Fuel Consumption and Transmission Type

Masaaki Inaba

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Contents

1. Executive Summary

We 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

2. Data Processing

```
data(mtcars)
mtcars$am   = factor(mtcars$am)
mtcars$cyl  = factor(mtcars$cyl)
mtcars$vs   = factor(mtcars$vs)
mtcars$gear = factor(mtcars$gear)
mtcars$carb = factor(mtcars$carb)
```

3. Regression Analysis

3.1. We start regression analysis based on intial model which inclueds all variables and choose a best model by AIC in a Stepwise Algorithm.

```
initial_model = lm(mpg ~ ., data = mtcars)
best_model = step(initial_model)
```

3.2. The best model is as below:

```
summary(best_model)
```

```
##
## Call:
## lm(formula = mpg ~ cyl + hp + wt + am, data = mtcars)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.9387 -1.2560 -0.4013  1.1253  5.0513
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 33.70832    2.60489  12.940 7.73e-13 ***
## cyl6        -3.03134    1.40728  -2.154  0.04068 *
## cyl8        -2.16368    2.28425  -0.947  0.35225
## hp          -0.03211    0.01369  -2.345  0.02693 *
## wt          -2.49683    0.88559  -2.819  0.00908 **
## am1          1.80921    1.39630   1.296  0.20646
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.41 on 26 degrees of freedom
## Multiple R-squared:  0.8659, Adjusted R-squared:  0.8401
## F-statistic: 33.57 on 5 and 26 DF,  p-value: 1.506e-10
```

4. Conclusion

Question 1. Is an automatic or manual transmission better for MPG?

=> Automatic transmission is better than manual transmission for MPG.

Question 2. Quantify the MPG difference between automatic and manual transmissions.

=> Manual transmission get 1.80921 more MPG compared to automatic transmission.

Appendix

Figure 1. MPG per Transmission

```
boxplot(mpg ~ am, data = mtcars, main = "MPG per Transmission",
        xlab = "Transmission (0 = automatic, 1 = manual)", ylab = "MPG")
```

