Proiect modele de regresie

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Introducem setul de date in R:

```
library(tidyverse)
library(readr)
iris <- read_csv("C:/Users/Ana Maria/Desktop/irisi/iris.csv")
View(iris)
```

Verificam structura setului de date:

```
str(iris)
```

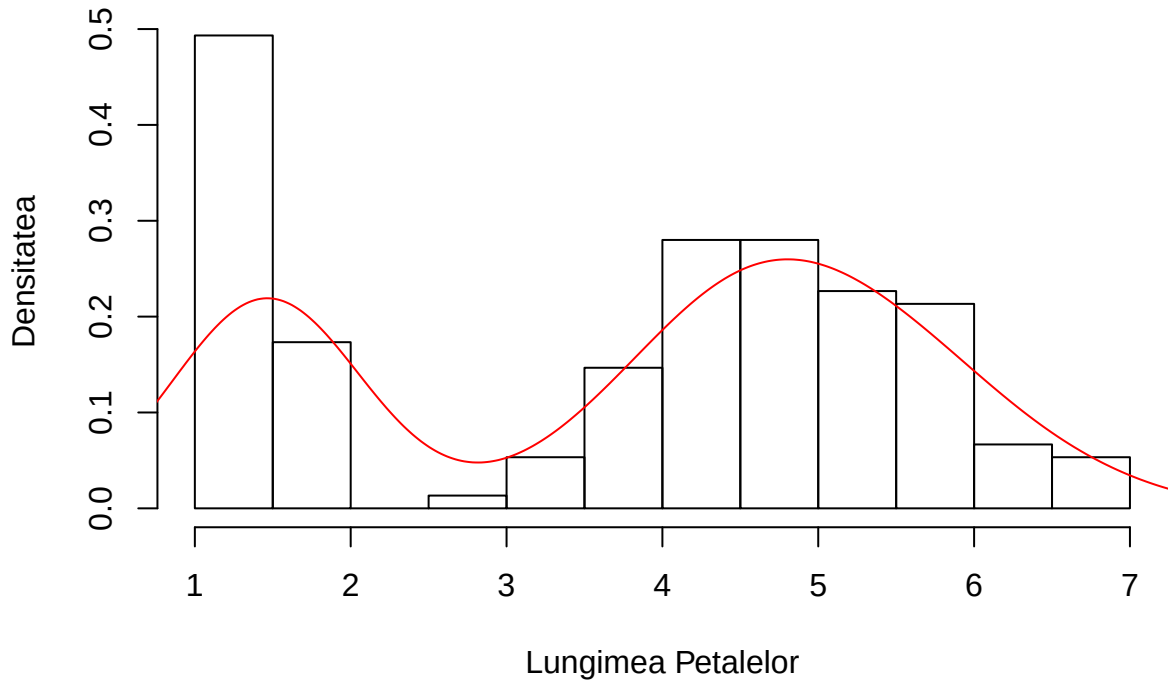
```
## tibble [150 x 6] (S3: spec_tbl_df/tbl_df/tbl/data.frame)
##  $ Id           : num [1:150] 1 2 3 4 5 6 7 8 9 10 ...
##  $ SepalLengthCm: num [1:150] 5.1 4.9 4.7 4.6 5 5.4 4.6 5 4.4 4.9 ...
##  $ SepalWidthCm : num [1:150] 3.5 3 3.2 3.1 3.6 3.9 3.4 3.4 2.9 3.1 ...
##  $ PetalLengthCm: num [1:150] 1.4 1.4 1.3 1.5 1.4 1.7 1.4 1.5 1.4 1.5 ...
##  $ PetalWidthCm : num [1:150] 0.2 0.2 0.2 0.2 0.2 0.4 0.3 0.2 0.2 0.1 ...
##  $ Species      : chr [1:150] "Iris-setosa" "Iris-setosa" "Iris-setosa" "Iris-setosa" ...
##  - attr(*, "spec")=
##   .. cols(
##   ..   Id = col_double(),
##   ..   SepalLengthCm = col_double(),
##   ..   SepalWidthCm = col_double(),
##   ..   PetalLengthCm = col_double(),
##   ..   PetalWidthCm = col_double(),
##   ..   Species = col_character()
##   .. )
```

```
summary(iris)
```

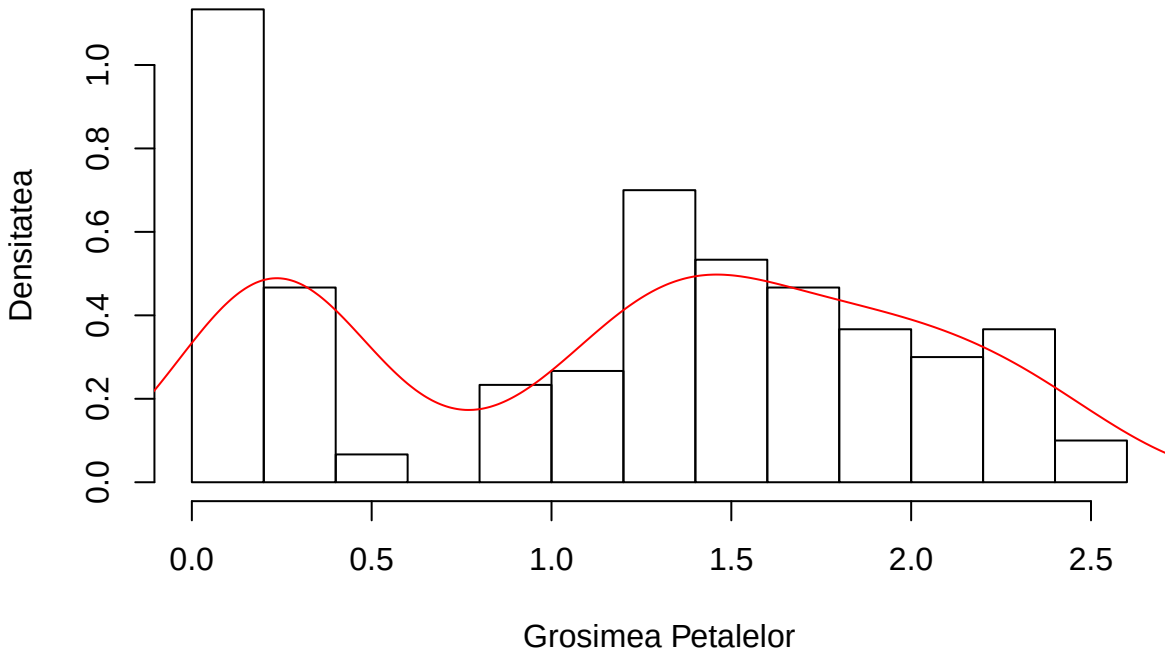
```
##        Id         SepalLengthCm    SepalWidthCm   PetalLengthCm
##  Min.   :  1.00   Min.   :4.300   Min.   :2.000   Min.   :1.000
##  1st Qu.: 38.25   1st Qu.:5.100   1st Qu.:2.800   1st Qu.:1.600
##  Median : 75.50   Median :5.800   Median :3.000   Median :4.350
##  Mean   : 75.50   Mean   :5.843   Mean   :3.054   Mean   :3.759
##  3rd Qu.:112.75   3rd Qu.:6.400   3rd Qu.:3.300   3rd Qu.:5.100
##  Max.   :150.00   Max.   :7.900   Max.   :4.400   Max.   :6.900
##   PetalWidthCm     Species
##  Min.   :0.100   Length:150
##  1st Qu.:0.300   Class :character
##  Median :1.300   Mode  :character
##  Mean   :1.199
##  3rd Qu.:1.800
##  Max.   :2.500
```

Facem histogramele:

