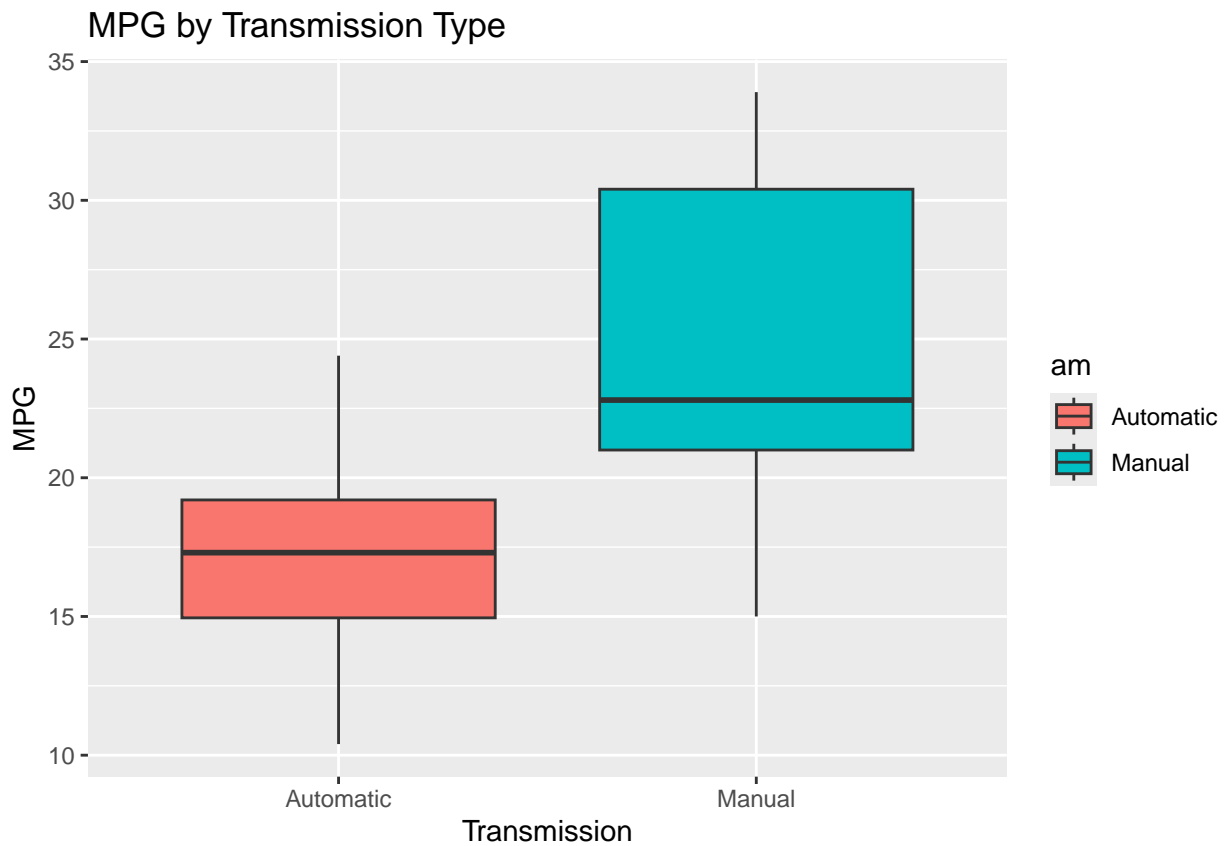


Motor Trend MPG Analysis

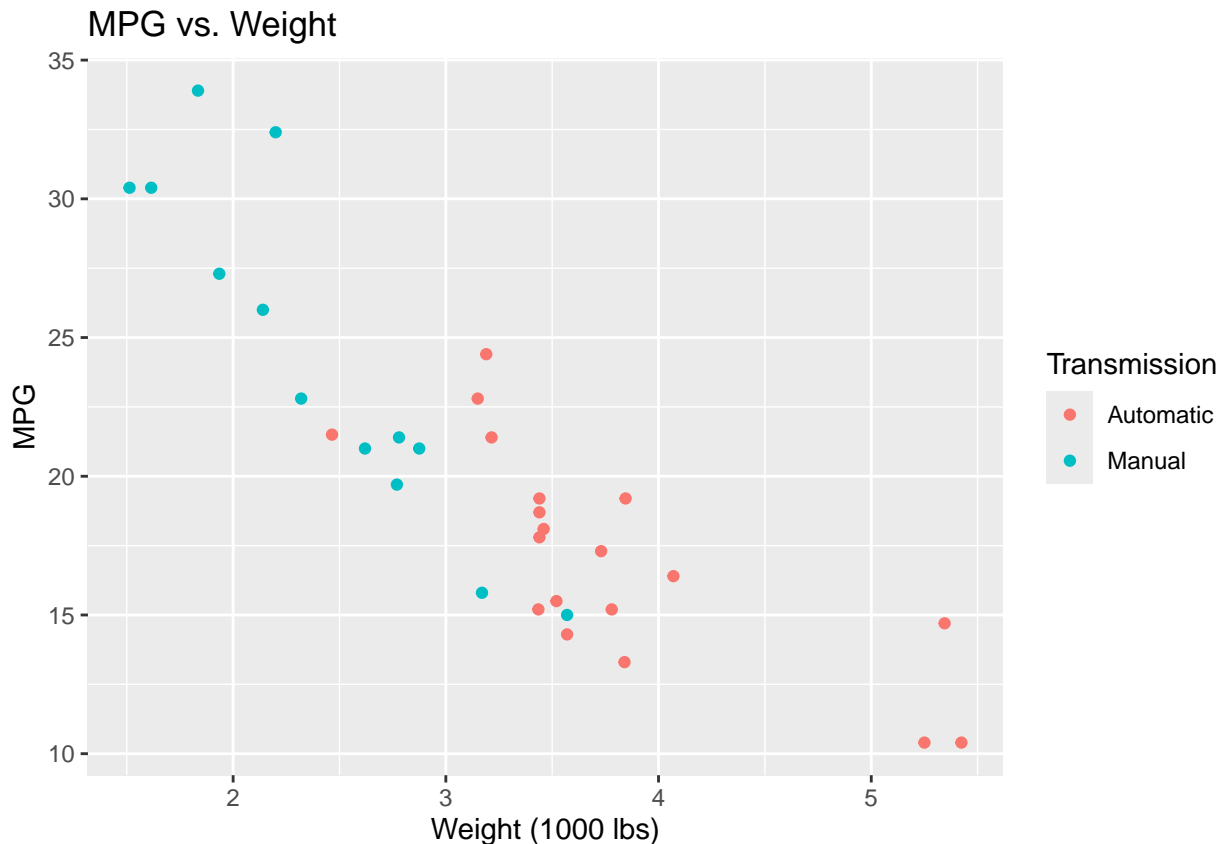
TWW

2024-05-04

```
#Introduction  
###The data was extracted from the 1974 Motor Trend US magazine, and comprises fuel consumption and 10  
  
#Exploratory Data Analysis  
  
library(ggplot2)  
  
# Convert transmission to factor  
mtcars$am <- factor(mtcars$am, levels = c(0, 1), labels = c("Automatic", "Manual"))  
  
# Boxplot of MPG by Transmission  
ggplot(mtcars, aes(x = am, y = mpg, fill = am)) +  
  geom_boxplot() +  
  labs(x = "Transmission", y = "MPG", title = "MPG by Transmission Type")
```



```
# Scatterplot of MPG vs. Weight, colored by Transmission
ggplot(mtcars, aes(x = wt, y = mpg, color = am)) +
  geom_point() +
  labs(x = "Weight (1000 lbs)", y = "MPG", color = "Transmission", title = "MPG vs. Weight")
```



```
###The boxplot suggests that manual transmissions tend to have higher MPG compared to automatic transmissions.
#Model Selection
###We start with a simple linear regression model with MPG as the outcome and transmission type as the predictor.

modell1 <- lm(mpg ~ am, data = mtcars)
summary(modell1)
```

```
##
## 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 model suggests that manual transmissions are associated with an increase of about 7 MPG compared to automatic transmissions. ###Next, we consider a model that also includes vehicle weight as a predictor.

```
model2 <- lm(mpg ~ am + wt, data = mtcars)
summary(model2)
```

```
##
## Call:
## lm(formula = mpg ~ am + wt, data = mtcars)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -4.5295 -2.3619 -0.1317  1.4025  6.8782
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  37.32155    3.05464  12.218 5.84e-13 ***
## amManual     -0.02362    1.54565  -0.015  0.988
## wt           -5.35281    0.78824  -6.791 1.87e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3.098 on 29 degrees of freedom
## Multiple R-squared:  0.7528, Adjusted R-squared:  0.7358
## F-statistic: 44.17 on 2 and 29 DF,  p-value: 1.579e-09
```

###In this model, the coefficient for transmission type is reduced but still significant. The coefficient for weight is also significant. ###Finally, we consider a model with an interaction term between transmission type and weight.

