R Notebook

Executive Summary

This report summarizes the relationship between MPG and transmission types in the mtcars dataset. The result of the statistical analysis using linear regression models is that a switch from automatic to manual transmission should lead to an **increase in miles per gallon**.

Data: mtcars

Change format of variable 'am' to factor and review structure of 'mtcars'.

```
library(data.table)
library(tinytex)
# tinytex::install_tinytex()
attach(mtcars)
mtcars <- as.data.table(mtcars)
levels(mtcars$am)
```

```
## NULL
```

```
mtcars$am <- factor(mtcars$am, labels = c("auto", "man"))
str(mtcars)
```

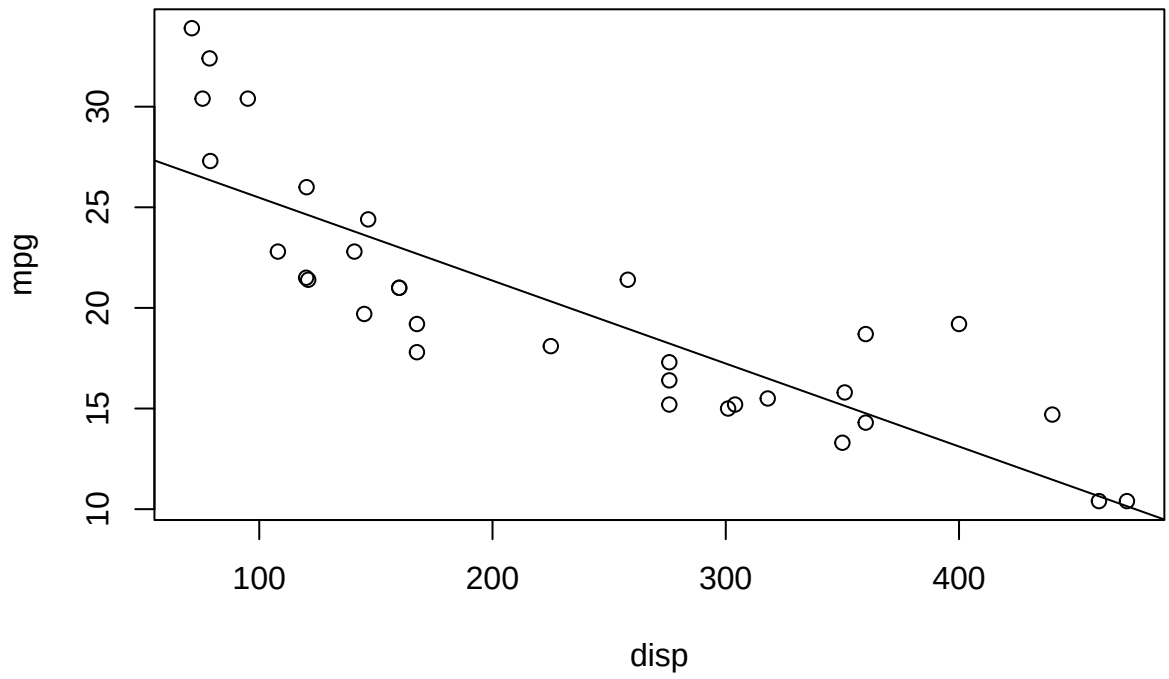
```
## Classes 'data.table' and 'data.frame':   32 obs. of  11 variables:
##  $ mpg : num  21 21 22.8 21.4 18.7 18.1 14.3 24.4 22.8 19.2 ...
##  $ cyl : num  6 6 4 6 8 6 8 4 4 6 ...
##  $ disp: num  160 160 108 258 360 ...
##  $ hp  : num  110 110 93 110 175 105 245 62 95 123 ...
##  $ drat: num  3.9 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  : Factor w/ 2 levels "auto","man": 2 2 2 1 1 1 1 1 1 1 ...
##  $ gear: num  4 4 4 3 3 3 3 4 4 4 ...
##  $ carb: num  4 4 1 1 2 1 4 2 2 4 ...
##  - attr(*, ".internal.selfref")=<externalptr>
```

Transmission is represented by a factor variable 'am' where 0 stands for automatic and 1 represents manual.