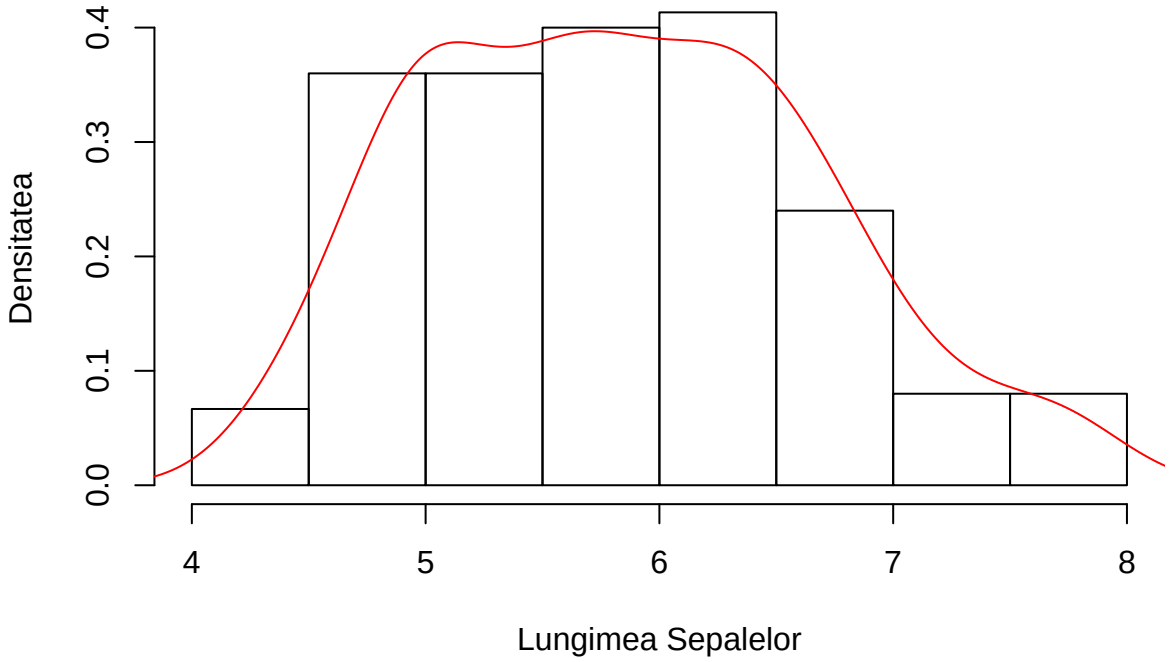
```
#histogramele
#par(mfrow = c(1,4)) pe asta o pun doar daca vreau sa imi afiseze toate histogramele intr-o poza
hist(iris$PetalLengthCm,
     probability = TRUE,
     main = "",
     cex.main = 0.7,
     xlab = "Lungimea Petalelor",
     ylab = "Densitatea")
lines(density(iris$PetalLengthCm),
      col = "red")
```



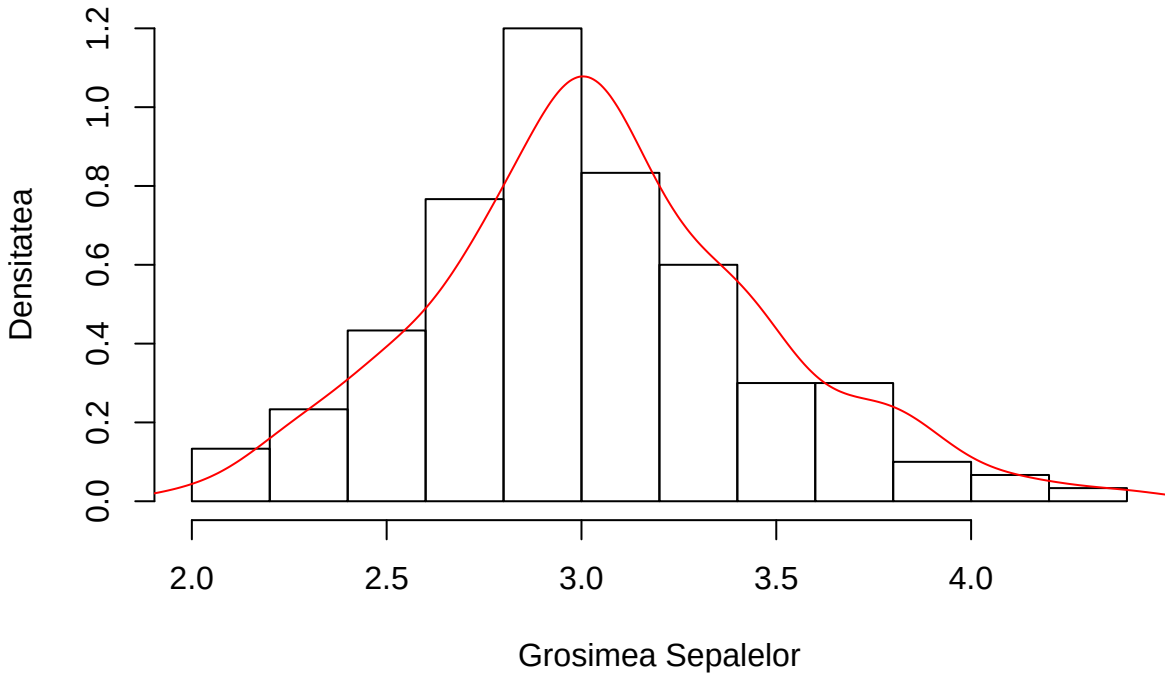

```
hist(iris$PetalWidthCm,
     probability = TRUE,
     main = "",
     cex.main = 0.7,
     xlab = "Grosimea Petalelor",
     ylab = "Densitatea")
lines(density(iris$PetalWidthCm),
      col = "red")
```



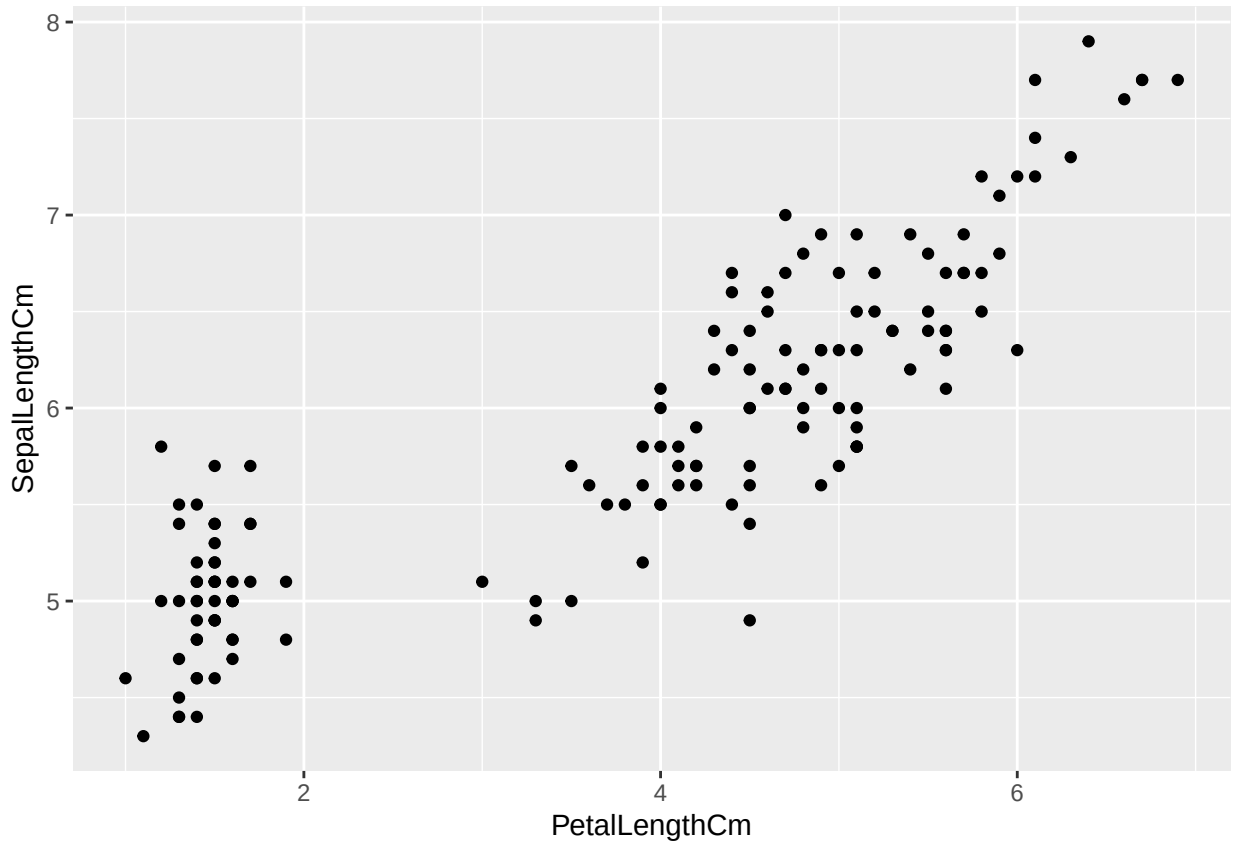

```
hist(iris$SepalLengthCm,
     probability = TRUE,
     main = "",
     cex.main = 0.7,
     xlab = "Lungimea Sepalelor",
     ylab = "Densitatea")
lines(density(iris$SepalLengthCm),
      col = "red")
```



