Autoregressive model of order 1 (AR1)

Parametrization

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

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

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>,prior=c(<prior.model.theta1>,<prior.model.theta2>),
             param=c(<param.prior.theta1>,<param.prior.theta1>,
                     <param.prior.theta2>,<param.prior.theta2>))
```

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.

Example

In this exaple we implement a ar1 model where θ_1 has a log-Gamma prior with parameters 1 and 0.001 and θ_2 has a Gaussian prior with parameters 0 and 0.001

```
#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",prior=c("loggamma","gaussian"),param=c(1,0.001,0,0.001))
result = inla(formula,family="poisson", data = data)
```

Notes

None