mtcars data exploring

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Summary

objective In this course I explore the relationship between a set of variables and miles per gallon (MPG)

Particularly I focus on the following two questions: 1. Is an automatic or manual transmission better for MPG? 2. Quantify the MPG difference between automatic and manual transmissions.

procedure Firstly exploratory analysis are conducted. As graphs showed, there ware some relationships between mpg and other variables. Then several fit models were compared in order to inspect whether these variables were properly included in the model. Outliers were checked by using Q-Q plot and removed.

conclusion From the analysis of variance, transmission, number of cylinders, Gross horsepower were included in the fitted model. Manual transmission is concluded to be better for mpg by 3.77 miles per gallon.

exploratory data analysis

processing data

```
## '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 ...
```

compare mpg vs other valuables (Graphs are shown in appendices) As the graph shows, transmission and other variables seem to affect on mileage.

model selection

I created several fitted model which contains variables of mpg datasets. Then I compared these fitted model by using analysis of variance (anova) to tell which variables are necessary to explain mileage change.

```
## Analysis of Variance Table
##
## Model  1: mpg ~ factor(am)
## Model  2: mpg ~ factor(am) + factor(cyl)
## Model  3: mpg ~ factor(am) + factor(cyl) + disp
## Model  4: mpg ~ factor(am) + factor(cyl) + disp + hp
## Model  5: mpg ~ factor(am) + factor(cyl) + disp + hp + drat
## Model  6: mpg ~ factor(am) + factor(cyl) + disp + hp + drat + wt
## Model  7: mpg ~ factor(am) + factor(cyl) + disp + hp + drat + wt + qsec
## Model  8: mpg ~ factor(am) + factor(cyl) + disp + hp + drat + wt + qsec +
##     factor(vs)
## Model  9: mpg ~ factor(am) + factor(cyl) + disp + hp + drat + wt + qsec +
##     factor(vs) + factor(gear)
## Model 10: mpg ~ factor(am) + factor(cyl) + disp + hp + drat + wt + qsec +
##     factor(vs) + factor(gear) + factor(carb)
##    Res.Df    RSS Df Sum of Sq       F   Pr(>F)
## 1      30 720.90
## 2      28 264.50  2    456.40 28.4297 7.89e-06 ***
## 3      27 230.46  1     34.04  4.2402  0.05728 .
## 4      26 183.04  1     47.42  5.9078  0.02809 *
## 5      25 182.38  1      0.66  0.0820  0.77855
## 6      24 150.10  1     32.28  4.0216  0.06331 .
## 7      23 141.21  1      8.89  1.1081  0.30916
## 8      22 139.02  1      2.18  0.2719  0.60964
## 9      20 134.00  2      5.02  0.3128  0.73606
## 10     15 120.40  5     13.60  0.3388  0.88144
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

As the analysis of variance shows, it can be said that number of cylinders(cyl) and Gross horsepower (hp) affect mpg.

From the Q-Q plot, there are several outliers ("Maserati Bora","Toyota Corolla","Volvo 142E")

These outliers are removed and fit is calculated again.

