

An Analysis of the Effect of Manual vs Automatic Transmissions on Gas Mileage for a Sample of Cars Build in 1973 and 1974

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Executive Summary

Were manual transmissions or automatic transmissions better for gas mileage in 1974?

This report analyzes data from the 1974 Motor Trend US magazine, and comprises fuel consumption and 10 aspects of automobile design and performance for 32 automobiles (1973–74 models). We have a small sample of 32 cars. 19 have automatic transmissions, and 13 have manual transmissions.

Analysis

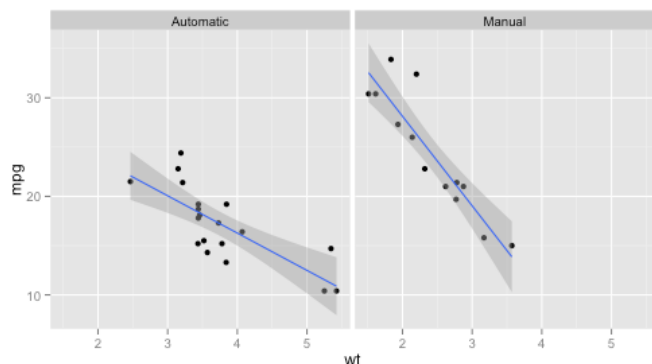
Here is a table showing the analysis of nine aspects of design and their impact on mpg for cars with automatic or manual transmissions. The data is sorted by best model fit to worse model fit according to the r^2 statistic:

	meanX	mpg@mean	mpg@meanManual	mpg@meanAuto	icTotal	beta1Total	icManual	beta1Manual	icAuto	beta1Auto	r^2	cor
wt	3.2172	20.0906	17.0681	19.2358	37.2851	-5.3445	46.2945	-9.0843	31.4161	-3.7859	0.7528	-0.8677
cyl	6.1875	20.0906	20.7487	18.6487	37.8846	-2.8758	41.0489	-3.2809	30.8735	-1.9757	0.7262	-0.8522
disp	230.7219	20.0906	19.2447	18.7929	29.5999	-0.0412	32.8661	-0.0590	25.1571	-0.0276	0.7183	-0.8476
hp	146.6875	20.0906	23.2269	17.9502	30.0989	-0.0682	31.8425	-0.0587	26.6248	-0.0591	0.6024	-0.7762
drat	3.5966	20.0906	20.7820	18.5671	-7.5246	7.6782	-7.8544	7.9621	2.1084	4.5762	0.4640	0.6812
vs	0.4375	20.0906	23.5219	17.5406	16.6167	7.9405	19.7500	8.6214	15.0500	5.6929	0.4409	0.6640
carb	2.8125	20.0906	24.6346	16.9814	25.8723	-2.0557	30.7962	-2.1908	23.1520	-2.1940	0.3035	-0.5509
gear	3.6875	20.0906	27.8047	19.5052	5.6233	3.9233	45.8550	-4.8950	1.2767	4.9433	0.2307	0.4803
qsec	17.8487	20.0906	25.7412	16.6663	-5.1140	1.4121	-23.5205	2.7600	-9.0099	1.4385	0.1753	0.4187

The top three variable listed seem to make sense. We should expect heavy cars with big engines to get worse mileage than light cars with small engines. Let's look at each variable individually.

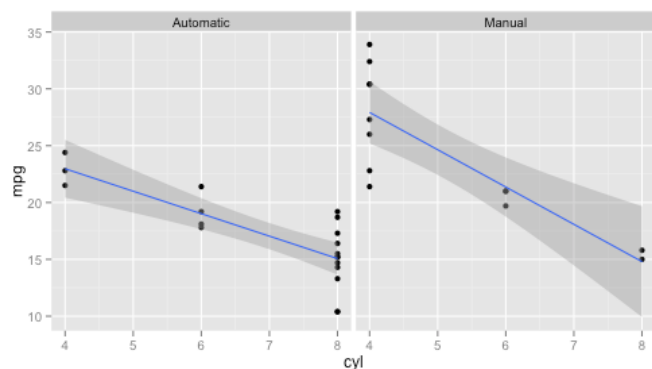
wt – weight in thousands of pounds

It's no surprise that weight has the biggest impact on fuel efficiency. More than 75% of the variance of the data is explained by weight. We see something strange, however. The average car weighing 3,217 pounds is expected to get 20 mpg. If we look at the model built on automatic transmissions only, we expect to get 19 mpg. For the model built on manual transmissions, we expect to get 17 mpg. We should expect the overall average to be between the values specific to manual or automatic transmissions. Since we don't see that, we know that either the data is too small to get a good fit, or looking at weight alone is insufficient.