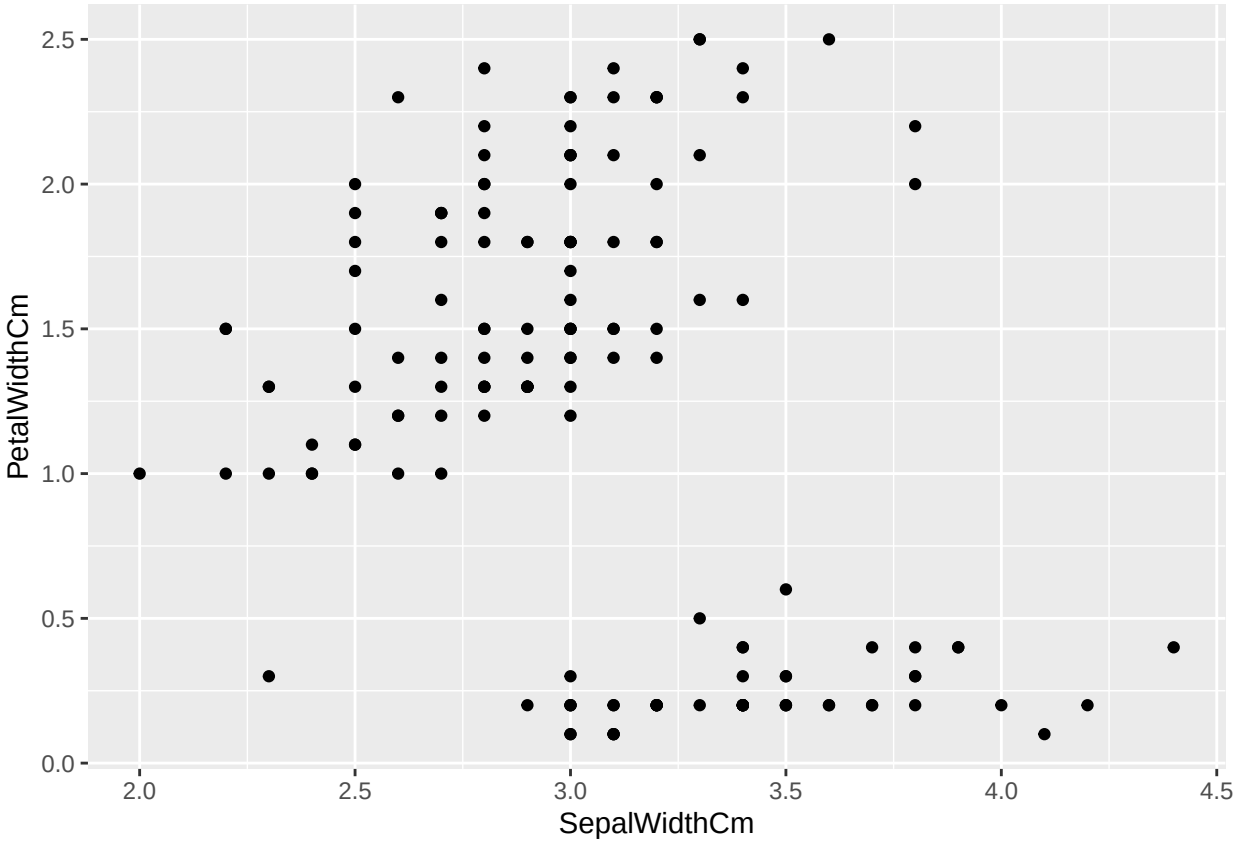

```
hist(iris$SepalWidthCm,
     probability = TRUE,
     main = "",
     cex.main = 0.7,
     xlab = "Grosimea Sepalelor",
     ylab = "Densitatea")
lines(density(iris$SepalWidthCm),
      col = "red")
```



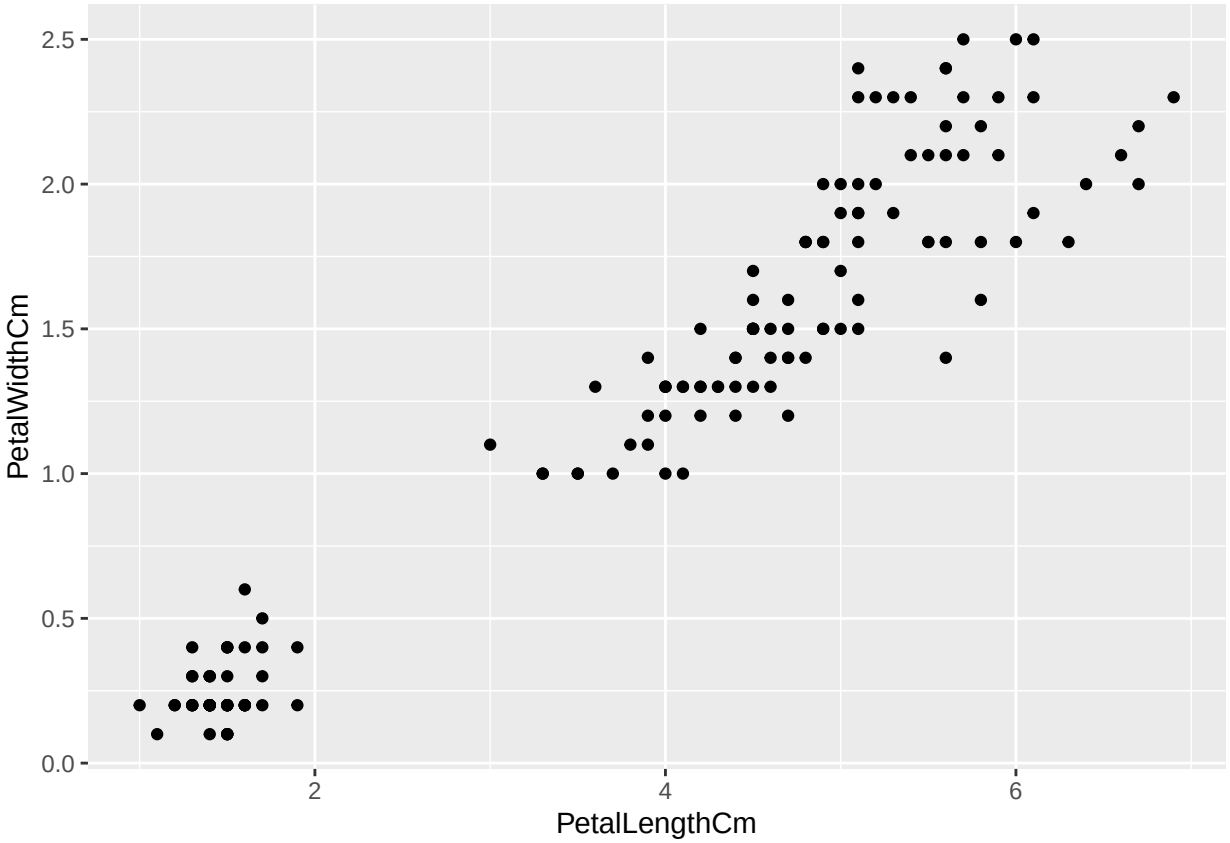

```
#folosesc functia ggplot pentru a ilustra relatia dintre lungimea petalelor si lungimea sepalelor
ggplot(iris, aes(x=PetalLengthCm, y=SepalLengthCm))+geom_point()
```




```
#folosesc ggplot pentru a ilustra relatia dintre grosimea petalelor si grosimea sepalelor
ggplot(iris, aes(x=SepalWidthCm, y=PetalWidthCm))+geom_point()
```

