# Regression Models

Rehab Fathi

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Executive Summary

I 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"

In the simple model, the MPG difference is 7.245 MPG, and in the multivariate enhanced model, the MPG difference is 1.47.

Data Analysis
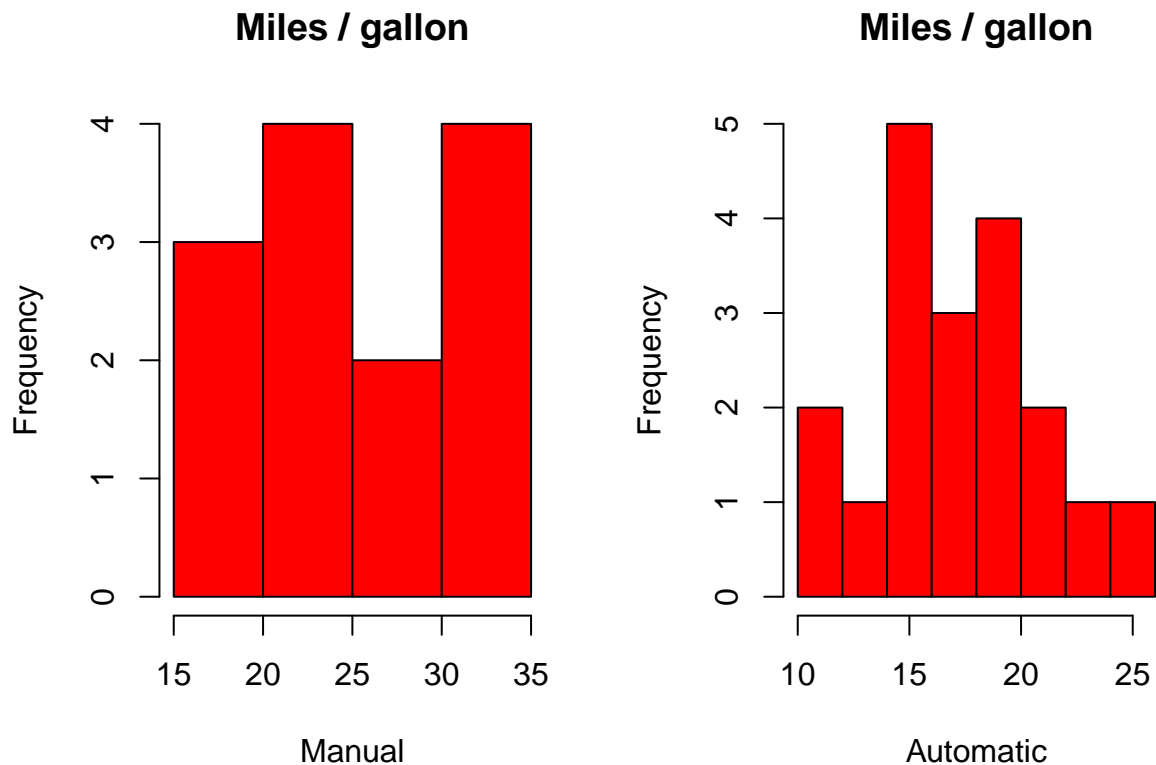

```
##        Type Mean mpg
## 1 automatic 17.14737
## 2    manual 24.39231
```

Hypothesis

Automatic cars have lower mpg than manual cars

T-Test

```
##
##  Welch Two Sample t-test
##
## data:  automatic$mpg and manual$mpg
## t = -3.7671, df = 18.332, p-value = 0.001374
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -11.280194  -3.209684
## sample estimates:
## mean of x mean of y
##  17.14737  24.39231
```

The p-value is 0.001374 showing a significant difference

Regression Model

```
##
## Call:
## lm(formula = mtcars$mpg ~ mtcars$am)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -9.3923 -3.0923 -0.2974  3.2439  9.5077
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)       17.147      1.125  15.247 1.13e-15 ***
## mtcars$ammanual    7.245      1.764   4.106 0.000285 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 4.902 on 30 degrees of freedom
## Multiple R-squared:  0.3598, Adjusted R-squared:  0.3385
## F-statistic: 16.86 on 1 and 30 DF,  p-value: 0.000285
```

The average mpg for manual cars is 7.245 higher than automatic cars. The model explains 36% of the variance in the data

Multivariate Regression

```
##
## Call:
## lm(formula = mpg ~ cyl + hp + wt + am, data = mtcars)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
```

```
## -3.4765 -1.8471 -0.5544  1.2758  5.6608
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 36.14654    3.10478  11.642 4.94e-12 ***
## cyl         -0.74516    0.58279  -1.279   0.2119
## hp          -0.02495    0.01365  -1.828   0.0786 .
## wt          -2.60648    0.91984  -2.834   0.0086 **
## ammanual     1.47805    1.44115   1.026   0.3142
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.509 on 27 degrees of freedom
## Multiple R-squared:  0.849,  Adjusted R-squared:  0.8267
## F-statistic: 37.96 on 4 and 27 DF,  p-value: 1.025e-10
```

This model explains 85% of the variance Manual cars have higher mpg by 1.47

Plot Residuals