

Regression Models Peer Graded Assignment

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```
library("plyr")
```

Automatic vs Manual Transmission for better Mileage

Instructions

You work for Motor Trend, a magazine about the automobile industry. Looking at a data set of a collection of cars, they are interested in exploring the relationship between a set of variables and miles per gallon (MPG) (outcome). They are particularly interested in the following two questions:

“Is an automatic or manual transmission better for MPG” “Quantify the MPG difference between automatic and manual transmissions”

Dataset

Import the dataset

```
data(mtcars)
head(mtcars)
```

| ## | mpg | cyl | disp | hp | drat | wt | qsec | vs | am | gear | carb |
|----------------------|------|-----|------|-----|------|-------|-------|----|----|------|------|
| ## Mazda RX4 | 21.0 | 6 | 160 | 110 | 3.90 | 2.620 | 16.46 | 0 | 1 | 4 | 4 |
| ## Mazda RX4 Wag | 21.0 | 6 | 160 | 110 | 3.90 | 2.875 | 17.02 | 0 | 1 | 4 | 4 |
| ## Datsun 710 | 22.8 | 4 | 108 | 93 | 3.85 | 2.320 | 18.61 | 1 | 1 | 4 | 1 |
| ## Hornet 4 Drive | 21.4 | 6 | 258 | 110 | 3.08 | 3.215 | 19.44 | 1 | 0 | 3 | 1 |
| ## Hornet Sportabout | 18.7 | 8 | 360 | 175 | 3.15 | 3.440 | 17.02 | 0 | 0 | 3 | 2 |
| ## Valiant | 18.1 | 6 | 225 | 105 | 2.76 | 3.460 | 20.22 | 1 | 0 | 3 | 1 |

In the dataset the am column shows what type of transmission the car has. According to the Documentation: [, 9] am Transmission (0 = automatic, 1 = manual) We require only the mpg and the am column for our analysis. Lets create a dataframe with only these variables.

```
mydata <- mtcars[c("mpg", "am")]
head(mydata)
```

| ## | mpg | am |
|------------------|------|----|
| ## Mazda RX4 | 21.0 | 1 |
| ## Mazda RX4 Wag | 21.0 | 1 |
| ## Datsun 710 | 22.8 | 1 |

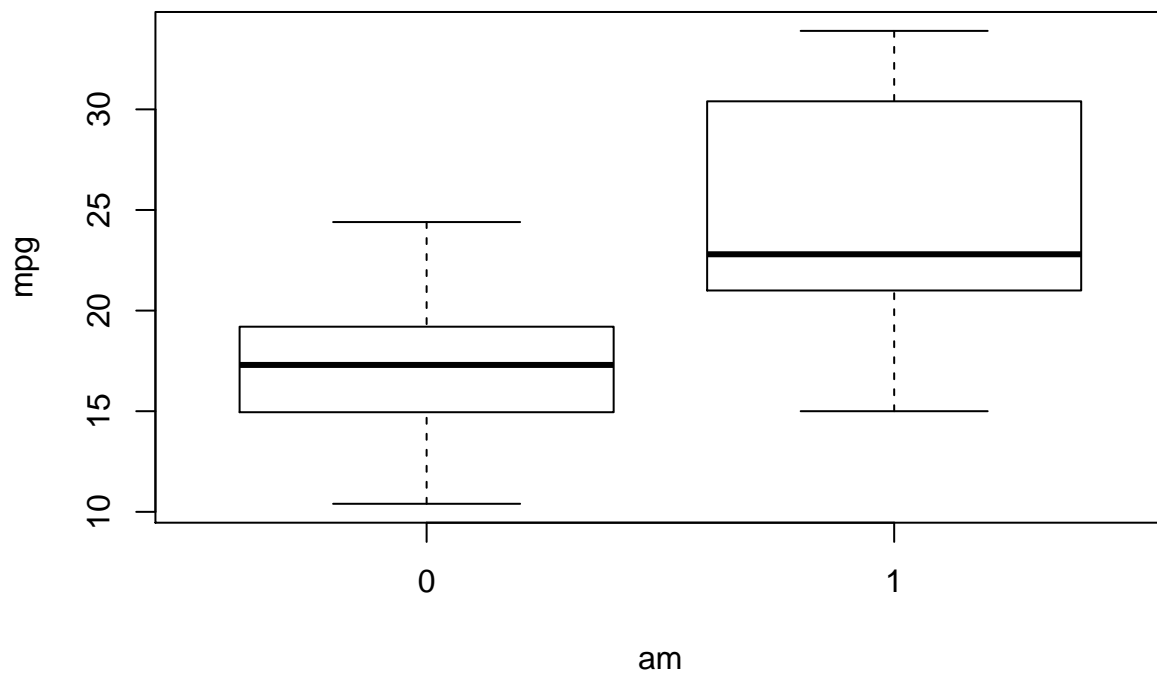
```
## Hornet 4 Drive      21.4  0
## Hornet Sportabout  18.7  0
## Valiant             18.1  0
```

Exploratory Analysis

