Entregable 1 solucions

R Markdown

```
setwd("~/pie")
library(car)
```

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

```
library(nlme)

dd<-read.csv2("dades.csv")

Days<-dd$Days
FDays<-as.factor(Days)

print("e1a")
```

```
## [1] "e1a"
```

```
print("Apartat 1")
```

```
## [1] "Apartat 1"
```

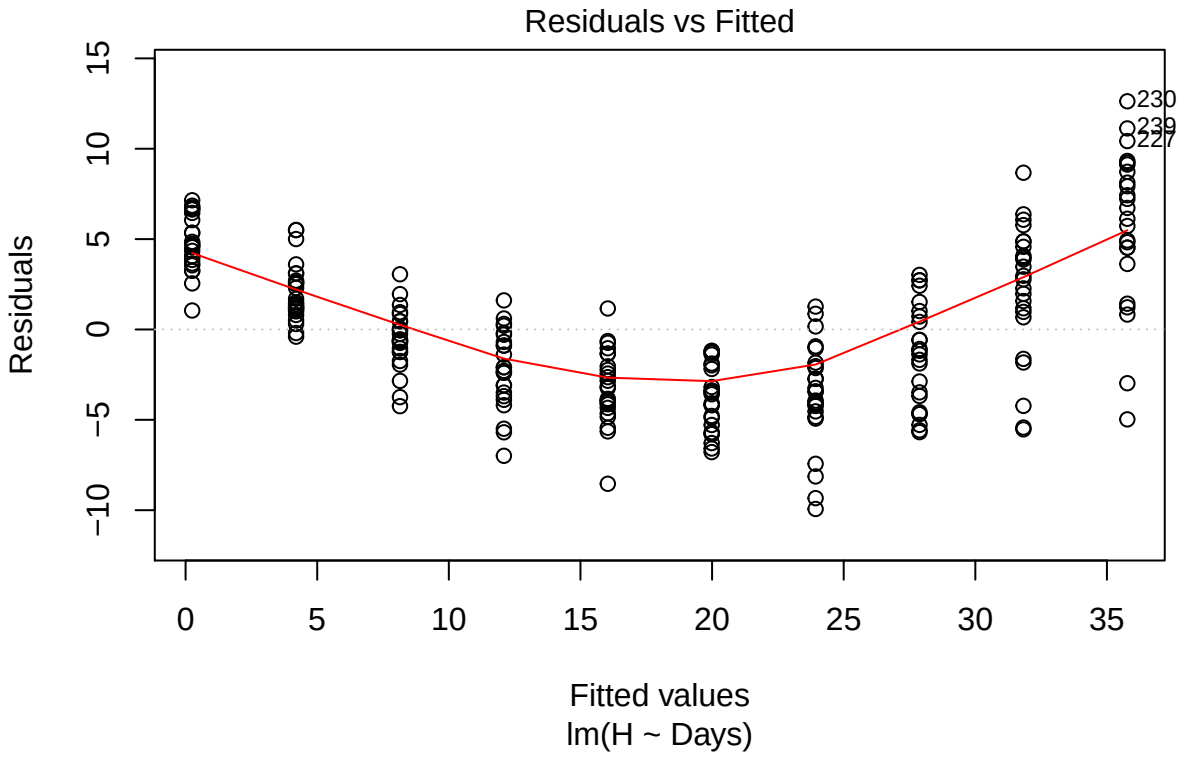
```
print(summary(e1a<-lm(H~Days,
                      data = dd)))
```

```
##
## Call:
## lm(formula = H ~ Days, data = dd)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -9.9336 -3.3865 -0.5807  2.9840 12.6252
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) -0.87676    0.52744  -1.662   0.0978 .
