

# LogNormal

## Parametrisation

The LogNormal has density

$$f(y) = \frac{1}{y\sqrt{2\pi}} \sqrt{\tau} \exp\left(-\frac{1}{2}\tau(\log y - \mu)^2\right), \quad y > 0$$

where

$\tau > 0$  is the precision parameter,

$\mu$  is the mean parameter.

## Link-function

The parameter  $\mu$  is linked to the linear predictor as:

$$\eta = \mu$$

## Hyperparameters

The  $\tau$  parameter is represented as

$$\theta = \log \tau$$

and the prior is defined on  $\theta$ .

## Specification

- `family="lognormal"` for regression models and `family="lognormalsurv"` for survival models.
- Required arguments:  $y$ . Given in a format by using `inla.surv()` function for `"lognormal.surv"`

## Hyperparameter spesification and default values

### lognormal

`doc` The log-Normal likelihood

`hyper`

`theta`

`hyperid` 77101

`name` log precision

`short.name` prec

`output.name` Precision for the lognormal observations

`output.name.intern` Log precision for the lognormal observations

`initial` 0

`fixed` FALSE

`prior` loggamma

`param` 1 5e-05

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

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

`survival` FALSE

`discrete` FALSE

`link` default identity

`pdf` lognormal

## lognormalsurv

doc The log-Normal likelihood (survival)

hyper

theta1

hyperid 78001

name log precision

short.name prec

output.name Precision for the lognormalsurv observations

output.name.intern Log precision for the lognormalsurv observations

initial 0

fixed FALSE

prior loggamma

param 1 5e-05

to.theta function(x) log(x)

from.theta function(x) exp(x)

theta2

hyperid 78002

name beta1

short.name beta1

output.name beta1 for logNormal-Cure

output.name.intern beta1 for logNormal-Cure

initial -7

fixed FALSE

prior normal

param -4 100

to.theta function(x) x

from.theta function(x) x

theta3

hyperid 78003

name beta2

short.name beta2

output.name beta2 for logNormal-Cure

output.name.intern beta2 for logNormal-Cure

initial 0

fixed FALSE

prior normal

param 0 100

to.theta function(x) x

from.theta function(x) x

theta4

hyperid 78004

name beta3

short.name beta3

output.name beta3 for logNormal-Cure

```

    output.name.intern beta3 for logNormal-Cure
    initial 0
    fixed FALSE
    prior normal
    param 0 100
    to.theta function(x) x
    from.theta function(x) x
theta5
    hyperid 78005
    name beta4
    short.name beta4
    output.name beta4 for logNormal-Cure
    output.name.intern beta4 for logNormal-Cure
    initial 0
    fixed FALSE
    prior normal
    param 0 100
    to.theta function(x) x
    from.theta function(x) x
theta6
    hyperid 78006
    name beta5
    short.name beta5
    output.name beta5 for logNormal-Cure
    output.name.intern beta5 for logNormal-Cure
    initial 0
    fixed FALSE
    prior normal
    param 0 100
    to.theta function(x) x
    from.theta function(x) x
theta7
    hyperid 78007
    name beta6
    short.name beta6
    output.name beta6 for logNormal-Cure
    output.name.intern beta6 for logNormal-Cure
    initial 0
    fixed FALSE
    prior normal
    param 0 100
    to.theta function(x) x
    from.theta function(x) x
theta8
    hyperid 78008

```

```

name beta7
short.name beta7
output.name beta7 for logNormal-Cure
output.name.intern beta7 for logNormal-Cure
initial 0
fixed FALSE
prior normal
param 0 100
to.theta function(x) x
from.theta function(x) x
theta9
  hyperid 78009
  name beta8
  short.name beta8
  output.name beta8 for logNormal-Cure
  output.name.intern beta8 for logNormal-Cure
  initial 0
  fixed FALSE
  prior normal
  param 0 100
  to.theta function(x) x
  from.theta function(x) x
theta10
  hyperid 78010
  name beta9
  short.name beta9
  output.name beta9 for logNormal-Cure
  output.name.intern beta9 for logNormal-Cure
  initial 0
  fixed FALSE
  prior normal
  param 0 100
  to.theta function(x) x
  from.theta function(x) x
theta11
  hyperid 78011
  name beta10
  short.name beta10
  output.name beta10 for logNormal-Cure
  output.name.intern beta10 for logNormal-Cure
  initial 0
  fixed FALSE
  prior normal
  param 0 100
  to.theta function(x) x

```

```

      from.theta function(x) x
survival TRUE
discrete FALSE
link default identity
pdf lognormal

```

## Example

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

```

n = 300
x = c(scale(runif(n)))
eta = 1+2.2*x
y = exp(rnorm(n, mean = eta, sd = 1))
data = list(y=y, event=rep(1, n), x=x)
formula = inla.surv(y, event) ~ 1 + x
r=inla(formula, family ="lognormalsurv", data=data)
summary(r)

data = data.frame(y, x)
formula = y ~ 1 + x
r=inla(formula, family ="lognormal", data=data)
summary(r)

```

## Notes

- lognormalsurv can be used for right censored, left censored, interval censored data. A general framework to represent time is given by `inla.surv`. If the observed times  $y$  are large/huge, then this can cause numerical overflow, and if you encounter this problem, try to scale the observations, like `time = time / max(time)`.