Gas Mileage Prediction

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5/5/2020

Overview

We will predict whether a given car gets high or low gas mileage given data from Auto dataset

```
Auto<-Auto%>%mutate(mileage=ifelse(mpg > median(mpg),1,0))
Auto$mileage<-as.factor(Auto$mileage)
attach(Auto)
```

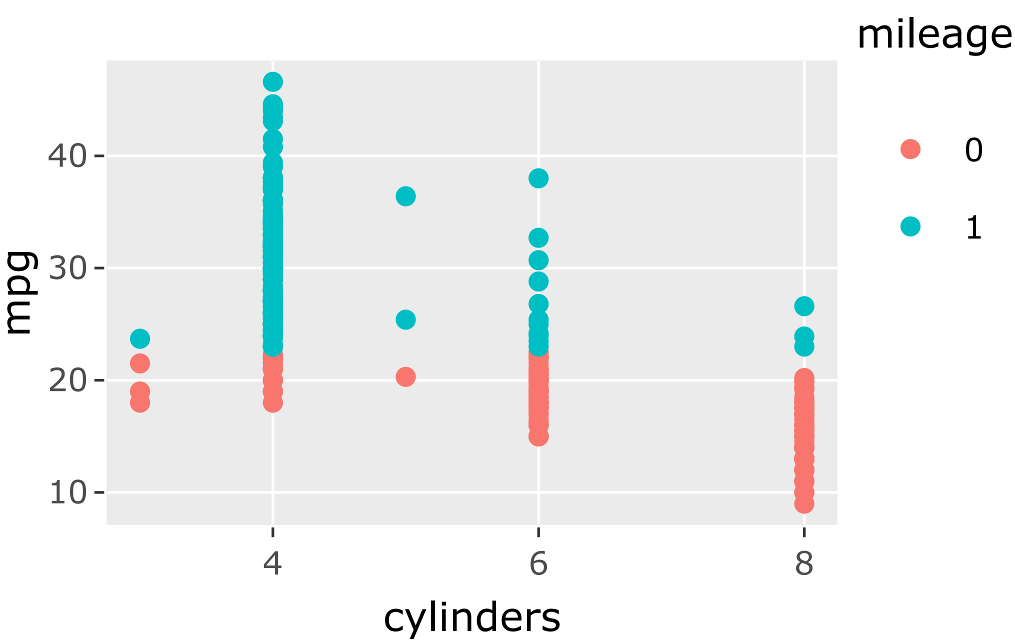
```
The following object is masked from package:ggplot2:

    mpg
```

