

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 :-

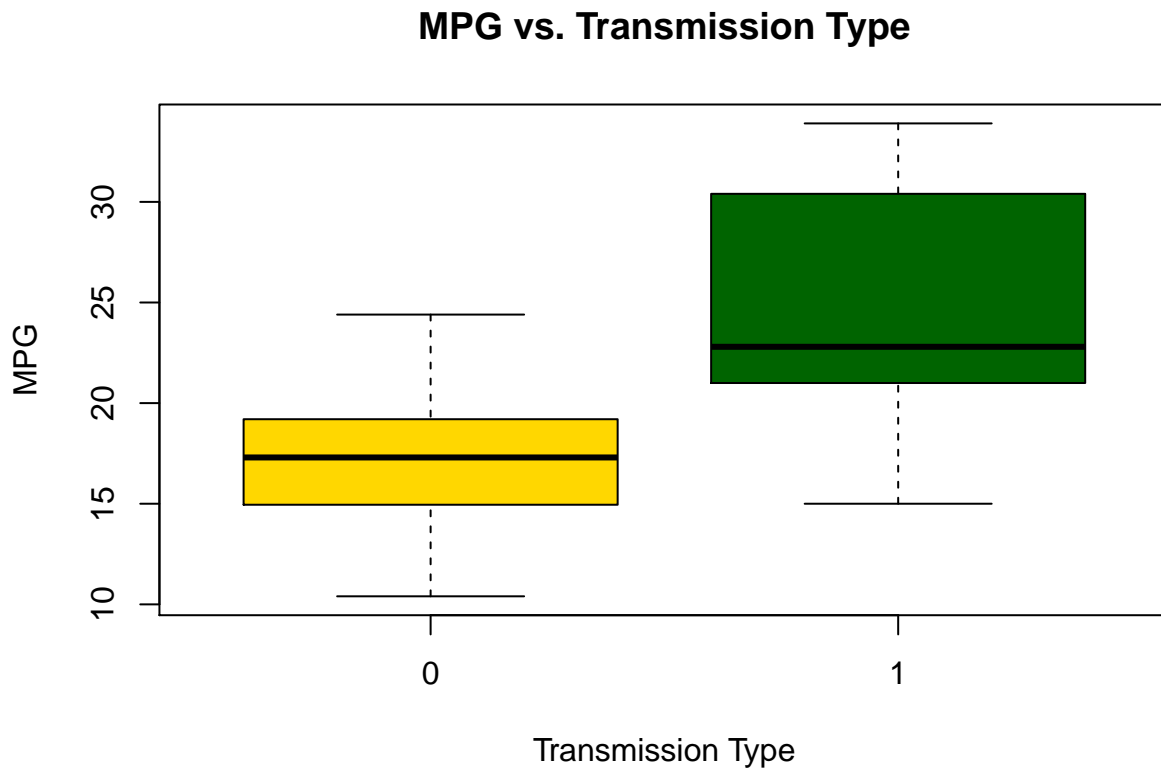
1. mpg: Miles per US gallon
2. cyl: Number of cylinders
3. disp: Displacement (cc)
4. hp: Raw Horsepower
5. drat: Rear axle ratio
6. wt: Weight (lb / 1000)
7. qsec: 1/4 mile time in sec
8. vs: V engine or Straight engine
9. am: Transmission (0 = automatic, 1 = manual)
10. gear: Number of gears
11. carb: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



it proves that manual = 1 transmission is higher mpg mean than automatic = 0

- “Quantify the MPG difference between automatic and manual transmissions”