Generic⁰ model

Parametrization

The Type 0 generic model implements the following precision matrix

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

where C is the structure matrix.

Hyperparameters

The precision parameters of the generic model is represented as

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

and prior is assigned to θ

Specification

The generic 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

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

where i and j are the row and column index and 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

```
doc A generic model (type 0)
```

hyper

theta

hyperid 18001
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

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

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

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

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.