

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)
```

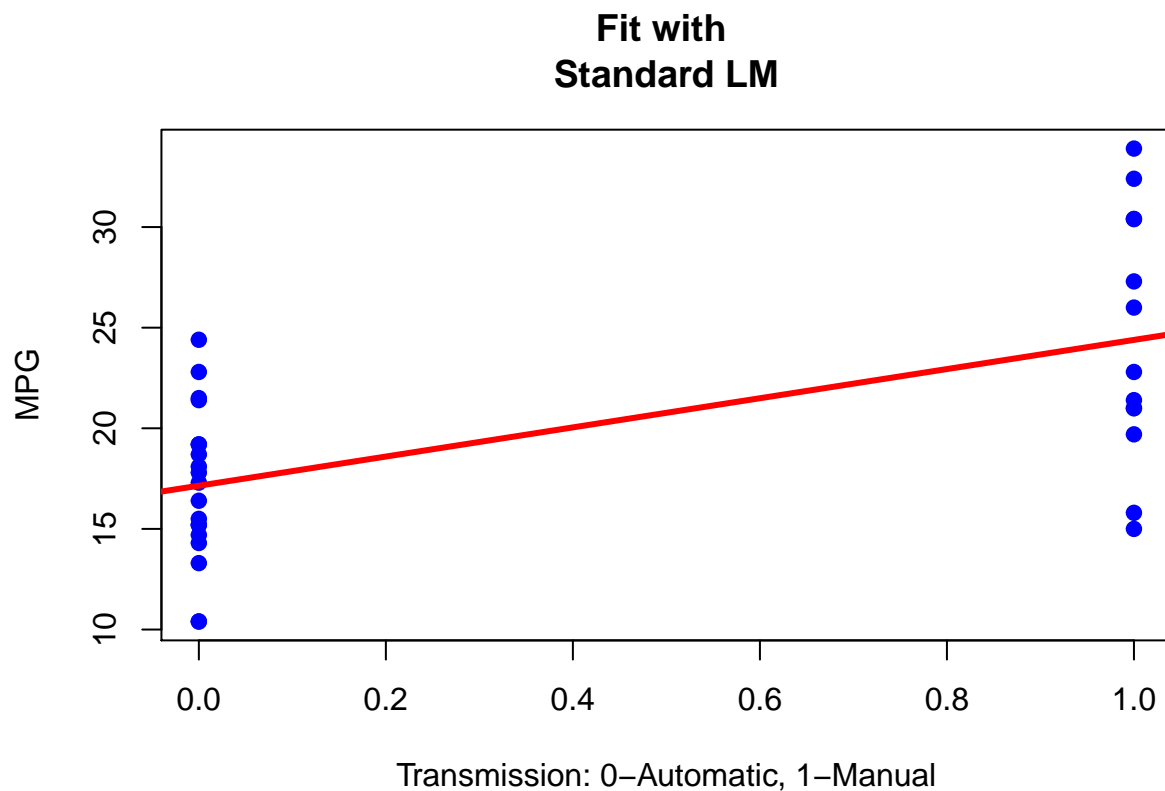
	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
## Mazda RX4	21.0	6	160	110	3.90	2.620	16.46	0	1	4	4
## Mazda RX4 Wag	21.0	6	160	110	3.90	2.875	17.02	0	1	4	4
## Datsun 710	22.8	4	108	93	3.85	2.320	18.61	1	1	4	1
## Hornet 4 Drive	21.4	6	258	110	3.08	3.215	19.44	1	0	3	1
## Hornet Sportabout	18.7	8	