Лабораторная работа №5.0

Цель работы: Научиться следующим навыкам:

1. Использование датафреймов для статистических вычислений;
2. Преобразование данных для удобной работы с ними;
3. Линейные модели.

Загрузка исходных данных

Проанализируйте данные о возрасте и физ. характеристиках молюсков

```
datafrm <- read.csv("https://archive.ics.uci.edu/ml/machine-learning-
databases/abalone/abalone.data", header = TRUE, sep = ",")
summary(datafrm)
```

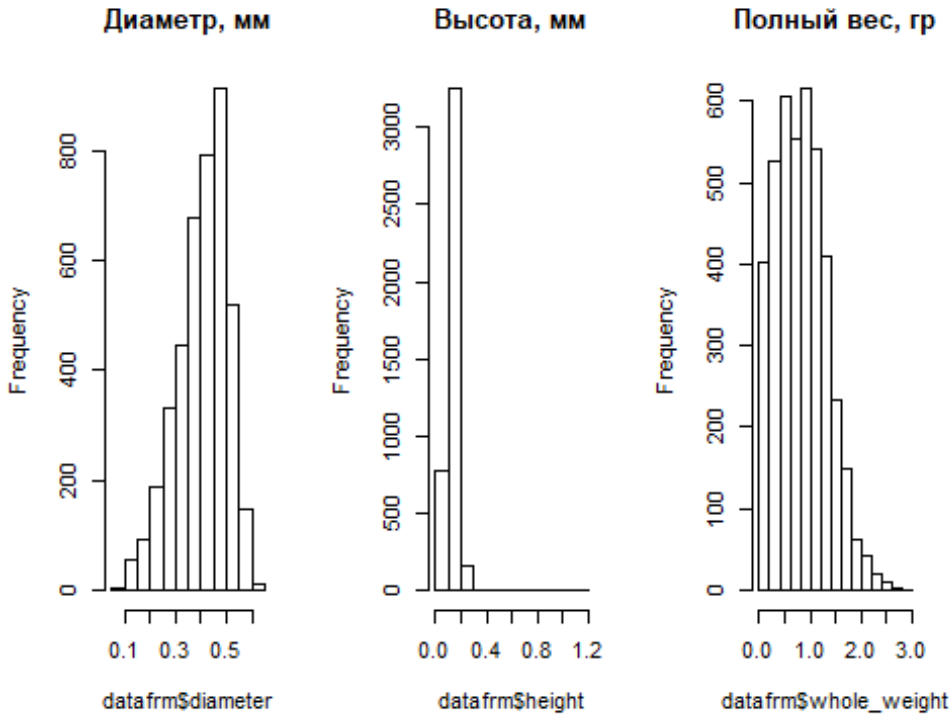
```
##  M            X0.455          X0.365           X0.095
##  F:1307   Min.   :0.075   Min.   :0.0550   Min.   :0.0000
##  I:1342   1st Qu.:0.450   1st Qu.:0.3500   1st Qu.:0.1150
##  M:1527   Median :0.545   Median :0.4250   Median :0.1400
##           Mean   :0.524   Mean   :0.4079   Mean   :0.1395
##           3rd Qu.:0.615   3rd Qu.:0.4800   3rd Qu.:0.1650
##           Max.   :0.815   Max.   :0.6500   Max.   :1.1300
##      X0.514          X0.2245           X0.101            X0.15
##  Min.   :0.0020   Min.   :0.0010   Min.   :0.00050   Min.   :0.0015
##  1st Qu.:0.4415   1st Qu.:0.1860   1st Qu.:0.09337   1st Qu.:0.1300
##  Median :0.7997   Median :0.3360   Median :0.17100   Median :0.2340
##  Mean   :0.8288   Mean   :0.3594   Mean   :0.18061   Mean   :0.2389
##  3rd Qu.:1.1533   3rd Qu.:0.5020   3rd Qu.:0.25300   3rd Qu.:0.3290
##  Max.   :2.8255   Max.   :1.4880   Max.   :0.76000   Max.   :1.0050
##       X15
##  Min.   : 1.000
##  1st Qu.: 8.000
##  Median : 9.000
##  Mean   : 9.932
##  3rd Qu.:11.000
##  Max.   :29.000
```

```
colnames(datafrm)
```

```
## [1] "M"       "X0.455"  "X0.365"  "X0.095"  "X0.514"  "X0.2245" "X0.101"
## [8] "X0.15"   "X15"
```

```
colnames(datafrm) <- c("sex", "length", "diameter", "height",
                "whole_weight", "shucked_weight",
                "viscera_weight", "shell_weight", "rings")

colnames(datafrm)
```

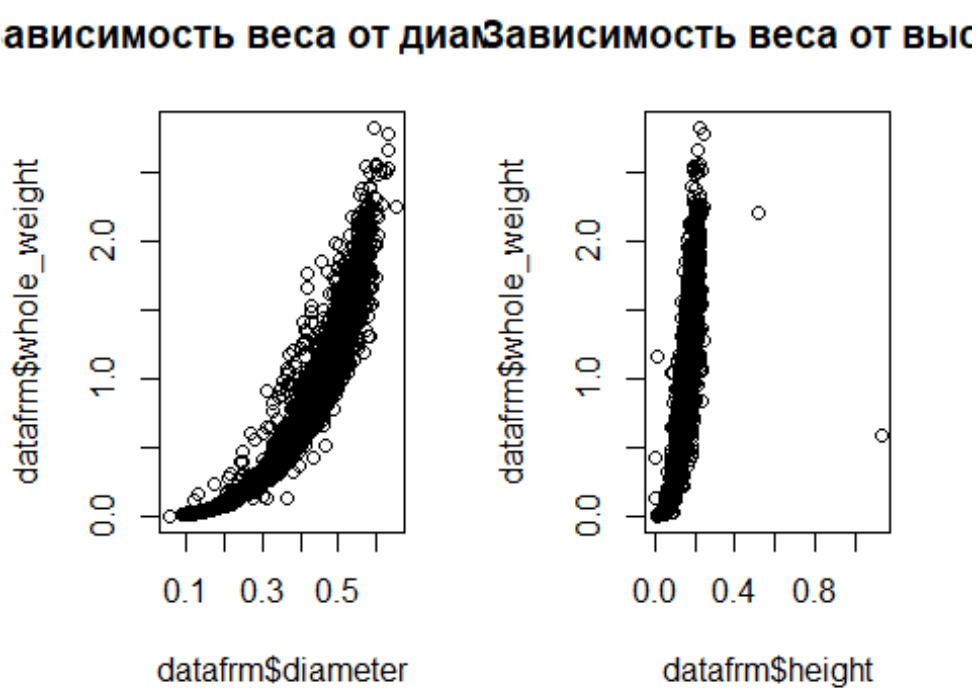
```
## [1] "sex"            "length"         "diameter"       "height"
## [5] "whole_weight"   "shucked_weight" "viscera_weight" "shell_weight"
## [9] "rings"

datafrm$sex <- factor(c("Female", "Infant", "Male")[datafrm$sex])
par(mfrow = c(1, 3))
hist(datafrm$diameter, main = "Диаметр, мм")
hist(datafrm$height, main = "Высота, мм")
hist(datafrm$whole_weight, main = "Полный вес, гр")
```



Видим ассиметрию и выбросы (от них нужно избавиться)

Визулизируем возможные зависимости

```
par(mfrow = c(1, 2))
plot(datafrm$diameter, datafrm$whole_weight, 'p', main = "Зависимость веса от
диаметра")
plot(datafrm$height, datafrm$whole_weight, 'p', main = "Зависимость веса от
высоты")
```



Хорошо видна зависимость, нужно её исследовать.

