Besag model for spatial effects

Parametrization

The besag model for random vector $\mathbf{x} = (x_1, \dots, x_n)$ is defined as

$$x_i | x_j, i \neq j, \tau \sim \mathcal{N}(\frac{1}{n_i} \sum_{i \sim j} x_j, \frac{1}{n_i \tau}) \tag{1}$$

where n_i is the number of neighbours of node i, $i \sim j$ indicates that the two nodes i and j are neighbours.

Hyperparameters

The precision parameter τ is represented as

$$\theta_1 = \log \tau$$

and the prior is defined on θ_1.

Specification

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

```
f(<whatever>,model="besag",graph=<graph>,
  hyper=<hyper>, adjust.for.con.comp = TRUE,
  scale.model = FALSE)
```

The neighbourhood structure of $\mathbf{x}$ is passed to the program through the `graph` argument.

If the option `adjust.for.con.comp=TRUE` then the model is adjusted if the graph has more than one connected compoment. This adjustment can be disabled setting this option to `FALSE`. If `adjust.for.con.comp=TRUE` then `constr=TRUE` is interpreted as a sum-to-zero constraint on *each* connected component in the graph and the `rankdef` parameter is set to the number of connected components.

The logical option `scale.model` determine if the model should be scaled to have an average variance (the diagonal of the generalized inverse) equal to 1. This makes prior spesification much easier. Default is `FALSE` so that the model is not scaled.

Hyperparameter spesification and default values

hyper

theta

hyperid 8001
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 TRUE

set.default.values TRUE

pdf besag

Example

For examples of application of this model see the `Bym`, `Munich`, `Zambia` or `Scotland` examples in Volume I.

Notes

The besag model intrinsic with rankdef 1.

The term $\frac{1}{2}\log(|R|^*)$ of the normalisation constant is not computed, hence you need to add this part to the log marginal likelihood estimate, if you need it. Here R is the precision matrix with a unit precision parameter.