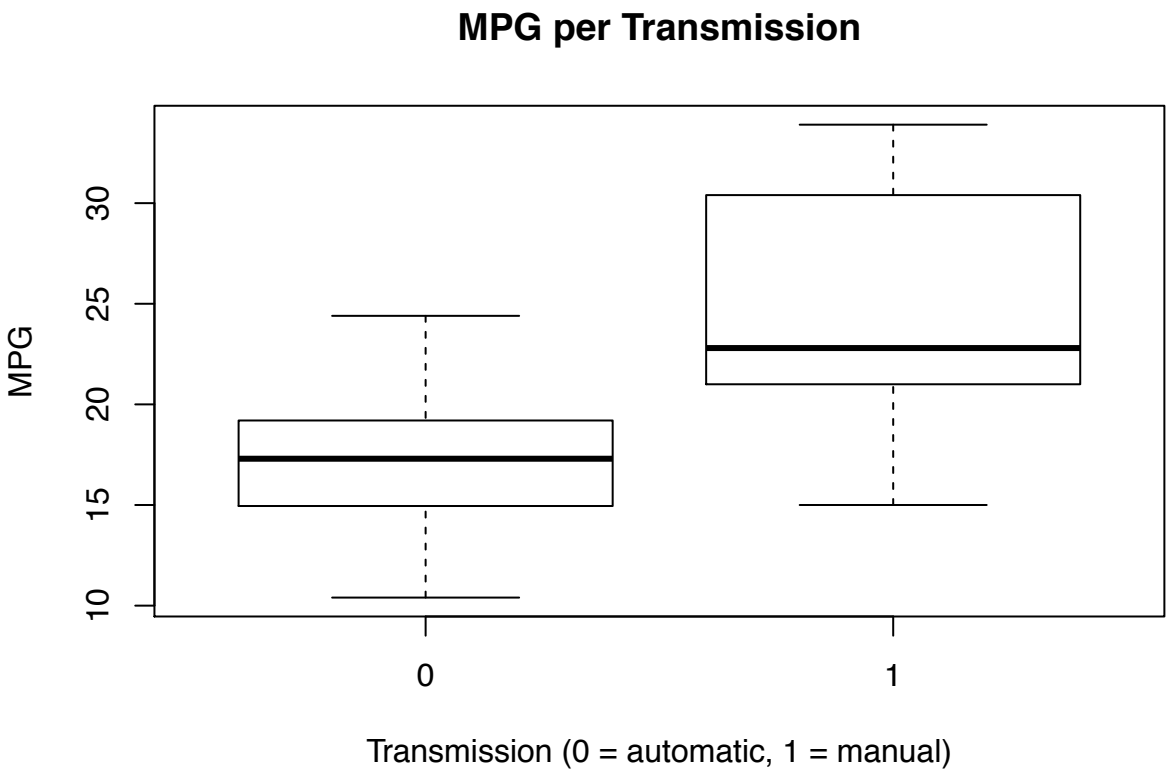
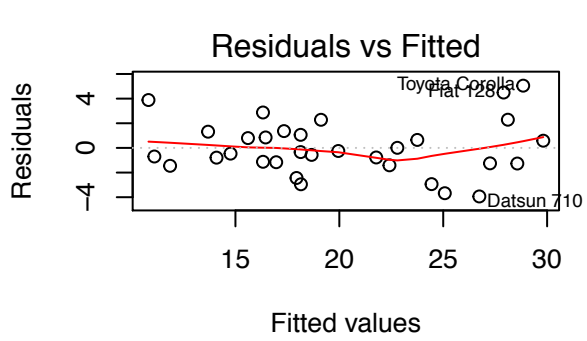
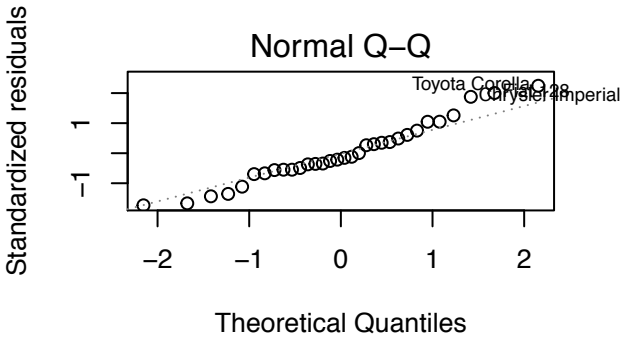
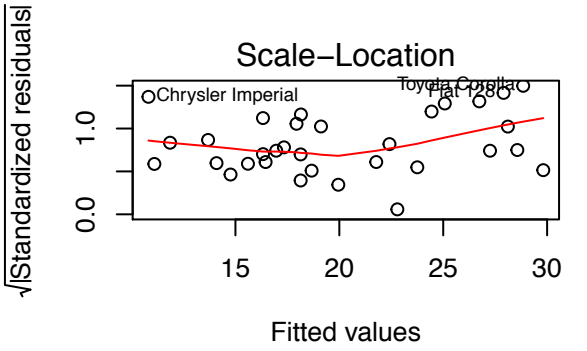


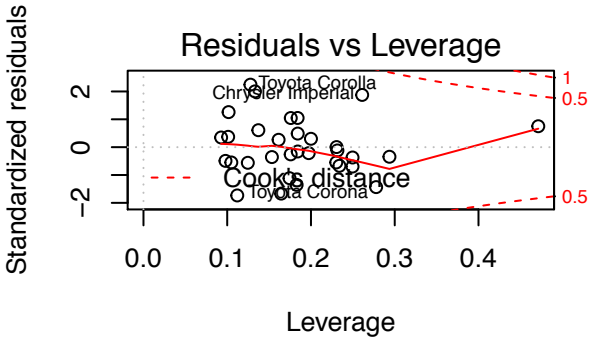
Figure 2. Residual Plot and Diagnostics

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


Residuals vs Fitted
Residuals
Fitted values
Toyota Corolla
Fiat 128
Datsun 710


Normal Q–Q
Standardized residuals
Theoretical Quantiles
Toyota Corolla
Chrysler Imperial


Scale–Location
√|Standardized residuals|
Fitted values
Chrysler Imperial
Toyota Corolla
Fiat 128


Residuals vs Leverage
Standardized residuals
Leverage
Cook's distance
Toyota Corolla
Chrysler Imperial
Toyota Corona