

Regression Model Assignment

Stephen Sani

April 27, 2016

Executive Summary

We explored the relationship between a set of variables and miles per gallon (MPG) for the Motor Trend Magazine.

The report is based on the mtcars data in R: A data frame with 32 observations on 11 variables.

- [, 1] mpg Miles/(US) gallon
- [, 2] cyl Number of cylinders
- [, 3] disp Displacement (cu.in.)
- [, 4] hp Gross horsepower
- [, 5] drat Rear axle ratio
- [, 6] wt Weight (1000 lbs)
- [, 7] qsec 1/4 mile time
- [, 8] vs V/S
- [, 9] am Transmission (0 = automatic, 1 = manual)
- [,10] gear Number of forward gears
- [,11] carb Number of carburetors

The following questions were answered :

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

We conclude that regardless of whether or not we adjust for other variables, automatic transmission is better for mpg.

Analysis

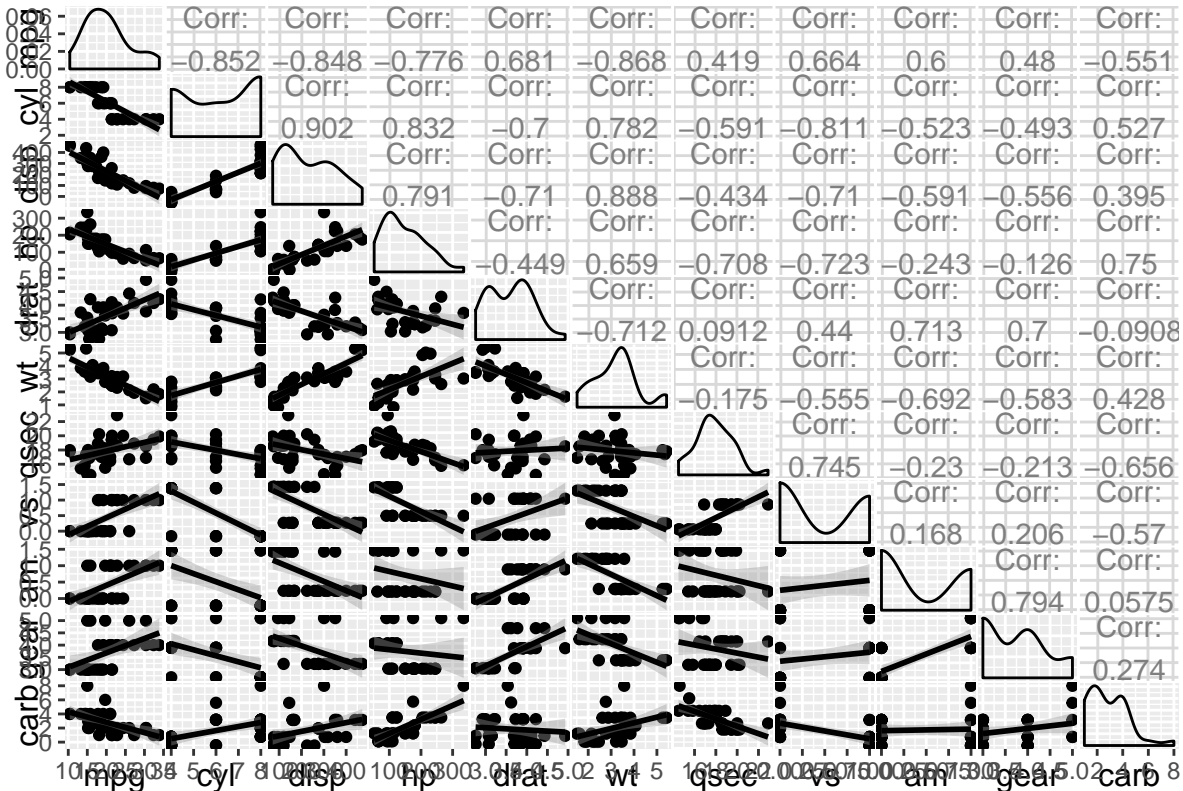
The data was loaded into R and the first few rows viewed

```
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
```

The relationships for the variables in the mtcars data was plotted.

```
library(GGally); library(ggplot2);
g <- ggpairs(mtcars, lower = list(continuous = "smooth"))
g
```



Model fit1: mpg as outcome, adjusted for all variables (am is factor variable).