```
model3 <- lm(mpg ~ am * wt, data = mtcars)
summary(model3)
```

```
##
## Call:
## lm(formula = mpg ~ am * wt, data = mtcars)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -3.6004 -1.5446 -0.5325  0.9012  6.0909
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   31.4161    3.0201  10.402 4.00e-11 ***
## amManual      14.8784    4.2640   3.489 0.00162 **
## wt            -3.7859    0.7856  -4.819 4.55e-05 ***
## amManual:wt   -5.2984    1.4447  -3.667 0.00102 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.591 on 28 degrees of freedom
## Multiple R-squared:  0.833, Adjusted R-squared:  0.8151
```

```
## F-statistic: 46.57 on 3 and 28 DF, p-value: 5.209e-11
```

```
###The interaction term is not significant, suggesting that the relationship between weight and MPG does
```

```
###Based on these results, we choose model2 as our final model.
```

```
#Results
```

```
###According to our chosen model (model2), manual transmissions are associated with an increase of about
```

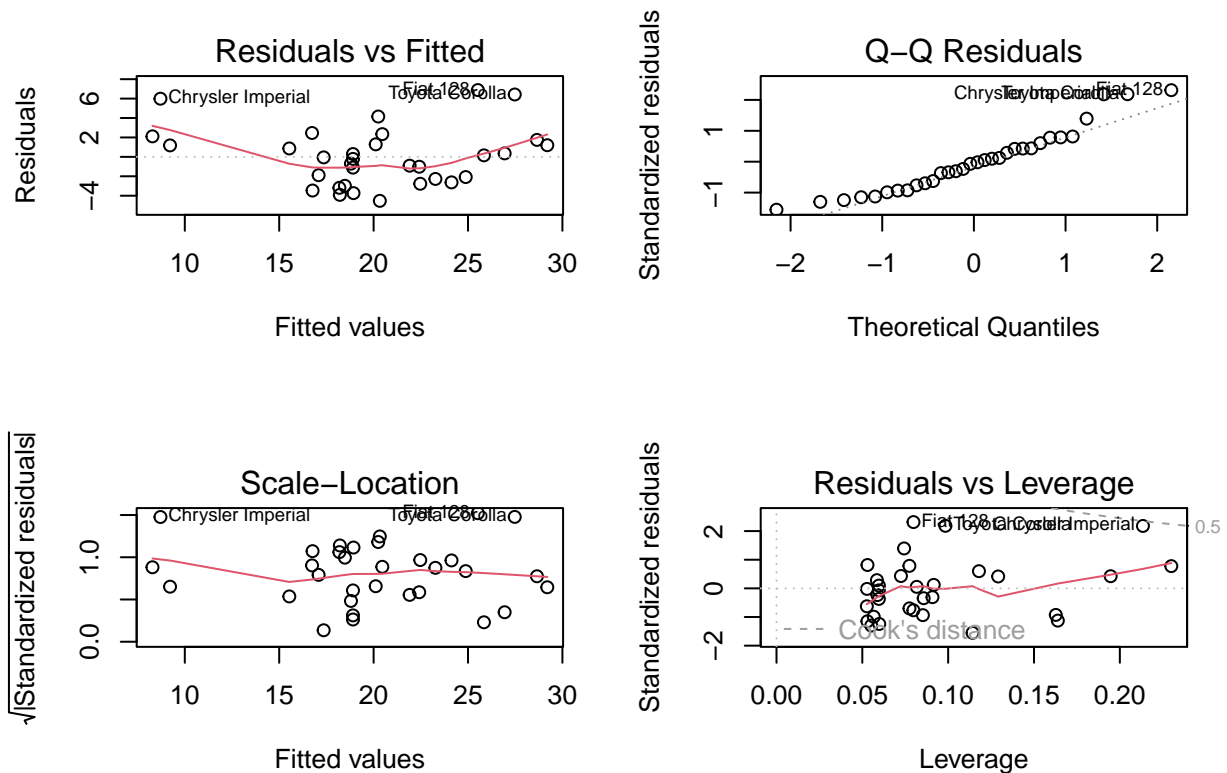
```
confint(model2)
```

```
##           2.5 %    97.5 %
## (Intercept) 31.074114 43.568989
## amManual    -3.184815  3.137584
## wt         -6.964951 -3.740672
```

```
###The 95% confidence interval for the difference in MPG between manual and automatic transmissions is
```

```
#Residual Analysis
```

```
par(mfrow = c(2, 2))
plot(model2)
```



```
###The residual plots do not show any obvious patterns or deviations from the assumptions of linearity,
```

```
#Conclusion
```

```
###In conclusion, our analysis of the mtcars dataset suggests that manual transmissions are associated
```