## Days         0.28193    0.00675  41.769   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 4.205 on 238 degrees of freedom
## Multiple R-squared:   0.88,  Adjusted R-squared:  0.8795
## F-statistic:  1745 on 1 and 238 DF,  p-value: < 2.2e-16
```

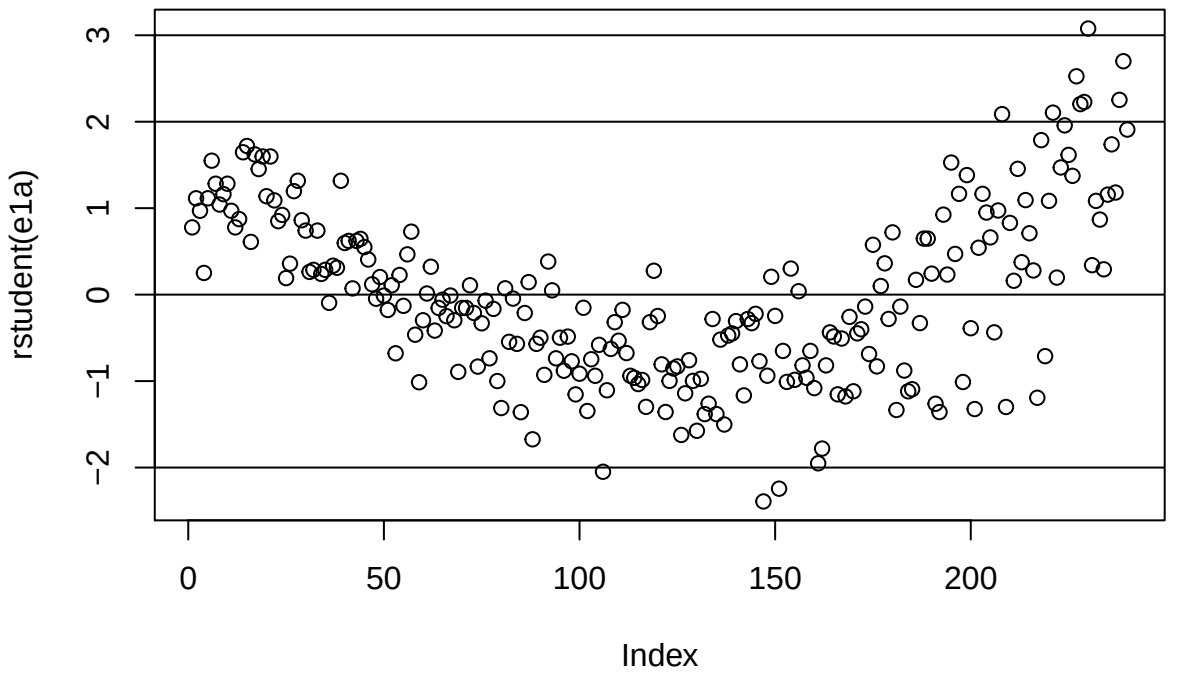
```
print("Apartat 2")
```

```
## [1] "Apartat 2"
```

```
plot(e1a,which=1)
```




```
plot(rstudent(e1a))
abline(h=c(-3,-2,0,2,3))
```




```
print("Apartat 3")
```

```
## [1] "Apartat 3"
```

```
print(anova(e1a,lm(H~Days+FDays,
                   data = dd)))
```

```
## Analysis of Variance Table
##
## Model 1: H ~ Days
## Model 2: H ~ Days + FDays
##   Res.Df    RSS Df Sum of Sq      F    Pr(>F)
## 1    238 4208.2
## 2    230 1575.0  8    2633.2 48.068 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
print(anova(lm(H~Days+FDays,
               data = dd)))
```

```
## Analysis of Variance Table
##
## Response: H
##            Df  Sum Sq Mean Sq  F value    Pr(>F)
## Days        1 30847.5 30847.5 4504.822 < 2.2e-16 ***
## FDays       8  2633.2   329.2   48.068 < 2.2e-16 ***
## Residuals 230  1575.0     6.8
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
print("Apartat 4")
```

```
## [1] "Apartat 4"
```

```
print(leveneTest(resid(e1a)~FDays))
```

```
## Levene's Test for Homogeneity of Variance (center = median)
##        Df F value    Pr(>F)
## group   9  4.4376 2.254e-05 ***
##       230
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
print("Apartat 5")
```

```
## [1] "Apartat 5"
```

```
customDays <- data.frame(Days=c(0,105,150))
print(cbind(mu = predict(e1a, customDays),
            sd = summary(e1a)$sigma))
```

```
##           mu       sd
## 1 -0.8767569 4.204923
## 2 28.7264628 4.204923
## 3 41.4135570 4.204923
```

```
print("e1b")
```

```
## [1] "e1b"
```

```
print("Apartat 1")
```

```
## [1] "Apartat 1"
```

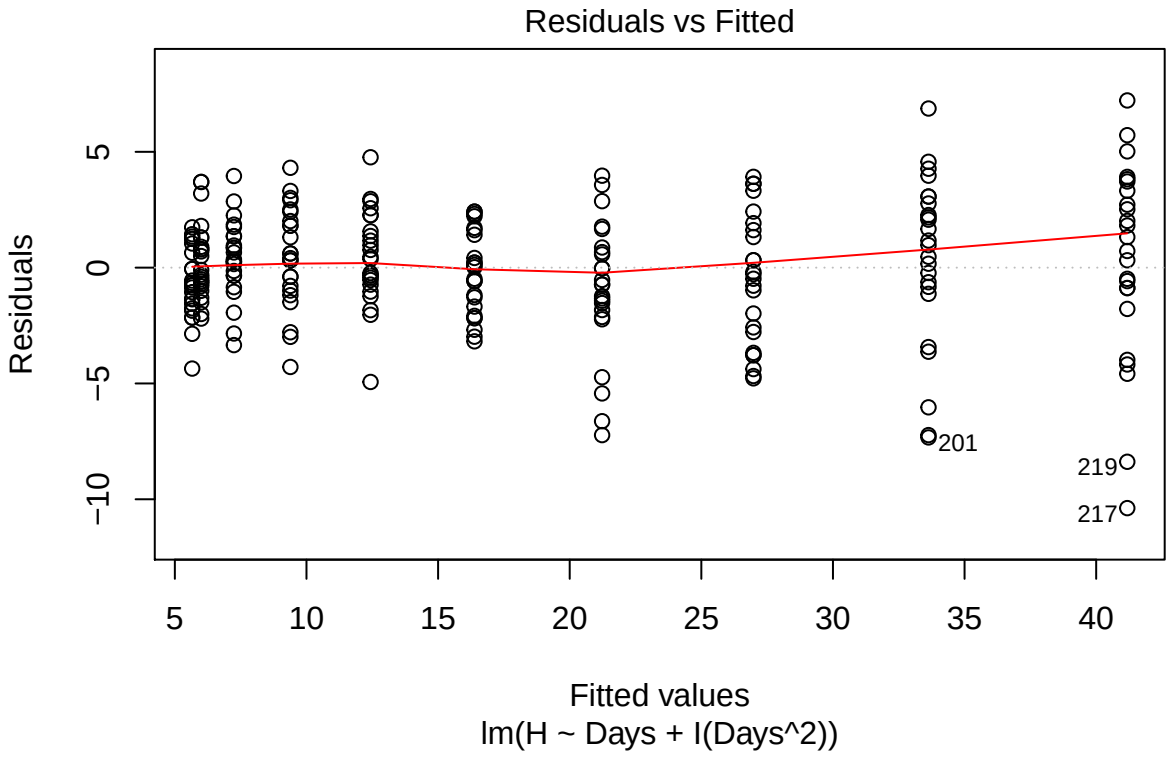
```
print(summary(e1b<-lm(H~Days+I(Days^2),
                      data = dd)))
```

```
##
## Call:
## lm(formula = H ~ Days + I(Days^2), data = dd)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -10.3817  -1.2865   0.0681   1.7241   7.2183
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)  5.7254463  0.4748874  12.056   <2e-16 ***
## Days        -0.0261061  0.0165027  -1.582    0.115
## I(Days^2)    0.0022988  0.0001191  19.307   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.627 on 237 degrees of freedom
## Multiple R-squared:  0.9533, Adjusted R-squared:  0.9529
## F-statistic:  2421 on 2 and 237 DF,  p-value: < 2.2e-16
```

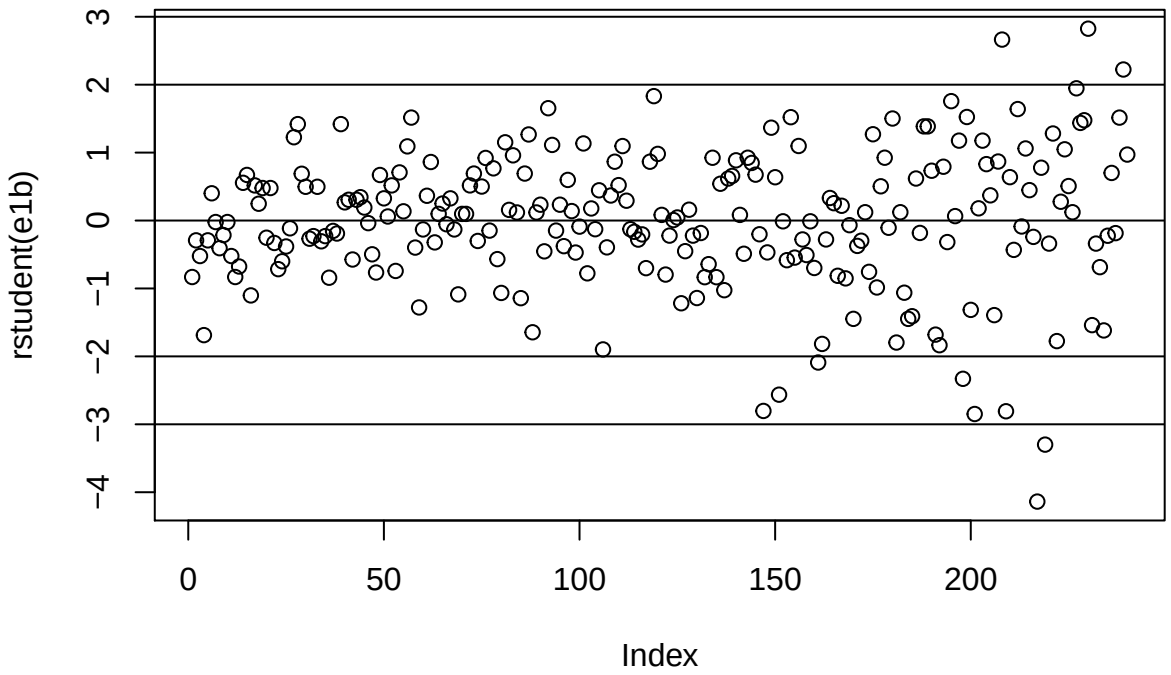
```
print("Apartat 2")
```

```
## [1] "Apartat 2"
```

```
plot(e1b,which=1)
```




```
plot(rstudent(e1b))
abline(h=c(-3,-2,0,2,3))
```




```
print("Apartat 3")
```

```
## [1] "Apartat 3"
```

```
print(anova(e1b, lm(H ~ Days + I(Days^2) + FDays,
                    data = dd)))
```

```
