Lista 2 - Análise de Sobrevivência

Augusto Cesar Nunes - 13/0103004

Exercício 1

Item (a)

$P(T > 1) = 1 - P(T < 1) = 1 - \int_0^1 2t * exp\{-t^2\}dt = 1 - (1 - exp\{-1\}) \approx 0,3679$

Item (b)

$h(t) = \frac{f(t)}{S(t)} = \frac{2t*exp\{-t^2\}}{exp\{-t^2\}} \Rightarrow \lim_{t\to\infty} h(t) = \infty$

Exercício 2

```
##       tempos.ex2 censuras.ex2
##  [1,]          7            1
##  [2,]         34            1
##  [3,]         42            1
##  [4,]         63            1
##  [5,]         64            1
##  [6,]         74            0
##  [7,]         83            1
##  [8,]         84            1
##  [9,]         91            1
## [10,]        108            1
## [11,]        112            1
## [12,]        129            1
## [13,]        133            1
## [14,]        133            1
## [15,]        139            1
## [16,]        140            1
## [17,]        140            1
## [18,]        146            1
## [19,]        149            1
## [20,]        154            1
## [21,]        157            1
## [22,]        160            1
## [23,]        160            1
## [24,]        165            1
## [25,]        173            1
## [26,]        176            1
## [27,]        185            0
## [28,]        218            1
## [29,]        225            1
## [30,]        241            1
## [31,]        248            1
## [32,]        273            1
```

```
## [33,]        279            0
## [34,]        297            1
## [35,]        319            0
## [36,]        405            1
## [37,]        417            1
## [38,]        420            1
## [39,]        440            1
## [40,]        523            1
## [41,]        523            0
## [42,]        583            1
## [43,]        594            1
## [44,]       1101            1
## [45,]       1116            0
## [46,]       1146            1
## [47,]       1226            0
## [48,]       1349            0
## [49,]       1412            0
## [50,]       1417            1
```

Item (a)

```
require(survival)
```

```
## Loading required package: survival
```

```
KM.ex2 <-
survfit(Surv(time = tempos.ex2, event = censuras.ex2) ~ 1, conf.int = F)
NA.ex2 <-
survfit(coxph(Surv(tempos.ex2, censuras.ex2) ~ 1, method = "breslow"))
summary(KM.ex2)
```

```
## Call: survfit(formula = Surv(time = tempos.ex2, event = censuras.ex2) ~
##     1, conf.int = F)
##
##  time n.risk n.event survival std.err
##     7     50       1    0.980  0.0198
##    34     49       1    0.960  0.0277
##    42     48       1    0.940  0.0336
##    63     47       1    0.920  0.0384
##    64     46       1    0.900  0.0424
##    83     44       1    0.880  0.0461
##    84     43       1    0.859  0.0494
##    91     42       1    0.839  0.0523
##   108     41       1    0.818  0.0549
##   112     40       1    0.798  0.0572
##   129     39       1    0.777  0.0593
##   133     38       2    0.736  0.0628
##   139     36       1    0.716  0.0643
##   140     35       2    0.675  0.0668
##   146     33       1    0.655  0.0678
##   149     32       1    0.634  0.0687
##   154     31       1    0.614  0.0695
##   157     30       1    0.593  0.0701
##   160     29       2    0.552  0.0710
```

```
##   165     27       1    0.532  0.0713
##   173     26       1    0.511  0.0714
##   176     25       1    0.491  0.0714
##   218     23       1    0.470  0.0714
##   225     22       1    0.448  0.0713
##   241     21       1    0.427  0.0710
##   248     20       1    0.406  0.0706
##   273     19       1    0.384  0.0700
##   297     17       1    0.362  0.0695
##   405     15       1    0.337  0.0689
##   417     14       1    0.313  0.0681
##   420     13       1    0.289  0.0670
##   440     12       1    0.265  0.0656
##   523     11       1    0.241  0.0639
##   583      9       1    0.214  0.0622
##   594      8       1    0.187  0.0599
##  1101      7       1    0.161  0.0570
##  1146      5       1    0.129  0.0539
##  1417      1       1    0.000     NaN
```

