

Autoregressive model of order 1 (AR1)

Parametrization

The autoregressive model of order 1 (AR1) for the Gaussian vector $\mathbf{x} = (x_1, \dots, x_n)$ is defined as:

$$\begin{aligned}x_1 &\sim \mathcal{N}(0, (\tau(1 - \phi^2))^{-1}) \\x_i &= \phi x_{i-1} + \epsilon_i; \quad \epsilon_i \sim \mathcal{N}(0, \tau^{-1}) \quad i = 2, \dots, n\end{aligned}$$

where

$$|\phi| < 1$$

Hyperparameters

The precision parameter κ is represented as

$$\theta_1 = \log(\kappa)$$

where κ is the *marginal* precision,

$$\kappa = \tau(1 - \phi^2).$$

The parameter ϕ is represented as

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

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

Specification

The AR1 model is specified inside the `f()` function as

```
f(<whatever>, model="ar1", values=<values>, hyper = <hyper>)
```

The (optional) argument `values` is a numeric or factor vector giving the values assumed by the covariate for which we want the effect to be estimated. See the example for RW1 for an application.

Hyperparameter specification and default values

hyper

theta1

```
name    precision
short.name  prec
initial  4
fixed    FALSE
prior    loggamma
param    c(1, 1e-04)
```

theta2

```
name    lag-one correlation
short.name  rho
initial  2
fixed    FALSE
prior    normal
param    c(0, 0.2)
```

```
constr FALSE
nrow.ncol FALSE
augmented FALSE
aug.factor 1
aug.constr NULL
n.div.by NULL
n.required FALSE
set.default.values FALSE
```

Example

In this exaple we implement an ar1 model observed with Poisson counts

```
#simulate data
n = 100
phi = 0.8
prec = 10
## note that the marginal precision would be
marg.prec = prec * (1-phi^2)

E=sample(c(5,4,10,12),size=n,replace=T)
eta = as.vector(arima.sim(list(order = c(1,0,0), ar = phi), n = n,sd=sqrt(1/prec)))
y=rpois(n,E*exp(eta))
data = list(y=y,z=1:n)

## fit the model
formula = y~f(z,model="ar1")
result = inla(formula,family="poisson", data = data)
```

Notes

None