The Relationship Between Transmission and Mile Per Gallon (MPG)

Cynthia Tang

June 9, 2019

## Summary

The report explored the relationship between transmission types and miles per gallon (MPG). Figure 1 in appendix showed that an automatic transmission trend to be better for MPG. Then, we performed t-test to verify the hypothesis and draw a conclusion. To quantify the MPG difference between automatic and manual transmissins, we fit the MPG (outcome) and transmission (regressor) in to the linar model.

## Results

The mean mpg of automatic transmission is 24.3923077 miles per gallon, the mean of manual transmission is 17.1473684 miles per gallon. An automatic transmission is better for MPG. MPG can fiited into linear regression with the regressor of transmission.

**Model Selection**

We set **mpg** as the outcome and **transmission(am)** as the repressor. We selected linear regression model, , is either 0 for automatic or 1 for manual.

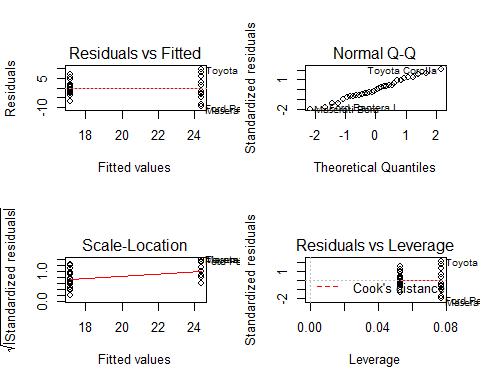
**Interpretion**

The intercept is 24.3923077, which is interpret as the expected mpg of automatic transmission and is euqal to the mean mpg of automatic transmission.  
The slope is -7.2449393, which is interpreted as the expected change of the mean mpg comparing those in manual to those in automatic transmission. is equal to the mean mpg of manual transmission.

**T-test**

We did student t-test with the : The difference in means in automatic and manual transmission is equal, and the : The mean in automatic is greater than that in manual transmission. The p-value is 1.425103710^{-4}. If we assumed the type I error = 0.05, then we rejected and concluded that an automatic transmission is better for MPG.

**Diagnostics**



## [1] 3.434752e-16

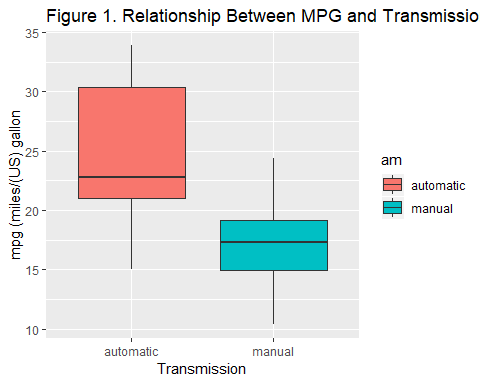
The mean of residuals is 3.434752510^{-16}, approximating to zero.  
The patten in plot “Residual vs Fitted” is approximately flat, indicating the homoscedasticity of residuals or equal variance.

**The uncertainty**

We assumed other variables not included in the linear model were completely randomized. The error in the linear model followed normal distribution.

## Appendix

## 'data.frame': 32 obs. of 11 variables:  
## $ mpg : num 21 21 22.8 21.4 18.7 18.1 14.3 24.4 22.8 19.2 ...  
## $ cyl : num 6 6 4 6 8 6 8 4 4 6 ...  
## $ disp: num 160 160 108 258 360 ...  
## $ hp : num 110 110 93 110 175 105 245 62 95 123 ...  
## $ drat: num 3.9 3.9 3.85 3.08 3.15 2.76 3.21 3.69 3.92 3.92 ...  
## $ wt : num 2.62 2.88 2.32 3.21 3.44 ...  
## $ qsec: num 16.5 17 18.6 19.4 17 ...  
## $ vs : num 0 0 1 1 0 1 0 1 1 1 ...  
## $ am : num 1 1 1 0 0 0 0 0 0 0 ...  
## $ gear: num 4 4 4 3 3 3 3 4 4 4 ...  
## $ carb: num 4 4 1 1 2 1 4 2 2 4 ...



##   
## Call:  
## lm(formula = mpg ~ factor(am), data = mtcars1)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -9.3923 -3.0923 -0.2974 3.2439 9.5077   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 24.392 1.360 17.941 < 2e-16 \*\*\*  
## factor(am)manual -7.245 1.764 -4.106 0.000285 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 4.902 on 30 degrees of freedom  
## Multiple R-squared: 0.3598, Adjusted R-squared: 0.3385   
## F-statistic: 16.86 on 1 and 30 DF, p-value: 0.000285

##   
## Welch Two Sample t-test  
##   
## data: mpg by factor(am)  
## t = 3.7671, df = 18.332, p-value = 0.0006868  
## alternative hypothesis: true difference in means is greater than 0  
## 95 percent confidence interval:  
## 3.913256 Inf  
## sample estimates:  
## mean in group automatic mean in group manual   
## 24.39231 17.14737