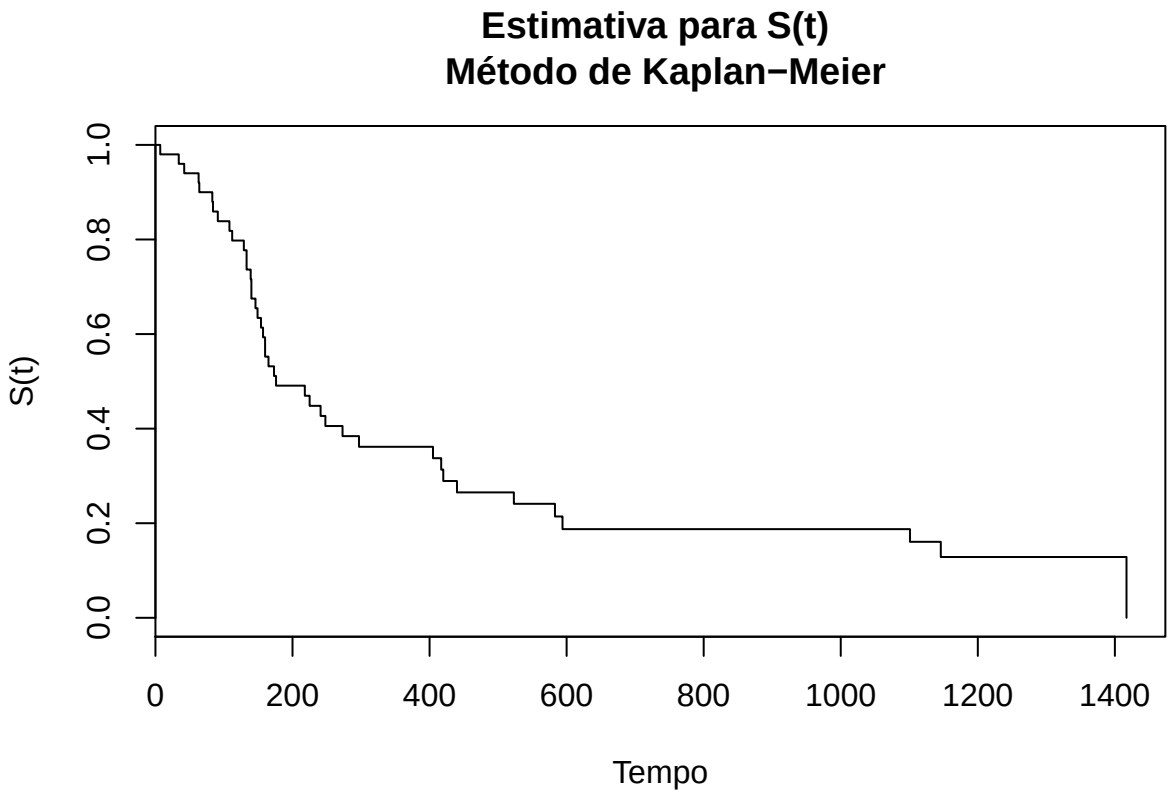
```
summary(NA.ex2)
```

```
## Call: survfit(formula = coxph(Surv(tempos.ex2, censuras.ex2) ~ 1, method = "breslow"))
##
##  time n.risk n.event survival std.err lower 95% CI upper 95% CI
##     7     50       1   0.9802  0.0196      0.94252        1.000
##    34     49       1   0.9604  0.0274      0.90809        1.000
##    42     48       1   0.9406  0.0333      0.87761        1.000
##    63     47       1   0.9208  0.0380      0.84925        0.998
##    64     46       1   0.9010  0.0420      0.82227        0.987
##    83     44       1   0.8807  0.0457      0.79558        0.975
##    84     43       1   0.8605  0.0489      0.76975        0.962
##    91     42       1   0.8403  0.0518      0.74463        0.948
##   108     41       1   0.8200  0.0544      0.72009        0.934
##   112     40       1   0.7998  0.0567      0.69607        0.919
##   129     39       1   0.7795  0.0587      0.67249        0.904
##   133     38       2   0.7396  0.0622      0.62724        0.872
##   139     36       1   0.7193  0.0637      0.60473        0.856
##   140     35       2   0.6793  0.0661      0.56139        0.822
##   146     33       1   0.6591  0.0672      0.53974        0.805
##   149     32       1   0.6388  0.0681      0.51835        0.787
##   154     31       1   0.6185  0.0689      0.49722        0.769
##   157     30       1   0.5982  0.0695      0.47634        0.751
##   160     29       2   0.5584  0.0704      0.43613        0.715
##   165     27       1   0.5381  0.0707      0.41591        0.696
##   173     26       1   0.5178  0.0709      0.39591        0.677
##   176     25       1   0.4975  0.0710      0.37614        0.658
##   218     23       1   0.4763  0.0710      0.35559        0.638
##   225     22       1   0.4551  0.0709      0.33531        0.618
##   241     21       1   0.4340  0.0707      0.31529        0.597
##   248     20       1   0.4128  0.0704      0.29554        0.577
##   273     19       1   0.3916  0.0699      0.27606        0.556
##   297     17       1   0.3693  0.0694      0.25551        0.534
##   405     15       1   0.3454  0.0689      0.23372        0.511
##   417     14       1   0.3216  0.0681      0.21238        0.487
```

```
##   420      13       1   0.2978  0.0671       0.19150        0.463
##   440      12       1   0.2740  0.0658       0.17111        0.439
##   523      11       1   0.2502  0.0643       0.15124        0.414
##   583       9       1   0.2239  0.0627       0.12937        0.387
##   594       8       1   0.1976  0.0606       0.10836        0.360
##  1101       7       1   0.1713  0.0579       0.08828        0.332
##  1146       5       1   0.1402  0.0551       0.06493        0.303
##  1417       1       1   0.0516  0.0554       0.00628        0.424
```