Построить линейные модели при помощи функции lm, посмотреть их характеристики

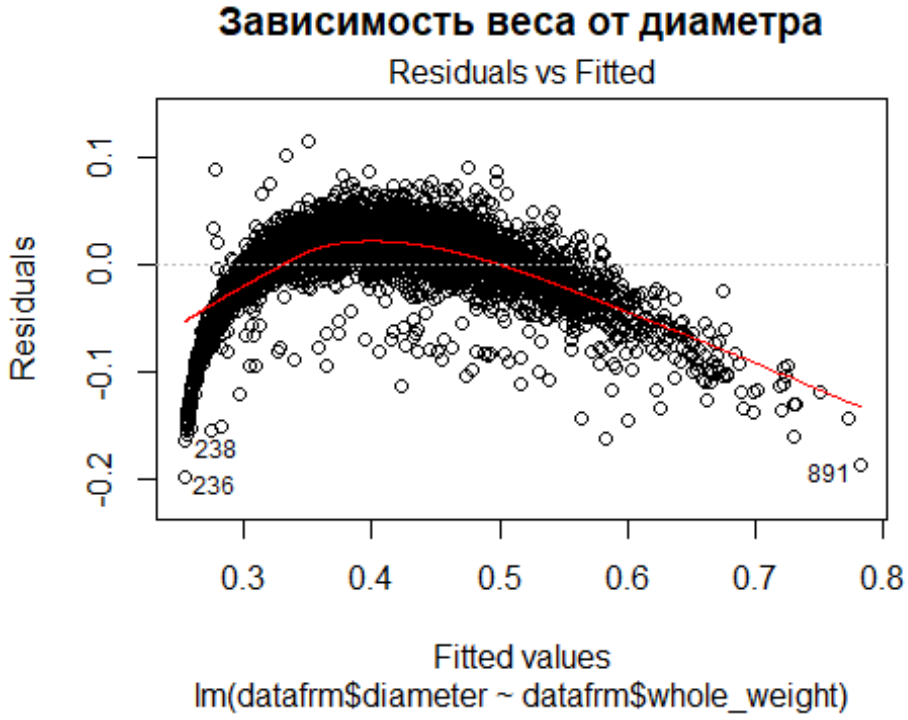
```
linear.model.d_w <- lm(datafrm$diameter ~ datafrm$whole_weight, data = datafrm)
summary(linear.model.d_w)
```

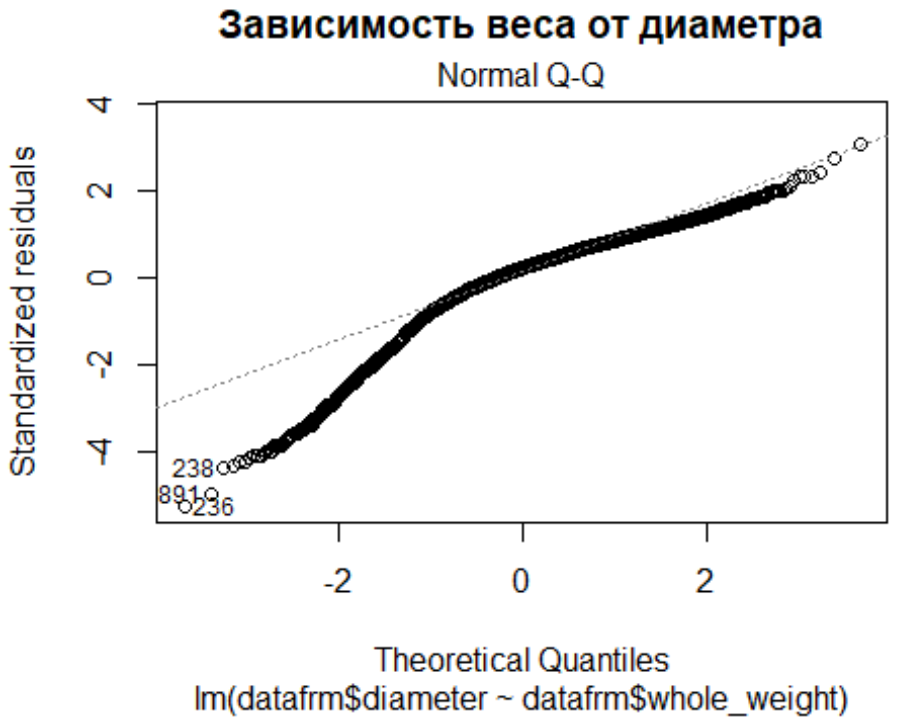
```
##
## Call:
## lm(formula = datafrm$diameter ~ datafrm$whole_weight, data = datafrm)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.198038 -0.015281  0.008041  0.024858  0.114478
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)          0.252664   0.001143   221.1   <2e-16 ***
## datafrm$whole_weight 0.187288   0.001187   157.8   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.03761 on 4174 degrees of freedom
## Multiple R-squared:  0.8565, Adjusted R-squared:  0.8564
## F-statistic: 2.491e+04 on 1 and 4174 DF,  p-value: < 2.2e-16
```

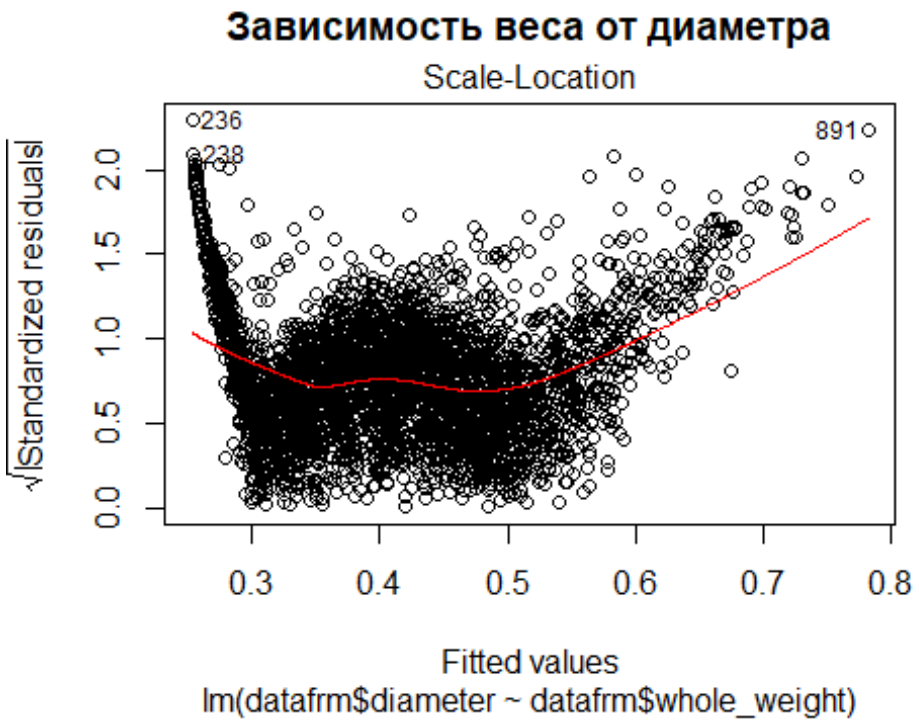
```
linear.model.h_w <- lm(datafrm$height ~ datafrm$whole_weight, data = datafrm)
summary(linear.model.h_w)
```

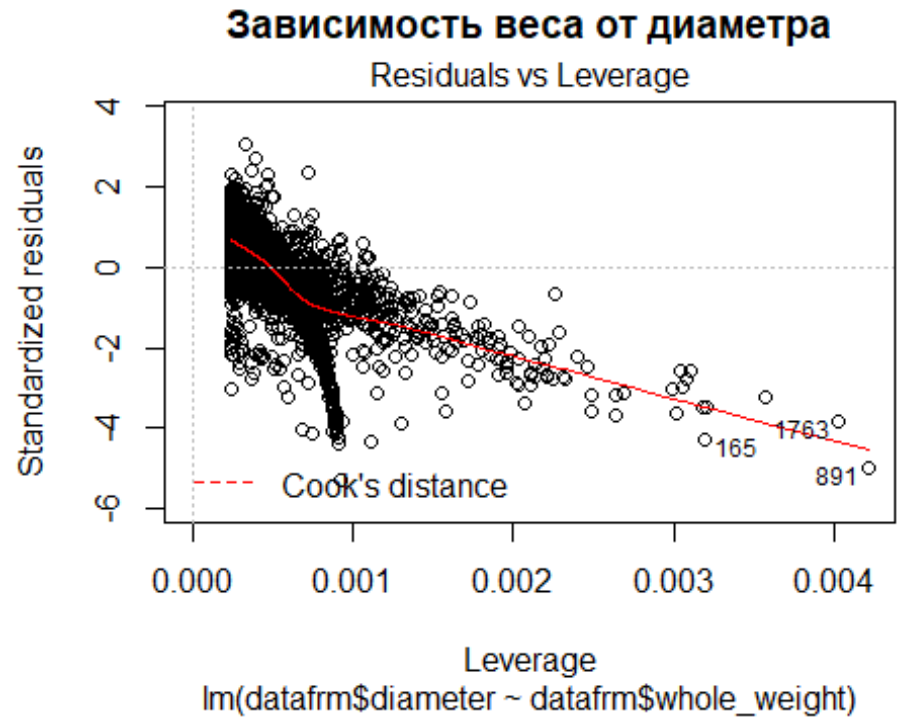
```
##
## Call:
## lm(formula = datafrm$height ~ datafrm$whole_weight, data = datafrm)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.14742 -0.01031 -0.00035  0.00993  1.00688
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)          0.0816199  0.0007291  111.95   <2e-16 ***
## datafrm$whole_weight 0.0698672  0.0007571   92.29   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.02399 on 4174 degrees of freedom
## Multiple R-squared:  0.6711, Adjusted R-squared:  0.671
## F-statistic:  8517 on 1 and 4174 DF,  p-value: < 2.2e-16
```

```r
plot(linear.model.d_w, main = "Зависимость веса от диаметра")
```

