

MPG Automatic Transmissions VS Standard

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In this document we take the Motor Trend cars data and try to quantify what the effect of automatic transmissions on a cars mpg is. We will be using a study of variance inflation along with ANOVA of models based on this to determine the best model for our study. Once we have selected a model we will create two data sets based on the original data one where all the cars are attributed a standard transmission and the other with all the cars are attributed an automatic transmission. We will plot the prediction band for each data set on the same plot to visualize the effect of automatic transmission usage.

Checking Variance Inflation on all model elements we get:

##	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
##	15.374	21.620	9.832	3.375	15.165	7.528	4.966	4.648	5.357	7.909

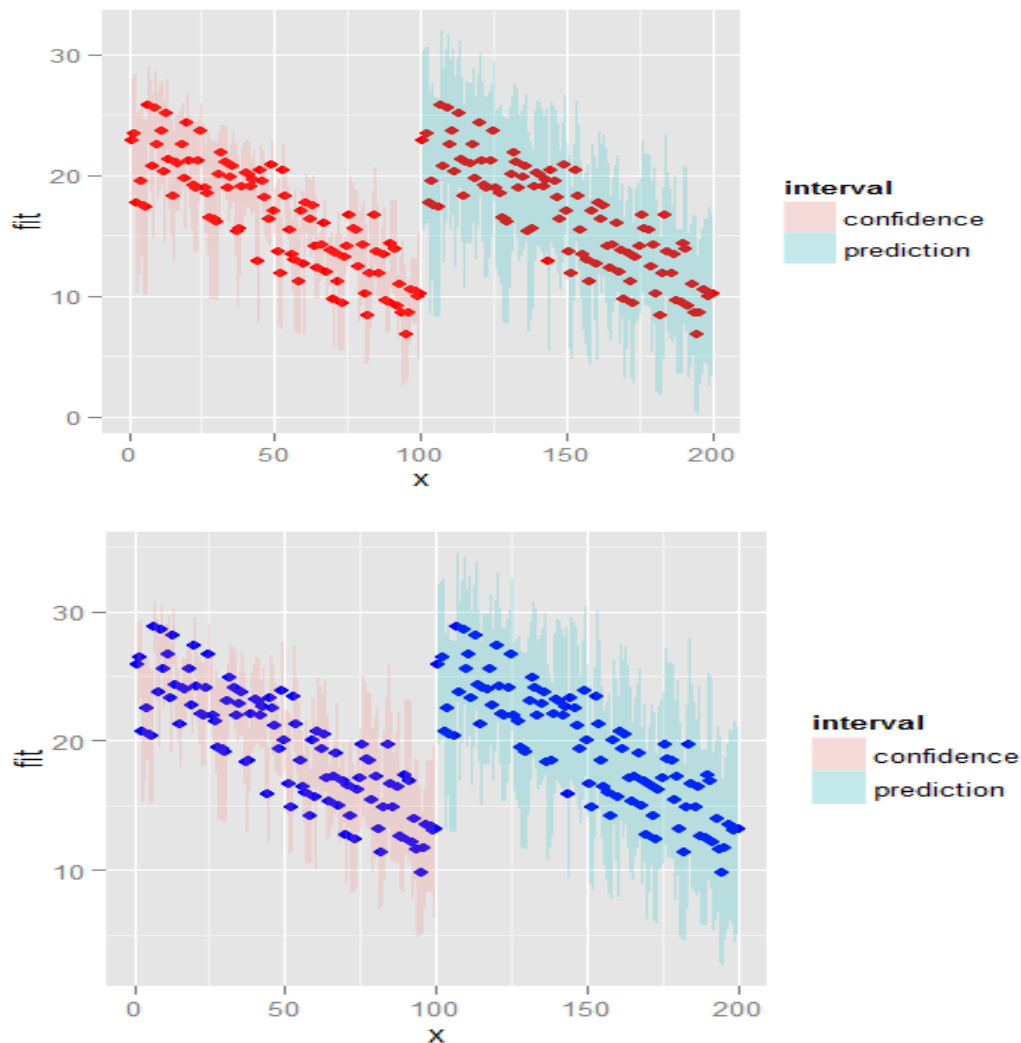
We do two ANOVA analysis on series of models built using elements in ascending order of variance inflation and in descending order of variance inflation. See Tables 1 and 2

Utilizing the top three from each study we get the following anova analysis (see Table 3)

Adding drat into the model seems of rather low significance so we remove it to get our final model $\text{mpg} \sim \text{am} + \text{disp} + \text{wt} + \text{vs} + \text{carb}$

Examining our residuals we see a normally distributed set of residual values with a single high leverage point. (See Appendix)

We now examine the difference the choice of transmission makes in our model



Conclusions

A line fitted through the predicted values for our model using a standard transmission has an y intercept of 19.7422619. A line fitted through the predicted values for our model using an automatic transmission has an y intercept of 22.7335817. However the mean prediction interval of the model for the standard transmission is 10.3780866. While the mean prediction interval of the model for the automatic transmission is 10.6555746. Since the difference between the intercepts is 2.9913198 which is less than half the mean prediction interval of both models we conclude that the choice of an automatic transmission vs. a standard transmission has little if no effect on the miles per gallon and that the engine choice , the weight, the type of carburator and the engine displacement have an overriding effect.

