NTNU

Lifetime Anlaysis Exercise set 4

February 8, 2017

1 A few words

If you want solutions to the questions that do not require R code, I refer you to the other solution where everything is already explained. However, all the code you need is given in this solution, I invite you to try and run it on your own laptop, and see for yourself.

2 Problem 1

2.1 Question A

```
> time <- c(31.7, 39.2, 57.5, 65.5, 65.8, 70.0, 75.0, 75.2, 87.5, 88.3,
+           94.2, 101.7, 105.8, 109.2, 110.0,
+ 130.0) # data
> delta <- c(1,0,1,1,0,1,0,0,0,0,1,0,0,1,1,0) # censoring
> data1 <- Surv(time,delta) # Format
> # Kaplan-Merier estimate
> Rhat <- survfit(Surv(time,delta)~1)
> printfig('KM')
> plot(Rhat)
> invisible(dev.off())
```

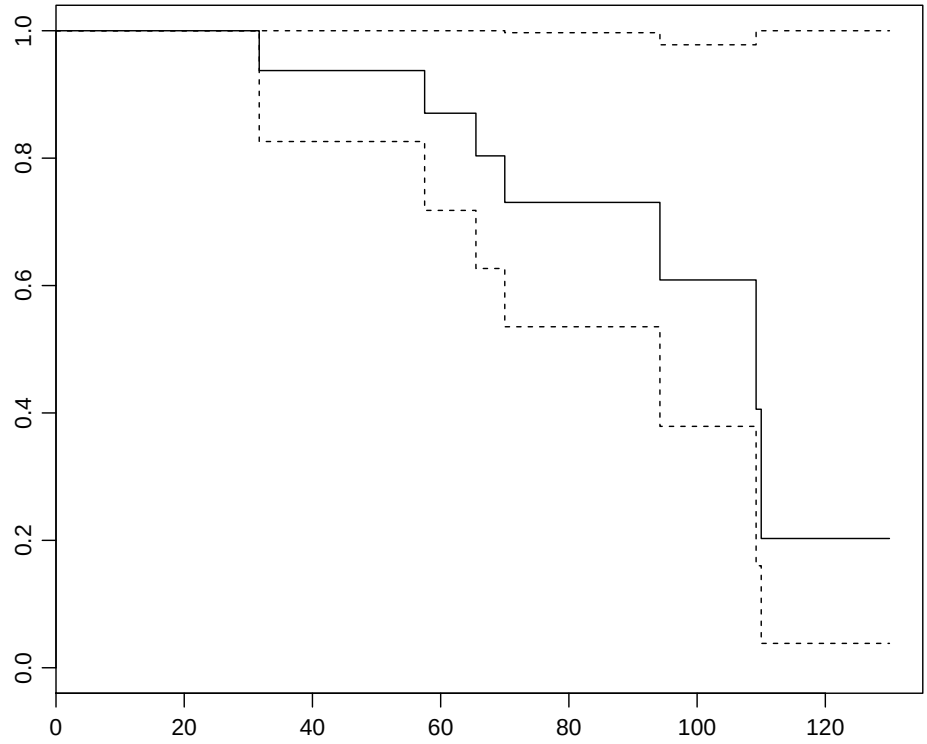

Figure 1: Kaplan Meier estimate of $\hat{R(t)}$

2.2 Question B

```
> # MTTF: Can be show that MTTF = E(R(t))
> print(Rhat, print.rmean=TRUE)

Call: survfit(formula = Surv(time, delta) ~ 1)

         n     events     *rmean *se(rmean)     median    0.95LCL    0.95UCL
     16.00       7.00      97.66       7.86     109.20      94.20         NA
    * restricted mean with upper limit =  130
```

The MTTF is also the Area under $R(t)$.