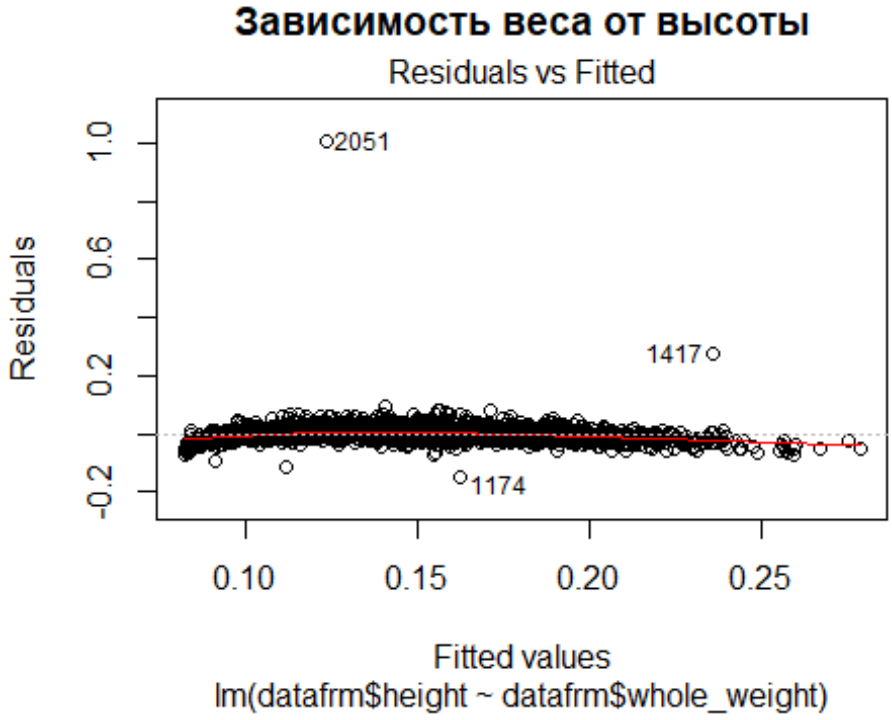

Зависимость веса от диаметра
Residuals vs Fitted
Residuals
0.1
0.0
-0.1
-0.2
238
236
891
0.3
0.4
0.5
0.6
0.7
0.8
Fitted values
lm(datafrm$diameter ~ datafrm$whole_weight)

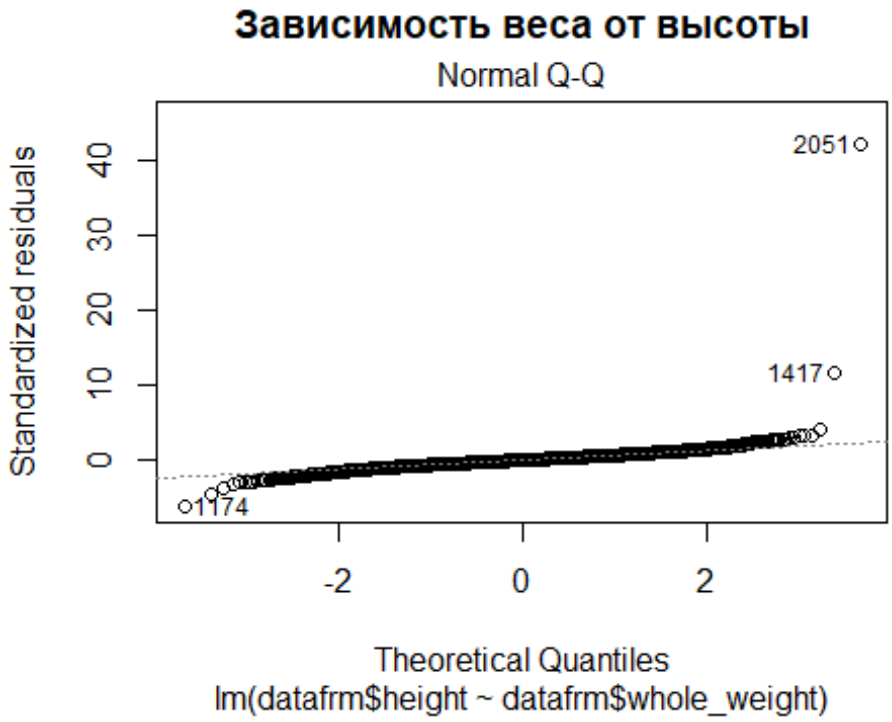

Зависимость веса от диаметра
Normal Q-Q
Standardized residuals
4
2
0
-2
-4
238
891
236
-2
0
2
Theoretical Quantiles
lm(datafrm$diameter ~ datafrm$whole_weight)

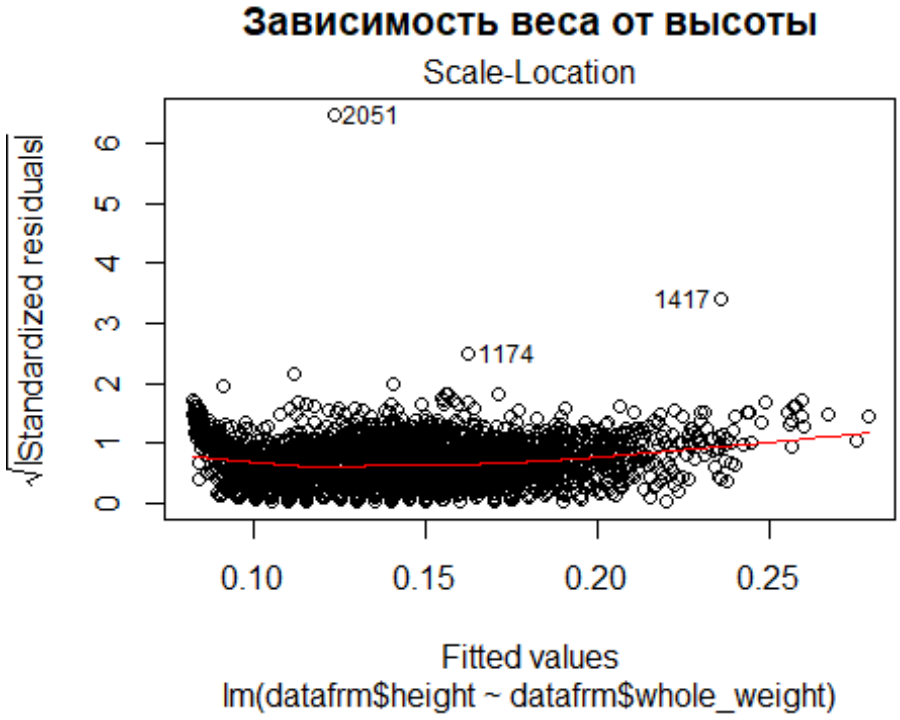


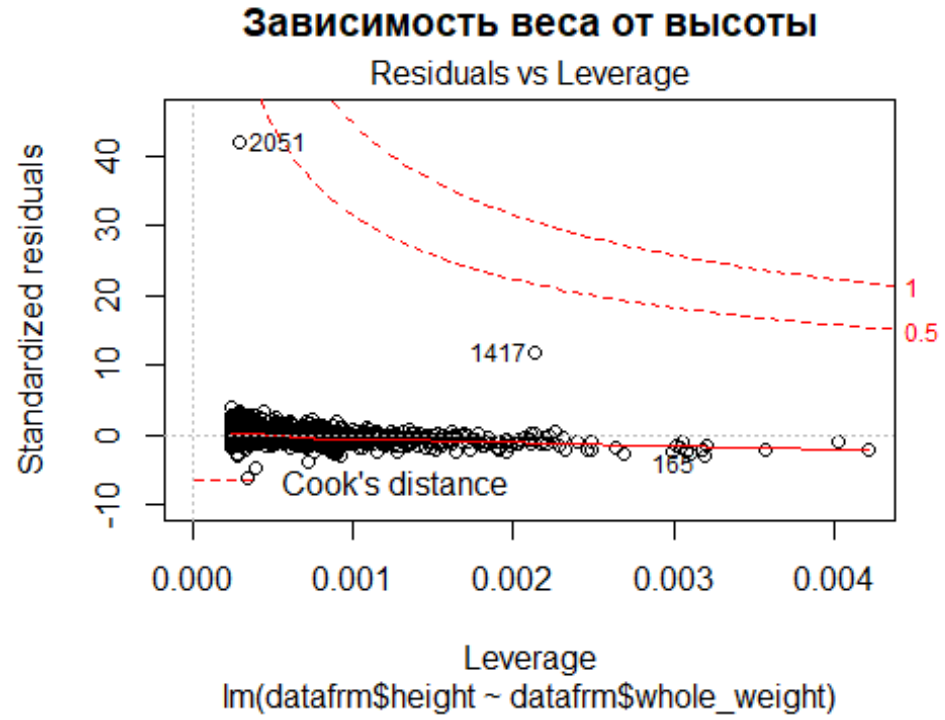



```r
plot(linear.model.h_w, main = "Зависимость веса от высоты")
```


