Regression Analysis Final Project

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SUMMARY

The mtcars dataset originates from the 1974 Motor Trend US magazine, and it comprises fuel consumption (mpg, or miles per gallon) and 10 aspects of automobile design and performance for 32 automobiles (1973–74 models). The dataset includes a dozen categories of information and is often used in statistical analysis and machine learning to demonstrate data exploration, visualization, and regression techniques. It's popular for its simplicity yet effectiveness in teaching various concepts related to data science and statistics.

DATASET COMPONENTS:

- mpg: Miles/(US) gallon
- qsec: 1/4 mile time
- cyl: Number of cylinders
- vs: Engine (0 = V-shaped, 1 = straight)
- disp: Displacement (cu.in.)
- am: Transmission (0 = automatic, 1 = manual)
- hp: Gross horsepower
- gear: Number of forward gears
- drat: Rear axle ratio
- carb: Number of carburetors
- wt: Weight (1,000 lbs)

PROJECT GOAL:

- Determine if an automatic or manual transmission is better for MPG
- Quantify the MPG difference between automatic and manual transmissions

ANALYSIS:

- Determine if an automatic or manual transmission is better for MPG
- Quantify the MPG difference between automatic and manual transmissions

```
## Registered S3 method overwritten by 'GGally':
##   method from
##   +.gg   ggplot2
```

```
##
##
## The mtcars data set consists of the following variables and data types:
```

```
## mpg : Miles/(US) gallon - Data type: numeric
## cyl : Number of cylinders - Data type: numeric
## disp : Displacement (cu.in.) - Data type: numeric
## hp : Gross horsepower - Data type: numeric
## drat : Rear axle ratio - Data type: numeric
## wt : Weight (1000 lbs) - Data type: numeric
## qsec : 1/4 mile time - Data type: numeric
## vs : Engine shape (0 = V-shaped, 1 = straight) - Data type: numeric
## am : Transmission (0 = automatic, 1 = manual) - Data type: factor
## gear : Number of forward gears - Data type: numeric
## carb : Number of carburetors - Data type: numeric
```

```
##       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
##  Automatic:19   Min.   :3.000   Min.   :1.000
##  Manual   :13   1st Qu.:3.000   1st Qu.:2.000
##                 Median :4.000   Median :2.000
##                 Mean   :3.688   Mean   :2.812
##                 3rd Qu.:4.000   3rd Qu.:4.000
##                 Max.   :5.000   Max.   :8.000
```

```
##
## Summary Statistics for MPG by Transmission Type:
```

```
## $Automatic
##      mean        sd
## 17.147368  3.833966
##
## $Manual
##      mean        sd
## 24.392308  6.166504
```