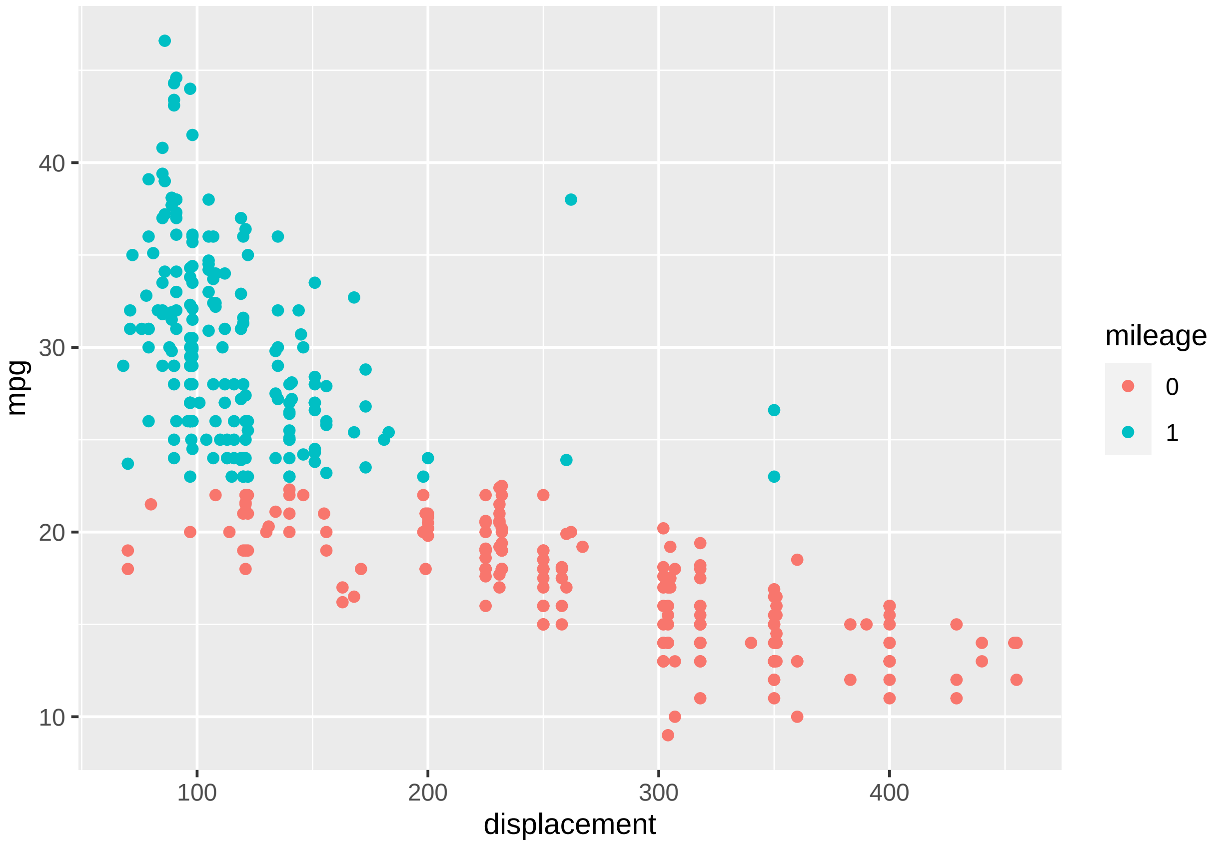
```
names(Auto)
```

```
 [1] "mpg"          "cylinders"    "displacement" "horsepower"   "weight"
 [6] "acceleration" "year"         "origin"       "name"         "mileage"
```

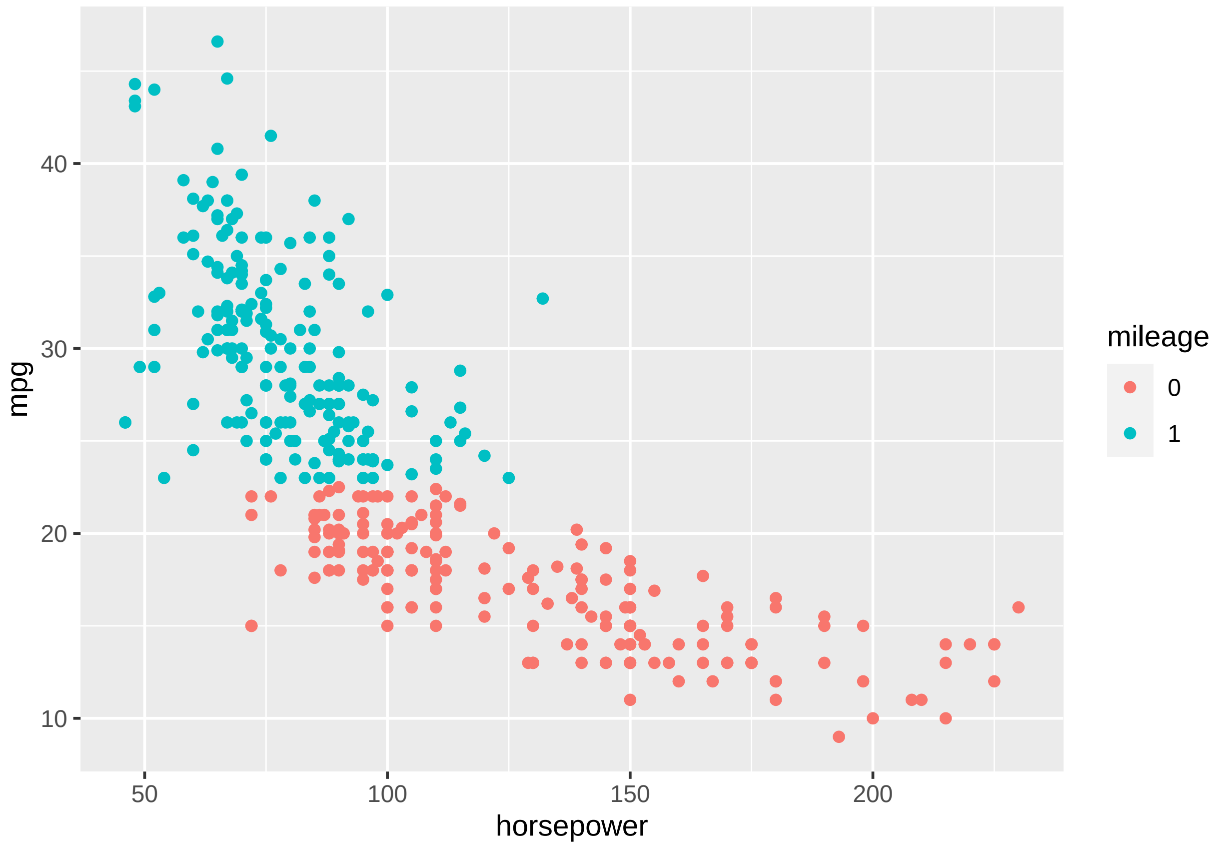
```
ggplotly(ggplot(data=Auto,aes(y=mpg,x=cylinders,color=mileage))+geom_point())
```



```r
ggplot(data=Auto,aes(y=mpg,x=displacement,color=mileage))+geom_point()
```