From the plot, all the variables are corellated with mpg thus all variables was used to fit a model.

We fit a linear model with “mpg” as outcome and all the other variables (“am” as a factor variable).

```
fit1 <- lm(mpg~cyl+disp+hp+drat+qsec+vs+gear+carb+factor(am), data=mtcars)
round(summary(fit1)$coef, 3)
```

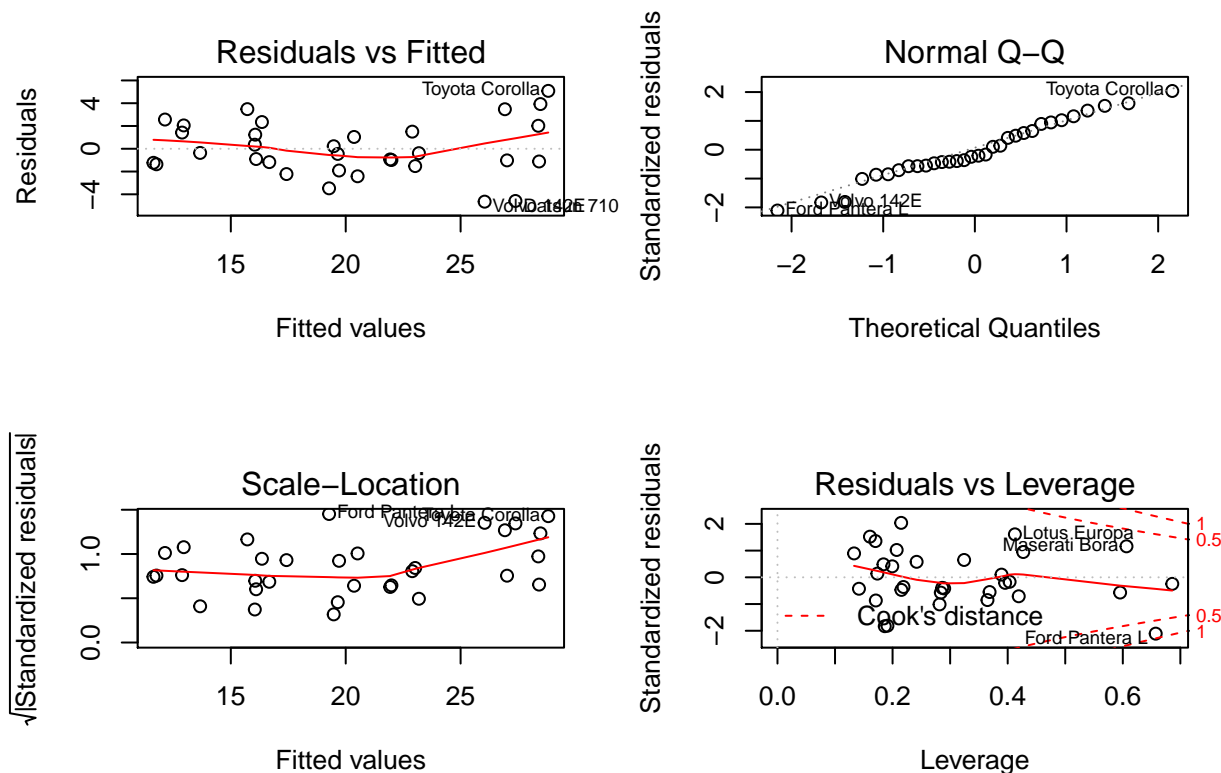
```
##           Estimate Std. Error t value Pr(>|t|)
## (Intercept)  15.571      19.813   0.786   0.440
## cyl           0.120       1.103   0.109   0.915
## disp        -0.014       0.012  -1.122   0.274
## hp          -0.011       0.022  -0.500   0.622
## drat         1.327       1.713   0.775   0.447
## qsec         0.094       0.669   0.141   0.889
## vs           0.668       2.228   0.300   0.767
## gear         1.186       1.561   0.760   0.455
```

```
## carb          -1.329      0.633  -2.099    0.048
## factor(am)1    2.901      2.176   1.333    0.196
```

From the coefficients, the mean mpg for automatic transmission is higher than that of manual transmission by 2.901 thus Automatic transmission is better than manual transmission if all other variables are held constant.

To investigate the model fit, We plot the model

```
par(mfrow = c(2,2))
plot(fit1)
```



There is no clear pattern to be discovered from the Residual Vs Fitted values plot.

