

Report on Fuel Economy of Automatic and Manual Transmission Cars

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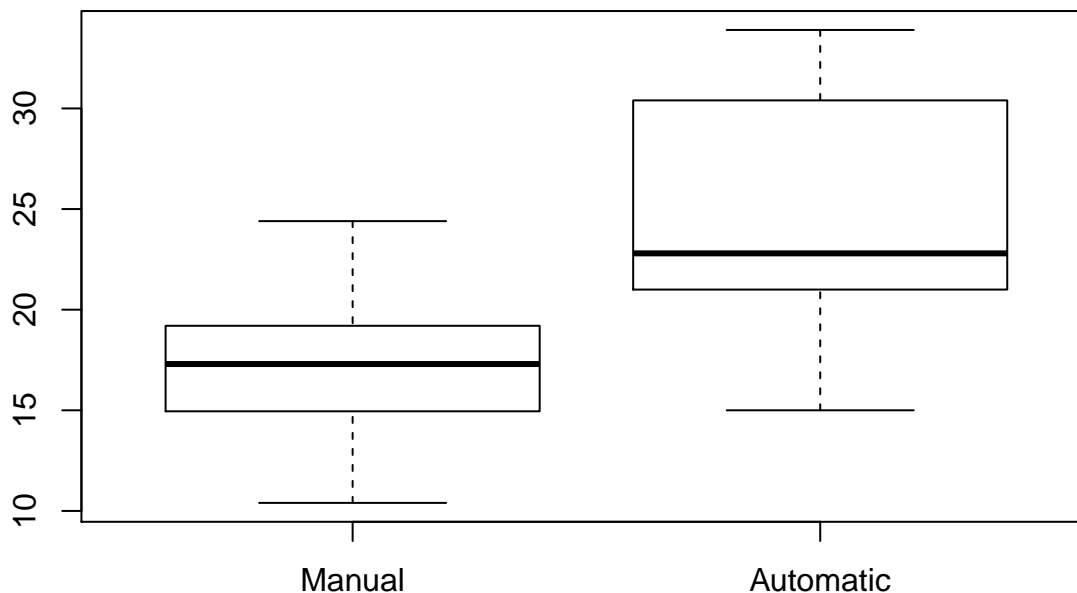
Summary

In the small sample of cars we have in the data, the mean mpg figure is certainly lower for manual transmission cars. Manual cars mean is 17.15 mpg; automatic cars 24.39 mpg, a difference of 7.24 mpg. We have 95% confidence that the actual average difference lies between 3.21 and 11.28 mpg. There are, however other factors which need to be considered. Vehicle weight has more significance in the regression plot, as does the time taken for a quarter mile (which is correlated with gear and axle ratios, engine displacement, number of cylinders and horsepower).

Analysis

An initial boxplot of mpg and transmission type shows the difference in means

```
mtcars$am <- factor(mtcars$am, levels=c(0,1), labels=c("Manual", "Automatic"))
boxplot(mpg ~ am, data=mtcars)
```



A t-test confirms that the difference in means is real, and provides a 95% confidence interval for it.

```
t.test(mpg ~ am, data=mtcars)
```

```
##
##  Welch Two Sample t-test
##
## data:  mpg by am
## t = -3.767, df = 18.33, p-value = 0.001374
```

```
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -11.28  -3.21
## sample estimates:
##      mean in group Manual mean in group Automatic
##                17.15                24.39
```

A fit of all variables gives:

```
fit <- lm(mpg ~ ., data = mtcars)
summary(fit)$coef
```

```
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 12.30337    18.71788  0.6573  0.51812
## cyl         -0.11144     1.04502 -0.1066  0.91609
## disp         0.01334     0.01786  0.7468  0.46349
## hp          -0.02148     0.02177 -0.9868  0.33496
## drat         0.78711     1.63537  0.4813  0.63528
## wt          -3.71530     1.89441 -1.9612  0.06325
## qsec         0.82104     0.73084  1.1234  0.27394
## vs           0.31776     2.10451  0.1510  0.88142
## amAutomatic  2.52023     2.05665  1.2254  0.23399
## gear         0.65541     1.49326  0.4389  0.66521
## carb        -0.19942     0.82875 -0.2406  0.81218
```

This can be refined to three variables which have the lowest correlation:

```
fit1 <- step(fit, direction="backward")
```

```
summary(fit1)$coef
```

```
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   9.618      6.9596   1.382 1.779e-01
## wt           -3.917      0.7112  -5.507 6.953e-06
## qsec          1.226      0.2887   4.247 2.162e-04
## amAutomatic   2.936      1.4109   2.081 4.672e-02
```

Showing that mpg decreases by 3.9 for each ton increase in weight, increases by 1.3 for each second of quarter mile time and increases between manual and automatic transmission.

A final plot of residuals vs. leverage appears to show no outliers in the data.

```
plot(fit1, which=5)
```