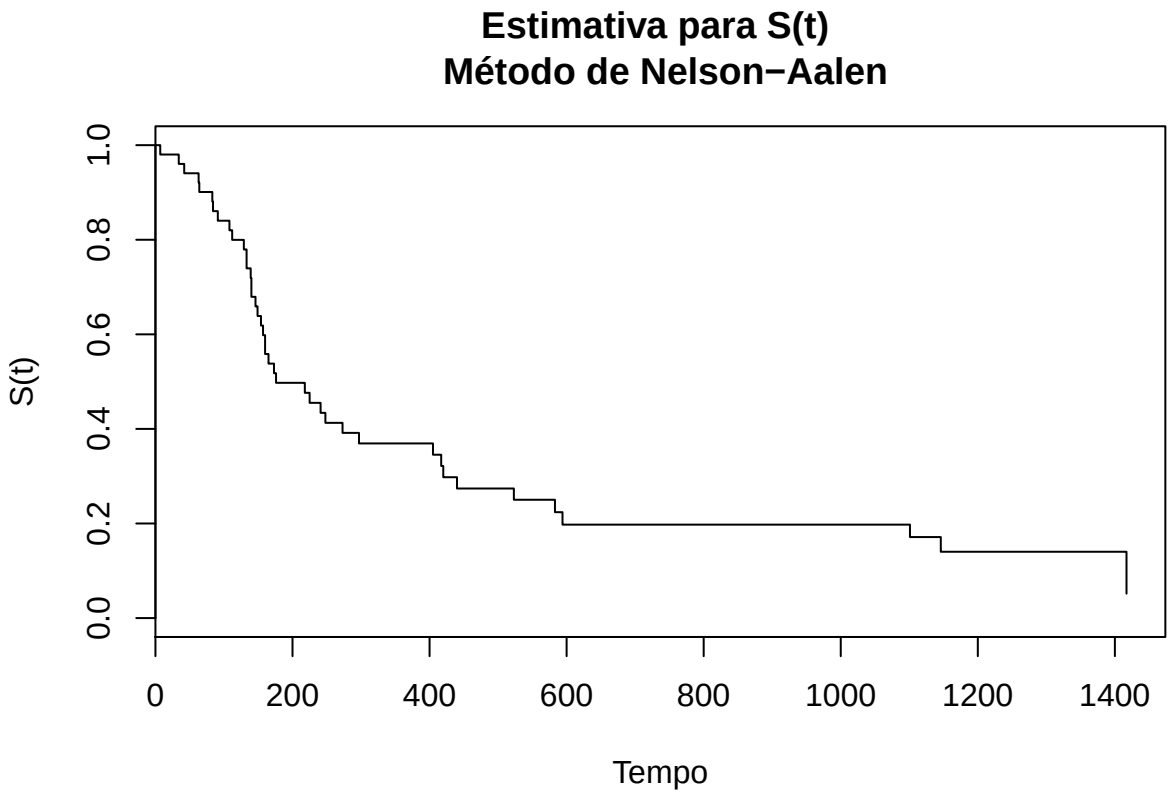
Item (b)

```
plot(
KM.ex2,
conf.int = FALSE,
xlab = "Tempo",
ylab = "S(t)",
main = "Estimativa para S(t) \n Método de Kaplan-Meier"
)
```