360	175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

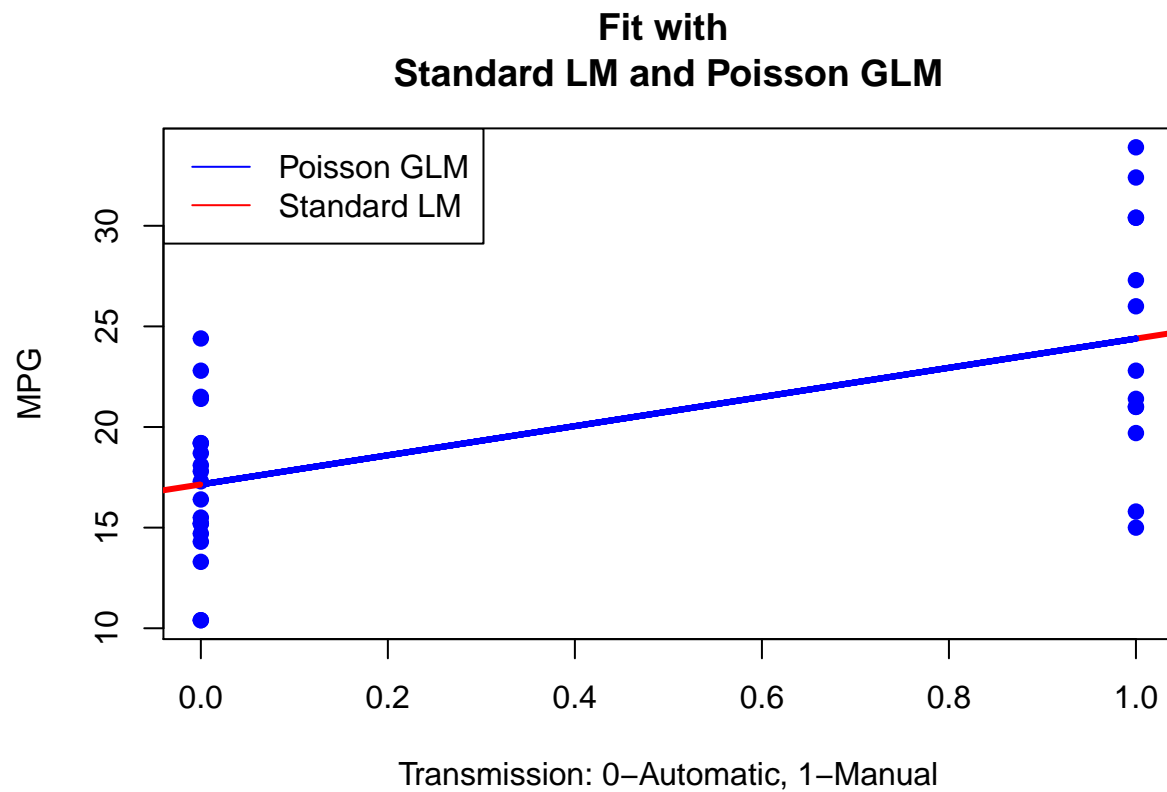
```
##
## Call:
## lm(formula = mpg ~ am, data = mtcars)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -9.3923 -3.0923 -0.2974  3.2439  9.5077
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   17.147      1.125   15.247 1.13e-15 ***
## am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



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

Poisson General Linear Model (GLM)



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

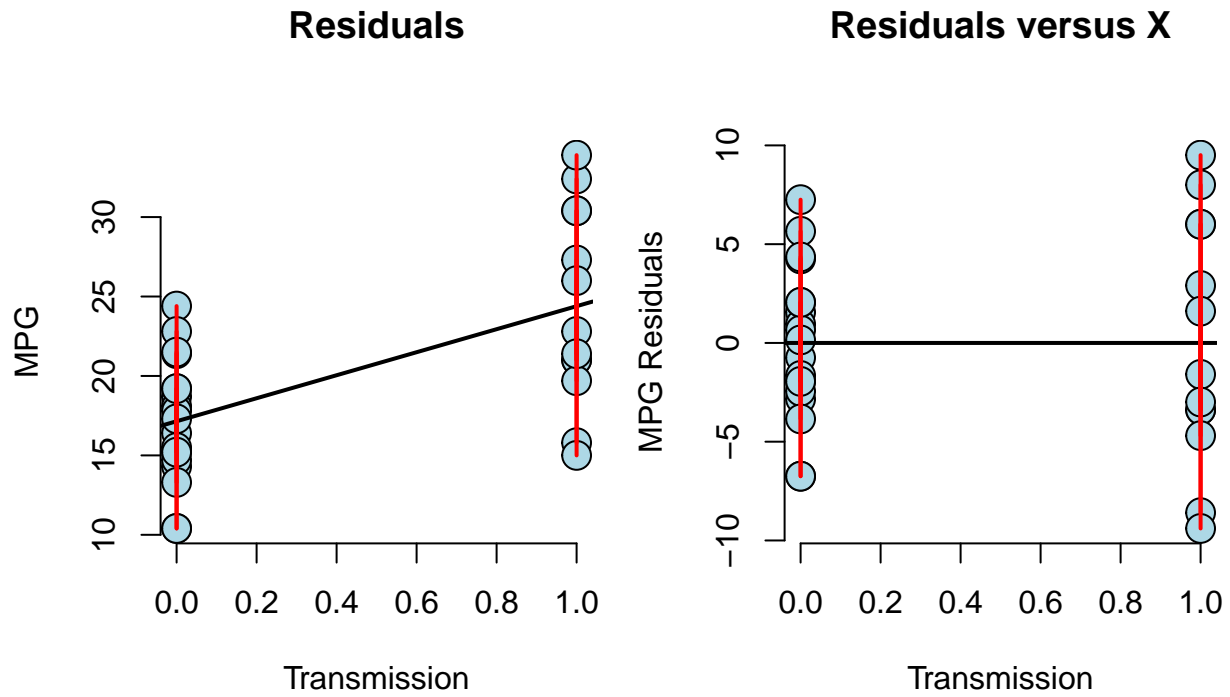
```
## [1] 4.840572e-14
```

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

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

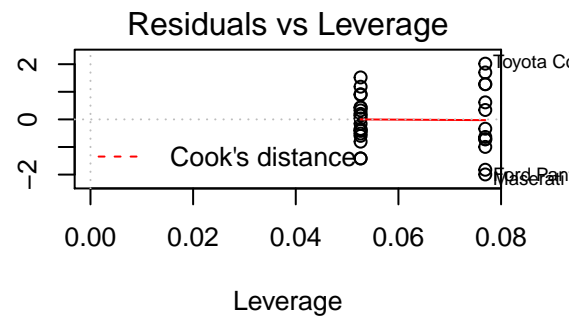
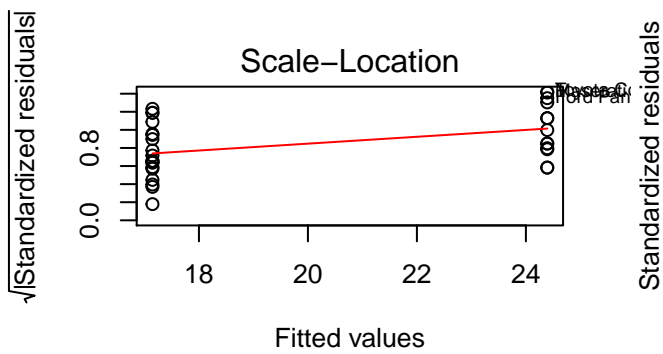
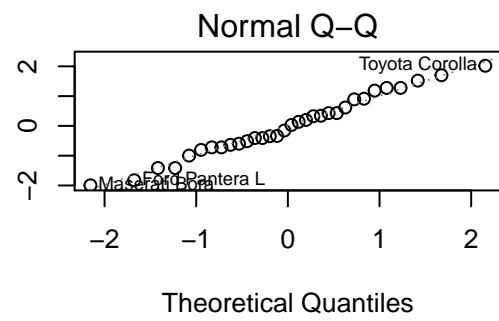
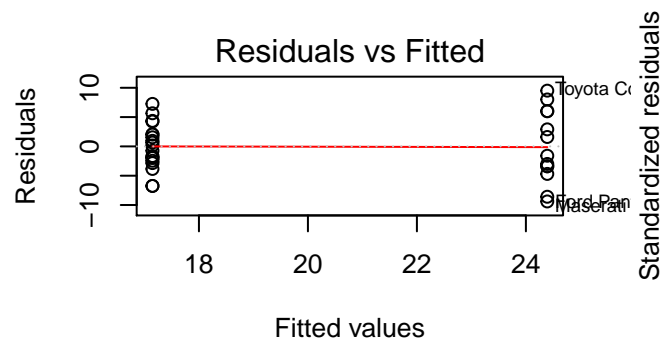
Residual Plots

