Proper Besag model for spatial effects

Parametrization

The proper version of the Besag model for random vector $\mathbf{x} = (x_1, \dots, x_n)$ is defined as

$$x_i|x_{-i}, \tau, \phi \sim \mathcal{N}\left(\frac{\phi}{1+\phi n_i} \sum_{i \sim j} x_j, \frac{1}{(1+\phi n_i)\tau}\right)$$
 (1)

where n_i is the number of neighbours of node $i, i \sim j$ indicates that the two nodes i and j are neighbours, $\phi > 0$ is as weight parameter and $\tau > 0$ is a "precision-like" (or scaling) parameter.

Hyperparameters

The precision parameter τ is represented as

$$\theta_1 = \log \tau$$

and the prior is defined on θ_1 .

The weight parameter ϕ is represented as

$$\theta_2 = \log \phi$$

and the prior is defined on θ_2 .

Specification

The besag model is specified inside the f() function as

```
f(<whatever>,model="besagproper",graph=<graph>,
    hyper=<hyper>)
```

The neighbourhood structure of \mathbf{x} is passed to the program through the graph argument. The structure of this file is described below.

Hyperparameter spesification and default values

 $\operatorname{\mathbf{doc}}$ A proper version of the Besag model

hyper

theta1

hyperid 12001
name log precision
short.name prec
prior loggamma
param 1 5e-04
initial 2
fixed FALSE
to.theta function(x) log(x)
from.theta function(x) exp(x)

theta2

hyperid 12002

```
name log diagonal
         short.name diag
         prior loggamma
         param 1 1
         initial 1
         fixed FALSE
         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 TRUE
set.default.values TRUE
pdf besagproper
```

Structure of the graph file

OLD: We describe the required format for the graph file using a small example. Let the file gra.dat, relative to a small graph of only 5 elements, be

Line 1 declares the total number of nodes in the graph (5), then, in lines 2-6 each node is described. For example, line 4 states that node 3 has 4 neighbours and these are nodes 2, 4 and 5.

The graph file can either have nodes indexed from 1 to n, or from 0 to n-1. Note that in the latter case, node i seen from R corresponds to node i-1 in the 0-indexed graph.

Example

To be added

Notes

Add notes later?