Зависимость веса от высоты
Residuals vs Fitted
Residuals
2051
1417
1174
1.0
0.6
0.2
-0.2
0.10
0.15
0.20
0.25
Fitted values
lm(datafrm$height ~ datafrm$whole_weight)


Зависимость веса от высоты
Normal Q-Q
Standardized residuals
2051
1417
1174
40
30
20
10
0
-2
0
2
Theoretical Quantiles
lm(datafrm$height ~ datafrm$whole_weight)

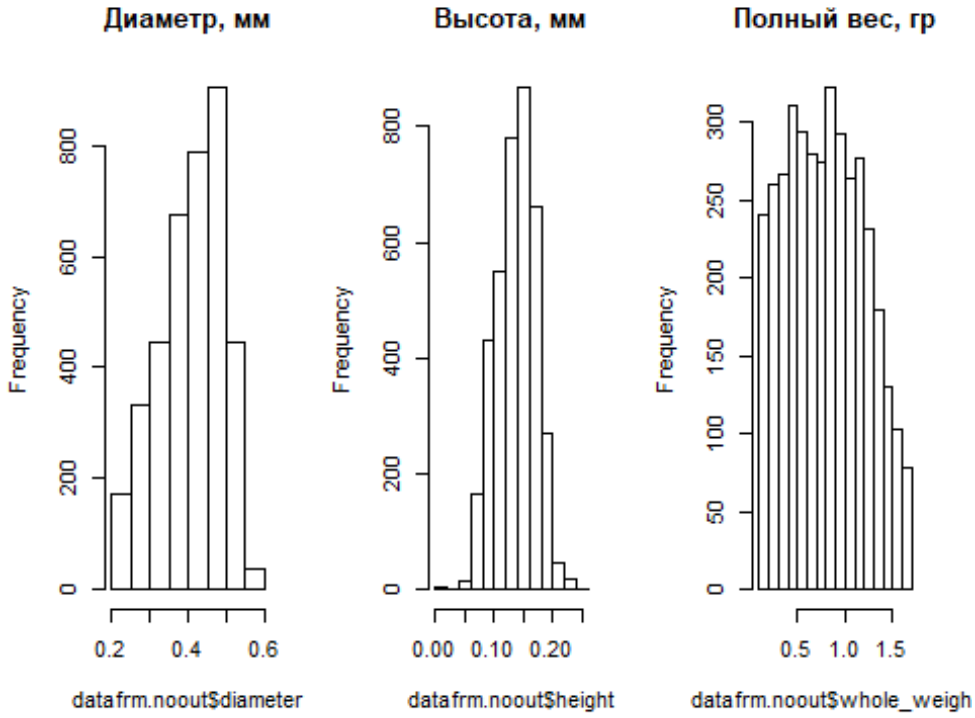




Избавиться от выборосов, построить ещё модели и проверить их

```
datafrm.noout <- datafrm[datafrm$height < 0.4 & datafrm$diameter > 0.2 &
datafrm$diameter < 0.6 & datafrm$whole_weight < 1.7 & datafrm$whole_weight >
0.1,]
par(mfrow = c(1, 3))
hist(datafrm.noout$diameter, main = "Диаметр, мм")
```

```r
hist(datafrm.noout$height, main = "Высота, мм")
hist(datafrm.noout$whole_weight, main = "Полный вес, гр")
```



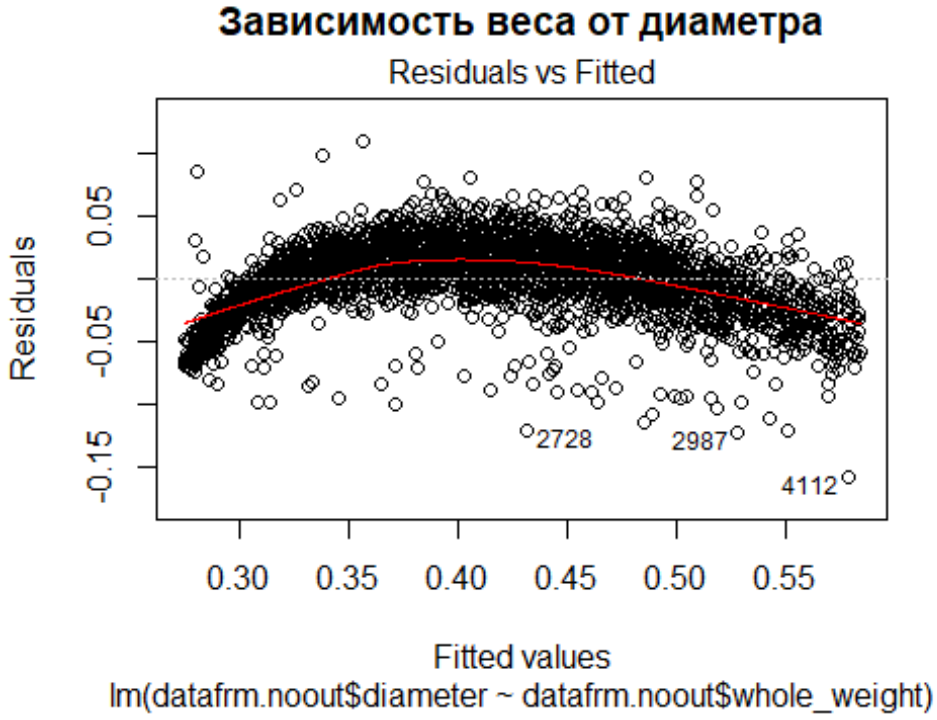

```r
par(mfrow = c(1, 1))

linear.model.d_w <- lm(datafrm.noout$diameter ~ datafrm.noout$whole_weight, data
= datafrm.noout)
summary(linear.model.d_w)
```

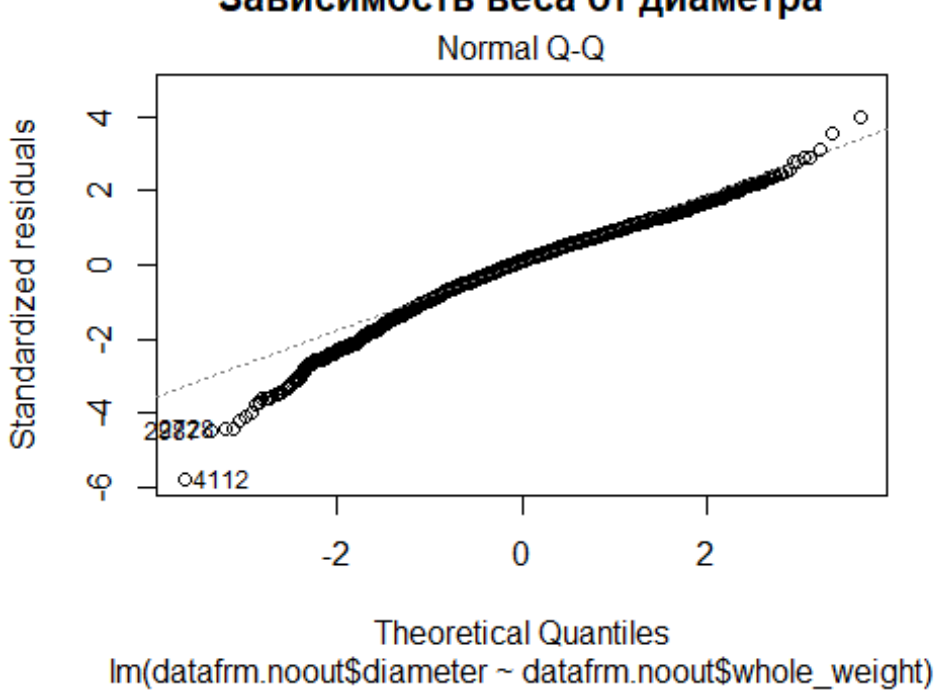
```
##
## Call:
## lm(formula = datafrm.noout$diameter ~ datafrm.noout$whole_weight,
##     data = datafrm.noout)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.157985 -0.014944  0.003189  0.018626  0.108706
##
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)                  0.2548634  0.0009811   259.8   <2e-16 ***
## datafrm.noout$whole_weight 0.1941255  0.0010945   177.4   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.02735 on 3800 degrees of freedom
## Multiple R-squared:  0.8922, Adjusted R-squared:  0.8922
## F-statistic: 3.146e+04 on 1 and 3800 DF,  p-value: < 2.2e-16
```

