

Lifetime data analysis

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Examples

Aluminium smelting :

Alumina liquefied in steel-lined cell. Cell replaced when carbon lining cracks. Record days of service until cell replacement.

Australian Prime Ministers :

Months in office of Australian Prime Minister.

Leukaemia patients :

Survival time in weeks of two groups of leukaemia patients. The groups are AG+ and AG-, and white blood cell count is known. (Feigl and Zelen).

Examples

Electrical insulating fluid :

Investigate time to breakdown for insulating fluid.
Relate to high voltage level, and then 'normal' voltage level.

Brain tumours and Epilepsy :

Which drug reduces the number of seizures in children? Does the same drug work in adults?

Cerebral Palsy :

What affects long will my child live?

Aluminium smelting

Failure time for reduction cells in aluminium smelting, in days:
1540, 1415, 660, 999, 1193, 1006, 869, 1035, 797, 296, 775, 1424,
1169, 1500, 728, 670, 841

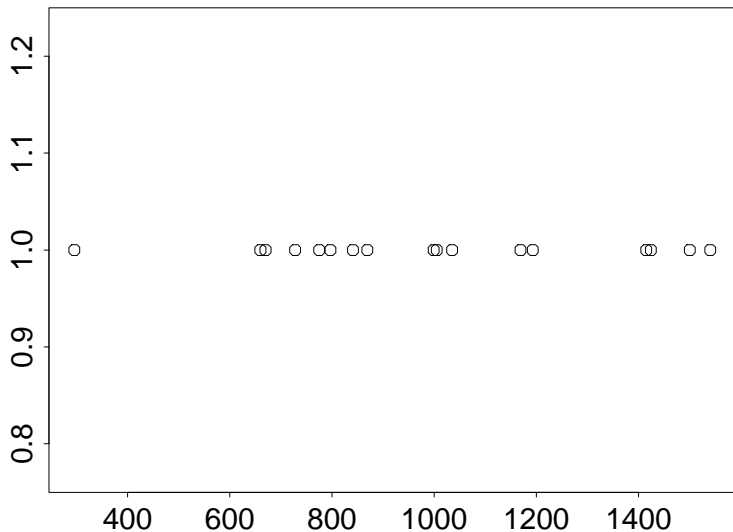
Sort into increasing order:

296 660 670 728 775 797 841 869 999 1005 1035 1169 1193
1415 1424 1500 1540

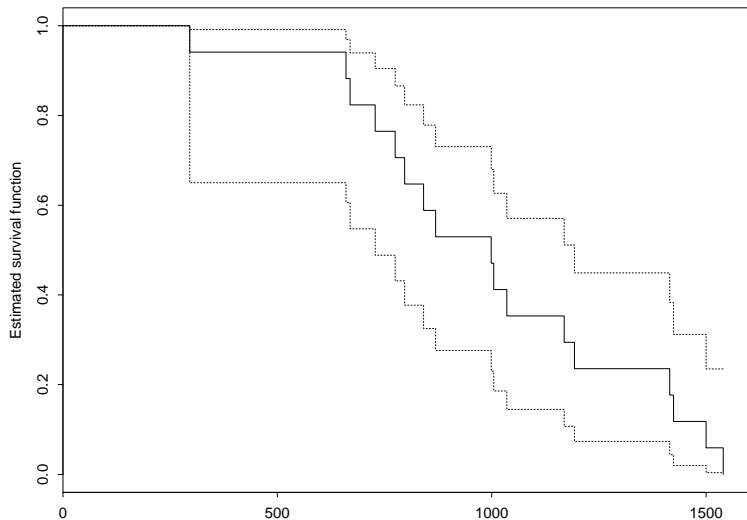
Five number summary:

| Minimum | Lower Quartile | Median | Upper Quartile | Maximum |
|---------|-------------------|--------|-------------------|---------|
| 296.0 | 775.0 | 999.0 | 1193.0 | 1540.0 |