## Analysis of Variance Table
##
## Model 1: H ~ Days + I(Days^2)
## Model 2: H ~ Days + I(Days^2) + FDays
##   Res.Df    RSS Df Sum of Sq      F Pr(>F)
## 1    237 1635.6
## 2    230 1575.0  7     60.64 1.2651 0.2686
```

```
print(anova(lm(H ~ Days + I(Days^2) + FDays,
               data = dd)))
```

```
## Analysis of Variance Table
##
## Response: H
##             Df  Sum Sq Mean Sq   F value Pr(>F)
## Days         1 30847.5 30847.5 4504.8217 <2e-16 ***
## I(Days^2)    1  2572.6  2572.6  375.6845 <2e-16 ***
## FDays        7    60.6     8.7    1.2651 0.2686
## Residuals  230  1575.0     6.8
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
print("Apartat 4")
```

```
## [1] "Apartat 4"
```

```
print(leveneTest(resid(e1b)~FDays))
```

```
## Levene's Test for Homogeneity of Variance (center = median)
```

```
##        Df F value    Pr(>F)
## group   9  4.4376 2.254e-05 ***
##       230
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
print("Apartat 5")
```

```
## [1] "Apartat 5"
```

```
customDays <- data.frame(Days=c(0,105,150))
print(cbind(mu = predict(e1b, customDays),
            sd = summary(e1b)$sigma))
```

```
##          mu       sd
## 1  5.725446 2.627029
## 2 28.328767 2.627029
## 3 53.532922 2.627029
```

```
print("e1c")
```

```
## [1] "e1c"
```

```
print("Apartat 1")
```

```
## [1] "Apartat 1"
```

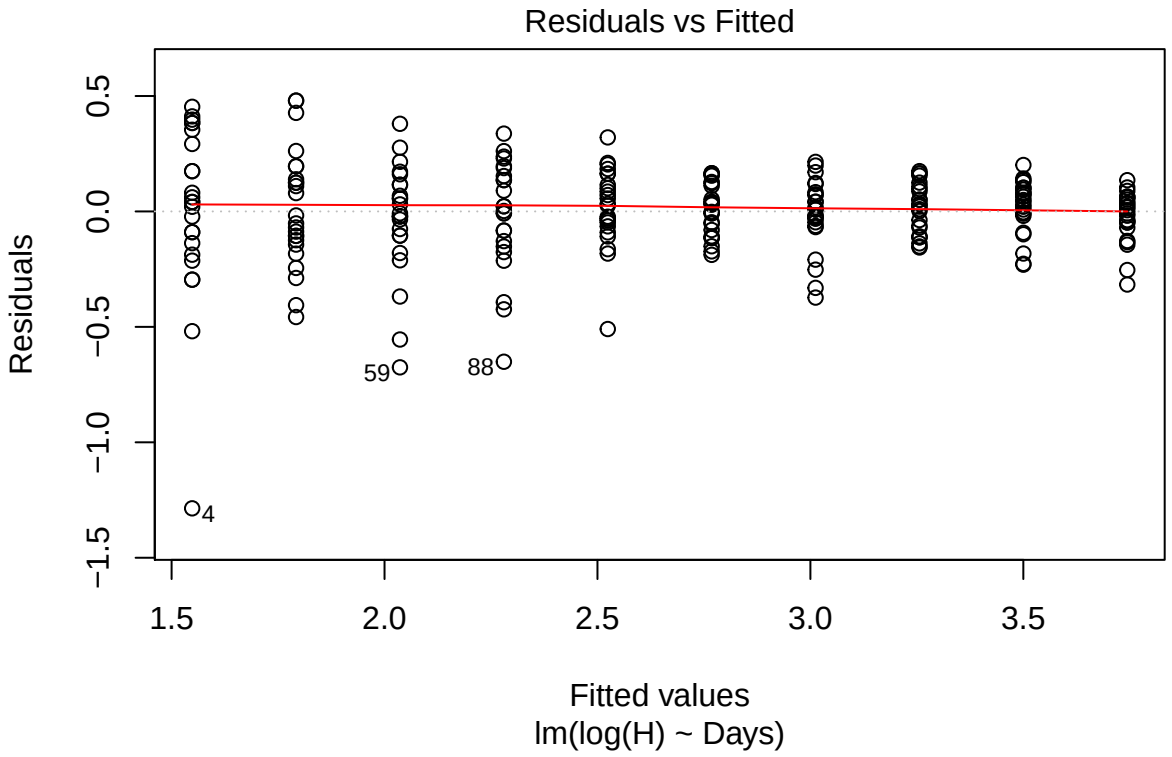
```
print(summary(e1c <- lm(log(H) ~ Days,
                        data = dd)))
```

```
##
## Call:
## lm(formula = log(H) ~ Days, data = dd)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.28596 -0.09103  0.02031  0.11549  0.47983
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 1.4786156  0.0255335   57.91   <2e-16 ***
