MPG Per Transmission

EGB

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The following analysis looks into the affect of miles per gallon (MPG) based on type of transmission. We look at the **mtcars** dataset and compare the impact on MPG from a manual transmission versus an automatic one. By doing the analysis below, we find that on average a *MANUAL* transmission will give you a higher MPG rate.

Getting Data

```
library(datasets)
data("mtcars")
```

Exploratory Data Analysis

```
str(mtcars)
```

```
## 'data.frame':    32 obs. of  11 variables:
##  $ mpg : num  21 21 22.8 21.4 18.7 18.1 14.3 24.4 22.8 19.2 ...
##  $ cyl : num  6 6 4 6 8 6 8 4 4 6 ...
##  $ disp: num  160 160 108 258 360 ...
##  $ hp  : num  110 110 93 110 175 105 245 62 95 123 ...
##  $ drat: num  3.9 3.9 3.85 3.08 3.15 2.76 3.21 3.69 3.92 3.92 ...
##  $ wt  : num  2.62 2.88 2.32 3.21 3.44 ...
##  $ qsec: num  16.5 17 18.6 19.4 17 ...
##  $ vs  : num  0 0 1 1 0 1 0 1 1 1 ...
##  $ am  : num  1 1 1 0 0 0 0 0 0 0 ...
##  $ gear: num  4 4 4 3 3 3 3 4 4 4 ...
##  $ carb: num  4 4 1 1 2 1 4 2 2 4 ...
```

```
head(mtcars)
```

```
##                    mpg cyl disp  hp drat    wt  qsec vs am gear carb
## Mazda RX4         21.0   6  160 110 3.90 2.620 16.46  0  1    4    4
## Mazda RX4 Wag     21.0   6  160 110 3.90 2.875 17.02  0  1    4    4
## Datsun 710        22.8   4  108  93 3.85 2.320 18.61  1  1    4    1
## Hornet 4 Drive    21.4   6  258 110 3.08 3.215 19.44  1  0    3    1
## Hornet Sportabout 18.7   8  360 175 3.15 3.440 17.02  0  0    3    2
## Valiant           18.1   6  225 105 2.76 3.460 20.22  1  0    3    1
```

Standard Linear Model (LM)

```
CR <- lm(mpg ~ am, data = mtcars)
summary(CR)
```
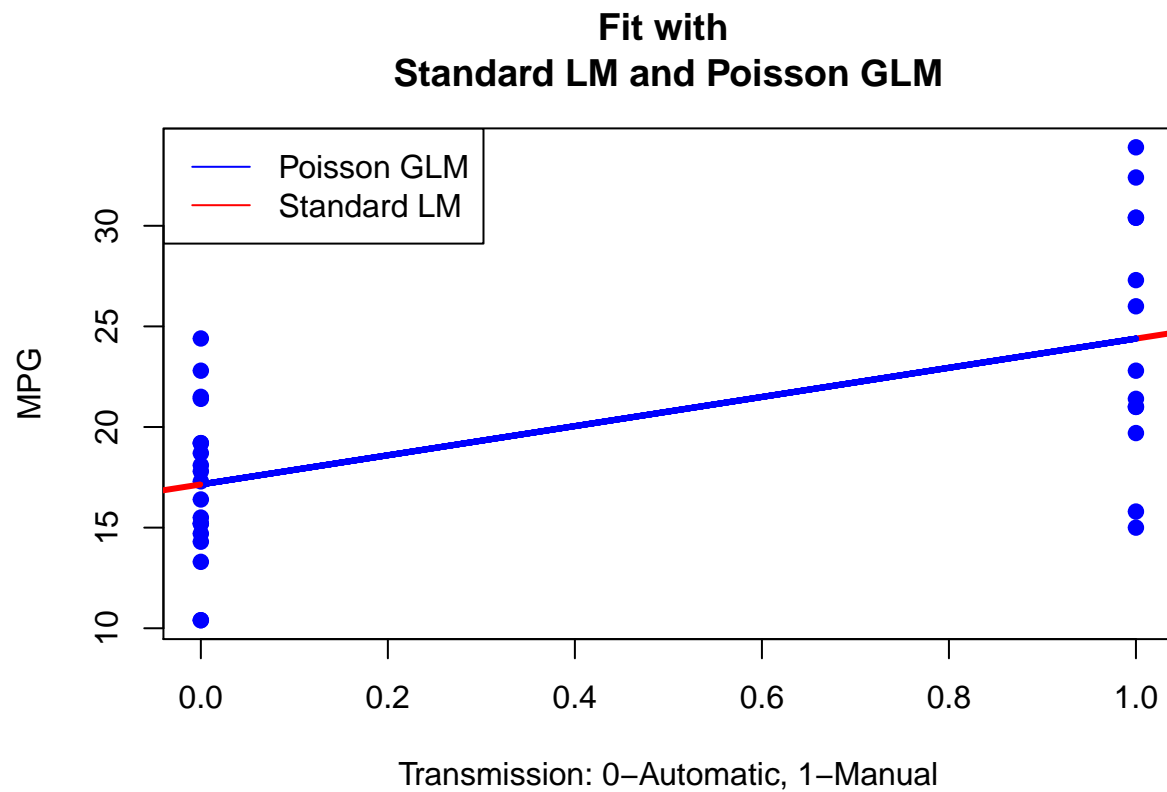
```
##
## Call:
## lm(formula = mpg ~ am, data = mtcars)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -9.3923 -3.0923 -0.2974  3.2439  9.5077
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   17.147      1.125  15.247 1.13e-15 ***
## am             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
```

