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 $|y - \mu| \le \pi$ and $|\mu| \le \pi$. 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

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

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

 doc The circular Gaussian likelihoood

hyper

theta

hyperid 67001
name log precision parameter
short.name prec
output.name Precision parameter for the Circular Normal observations
output.name.intern Log precision parameter for the Circular Normal observations

```
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 disabled
```

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(\text{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.