```
summary(mydata)
```

```
##      mpg      am
## Min.   :10.40  Min.   :0.0000
## 1st Qu.:15.43  1st Qu.:0.0000
## Median :19.20  Median :0.0000
## Mean   :20.09  Mean   :0.4062
## 3rd Qu.:22.80  3rd Qu.:1.0000
## Max.   :33.90  Max.   :1.0000
```

```
boxplot(mpg~am, data = mydata)
```



A very preliminary Analysis shows the superiority of Manual Transmission in Mileage.

Lets create some models to find out, but lets also keep in mind, there may be other variables that affect this. The results of the difference in mpg aren't solely due to the type of transmission.

```
count(mtcars, vars = "am")
```

```
##   am freq
## 1  0   19
## 2  1   13
```

There are slightly more Automatic than Manual cars in this dataset

Model

```
premodel <- lm(mpg ~ ., mtcars);
summary(premodel)
```

```
##
## Call:
## lm(formula = mpg ~ ., data = mtcars)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -3.4506 -1.6044 -0.1196  1.2193  4.6271
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 12.30337    18.71788   0.657  0.5181
## cyl         -0.11144     1.04502  -0.107  0.9161
## disp         0.01334     0.01786   0.747  0.4635
## hp          -0.02148     0.02177  -0.987  0.3350
## drat         0.78711     1.63537   0.481  0.6353
## wt          -3.71530     1.89441  -1.961  0.0633 .
## qsec         0.82104     0.73084   1.123  0.2739
## vs           0.31776     2.10451   0.151  0.8814
## am           2.52023     2.05665   1.225  0.2340
## gear         0.65541     1.49326   0.439  0.6652
## carb        -0.19942     0.82875  -0.241  0.8122
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.65 on 21 degrees of freedom
## Multiple R-squared:  0.869, Adjusted R-squared:  0.8066
## F-statistic: 13.93 on 10 and 21 DF, p-value: 3.793e-07
```