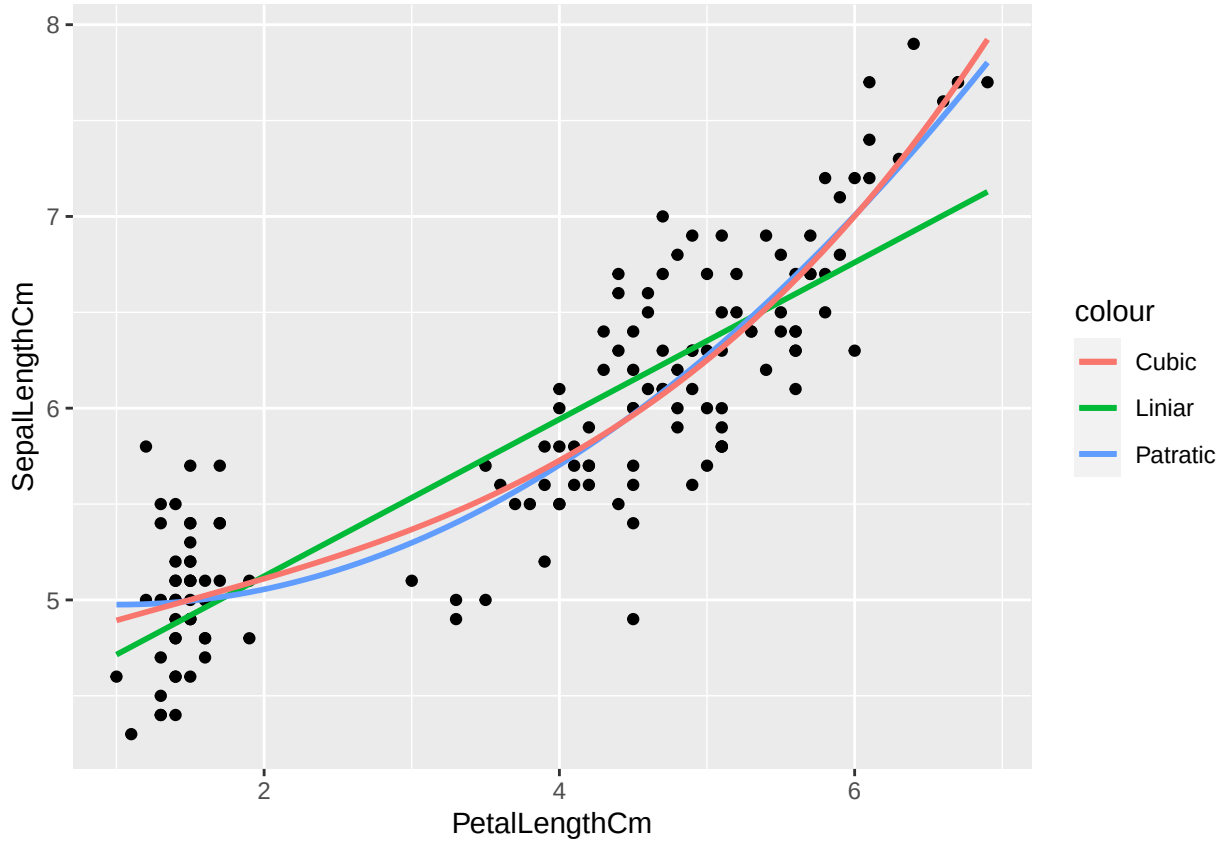



```
#folosesc ggplot pentru a ilustra relatia dintre lungimea petalelor si grosimea petalelor
ggplot(iris, aes(x=PetalLengthCm, y=PetalWidthCm))+geom_point()
```




```
#in continuare utilizez coloanele PetalLengthCm si SepalLengthCm din setul de date
#cele 3 drepte de regresie
ggplot(iris, aes(x = PetalLengthCm, y = SepalLengthCm)) +
  geom_point() +
  #regresia liniara
  geom_smooth(method = "lm",
              se = FALSE,
              aes(color = "Liniar") ) +
  #regresia patratica
  geom_smooth(method = "lm",
              formula = y ~ poly(x, 2),
              se = FALSE,
              aes(color = "Patratic") ) +
  #regresia cubica
  geom_smooth(method = "lm",
              formula = y ~ poly(x, 3),
              se = FALSE,
              aes(color = "Cubic") )
```

```
## `geom_smooth()` using formula 'y ~ x'
```




```
#estimatorii parametrilor beta1 si beta0 prin metoda celor mai mici patrate
b1 = cov(iris$PetalLengthCm, iris$SepalLengthCm)/var(iris$PetalLengthCm)
cat("b1 = ", b1, "\n")
```

```
## b1 =  0.4091259
```

```
b0 = mean(iris$SepalLengthCm) - b1*mean(iris$PetalLengthCm)
cat("b0 = ", b0)
```

```
## b0 =  4.305565
```

```
#inregistrez modelul de regresie (in functie de petale si am pus P)
iris_modelP=lm(lm(SepalLengthCm~PetalLengthCm,data=iris))

#coeficientii modelului
iris_modelP$coefficients
```

```
##   (Intercept) PetalLengthCm
##     4.3055655     0.4091259
```

```
#interpretare :daca lungimea sepalelor ar fi 0, atunci lungimea sepalelor ar fi 4.305565. de asemenea,
#sepalelor ar creste cu 10cm, atunci lungimea sepalelor ar creste cu 1.8 cm. ??

#valorile reziduale
cat('Valorile reziduale sunt:')
```

```
## Valorile reziduale sunt:
```

```
iris_modelP$residuals
```

```
##           1           2           3           4           5           6
##  0.22165829  0.02165829 -0.13742912 -0.31925430  0.12165829  0.39892052
##           7           8           9          10          11          12
## -0.27834171  0.08074570 -0.47834171 -0.01925430  0.48074570 -0.16016689
##          13          14          15          16          17          18
## -0.07834171 -0.45560394  1.00348347  0.78074570  0.56257088  0.22165829
##          19          20          21          22          23          24
##  0.69892052  0.18074570  0.39892052  0.18074570 -0.11469135  0.09892052
##          25          26          27          28          29          30
## -0.28290466  0.03983311  0.03983311  0.28074570  0.32165829 -0.26016689
##          31          32          33          34          35          36
## -0.16016689  0.48074570  0.28074570  0.62165829 -0.01925430  0.20348347
##          37          38          39          40          41          42
##  0.66257088 -0.01925430 -0.43742912  0.18074570  0.16257088 -0.33742912
##          43          44          45          46          47          48
## -0.43742912  0.03983311  0.01709534 -0.07834171  0.13983311 -0.27834171
##          49          50          51          52          53          54
##  0.38074570  0.12165829  0.77154282  0.25336800  0.58971764 -0.44206905
##          55          56          57          58          59          60
##  0.31245541 -0.44663200  0.07154282 -0.75568092  0.41245541 -0.70115646
##          61          62          63          64          65          66
## -0.73750610 -0.12389423  0.05793095 -0.12845718 -0.17841869  0.59428059
##          67          68          69          70          71          72
## -0.54663200 -0.18298164  0.05336800 -0.30115646 -0.36936977  0.15793095
##          73          74          75          76          77          78
## -0.01028236 -0.12845718  0.33519318  0.49428059  0.53063023  0.34880505
##          79          80          81          82          83          84
## -0.14663200 -0.03750610 -0.36024387 -0.31933128 -0.10115646 -0.39210754
##          85          86          87          88          89          90
## -0.74663200 -0.14663200  0.47154282  0.19428059 -0.38298164 -0.44206905
##          91          92          93          94          95          96
## -0.60571941 -0.08754459 -0.14206905 -0.65568092 -0.42389423 -0.32389423
##          97          98          99         100         101         102
## -0.32389423  0.13519318 -0.43294315 -0.28298164 -0.46032085 -0.59210754
##         103         104         105         106         107         108
##  0.38059174 -0.29667049 -0.17849567  0.59420361 -1.24663200  0.41694138
##         109         110         111         112         113         114
##  0.02150433  0.39876656  0.10789246 -0.07393272  0.24424210 -0.65119495
##         115         116         117         118         119         120
## -0.59210754 -0.07393272 -0.05575790  0.65329102  0.57146584 -0.35119495
##         121         122         123         124         125         126
##  0.26241692 -0.71028236  0.65329102 -0.01028236  0.06241692  0.43967915
##         127         128         129         130         131         132
## -0.06936977 -0.21028236 -0.19667049  0.52150433  0.59876656  0.97602879
##         133         134         135         136         137         138
## -0.19667049 -0.09210754 -0.49667049  0.89876656 -0.29667049 -0.15575790
##         139         140         141         142         143         144
## -0.26936977  0.38515469  0.10332951  0.50789246 -0.59210754  0.08059174
##         145         146         147         148         149         150
##  0.06241692  0.26697987 -0.05119495  0.06697987 -0.31484531 -0.49210754
```

```
#valorile ajustate
cat('Valorile ajustate sunt:')
```

```
## Valorile ajustate sunt:
```

```
iris_modelP$fitted.values
```

```
##        1        2        3        4        5        6        7        8
## 4.878342 4.878342 4.837429 4.919254 4.878342 5.001079 4.878342 4.919254
##        9       10       11       12       13       14       15       16
## 4.878342 4.919254 4.919254 4.960167 4.878342 4.755604 4.796517 4.919254
##       17       18       19       20       21       22       23       24
## 4.837429 4.878342 5.001079 4.919254 5.001079 4.919254 4.714691 5.001079
##       25       26       27       28       29       30       31       32
## 5.082905 4.960167 4.960167 4.919254 4.878342 4.960167 4.960167 4.919254
##       33       34       35       36       37       38       39       40
## 4.919254 4.878342 4.919254 4.796517 4.837429 4.919254 4.837429 4.919254
##       41       42       43       44       45       46       47       48
## 4.837429 4.837429 4.837429 4.960167 5.082905 4.878342 4.960167 4.878342
##       49       50       51       52       53       54       55       56
## 4.919254 4.878342 6.228457 6.146632 6.310282 5.942069 6.187545 6.146632
##       57       58       59       60       61       62       63       64
## 6.228457 5.655681 6.187545 5.901156 5.737506 6.023894 5.942069 6.228457
##       65       66       67       68       69       70       71       72
## 5.778419 6.105719 6.146632 5.982982 6.146632 5.901156 6.269370 5.942069
##       73       74       75       76       77       78       79       80
## 6.310282 6.228457 6.064807 6.105719 6.269370 6.351195 6.146632 5.737506
##       81       82       83       84       85       86       87       88
## 5.860244 5.819331 5.901156 6.392108 6.146632 6.146632 6.228457 6.105719
##       89       90       91       92       93       94       95       96
## 5.982982 5.942069 6.105719 6.187545 5.942069 5.655681 6.023894 6.023894
##       97       98       99      100      101      102      103      104
## 6.023894 6.064807 5.532943 5.982982 6.760321 6.392108 6.719408 6.596670
##      105      106      107      108      109      110      111      112
## 6.678496 7.005796 6.146632 6.883059 6.678496 6.801233 6.392108 6.473933
##      113      114      115      116      117      118      119      120
## 6.555758 6.351195 6.392108 6.473933 6.555758 7.046709 7.128534 6.351195
##      121      122      123      124      125      126      127      128
## 6.637583 6.310282 7.046709 6.310282 6.637583 6.760321 6.269370 6.310282
##      129      130      131      132      133      134      135      136
## 6.596670 6.678496 6.801233 6.923971 6.596670 6.392108 6.596670 6.801233
##      137      138      139      140      141      142      143      144
## 6.596670 6.555758 6.269370 6.514845 6.596670 6.392108 6.392108 6.719408
##      145      146      147      148      149      150
## 6.637583 6.433020 6.351195 6.433020 6.514845 6.392108
```

```
#gradele de libertate
cat('numarul de grade de libertate:')
```

```
## numarul de grade de libertate:
```

```
iris_modelP$df.residual
```

```
## [1] 148
```