Mean time for reduction cells in aluminium smelting

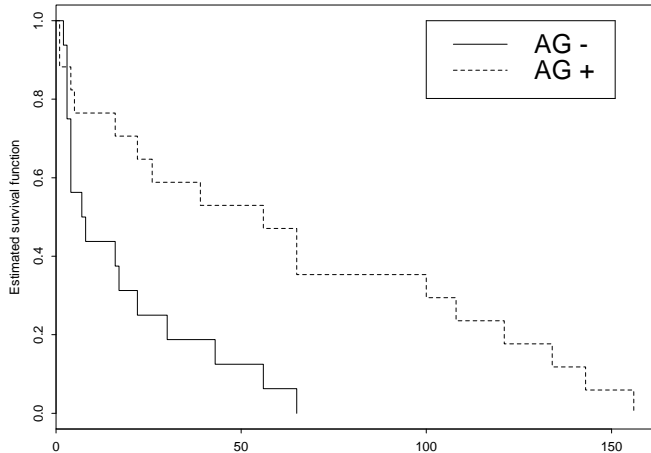


Distribution of failure time for reduction cells in aluminium smelting

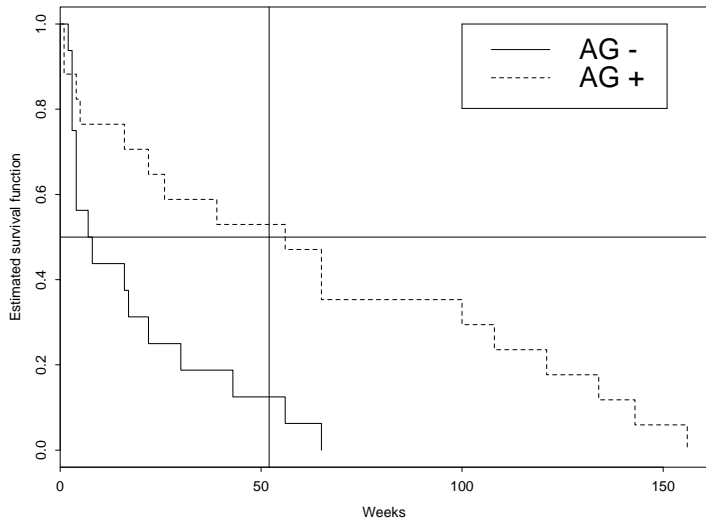


Leukaemia patients

Survival of leukaemia patients

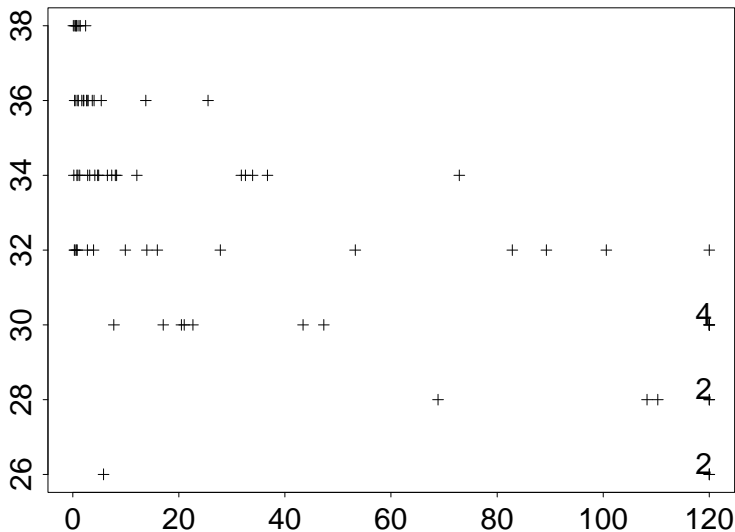


Survival of leukaemia patients

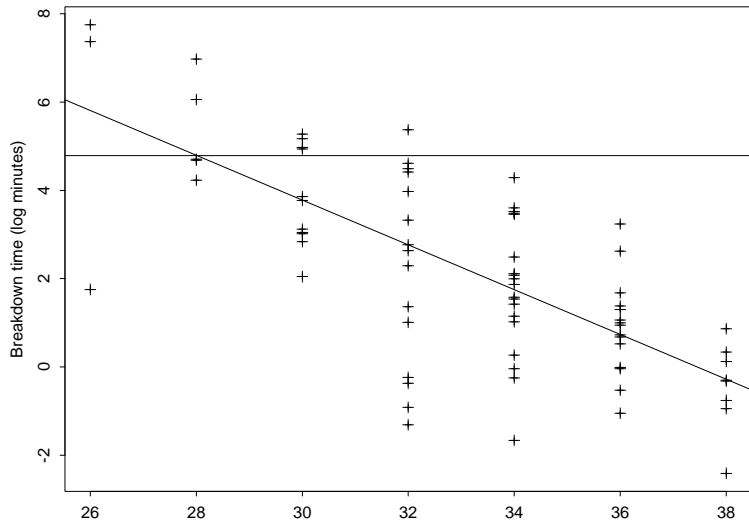


Electrical insulating fluid

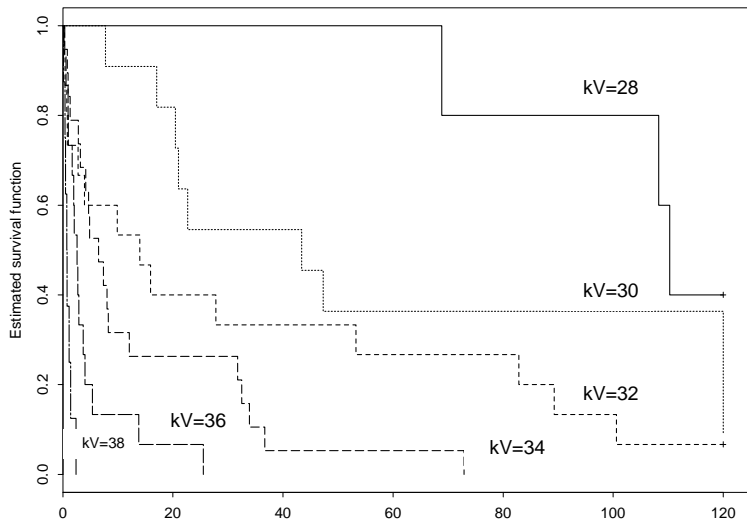
Breakdown time by voltage level



Breakdown by voltage level; log plot

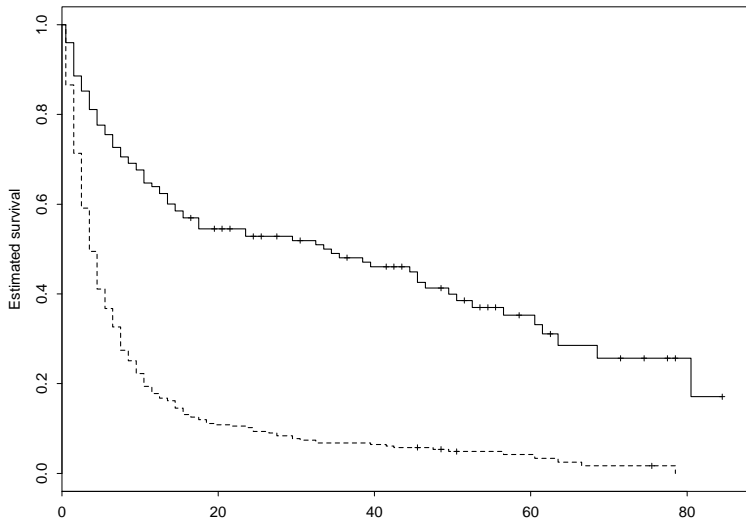


Breakdown time by voltage level

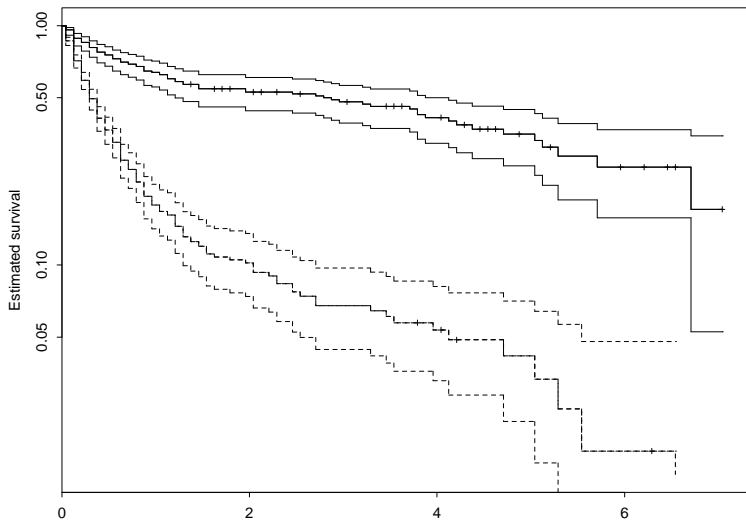


Brain tumours and Epilepsy

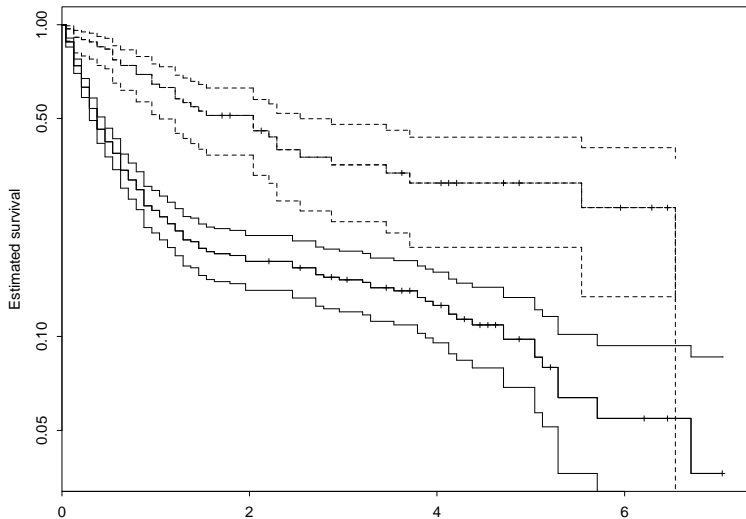
Survival of people with brain tumours



Survival of people with brain tumours F