## Days        0.0174268  0.0003268   53.33   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.2036 on 238 degrees of freedom
## Multiple R-squared:  0.9228, Adjusted R-squared:  0.9225
## F-statistic:  2844 on 1 and 238 DF,  p-value: < 2.2e-16
```

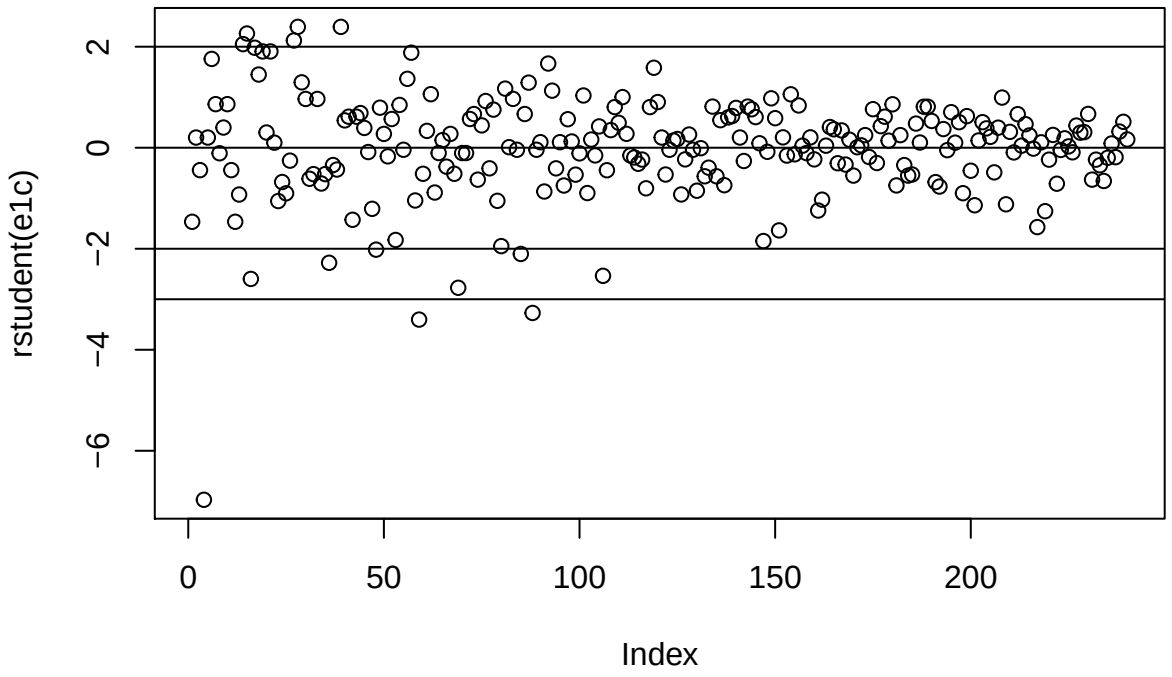
```
print("Apartat 2")
```

```
## [1] "Apartat 2"
```

```r
plot(e1c, which=1)
```




```r
plot(rstudent(e1c))
abline(h=c(-3,-2,0,2,3))
```




```r
print("Apartat 3")
```

```
## [1] "Apartat 3"
```

```
print(anova(e1c,lm(log(H) ~ Days + FDays,
                   data = dd)))
```

```
## Analysis of Variance Table
##
## Model 1: log(H) ~ Days
## Model 2: log(H) ~ Days + FDays
##   Res.Df    RSS Df Sum of Sq     F Pr(>F)
## 1    238 9.8619
## 2    230 9.7901  8  0.071846 0.211 0.9888
```

```
print(anova(lm(log(H) ~ Days + FDays,
               data = dd)))
```

```
## Analysis of Variance Table
##
## Response: log(H)
##            Df  Sum Sq Mean Sq  F value Pr(>F)
## Days        1 117.858 117.858 2768.861 <2e-16 ***
## FDays       8   0.072   0.009    0.211 0.9888
## Residuals 230   9.790   0.043
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
print("Apartat 4")
```

```
## [1] "Apartat 4"
```

```
print(leveneTest(resid(e1c) ~ FDays))
```

```
## Levene's Test for Homogeneity of Variance (center = median)
##        Df F value    Pr(>F)
## group   9  4.6179 1.264e-05 ***
##       230
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
