

LogLogistic likelihood

Parametrisation

The LogLogistic distribution has cumulative distribution function

$$F_0(y) = \frac{1}{1 + \lambda y^{-\alpha}}, \quad y > 0$$

if `variant=0`, or

$$F_1(y) = \frac{1}{1 + (\lambda y)^{-\alpha}}, \quad y > 0$$

if `variant=1`, where

$\alpha > 0$ is a shape parameter, and

$\lambda > 0$ is a scale parameter.

Link-functions

The parameter λ is linked to the linear predictor, by default as

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

Hyperparameters

The α parameter is represented as

$$\theta = \log \alpha$$

and the prior is defined on θ .

Specification

- `family` equals `loglogistic` (regression) or `loglogisticsurv` (survival)
- `variant=0` (default) or 1, choosing between parameterisation F_0 or F_1 .
- Required arguments: y (regression) or an `inla.surv`-object using `inla.surv()` (for survival data)

Hyperparameter specification and default values

Regression:

doc The loglogistic likelihood

hyper

theta

hyperid 80001

name log alpha

short.name alpha

initial 1

fixed FALSE

prior loggamma

param 25 25

```
    to.theta function(x) log(x)
    from.theta function(x) exp(x)
```

survival FALSE

discrete FALSE

link default log neglog

pdf loglogistic

Survival:

doc The loglogistic likelihood (survival)

hyper

theta

hyperid 80011

name log alpha

short.name alpha

initial 1

fixed FALSE

prior loggamma

param 25 25

to.theta function(x) log(x)

from.theta function(x) exp(x)

survival TRUE

discrete FALSE

link default log neglog

pdf loglogistic

Example

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

```
rloglogistic = function(n, lambda, alpha, variant=0)
{
  u = runif(n)
  if (variant == 0) {
    y = (lambda/(1.0/u - 1.0))^(1.0/alpha)
  } else if (variant == 1) {
    y = (1.0/(1.0/u - 1.0))^(1.0/alpha) / lambda
  } else {
    stop("ERROR")
  }
}

n = 1000
alpha = 2.1
```

```

x = c(scale(runif(n)))
eta = 1.1+2.2*x
lambda = exp(eta)

for(variant in 0:1) {

  print(paste("variant=", variant))
  y = rloglogistic(n, lambda = lambda,
                  alpha = alpha,
                  variant = variant)

  formula = y ~ 1 + x
  r=inla(formula,
        family ="loglogistic",
        data=data.frame(y, x),
        control.family = list(variant = variant))
  print("REGRESSION")
  print(summary(r))

  event = rep(1,n)
  formula=inla.surv(y,event) ~ 1 + x
  r=inla(formula,
        family ="loglogisticsurv",
        data = list(y=y, event=event, x=x),
        control.family = list(variant = variant))
  print("SURVIVAL")
  print(summary(r))
}

```

Notes

- Loglogisticsurv 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.