How to Automatically Know if your Gas Mileage needs a Manual Takeover
An exploration into the difference in miles per gallon of manaul vs automatic transmissions

Summary
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Which transmission type is better for miles per gallon?
The age old struggle of which transmission type is better, automatic or manual, is an age old struggle that we here at *Motor Trend* do not take lightly. We are here to take you on a journey examining which transmission is ultimately the best for getting the most from your dollar per mile traveled. Get ready to dive in becasue you are in for a ride!

Let's take an initial look at the data of the current cars on the market grouped by transmission. Figure 1 is a plot of the percentage of cars of a given transmission type vs a given MPG rating. At first glance it would appear that on average, automatic transmission cars have a MPG rating of ~18 MPG while manual tranmsission cars have an average rating of ~22 MPG. However, could there be other variables affecting this average?

One of the factors that contributes the most to the MPG rating of cars is the engine. The plot in Figure 2 shows three individual plots of MPG vs horsepower broken up by 4, 6 and 8 cylinder cars. One would expect lower cylinder engine cars to have better gas mileage becasuse they require less gas to run. This is confirmed by the plot in Figure 2 which shows a negative relationship between mpg and cylinder count. What is interesting to note in this data set is that a majority of the automatic cars are of the eight cylinder variety while a majority of the manual cars are of four cylinders! This relationship clearly skews our initial look from the density plot in Figure 1. Clearly, if the manual group has more cars with less cylinders the average gas mileage will go up and if a majority of automatic cars have higher cylinder engines we would expect the gas mileage to go down. We have found some confounding variables that we need to control for.

To full account for these confounding variables we should create one variable that accounts for the various effects of the car's architecture on its gas mileage. This new variable should allow us to normalize the difference between cars so that they can be analyzed without worry of confounding groups. Let us define a variable called EV3 which is defined as EV3 = (Car Weight (per 1000 lbs) * Horsepower) / (Number of Cylinders). Figure 3 plots EV3 vs MPG with a fit regression line to the two groups of transmissions

```{r, echo=FALSE}
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```
library(ggplot2)
library(lattice)

data(mtcars)
data <- mtcars
data$am[data$am == 0] <- "automatic"
data$am[data$am == 1] <- "manual"
auto <- data[data$am == "automatic",]
manual <- data[data$am == "manual",]
data$ev <- data$hp * data$cyl * data$wt

ggplot(data, aes(x=mpg, color=am)) + geom_density() +
scale_colour_discrete(name = "Transmission Type") + ggtitle("Figure 1.
Density plot of MPG by transmission type")
```

```{r, echo=FALSE}
xyplot(mpg ~ hp | cyl, data, group=am, main = "Figure 2. Horsepower vs
MPG by Cylinder Count", auto.key = list(title = "Type",
               x = .75, y=1, corner = c(0,2),
               border = TRUE, lines = FALSE))
```

```{r, echo=FALSE}
data$ev3 <- data$hp * data$wt / data$cyl
data$ev4 <- sqrt(data$hp) * data$wt / data$cyl
qplot(ev3, mpg, data=data, col = am) +
geom_smooth(method='lm',formula=y~x) + ggtitle("Figure 3. Regression
fits of EV3 vs MPG by Transmission Type")
qplot(ev4, mpg, data=data, col = am) +
geom_smooth(method='lm',formula=y~x) + ggtitle("Figure 3. Regression
fits of EV3 vs MPG by Transmission Type")
```

```{r, echo=FALSE}

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