Scatterplots

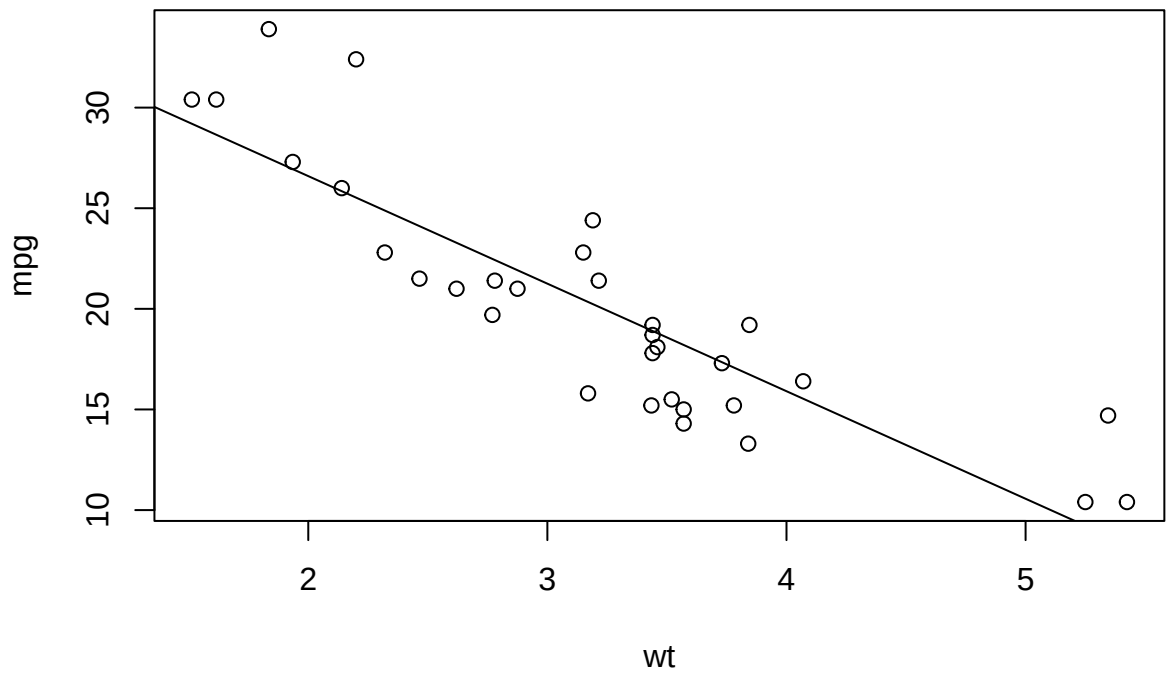
Scatterplot mpg ~ disp

```
plot(disp, mpg)
abline(lm(mpg ~ disp))
```



Scatterplot mpg ~ wt

```
plot(wt, mpg)
abline(lm(mpg ~ wt))
```



Fit linear model with reasonable regressors

Fit a model including all regressors that seem reasonable, i.e. are expected to have an effect on 'miles per gallon':

```
fit_reas <- lm(mpg ~ disp + wt + am - 1)
summary(fit_reas)
```

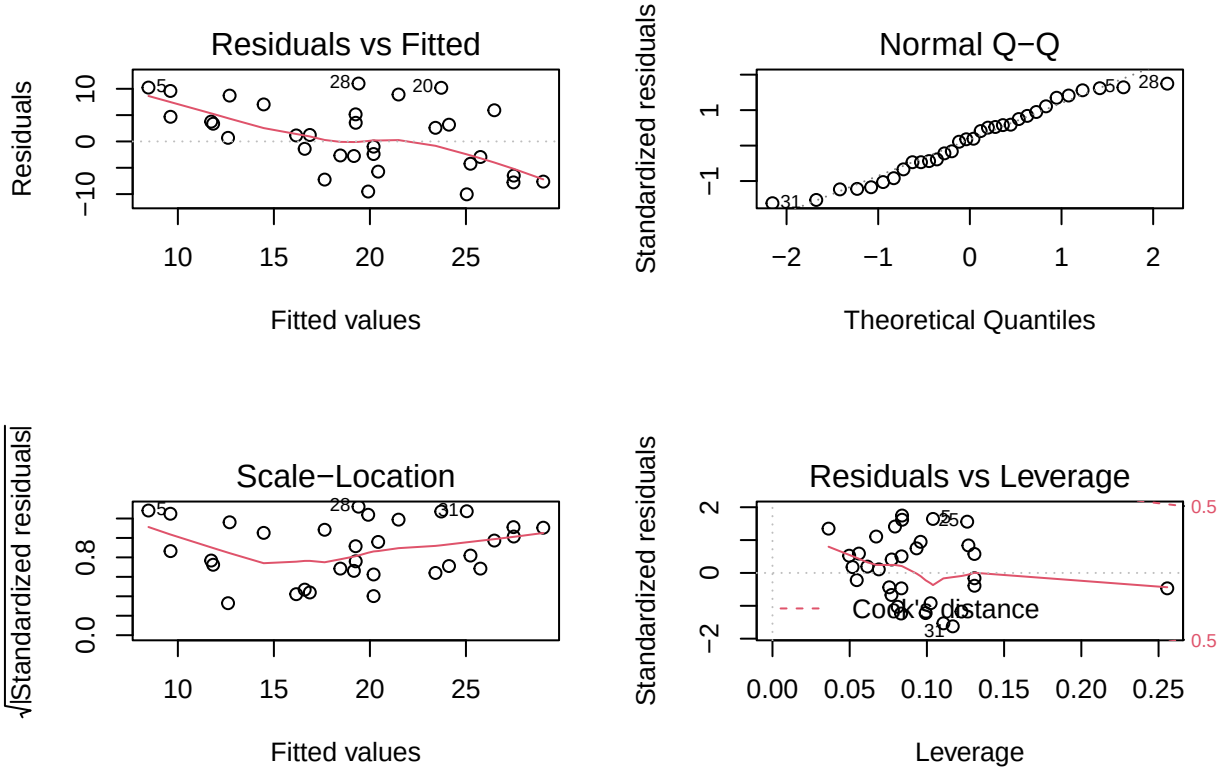
```
##
## Call:
## lm(formula = mpg ~ disp + wt + am - 1)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -10.041  -3.274   1.184   5.340  10.993
##
## Coefficients:
##      Estimate Std. Error t value Pr(>|t|)
## disp -0.06092    0.01876  -3.247  0.00294 **
## wt    8.83768    1.53585   5.754 3.13e-06 ***
## am   11.82922    2.23605   5.290 1.13e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 6.578 on 29 degrees of freedom
## Multiple R-squared:  0.9106, Adjusted R-squared:  0.9014
## F-statistic: 98.51 on 3 and 29 DF,  p-value: 2.61e-15
```