From the table we can note that wt, am, drat, qsec, gear have high coefficients and are significant in our model

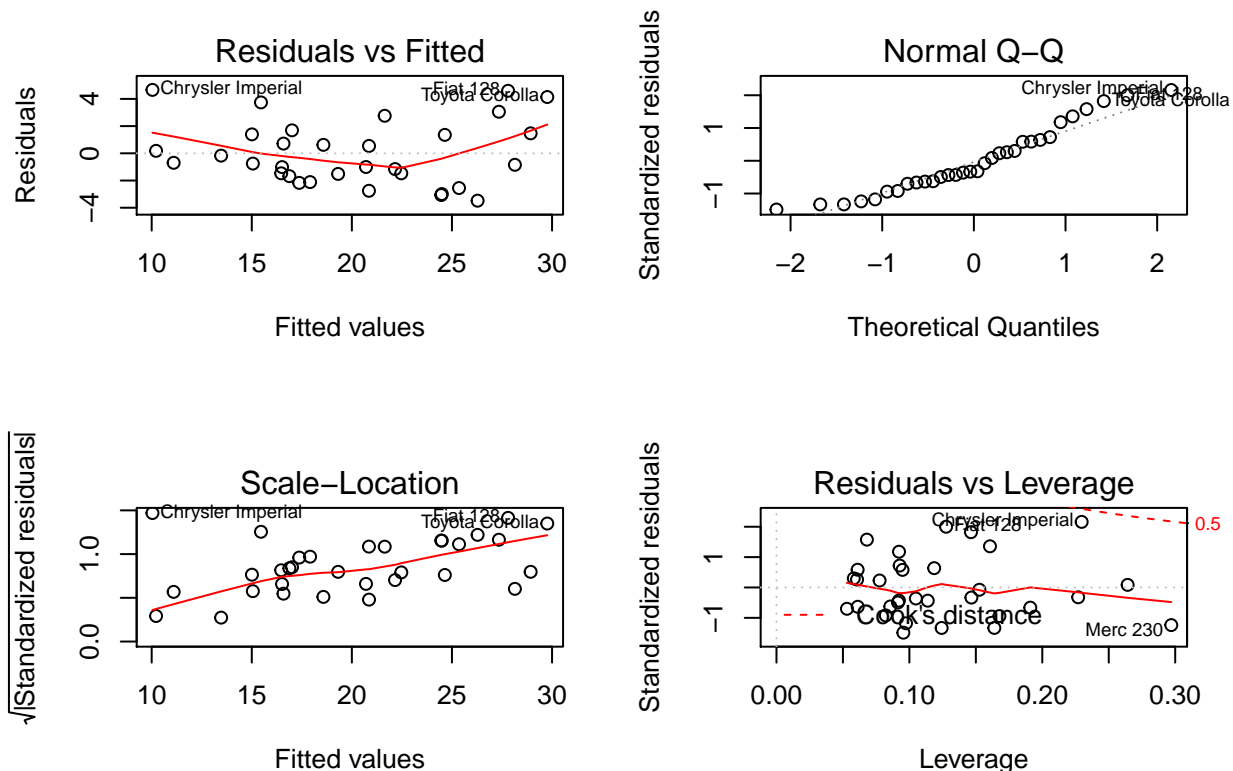
Lets compare multiple models using ANOVA

```
anova(lm(mpg ~ am, mtcars),
      lm(mpg ~ am + wt, mtcars),
      lm(mpg ~ am + wt + qsec, mtcars),
      lm(mpg ~ am + wt + qsec + drat, mtcars),
      lm(mpg ~ am + wt + qsec + drat + gear, mtcars)
)
```

```
## Analysis of Variance Table
##
## Model 1: mpg ~ am
## Model 2: mpg ~ am + wt
## Model 3: mpg ~ am + wt + qsec
## Model 4: mpg ~ am + wt + qsec + drat
## Model 5: mpg ~ am + wt + qsec + drat + gear
##   Res.Df    RSS Df Sum of Sq    F    Pr(>F)
## 1      30 720.90
## 2      29 278.32  1    442.58 68.8055 8.913e-09 ***
## 3      28 169.29  1    109.03 16.9510 0.0003442 ***
## 4      27 167.89  1      1.40  0.2176 0.6447654
## 5      26 167.24  1      0.65  0.1006 0.7537011
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

We see high P values for the 4th and 5th Model. The 3rd model seems to be a better one given lower RSS and P. This includes am, wt and qsec.

```
model2 <- lm(mpg ~ am + wt + qsec, mtcars)
par(mfrow = c(2,2)); plot(model2)
```



```
model1 <- lm(mpg ~ am, mtcars)
coef(model1)
```

```
## (Intercept)          am
##    17.147368    7.244939
```

```
coef(model2)
```

```
## (Intercept)          am          wt          qsec
##    9.617781    2.935837   -3.916504    1.225886
```

Executive Summary

As we can see in general Manual cars have a mileage about 7.244939 higher than automatic transmission. If we bring in other variables like wt and qsec which are significant into the picture, Manual cars have higher mileage by about 2.935837.

In either case its safe to say Manual cars have a better mileage.