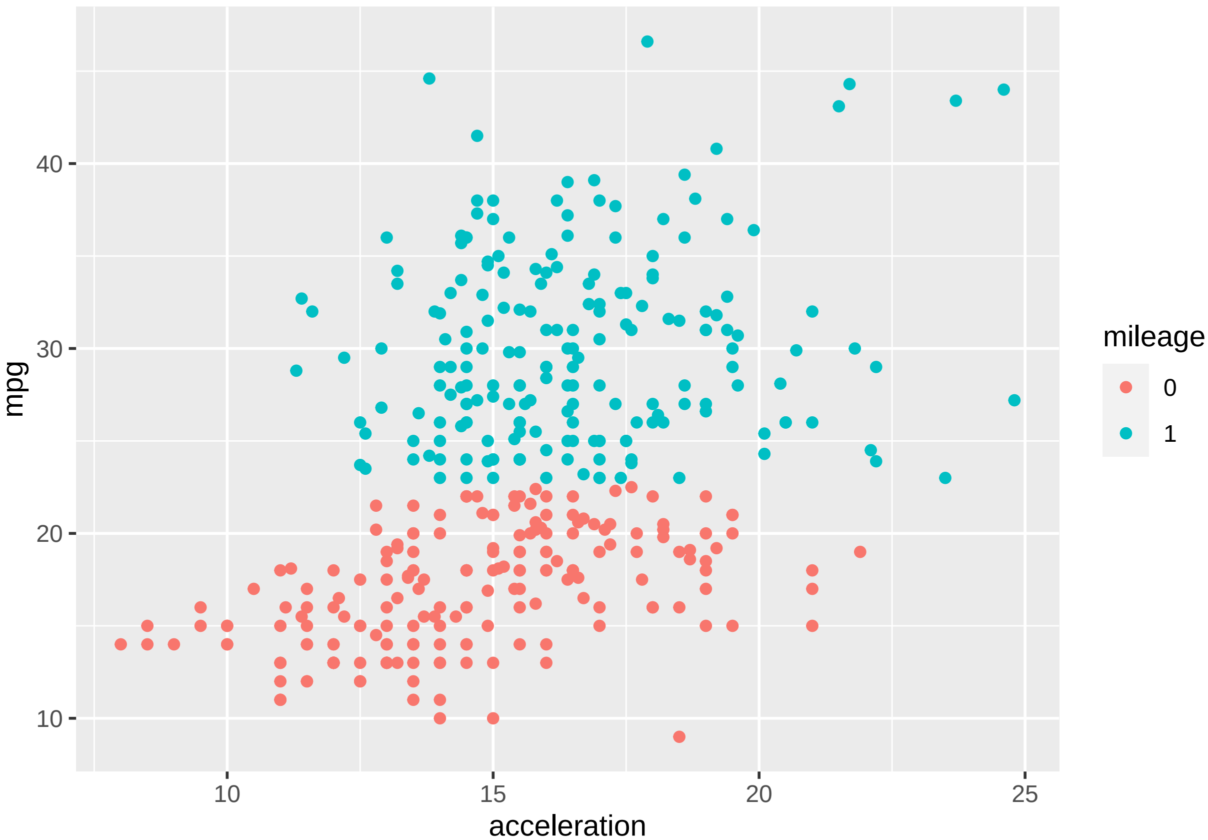



```r
ggplot(data=Auto,aes(y=mpg,x=horsepower,color=mileage))+geom_point()
```