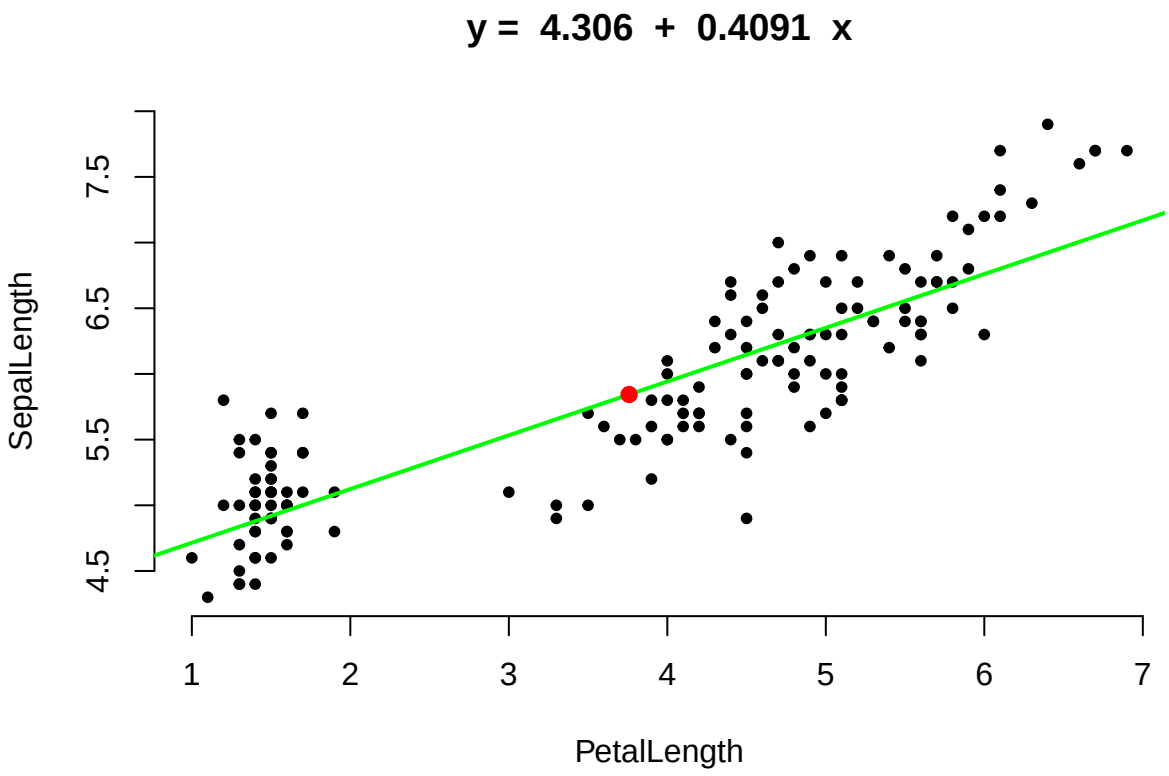
```
#am pus sumarul modelului de regresie intr-o variabila
Siris<-summary(iris_modelP)

#afisez sumarul modelului de regresie
summary(iris_modelP)
```

```
##
## Call:
## lm(formula = lm(SepalLengthCm ~ PetalLengthCm, data = iris))
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.24663 -0.29667 -0.01925  0.27730  1.00348
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)    4.30557    0.07843   54.90   <2e-16 ***
## PetalLengthCm  0.40913    0.01890   21.65   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.4071 on 148 degrees of freedom
## Multiple R-squared:   0.76,  Adjusted R-squared:  0.7583
## F-statistic: 468.6 on 1 and 148 DF,  p-value: < 2.2e-16
```

```
#matricea varianta-covarianta a modelului:
w=vcov(iris_modelP)
w
```

```
##                (Intercept) PetalLengthCm
## (Intercept)    0.006151619 -0.0013427343
## PetalLengthCm -0.001342734  0.0003572369
```

```
#aratam ca dreapta de regresie trece prin punctul (x,y)

plot(iris$PetalLengthCm, iris$SepalLengthCm,
     xlab = "PetalLength",
     ylab = "SepalLength",
     col = "black",
     pch = 20,
     bty="n",
     main = paste("y = ", format(b0, digits = 4), " + ",
                  format(b1, digits = 4), " x"))
abline(a = b0, b = b1, col = "green", lwd = 2)
points(mean(iris$PetalLengthCm), mean(iris$SepalLengthCm),
       pch = 16,
       col = "red",
       cex = 1.2)
text(mean(iris$PetalLengthCm), mean(iris$SepalLengthCm)-2,
     col = "magenta", cex = 1.4,
     labels = expression(paste("(", bar(x), ",", bar(y),")")))
```




```
#estimatorul sigma_hat pentru sigma
n = length(iris$SepalLengthCm)
e_hat = iris$SepalLengthCm - (b0+b1*iris$PetalLengthCm)
rss = sum(e_hat^2)

#intervale de incredere
confint(iris_modelP)
```

```
##                   2.5 %   97.5 %
## (Intercept)   4.1505737 4.460557
## PetalLengthCm 0.3717758 0.446476
```

```
#elipsa
library(ellipse)
```

```
## Warning: package 'ellipse' was built under R version 3.6.3
```

```
##
## Attaching package: 'ellipse'
```

```
## The following object is masked from 'package:graphics':
##
##     pairs
```

```
library(car)
```

```
## Warning: package 'car' was built under R version 3.6.3
```

```
## Loading required package: carData
```

```
## Warning: package 'carData' was built under R version 3.6.3
```

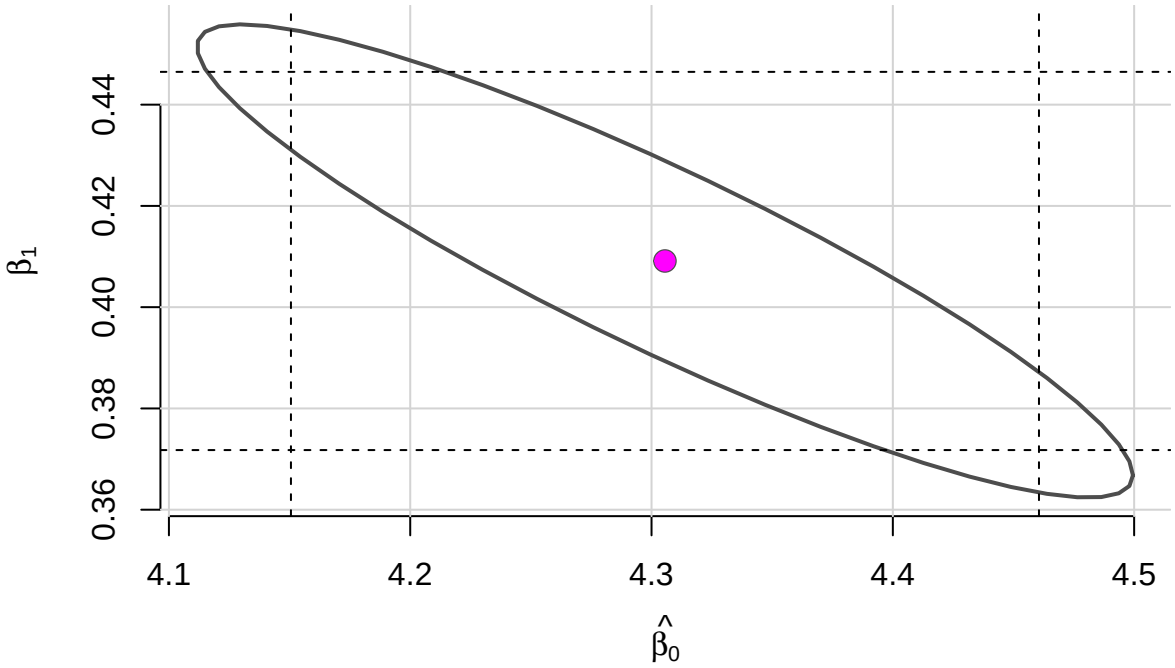
```
##
## Attaching package: 'car'
```

```
## The following object is masked from 'package:ellipse':
##
##     ellipse
```

