

# Bym model for spatial effects

## Parametrization

This model is simply the sum of a besag model and a iid model.

The benefite is that this allows to get the posterior marginals of the sum of the spatial and iid model; otherwise it offers no advantages.

## Hyperparameters

The hyperparameters are the precision  $\tau_1$  of the iid model and the precision  $\tau_2$  of the besag model. The precision parameters are represented as

$$\theta = (\theta_1, \theta_2) = (\log \tau_1, \log \tau_2)$$

and the prior is defined on  $\theta$ .

## Specification

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

```
f(<whatever>, model="bym", graph.file=<graph file name>, hyper=<hyper>)
```

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

## Hyperparameter spesification and default values

### hyper

#### theta1

```
name  log unstructured precision
short.name  prec.unstruct
prior  loggamma
param  1 0.001
initial  4
fixed  FALSE
to.theta  function(x) log(x)
from.theta  function(x) exp(x)
```

#### theta2

```
name  log spatial precision
short.name  prec.spatial
prior  normal
param  0 5e-05
initial  4
fixed  FALSE
to.theta  function(x) log(x)
from.theta  function(x) 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
```

### Structure of the graph file

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

```
5
1 1 2
2 2 1 3
3 3 2 4 5
4 1 3
5 1 3
```

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

For examples of application of this model see the `Bym` example in Volume I.

The model is modified accordingly is the graph has more than one connected components.

### Notes

None