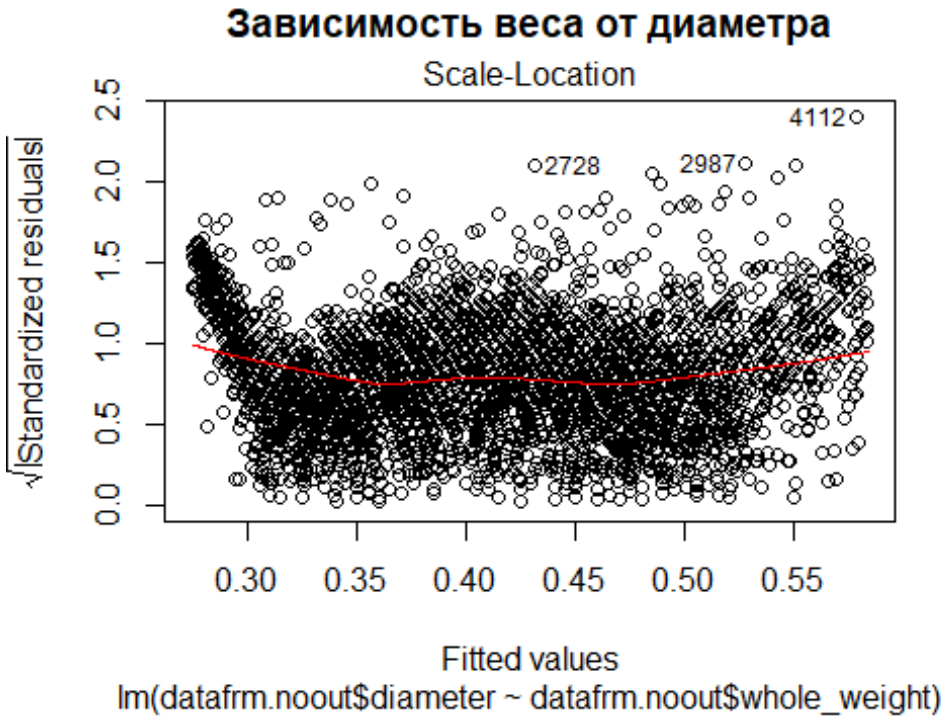
```r
linear.model.h_w <- lm(datafrm.noout$height ~ datafrm.noout$whole_weight, data =
datafrm.noout)
summary(linear.model.h_w)
```

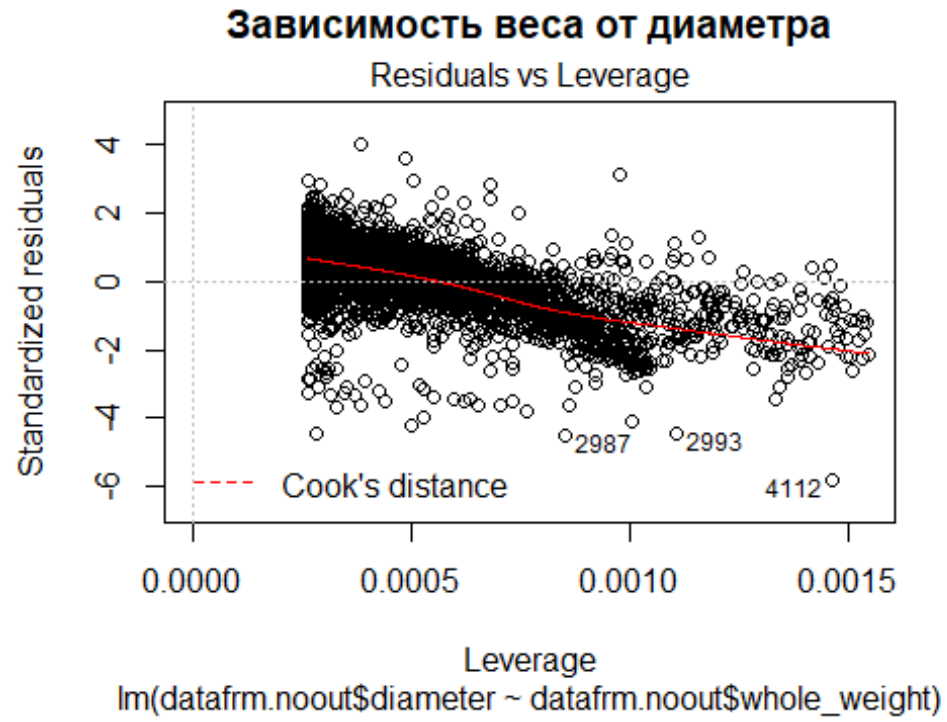
```
##
## Call:
## lm(formula = datafrm.noout$height ~ datafrm.noout$whole_weight,
##     data = datafrm.noout)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.150195 -0.009841 -0.001024  0.008979  0.092608
##
## Coefficients:
##                              Estimate Std. Error t value Pr(>|t|)
## (Intercept)                 0.0820025  0.0005708   143.7   <2e-16 ***
## datafrm.noout$whole_weight 0.0719349  0.0006368   113.0   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.01591 on 3800 degrees of freedom
## Multiple R-squared:  0.7706, Adjusted R-squared:  0.7705
## F-statistic: 1.276e+04 on 1 and 3800 DF,  p-value: < 2.2e-16
```

```r
plot(linear.model.d_w, main = "Зависимость веса от диаметра")
```

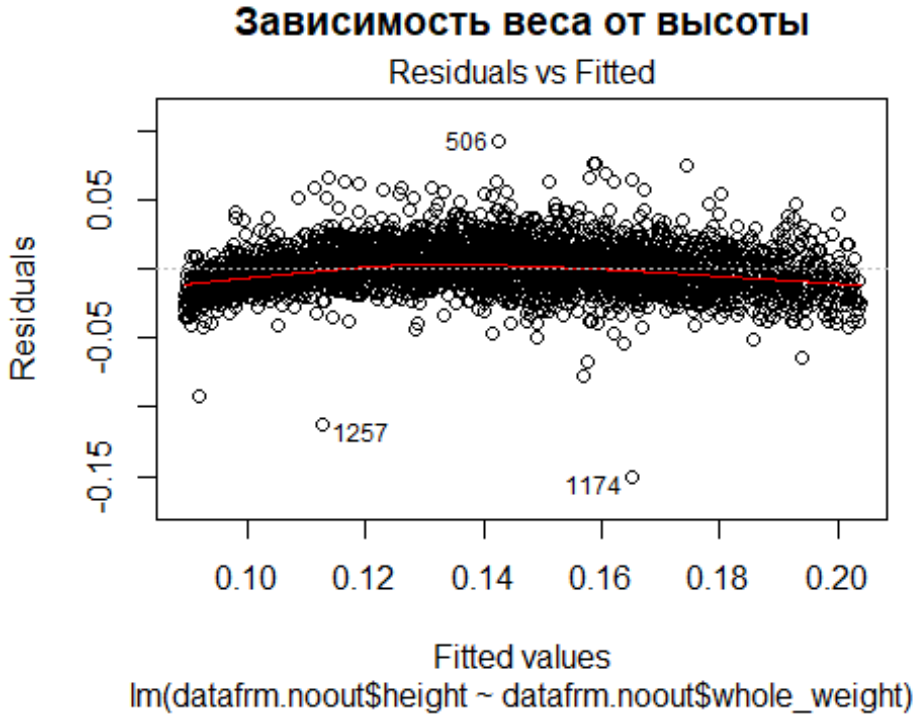

Зависимость веса от диаметра
Residuals vs Fitted
Residuals
0.05
-0.05
-0.15
2728
2987
4112
0.30
0.35
0.40
0.45
0.50
0.55
Fitted values
lm(datafrm.noout$diameter ~ datafrm.noout$whole_weight)

