# Research : What is Transmission Effects on Fuel Efficiency ?

# Overview

You work for Motor Trend, a magazine about the automobile industry. Looking at a data set of a collection of cars, they are interested in exploring the relationship between a set of variables and miles per gallon (MPG) (outcome). They are particularly interested in the following two questions:

* "Is an automatic or manual transmission better for MPG"
* "Quantify the MPG difference between automatic and manual transmissions"

The data was extracted 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).

# Research Method

* Dataset Details

Summary for all cars

summary(mtcars)

## mpg cyl disp hp   
## Min. :10.40 Min. :4.000 Min. : 71.1 Min. : 52.0   
## 1st Qu.:15.43 1st Qu.:4.000 1st Qu.:120.8 1st Qu.: 96.5   
## Median :19.20 Median :6.000 Median :196.3 Median :123.0   
## Mean :20.09 Mean :6.188 Mean :230.7 Mean :146.7   
## 3rd Qu.:22.80 3rd Qu.:8.000 3rd Qu.:326.0 3rd Qu.:180.0   
## Max. :33.90 Max. :8.000 Max. :472.0 Max. :335.0   
## drat wt qsec vs   
## Min. :2.760 Min. :1.513 Min. :14.50 Min. :0.0000   
## 1st Qu.:3.080 1st Qu.:2.581 1st Qu.:16.89 1st Qu.:0.0000   
## Median :3.695 Median :3.325 Median :17.71 Median :0.0000   
## Mean :3.597 Mean :3.217 Mean :17.85 Mean :0.4375   
## 3rd Qu.:3.920 3rd Qu.:3.610 3rd Qu.:18.90 3rd Qu.:1.0000   
## Max. :4.930 Max. :5.424 Max. :22.90 Max. :1.0000   
## am gear carb   
## Min. :0.0000 Min. :3.000 Min. :1.000   
## 1st Qu.:0.0000 1st Qu.:3.000 1st Qu.:2.000   
## Median :0.0000 Median :4.000 Median :2.000   
## Mean :0.4062 Mean :3.688 Mean :2.812   
## 3rd Qu.:1.0000 3rd Qu.:4.000 3rd Qu.:4.000   
## Max. :1.0000 Max. :5.000 Max. :8.000

Summary for automatic type cars

summary(mtcars[mtcars$am==0,])

## mpg cyl disp hp   
## Min. :10.40 Min. :4.000 Min. :120.1 Min. : 62.0   
## 1st Qu.:14.95 1st Qu.:6.000 1st Qu.:196.3 1st Qu.:116.5   
## Median :17.30 Median :8.000 Median :275.8 Median :175.0   
## Mean :17.15 Mean :6.947 Mean :290.4 Mean :160.3   
## 3rd Qu.:19.20 3rd Qu.:8.000 3rd Qu.:360.0 3rd Qu.:192.5   
## Max. :24.40 Max. :8.000 Max. :472.0 Max. :245.0   
## drat wt qsec vs   
## Min. :2.760 Min. :2.465 Min. :15.41 Min. :0.0000   
## 1st Qu.:3.070 1st Qu.:3.438 1st Qu.:17.18 1st Qu.:0.0000   
## Median :3.150 Median :3.520 Median :17.82 Median :0.0000   
## Mean :3.286 Mean :3.769 Mean :18.18 Mean :0.3684   
## 3rd Qu.:3.695 3rd Qu.:3.842 3rd Qu.:19.17 3rd Qu.:1.0000   
## Max. :3.920 Max. :5.424 Max. :22.90 Max. :1.0000   
## am gear carb   
## Min. :0 Min. :3.000 Min. :1.000   
## 1st Qu.:0 1st Qu.:3.000 1st Qu.:2.000   
## Median :0 Median :3.000 Median :3.000   
## Mean :0 Mean :3.211 Mean :2.737   
## 3rd Qu.:0 3rd Qu.:3.000 3rd Qu.:4.000   
## Max. :0 Max. :4.000 Max. :4.000

Summary for manual type cars

summary(mtcars[mtcars$am==1,])

## mpg cyl disp hp   
## Min. :15.00 Min. :4.000 Min. : 71.1 Min. : 52.0   
## 1st Qu.:21.00 1st Qu.:4.000 1st Qu.: 79.0 1st Qu.: 66.0   
## Median :22.80 Median :4.000 Median :120.3 Median :109.0   
## Mean :24.39 Mean :5.077 Mean :143.5 Mean :126.8   
## 3rd Qu.:30.40 3rd Qu.:6.000 3rd Qu.:160.0 3rd Qu.:113.0   
## Max. :33.90 Max. :8.000 Max. :351.0 Max. :335.0   
## drat wt qsec vs   
## Min. :3.54 Min. :1.513 Min. :14.50 Min. :0.0000   
## 1st Qu.:3.85 1st Qu.:1.935 1st Qu.:16.46 1st Qu.:0.0000   
## Median :4.08 Median :2.320 Median :17.02 Median :1.0000   
## Mean :4.05 Mean :2.411 Mean :17.36 Mean :0.5385   
## 3rd Qu.:4.22 3rd Qu.:2.780 3rd Qu.:18.61 3rd Qu.:1.0000   
## Max. :4.93 Max. :3.570 Max. :19.90 Max. :1.0000   
## am gear carb   
## Min. :1 Min. :4.000 Min. :1.000   
## 1st Qu.:1 1st Qu.:4.000 1st Qu.:1.000   
## Median :1 Median :4.000 Median :2.000   
## Mean :1 Mean :4.385 Mean :2.923   
## 3rd Qu.:1 3rd Qu.:5.000 3rd Qu.:4.000   
## Max. :1 Max. :5.000 Max. :8.000

unique(mtcars)

