Linear Regression

Module 3 - Activity 4

Of the models with a convex representation of their parametricestimation, generalized linear models (GLM) are a crucial case.The two most frequent examples of GLM are linear regression andlogistic regression. Therefore, in this activity, several linear regressionand logistic regression exercises will be solved with R software andsome of its packages.

Activities Problem 1: Warm Up

1. Section 3.7 Problem 8.

This question involves the use of simple linear regression on the Auto data set.

a) Use the lm() function to perform a simple linear regression with mpg as the response and horsepower as the predictor. Use the summary() function to print the results. Comment on the output.

Adding the necessary libraries

```
library(ISLR2)
library(tidymodels)
library(dplyr)
```

Loading dataframe

```
auto <- Auto
head(auto)
```

```
  mpg cylinders displacement horsepower weight acceleration year origin
1  18         8          307        130   3504         12.0   70      1
2  15         8          350        165   3693         11.5   70      1
3  18         8          318        150   3436         11.0   70      1
4  16         8          304        150   3433         12.0   70      1
5  17         8          302        140   3449         10.5   70      1
6  15         8          429        198   4341         10.0   70      1
                       name
1 chevrolet chevelle malibu
2         buick skylark 320
3        plymouth satellite
4             amc rebel sst
5               ford torino
6          ford galaxie 500
```

The Auto df counts with 9 columns that show information of different models of vehicles. For the present exercise is intended to evaluate if exists any relationship

```
linearmodelauto <- lm(mpg ~ horsepower, data = auto)
linearmodelauto
```

```

Call:
lm(formula = mpg ~ horsepower, data = auto)

Coefficients:
(Intercept)   horsepower
    39.9359      -0.1578
```

- Is there a relationship between the predictor and the response?

  Yes there is a relationship between the variables

```
summary(linearmodelauto)
```

```

Call:
lm(formula = mpg ~ horsepower, data = auto)

Residuals:
     Min       1Q   Median       3Q      Max
-13.5710  -3.2592  -0.3435   2.7630  16.9240
```

```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 39.935861   0.717499   55.66   <2e-16 ***
horsepower  -0.157845   0.006446  -24.49   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 4.906 on 390 degrees of freedom
Multiple R-squared:  0.6059,    Adjusted R-squared:  0.6049
F-statistic: 599.7 on 1 and 390 DF,  p-value: < 2.2e-16
```

- How strong is the relationship between the predictor and the response

  With the p values of the model (<0.0001) we can assume that the model is significant to explain the relationship between our variables . Also the R^2 of 60% indicates that there is a highly correlation between this variables

- Is the relationship between the predictor and the response positive or negative?

  The relationship is negative

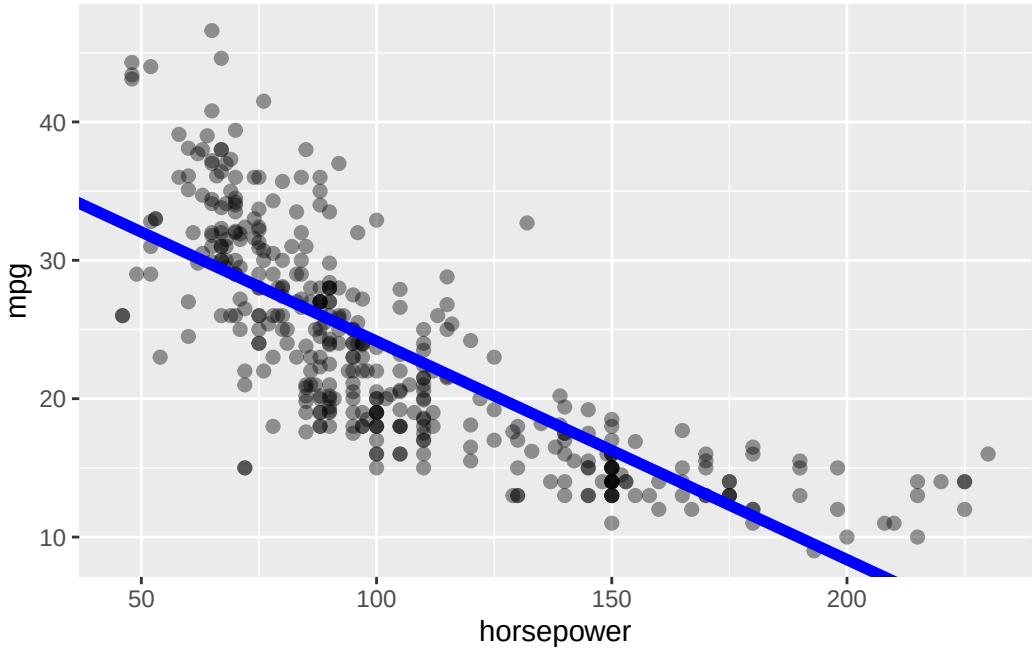
- What is the predicted mpg associated with a horsepower of 98? What are the associated 95 % confidence and prediction intervals?

```r
predict(linearmodelauto, tibble(horsepower=98), interval = "confidence")
```

```
       fit      lwr      upr
1 24.46708 23.97308 24.96108
```

b) Plot the response and the predictor. Use the abline() functionto display the least squares regression line.

```r
auto %>%
  ggplot(aes(x = horsepower)) +
  geom_point(aes(y = mpg), size = 2, alpha = 0.4) +
  geom_abline(slope = coef(linearmodelauto)["horsepower"],
              intercept = coef(linearmodelauto)["(Intercept)"],
              size = 2, color = "blue")
```

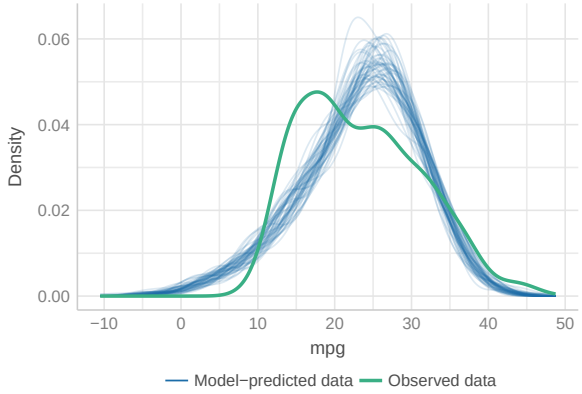


c) Use the plot() function to produce diagnostic plots of the least squares regression fit. Comment on any problems you see with the fit.

```
linearmodelauto %>% performance::check_model()
```

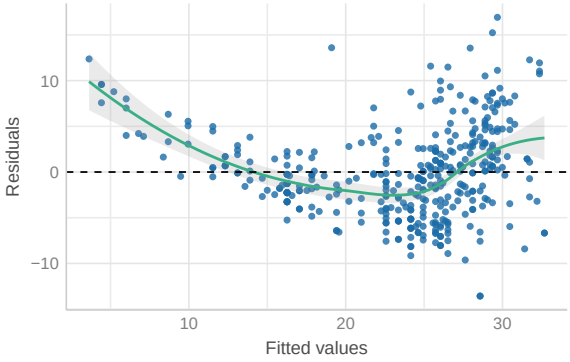
Posterior Predictive Check

Model−predicted lines should resemble observed data line



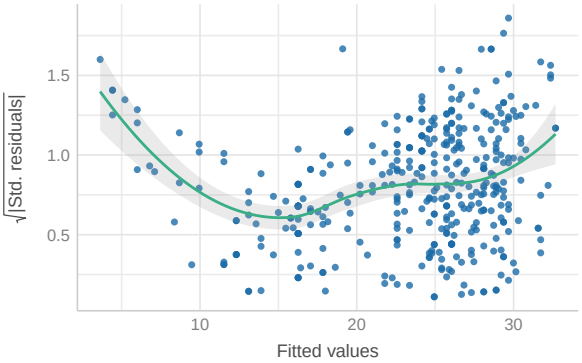
Linearity

Reference line should be flat and horizontal



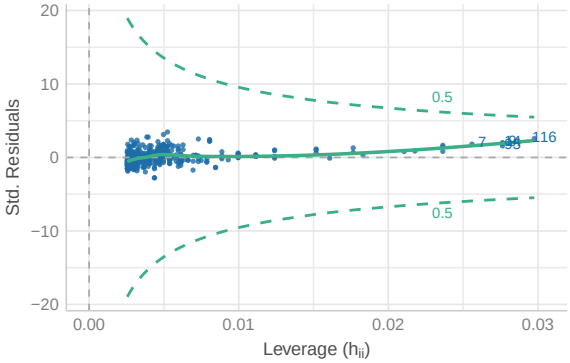
Homogeneity of Variance

Reference line should be flat and horizontal



Influential Observations

Points should be inside the contour lines



Normality of Residuals

Dots should fall along the line