Does transmission type affect MPG?

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Executive Summary

Based on the data used, this paper concludes that type of transmission does not signifiantly affect a car's mile per gallon (MPG) rating. The data is from the 1974 Motor Trend magazine article that lists 10 car specifications for 32 different types of cars. The manual cars in the set of data tend to have better MPG ratings but this can be explained by other specifications such as horsepower and weight.

Methodology

1. Explore the data
2. Create linear models and compare models
3. Confirm the validity of Models
4. Conclusions

1. Explore the data

A sample of the data can be seen below.

```
##                   mpg cyl disp  hp drat    wt  qsec vs am gear carb
## Mazda RX4         21.0   6  160 110 3.90 2.620 16.46  0  1    4    4
## Mazda RX4 Wag     21.0   6  160 110 3.90 2.875 17.02  0  1    4    4
## Datsun 710        22.8   4  108  93 3.85 2.320 18.61  1  1    4    1
## Hornet 4 Drive    21.4   6  258 110 3.08 3.215 19.44  1  0    3    1
## Hornet Sportabout 18.7   8  360 175 3.15 3.440 17.02  0  0    3    2
## Valiant           18.1   6  225 105 2.76 3.460 20.22  1  0    3    1
```

- mpg = miles per gallon,
- am = transmission type (0 = automatic, 1 = manual)
- hp = horsepower
- wt = weight in thousand of pounds

Please see Figure 1: Transmission Type versus MPG. All Figures can be seen in the Appendix.

2. Create linear models and compare models

Linear Model 1: Horsepower, Weight and Transmission type

```
fit1 <- lm(mpg ~ hp + wt + am, data=mtcars)
```

In Figure 2, we see that Model 1 explains 84% (Multiple R-squared) of the variance between predictions and residuals.

Linear Model 2: Horsepower and Weight

```
fit2 <- lm(mpg ~ hp + wt, data=mtcars)
```

In Figure 3, we see that Model 2 explains 83% (Multiple R-squared) of the variance between predictions and residuals.

Model 1 and Model 2 both equally explain the variance equally (84% versus 83%). The conclusions seems to be Transmission type is not required in our model. Only Weight and Horsepower seem significantly correlated to Miles per Gallon. We need to confirm this by looking at the validity of our models.

3. Confirm the validity of Models

Residuals can help validate models.

The plot in Figure 4 suggests there we do not need to change our current model as the residuals and the fitted values seem uncorrelated.

4. Conclusions

The comparison of models with and without Transmission type included suggest that the type of transmission does not signifiantly affect a car’s mile per gallon rating.

Appendix

Figure 1: Transmission Type versus MPG

```
mtcars$am <- as.factor(mtcars$am)
levels(mtcars$am) <- c("Automatic", "Manual")
boxplot(mpg ~ am, data = mtcars, llab="Transmission Type", xlab="Miles per Gallo
n", horizontal = TRUE)
```