## mpg cyl disp hp drat wt qsec vs am gear carb  
## Mazda RX4 21.0 6 160.0 110 3.90 2.620 16.46 0 1 4 4  
## Mazda RX4 Wag 21.0 6 160.0 110 3.90 2.875 17.02 0 1 4 4  
## Datsun 710 22.8 4 108.0 93 3.85 2.320 18.61 1 1 4 1  
## Hornet 4 Drive 21.4 6 258.0 110 3.08 3.215 19.44 1 0 3 1  
## Hornet Sportabout 18.7 8 360.0 175 3.15 3.440 17.02 0 0 3 2  
## Valiant 18.1 6 225.0 105 2.76 3.460 20.22 1 0 3 1  
## Duster 360 14.3 8 360.0 245 3.21 3.570 15.84 0 0 3 4  
## Merc 240D 24.4 4 146.7 62 3.69 3.190 20.00 1 0 4 2  
## Merc 230 22.8 4 140.8 95 3.92 3.150 22.90 1 0 4 2  
## Merc 280 19.2 6 167.6 123 3.92 3.440 18.30 1 0 4 4  
## Merc 280C 17.8 6 167.6 123 3.92 3.440 18.90 1 0 4 4  
## Merc 450SE 16.4 8 275.8 180 3.07 4.070 17.40 0 0 3 3  
## Merc 450SL 17.3 8 275.8 180 3.07 3.730 17.60 0 0 3 3  
## Merc 450SLC 15.2 8 275.8 180 3.07 3.780 18.00 0 0 3 3  
## Cadillac Fleetwood 10.4 8 472.0 205 2.93 5.250 17.98 0 0 3 4  
## Lincoln Continental 10.4 8 460.0 215 3.00 5.424 17.82 0 0 3 4  
## Chrysler Imperial 14.7 8 440.0 230 3.23 5.345 17.42 0 0 3 4  
## Fiat 128 32.4 4 78.7 66 4.08 2.200 19.47 1 1 4 1  
## Honda Civic 30.4 4 75.7 52 4.93 1.615 18.52 1 1 4 2  
## Toyota Corolla 33.9 4 71.1 65 4.22 1.835 19.90 1 1 4 1  
## Toyota Corona 21.5 4 120.1 97 3.70 2.465 20.01 1 0 3 1  
## Dodge Challenger 15.5 8 318.0 150 2.76 3.520 16.87 0 0 3 2  
## AMC Javelin 15.2 8 304.0 150 3.15 3.435 17.30 0 0 3 2  
## Camaro Z28 13.3 8 350.0 245 3.73 3.840 15.41 0 0 3 4  
## Pontiac Firebird 19.2 8 400.0 175 3.08 3.845 17.05 0 0 3 2  
## Fiat X1-9 27.3 4 79.0 66 4.08 1.935 18.90 1 1 4 1  
## Porsche 914-2 26.0 4 120.3 91 4.43 2.140 16.70 0 1 5 2  
## Lotus Europa 30.4 4 95.1 113 3.77 1.513 16.90 1 1 5 2  
## Ford Pantera L 15.8 8 351.0 264 4.22 3.170 14.50 0 1 5 4  
## Ferrari Dino 19.7 6 145.0 175 3.62 2.770 15.50 0 1 5 6  
## Maserati Bora 15.0 8 301.0 335 3.54 3.570 14.60 0 1 5 8  
## Volvo 142E 21.4 4 121.0 109 4.11 2.780 18.60 1 1 4 2

The dataset contains of 32 rows on 11 variables name below :-

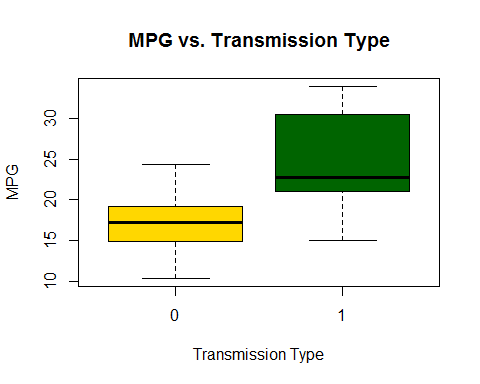
1. mpg: Miles per US gallon
2. cyl: Number of cylinders
3. disp: Displacement (cc)
4. hp: Raw Horsepower
5. drat: Rear axle ratio
6. wt: Weight (lb / 1000)
7. qsec: 1/4 mile time in sec
8. vs: V engine or Straight engine
9. am: Transmission (0 = automatic, 1 = manual)
10. gear: Number of gears
11. carb: Number of carburetors

# Research Questions

* "Is an automatic or manual transmission better for MPG"

We found that the mean for MPG for manual cars is bigger than automatic which is [ 24.39 > 17.15 ]. Further investigation need to be done to verify this . By plotting into BoxPlot we can have more info

boxplot(mpg ~ am, data = mtcars, col=(c("gold","darkgreen")),   
 xlab = "Transmission Type", ylab = "MPG",  
 main="MPG vs. Transmission Type")



* "Quantify the MPG difference between automatic and manual transmissions"