Automotive Analysis of Transmission vs MPG

July 15, 2015

Executive Summary

Automotive efficiency is an important qualification for many car buyers. This report analyzes the relationship between miles-per-gallen (MPG) and type of transmission. It was found that, overall, manual transmissions achieve the highest mpg efficiency. When combined with number of cylinders and weight, 4-cylinder manual transmissions result in the highest mpg efficency.

Data Processing

The data source for the analysis is extracted from the 1974 Motor Trend US magazine, which includes fuel consumption and details of different car models for the years 1973 and 1974.

We begin the data analysis by including relevant libraries for processing the “mtcars” dataset.

The data set contains 11 columns, of which two are relevant for our analysis. They are “Number of cylinders” and “Transmission”, or cyl and am, respectively.

By examining the contents of the data set, it can be determined that the cylinder and transmission information may be converted to factors for processing.

Model Selection

For model selection, we’ll analyze the direct relationship between miles-per-gallon and transmission type (automatic and manual).

An initial plot of the mpg vs transmission data displays a dispersal of points, across the types of transmission. We can see a visible difference between mpg for automatic versus manual, with manual transmissions achieving the upper range of MPG. See Figure 1.

We can obtain a more detailed view of the actual data points in the samples by plotting the points across the transmission type, and overlaying a linear model to highlight the trend.

Data Analysis

By analyzing the coefficients in the linear model, it can be found that the transmission type is statistically significant when compared with the mpg.

However, there may be other important factors that impact mpg and transmission type. We can determine which factors may be statistically significant by creating a linear model of all regressors in the data set and checking their significance.

The resulting data indicates that the statistically significant regressors with regard to mpg include number of cylinders, displacement, and weight. We can compare residual plots to determine which combination offers the closest model for the data.

Residual Plots

The first residual plot displays a close correlation and non-random pattern between transmission type and mpg. After adding number of cylinders to the model, the correlation begins to appear more random. A final residual plot that includes mpg, transmission, cylinders, and weight displays a random pattern, indicating the linear model is an appropriate fit. See Figure 2.

Is an automatic or manual transmission better for MPG?

As shown in Figure 3, we can determine that manual transmission is generally better for mpg. 6 and 8-cylinder cars have a negative effect on mpg. By contrast, 4-cylinder cars have a positive impact on mpg, and when combined with manual transmission, the highest efficiency of mpg fuel utilization can be reached.

What is the MPG difference between automatic and manual transmissions?

While manual transmission, overall, achieves higher mpg efficiency than automatic transmissions, there is a division at around 25 mpg where automatic and manual transmissions differ. At this level, manual transmissions exceed automatic in mpg, most notably with those of 4-cylinder engines.

Conclusion

In this analysis, we've determined that there is an overall trend of manual transmission achieving higher mpg efficiency than automatic transmissions. This effect is less for higher cylinder cars. However, we've found that lower cyclinder engines achieve the most optimal mpg usage, with 4-cycliner engines resulting in the highest mpg.

