

# Piece-wise exponential models

Philipp Kopper

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## Data propecessing

As outlined in the previous section, the **PEM data structure** deals with the survival problem as a count data problem. The main feature of this representation is the partition of the follow-up time into a finite number of intervals. Within these intervals hazard rates are assumed to be piece-wise constant.

## Survival times & Events

Below, I show how to transform regular survival data into PEM format where the intervals are equidistant and of size 0.4. Still, it should be chosen with great care. The data set contains a case `id`, a variable indicating the observed event time (`obs_times`) and the observed event (`status`). As usual in survival analysis, the `status` 1 refers to the event while 0 to a censoring. A priori the selected interval cut points defining the baseline hazard in each interval are arbitrary.

```
library(pammttools)
library(tidyr)
library(dplyr)
data_set <- data.frame(id = 1:3, obs_times = c(1, 0.5, 2), status = c(0, 1, 1))
ped <- as_ped(data = data_set, Surv(obs_times, status) ~ ., id = "id",
             cut = seq(0, max(data_set$obs_times), 0.4))
data_set
ped
```

```
## The add_term function has changed in pammttools 0.1.12.
## The argument `relative` is deprecated and replaced by `reference`.
## See help page for details.
```

```
##
## Attaching package: 'pammttools'
## The following object is masked from 'package:stats':
##
## filter
```

```
##   id obs_times status
## 1  1      1.0      0
## 2  2      0.5      1
## 3  3      2.0      1

##   id tstart tend interval      offset ped_status
## 1  1   0.0  0.4  (0,0.4] -0.9162907      0
## 2  1   0.4  0.8  (0.4,0.8] -0.9162907      0
## 3  1   0.8  1.2  (0.8,1.2] -1.6094379      0
## 4  2   0.0  0.4  (0,0.4] -0.9162907      0
## 5  2   0.4  0.8  (0.4,0.8] -2.3025851      1
```

##	6	3	0.0	0.4	(0,0.4]	-0.9162907	0
##	7	3	0.4	0.8	(0.4,0.8]	-0.9162907	0
##	8	3	0.8	1.2	(0.8,1.2]	-0.9162907	0
##	9	3	1.2	1.6	(1.2,1.6]	-0.9162907	0
##	10	3	1.6	2.0	(1.6,2]	-0.9162907	1

The offset reflects information on the observed survival time. Re-arranging the *Poisson likelihood* of the PEM one can derive the following definition: