Bym2 model for spatial effects

Parametrization

This model is a reparameterisation of the BYM-model, which is a union of the besag model u^* and a iid model v^*, so that

$$x = \begin{pmatrix} v^* + u^* \\ u^* \end{pmatrix}$$

where both u^* and v^* has a precision (hyper-)parameter. The length of x is $2n$ if the length of u^* (and v^*) is n. The BYM2 model uses a different parameterisation of the hyperparameters where

$$x = \begin{pmatrix} \frac{1}{\sqrt{\tau}} \left(\sqrt{1-\phi}\, v + \sqrt{\phi}\, u \right) \\ u \end{pmatrix}$$

where both u and v are *standardised* to have (generalised) variance equal to one. The *marginal* precision is then τ and the proportion of the marginal variance explained by the spatial effect (u) is ϕ.

Hyperparameters

The hyperparameters are the margainal precision τ and the mixing parameter ϕ. The marginal precision τ is represented as

$$\theta_1 = \log(\tau)$$

and the mixing parameter as

$$\theta_2 = \log\left(\frac{\phi}{1-\phi}\right)$$

and the prior is defined on $\theta = (\theta_1, \theta_2)$.

Specification

The bym2 model is specified inside the `f()` function as

```
f(<whatever>, model="bym2", graph=<graph>,
  hyper=<hyper>, adjust.for.con.comp = TRUE)
```

The neighbourhood structure of **x** is passed to the program through the `graph` argument.

The option `adjust.for.con.comp` adjust the model if the graph has more than one connected compoment, and this adjustment can be disabled setting this option to `FALSE`. This means that `constr=TRUE` is interpreted as a sum-to-zero constraint on *each* connected component and the `rankdef` parameter is set accordingly.

Hyperparameter spesification and default values

hyper

theta1

name log precision
short.name prec
prior pc.prec
param 1 0.01
initial 4
fixed FALSE

to.theta `function(x) log(x)`

from.theta `function(x) exp(x)`

theta2

name logit phi

short.name phi

prior pc

param 0.5 -1

initial -3

fixed FALSE

to.theta `function(x) log(x/(1-x))`

from.theta `function(x) exp(x)/(1+exp(x))`

constr TRUE

nrow.ncol FALSE

augmented TRUE

aug.factor 2

aug.constr 2

n.div.by

n.required TRUE

set.default.values TRUE

status experimental

pdf bym2

Example

Notes

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 for the standardised Besag part of the model.

The generic PC-prior for ϕ is available as `prior="pc"` and parameters `param="c(u, alpha)"`, where $\text{Prob}(\phi \leq u) = \alpha$. If $\alpha < 0$ or $\alpha > 1$, then it is set to a value close to the minimum value of α allowed. This prior depends on the graph and its computational cost is $\mathcal{O}(n^3)$.