We see that transmission is very significant in determining MPG. If you have an automatic transmission, your average MPG is 17.147 while a manual transmission your average is +7.245 more making it 24.392 MPG.

Fit with
Standard LM
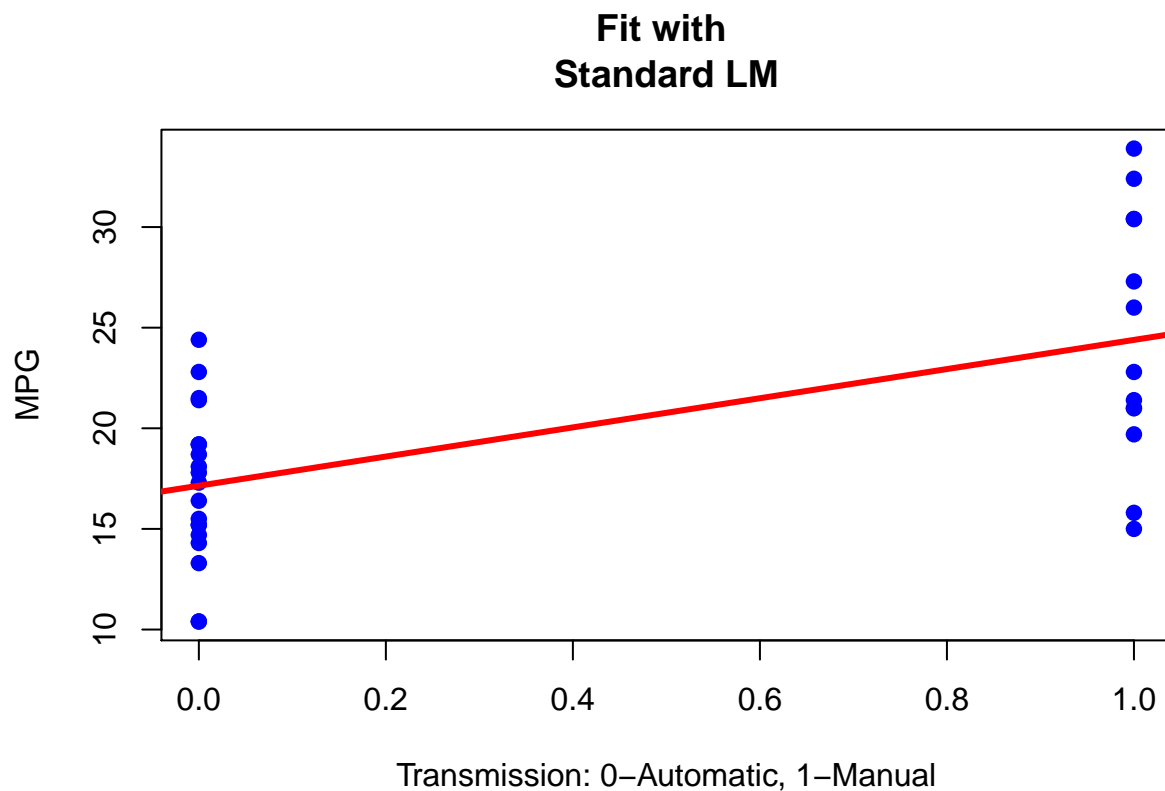
From the plot, we have further support that manual transmissions tend to have higher MPG's.

