# 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 family = lognormal.surv

# Hyperparameter spesification and default values

#### lognormal

```
doc The log-Normal likelihood
hyper
    theta
        hyperid 77101
        name log precision
        short.name prec
        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
theta
hyperid 78001
name log precision
short.name prec
initial 0
fixed FALSE
prior loggamma
param 1 5e-05
to.theta function(x) log(x)
from.theta function(x) exp(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 observatios, like time = time / max(time).