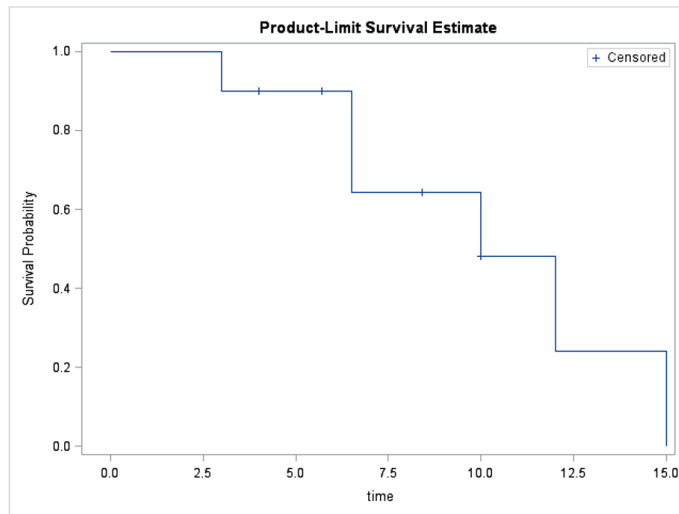# Analysis of Survival Data

Lecture 3 in-class
Nonparametric estimation of basic quantities

$$\hat{S}(t) = \begin{cases} 1 & \text{if } t < t_1 \\ \prod_{t_i \leq t}\left(1 - \dfrac{d_i}{Y_i}\right) & \text{if } t_1 \leq t \end{cases}$$

Inger Persson

Program L3 in-class

- **Nonparametric estimation of basic quantities**

- Online lecture follow-up
- Review questions
- Exercises

- **Home assignment 1**

Review question

1) Summarize the pros and cons of the Kaplan-Meier and the Nelson-Aalen estimators.

2) Summarize the pros and cons of pointwise confidence intervals and confidence bands.

3) Summarize the pros and cons of mean and median survival.

In section 1.3, a clinical trial for leukemia is described. In this trial, the variable of interest is the time from bone marrow transplantation to leukemia relapse (*BMT.txt*).

Patients at four hospitals were included if they were transplanted within a certain time period.
Maximum follow-up was 7 years.

Variables:

Group = disease group (ALL, AML low risk, AML high risk)

TD = Time to death (survival time)

TDFS = Disease free survival time (time to relapse or death)

Death = Death indicator

Relapse = Relapse indicator

DFS = Event indicator, 1 denotes relapse or death

More variables: TA A TC C TP P PatAge DonAge PatSex DonSex PatCMV DonCMV Transpl FAB Hosp MTX

Plot the Kaplan-Meier (Product-Limit) survival estimates for the three disease groups.

Plot the Nelson-Aalen cumulative hazard estimates for the three disease groups.

Add 95% pointwise confidence intervals to the survival plot.

Add 95% EP confidence bands to the survival plot

Add 95% Hall-Wellner confidence bands to the survival plot.

Put all three confidence intervals/bands in the same plot.

Estimate the mean disease free survival time.

Present a 95% confidence interval for the mean disease free survival time.

Estimate the median disease free survival time.

Present a 95% confidence interval for the median disease free survival time.

In section 1.2, a clinical trial for acute leukemia is discussed. In this trial, the event of interest is the time from treatment to leukemia relapse.

A clinical trial of a drug 6-mercaptopurine (6-MP) versus a placebo in 42 children with acute leukemia.

The trial was conducted at 11 American hospitals.

Patients were selected who had a complete or partial remission of their leukemia induced by treatment with the drug prednisone. (A complete or partial remission means that either most or all signs of disease had disappeared from the bone marrow).

Patients were followed until their leukemia returned (relapse) or until the end of the study (in months).

In section 1.2, a clinical trial for acute leukemia is discussed. In this trial, the event of interest is the time from treatment to leukemia relapse.

Use the data for the 6-MP group *(6mp.txt)*.

Construct the Kaplan-Meier (Product-Limit) estimator and store the estimated survival and their standard errors in a dataset.

Construct the Nelson-Aalen estimator and store the estimated cumulative hazard, survival, and standard errors in a dataset.

Plot the two estimated survival functions in the same graph.

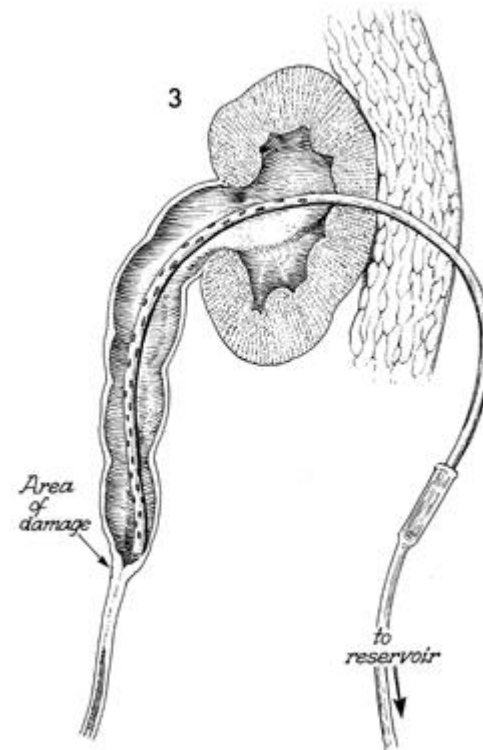Which estimator is better to use in this case?

In section 1.4 the times to first exit-site infection (in months) of patients with renal insufficiency was reported.

In the study 43 patients had a surgically placed catheter (Group 1) and 76 patients had a percutaneous placement of their catheter (Group 0).

(Kidney.txt)

a) For each group plot the estimated survival function. Which technique seems better in delaying the time to infection?

b) Estimate the cumulative hazard rate for each group of patients. Provide a crude estimate of the hazard rate at 5 months after placement of the catheter in each group.

c) Find a 95% confidence interval for the mean time to first exit site infection restricted to 36 months for both groups

Home assignment 1

Work in groups of 2-3 persons.

A number of tasks to solve by using SAS. You can now start with the plots in tasks 1+2.

Complete one task at a time, <u>follow the instructions</u>.

Write your results in the form of a report, hand in as a pdf file (one per group).

If you pass on the first try you get 2 bonus points!
If you don't pass, I'll let you know which tasks to correct and you'll hand in a new version.

Home assignments

Imagine being at your first job, you've just been handed your first assignment.

You want to show your boss that you know what you're doing.

Follow the instructions carefully. Make sure to e.g. find out which assumptions that apply to each method that you decide to use and check if they hold. Motivate every choice of method. For every test you perform, motivate the choice of significance level.

Home assignments

When including a graph or a table, make sure to interpret it in words.

Your boss doesn't know half as much as you do about survival analysis.