

## Generic1 model

### Parametrization

The Type 1 generic model implements the following precision matrix

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

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  $\beta \in [0, 1)$

**Note that  $\lambda_{max}$  is computed unless given, which can be very time consuming for a large dimension.**

### 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>)
```

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

- a dense matrix or a sparse-matrix defined be `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 spesification 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(idy, model = "generic1", Cmatrix = file) + z

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

## Alternative 3
## formula = y ~ f(idy, 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