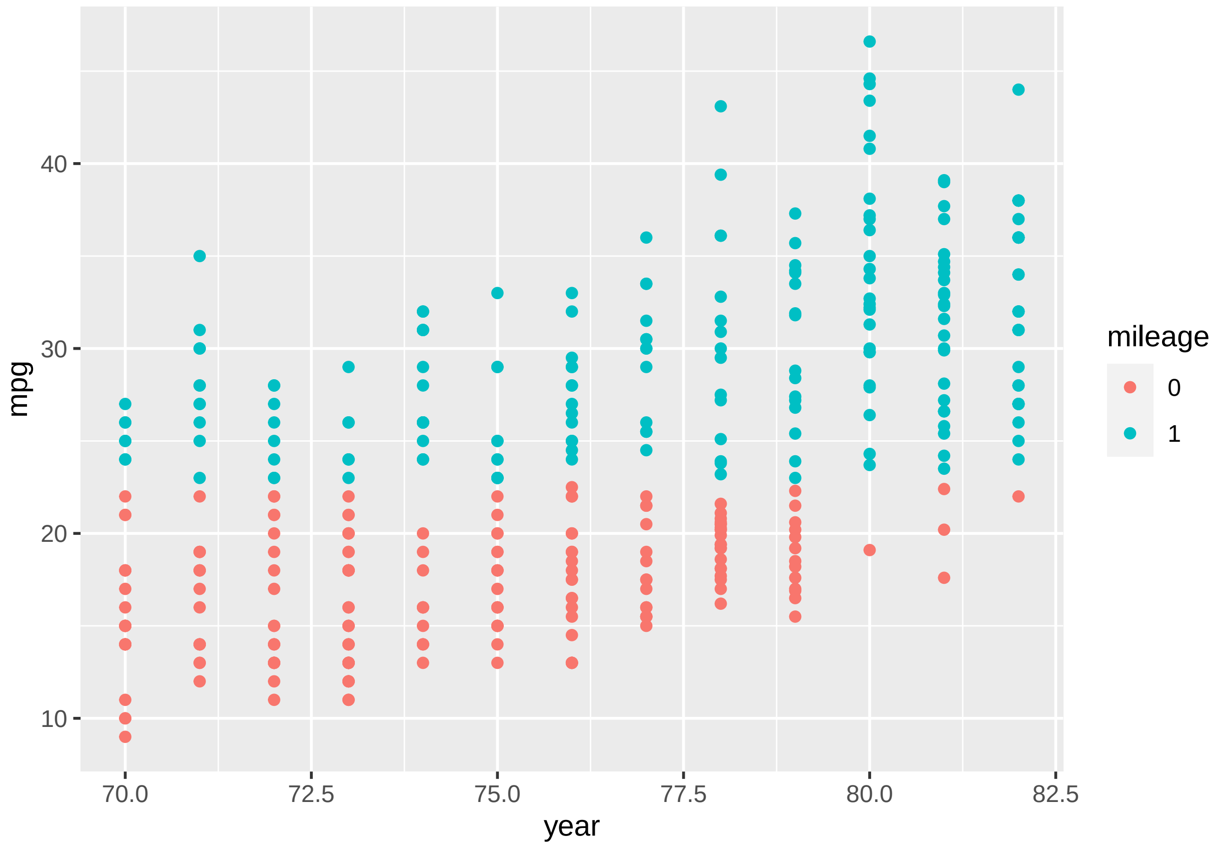



```
ggplot(data=Auto,aes(y=mpg,x=weight,color=mileage))+geom_point()
```