print("Apartat 5")
```

```
## [1] "Apartat 5"
```

```
customDays <- data.frame(Days=c(0,105,150))
aa <- predict(e1c, customDays)
print(cbind(mu = exp(aa),
            sd = summary(e1c)$sigma*exp(aa)))
```

```
##          mu         sd
## 1  4.386868  0.8929901
## 2 27.342285  5.5657908
## 3 59.897962 12.1928187
```

```
print("e1d")
```

```
## [1] "e1d"
```

```
print("Apartat 1")
```

```
## [1] "Apartat 1"
```

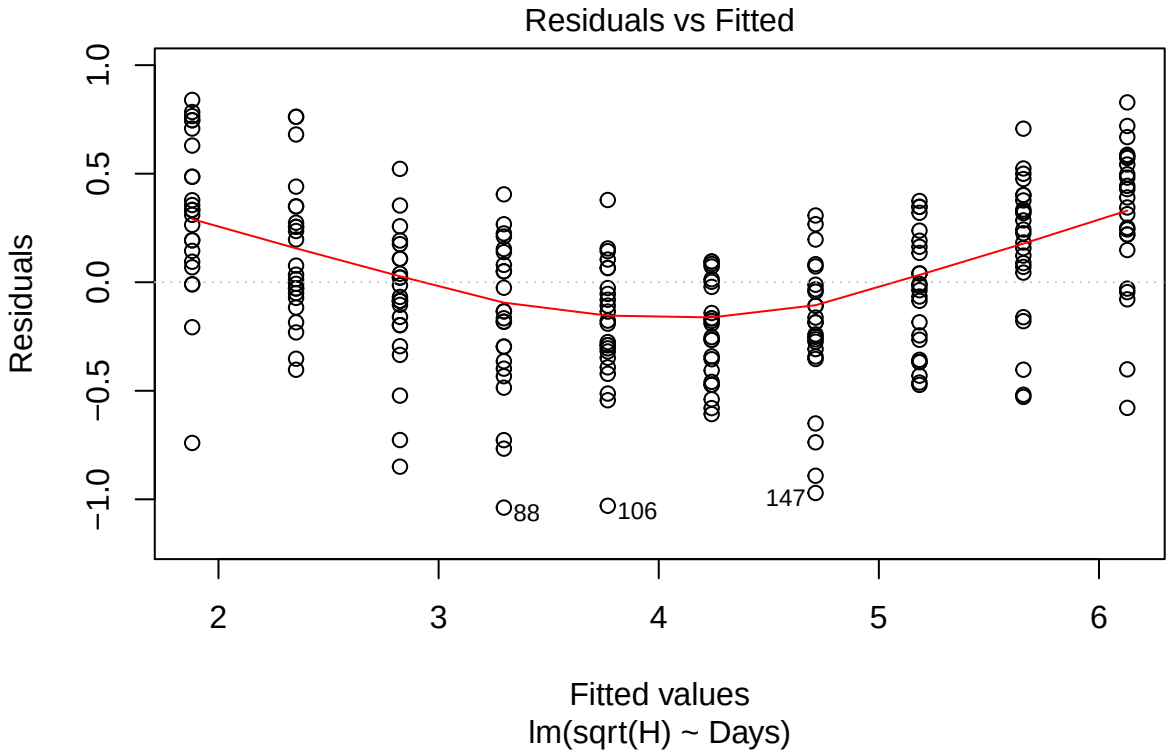
```
print(summary(e1d<-lm(sqrt(H)~Days,
                      data = dd)))
```

```
##
## Call:
## lm(formula = sqrt(H) ~ Days, data = dd)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.03819 -0.25549 -0.00866  0.25519  0.83981
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 1.7456237  0.0469070   37.22   <2e-16 ***
## Days        0.0337149  0.0006003   56.16   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.374 on 238 degrees of freedom
## Multiple R-squared:  0.9298, Adjusted R-squared:  0.9295
## F-statistic:  3154 on 1 and 238 DF,  p-value: < 2.2e-16
```

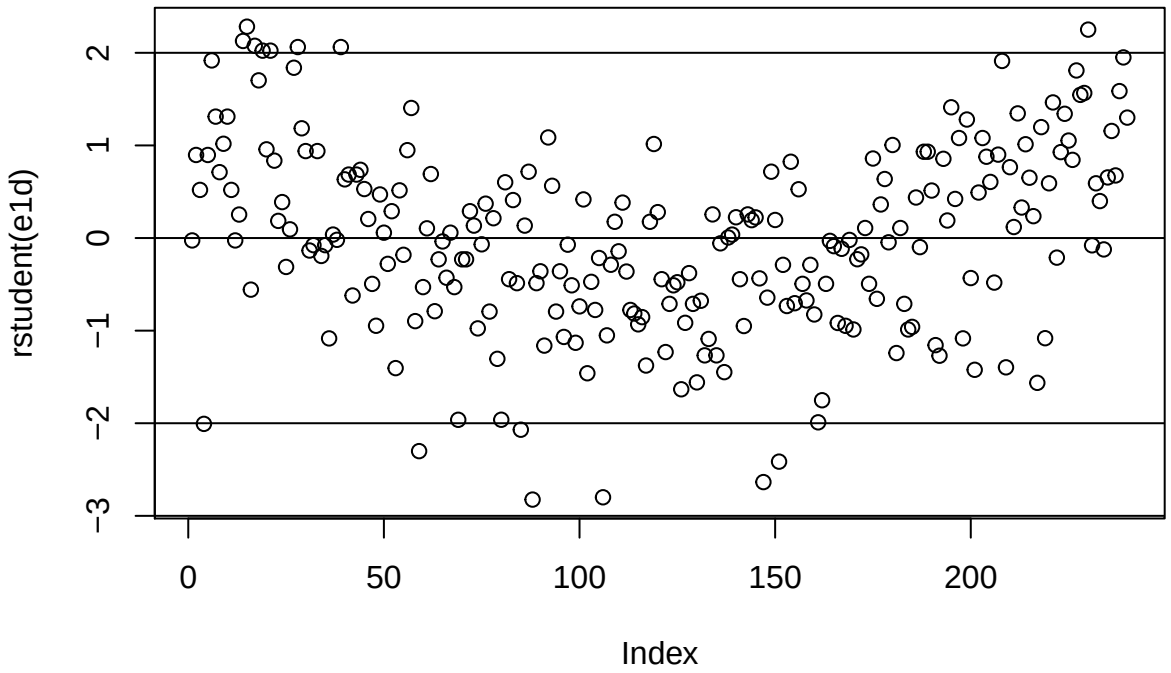
```
print("Apartat 2")
```

```
## [1] "Apartat 2"
```

```
plot(e1d,which=1)
```




```
plot(rstudent(e1d))
abline(h=c(-3,-2,0,2,3))
```




```
print("Apartat 3")
```

```
## [1] "Apartat 3"
```

```
print(anova(e1d,lm(sqrt(H)~Days+FDays,
                   data = dd)))
```

```