The Normal Q-Q plot also show that the Standardized residuals and the Theoretical Quantiles nearly follows a straight line as expected.

Model fit2: mpg as outcome and am as predictor.

We fit a linear model with “mpg” as outcome and am as predictor (“am” is a factor variable).

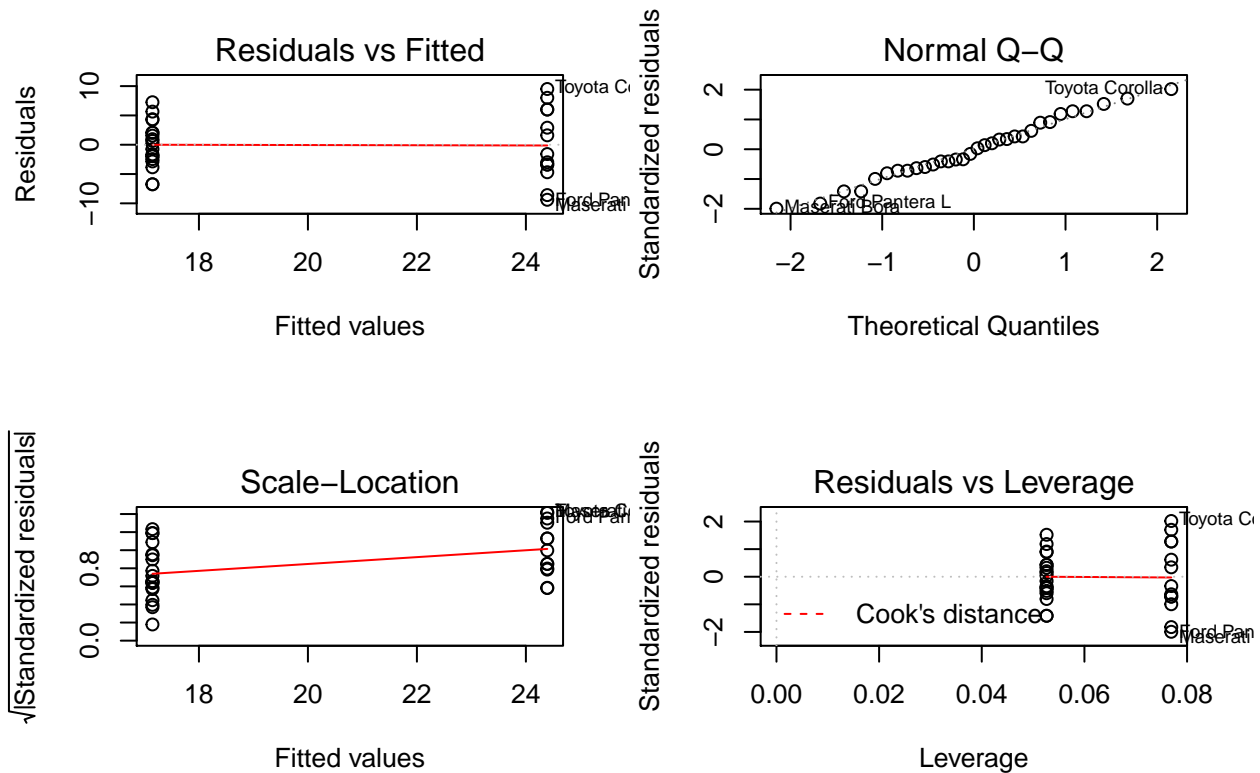
```
fit2 <- lm(mpg~factor(am), data=mtcars)
round(summary(fit2)$coef, 3)
```

```
##           Estimate Std. Error t value Pr(>|t|)
## (Intercept)  17.147      1.125  15.247     0
## factor(am)1   7.245      1.764   4.106     0
```

From the coefficients, the mean mpg for automatic Transmission is higher than that of manual transmission by 7.245 thus Automatic transmission is better than manual transmission.

To investigate the model fit, We plot the model

```
par(mfrow = c(2,2))
plot(fit2)
```



There is no clear pattern to be discovered from the Residual Vs Fitted values plot.

The Normal Q-Q plot also show that the Standardized residuals and the Theoretical Quantiles nearly follows a straight line as expected.

Conclusion

Based on the mtcars data, automatic transmission is better than manual transmission for Miles per Gallon (mpg) whether or not we adjust for other variables.