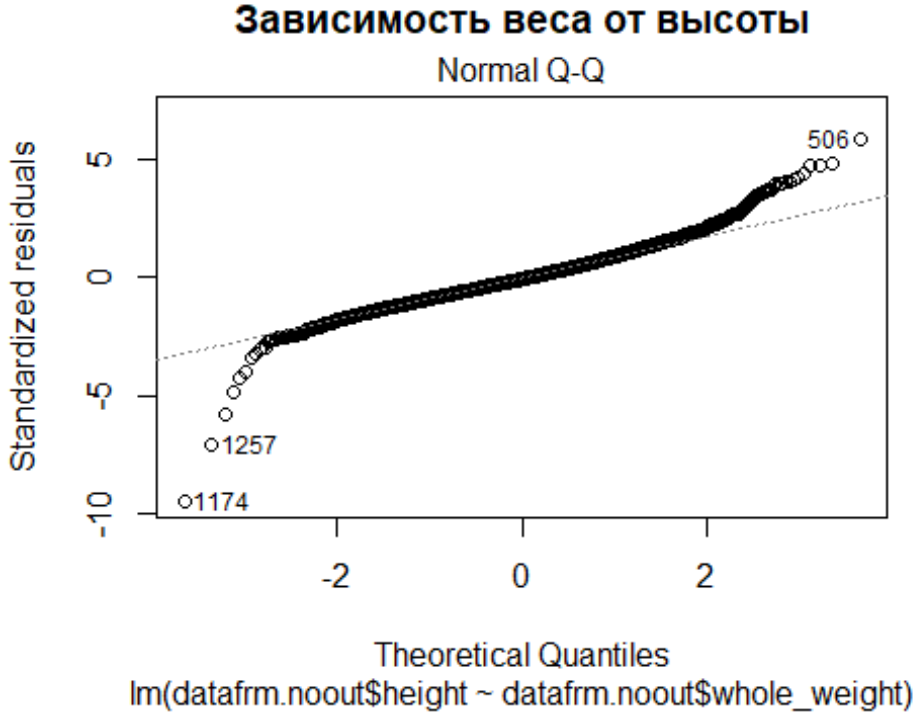

Зависимость веса от диаметра
Normal Q-Q
Standardized residuals
4
2
0
-2
-4
-6
4112
-2
0
2
Theoretical Quantiles
lm(datafrm.noout$diameter ~ datafrm.noout$whole_weight)

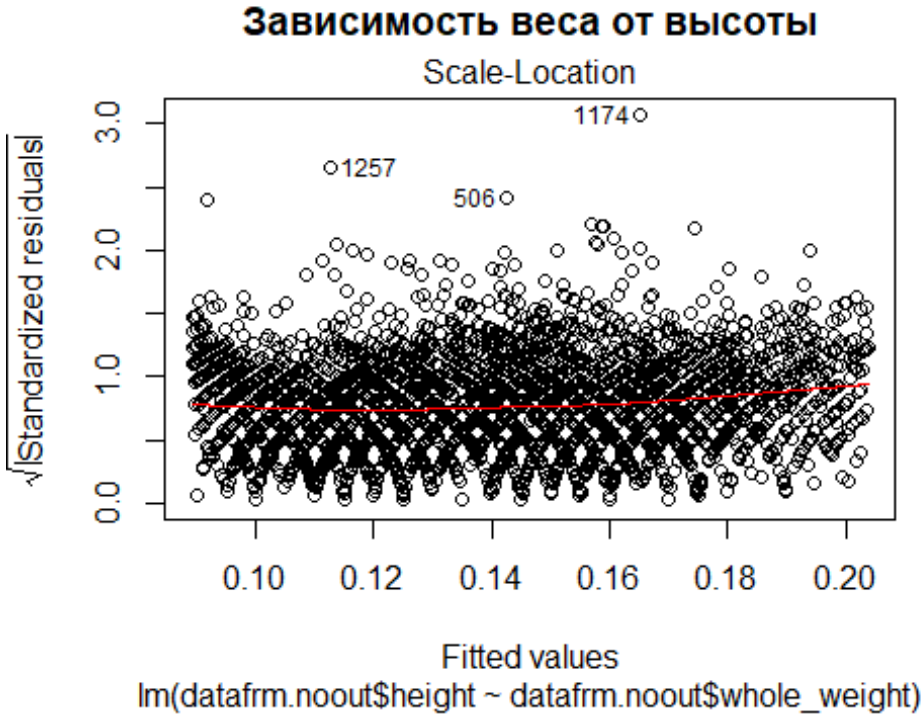


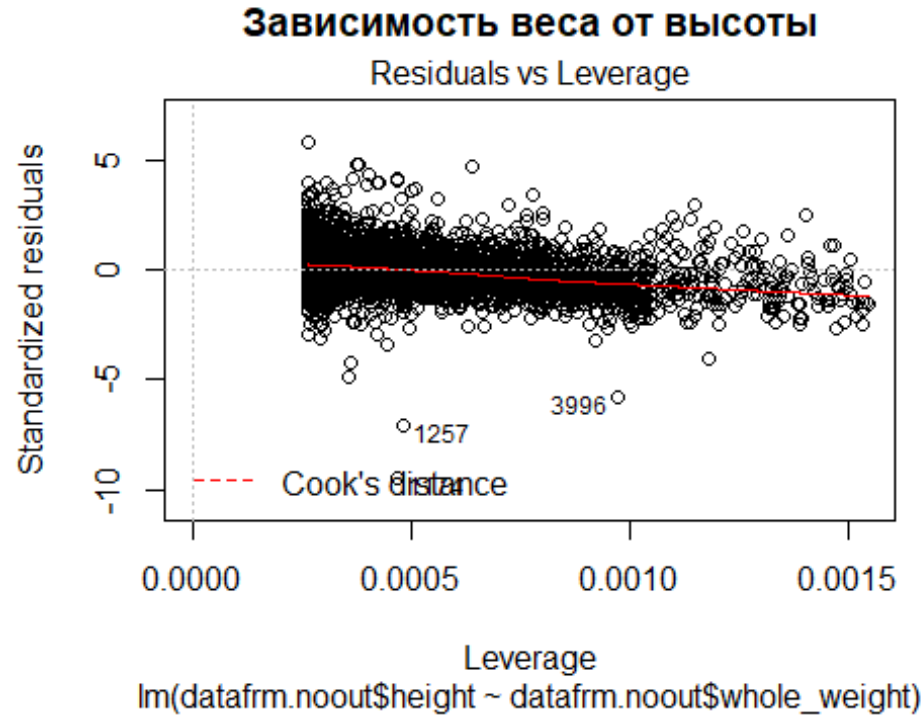



```r
plot(linear.model.h_w, main = "Зависимость веса от высоты")
```


Зависимость веса от высоты
Residuals vs Fitted
Residuals
0.05
-0.05
-0.15
506
1257
1174
0.10
0.12
0.14
0.16
0.18
0.20
Fitted values
lm(datafrm.noout$height ~ datafrm.noout$whole_weight)


Зависимость веса от высоты
Normal Q-Q
Standardized residuals
5
0
-5
-10
506
1257
1174
-2
0
2
Theoretical Quantiles
lm(datafrm.noout$height ~ datafrm.noout$whole_weight)



