ProjectRegressionModels

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Peer-graded Assignment: Regression Models Course Project

Executivy summary

The main objective of this projet is to apply the regressions model to answer the following questions :

1. "Is an automatic or manual transmission better for MPG"?
2. "Quantify the MPG difference between automatic and manual transmissions" ?

Using exploratory data anlysis the difference between automatic and manual transmission cars was evident. Furthermore a t test was perfomed for the two groups showing a significant difference between the groups, showing the automatic cats achived less MPG than manual cars.

For quantifiy the difference a linear regrtession model was used. Thre models were tested with differente explanatory variables. With the best model it was determined that to have a manual transmission increase 1.63 MPG when all the other variable are held constant.

Exploratory Data Analysis

The dataset is preload in Rstudio. The columns with categorical value were changd to factor using the mutate function.

```
library(dplyr)
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(ggplot2)
library(GGally)
```

```
##
## Attaching package: 'GGally'
```

```
## The following object is masked from 'package:dplyr':
##
##     nasa
```

```
data <- mtcars %>%
  mutate_at(c("cyl","gear","carb","am","vs"), as.factor)
levels(data$am) <- list(automatic="0", manual="1")
```

A serie of plots using ggpairs and gplot were done to see the relationship between MPG and the varaible (see APEENDIX)

The first exploration indicates that manual cars yield higher MPG.

T-Test

In order to perform a t-test the data was divided depending on the type of transmission. Then the t.test function was performed:

```
t.test(automatic$mpg,manual$mpg,paired = FALSE)
```

```
##
##  Welch Two Sample t-test
##
## data:  automatic$mpg and manual$mpg
## t = -3.7671, df = 18.332, p-value = 0.001374
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -11.280194  -3.209684
## sample estimates:
## mean of x mean of y
##  17.14737  24.39231
```

As can be seen there is a significant diffrente with a lower mean for automatic cars. The interval confidence does not contain 0 and p value is lowwer than 0.05

Regression models

In order to quantify the difference between automatic and manual transmissions three linear models were used.

Model 1

Model 1 just consider the type of tranmission (am) as explanatory varaible

The coefficient of the am variable indicates that the use of manual transmission increase 7.245 MPG, However, the R-squared is low indicating the change in transmission can just explain 35.9% the variation of the MPG.

Model2

The model 2 take in consideration the variable that seem to have influence according to the pair plot from the EDA:

The R-square for this model is 0.8428 with Adjusted R-squared : 0.8196. This indicates a better model. The residual plot are distributed around 0 which indicates a good fitting model.

Model3

Finlaly model 3 take in considreation all the variables

```
model3 <- lm(mpg ~., data= data)
```

The R-square for this model is 0.8931, but an Adjusted R-squared : 0.779. This is an indication of overfitting of the model. Finally we can compare between the models using the anova anlysis:

```
anova(model1,model2,model3)
```