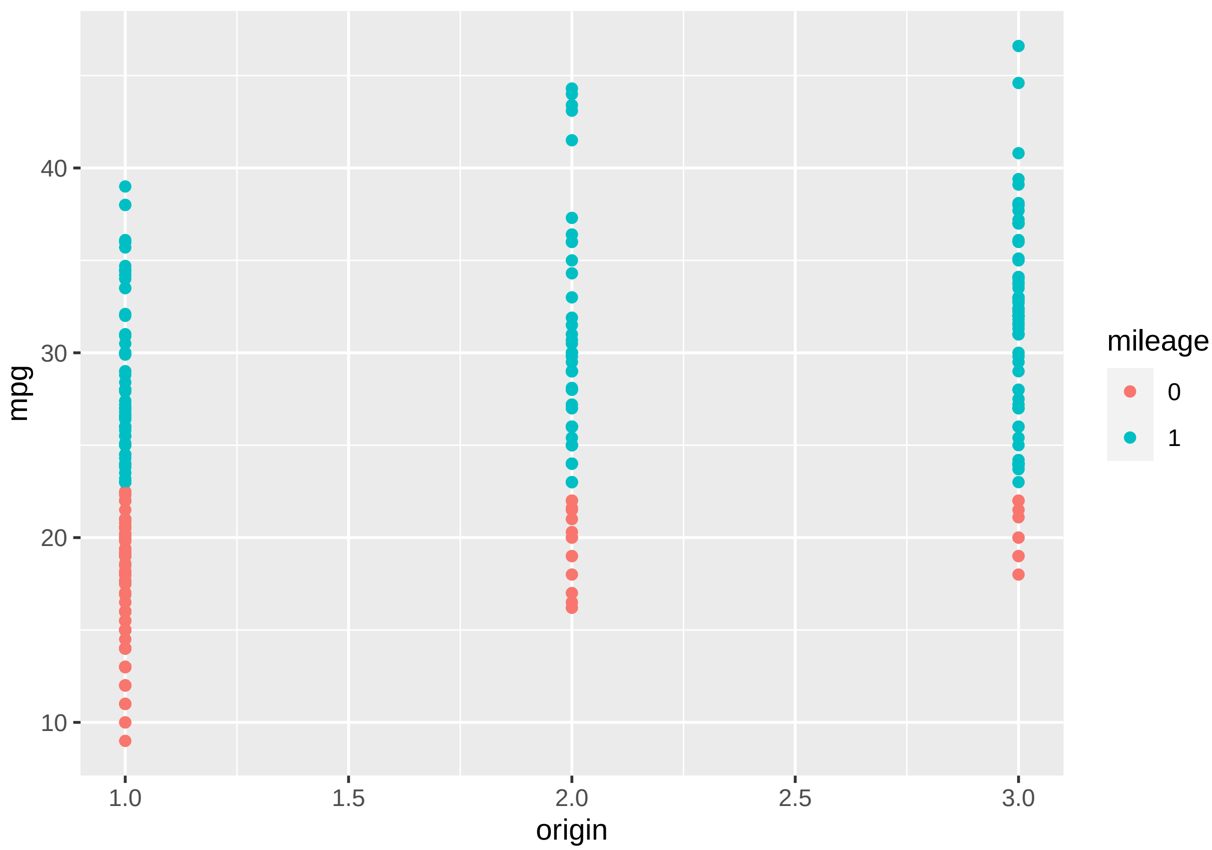

```
ggplot(data=Auto,aes(y=mpg,x=acceleration,color=mileage))+geom_point()
```




```r
ggplot(data=Auto,aes(y=mpg,x=year,color=mileage))+geom_point()
```




```
ggplot(data=Auto,aes(y=mpg,x=origin,color=mileage))+geom_point()
```



