The Impact of Automatic or Manual Transmission on Car Fuel Efficiency

Jacob Spangler

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This report is an analysis of the 1974 *Motor Trend* car data that is part of the standard R datasets. The dataset contains 11 variables across 32 car models from 1973 to 1974. The objective of this report is to answer the following question using Regression Modeling: **"Is an automatic or manual transmission better for MPG?"** Any differences between automatic and manual transmissions will then be quantified using the most appropriate regression model(s).

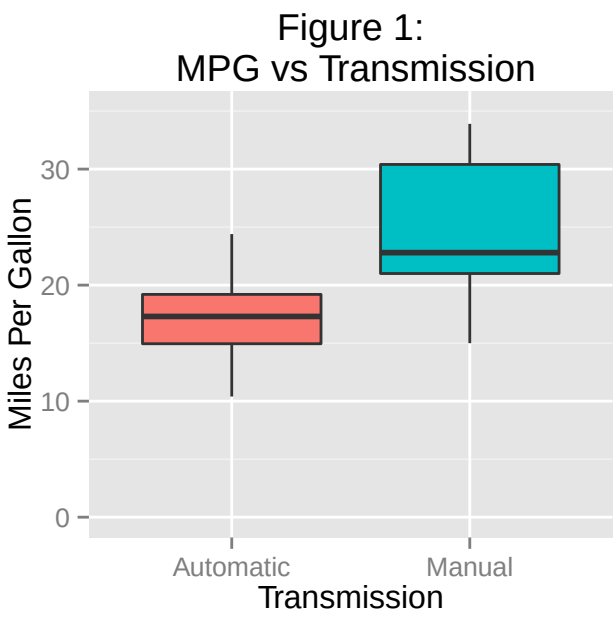
The median mpg for manual cars is 22.8, while the median mpg for automatic cars is 17.3. This simple comparison would suggest that manual transmissions improve fuel effienciency by roughly 5.5 mpg. A simple linear regression model of mpg vs transmission gives a similar answer with an intercept of 24.4 for manual transmissions and 17.1 for automatic transmissions. The difference in fuel efficiency between manual and automatic transmissions is also apparent when visualized in a boxplot (Appx Fig 1).

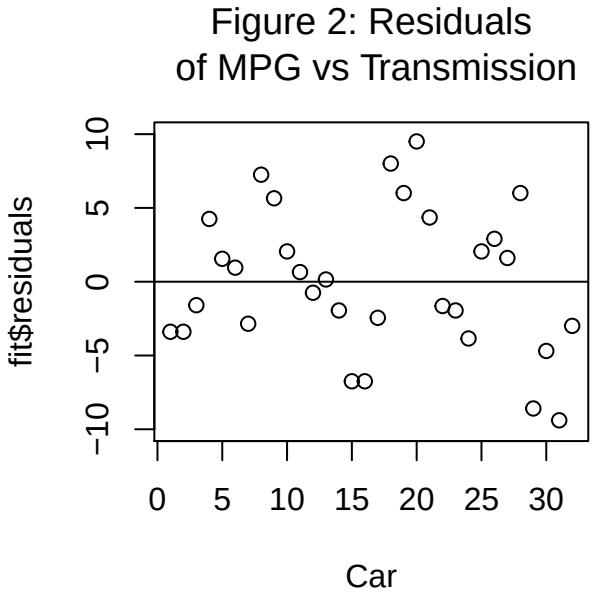
A plot of the residuals from the simple linear model suggest a fair amount of variation is still unaccounted for in the dataset (Appx Fig 2). As there are other factors known to affect fuel efficiency for vehicles I examined other variables within the dataset to ensure I had the best possible model. A quick check of car weight (Appx Fig 3) showed that most of the cars with manual transmission were lighter (2320 lbs) than those with automatic transmissions (3520 lbs). In addition to car weight, there is a bias in the number of engine cylinders between manual and automatic transmissions (Table 1).

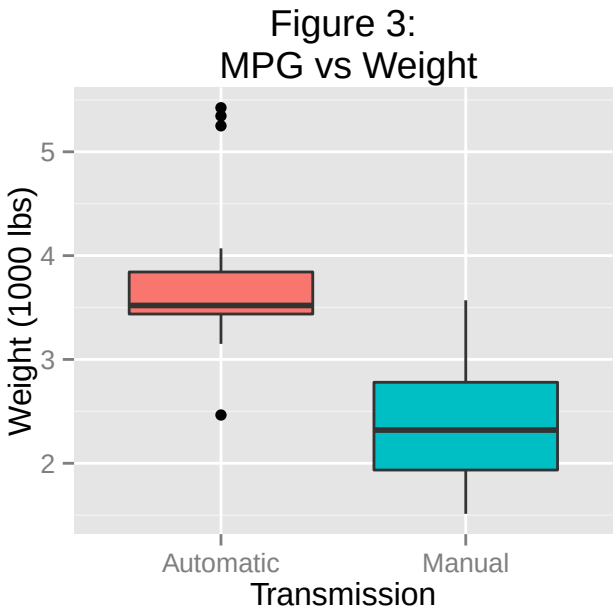
Transmission	4 cyl	6 cyl	8 cyl
Automatic	3	4	12
Manual	8	3	2

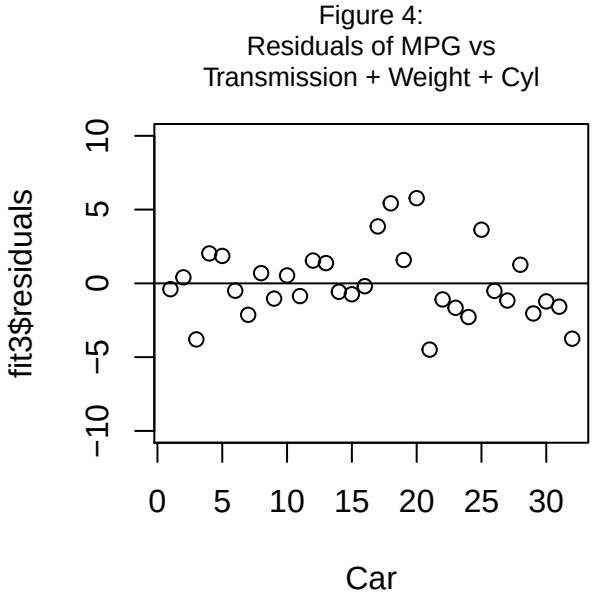
Constructing a new regression model factoring in car weight and number of cylinders now shows a fuel efficiency of 33.9 for manual transmissions and 33.8 for automatic transmissions. This suggests that the differences observed from the intial regression model were primarily due to confounding caused by car weight and the number of cylinders.

Appendix









summary(lm(mpg~am, Data))$coefficients summary(lm(mpg am+wt, Data))coefficients summary(lm(mpg~am + wt + cyl, Data))$coefficients summary(lm(mpg am + wt + cyl + gear, Data))coefficients

Note that the `echo = FALSE` parameter was added to the code chunk to prevent printing of the R code that generated the plot.