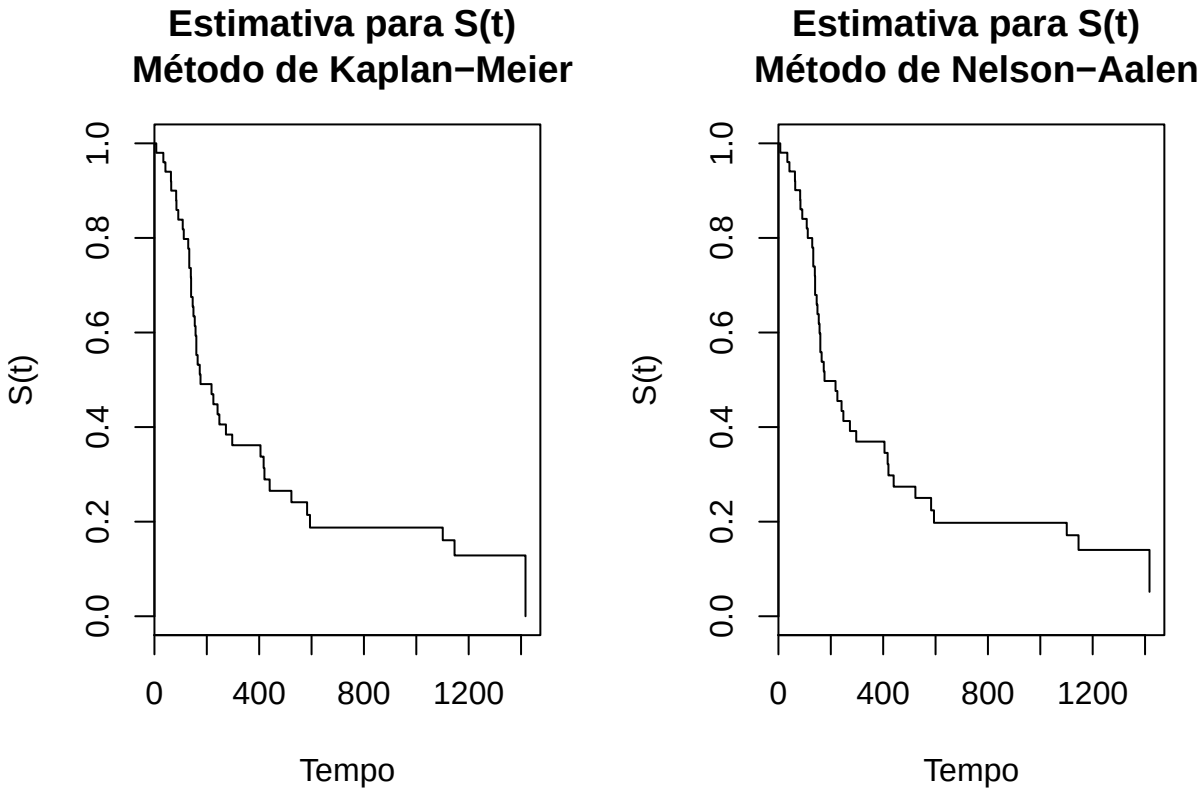



```
plot(
NA.ex2,
conf.int = FALSE,
xlab = "Tempo",
ylab = "S(t)",
main = "Estimativa para S(t) \n Método de Nelson-Aalen"
```