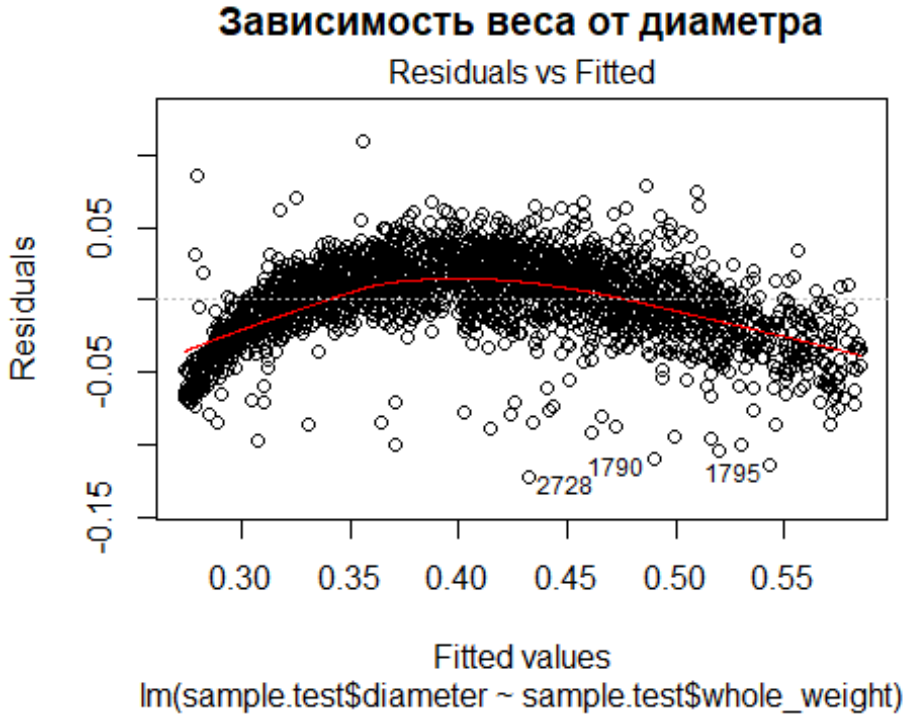


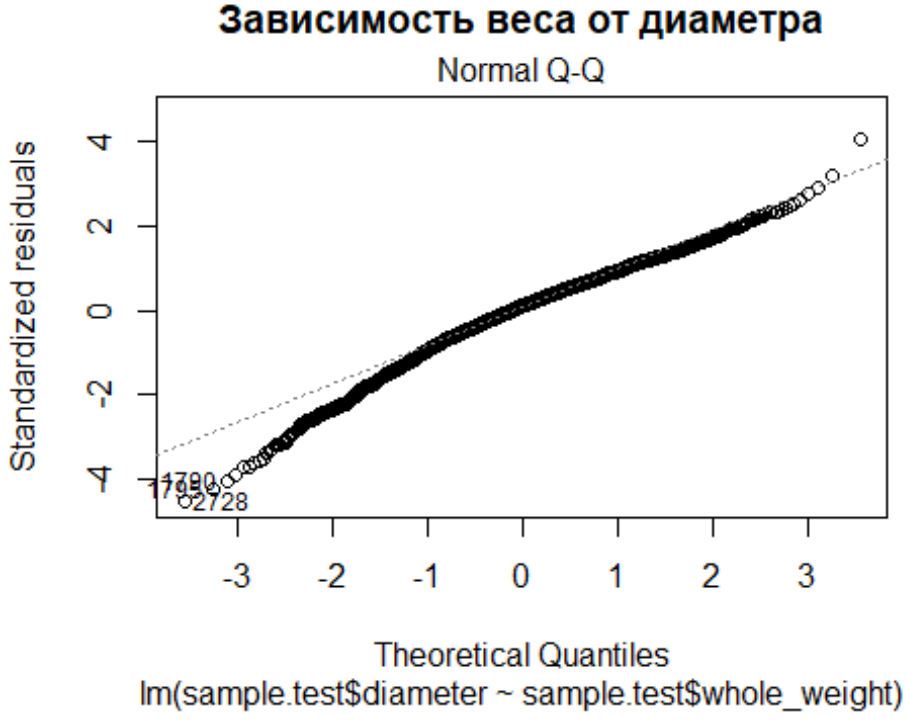
разделить массив данных на 2 случайные части

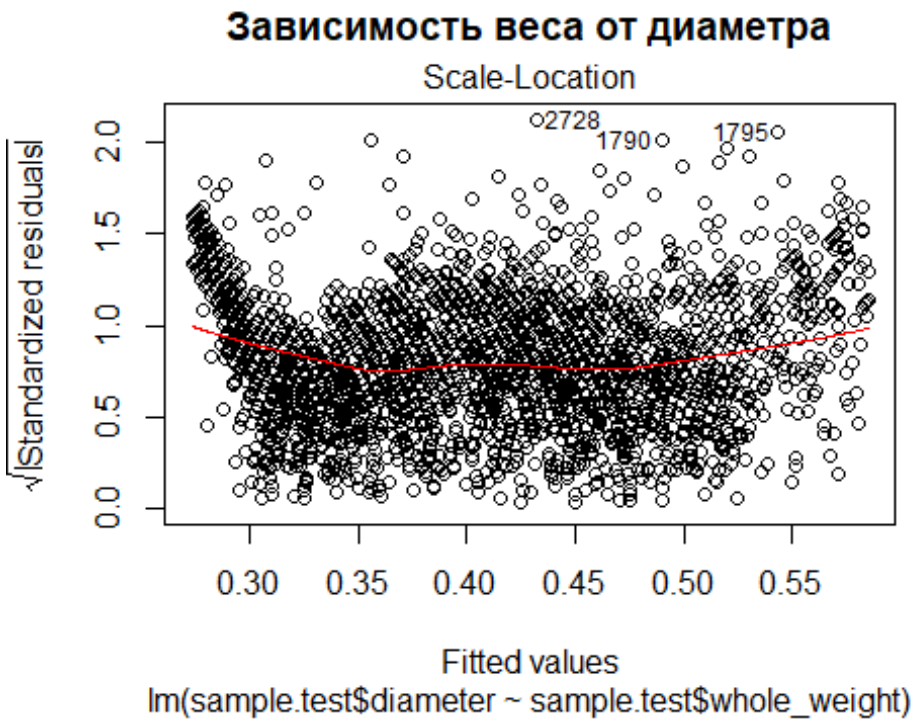
```
datalength <- nrow(datafrm.noout)
testindex <- seq(1, trunc(datalength * 0.7), by = 1)
controlindex <- seq(round(datalength * 0.3) + 1, datalength, by = 1)
sample.test <- datafrm.noout[testindex,]
sample.control <- datafrm.noout[controlindex,]
```

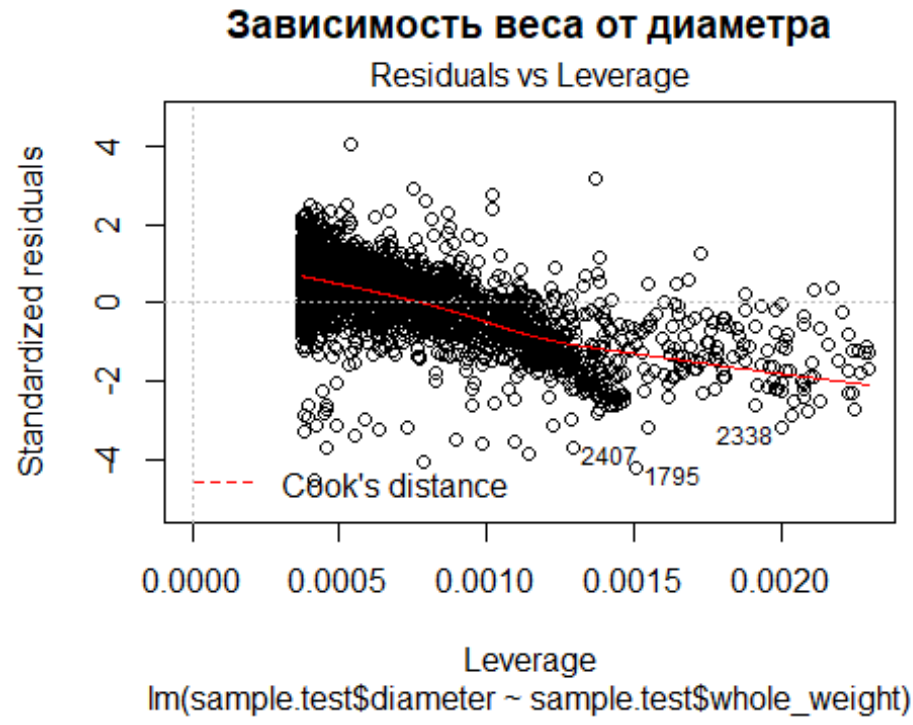
подогнать модель по первой части

```
linear.model.d_w <- lm(sample.test$diameter ~ sample.test$whole_weight, data =
sample.test)
linear.model.h_w <- lm(sample.test$height ~ sample.test$whole_weight, data =
sample.test)

plot(linear.model.d_w, main = "Зависимость веса от диаметра")
```

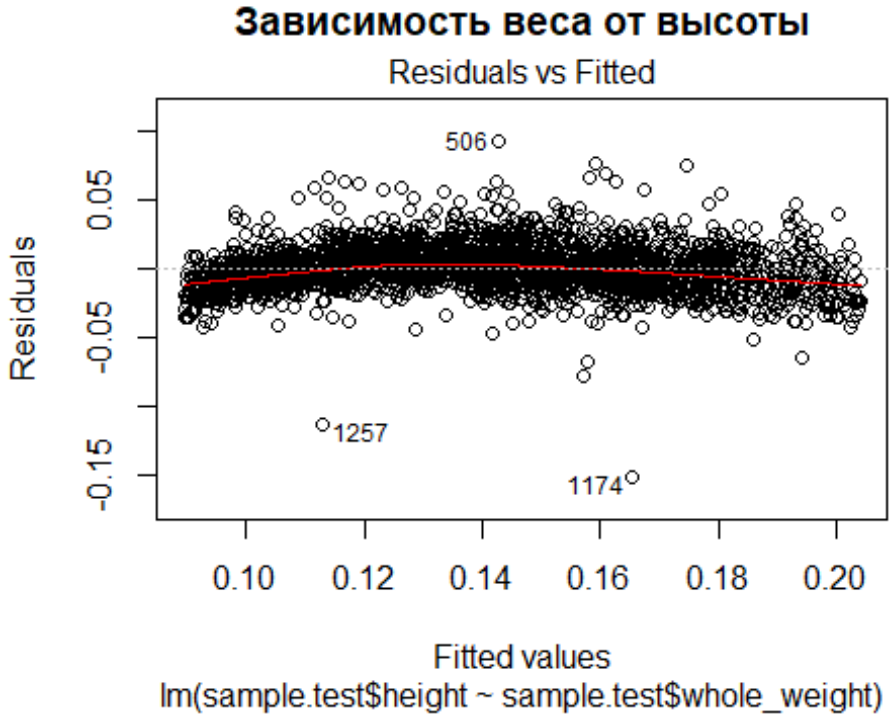

Зависимость веса от диаметра
Residuals vs Fitted
Residuals
0.05
-0.05
-0.15
2728
1790
1795
0.30
0.35
0.40
0.45
0.50
0.55
Fitted values
lm(sample.test$diameter ~ sample.test$whole_weight)

