

# 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>, adjust.for.con.comp = TRUE)
```

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

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 unstructured precision  
short.name  prec.unstruct  
prior  loggamma  
param  1 5e-04  
initial  4  
fixed  FALSE  
to.theta  
from.theta
```

#### theta2

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

```

        from.theta
constr  TRUE
nrow.ncol  FALSE
augmented  TRUE
aug.factor  2
aug.constr  2
n.div.by
n.required  TRUE
set.default.values  TRUE
pdf  bym

```

### 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.

### Notes

None