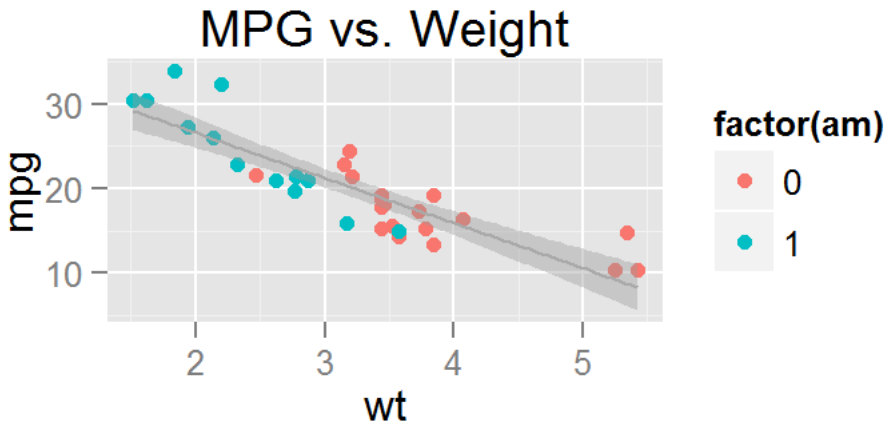
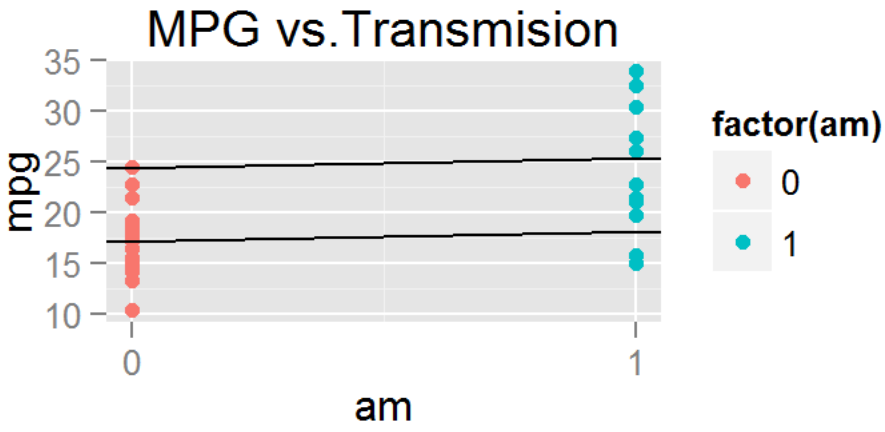
Executive Summary

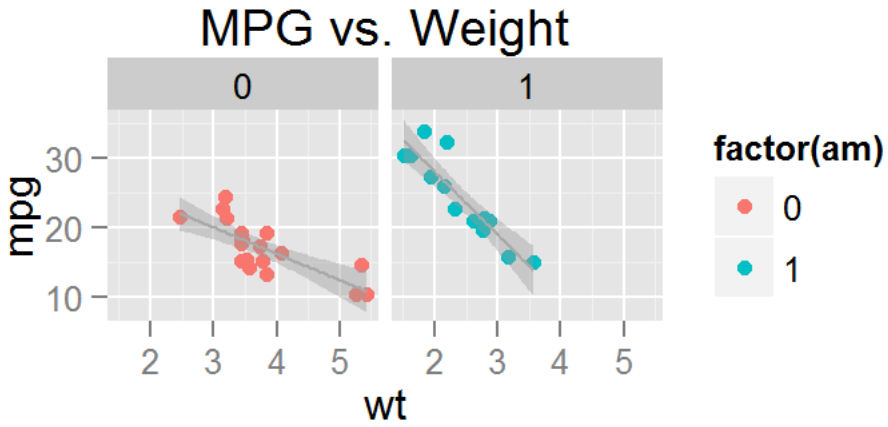
The objective of this report is to investigate and establish a relationship between Miles per Gallon (Mileage) of cars and their Transmission system - Manual and Automatic. We have to test the hypothesis whether the Miles per gallon are related to the Transmission type at all and by how much. Based on the analysis it was found that cars with Manual transmission tend to have greater MPG than those with AUtomatic transmission.