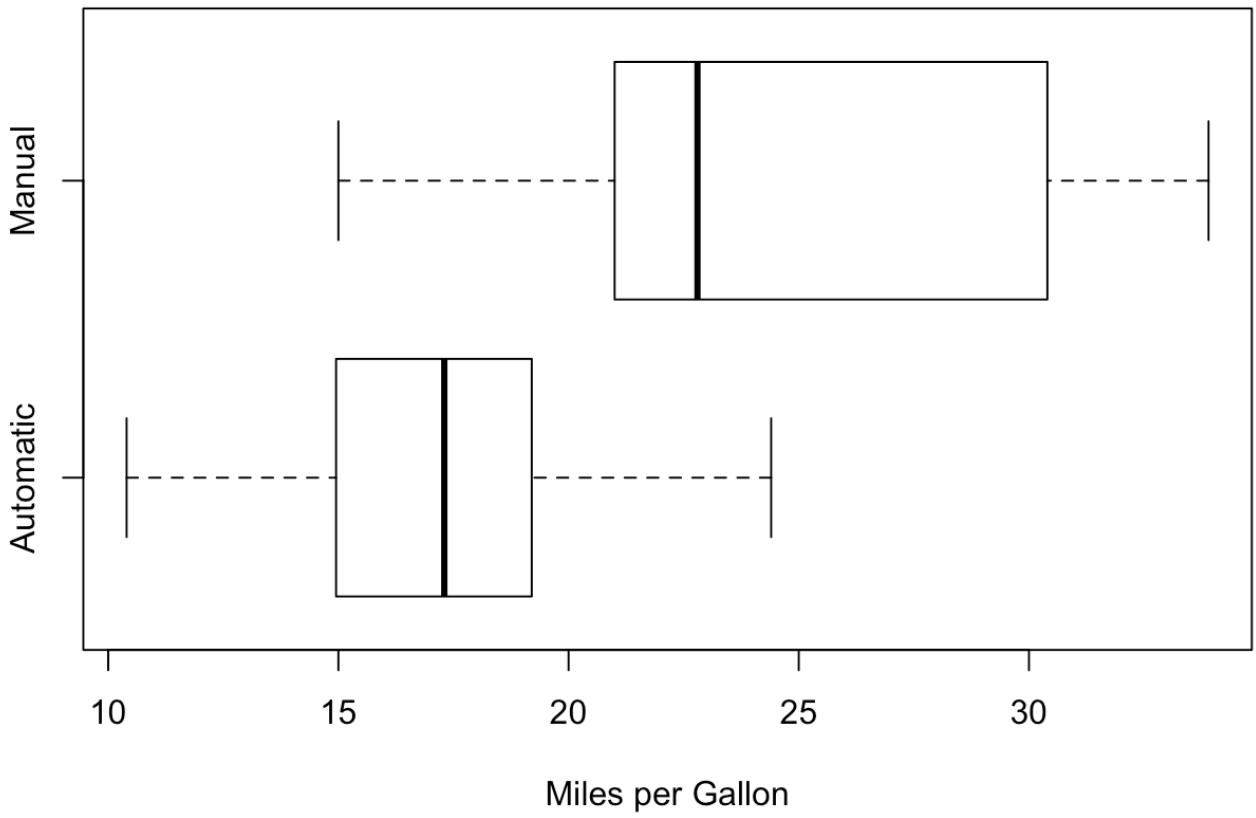

Figure 2: Linear model summary of Horsepower, Weight and Transmission type

```
summary(fit1)
```

```
##
## Call:
## lm(formula = mpg ~ hp + wt + am, data = mtcars)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.4221 -1.7924 -0.3788  1.2249  5.5317
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 34.002875   2.642659  12.867 2.82e-13 ***
## hp          -0.037479   0.009605  -3.902 0.000546 ***
## wt          -2.878575   0.904971  -3.181 0.003574 **
## am           2.083710   1.376420   1.514 0.141268
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.538 on 28 degrees of freedom
## Multiple R-squared:  0.8399, Adjusted R-squared:  0.8227
## F-statistic: 48.96 on 3 and 28 DF,  p-value: 2.908e-11
```

Figure 3: Linear model summary of Horsepower and Weight

```
summary(fit2)
```

```
##
## Call:
## lm(formula = mpg ~ hp + wt, data = mtcars)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -3.941 -1.600 -0.182  1.050  5.854
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 37.22727    1.59879  23.285  < 2e-16 ***
## hp          -0.03177    0.00903  -3.519  0.00145 **
## wt          -3.87783    0.63273  -6.129 1.12e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.593 on 29 degrees of freedom
## Multiple R-squared:  0.8268, Adjusted R-squared:  0.8148
## F-statistic: 69.21 on 2 and 29 DF,  p-value: 9.109e-12
```

Figure 4: Model 2 plot of Residuals

```
plot(fitted(fit2), resid(fit2))
abline(h = 0)
```