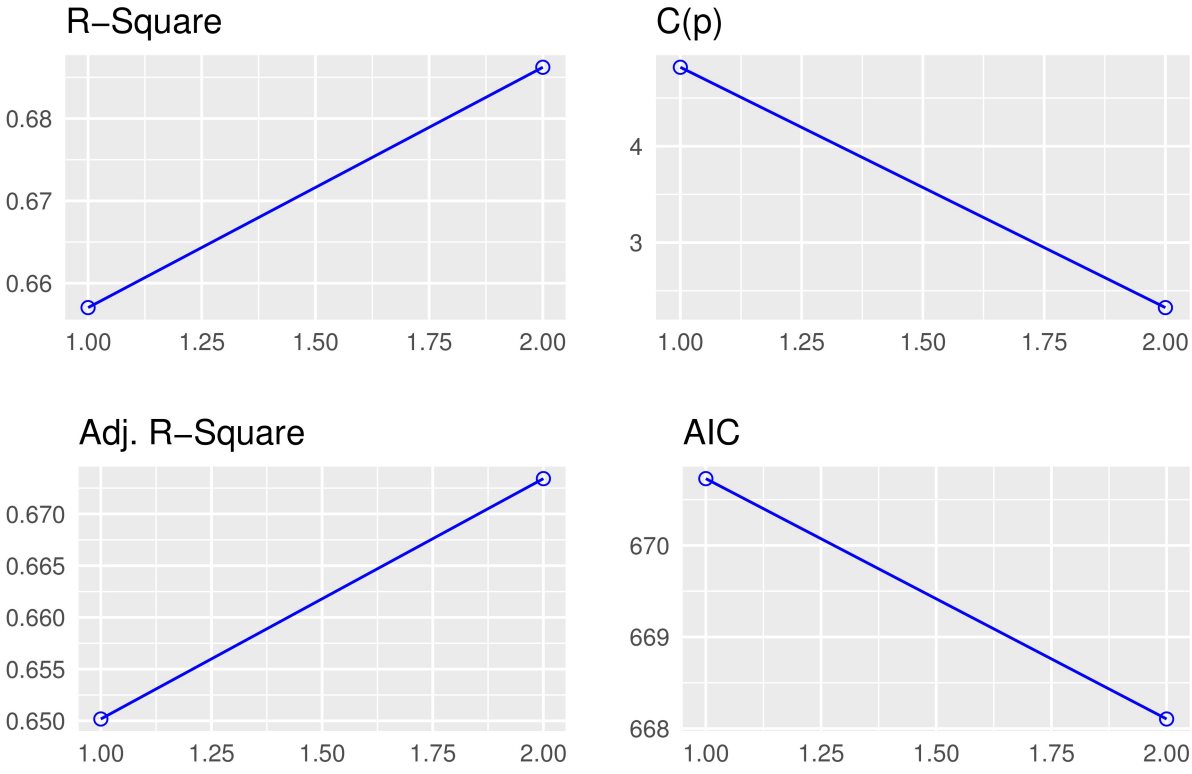
```
#Stepwise

library(olsrr)
```

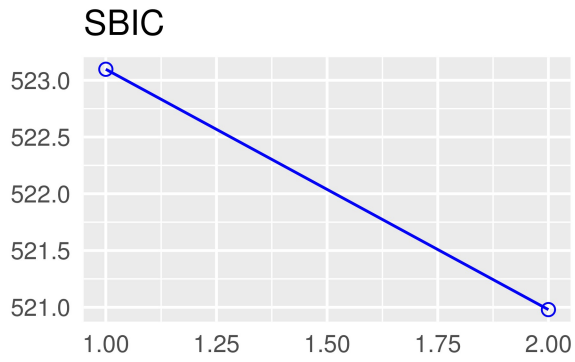
```
##
## Attaching package: 'olsrr'

## The following object is masked from 'package:datasets':
##
##     rivers
```