Appendix

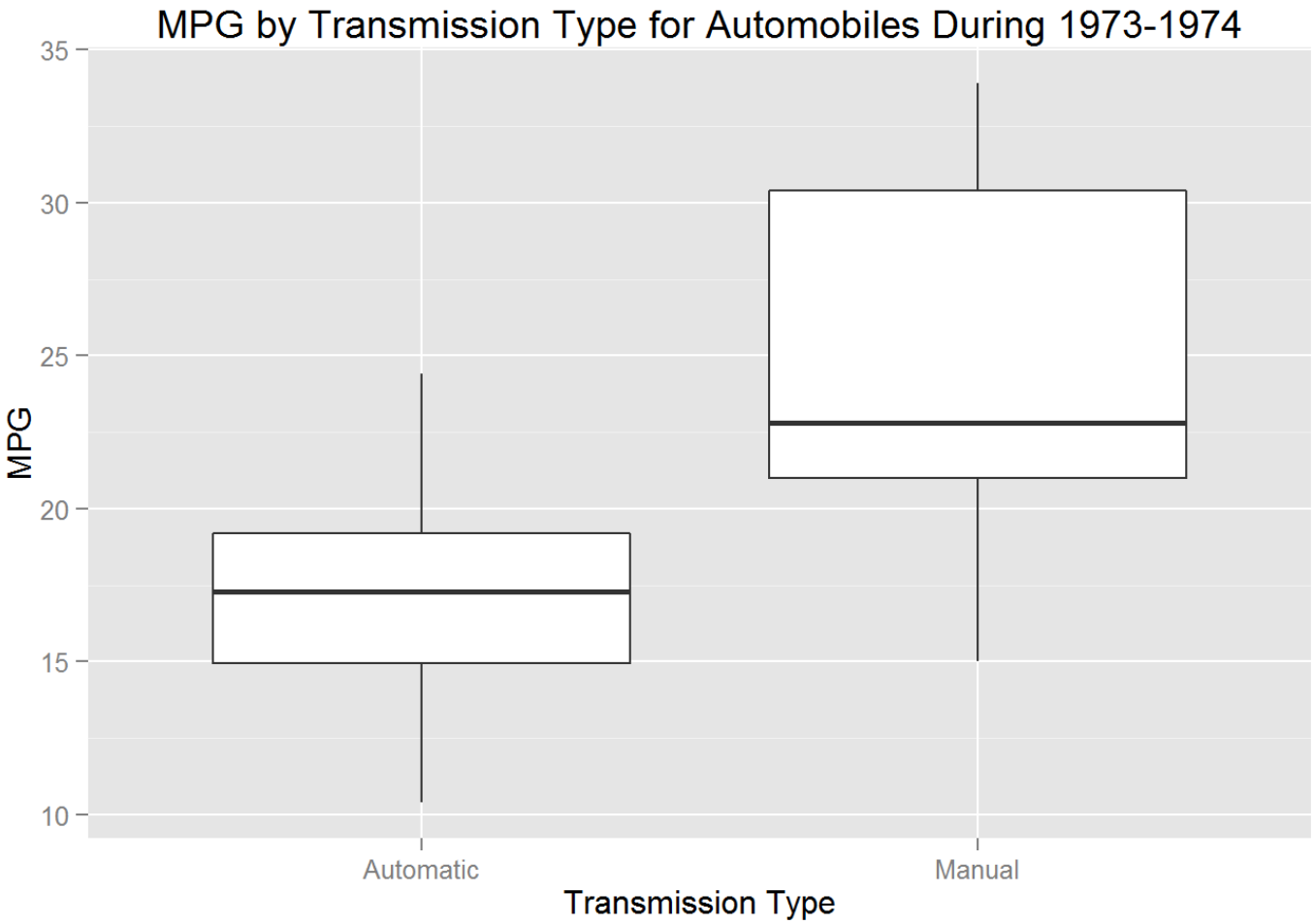

Figure 1. This chart displays the difference in MPG by transmission type. Manual transmissions generally achieve higher values for MPG than automatic, with a clear separation arond 23 MPG.