Poisson General Linear Model (GLM)

Fit with
Standard LM and Poisson GLM

(plot with legend: Poisson GLM (blue), Standard LM (red); x-axis "Transmission: 0–Automatic, 1–Manual"; y-axis "MPG")

Running a Poisson GLM did not result in a better fit. It is the same as with a standard linear model.

Residuals and Residual Plots

```
n <- length(mtcars$mpg)
e <- resid(CR)
yhat <- predict(CR)
max(abs(e -(mtcars$mpg - yhat)))
```
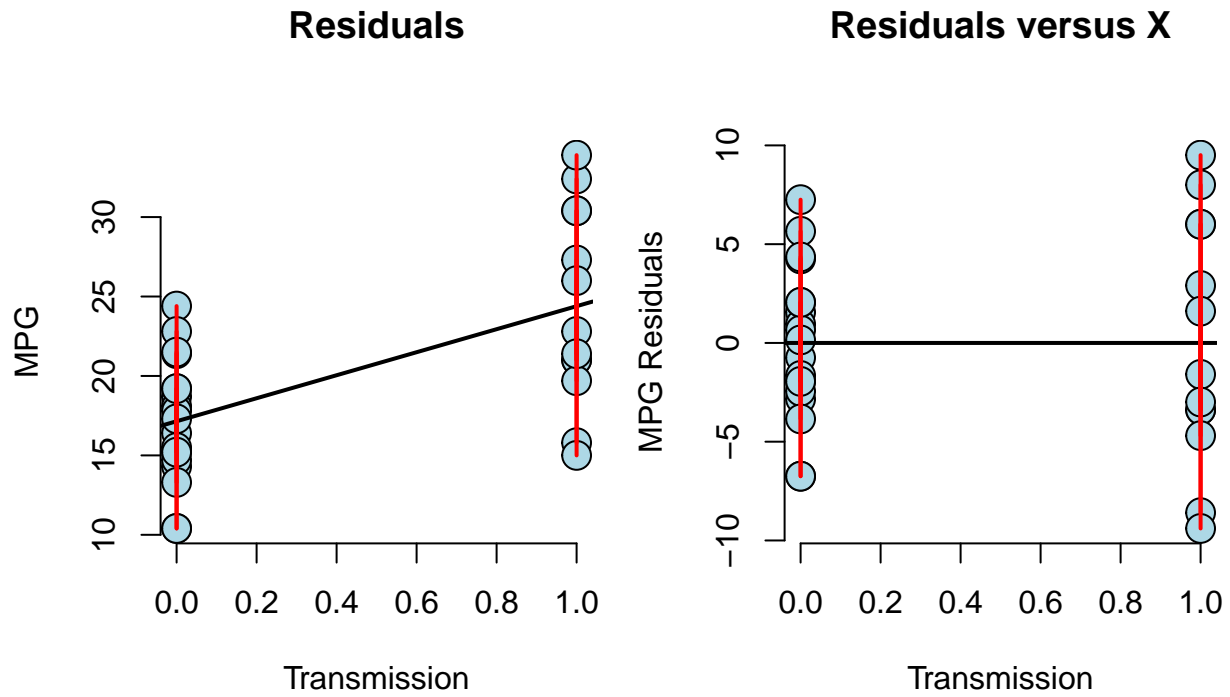
Residuals

```
## [1] 4.840572e-14
```

```
max(abs(e - (mtcars$mpg  - coef(CR)[1] - coef(CR)[2] * mtcars$am)))
```

```
## [1] 4.840572e-14
```

Residual Plots

Residual Plots1

Residuals

Residuals versus X

Confidence Intervals

```
confint(CR)
```

```
##                2.5 %    97.5 %
## (Intercept) 14.85062 19.44411
## am           3.64151 10.84837
```

```
confint(glm1)
```

```
## Waiting for profiling to be done...
```

```
##                2.5 %     97.5 %
## (Intercept) 2.7312549 2.9484974
## mtcars$am   0.1976786 0.5070595
```

From this, we see that although the fit may not show a difference, the confidence of the Poisson GLM is greater than the standard linear model.