2.3 Question C

```
> # Quantiles and IQR
> quantile(Rhat, probs = c(0.25, 0.5, 0.75), conf.int = TRUE,
+   tolerance= sqrt(.Machine$double.eps))$quantile

   25    50    75
 70.0 109.2 110.0
```

NB: IQR = difference between $quantile_{0.75}$ and $quantile_{0.25}$

2.4 Question D

Cf. Question B.

3 Problem 2

3.1 Question B

```
> printfig('NA1')
> Zhat.NA <- cumsum(Rhat$n.event/Rhat$n.risk)
> plot(Rhat$time, Zhat.NA) # Nelson-Aalen estimate
> invisible(dev.off())
```

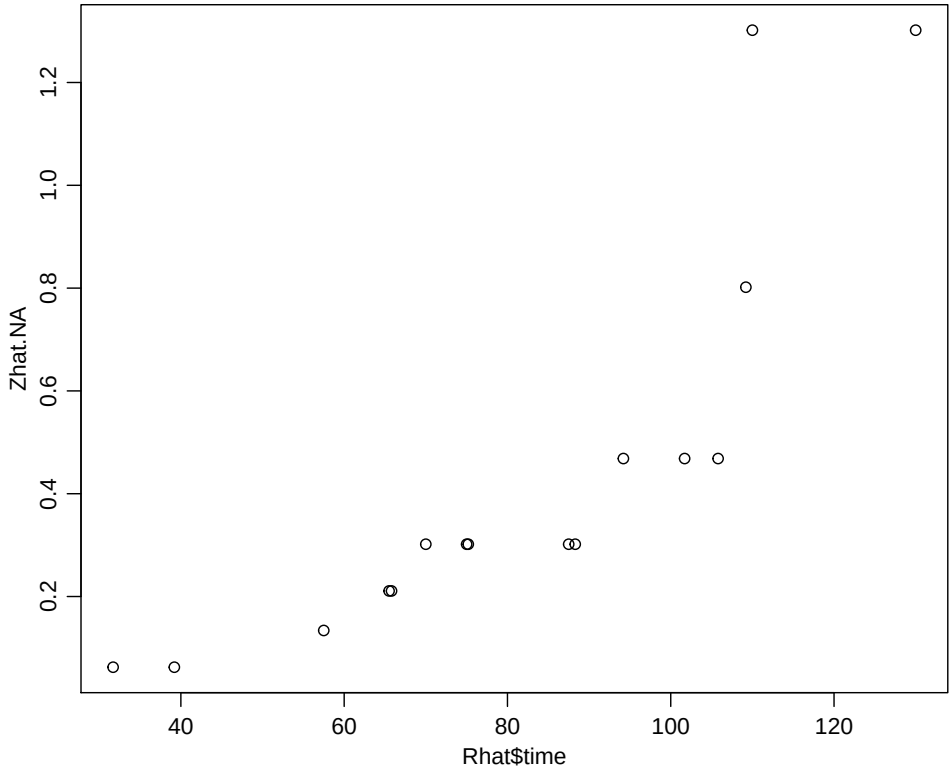

Figure 2: Nelson-Aalen estimate of $\hat{Z(t)}$

Z is an increasing function of t.

3.2 Question C

```
> Zhat.NA <- cumsum(Rhat$n.event/Rhat$n.risk)
> Zhat.KM <- -log(Rhat$surv) # Kaplan-Meier estimate (of Z(t))
> printfig('NA')
> plot(Rhat$time, Zhat.NA) # Nelson-Aalen estimate
> points(Rhat$time, Zhat.KM, col="red")
> invisible(dev.off())
```

