UNIVERSITÉ DU LUXEMBOURG

LUXEMBOURG INSTITUTE OF HEALTH
RESEARCH DEDICATED TO LIFE

from PhD Course
Advanced Biostatistics

Survival Analysis

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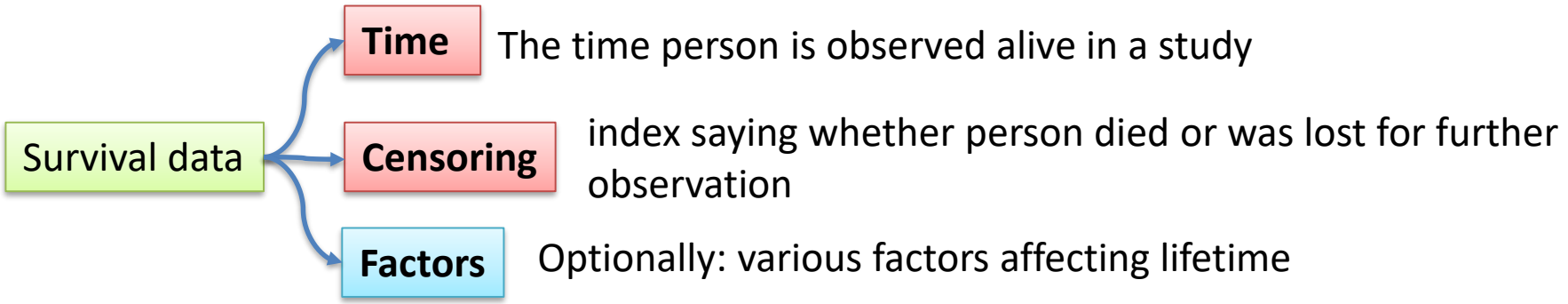
Survival Data

Survival analysis
is a branch of statistics which deals with analysis of time to events, such as death in biological organisms and failure in mechanical systems (i.e. **reliability theory** in engineering).

Survival analysis attempts to answer questions such as:

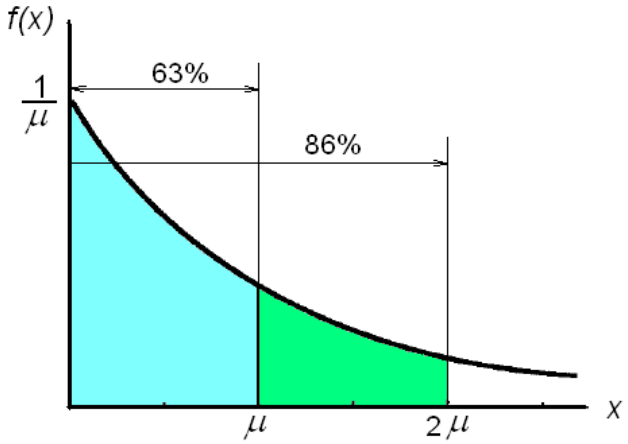
- What is the proportion of a population which will survive past a certain time?
- Of those that survive, at what rate will they die or fail?
- Can multiple causes of death or failure be taken into account?
- How do particular circumstances or characteristics increase or decrease the probability of survival?



http://www.partek.com/webinars/survival-analysis-partek-genomics-suite-software

Cox's Survival Model

$$f(x) = \frac{1}{\mu} e^{-\frac{x}{\mu}} \quad for\ x \geq 0, \mu > 0$$



$$h(t) = h_0(t) e^{\beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_n x_n}$$

h(t) – hazard function
$h_0(t)$ – basic hazard
$x_1 \ldots x_n$ – variables (expression of gene X) and covariates (age, smoking,) which are time-independent!
$\beta_1 \ldots \beta_n$ – fitted parameters

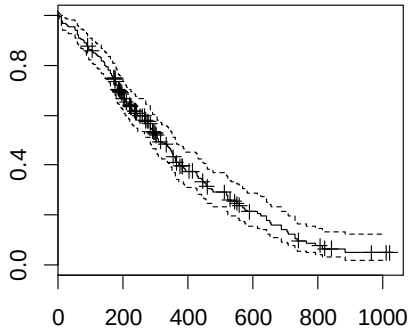
$$HR = \frac{h_i(t)}{h_j(t)} = \exp\left\{\beta_1 (x_{i1} - x_{j1}) + \ldots + \beta_n (x_{in} - x_{jn})\right\}$$

To identify significantly involved covariate: partial likelihood is calculated

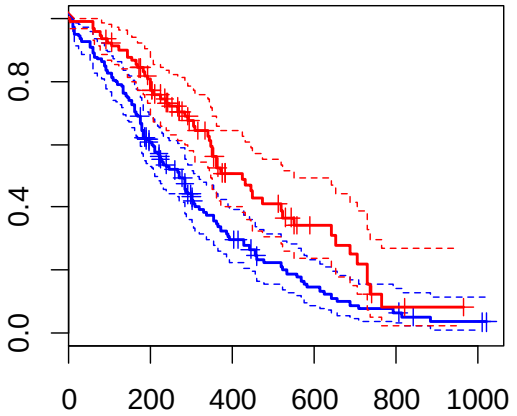
L5.2. Survival Analysis

Example: Lung

```
library(survival)
str(lung)

## create a survival object
## lung$status: 1-censored, 2-dead
sData = Surv(lung$time,event = lung$status == 2)
print(sData)

## Let's visualize it
fit = survfit(sData~1)
plot(fit)

## Let's visualize it for male/female
fit.sex = survfit(sData ~ lung$sex)
plot(fit.sex, col=c("blue","red"), conf.int = TRUE)

## Rank test for survival data
dif.sex = survdiff(sData ~ lung$sex)
dif.sex

## build Cox regression model
mod = coxph(sData ~ sex + age, data=lung)
summary(mod)
```



"event" should be:
0 – for censored
1 – for dead patients



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