Sigmoidal effect of a covariate

Parametrization

This model implements a non-linear effect of a positive covariate x as a part of the linear predictor. It comes in two variants, *sigmoidal*

$$\beta\frac{x^k}{x^k+a^k} \qquad \text{or} \qquad \beta\frac{z}{z+1}$$

with $z=(x/a)^k$, $x\geq 0$, $k>0$ and $a>0$, and the *reverse-sigmoidal*

$$\beta\frac{a^k}{x^k+a^k} \qquad \text{or} \qquad \beta\frac{1}{z+1}.$$

Here, a is the halflife parameter, k the shape-parameter and β the scaling.

Hyperparameters

This model has three hyperparameters, the scaling β, halflife a and shape k,

$$\theta_1=\beta \qquad \theta_2=\log(a) \qquad \theta_3=\log(k)$$

and the priors are given for θ_1,θ_2 and θ_3.

Specification

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

hyper

theta1

hyperid 38001
name beta
short.name b
initial 1
fixed FALSE
prior normal
param 1 10
to.theta `function(x) x`
from.theta `function(x) x`

theta2

hyperid 38002
name loghalflife
short.name halflife
initial 3
fixed FALSE

prior loggamma
param 3 1
to.theta `function(x) log(x)`
from.theta `function(x) exp(x)`

theta3

hyperid 38003
name logshape
short.name shape
initial 0
fixed FALSE
prior loggamma
param 10 10
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 sigm

Example

```
sigm = function(x, halflife, shape = 1)
{
    xx = (x/halflife)^shape
    return (xx/(1.0+xx))
}
revsigm = function(x, halflife, shape = 1)
{
    xx = (x/halflife)^shape
    return (1.0/(1.0+xx))
}

n = 1000
lambda = 10
s=0.01
x = rpois(n, lambda = lambda)
halflife = lambda
```

```
shape = 2

y = sigm(x, halflife, shape) + rnorm(n, sd = s)
r = inla(y ~ -1 + f(x, model="sigm"),
        data = data.frame(y, x),
        family = "gaussian",
        control.family = list(
                hyper = list(
                        prec = list(
                                initial = log(1/s^2),
                                fixed = TRUE))))
summary(r)

y = revsigm(x, halflife, shape) + rnorm(n, sd = s)
r = inla(y ~ -1 + f(x, model="revsigm"),
        data = data.frame(y, x),
        family = "gaussian",
        control.family = list(
                hyper = list(
                        prec = list(
                                initial = log(1/s^2),
                                fixed = TRUE))))
summary(r)
```

Notes

None