

## RW2DIID model for spatial effects

### Parametrization

This model is a union of the RW2D model  $u^*$  and a iid model  $v^*$ , so that

$$x = \begin{pmatrix} v^* + u^* \\ u^* \end{pmatrix}$$

where both  $u^*$  and  $v^*$  has a precision (hyper-)parameter. The length of  $x$  is  $2n$  if the length of  $u^*$  (and  $v^*$ ) is  $n$ . The RW2DIID model uses a different parameterisation of the hyperparameters where

$$x = \begin{pmatrix} \frac{1}{\sqrt{\tau}} (\sqrt{1-\phi} v + \sqrt{\phi} u) \\ u \end{pmatrix}$$

where both  $u$  and  $v$  are *standardised* to have (generalised) variance equal to one. The *marginal* precision is then  $\tau$  and the proportion of the marginal variance explained by the spatial effect ( $u$ ) is  $\phi$ .

### Hyperparameters

The hyperparameters are the marginal precision  $\tau$  and the mixing parameter  $\phi$ . The marginal precision  $\tau$  is represented as

$$\theta_1 = \log(\tau)$$

and the mixing parameter as

$$\theta_2 = \log\left(\frac{\phi}{1-\phi}\right)$$

and the prior is defined on  $\theta = (\theta_1, \theta_2)$ .

### Specification

The `rw2diid` model is specified inside the `f()` function as

```
f(<whatever>, model="rw2didd", nrow=<nrow>, ncol=<ncol>,  
  hyper=<hyper>)
```

### Hyperparameter spesification and default values

**doc** Thin-plate spline with iid noise

**hyper**

**theta1**

**hyperid** 33001

**name** log precision

**short.name** prec

**prior** pc.prec

**param** 1 0.01

**initial** 4

**fixed** FALSE

**to.theta** function(x) log(x)

**from.theta** function(x) exp(x)

## **theta2**

```
hyperid 33002
name logit phi
short.name phi
prior pc
param 0.5 0.5
initial 3
fixed FALSE
to.theta function(x) log(x / (1 - x))
from.theta function(x) exp(x) / (1 + exp(x))
```

**constr** TRUE

**nrow.ncol** TRUE

**augmented** TRUE

**aug.factor** 2

**aug.constr** 2

**n.div.by**

**n.required** FALSE

**set.default.values** TRUE

**status** experimental

**pdf** rw2diid

## **Example**

### **Notes**

The term  $\frac{1}{2} \log(|R|^*)$  of the normalisation constant is not computed, hence you need to add this part to the log marginal likelihood estimate, if you need it. Here  $R$  is the precision matrix for the standardised RW2D part of the model.

The generic PC-prior for  $\phi$  is available as **prior**="pc" and parameters **param**="c(u, alpha)", where  $\text{Prob}(\phi \leq u) = \alpha$ . If  $\alpha < 0$  or  $\alpha > 1$ , then it is set to a value close to the minimum value of  $\alpha$  allowed.