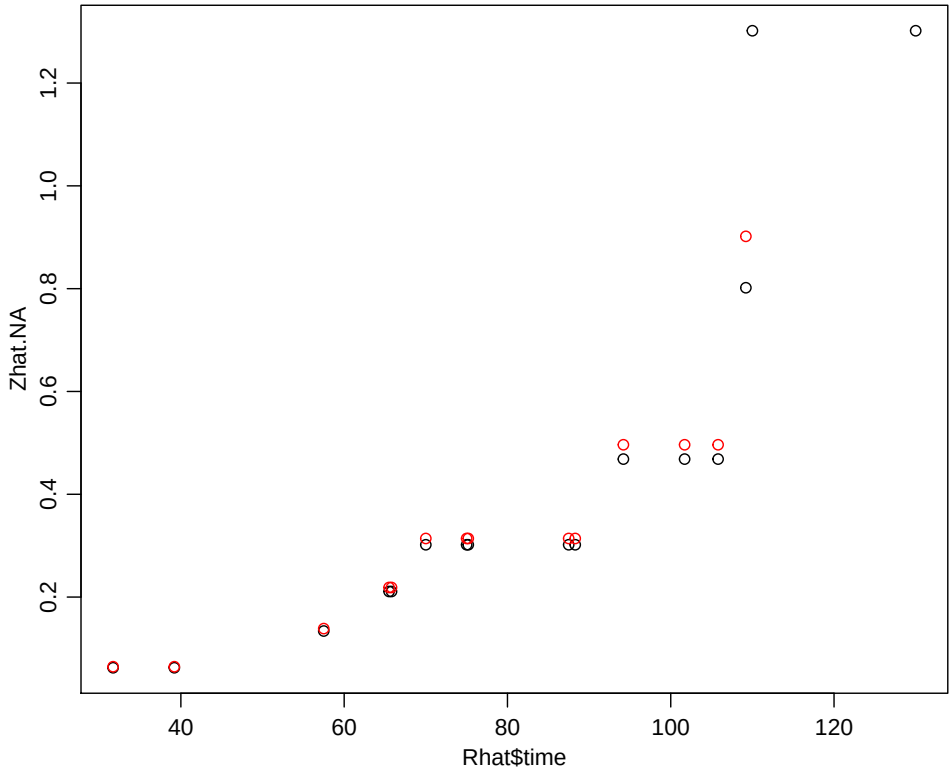

Figure 3: Nelson-Aalen estimate(black) vs Kaplan Meier estimate(red) of $\hat{Z(t)}$

4 Problem 3

4.1 Question A and B

```
> time2<- c(26.8, 29.6, 33.4, 35.0, 35.0, 36.3, 64.2,
+           70.8, 70.8, 85.0, 99.6, 117.5, 122.0, 137.1, 146.9,
+           180.5, 180.5, 180.5, 195.0, 200.0)
> dead2 <- c(0,0,0,0,0,0, 1, 0, 0, 1, 1, 1,
+            1,1, 1, 1, 1,1, 1, 0)
> data2 = Surv(time2,dead2)
> # Kaplan-Merier estimate
> Rhat2 <- survfit(data2~1)
> printfig('KM3')
> plot(Rhat2)
> invisible(dev.off())
> # Nelson-Aalen estimate
> Zhat.NA <- cumsum(Rhat2$n.event/Rhat2$n.risk)
> printfig('NA3')
> plot(Rhat2$time, Zhat.NA)
> invisible(dev.off())
```