Appendix

Plot of final model residuals

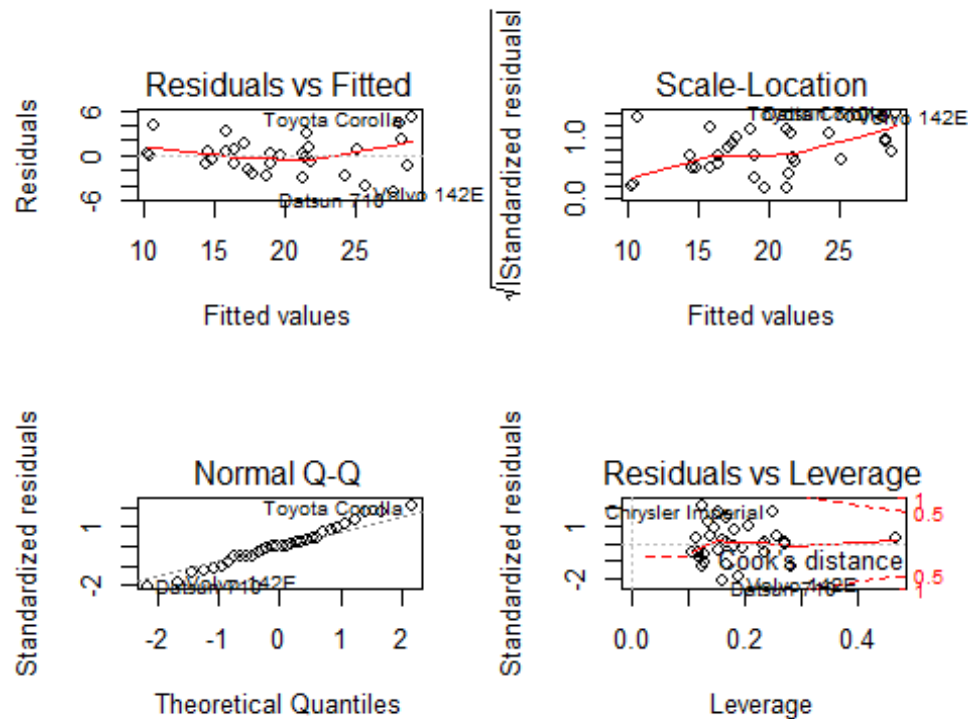


Table 1

Models Ascending Order Of Variance Inflation	Significance
$\text{mpg} \sim \text{am} + \text{drat}$	1.628917910^{-4}
$\text{mpg} \sim \text{am} + \text{drat} + \text{vs}$	1.003151510^{-5}
$\text{mpg} \sim \text{am} + \text{drat} + \text{vs} + \text{gear}$	0.222504
$\text{mpg} \sim \text{am} + \text{drat} + \text{vs} + \text{gear} + \text{qsec}$	0.0516421
$\text{mpg} \sim \text{am} + \text{drat} + \text{vs} + \text{gear} + \text{qsec} + \text{carb}$	0.0015164
$\text{mpg} \sim \text{am} + \text{drat} + \text{vs} + \text{gear} + \text{qsec} + \text{carb} + \text{hp}$	0.0997112
$\text{mpg} \sim \text{am} + \text{drat} + \text{vs} + \text{gear} + \text{qsec} + \text{carb} + \text{hp} + \text{wt}$	0.0407154
$\text{mpg} \sim \text{am} + \text{drat} + \text{vs} + \text{gear} + \text{qsec} + \text{carb} + \text{hp} + \text{wt} + \text{cyl}$	0.9247723
$\text{mpg} \sim \text{am} + \text{drat} + \text{vs} + \text{gear} + \text{qsec} + \text{carb} + \text{hp} + \text{wt} + \text{cyl} + \text{disp}$	0.4634887

Table 2

Models Descending Order Of Variance Inflation	Significance
$\text{mpg} \sim \text{am} + \text{disp}$	1.396804310^{-7}
$\text{mpg} \sim \text{am} + \text{disp} + \text{cyl}$	0.0160104
$\text{mpg} \sim \text{am} + \text{disp} + \text{cyl} + \text{wt}$	0.0066599

mpg ~ am + disp + cyl + wt + hp	0.0715057
mpg ~ am + disp + cyl + wt + hp + carb	0.6297266
mpg ~ am + disp + cyl + wt + hp + carb + qsec	0.2354918
mpg ~ am + disp + cyl + wt + hp + carb + qsec + gear	0.6331013
mpg ~ am + disp + cyl + wt + hp + carb + qsec + gear + vs	0.8702249
mpg ~ am + disp + cyl + wt + hp + carb + qsec + gear + vs + drat	0.6352779

Table 3

Models Top Six Elements	Significance
mpg ~ am + disp	3.249459110 ⁻⁸
mpg ~ am + disp + wt	0.0095176
mpg ~ am + disp + wt + drat	0.5094742
mpg ~ am + disp + wt + drat + vs	0.0465454
mpg ~ am + disp + wt + drat + vs + carb	0.0183706