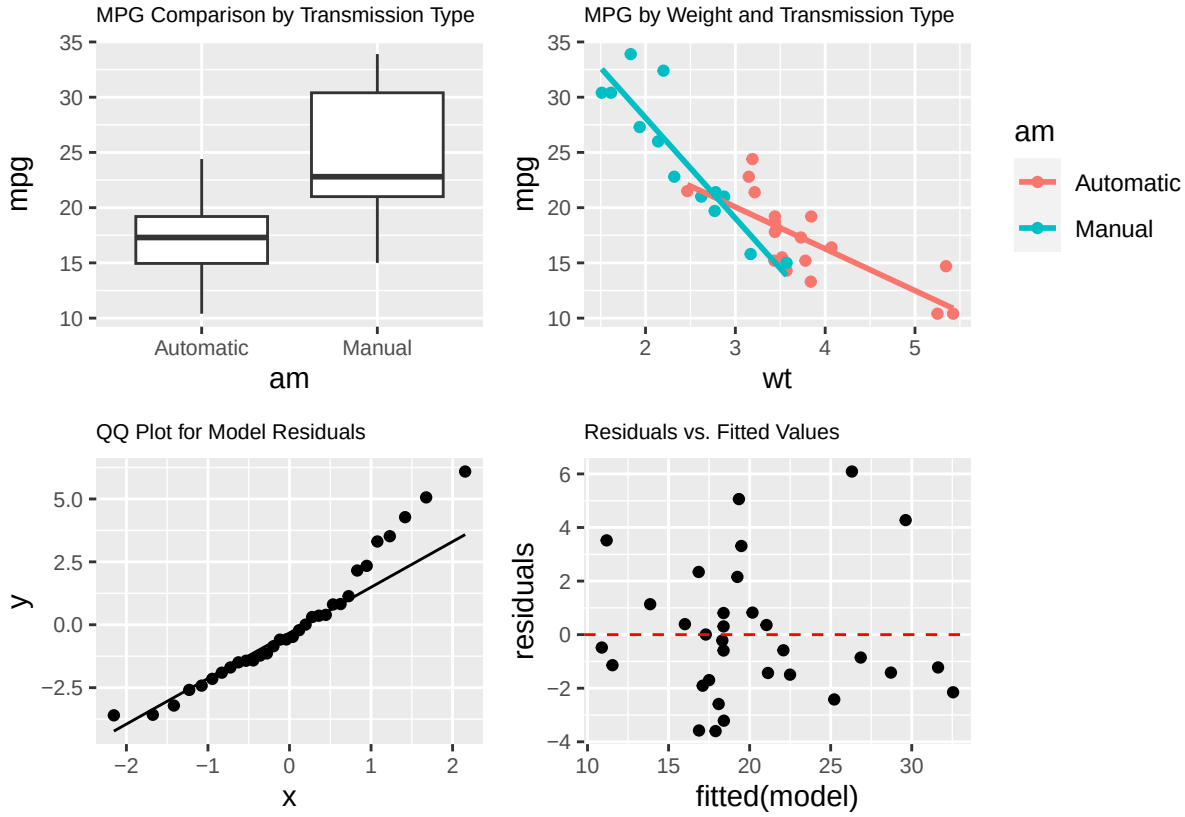
```
##
##  Welch Two Sample t-test
##
## data:  mpg by am
## t = -3.7671, df = 18.332, p-value = 0.001374
## alternative hypothesis: true difference in means between group Automatic and group Manual is not equa
## 95 percent confidence interval:
##  -11.280194  -3.209684
```

```
## sample estimates:
## mean in group Automatic    mean in group Manual
##                17.14737                24.39231

##
## The t-test results indicate if the difference in MPG between transmission types is statistically sig

## A p-value less than 0.05 suggests a significant difference.

##
## 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 ***
## 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 linear regression model quantifies the relationship between transmission type and MPG.

## The coefficient for 'amManual' represents the difference in MPG when switching from automatic to manu

##
## Call:
## lm(formula = mpg ~ am + wt + hp + cyl, 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 ***
## amManual     1.47805    1.44115   1.026   0.3142
## wt          -2.60648    0.91984  -2.834   0.0086 **
## hp          -0.02495    0.01365  -1.828   0.0786 .
## cyl         -0.74516    0.58279  -1.279   0.2119
## ---
## 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
```

```
##
## The comprehensive model considers additional variables, providing insight into their relationship wi
```

PLOTS:

```
## `geom_smooth()` using formula = 'y ~ x'
```




```
## `geom_smooth()` using formula = 'y ~ x'
```

CONCLUSION

The results of the analysis indicate that there is a statistically significant difference in fuel economy (MPG) between vehicles which have automatic and manual transmissions. Average MPG is noticeably higher for manual transmissions and the range of potential outcomes is also better with the bottom of the interquartile range for manual transmissions exceeding the top of the interquartile range for automatic transmissions. The average MPG for manual transmission vehicles is 24.4 MPG while the average MPG for automatic transmission vehicles was substantially lower at 17.1 MPG, leaving a gap of approximately 7.3 MPG between the two groups.