Split Data to Train & Test

```r
set.seed(1)
sample <- sample.split(Auto$mileage, SplitRatio = .75)
train <- subset(Auto, sample == TRUE)
test  <- subset(Auto, sample == FALSE)
```

Logistic Regression

```r
glm.fit<-glm(mileage~displacement+horsepower+weight+acceleration+year+cylinders+origin,family=binomial,d

summary(glm.fit)
```

```
Call:
glm(formula = mileage ~ displacement + horsepower + weight +
    acceleration + year + cylinders + origin, family = binomial,
    data = train)

Deviance Residuals:
     Min        1Q    Median        3Q       Max
-2.27305  -0.09392   0.00790   0.22766   3.10823
```

```
Coefficients:
              Estimate Std. Error z value Pr(>|z|)
(Intercept)  -18.919142   6.505128  -2.908 0.003633 **
displacement  -0.001618   0.013913  -0.116 0.907420
horsepower    -0.024222   0.027116  -0.893 0.371704
weight        -0.005248   0.001379  -3.806 0.000141 ***
acceleration   0.076713   0.157582   0.487 0.626388
year           0.434125   0.085768   5.062 4.16e-07 ***
cylinders      0.271768   0.474154   0.573 0.566534
origin         0.351906   0.396237   0.888 0.374476
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 407.57  on 293  degrees of freedom
Residual deviance: 120.99  on 286  degrees of freedom
AIC: 136.99

Number of Fisher Scoring iterations: 8
```

```
glm.probs=predict(glm.fit,test,type="response")

glm.prediction=rep(0,length(test$mileage))
glm.prediction[glm.probs>0.5]=1

table(glm.prediction,test$mileage)
```

```
glm.prediction  0  1
             0 45  5
             1  4 44
```

```
mean(glm.prediction==test$mileage)
```

```
[1] 0.9081633
```

```
mean(glm.prediction!=test$mileage)
```

```
[1] 0.09183673
```

Linear Discriminant Analysis

```
lda.fit=lda(mileage~displacement+horsepower+weight+acceleration+year+cylinders+origin,data=train)

lda.fit
```

```
Call:
```

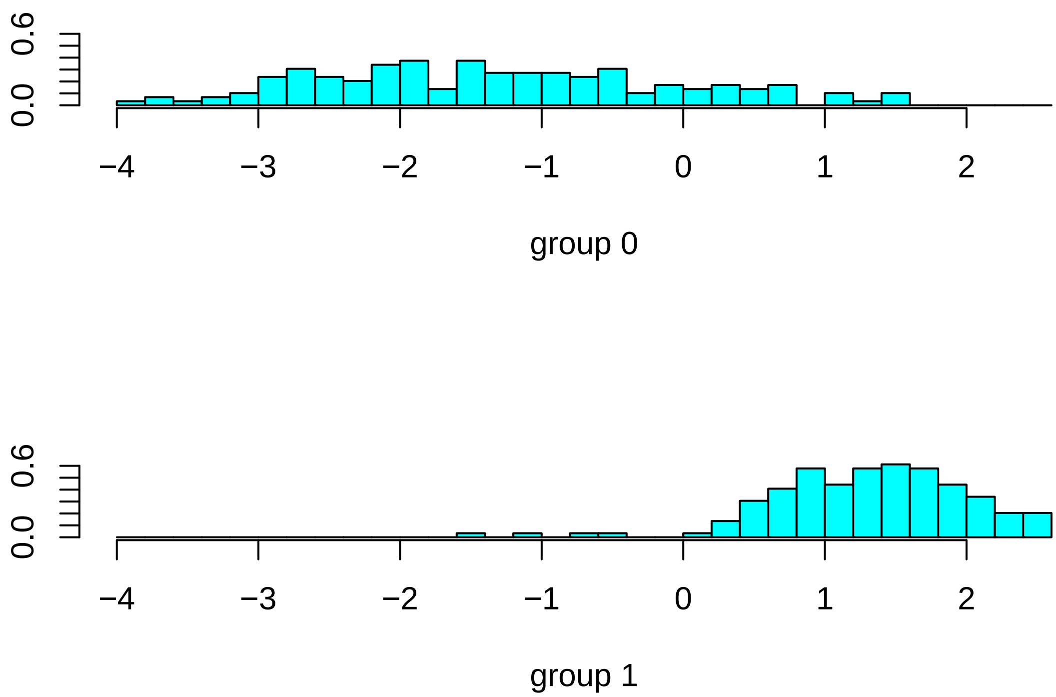
```
lda(mileage ~ displacement + horsepower + weight + acceleration +
    year + cylinders + origin, data = train)

Prior probabilities of groups:
  0   1
0.5 0.5

Group means:
  displacement horsepower   weight acceleration     year cylinders   origin
0     268.9116  128.92517 3597.619     14.62925 74.38095  6.680272 1.190476
1     114.6633   79.34694 2313.395     16.39592 77.46259  4.190476 2.013605

Coefficients of linear discriminants:
                       LD1
displacement -0.0002351927
horsepower    0.0097066538
weight       -0.0014434378
acceleration  0.0161947564
year          0.1272136926
cylinders    -0.2642234671
origin        0.1644223915
```

```r
plot(lda.fit)
```




```r
lda.prediction=predict(lda.fit, test)
lda.class=lda.prediction$class

table(lda.class,test$mileage)
```

```
lda.class  0  1
        0 45  3
        1  4 46
```

```r
mean(lda.class==test$mileage)
```

```
[1] 0.9285714
```

```r
mean(lda.class!=test$mileage)
```

```
[1] 0.07142857
```

