

# LogGamma prior

## Parametrization

The Gamma distribution has density

$$\pi(\tau) = \frac{b^a}{\Gamma(a)} \tau^{a-1} \exp(-b \tau) \quad (1)$$

for  $\tau > 0$  where:

$a > 0$  is the shape parameter, and

$b > 0$  is the inverse-scale parameter.

The mean of  $\tau$  is  $a/b$  and the variance is  $a/b^2$ , and we denote this distribution  $\text{Gamma}(a, b)$ . The variable  $\theta$  has<sup>1</sup> a  $\text{logGamma}(a, b)$  distribution, if  $\theta = \log(\tau)$  and  $\tau$  is  $\text{Gamma}(a, b)$  distributed.

## Specification

The LogGamma prior for the hyperparameters is specified inside the `f()` function as following using the old-style,

```
f(<whatever>,prior=loggamma, param=c(<a>,<b>))
```

or better, the new style

```
f(<whatever>, hyper = list(<theta> = list(prior="loggamma", param=c(<a>,<b>))))
```

In the case where there is one hyperparameter for that particular f-model. In the case where we want to specify the prior for the hyperparameter of an observation model, for example the Gaussian, the the prior spesification will appear inside the `control.family()`-argument; see the following example for illustration.

## Example

In the following example we estimate the parameters in a simulated example with gaussian responses and assign the hyperparameter (the precision parameter), a logGamma prior with parameters  $a = 0.1$  and  $b = 0.1$

```
n=100
z=rnorm(n)
y=rnorm(n,z,1)

data=list(y=y,z=z)
formula=y~1+z
result=inla(formula,family="gaussian",data=data,
            control.family=list(hyper = list(prec = list(prior="loggamma",param=c(0.1,0.1)))))
```

## Notes

None

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<sup>1</sup>We *define* it in this way; if variable  $X$  has distribution  $D$  then  $\log(X)$  has distribution  $\text{log}D$ . This is oposite to the implicite convention leading to the definition of the logNormal distribution, which we believe is confusing.