```
##  (Intercept)  factor(am)1 factor(cyl)6 factor(cyl)8           hp
##        27.52         3.77        -4.02        -3.93        -0.04
```

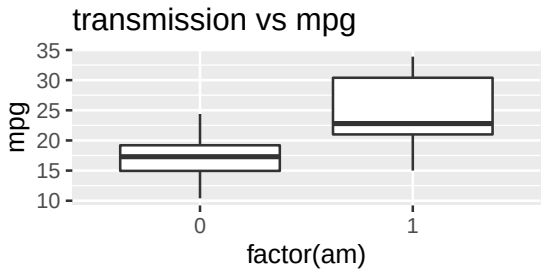
Coeffissient of transmanual was 3.77. It suggests that Manual transmission is better for MPG by 3.77 miles per gallon.

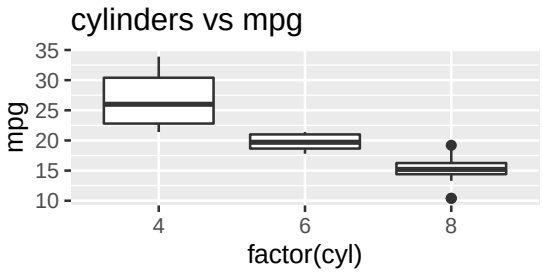
Conclusion

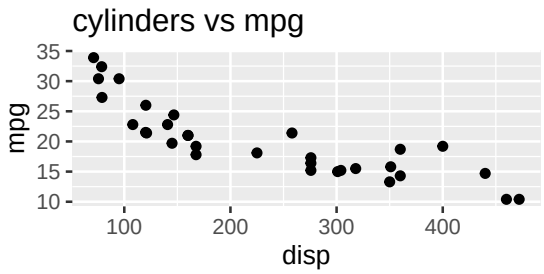
I conducted exploratory analysis and showed that manual transmission is better for mpg. Then I fitted the models to infer how much manual transmission is better than automatic transmission. As the model showed, manual transmission is better for mpg by 3.77 miles per gallon.

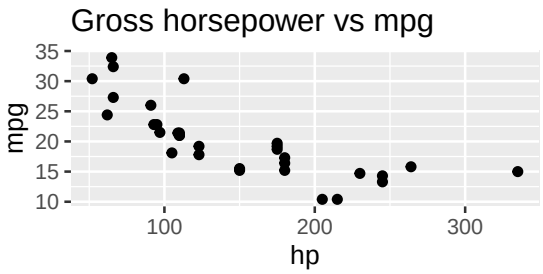
Appendices

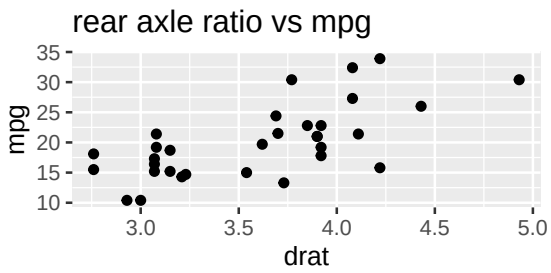
compare hwy,cty vs other valuables in graph

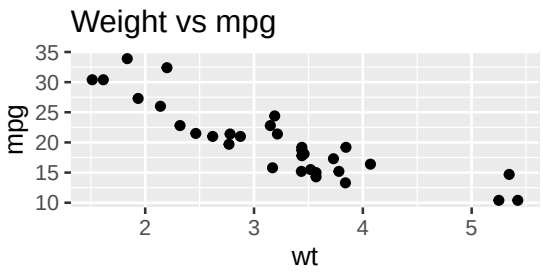

transmission vs mpg
mpg
35
30
25
20
15
10
0
1
factor(am)

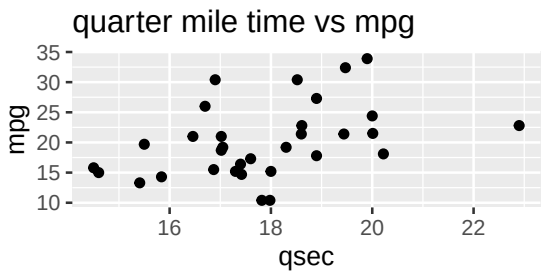

cylinders vs mpg
mpg
35
30
25
20
15
10
4
6
8
factor(cyl)

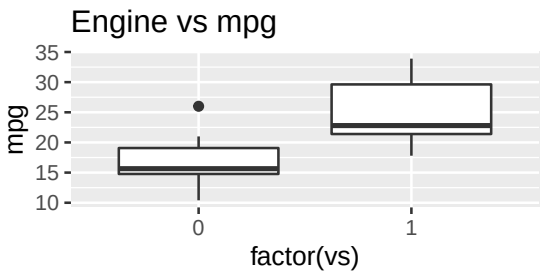

cylinders vs mpg
mpg
35
30
25
20
15
10
100
200
300
400
disp

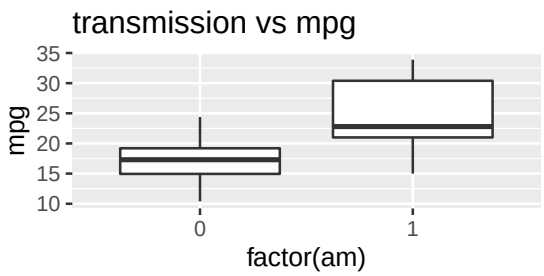

Gross horsepower vs mpg
mpg
35
30
25
20
15
10
100
200
300
hp

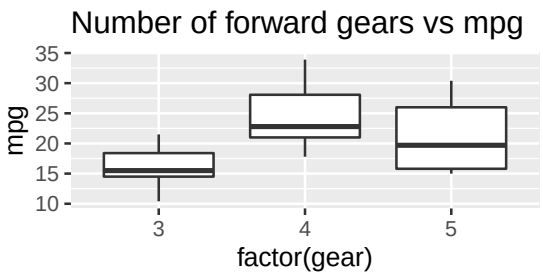

rear axle ratio vs mpg
mpg
35
30
25
20
15
10
3.0
3.5
4.0
4.5
5.0
drat

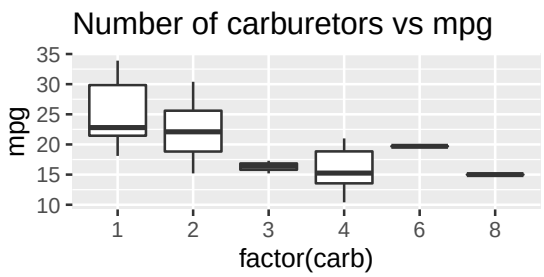

Weight vs mpg
mpg
35
30
25
20
15
10
2
3
4
5
wt


quarter mile time vs mpg
mpg
35
30
25
20
15
10
16
18
20
22
qsec


Engine vs mpg
mpg
35
30
25
20
15
10
0
1
factor(vs)


transmission vs mpg
mpg
35
30
25
20
15
10
0
1
factor(am)


Number of forward gears vs mpg
mpg
35
30
25
20
15
10
3
4
5
factor(gear)


Number of carburetors vs mpg
mpg
35
30
25
20
15
10
1
2
3
4
6
8
factor(carb)