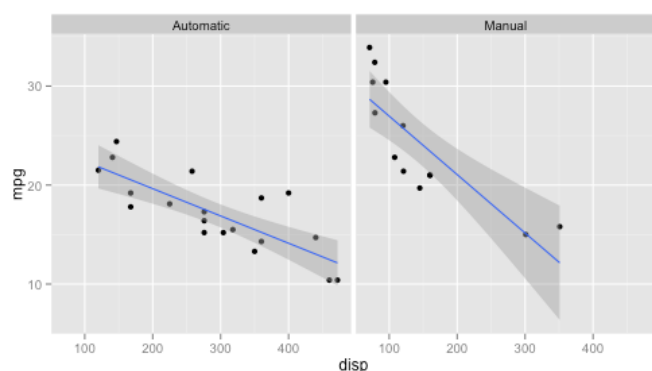
cyl – number of cylinders

Our second best variable is number of cylinders. Cars with more cylinders get worse fuel efficiency. Four cylinder cars generally get better mileage than six cylinder cars, and six cylinder cars generally get better mileage than eight cylinder cars.



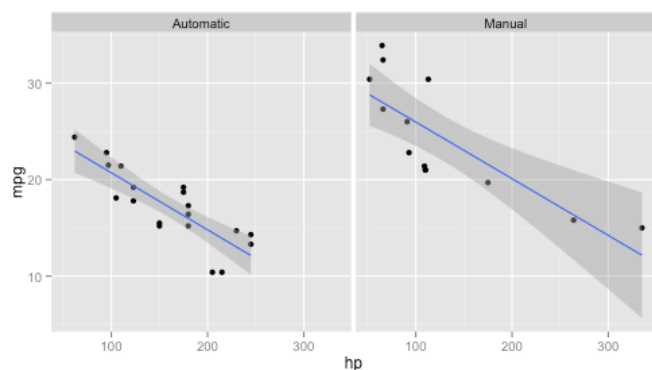
disp – engine displacement in cubic inches

Cars with big engines have worse fuel efficiency than cars with small engines. We unfortunately do not have a good spread of engine displacement data for cars with manual transmissions. The majority of cars with manual transmissions have small engines. The exception is our two muscle cars – the Ford Pantera L and the Maserati Bora.



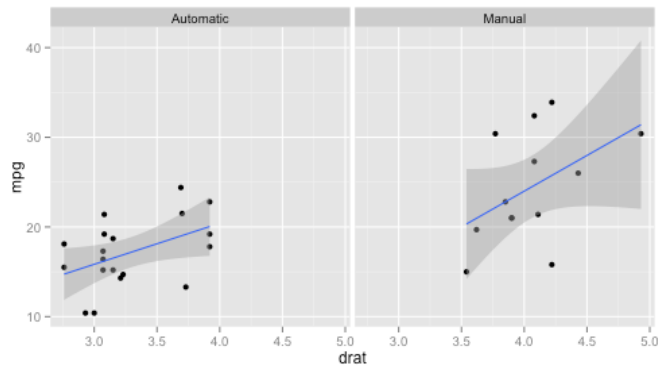
hp – Gross horsepower

Cars with powerful engines have worse fuel efficiency than cars with less powerful (and presumably more efficient) engines.

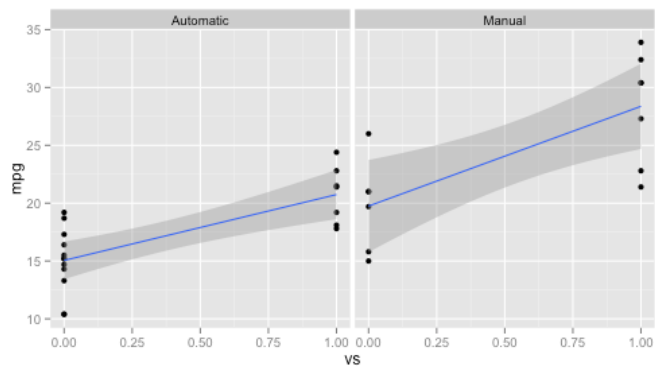


drat – Rear axle ratio

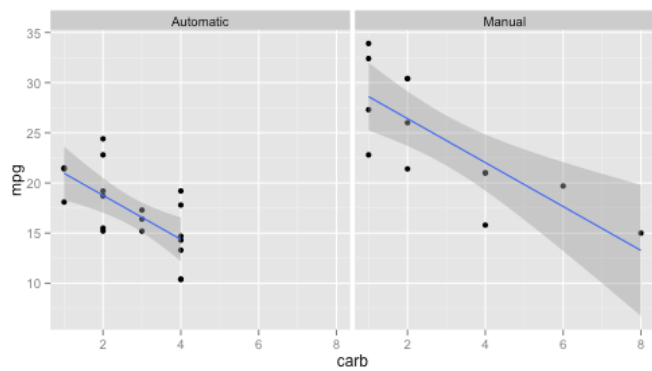
We will not consider data for rear axle ratio, since we do not have a good spread of data across manual and automatic transmissions. In the mtcars data set, the automatic transmissions were geared lower for torque, which should be better for mpg. The manual transmissions were geared higher for horsepower, when should be worse for mpg. Since there is little overlap of the data, we cannot trust that a generated model reflects the entire population of cars.