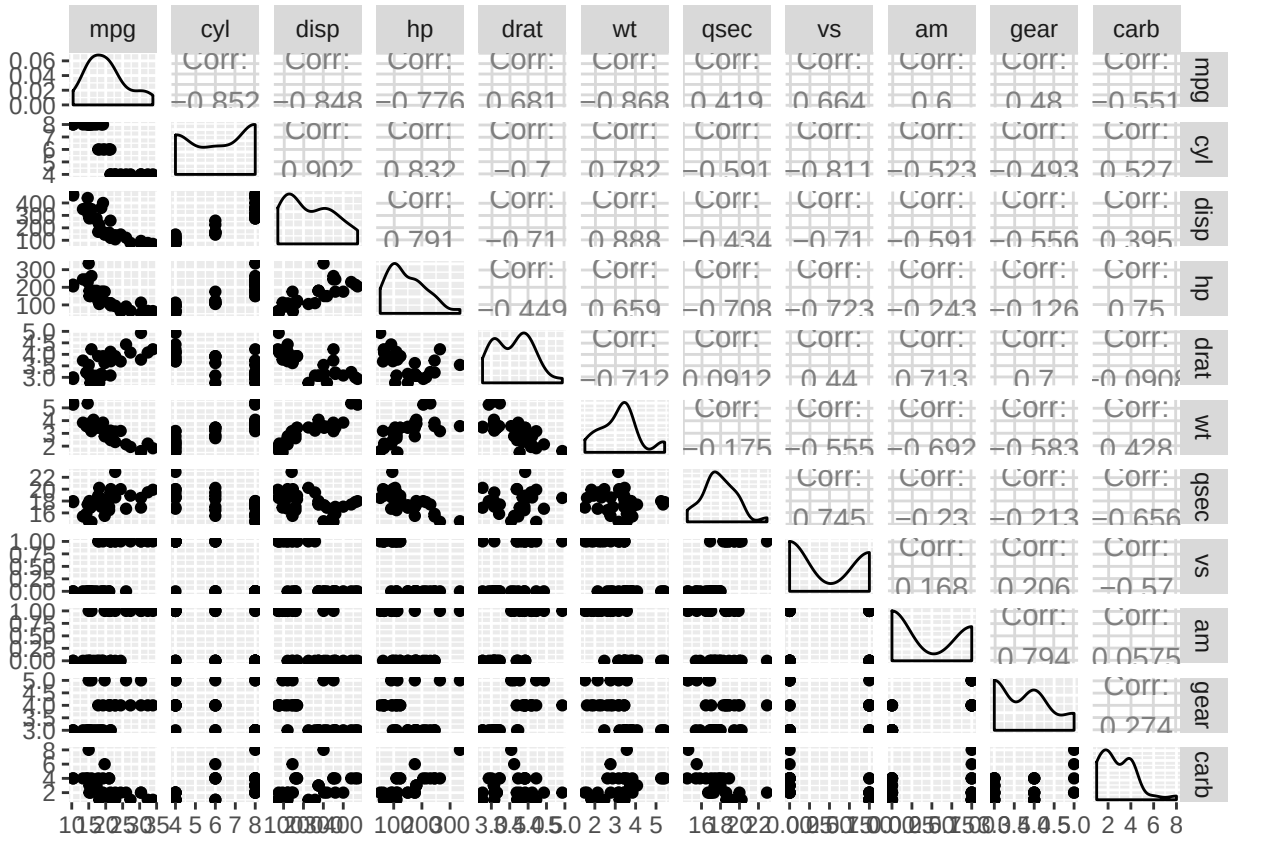
```
## Analysis of Variance Table
##
## Model 1: mpg ~ am
## Model 2: mpg ~ hp + drat + am + wt
## Model 3: mpg ~ cyl + disp + hp + drat + wt + qsec + vs + am + gear + carb
##   Res.Df    RSS Df Sum of Sq       F    Pr(>F)
## 1     30 720.90
## 2     27 176.96  3    543.93 22.5880 8.124e-06 ***
## 3     15 120.40 12     56.56  0.5872     