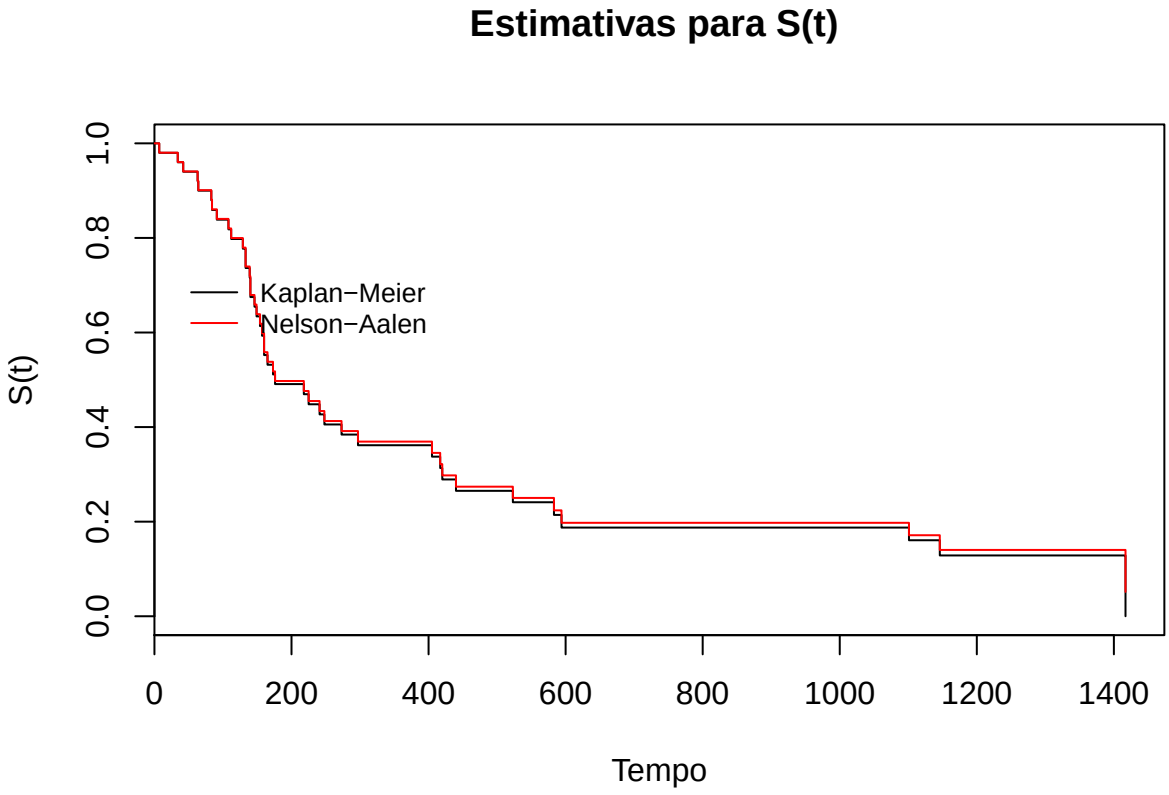
```
)
```



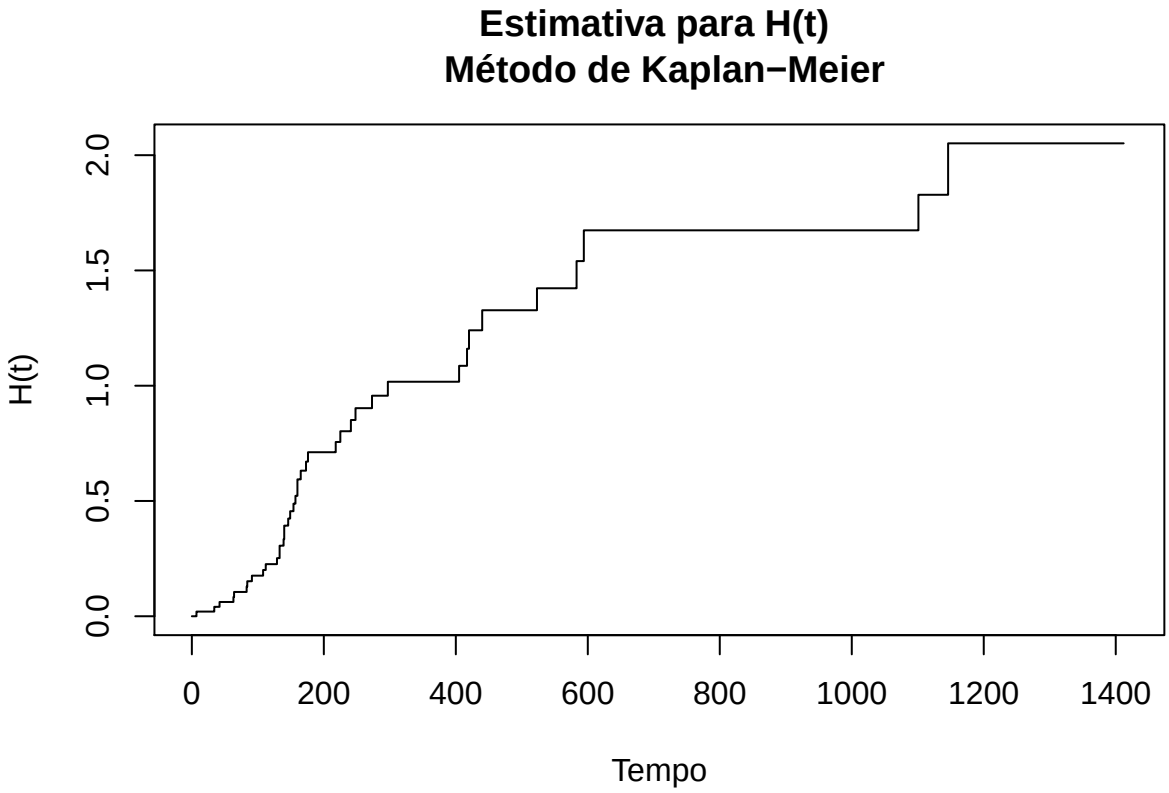

```
par(mfrow=c(1,2))
plot(
KM.ex2,
conf.int = FALSE,
xlab = "Tempo",
ylab = "S(t)",
main = "Estimativa para S(t) \n Método de Kaplan-Meier"
)
plot(
NA.ex2,
conf.int = FALSE,
xlab = "Tempo",
ylab = "S(t)",
main = "Estimativa para S(t) \n Método de Nelson-Aalen"
)
```



