Weibull With Cure Fraction

Background

$$
\begin{aligned}
Z_i &\sim \text{Bernoulli}(\rho) \\
[Y_i | Z_i = 0] &\sim \text{Weibull}(\lambda_i, \alpha) \\
[Y_i | Z_i = 1] &= \infty
\end{aligned}
$$

Parametrisation

The Weibull is parametrized as `variant=0` of the `weibull` family.

$$
f(y) = (1-\rho)\alpha y^{\alpha-1}\lambda \exp(-\lambda y^{\alpha}), \qquad 0 \leq y < \infty, \qquad \alpha > 0, \qquad \lambda > 0
$$

α: shape parameter.

ρ: the cure fraction parameter

Link-function

The parameter λ is linked to the linear predictor as:

$$
\lambda = \exp(\eta)
$$

Hyperparameters

The α parameter is represented as

$$
\theta_1 = \log \alpha
$$

and ρ is transformed to

$$
\theta_2 = \log[\rho/(1-\rho)].
$$

The priors are defined on θ.

Specification

Response variable y must be given using `inla.surv()`

Hyperparameter spesification and default values

- **doc** The Weibull-cure likelihood (survival)
- **hyper**
  - **theta1**
    - **hyperid** 81001
    - **name** log alpha
    - **short.name** a
    - **initial** 0.1
    - **fixed** FALSE
    - **prior** loggamma
    - **param** 25 25
    - **to.theta** `function(x) log(x)`
    - **from.theta** `function(x) exp(x)`

theta2

- **hyperid** 81002
- **name** logit probability
- **short.name** prob
- **initial** -1
- **fixed** FALSE
- **prior** gaussian
- **param** -1 0.2
- **to.theta** `function(x) log(x/(1-x))`
- **from.theta** `function(x) exp(x)/(1+exp(x))`

survival TRUE

discrete FALSE

link default log neglog

pdf weibullcure

Example

In the following example we estimate the parameters in a simulated case

```
n = 1000
alpha = 2
beta = 2
rho = 0.5

x = runif(n)
censorTime = runif(n,0,2)
eta = 1+beta*x
lambda = exp(eta)
y = rweibull(n, shape= alpha, scale= lambda^(1/-alpha))
z = rbinom(n,size=1, prob=rho)

censoredEvent = (y > censorTime) | z
yObs = y
yObs[censoredEvent] = censorTime[censoredEvent]
event = as.numeric(!censoredEvent)
data = list(y=inla.surv(yObs, event), x=x)

model=inla(
  y ~ x,
  family ="weibullcure",
  data=data,
  control.family = list(hyper=list(
      'log alpha' = list(
          prior='loggamma', param=c(1,1)),
      'logit probability' = list(
          prior='logitbeta', param=c(1,1)))))



summary(model)
```

Notes

- Weibull model can be used for right censored, left censored, interval censored data. If the observed times y are large/huge, then this can cause numerical overflow in the likelihood routine. If you encounter this problem, try to scale the observatios, `time = time / max(time)` or similar.