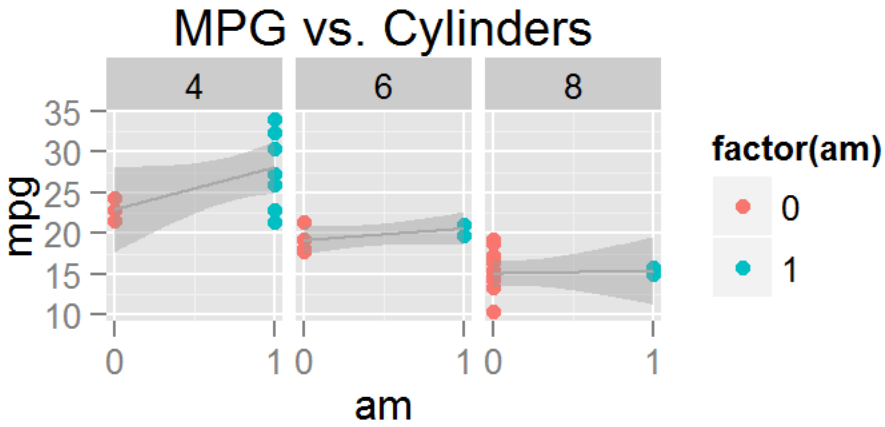
Exploratory Data Analysis

Let's first have a look at the MTCARS dataset that we are trying to investigate. We would like to explore the variation of MPG with respect to Weight, Number of Cylinders and Transmission (0=automatic, 1=manual).









Model Selection

From the graphs above it seems like MPG is co-related with Weight and Cylinders, as expected. However, Manual transmission tends to provide a greater MPG over Automatic transmission for a given number of Cylinders and Weight. Let's look at the effects of Transmission on MPG through the model below.

Now, Let's choose a model(1) where MPG is dependent on Weight, Cylinders and AM Yi = B0 + (B1i x Wt) + (B2i x Cyl) + (B3 x AM) + ei

```
fit <- lm(mpg ~ wt + factor(cyl) + factor(am) - 1, data=mtcars)
summary(fit)$coef
```

```
##                Estimate Std. Error    t value     Pr(>|t|)
## wt           -3.1495978  0.9080495 -3.4685309 1.770987e-03
## factor(cyl)4 33.7535920  2.8134831 11.9970836 2.495549e-12
## factor(cyl)6 29.4962735  3.3130170  8.9031458 1.614393e-09
## factor(cyl)8 27.6744731  3.7983025  7.2860109 7.755263e-08
## factor(am)1   0.1501031  1.3002231  0.1154441 9.089474e-01
```

All Co-efficients are significant except for Manual Transmission. However, to test wheteher or not Transmission poses any significant impact on MPG, we would have to evaluate our second model, as shown below.

Given the nature of Transmission, we would choose the Automatic Transmission type (AM=0) as the intercept and check how significant is the change in MPG when we shift from Automatic to manual transmission.

Now, Let's choose a model(2) where MPG is dependent on Transmission only Yi = B0 + (B1i x AM) + ei

```
fit2 <- lm(mpg ~ factor(am), data=mtcars)
summary(fit2)$coef
```

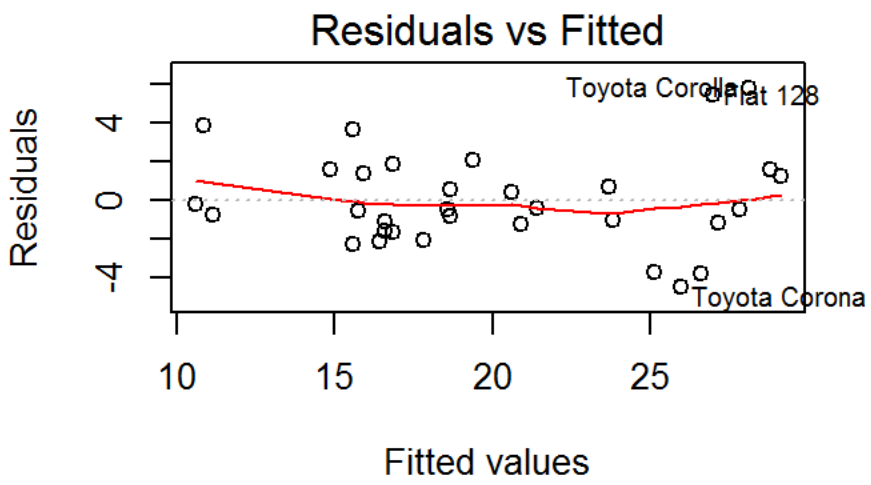
```
##              Estimate Std. Error   t value     Pr(>|t|)
## (Intercept) 17.147368   1.124603 15.247492 1.133983e-15
## factor(am)1  7.244939   1.764422  4.106127 2.850207e-04
```