Residual Plots1

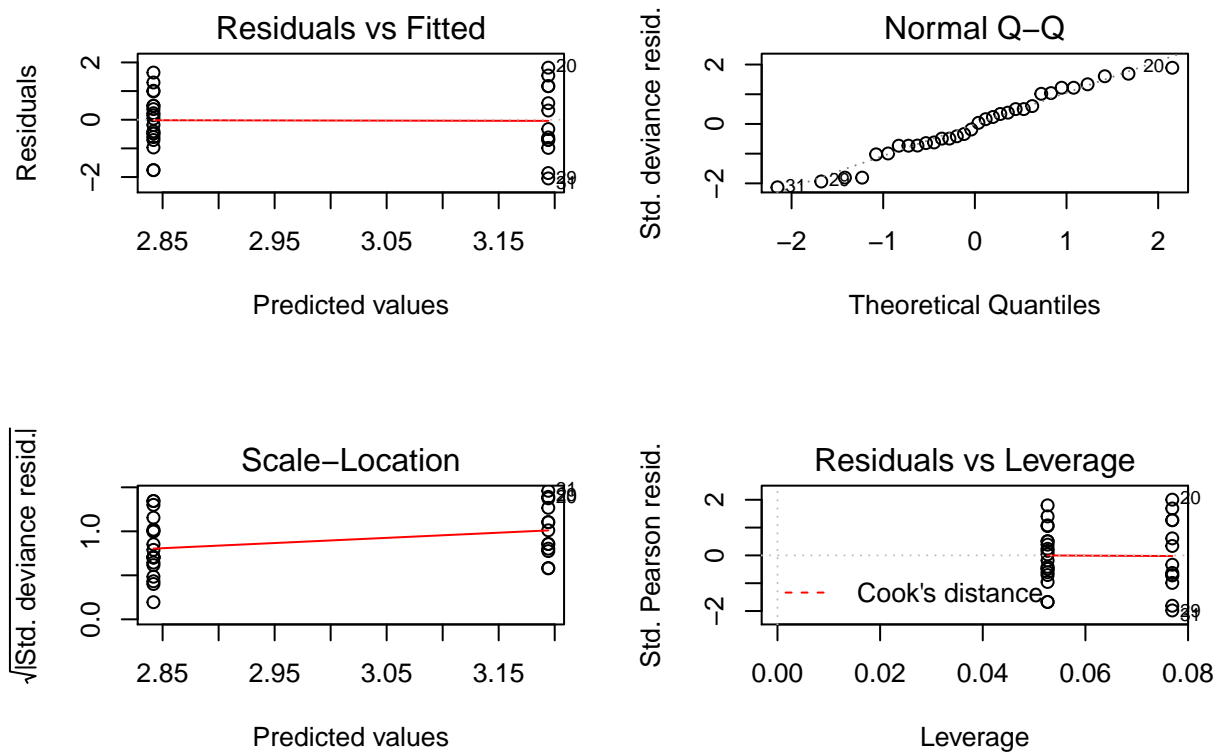


Better Residual Plots

Standard Linear Model



Poisson GLM



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.