Quadratic Discriminant Analysis

```r
qda.fit=qda(mileage~displacement+horsepower+weight+acceleration+year+cylinders+origin,data=train)

qda.fit
```

```
Call:
qda(mileage ~ displacement + horsepower + weight + acceleration +
    year + cylinders + origin, data = train)

Prior probabilities of groups:
  0   1
0.5 0.5

Group means:
  displacement horsepower   weight acceleration     year cylinders   origin
0     268.9116  128.92517 3597.619     14.62925 74.38095  6.680272 1.190476
1     114.6633   79.34694 2313.395     16.39592 77.46259  4.190476 2.013605
```

```r
qda.prediction=predict(qda.fit, test)
qda.class=qda.prediction$class

table(qda.class,test$mileage)
```

```
qda.class  0  1
        0 48  7
        1  1 42
```

```r
mean(qda.class==test$mileage)
```

```
[1] 0.9183673
```

```r
mean(qda.class!=test$mileage)
```

```
[1] 0.08163265
```

K-Nearest Neighbors

```
knn.pred=knn(train[2:8],test[2:8],train$mileage,k=1)

table(knn.pred,test$mileage)
```

```
knn.pred  0  1
       0 47 10
       1  2 39
```

```
mean(knn.pred==test$mileage)
```

```
[1] 0.877551
```

```
knn.pred=knn(train[2:8],test[2:8],train$mileage,k=3)
table(knn.pred,test$mileage)
```

```
knn.pred  0  1
       0 46  9
       1  3 40
```

```
mean(knn.pred==test$mileage)
```

```
[1] 0.877551
```

```
knn.pred=knn(train[2:8],test[2:8],train$mileage,k=10)
table(knn.pred,test$mileage)
```

```
knn.pred  0  1
       0 44 10
       1  5 39
```

```
mean(knn.pred==test$mileage)
```

```
[1] 0.8469388
```

Conclusions

We have compared the performance on test data for different classifiers trained on 75% of the dataset. The predictors we used to estimate our response were cylinders, displacement, horsepower, weight, acceleration, year & origin. The classification alrotighms used were Logistic Regression, Linear Discriminant Analysis, Quadratic Distriminant Analysis & K-Nearest Neighbors. Linear Discrimant Analysis outperformed all the classifiers with a 92% accuracy rate and KNN underperformed with a still relatively high accuracy of 85%