# Model for seasonal variation

#### Parametrization

A model for seasonal variation with periodicity m for the random vector  $\S = (x_1, \dots, x_n), n > m$  is obtained assuming that the sums  $x_i + x_{i+1} + \dots + x_{i+m-1}$  are independent Gaussian with precision  $\tau$ .

The density for **x** is derived from the n-m+1 increments as

$$\pi(\mathbf{x}|\tau) \propto \tau^{\frac{(n-m+1)}{2}} \exp\left\{-\frac{\tau}{2}\sum_{i=1}^{\infty}(x_i + x_{i+1} + \dots + x_{i+m-1})^2\right\}$$
 (1)

$$= \tau^{\frac{(n-m+1)}{2}} \exp\left\{-\frac{1}{2}\mathbf{x}^T \mathbf{Q} \mathbf{x}\right\}$$
 (2)

where  $\mathbf{Q} = \tau \mathbf{R}$  and  $\mathbf{R}$  is the structure matrix reflecting the neighbourhood structure of the model.

## Hyperparameters

The precision parameter  $\tau$  is represented as

$$\theta = \log \tau$$

and the prior is defined on  $\theta$ .

## Specification

The seasonal model is specified inside the f() function as

### Hyperparameter spesification and default values

```
doc Seasonal model for time series
```

#### hyper

## theta

```
hyperid 7001
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 FALSE
set.default.values FALSE
pdf seasonal
Example
n=203
n.seas=12
trend=1:n
seasonal.sim=rep(1:n.seas, ceiling(n/n.seas))[1:n]
a=1
b = 0.5
y = rnorm(n,a+b*trend,1)+rnorm(n,0.2*seasonal.sim,1)
data=data.frame(y=y,trend=trend,seasonal=trend)
formula = y~f(trend,model="rw2")+f(seasonal,model="seasonal",
              season.length=n.seas)
result=inla(formula,family="gaussian",data=data)
```

# Notes

The seasonal is intrinsic with rank deficiency m-1.