## Analysis of Variance Table
##
## Model 1: sqrt(H) ~ Days
## Model 2: sqrt(H) ~ Days + FDays
##   Res.Df    RSS Df Sum of Sq      F    Pr(>F)
## 1    238 33.283
## 2    230 23.179  8    10.104 12.533 6.752e-15 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
print(anova(lm(sqrt(H)~Days+FDays,
               data = dd)))
```

```
## Analysis of Variance Table
##
## Response: sqrt(H)
##            Df Sum Sq Mean Sq  F value    Pr(>F)
## Days        1 441.13  441.13 4377.274 < 2.2e-16 ***
## FDays       8  10.10    1.26   12.533 6.752e-15 ***
## Residuals 230  23.18    0.10
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
print("Apartat 4")
```

```
## [1] "Apartat 4"
```

```r
print(leveneTest(resid(e1d)~FDays))
```

```
## Levene's Test for Homogeneity of Variance (center = median)
##        Df F value Pr(>F)
## group   9  0.4167 0.9255
##       230
```

```r
print("Apartat 5")
```

```
## [1] "Apartat 5"
```

```r
customDays <- data.frame(Days=c(0,105,150))
aa <- predict(e1d, customDays)
print(cbind(mu = (aa)^2, # g(x) = x^2
            sd = summary(e1d)$sigma * 2*aa)) # g'(x) = 2x
```

```
##          mu       sd
## 1  3.047202 1.305572
## 2 27.938513 3.953229
## 3 46.278910 5.087939
```

```r
print("e1e")
```

```
## [1] "e1e"
```

```r
print("Apartat 1")
```

```
## [1] "Apartat 1"
```

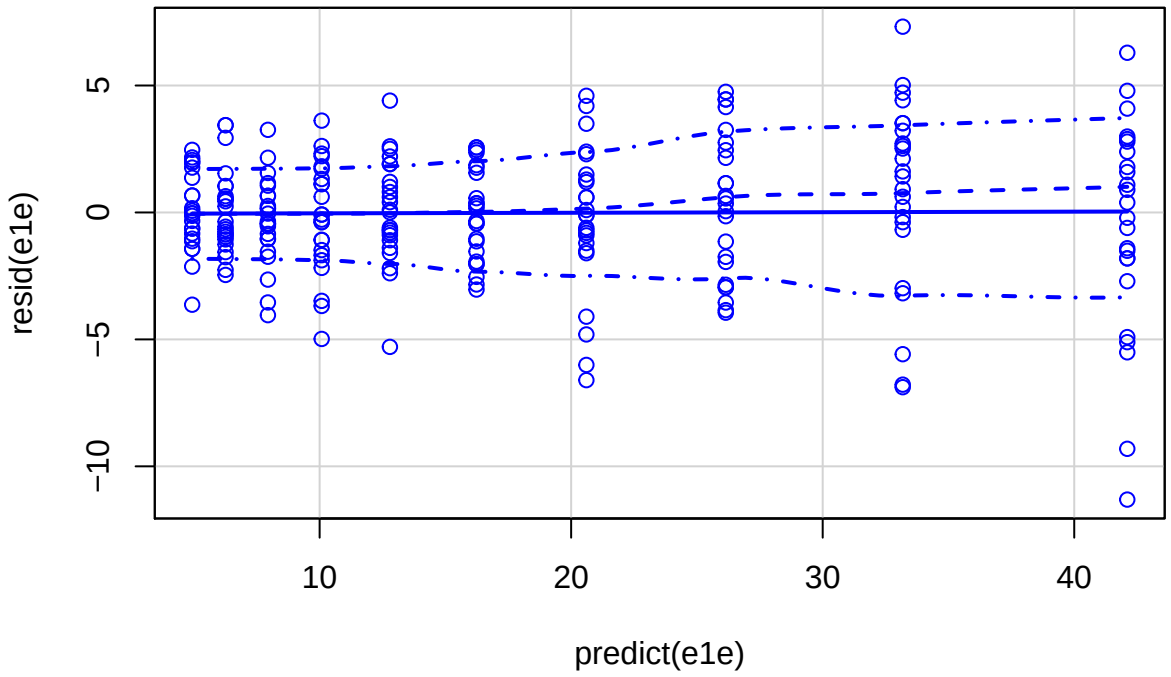
```r
e1ep <- coef(e1c)
names(e1ep) <- c("a","b")
print(summary(e1e<-nls(H ~ exp(a + b*Days),
                       start = e1ep,
                       data = dd)))
```

```