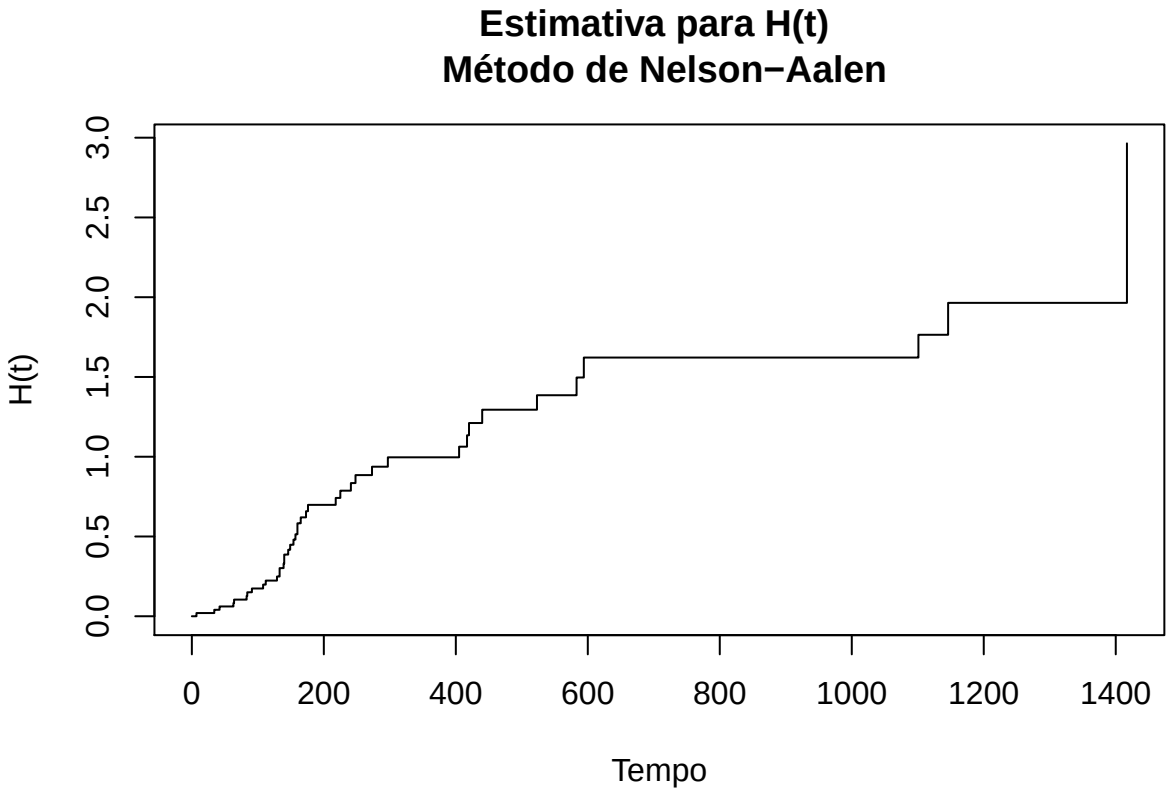

```
par(mfrow = c(1,1))
plot(
KM.ex2,
conf.int = FALSE,
xlab = "Tempo",
ylab = "S(t)",
main = "Estimativas para S(t) \n "
)
lines(NA.ex2, col = 2, conf.int = F)
legend(20,0.75,lty=c(1,1),c("Kaplan-Meier","Nelson-Aalen"),bty="n",cex=0.8,col=c(1,2))
```



