mtcars Analysis

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Executive Summary

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:

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

Data processing

Loading the required packages

```
library(ggplot2)
```

Loading the 'mtcars' data set. Coverting appropriate variables into factors.

```
data("mtcars")
mtcars$cyl <- factor(mtcars$cyl)
mtcars$vs <- factor(mtcars$vs, labels = c('V-Engine', 'Straight Engine'))
mtcars$gear <- factor(mtcars$gear)
mtcars$carb <- factor(mtcars$carb)
mtcars$am <- factor(mtcars$am,labels=c('Automatic','Manual'))
```

Exploratory Analysis

Refer apendix, to see the exploratory plots.

Hypothesis Testing.

Checking the variance of both the samples.

```
var(mtcars$mpg[mtcars$am == 'Automatic'])

## [1] 14.6993

var(mtcars$mpg[mtcars$am == 'Manual'])

## [1] 38.02577
```

As the variance isn't equal, performing Welch's t test.

```
t.test(mtcars$mpg~mtcars$am,conf.level=0.95)
```

The summary of the Welch's t test is in the appendix. As p-value < 0.05, we reject the Null Hypothesis that mean MPG is same for both the transmission types.

Fitting Models

Fitting a linear model with 'mpg' as the response and 'am' as the regressor.

```
model1 <- lm(mpg~am, data = mtcars)
summary(model1)
```

The summary for this model can be found in the appendix. As R-Squarred value is 0.3598, this model only accounts for 36% variablity in mpg. Hence this models isn't a good fit. A linear model with 'mpg' as the response and all the remaining variables as the regressors will result in overfitting. Hence we obtain the best model by backward selection, using 'step' function in r.

```
model2 <- lm(mpg~., data = mtcars)
best_model <- step(model2, direction = "backward")

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 **
## amManual     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
```

As the R-squarred value is 0.8659, the model accounts for 86.6% variablity in the mpg. This model is a good fit for the data. Various diagnostic plots are included in appendix.

Conclusion

According to the Welch's test and regression model, Manual Transmittion is better for mpg. Manual Transmission results in an increase of 1.8092 in mpg, keeping other variables constant. However this relation isn't very significant.

The depth of this analysis has been limited by the report length constraint.

To comply with the report brief length constraint, summary for Welch’s T test and Model 1 has been included in the appendix.

Apendix

Welch's t test summary

```
##
##  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 is not equal to 0
## 95 percent confidence interval:
##  -11.280194  -3.209684
## sample estimates:
## mean in group Automatic    mean in group Manual
##                17.14737                24.39231
```

Model 1 summary

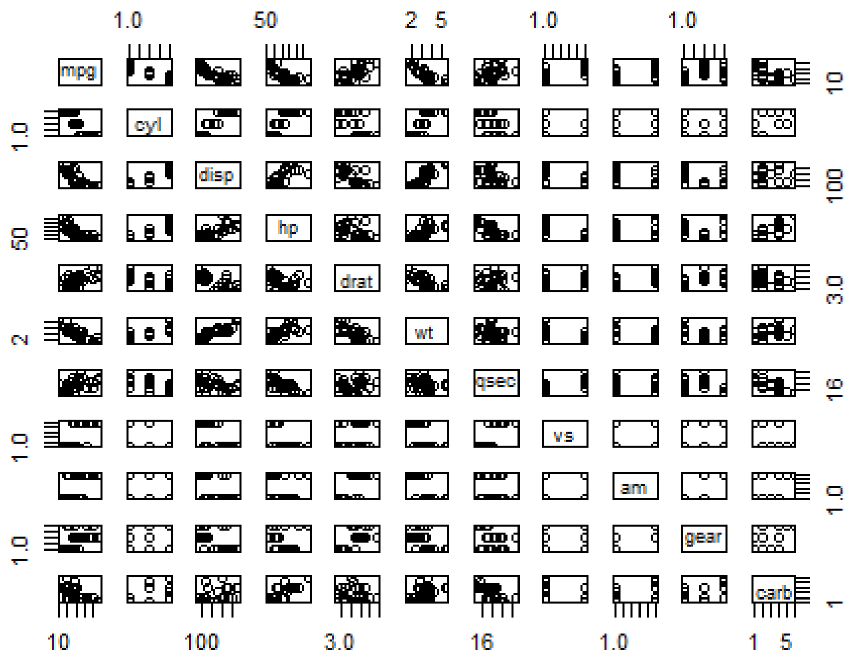
```
model1 <- lm(mpg~am, data = mtcars)
summary(model1)
```

```
##
## Call:
## lm(formula = mpg ~ am, data = mtcars)
##
## 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)   17.147      1.125  15.247 1.13e-15 ***
## amManual       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
```

Exploratory Analysis

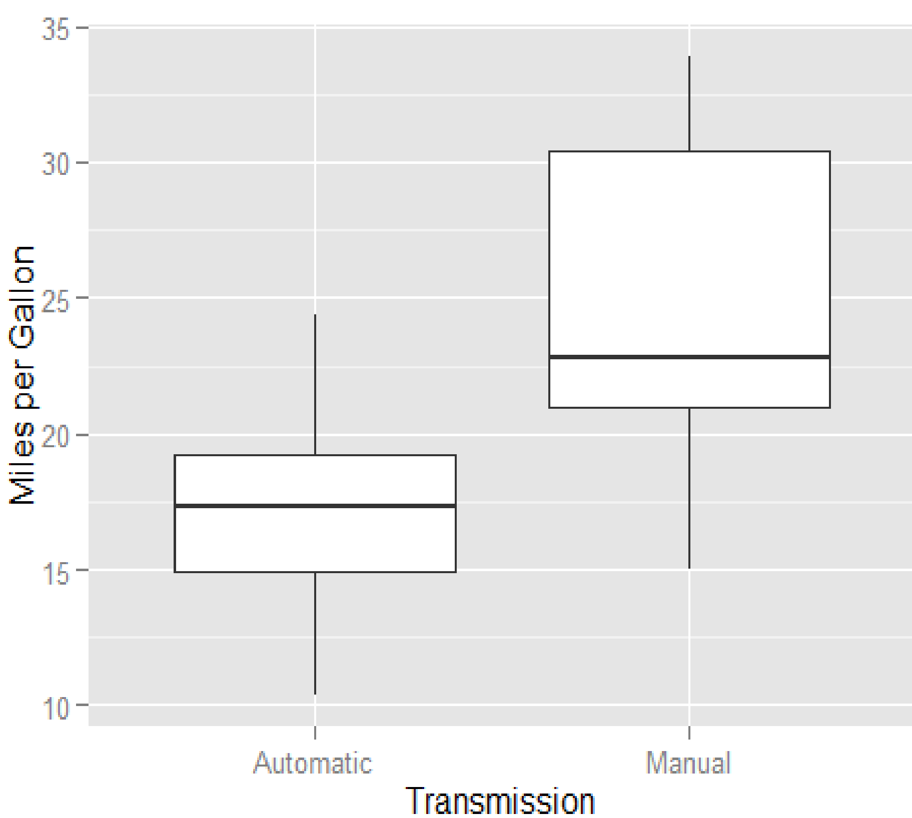
Mtcars pair plot

```
pairs(mtcars)
```



box plot of mpg ~ am

```
g <- ggplot(data = mtcars, aes(am,mpg))
g+geom_boxplot()+labs(x = 'Transmission', y = 'Miles per Gallon')
```



Residual and Diagnostic Plots

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