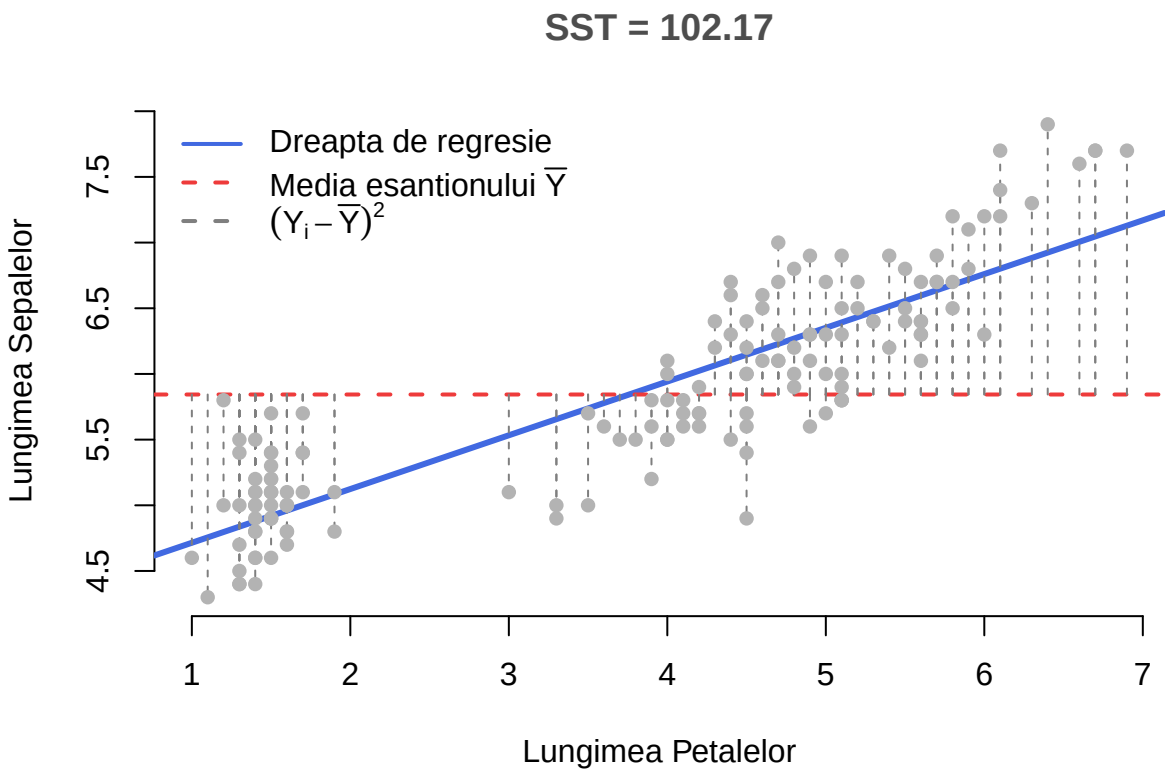
```
## The following object is masked from 'package:dplyr':
##
##     recode
```

```
## The following object is masked from 'package:purrr':
##
##     some
```

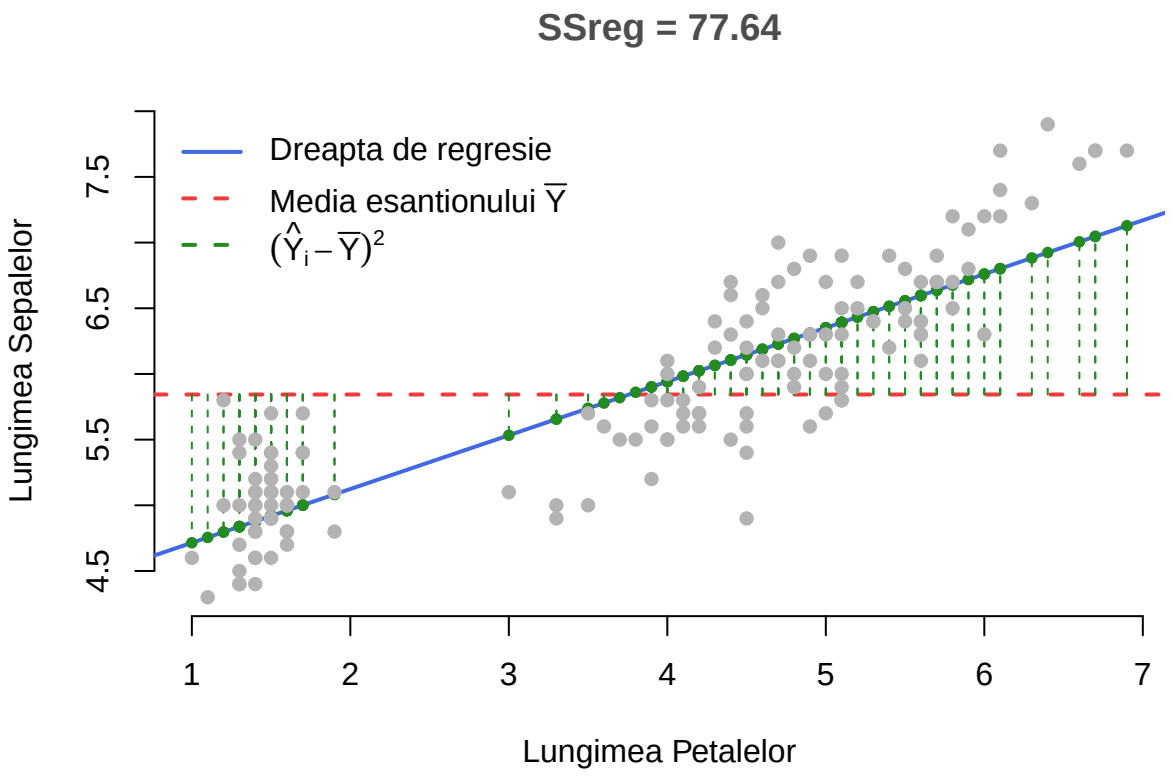
```
par(bty = "n")
# trasam regiunea de incredere
confidenceEllipse(iris_modelP,
                  xlab = expression(hat(beta[0])),
                  ylab = expression(hat(beta[1])),
                  col = "grey30")
points(coef(iris_modelP)[1], coef(iris_modelP)[2],
       pch = 20, col = "magenta",
       cex = 2)
# trasam intervalele de incredere
abline(v = confint(iris_modelP)[1,], lty = 2)
abline(h = confint(iris_modelP)[2,], lty = 2)
```



