

## Generic0 model

### Parametrization

The Type 0 generic model implements the following precision matrix

$$\mathbf{Q} = \tau \mathbf{C}$$

where  $\mathbf{C}$  is the structure matrix.

### Hyperparameters

The precision parameters of the generic0 model is represented as

$$\theta = \log(\tau)$$

and prior is assigned to  $\theta$

### Specification

The generic0 models is specified inside the `f()` function as

```
f(<whatever>, model="generic0", Cmatrix = <Cmat>, hyper = <hyper>)
```

where `<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.

See the following example for an application

### Hyperparameter spesification and default values

**hyper**

**theta**

**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)

**constr** FALSE

**nrow.ncol** FALSE

```
augmented FALSE
aug.factor 1
aug.constr
n.div.by
n.required TRUE
set.default.values TRUE
pdf generic0
```

## Example

In the example below we define a RW1 model first using the `generic0` model and this using the `rw1` model.

```
## Simulate data
n=100
z=1:n
y=sin(z/n*2*pi)+rnorm(n,mean=0,sd=0.5)
data=data.frame(y=y,z=z)

Q = toeplitz(c(2,-1, rep(0,n-3),-1))
Q[1,1] = Q[n,n] = 1
Q[n,1] = Q[1,n] = 0

## Q as dense
formula1 = y ~ f(z, model="generic0", Cmatrix = Q,
                 rankdef=1, constr=TRUE, diagonal=1e-05)
result1 = inla(formula1, data=data, family="gaussian")

## Q as sparse
Q.sparse = as(Q, "dgTMatrix")
formula2 = y ~ f(z, model="generic0", Cmatrix = Q.sparse,
                 rankdef=1, constr=TRUE, diagonal=1e-05)
result2 = inla(formula2, data=data, family="gaussian")

## This is the same model defined using the rw1 model
formula3 = y ~ f(z,model="rw1")
result3 = inla(formula3, data=data, family="gaussian")
```

## Notes

INLA uses for this model the following normalizing constant

$$\tau^{n/2} \left( \frac{1}{2\pi} \right)^{n/2}$$

where  $n$  is the dimension of the  $C$  matrix, and NOT the correct one

$$\tau^{n/2} \left( \frac{1}{2\pi} \right)^{n/2} |C|^{1/2}.$$

Different algorithms are required to compute the determinant depending on the structure and size of  $C$  (and it might be singular), and therefore this constant is not computed. However, for near-all use of this `generic0` model, this constant is not of interest.

The missing constant *only matters* for the marginal likelihood value. Say you are comparing two runs with two models, one where this generic-component is present, and one where this generic-component is not present. Since the marginal likelihood does depend on the normalising constant not only the on the “shape”, then a comparison between the two models will be wrong using the reported `result$mlik`-values from INLA. You have to add to one of them

$$1/2 \log(|C|)$$

to account for this missing constant.