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 calculating hatvalues and drawing 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 3.97 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) + wt
## Model  4: mpg ~ factor(am) + factor(cyl) + wt + hp
## Model  5: mpg ~ factor(am) + factor(cyl) + wt + hp + drat
## Model  6: mpg ~ factor(am) + factor(cyl) + wt + hp + drat + disp
## Model  7: mpg ~ factor(am) + factor(cyl) + wt + hp + drat + disp + qsec
## Model  8: mpg ~ factor(am) + factor(cyl) + wt + hp + drat + disp + qsec +
##     factor(vs)
## Model  9: mpg ~ factor(am) + factor(cyl) + wt + hp + drat + disp + qsec +
##     factor(vs) + factor(gear)
## Model 10: mpg ~ factor(am) + factor(cyl) + wt + hp + drat + disp + 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      27 182.97  1     81.53 10.1568 0.006125 **
## 4      26 151.03  1     31.94  3.9795 0.064556 .
## 5      25 150.81  1      0.22  0.0274 0.870669
## 6      24 150.10  1      0.70  0.0878 0.771032
## 7      23 141.21  1      8.89  1.1081 0.309157
## 8      22 139.02  1      2.18  0.2719 0.609644
## 9      20 134.00  2      5.02  0.3128 0.736057
## 10     15 120.40  5     13.60  0.3388 0.881444
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


## Maserati Bora Toyota Corona    Mazda RX4 Mazda RX4 Wag  Ferrari Dino
##     0.4639579     0.2332027    0.2325879     0.2325879     0.2309873
```

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

From the hatvalues and Q-Q plot (see Appendices), one outlier("Maserati Bora") is removed from fitted model.

```
##  (Intercept)  factor(am)1 factor(cyl)6 factor(cyl)8          hp
##        28.24         3.97        -3.59        -2.66       -0.05
```
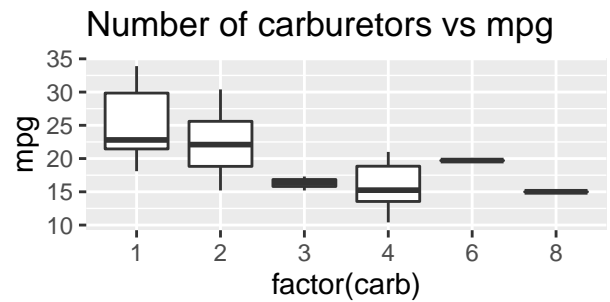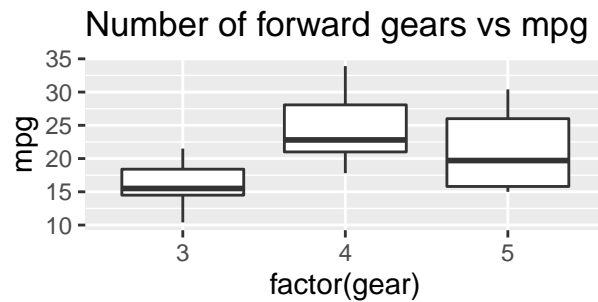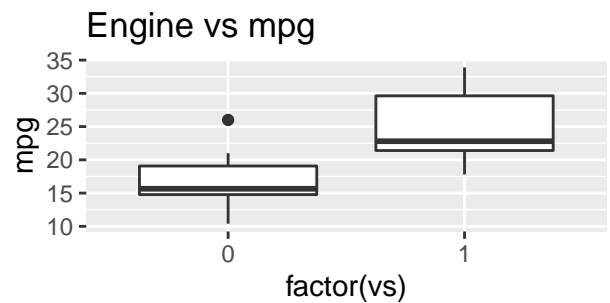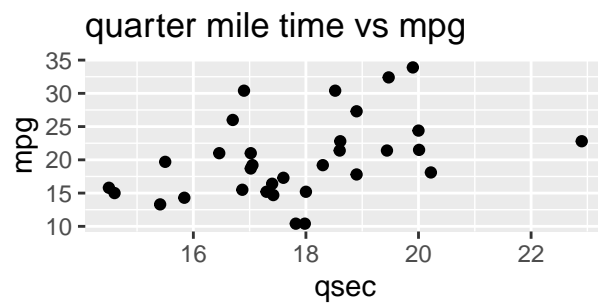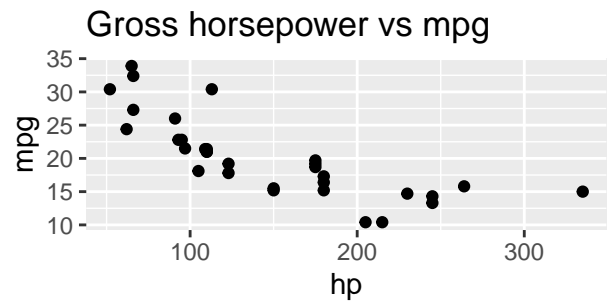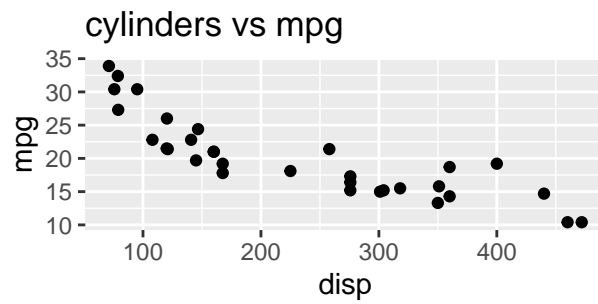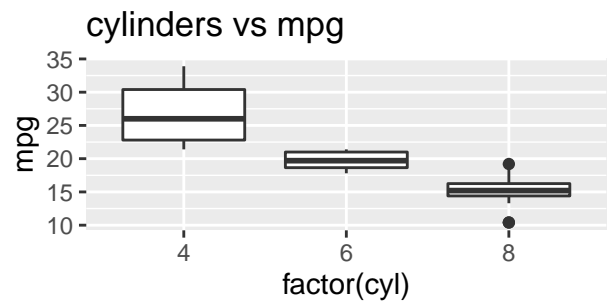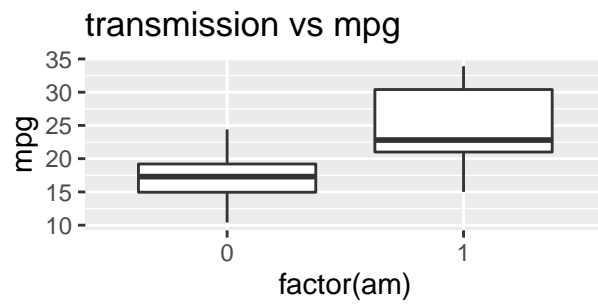
Coeffissient of transmanual was 3.97. It suggests that Manual transmission is better for MPG by 3.97 miles per gallon.

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 3.97 miles per gallon.

Appendices

compare mpg vs other valuables in graph

Normal Q–Q

Toyota Corolla○
Pontiac Firebird○

○Volvo 142E

Standardized residuals

Theoretical Quantiles
lm(mpg ~ factor(am) + factor(cyl) + disp)