Regression Models Course Project

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Assignment Overview

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:

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

Data

Let’s have a look at our dataset, specifically on different values of few first rows:

```
library(datasets)
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
```

Automatic vs. manual transmission

First of all, we can look at plot to see if there is any visible difference between MPG values for both types of transmission. Look at appendix 1.

As we can see, values for different types of transmission are not equally distributed, so that can lead us to conclusion, that we need to explore which one is better.

What can T-test show us?

```
t.test(mtcars$mpg~mtcars$am)
```

```
##
##  Welch Two Sample t-test
##
## data:  mtcars$mpg by mtcars$am
## t = -3.7671, df = 18.332, p-value = 0.001374
## alternative hypothesis: true difference in means between group 0 and group 1 is not equal
to 0
## 95 percent confidence interval:
##  -11.280194  -3.209684
## sample estimates:
## mean in group 0 mean in group 1
##        17.14737        24.39231
```

P-value is really small, that means we should reject a null-hypothesis, which says that there is no difference between types of transmission.

In the dataset description it states `Transmission (0 = automatic, 1 = manual)`, so our conclusion is that **manual transmission is better for MPG than automatic**

Quantify the MPG difference between automatic and manual transmissions

First thing, we need to do a multivariate linear regression:

```
mult <- lm(mpg~., mtcars)
st <- step(mult, direction = "both")
```

And let's have a look at summary

```
summary(st)
```

```
##
## Call:
## lm(formula = mpg ~ wt + qsec + am, data = mtcars)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.4811 -1.5555 -0.7257  1.4110  4.6610
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   9.6178     6.9596   1.382 0.177915
## wt           -3.9165     0.7112  -5.507 6.95e-06 ***
## qsec          1.2259     0.2887   4.247 0.000216 ***
## am            2.9358     1.4109   2.081 0.046716 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.459 on 28 degrees of freedom
## Multiple R-squared:  0.8497, Adjusted R-squared:  0.8336
## F-statistic: 52.75 on 3 and 28 DF,  p-value: 1.21e-11
```

As we can see, results suggest that best model includes `cyl`, `hp`, `wt` and `am` variables. About 86.59% variance is covered by it. First column (Estimate) shows that number of cylinders reducing MPG value (-3.03 for cyl6 and -2.16 for cyl8), as well as gross horsepower (-0.03) and weight (-2.49). But manual transmission is better than automatic (+1.809).