Switching from automatic to manual increases miles per gallons.

Extremely low **p-value** shows that result is **statistically significant**.

Check Residuals' Plot

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



Only 'am' as Regressor

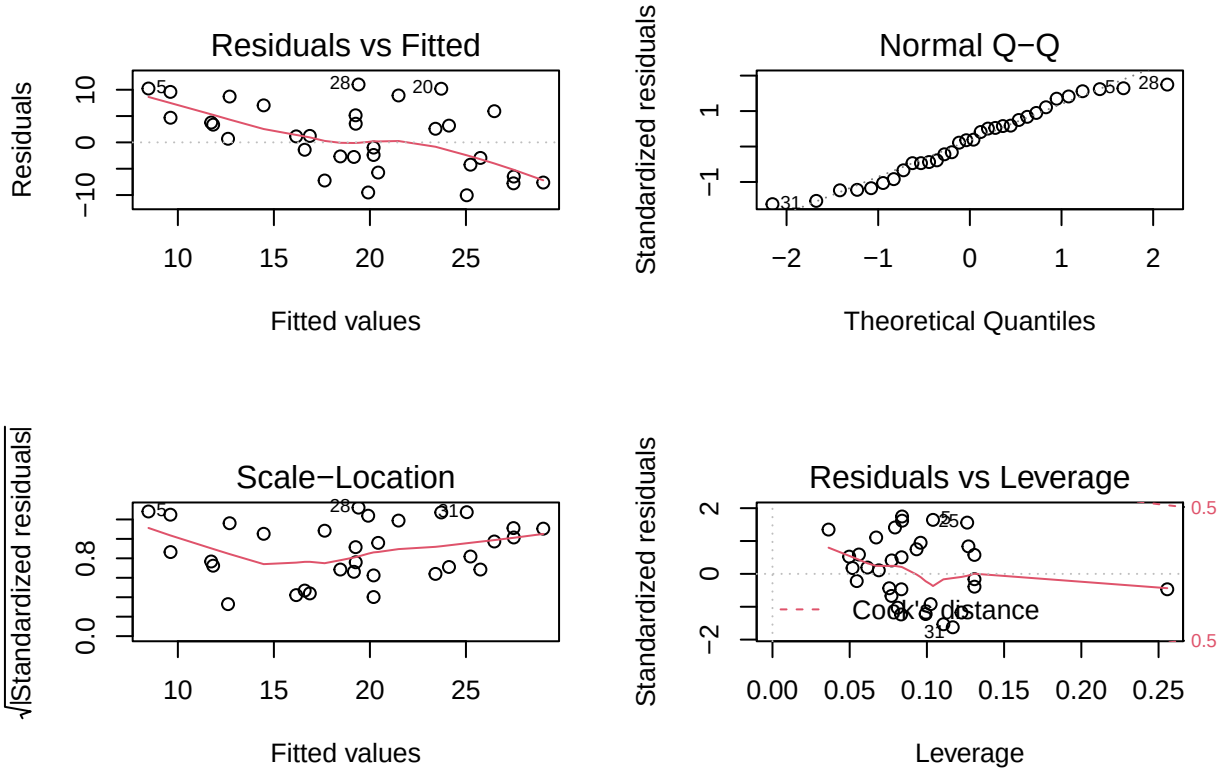
```
fit_am <- lm(mpg ~ am)
summary(fit_am)
```

```
##
## Call:
## lm(formula = mpg ~ am)
##
## 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
```

Result statistically significant as the p-value is far below 0.05.
Going from 'automatic' to 'manual' the **miles per gallons increases**.

Check Residuals' Plot

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



t-Test

```
t.test(mpg ~ am, mtcars)
```

```
##
##  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 auto and group man is not equal to 0
## 95 percent confidence interval:
##  -11.280194  -3.209684
## sample estimates:
## mean in group auto  mean in group man
##           17.14737           24.39231
```

The difference between the means is statistically significant considering the low p-value.