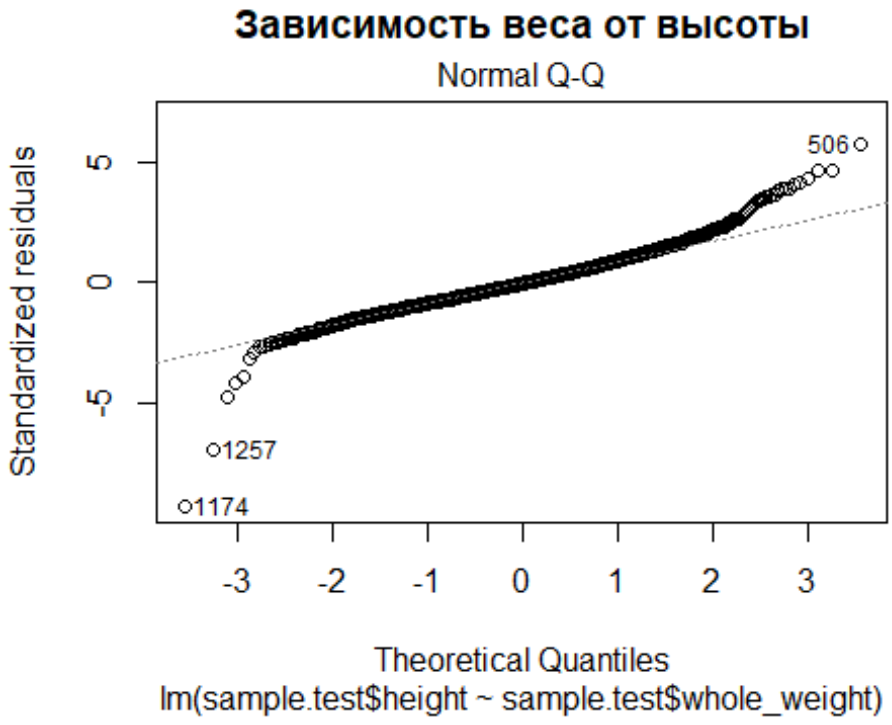

Зависимость веса от диаметра
Normal Q-Q
Standardized residuals
4
2
0
-2
-4
1790
2728
-3
-2
-1
0
1
2
3
Theoretical Quantiles
lm(sample.test$diameter ~ sample.test$whole_weight)

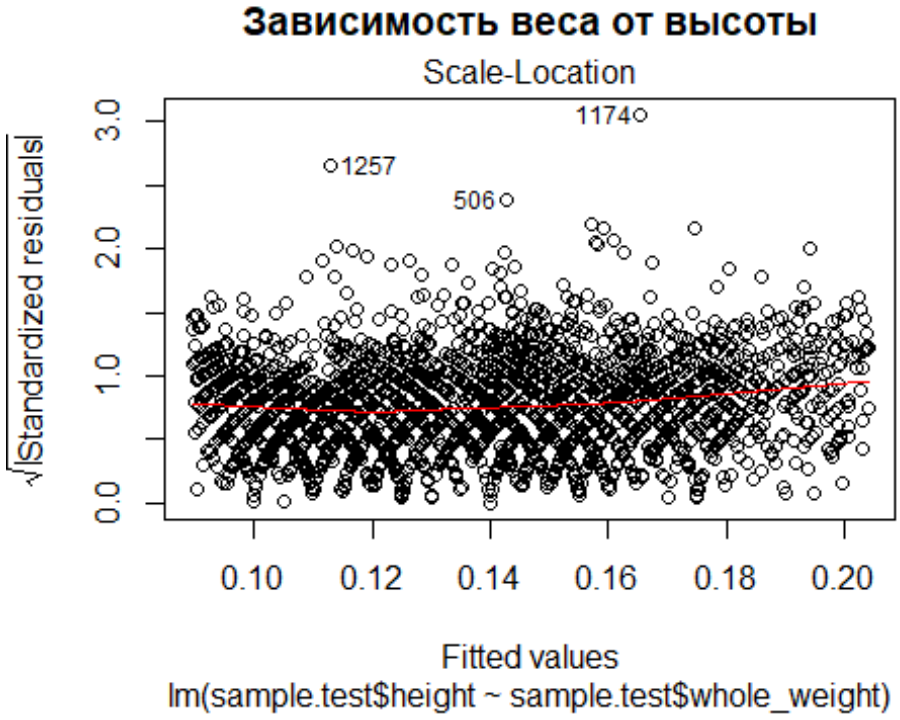


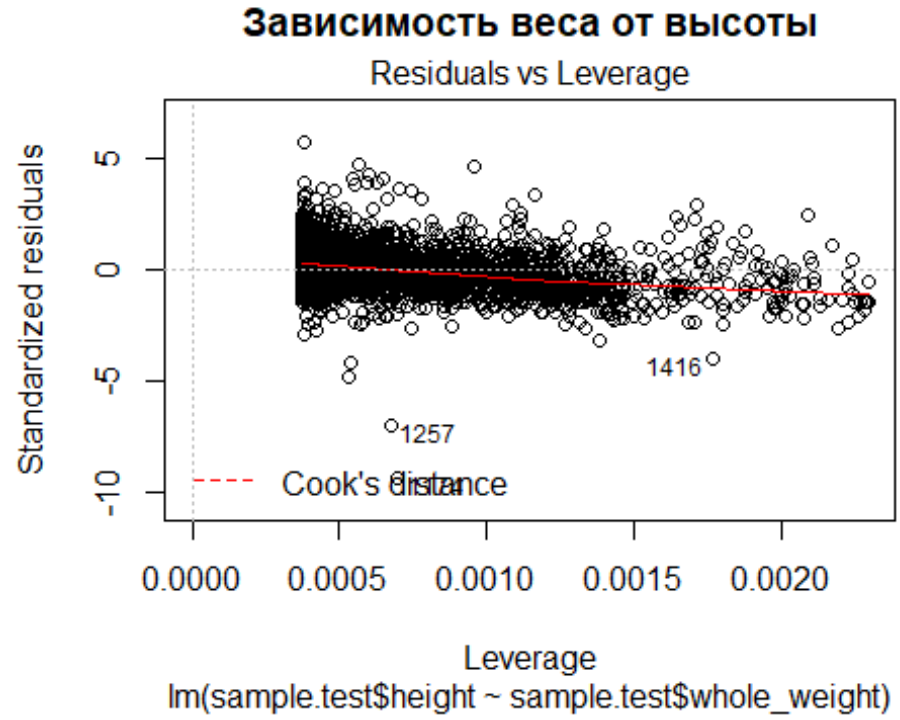



```r
plot(linear.model.h_w, main = "Зависимость веса от высоты")
```


Зависимость веса от высоты
Residuals vs Fitted
Residuals
0.05
-0.05
-0.15
506
1257
1174
0.10
0.12
0.14
0.16
0.18
0.20
Fitted values
lm(sample.test$height ~ sample.test$whole_weight)


Зависимость веса от высоты
Normal Q-Q
Standardized residuals
5
0
-5
506
1257
1174
-3
-2
-1
0
1
2
3
Theoretical Quantiles
lm(sample.test$height ~ sample.test$whole_weight)





спрогнозировать (функция predict) значения во второй части

```
predicted.d_w <- predict(linear.model.d_w, sample.control)
predicted.h_w <- predict(linear.model.h_w, sample.control)
```

проверить качесвто прогноза

```
cor(sample.control$whole_weight, predicted.d_w)
```

```
## [1] -0.01330944
```

```
cor(sample.control$whole_weight, predicted.h_w)
```

```
## [1] -0.01330944
```

Заключение

В ходе выполнения данной работы я получил незабываемый опыт и приобрел навыки, которые пригодятся в дальнейшей профессиональной деятельности. Были изучены и освоены на практике основы анализа данных. Прогноз исследуемых моделей получился достаточно точным.

С уважением,

студент гр. РИ-440005

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