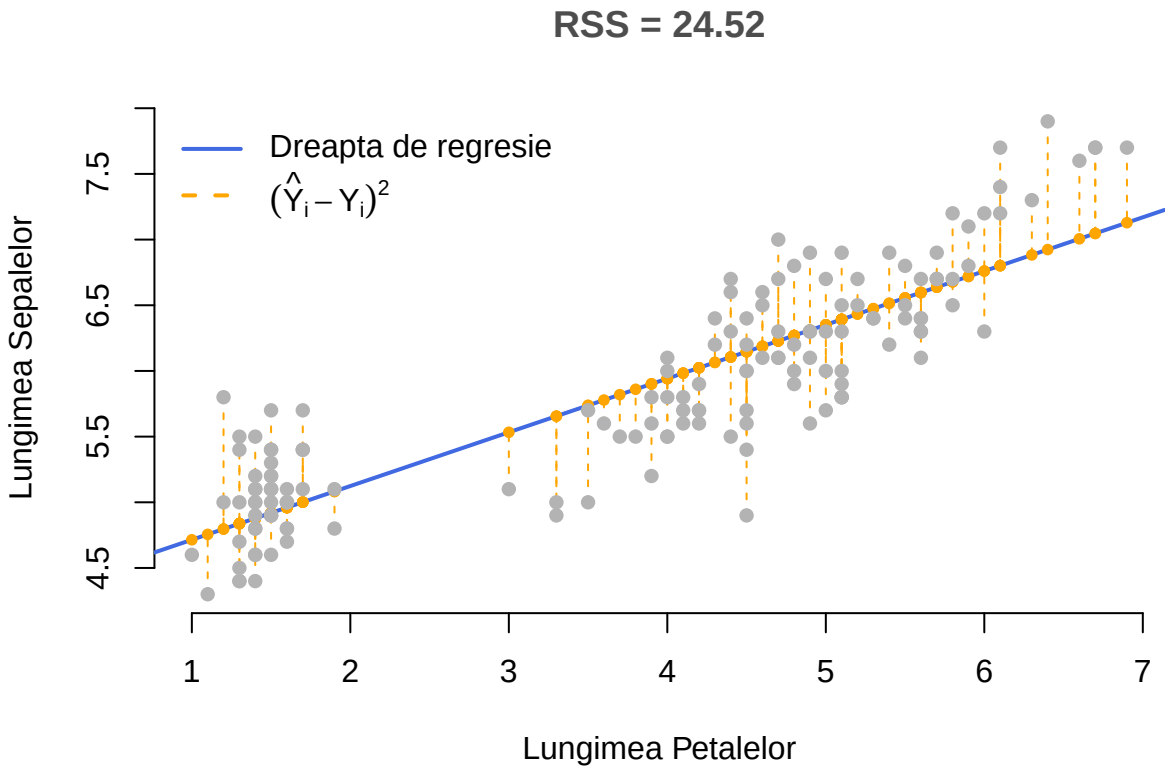

```
#descompunerea anova ilustrata prin metoda abaterilor patratice totala
plot(iris$PetalLengthCm, iris$SepalLengthCm, pch = 20, type = "n",
     main = paste("SST =", round(sum((iris$SepalLengthCm -
                                        mean(iris$SepalLengthCm))^2), 2)),
     col.main = "grey30",
     xlab = "Lungimea Petalelor",
     ylab = "Lungimea Sepalelor",
     bty = "n")
abline(iris_modelP$coefficients, col = "royalblue",lwd=3)
abline(h = mean(iris$SepalLengthCm), col = "brown2", lty = 2, lwd = 2)
segments(x0 = iris$PetalLengthCm, y0 = mean(iris$SepalLengthCm),
         x1 = iris$PetalLengthCm, y1 = iris$SepalLengthCm,
         col = "grey50", lwd = 1, lty = 2)
legend("topleft",
       legend = expression("Dreapta de regresie", "Media esantionului " * bar(Y),
                           (Y[i] - bar(Y))^2),
       lwd = c(2, 2, 2),
       col = c("royalblue", "brown2", "grey50"),
       lty = c(1, 2, 2),
       bty = "n")
points(iris$PetalLengthCm, iris$SepalLengthCm, pch = 16, col = "grey70")
```




```r
#descompunerea anova ilustrata prin suma abaterilor patratice de regresie
plot(iris$PetalLengthCm, iris$SepalLengthCm, pch = 20, type = "n",
     main = paste("SSreg =",
                  round(sum((iris_modelP$fitted.values -
                               mean(iris$SepalLengthCm))^2), 2)),
     col.main = "grey30",
     xlab = "Lungimea Petalelor",
     ylab = "Lungimea Sepalelor",
     bty = "n")
abline(iris_modelP$coefficients, col = "royalblue", lwd = 2)
abline(h = mean(iris$SepalLengthCm), col = "brown2", lty = 2, lwd = 2)
segments(x0 = iris$PetalLengthCm, y0 = mean(iris$SepalLengthCm),
         x1 = iris$PetalLengthCm, y1 = iris_modelP$fitted.values,
         col = "forestgreen", lwd = 1, lty = 2)
points(iris$PetalLengthCm, iris_modelP$fitted.values, pch = 20, col = "forestgreen")
legend("topleft",
       legend = expression("Dreapta de regresie", "Media esantionului " * bar(Y),
                           (hat(Y)[i] - bar(Y))^2),
       lwd = c(2, 2, 2),
       col = c("royalblue", "brown2", "forestgreen"),
       lty = c(1, 2, 2),
       bty = "n")
points(iris$PetalLengthCm, iris$SepalLengthCm, pch = 16, col = "grey70")
```




```
#descompunerea anova prin suma abaterilor patratice reziduale
plot(iris$PetalLengthCm, iris$SepalLengthCm, pch = 20, type = "n",
     main = paste("RSS =",
                  round(sum((iris$SepalLengthCm - iris_modelP$fitted.values)^2), 2)),
     col.main = "grey30",
     xlab = "Lungimea Petalelor",
     ylab = "Lungimea Sepalelor",
     bty = "n")
abline(iris_modelP$coefficients, col = "royalblue", lwd = 2)
segments(x0 = iris$PetalLengthCm, y0 = iris$SepalLengthCm,
         x1 = iris$PetalLengthCm, y1 = iris_modelP$fitted.values,
         col = "orange", lwd = 1, lty = 2)
points(iris$PetalLengthCm, iris_modelP$fitted.values, pch = 20, col = "orange")
legend("topleft",
       legend = expression("Dreapta de regresie", (hat(Y)[i] - Y[i])^2),
       lwd = c(2, 2),
       col = c("royalblue", "orange"),
       lty = c(1, 2),
       bty = "n")
points(iris$PetalLengthCm, iris$SepalLengthCm, pch = 16, col = "grey70")
```




```
#Tabelul anova
anova(iris_modelP)
```

```
## Analysis of Variance Table
##
## Response: SepalLengthCm
##                Df Sum Sq Mean Sq F value    Pr(>F)
## PetalLengthCm   1 77.643  77.643  468.55 < 2.2e-16 ***
## Residuals     148 24.525   0.166
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
summary(iris_modelP)
```

```
##
## Call:
## lm(formula = lm(SepalLengthCm ~ PetalLengthCm, data = iris))
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.24663 -0.29667 -0.01925  0.27730  1.00348
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)    4.30557    0.07843   54.90   <2e-16 ***
## PetalLengthCm  0.40913    0.01890   21.65   <2e-16 ***
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.4071 on 148 degrees of freedom
## Multiple R-squared:   0.76,  Adjusted R-squared:  0.7583
## F-statistic: 468.6 on 1 and 148 DF,  p-value: < 2.2e-16
```

```
lm(formula = SepalLengthCm ~ PetalLengthCm, data = iris)
```

```
##
## Call:
## lm(formula = SepalLengthCm ~ PetalLengthCm, data = iris)
##
## Coefficients:
##   (Intercept)  PetalLengthCm
##        4.3056         0.4091
```

```
#Predictie
newData = data.frame(PetalLengthCm = 6)
newData2 = data.frame(PetalLengthCm = c(130, 140, 150))

# Predictie
predict(iris_modelP, newdata = newData)
```

```
##        1
## 6.760321
```

```
# Predictie pentru valoarea raspunsului mediu
predict(iris_modelP, newdata = newData, interval = "confidence")
```

```
##        fit      lwr      upr
## 1 6.760321 6.653916 6.866726
```

```
predict(iris_modelP, newdata = newData2, interval = "confidence")
```

```
##        fit      lwr      upr
## 1 57.49193 52.77635 62.20752
## 2 61.58319 56.49414 66.67225
## 3 65.67445 60.21192 71.13698
```

```
# Predictie asupra observatiilor viitoare
predict(iris_modelP, newdata = newData, interval = "prediction")
```

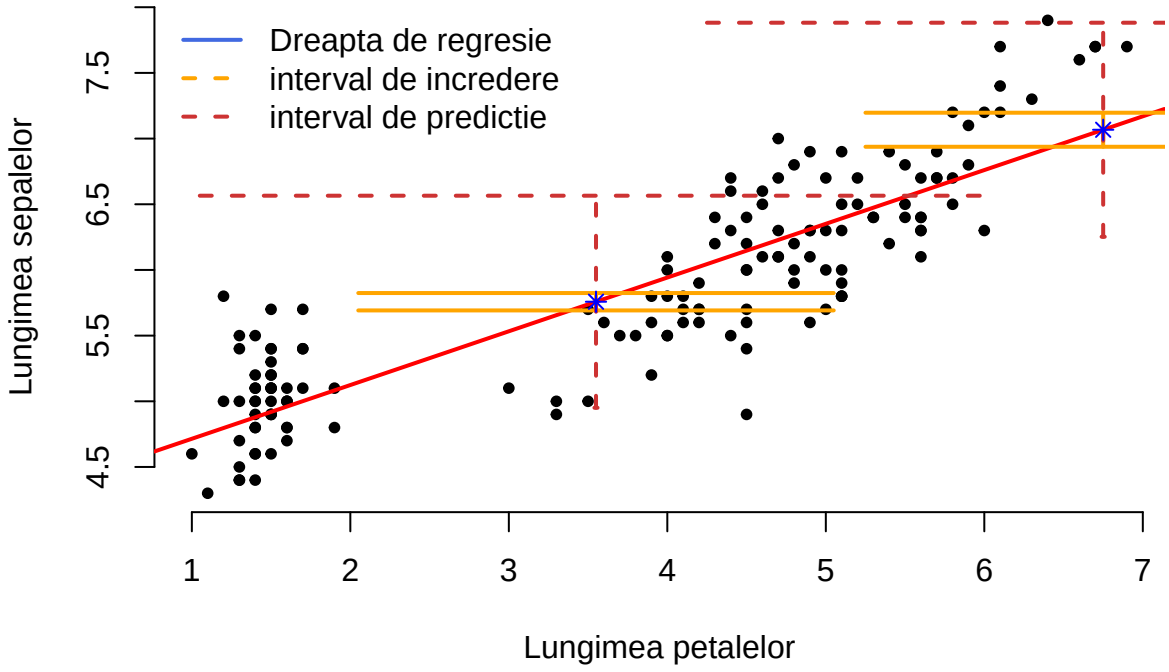
```
##        fit      lwr      upr
## 1 6.760321 5.948886 7.571756
```

```
predict(iris_modelP, newdata = newData2, interval = "prediction")
```