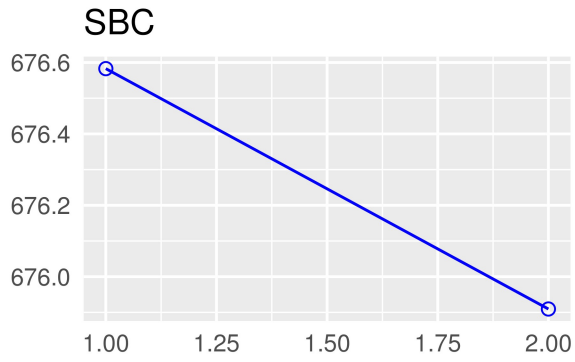
```
forward_Step<-ols_step_forward_p(fitModel)
print(forward_Step)
```

```
##
##                              Selection Summary
## ------------------------------------------------------------------------
##         Variable                    Adj.
## Step     Entered      R-Square    R-Square     C(p)       AIC         RMSE
## ------------------------------------------------------------------------
##    1    factor(X3)      0.6570      0.6502    4.8198    670.7292    147.2745
##    2    X1              0.6862      0.6734    2.3251    668.1045    142.2992
## ------------------------------------------------------------------------
```

```
plot(ols_step_forward_p(fitModel))
```


R−Square
0.68
0.67
0.66
1.00
1.25
1.50
1.75
2.00
C(p)
4
3
1.00
1.25
1.50
1.75
2.00
Adj. R−Square
0.670
0.665
0.660
0.655
0.650
1.00
1.25
1.50
1.75
2.00
AIC
670
669
668
1.00
1.25
1.50
1.75
2.00






```
back_Step<-ols_step_backward_p(fitModel)
print(back_Step)
```

```
##
##
##                             Elimination Summary
## ------------------------------------------------------------------------
##         Variable                  Adj.
## Step    Removed     R-Square    R-Square     C(p)       AIC          RMSE
## ------------------------------------------------------------------------
##    1    X2            0.6862      0.6734    2.3251    668.1045    142.2992
## ------------------------------------------------------------------------
```

```
print("From Forward and Backward both approaches giving same results. In our final model, we will keep
```

```
## [1] "From Forward and Backward both approaches giving same results. In our final model, we will keep
```

```
finalModel<- lm(Y~X1+factor(X3), data=dataFrame)
summary(finalModel)
```

```
##
## Call:
## lm(formula = Y ~ X1 + factor(X3), data = dataFrame)
##
```

```
## Residuals:
##      Min       1Q   Median       3Q      Max
## -286.249  -99.650   -9.251   70.746  292.311
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 4.058e+03  1.109e+02  36.592  < 2e-16 ***
## X1          7.704e-04  3.609e-04   2.135   0.0378 *
## factor(X3)1 6.196e+02  6.183e+01  10.021 1.88e-13 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 142.3 on 49 degrees of freedom
## Multiple R-squared:  0.6862, Adjusted R-squared:  0.6734
## F-statistic: 53.58 on 2 and 49 DF,  p-value: 4.647e-13
```

```
estimation_SigmaSquare_finalModel<- (sum((finalModel$residuals)^2))/finalModel$df.residual

cat("estimation sigma_SigmaSquare_finalModel:", estimation_SigmaSquare_finalModel)
```

```
## estimation sigma_SigmaSquare_finalModel: 20249.07
```

```
## Bestsubset using Cp Criteria
library(leaps)

models <- regsubsets(Y~., data = dataFrame, nvmax = 3)

modelSummary <- summary(models)

CP = which.min(modelSummary$cp)

#best model will have below predictors:
modelSummary$which[CP,]
```

```
## (Intercept)          X1          X2          X3
##        TRUE        TRUE       FALSE        TRUE
```

```
print("Checking the p-values in both small model and full model for the F-test to see the significance
```

```
## [1] "Checking the p-values in both small model and full model for the F-test to see the significance
```

```
#From part b
anova(finalModel)
```

```
## Analysis of Variance Table
##
## Response: Y
##            Df  Sum Sq Mean Sq  F value    Pr(>F)
## X1          1  136366  136366   6.7344   0.01244 *
## factor(X3)  1 2033565 2033565 100.4276 1.875e-13 ***
## Residuals  49  992204   20249
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
#From part a
anova(fitModel)
```

```
## Analysis of Variance Table
##
## Response: Y
##            Df  Sum Sq Mean Sq F value    Pr(>F)
## X1          1  136366  136366  6.6417   0.01309 *
## X2          1    5726    5726  0.2789   0.59987
## factor(X3)  1 2034514 2034514 99.0905 2.941e-13 ***
## Residuals  48  985530   20532
## ---
## Signif. codes:  0 ’***’ 0.001 ’**’ 0.01 ’*’ 0.05 ’.’ 0.1 ’ ’ 1
```

```r
print("Here we can see in the small model (final model) both predictors have very significant (less ther
```

```
## [1] "Here we can see in the small model (final model) both predictors have very significant (less th
```