Statistical Methods in Cancer Epidemiology using R

Survival model with long term survivors

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Survival model with long term survivors

- In standard survival analysis sufficient follow-up assumed
- Fraction of the study subjects will never experice the event of interest
  - fraction of patients treated will be cured
  - fraction of population non-susceptible (immune) to event

Survival model with long term survivors

- Let D be partially latent variable indicating if subject is susceptible, cured $D = 1$ and $D = 0$ otherwise
- Then the probability of an event for a subject is the product of probability of beeing susceptible and event at time t

$$P(D = 1 \mid X_i) f(t \mid D == 1, X_i)$$

- It is convienient to specify survivor function

$$S(t \mid D == 1, X_i) = P(T > t \mid D == 1, X_i)$$

Survival model with long term survivors

- Susceptibility can be modelled with any parametric function for binary rv. f.ex logistic

$$P(D = 1 \mid X_i) = \frac{exp(\alpha + \beta x_i)}{1 + exp(\alpha + \beta x_i)}$$

- Time-to-event with any parametric function exponential, weibull as well as proportional hazards
- Problems: identifiability between susceptiblity intercept and time-to-event parameters, need more censored observations
- Maller and Zhou presented a testing procedure for susceptiblity fraction 0.
- restrict to problems we consensus is that there is group of non-susceptibles in the population
- separate modelling more informative of the problem if the groups exist

Survival model with long term survivors

```
library(smcure); library(survival)
data("e1684"); attach(e1684); head(e1684)
```

```
  TRT FAILTIME FAILCENS          AGE SEX
1   1  1.15068        1 -11.0359437   0
2   1  0.62466        1  -5.1290437   0
3   0  1.89863        0  23.1859563   1
4   0  0.45479        1  11.1448563   1
5   0  2.09041        1 -13.3208437   0
6   1  9.38356        0   0.9421563   0
```

```
#Kaplan Meier estimate of S,CDF
fit <- survfit(Surv(FAILTIME,FAILCENS)~TRT,data = e1684)

#LTS model
pd <- smcure(Surv(FAILTIME,FAILCENS)~TRT,cureform=~TRT,
             data=e1684,model="ph",Var = FALSE)
```

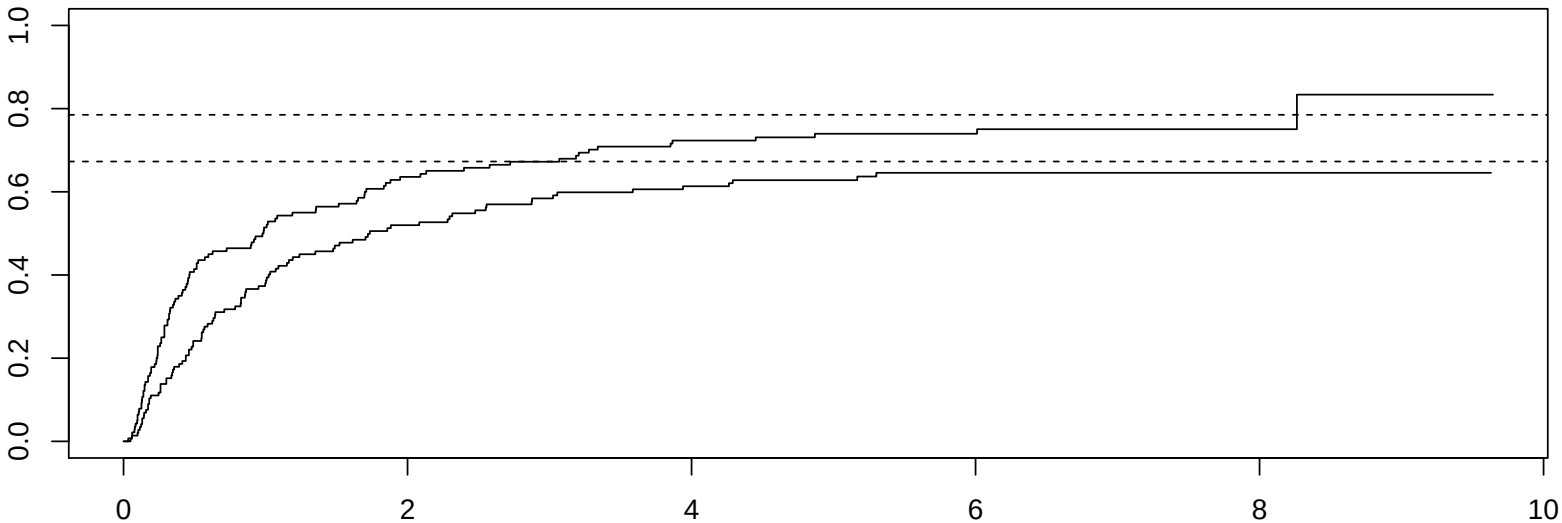
Survival model with long term survivors

```
Call:
smcure(formula = Surv(FAILTIME, FAILCENS) ~ TRT, cureform = ~TRT,
    data = e1684, model = "ph", Var = FALSE)

Cure probability model:
             Estimate
(Intercept)  1.2957164
TRT         -0.5747481


Failure time distribution model:
      Estimate
TRT -0.1318355
```

Survival model with long term survivors



- Proportion of immunes in TRT==0 is 0.2148868
- Proportion of immunes in TRT==1 is 0.3271798
- HR for TRT==1 vs TRT==0 for non-immunes is 0.8764852