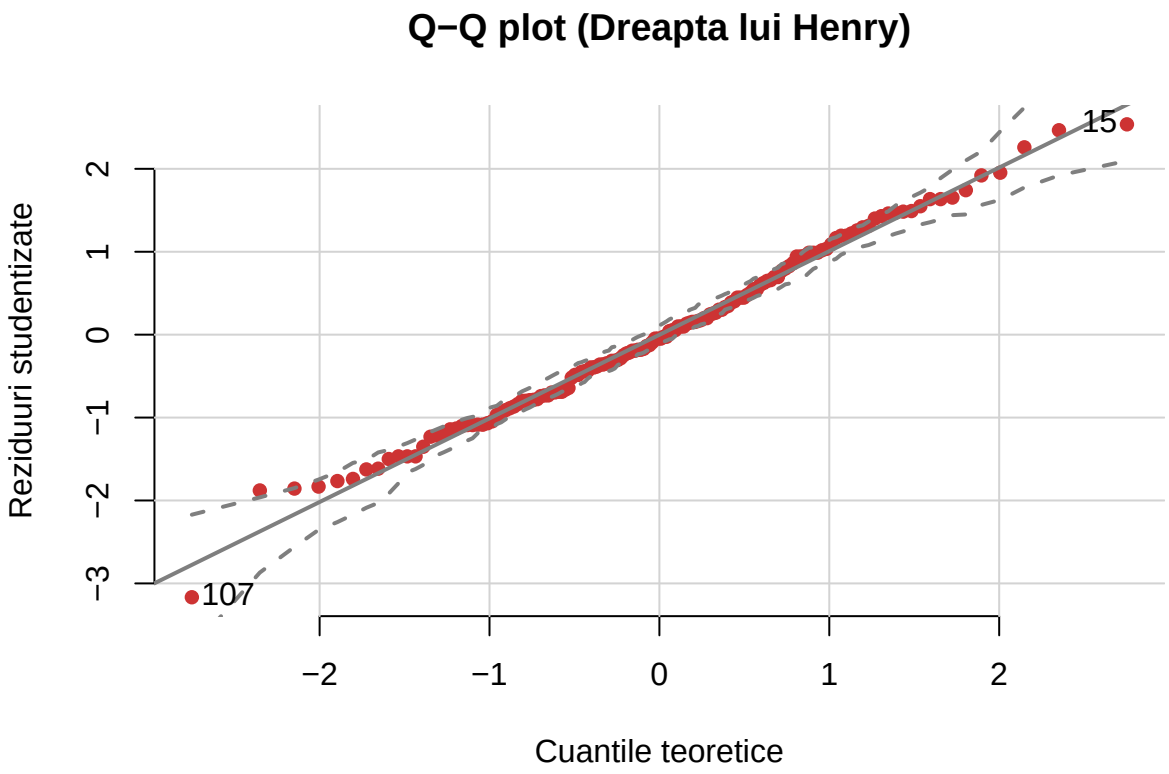
```
##        fit      lwr      upr
## 1 57.49193 52.70822 62.27564
## 2 61.58319 56.43095 66.73543
## 3 65.67445 60.15301 71.19589
```

```
alpha = 0.005
x0 = c(3.55,6.75)

p.conf = predict(iris_modelP, data.frame(PetalLengthCm = x0), se = T, interval = "confidence")
p.pred = predict(iris_modelP, data.frame(PetalLengthCm = x0), se = T, interval = "prediction")

# diagrama de imprastiesre
```

```r
plot(iris$PetalLengthCm, iris$SepalLengthCm,
     col = "black", pch = 20,
     xlab = "Lungimea petalelor",
     ylab = "Lungimea sepalelor",
     bty = "n")
#dreapta de regresie
abline(iris_modelP$coefficients, col = "red", lwd = 2)

#intervalele de incredere
segments(x0 = x0, y0 = p.conf$fit[,2], x1 = x0, y1 = p.conf$fit[,3],
         col = "orange", lty = 1, lwd = 2)
segments(x0 = x0-1.5, y0 = p.conf$fit[,2], x1 = x0+1.5, y1 = p.conf$fit[,2],
         col = "orange", lty = 1, lwd = 2)
segments(x0 = x0-1.5, y0 = p.conf$fit[,3], x1 = x0+1.5, y1 = p.conf$fit[,3],
         col = "orange", lty = 1, lwd = 2)

#intervalele de predictie
segments(x0 = x0, y0 = p.pred$fit[,2], x1 = x0, y1 = p.pred$fit[,3],
         col = "brown3", lty = 2, lwd = 2)
segments(x0 = x0-0.01, y0 = p.pred$fit[,2], x1 = x0+0.01, y1 = p.pred$fit[,2],
         col = "brown3", lty = 2, lwd = 2)
segments(x0 = x0-2.5, y0 = p.pred$fit[,3], x1 = x0+2.5, y1 = p.pred$fit[,3],
         col = "brown3", lty = 2, lwd = 2)
# valoarea prezisa
points(x0, p.conf$fit[,1],
       col = "blue",
       pch = 8)
legend("topleft",
       legend = c("Dreapta de regresie",
                  "interval de incredere",
                  "interval de predictie"),
       lwd = c(2, 2, 2),
       col = c("royalblue", "orange", "brown3"),
       lty = c(1, 2, 2),
       bty = "n")
```

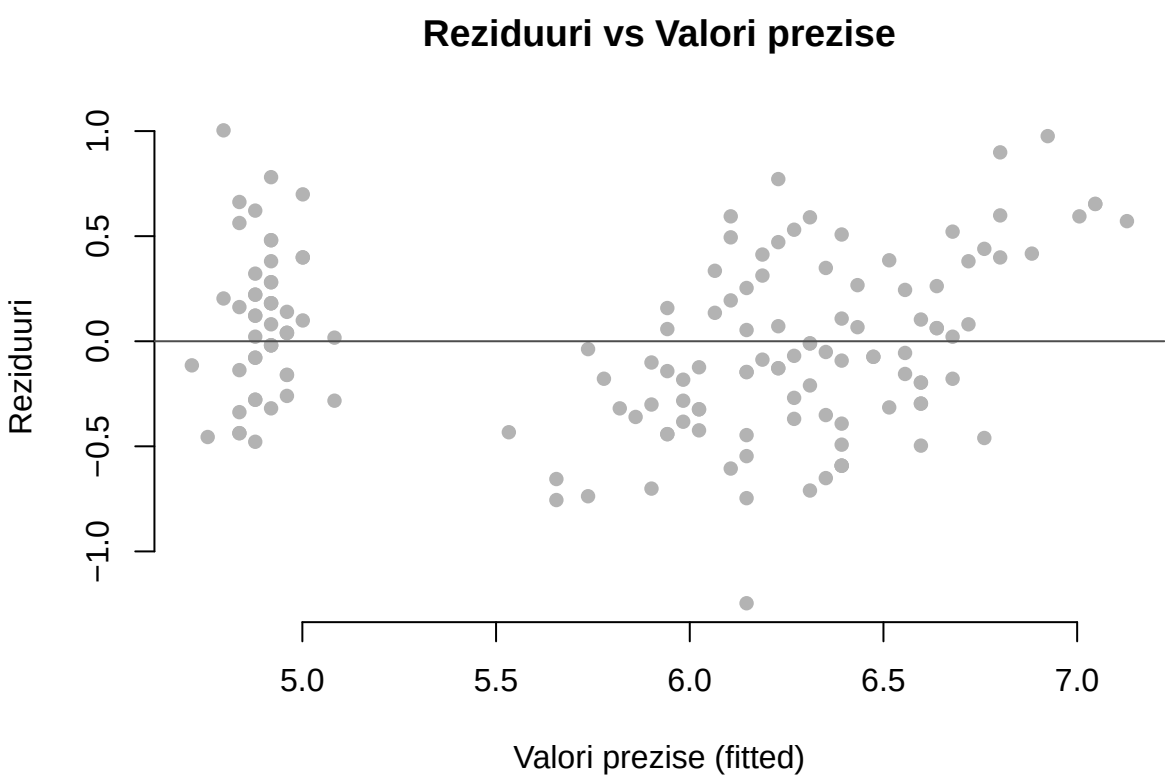



```
library(car)
par(bty = "n")
qqPlot(iris_modelP, col = "brown3", col.lines = "grey50", pch = 16,
       simulate = TRUE,
       xlab = "Cuantile teoretice",
       ylab = "Reziduuri studentizate",
       main = "Q-Q plot (Dreapta lui Henry)",
       bty = "n")
```




```
## [1]  15 107
```

```
plot(residuals(iris_modelP)~fitted(iris_modelP),
     col = "grey70", pch = 16,
     xlab = "Valori prezise (fitted)",
     ylab = "Reziduuri",
     main = "Reziduuri vs Valori prezise",
     bty = "n")
abline(h = 0, col = "grey30")
```


Reziduuri vs Valori prezise
Reziduuri
1.0
0.5
0.0
−0.5
−1.0
5.0
5.5
6.0
6.5
7.0
Valori prezise (fitted)