Survival of people with brain tumours R



Cerebral Palsy

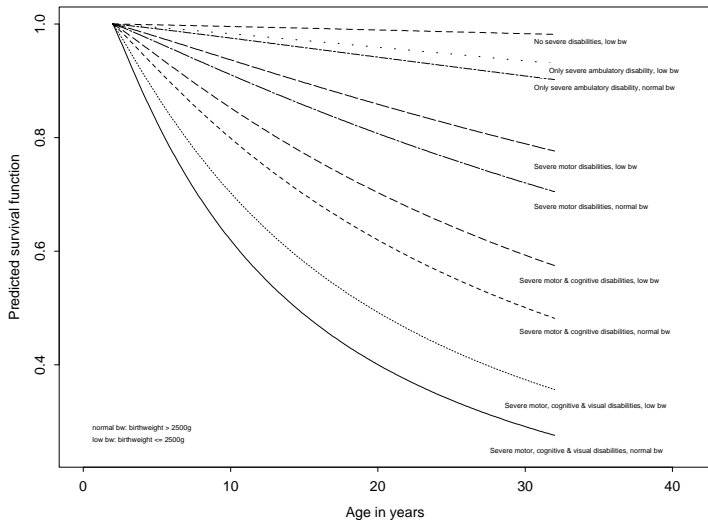
Dear Professor Hutton

John Winter v Royal York Hospital

I act on behalf of John Winter, who was born on 1 May 2003 at Royal York Hospital. My client's claim is being pursued through the High Court. The Defendants have made some admissions in relation to both breach of duty and causation.

John suffers from cerebral palsy, with profound developmental delay and quadraplegia. He has severe visual impairment, and suffers from epilepsy. I write to see whether you and Professor Pharoah would be willing to prepare a report on life expectancy in this case.

Predicted survival from age two years



Statistical model

Let \mathbf{t} denote lifetime, **Amb** indicate whether in wheel-chair, **Mand** indicate able to feed and dress self, **IQ** denote IQ level, **Blind** indicate blindness, **Lowbw** indicate low birth weight, **Yob** denote year of birth, and \mathbf{x} a vector of all covariates.

$$T_x = 11.37 - 1.11\text{Amb} - 1.02\text{Mand} - 0.81\text{IQ} - 0.70\text{Blind} \\ - 0.02\text{Yob} + 0.3\text{Yob} + \epsilon,$$

where ϵ is a random variable with a logistic distribution,
 $S(t) = x^{-1/0.76} / \{1 + x^{-1/0.76}\}.$

Course outline

- Introduction
 - Main definitions and formulae
- Non-parametric survival analysis
 - ▶ Kaplan-Meier estimate
 - ▶ Actuarial estimate
 - ▶ Log-rank test
- Parametric survival analysis
 - ▶ Survival functions
 - ▶ Likelihood methods
 - ▶ Diagnostic plots
- Regression models for survival data
 - ▶ Accelerated life models
 - ▶ Proportional hazards models