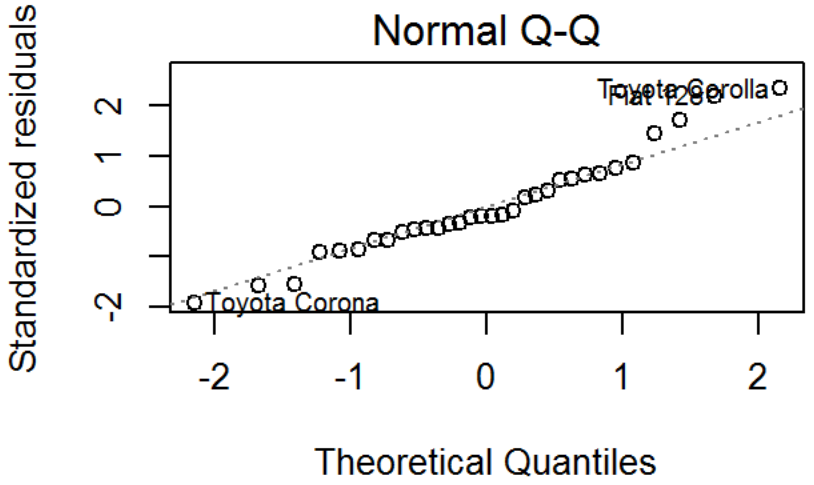
As suggested by the model fit, there is a significant difference between the Slopes (B1-B0) of Manual and Automatic Transmission. It can be seen that the mileage for cars increases by 7 Miles per gallon disregarding the weight and number of cylinders.

However, the change is reduced to 0.15 Miles per gallon at a specified Weight and Cylinder count.

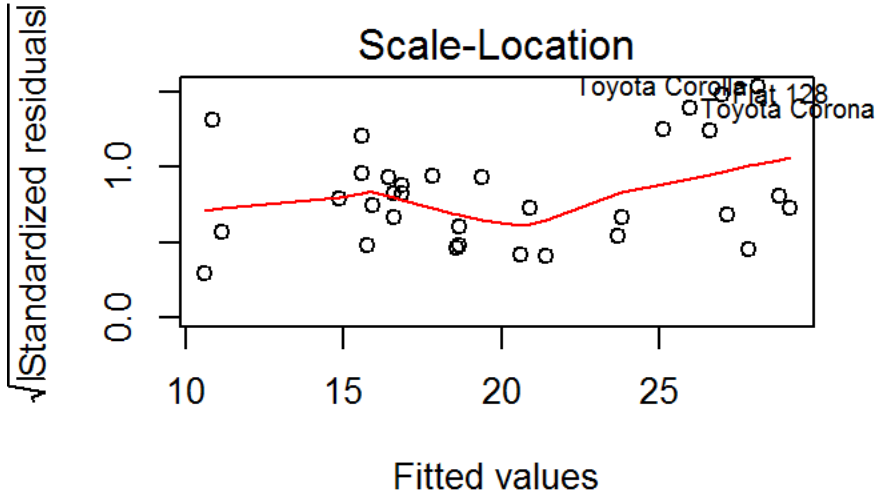
Appendix

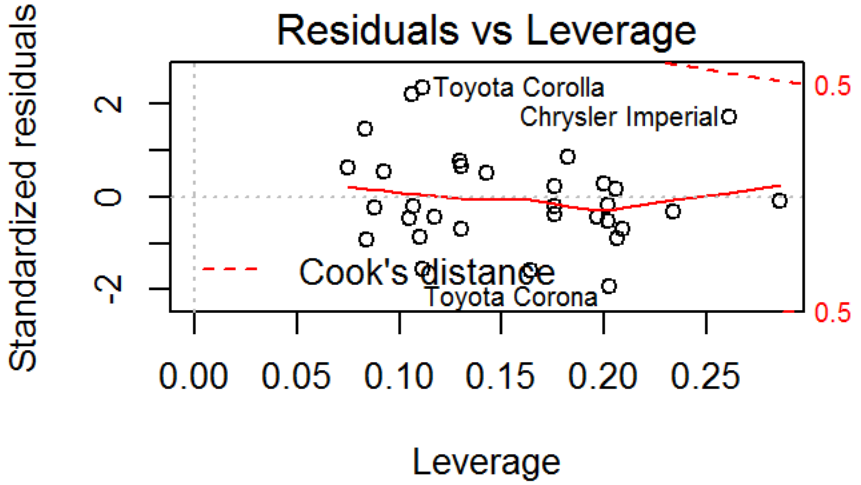
Residual and Leverage plots for Model 1





Model 1:





Residual and Leverage plots for Model 2: Model 1: