

## 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

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.