Random walk model of order 1 (RW1)

Parametrization

The random walk model of order 1 (RW1) for the Gaussian vector $\mathbf{x} = (x_1, \ldots, x_n)$ is constructed assuming independent increments:

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

The density for $\mathbf{x}$ is derived from its $n-1$ increments as

$$\begin{aligned} \pi(\mathbf{x}|\tau) &\propto \tau^{(n-1)/2} \exp\left\{-\frac{\tau}{2}\sum(\Delta x_i)^2\right\} &(1)\\ &= \tau^{(n-1)/2} \exp\left\{-\frac{1}{2}\mathbf{x}^T\mathbf{Q}\mathbf{x}\right\} &(2)\end{aligned}$$

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 RW1 model, in this case the graph is modified so that last node x_n is neighbour of x_{n-1} and x_1.

Hyperparameters

The precision parameter τ is represented as

$$\theta = \log \tau$$

and the prior is defined on θ.

Specification

The RW1 model is specified inside the `f()` function as

```
f(<whatever>,model="rw1",values=<values>,cyclic=<TRUE,FALSE>,
              prior=c(<prior.model.theta>),
              param=c(<param.prior.theta1>))
```

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 next example for an application.

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="rw1",prior="loggamma",param=c(1,0.01))
result=inla(formula,data=data,family="gaussian")

#here we estimate the effect only for some of the values in z
formula1=y~f(z,model="rw1",prior="loggamma",param=c(1,0.01),values=z[seq(1,length(z),2)])
result1=inla(formula1,data=data,family="gaussian")
```

Notes

The RW1 is a intrinsic random field with rank deficiency of 1.
    There exist also support to define irregular RW1 models.