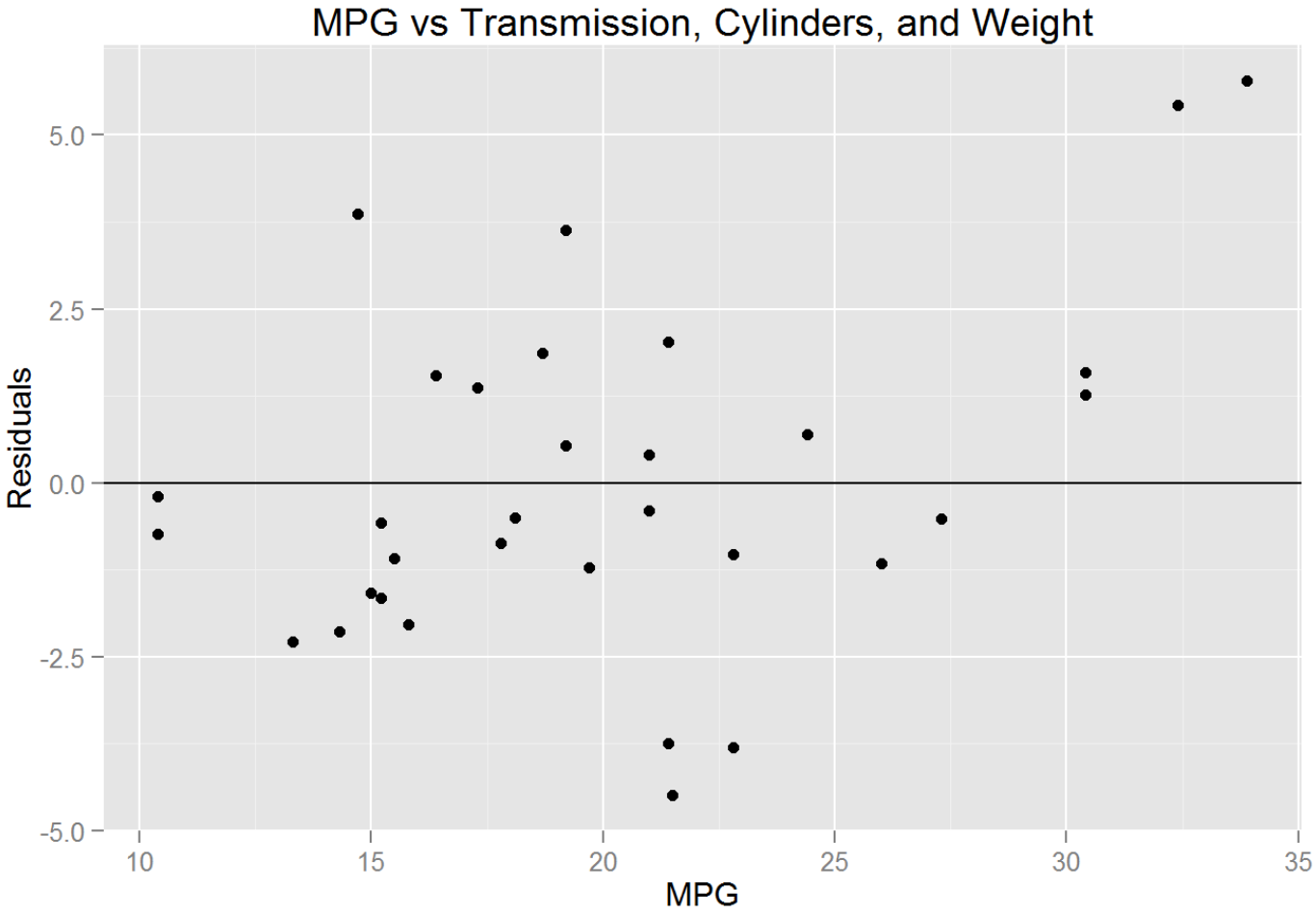

Figure 2. A residual plot of the linear model for mpg, transmission type, number of cylinders, and weight.

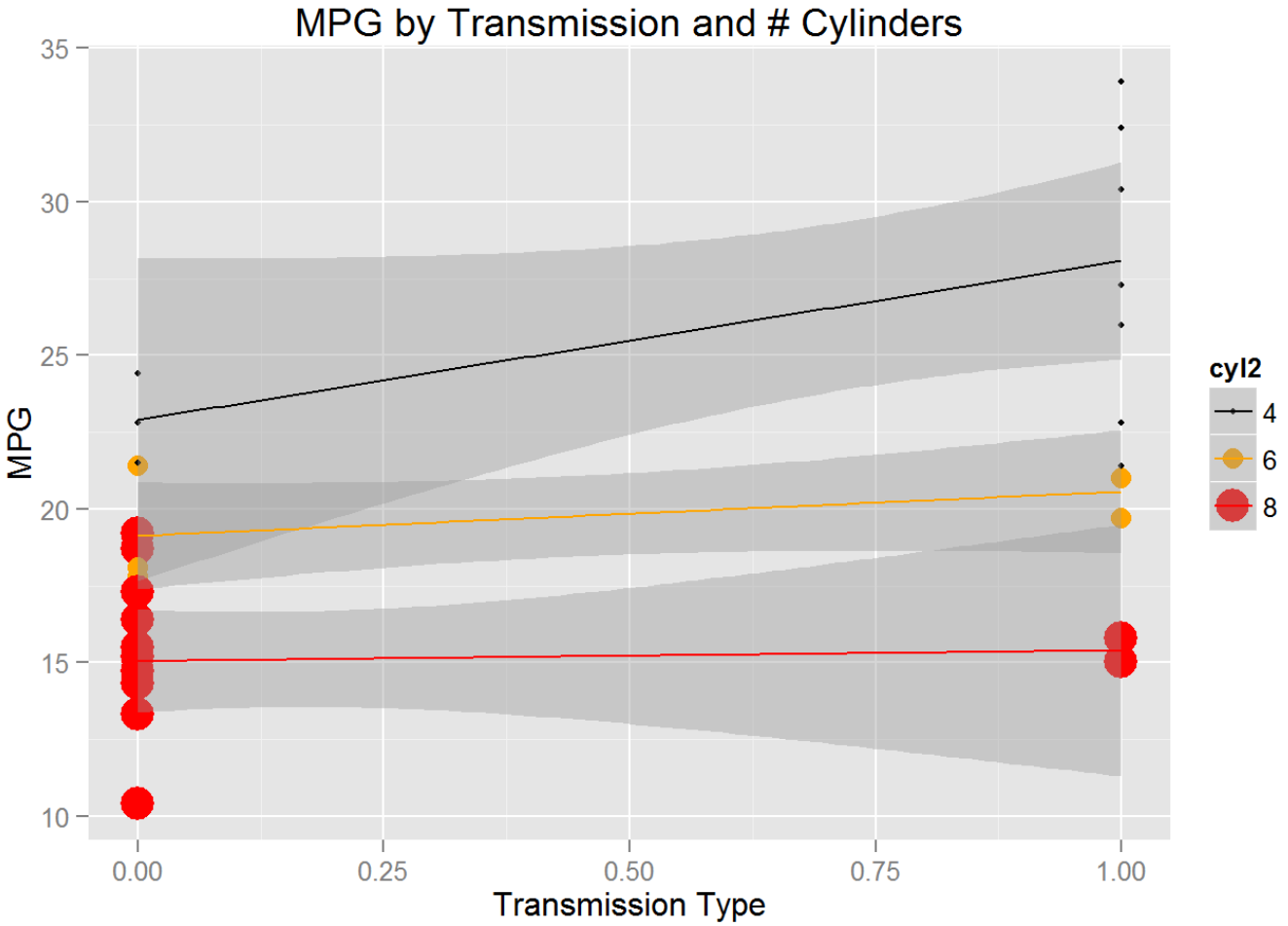

Figure 3. The linear model shows that the highest rates of MPG are achieved by 4-cylinder engines with manual transmissions.