0.821
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

From this results we can conclude there is not need to add all the variables in model 3 since there is not significant difference in the predections. However in comparison with model 1, model 2 does a significant better job (p-value lower than 0.05).

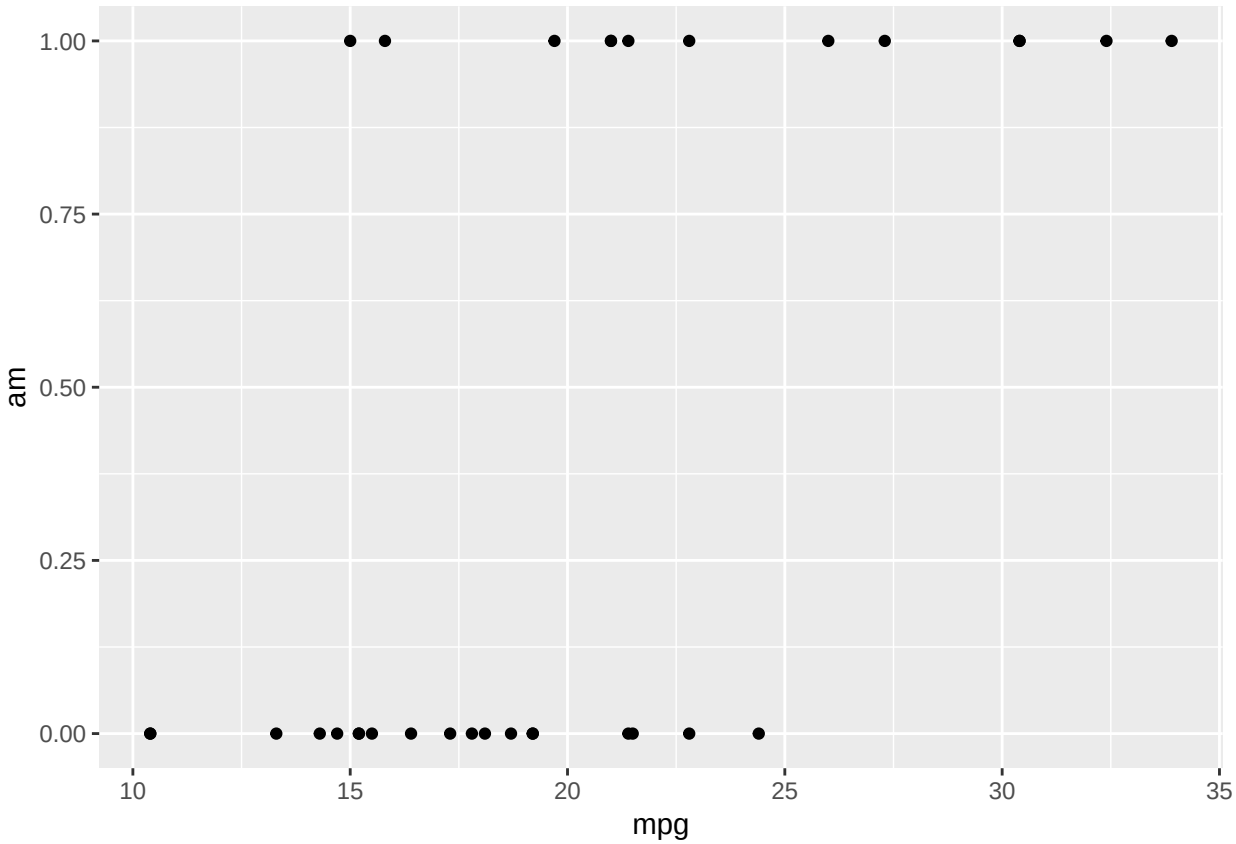
APPENDIX

GRID PLOTS