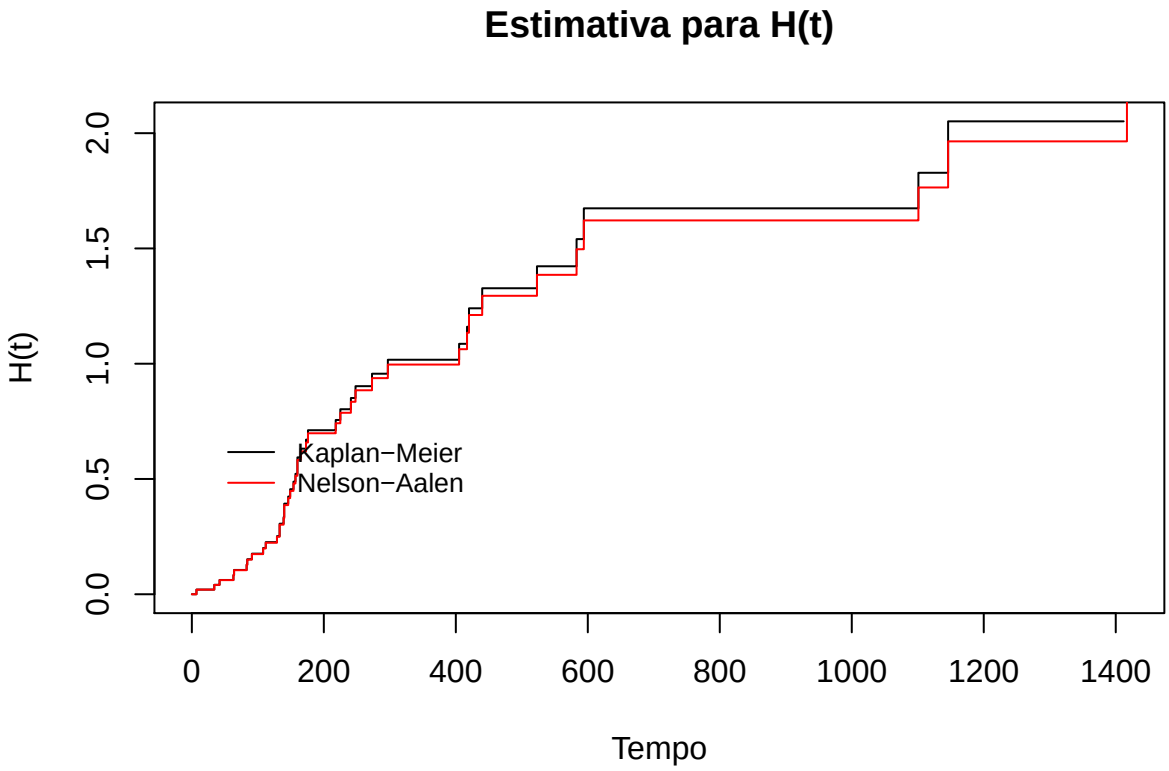

```
plot(KM.ex2, fun = "cumhaz", xlab = "Tempo", ylab = "H(t)", main = "Estimativa para H(t) \n Método de Ka
```




```
plot(NA.ex2, conf.int = F, fun = "cumhaz", xlab = "Tempo", ylab = "H(t)", main = "Estimativa para H(t) \
```




```
plot(KM.ex2, fun = "cumhaz", xlab = "Tempo", ylab = "H(t)", main = "Estimativa para H(t)")
lines(NA.ex2, col =2, fun = "cumhaz", conf.int = F)
legend(20,0.75,lty=c(1,1),c("Kaplan-Meier","Nelson-Aalen"),bty="n",cex=0.8,col=c(1,2))
```



Item (c)

Usando Interpolação:

$$\frac{176-173}{0,491-0,511} = \frac{\hat{t}_{MD,K-M}-173}{0,5-0,511} \Rightarrow \hat{t}_{MD,K-M} \approx 175(174,65)$$

$$\frac{176-173}{0,4975-0,5178} = \frac{\hat{t}_{MD,N-A}-173}{0,5-0,5178} \Rightarrow \hat{t}_{MD,N-A} \approx 175(174,993)$$

Item (d)

1. $\frac{42-34}{0,940-0,960} = \frac{40-34}{\hat{S(40)}_{K-M}-0,960} \Rightarrow \hat{S(40)}_{K-M} = 0,945$
2. $\frac{108-91}{0,818-0,839} = \frac{100-91}{\hat{S(100)}_{K-M}-0,839} \Rightarrow \hat{S(100)}_{K-M} = 0,827882$
3. $\frac{405-294}{0,337-0,362} = \frac{300-294}{\hat{S(300)}_{K-M}-0,362} \Rightarrow \hat{S(300)}_{K-M} = 0,360649$
4. $\frac{1101-594}{0,161-0,187} = \frac{1000-594}{\hat{S(1000)}_{K-M}-0,187} \Rightarrow \hat{S(1000)}_{K-M} = 0,166179$