MPG analysis for Automatic and Manual Transmissions

Executive Summary

This report exploring the relationship between miles per gallon (MPG) and transsion type aim to answer the questions below:

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

Data Exploration

```
library(ggplot2)
data('mtcars')
```

There are 11 variables including mpg and am, which stand for Miles/(US) gallon and Transmission (0=automatic, 1=manual), we can make a boxplot(Apendix-1) to find out the difference between those two types of transmission in mpg.

```
mtcars$am <- as.factor(mtcars$am)
mtcars$cyl <- as.factor(mtcars$cyl)
mtcars$vs <- as.factor(mtcars$vs)
mtcars$gear <- as.factor(mtcars$gear)
mtcars$carb <- as.factor(mtcars$carb)
df<-mtcars
mean_difference <- mean(df$mpg[which(df$am==1)])-mean(df$mpg[which(df$am==0)])
```

It seems that manual transmissionis have higher mpg(7.2449393) than automatic transmissions.

Regression Analysis

```
model1 <- lm(mpg ~ am, df)
## Multiple R-squared:  0.3598
```

Model 1 is Single Variable Linear Regression Model. The observed r-squared error show that variable am can only explain 35.98% of variance in mpg.

```
model2 <- lm(mpg ~ wt + hp + cyl + am , df)
## Multiple R-squared:  0.8659
```

Model 2 is a Multivariate Linear Regression Model. The observed r-squared error show that multi-variables can explain 86.59% of variance in mpg. It also concluded that on average, Manual Transmissions have 1.5 more mpg than Automatic Transmission.

```
anova(model1,model2)
```

```
## Analysis of Variance Table
##
## Model 1: mpg ~ am
## Model 2: mpg ~ wt + hp + cyl + am
##   Res.Df    RSS Df Sum of Sq      F    Pr(>F)
## 1     30 720.90
## 2     26 151.03  4    569.87 24.527 1.688e-08 ***
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Since the p-value is much less than .05 we cannot reject the null hypothesis and conclude that we should use model 2 when estimating the effect of am on mpg.

Conclusion

"Is an automatic or manual transmission better for MPG?"
We cannot answer this question cause the Residuals vs Leverage plot is not linear, even the Q-Q plot show that the sample is not normal distribute (Apendix). So there are other factors affect the mpg beside transmission.
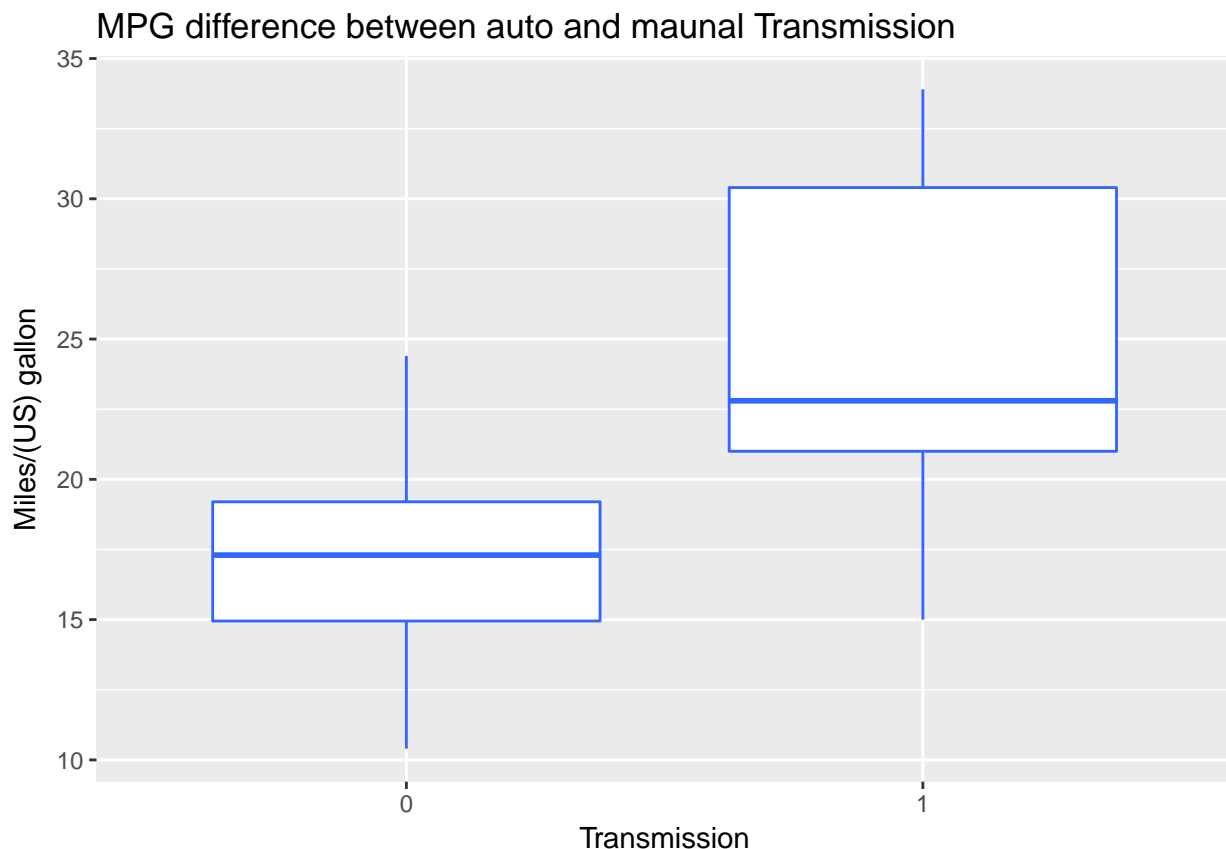
"Quantify the MPG difference between automatic and manual transmissions"
Taking into account hp, wt and cyl, the diffence in mpg between an automatic and a manual is only 1.5 mpg.

Apendix

Boxplot of mpg vs am

```
g<-ggplot(df,aes(am,mpg))
g+geom_boxplot(aes(group=am),colour = "#3366FF")+xlab("Transmission") +ylab("Miles/(US) gallon") +ggtitl
```



```
plot(model2)
```

Residuals vs Fitted

Toyota Corolla
Fiat 128

Datsun 710

Residuals

Fitted values
lm(mpg ~ wt + hp + cyl + am)

Normal Q–Q

Toyota Corolla
Fiat 128
Chrysler Imperial

Standardized residuals

Theoretical Quantiles
lm(mpg ~ wt + hp + cyl + am)

Scale–Location

√|Standardized residuals|

○Chrysler Imperial

Toyota Corolla○
Fiat 128○

Fitted values
lm(mpg ~ wt + hp + cyl + am)

Residuals vs Leverage

Standardized residuals

○Toyota Corolla

Chrysler Imperial○

Cook's distance

Toyota Corona○

Leverage
lm(mpg ~ wt + hp + cyl + am)

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