

## logdist effect of a covariate

### Parametrization

This model implements a non-linear effect of a positive covariate  $x$  as a part of the linear predictor,

$$\beta (1 + \exp(\alpha_1 \log(x) - \alpha_2 x))$$

where  $\beta \in \Re$ ,  $\alpha_1, \alpha_2 \in \Re^+$  and  $x \geq 0$ .

### Hyperparameters

This model has three hyperparameters, the scaling  $\beta$ ,  $\alpha_1$  and  $\alpha_2$ .

$$\theta_1 = \beta \quad \theta_2 = \log(\alpha_1) \quad \theta_3 = \log(\alpha_2)$$

and the priors are given for  $\theta_1, \theta_2$  and  $\theta_3$ .

### Specification

```
f(x, model="logdist", hyper = ..., precision = <precision>)
```

where **precision** is the precision for the tiny noise used to implement this as a latent model.

### Hyperparameter specification and default values

**doc** A nonlinear model of a covariate

**hyper**

**theta1**

```
hyperid 39021
name beta
short.name b
initial 1
fixed FALSE
prior normal
param 0 1
to.theta function(x) x
from.theta function(x) x
```

**theta2**

```
hyperid 39022
name alpha1
short.name a1
initial 0
fixed FALSE
prior loggamma
param 0.1 1
to.theta function(x) log(x)
from.theta function(x) exp(x)
```

**theta3**

```

    hyperid 39023
    name alpha2
    short.name a2
    initial 0
    fixed FALSE
    prior loggamma
    param 0.1 1
    to.theta function(x) log(x)
    from.theta function(x) exp(x)

constr FALSE

nrow.ncol FALSE

augmented FALSE

aug.factor 1

aug.constr

n.div.by

n.required FALSE

set.default.values FALSE

status experimental

pdf logdist

```

## Example

```

logdist = function(x, beta, alpha)
{
  return (beta * (1 + exp(alpha[1] * log(x) - alpha[2] * x)))
}

n = 1000
s=0.1
x = runif(n)
beta = 1
alpha = c(1, 0.5)
## start at the true values
hyper = list(
  beta = list(initial = beta),
  a1 = list(initial = log(alpha[1])),
  a2 = list(initial = log(alpha[2])))
## start somewhere else
hyper = list(
  beta = list(initial = 1),
  a1 = list(initial = 0),
  a2 = list(initial = 0))

y = logdist(x, beta, alpha) + rnorm(n, sd = s)

```

```
r = (inla(y ~ -1 + f(x, model="logdist", hyper = hyper),
  data = data.frame(y, x),
  family = "gaussian",
  verbose=TRUE,
  control.inla = list(h=0.0001),
  control.family = list(
    hyper = list(
      prec = list(
        initial = log(1/s^2),
        fixed = TRUE))))))
summary(r)
```

**Notes**

None