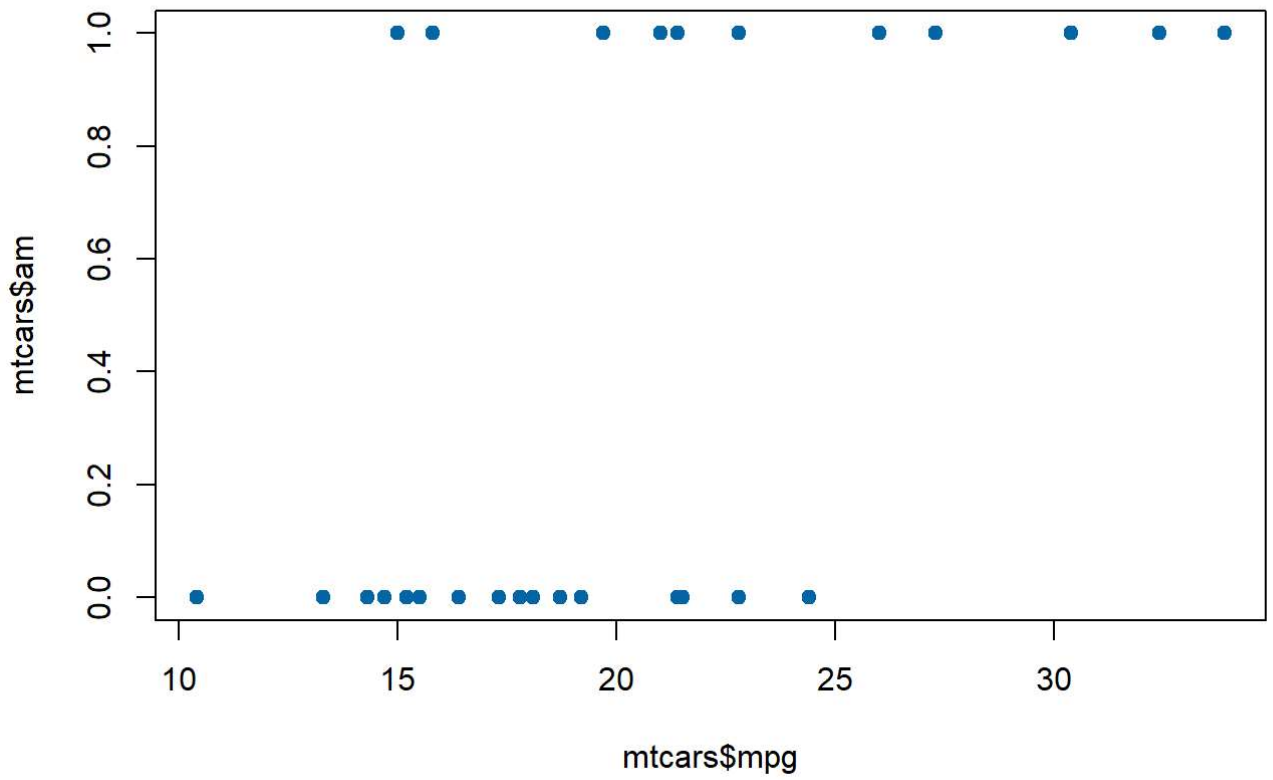
Conclusion

In general, manual transmission seems to be better than automatic by 1.809 mpg. But there are some other factors that have impact on mpg values.

Appendix

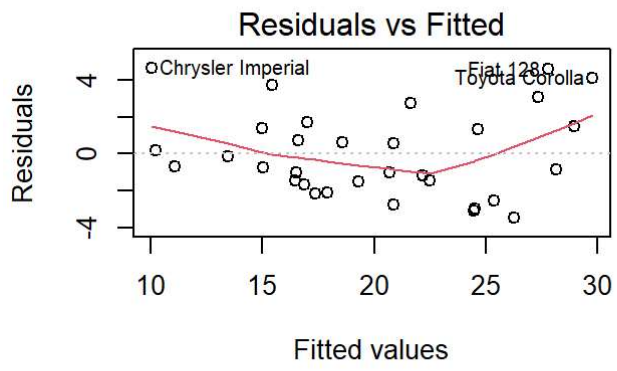
Appendix 1

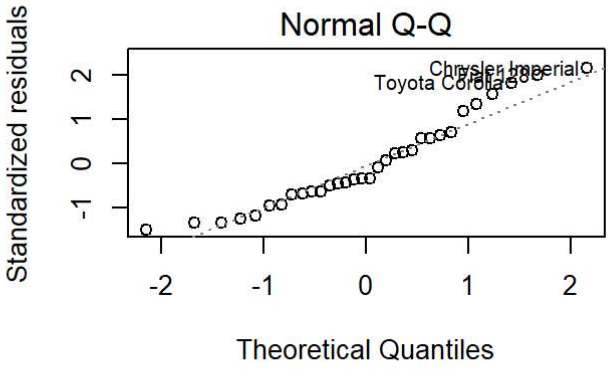
```
plot(mtcars$mpg, mtcars$am, pch = 19, col = "#0665a5")
```

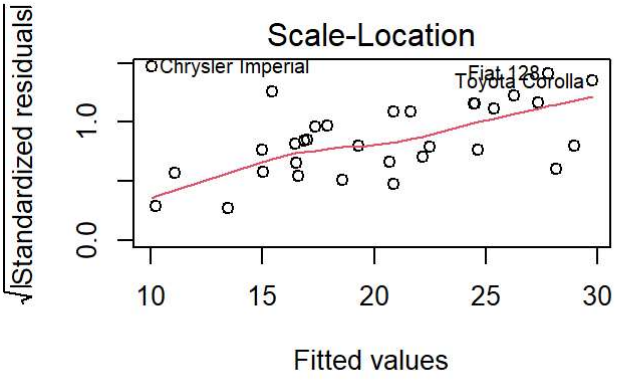


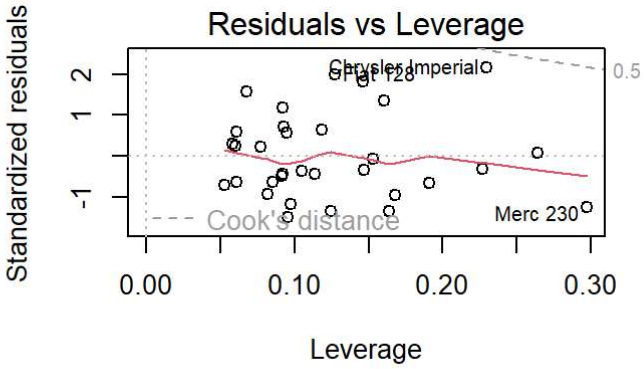
Appendix 2

```
par(mfrow = c(2, 2))
plot(st)
```


Residuals vs Fitted
Residuals
Fitted values
Chrysler Imperial
Fiat 128
Toyota Corolla
10
15
20
25
30
-4
0
4


Normal Q-Q
Standardized residuals
Theoretical Quantiles
Chrysler Imperial
Toyota Corolla
-2
-1
0
1
2


Scale-Location
√|Standardized residuals|
Fitted values
Chrysler Imperial
Fiat 128
Toyota Corolla
10
15
20
25
30
0.0
1.0


Residuals vs Leverage
Standardized residuals
Leverage
Chrysler Imperial
Fiat 128
Toyota Corolla
Merc 230
Cook's distance
0.5
0.00
0.10
0.20
0.30
-1
1
2