Regression Models Course Project - Manual vs. Automatic Transmission and MPG

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Friday, March 20, 2015

Executive Summary

Fuel efficienty and transmission type are both very important and greatly debated factors when selecting a new car. This report examines the relationship between tranmission type and fuel economy to determine if there is any MPG benefit to purchasing a car of either type transmission. The data used in this report is from the 1974 Motor Trend US magazine.

Exploring the Data

First the mtcars data is loaded and some brief exploratory statistics are discovered.

```
data(mtcars); attach(mtcars)
head(mtcars,2) #Examine how the data is structured in mtcars
```

```
##                mpg cyl disp  hp drat    wt  qsec vs am gear carb
## Mazda RX4      21   6  160 110  3.9 2.620 16.46  0  1    4    4
## Mazda RX4 Wag  21   6  160 110  3.9 2.875 17.02  0  1    4    4
```

```
mean(mpg[am=="0"]) #Automatic Transmission mean
```

```
## [1] 17.14737
```

```
mean(mpg[am=="1"]) #Manual Transmission mean
```

```
## [1] 24.39231
```

Quickly examining the data to determine the means we find that the average fuel economy among automatic cars is 17.14 Mpg whereas the average among manual transmissions is 24.39 Mpg. Furthermore, according to a boxplot of the data (*see* **Figure 1**) we could guess that the fuel efficiency of a manual transmission is greater than that of an automatic transmission. The average and median is MPG for manual transmission is distinctly higher than that of automatic transmissions. However, we cannot yet make a conclusion on based on this chart alone. First we will need to determine if a relationship does exist by using regression.

Regression Models

First we use a linear model using mpg as the outcome and transmission type (variable am, "0" denotes automatic whereas "1" denotes manual) as the predictor.

```
model_am <- lm(mpg ~ am)
summary(model_am)
```

```
##
## Call:
## lm(formula = mpg ~ am)
##
## 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 ***
## am             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
```

Appendix

Figure 1: Boxplot summarizing both automatic and manual transmission types

```
boxplot(mpg ~ am, xlab="Transmission Type", ylab="Miles per Gallon (MPG)", xaxt="n",
        main="Transmission and MPG",
        col=c("green", "yellow"))
axis(1, at=1:2, labels=c("Automatic", "Manual"))
```
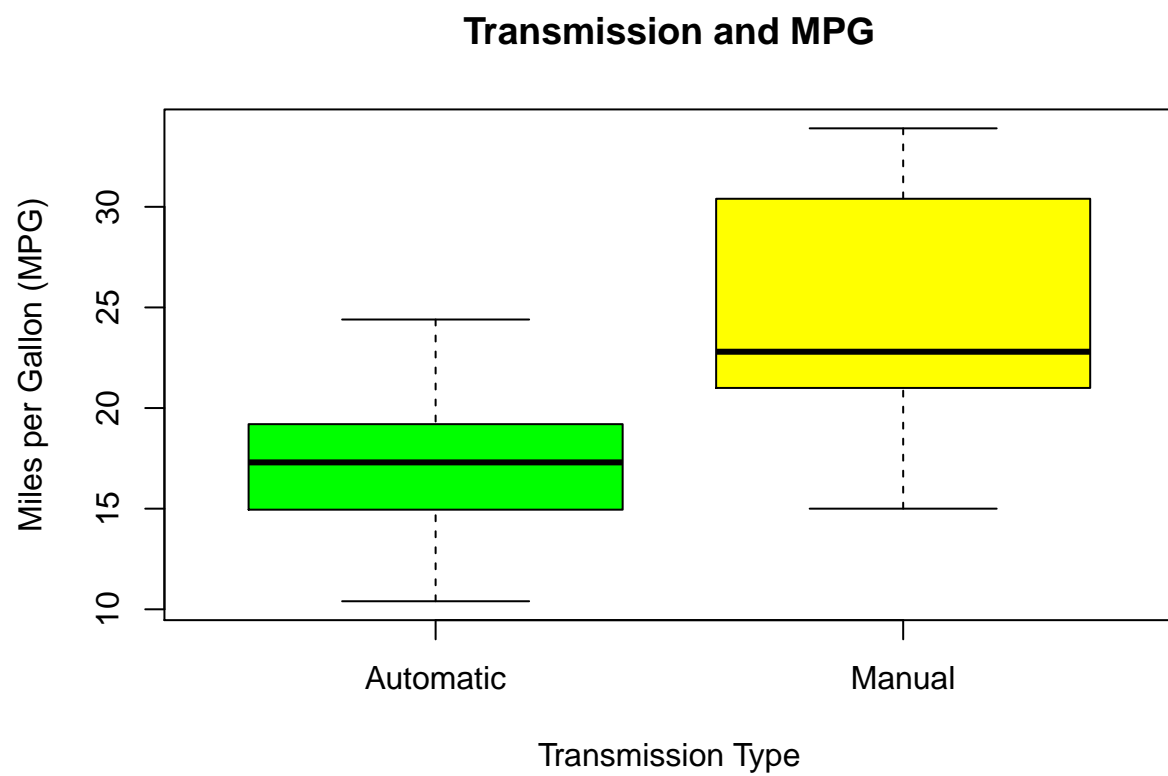
Figure 2:

```r
plot(model_am)
```

Residuals vs Fitted

Fitted values
lm(mpg ~ am)

Normal Q–Q

Theoretical Quantiles
lm(mpg ~ am)

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Scale–Location

√|Standardized residuals|

Fitted values
lm(mpg ~ am)

Residuals vs Leverage