```
ggpairs(mtcars)
```

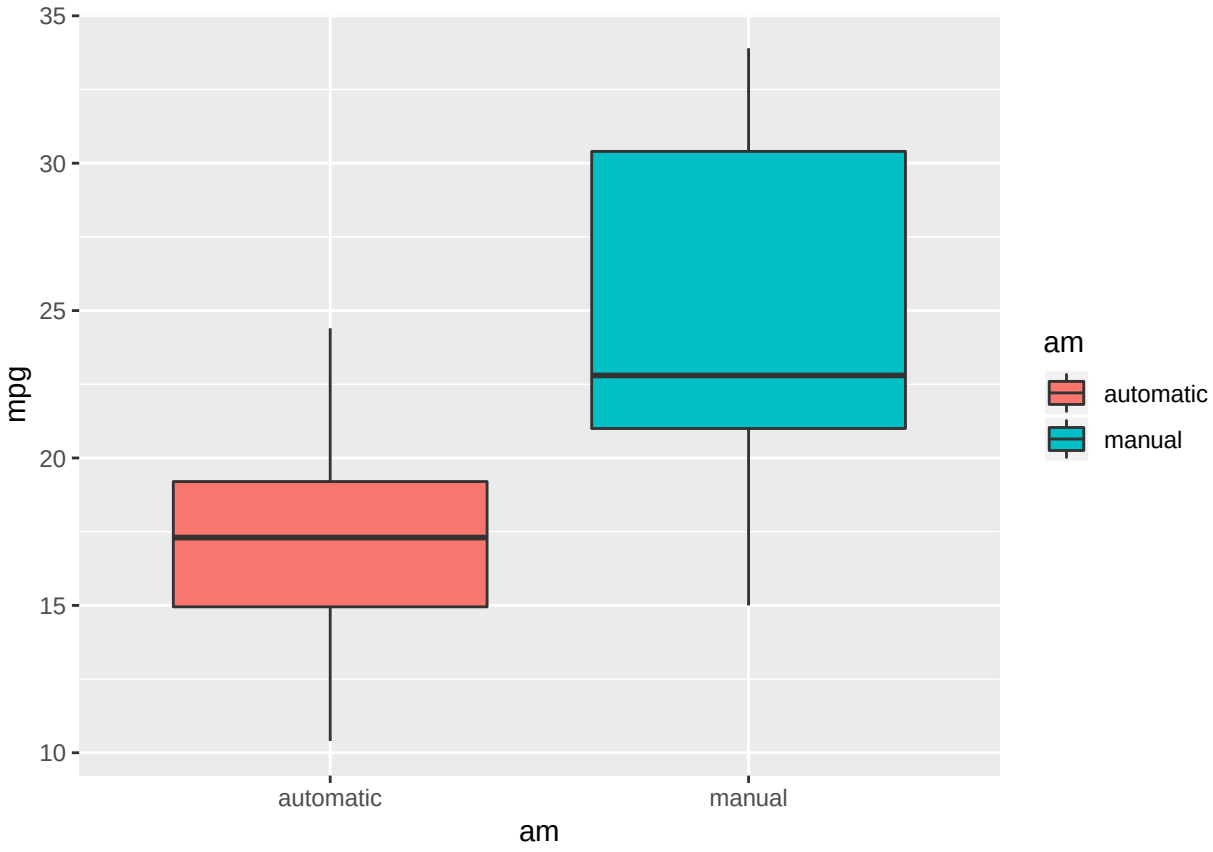



```
ggplot(data = mtcars, aes(y =am, x = mpg))+
  geom_point()
```



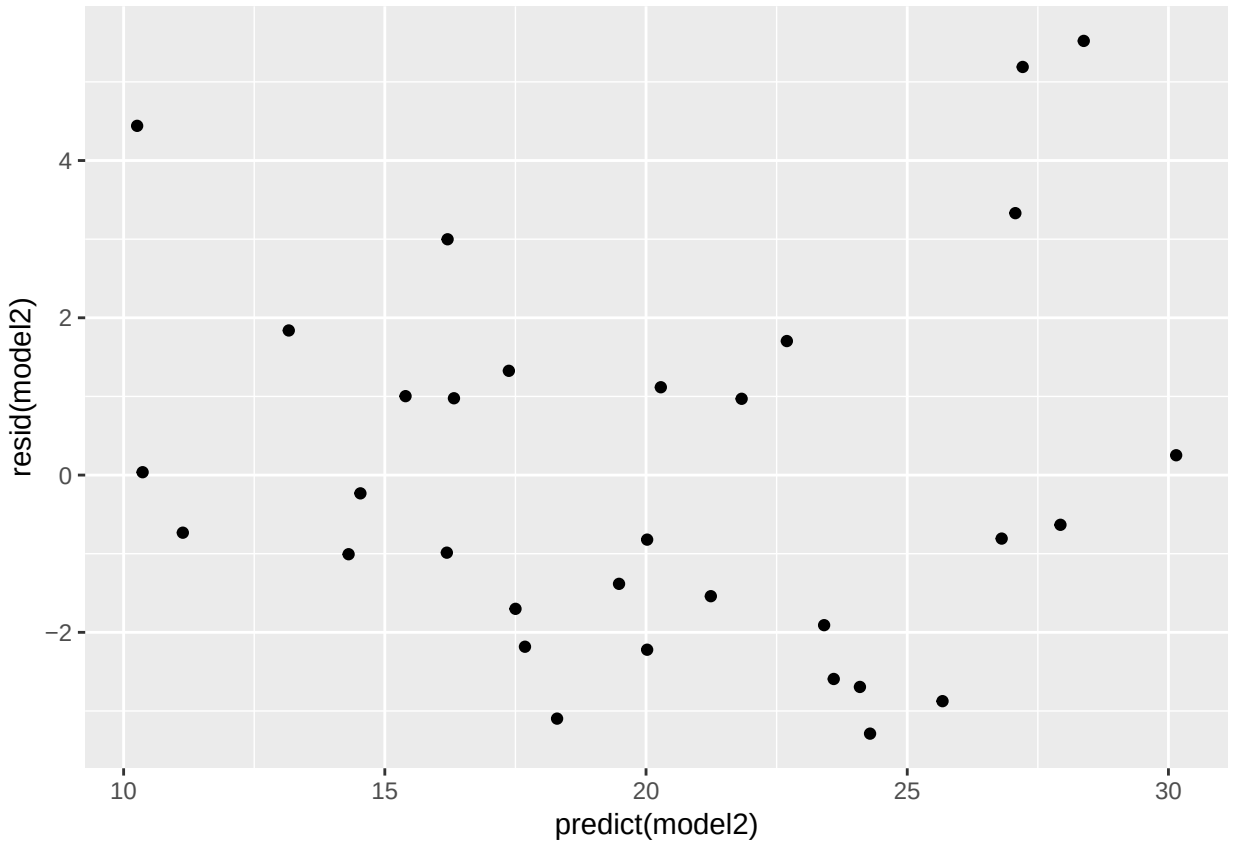
MEAN MPG FOR DIFFERENT TYPE OF TRANSMISSION

```
ggplot(data = data)+
  aes(x = am, y = mpg,fill=am)+
  geom_boxplot()
```



REISIDUAL PLOT FOR MODEL 2

```
qplot(predict(model2), resid(model2))
```


resid(model2)
predict(model2)
4
2
0
−2
10
15
20
25
30