Circular Normal (von Mises distribution)

Parametrisation

The circular Normal or von Mises distribution, has density

$$f(y) = \frac{1}{2\pi I_0(\kappa s)} \exp(\kappa s \cos(y - \mu)),$$

for continuously responses y where $|y - \mu| \leq \pi$ and $|\mu| \leq \pi$. Here,

μ is a measure of location, and

κ is a measure of the precision,

s is a fixed scaling, $s > 0$, and

I_0 is the modified Bessel of first kind and order zero

$$I_0(\tau) = \frac{1}{2\pi} \int_0^{2\pi} e^{\tau \cos\alpha} \mathrm{d}\alpha.$$

Link-function

The "mean" of y is given as μ and the mean is linked to the linear predictor as

$$\mu = 2 \arctan(\eta)$$

(Link function "tan")

Hyperparameters

The "precision" κ is represented as

$$\theta = \log \kappa$$

and the prior is defined on θ.

Specification

- family = `circularnormal`
- Required arguments: y and s (argument `scale`)

The scalings have default value 1.

Hyperparameter spesification and default values

hyper

theta

name log precision parameter
short.name prec
initial 2
fixed FALSE
prior loggamma
param 1 0.01

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

survival FALSE

discrete FALSE

link default tan

pdf circular-normal

status experimental

Example

In the following example we estimate the parameters in a simulated example with circular Normal responses.

```
ilink = function(x) 2*atan(x)
link = function(x) tan(x/2)

n = 300
z = rnorm(n, sd=0.3)
eta = 1 + z
y.pred = ilink(eta)

## create a simple, almost exact, sampler for the circular normal...
kappa = 5
x = seq(-pi, pi, len = 10000)
d = exp(kappa*cos(x))
dd = cumsum(d)
dd = dd /max(dd)
cn.icdf.func = splinefun(dd, x, method = "monoH.FC")
rcn = function(n) cn.icdf.func(runif(n))

y = y.pred + rcn(n)

formula = y ~ 1 + z
r=inla(formula,  data = data.frame(y, z),
        family = "circularnormal", control.inla = list(cmin = -Inf))
```

Notes

Try to use

```
control.inla=list(cmin = -Inf)
```

to avoid systematic-errors for low precisions.