

## Generic1 model

### Parametrization

The Type 1 generic model implements the following precision matrix

$$\mathbf{Q} = \tau \left( \mathbf{I} - \frac{\beta}{\lambda_{max}} \mathbf{C} \right)$$

where  $\mathbf{C}$  is the structure matrix. The parameter  $\lambda_{max}$  is the maximum eigenvalue of  $\mathbf{C}$ , which allows  $\beta$  to be in the range  $\beta \in [0, 1)$

### Hyperparameters

The two parameters of the generic1 model are represented as

$$\begin{aligned} \theta_1 &= \log(\tau) \\ \theta_2 &= \text{logit}(\beta) \end{aligned}$$

and priors are assigned to  $(\theta_1, \theta_2)$

### Specification

The generic1 model is specified inside the `f()` function as

```
f(<whatever>, model="generic1", Cmatrix = <Cmat>, hyper = <hyper>)
```

where `<Cmat>` can be given in two different ways:

- a dense matrix or a sparse-matrix defined by `Matrix::sparseMatrix()`.
- the name of a file giving the structure matrix. The file should have the following format

$$i \quad j \quad \mathbf{C}_{ij}$$

where  $i$  and  $j$  are the row and column index and  $\mathbf{C}_{ij}$  is the corresponding element of the precision matrix. Only the non-zero elements of the precision matrix need to be stored in the file.

### Hyperparameter specification and default values

**doc** A generic model (type 1)

**hyper**

**theta1**

**hyperid** 19001

**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)

## theta2

```
hyperid 19002
name beta
short.name beta
initial 2
fixed FALSE
prior gaussian
param 0 0.1
to.theta function(x) log(x / (1 - x))
from.theta function(x) exp(x) / (1 + 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 generic1

## Example

```
n = 100
## build a structure matrix
Cm = matrix(runif(n^2,min=-1,max=1),n,n)
diag(Cm) = 0
Cm = 0.5*(Cm + t(Cm))
lambda.max = max(eigen(Cm)$values)

## define the precision matrix
beta = 0.9
Q = diag(rep(1,n)) - beta/lambda.max * Cm
Sigma = solve(Q)

#simulate data
require(mvtnorm)
sd = 0.001
z = rnorm(n)
eta = rmvnorm(n=1,sigma = Sigma)
y = c(eta) + sd*rnorm(n) + z
idx = 1:n
d = list(y=y,idx=idx,z=z)

## Alternative 1
```

```

## print the file containing the C matrix
file = "Cmatrix.dat"
cat("",file=file, append = FALSE)
for(i in 1:n)
{
  j = i
  cat(i, j, Cm[i,j], "\n", sep = " ", file=file, append=TRUE)
  if (i < n)
    for(j in (i+1):n)
      cat(i, j, Cm[i,j], "\n", sep = " ", file=file, append=TRUE)
}
formula = y ~ f(idx, model = "generic1", Cmatrix = file) + z

## Alternative 2
## formula = y ~ f(idx, model = "generic1", Cmatrix = Cm) + z

## Alternative 3
## formula = y ~ f(idx, model = "generic1", Cmatrix = as(Cm, "dgTMatrix"))+z

#####

result = inla(formula, data=d,family="gaussian",
              control.family = list(initial = log(1/sd^2), fixed=TRUE),
              verbose=T, keep=T)

```

## Notes

None