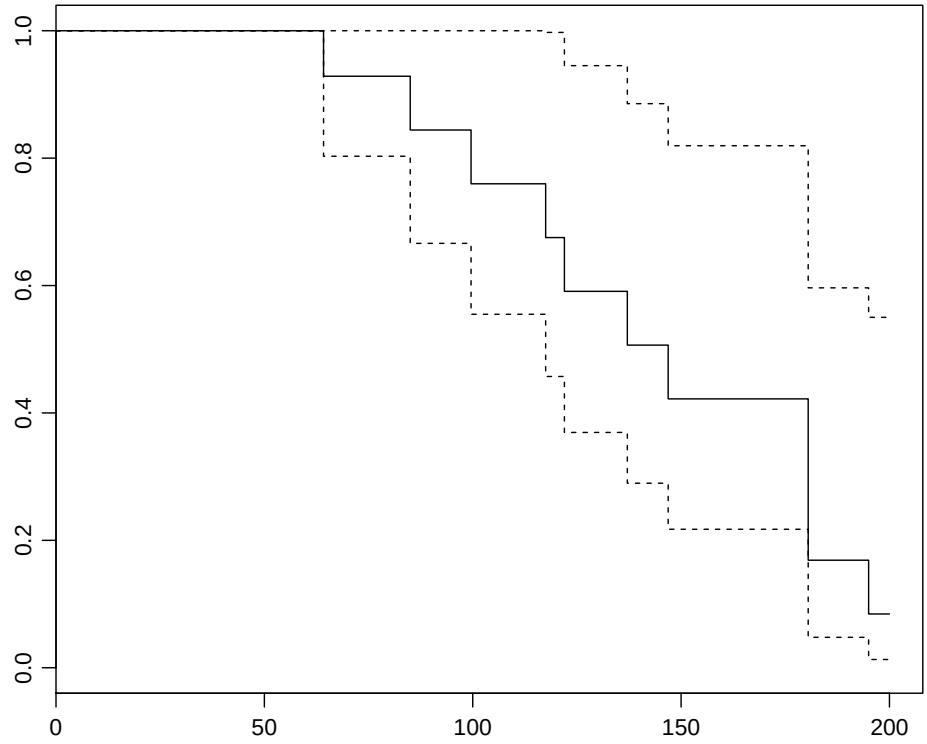

Figure 4: Kaplan Meier estimate of $\hat{R(t)}$

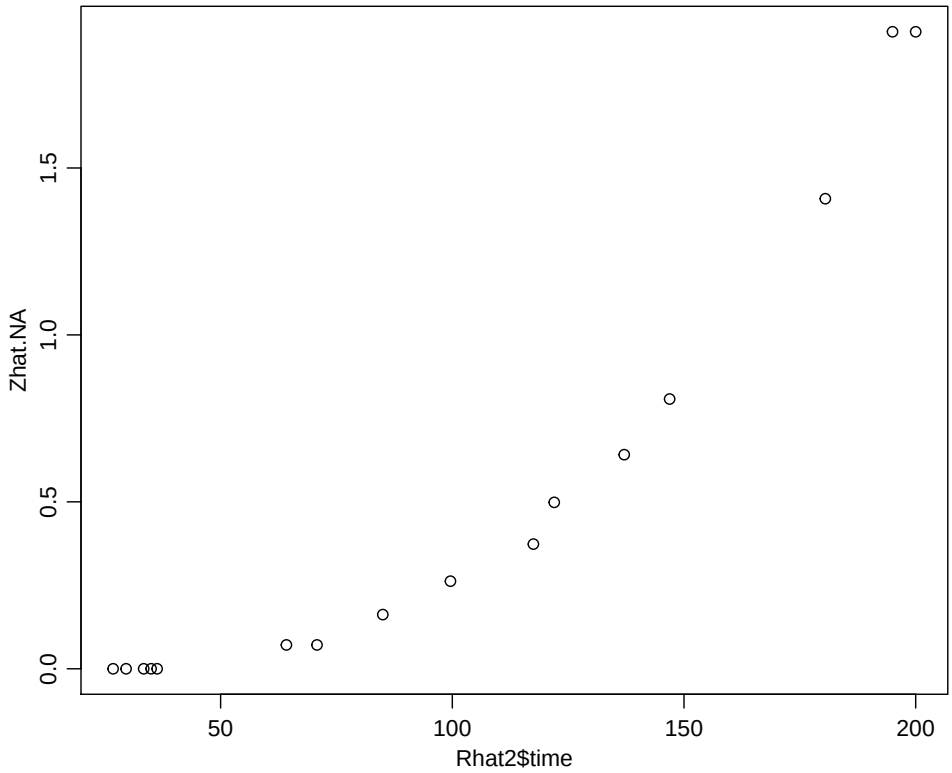

Figure 5: Nelson-Aalen estimate of $\hat{Z(t)}$