##
## Formula: H ~ exp(a + b * Days)
##
## Parameters:
##    Estimate Std. Error t value Pr(>|t|)
## a 1.5280289  0.0333326   45.84   <2e-16 ***
## b 0.0170173  0.0002993   56.85   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.599 on 238 degrees of freedom
##
## Number of iterations to convergence: 3
## Achieved convergence tolerance: 1.59e-07
```

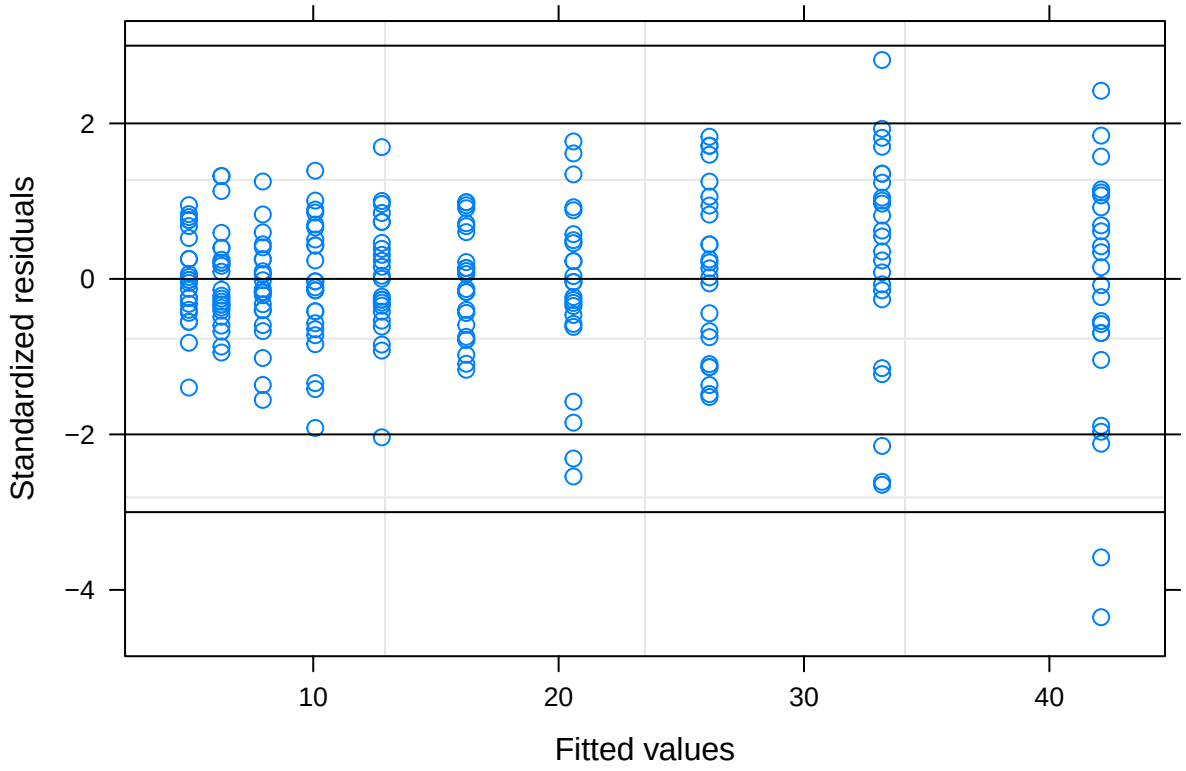
```r
print("Apartat 2")
```

```
## [1] "Apartat 2"
```

```r
sp(resid(e1e) ~ predict(e1e),
   boxplot=F)
```




```
plot(e1e,abline=c(-3,-2,0,2,3))
```




```
print("Apartat 4")
```

```
## [1] "Apartat 4"
```

```
print(leveneTest(resid(e1e) ~ FDays))
```

```
## Levene's Test for Homogeneity of Variance (center = median)
```

```
##        Df F value    Pr(>F)
## group   9  4.4376 2.254e-05 ***
##       230
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
print("Apartat 5")
```

```
## [1] "Apartat 5"
```

```r
#pp<-predict(e1e,data.frame(Days=c(0,105,150)))
pp<-exp(coef(e1e)[1] + coef(e1e)[2]*c(0,105,150))
print(cbind(pp, summary(e1e)$sigma))
```

```
##             pp
## [1,]  4.609083 2.599041
## [2,] 27.518030 2.599041
## [3,] 59.182046 2.599041
```

```r
print("càlculs per comparacions")
```

```
## [1] "càlculs per comparacions"
```

```r
#logLik
print(c(e1a=logLik(e1a),
        e1b=logLik(e1b),
        e1c=logLik(e1c),
        e1d=logLik(e1d),
        e1e=logLik(e1e)))
```

```
##        e1a        e1b        e1c        e1d        e1e
## -684.24251 -570.84068   42.48982 -103.47285 -568.77522
```