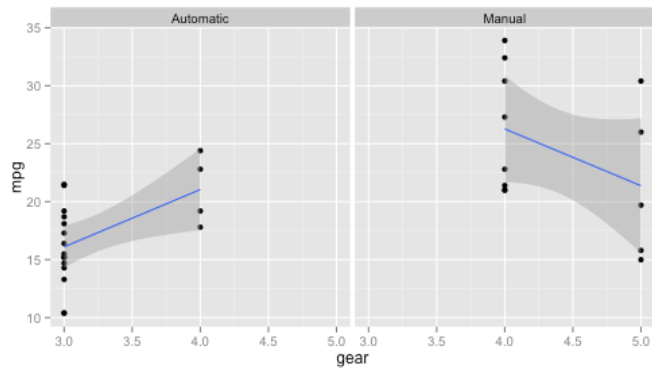
vs – Engine configuration (V vs Straight)



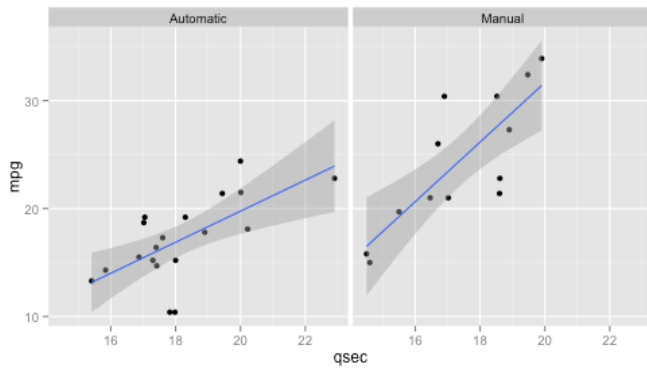
carb – Number of carburetors



gear – Number of forward gears



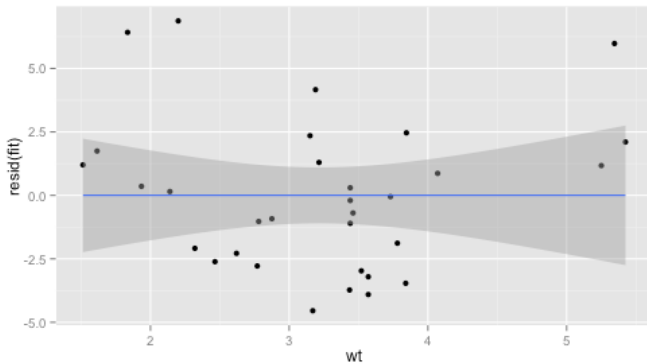
qsec – ¼ mile time



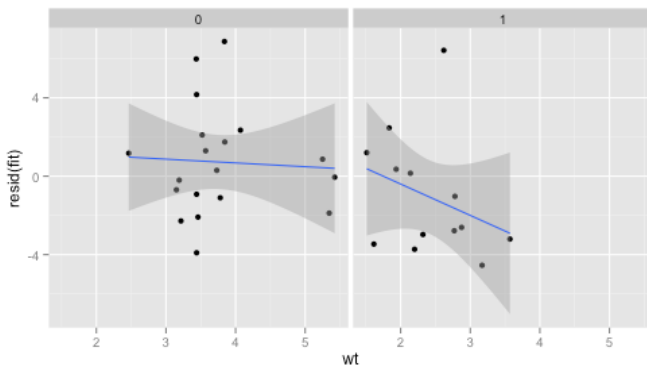
TODO: Figure out what to do with the rest of these charts and data

TODO: figure out what residual plot makes sense to include in the final report

The following residual plot shows that there is no obvious pattern for residuals based on the model that predicts mpg based on vehicle weight. Perhaps residuals for all three models (automatic, manual, and all cars)



I don't know that it makes sense to split the residuals by transmission type...



TODO: analyze weight against other variables to see if we have patterns (weightMultiVar.Rmd).

TODO: Final plot that predicts mpg differences between automatic and manual transmissions. Perhaps a table for each car as well.