Random walk model of order 2 (RW2)

Parametrization

The random walk model of order 2 (RW2) for the Gaussian vector $\mathbf{x} = (x_1, \ldots, x_n)$ is constructed assuming independent second-orderincrements:

$$\Delta^2 x_i = x_i - 2\,x_{i+1} + x_{i+2} \sim \mathcal{N}(0, \tau^{-1})$$

The density for $\mathbf{x}$ is derived from its $n-2$ second-order increments as

$$\pi(\mathbf{x}|\tau) \quad \propto \quad \tau^{(n-2)/2} \exp\left\{-\frac{\tau}{2}\sum(\Delta^2 x_i)^2\right\} \tag{1}$$

$$= \quad \tau^{(n-2)/2} \exp\left\{-\frac{1}{2}\mathbf{x}^T\mathbf{Q}\mathbf{x}\right\} \tag{2}$$

where $\mathbf{Q} = \tau\mathbf{R}$ and $\mathbf{R}$ is the structure matrix reflecting the neighbourhood structure of the model.

It is also possible to define a *cyclic* version of the RW2 model.

Hyperparameters

The precision parameter τ is represented as

$$\theta = \log\tau$$

and the prior is defined on θ.

Specification

The RW2 model is specified inside the `f()` function as

```
f(<whatever>,model="rw2",values=<values>,cyclic=<TRUE,FALSE>,
```

The (optional) argument `values` is a numeric or factor vector giving the values assumed by the covariate for which we want the effect to be estimated. See the example for RW1 for an application.

Hyperparameter spesification and default values

hyper

    theta

        name   log precision
        short.name   prec
        prior   loggamma
        param   1 5e-05
        initial   4
        fixed   FALSE
        to.theta   `function(x) log(x)`
        from.theta   `function(x) exp(x)`

constr   TRUE

nrow.ncol   FALSE

augmented   FALSE

aug.factor 1

aug.constr

n.div.by

n.required FALSE

set.default.values FALSE

pdf rw2

Example

```
n=100
z=seq(0,6,length.out=n)
y=sin(z)+rnorm(n,mean=0,sd=0.5)
data=data.frame(y=y,z=z)

formula=y~f(z,model="rw2")
result=inla(formula,data=data,family="gaussian")
```

Notes

The RW2 is a intrinsic with rank deficiency 2.
There model also supports irregular locations or values.