Normal Inverse Gaussian (NIG) model for Stochastic volatility

Parametrization

The NIG likelihood for stochastic volatility models is defined as:

$$\pi(y|\eta) = \sigma\epsilon$$

where

$$\epsilon \sim \text{NIG}(\beta, \psi)$$

and $\text{NIG}(\beta, \psi)$ is a standardised NIG distribution with density

$$\pi(\cdot|\beta, \psi) = \frac{\gamma\psi}{\pi}\sqrt{\frac{\beta^2+\psi^2}{(\gamma x+\beta)^2+\psi^2}}\ \exp\left(\psi^2+\beta(\gamma x+\beta)\right)\ K_1\left(\sqrt{(\beta^2+\psi^2)\left((\gamma x+\beta)^2+\psi^2\right)}\right)$$

where $\gamma^2 = 1 + \beta^2/\psi^2$.

Link-function

The scale parameter σ is linked to the linear predictor η as:

$$\sigma = \exp(\eta/2)$$

Hyperparameters

The skewness parameter β is represented as:

$$\theta_1 = \beta$$

and the shape parameter ψ as

$$\theta_2 = \log(\psi - 1)$$

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

Specification

- family = `stochvol.nig`
- Required argument: y.

Hyperparameter spesification and default values

hyper

theta1

- **name** skewness
- **short.name** skew
- **initial** 0
- **fixed** FALSE
- **prior** gaussian
- **param** c(0, 10)

theta2

- **name** shape
- **short.name** shape

initial 0
fixed FALSE
prior loggamma
param c(1, 0.5)

survival FALSE

discrete FALSE

Example

In the following example we specify the likelihood for the stochastic volatility model to be NIG

```
#simulated data
n=500
phi=0.53
eta=rep(0.1,n)
for(i in 2:n)
  eta[i]=0.1+phi*(eta[i-1]-0.1)+rnorm(1,0,0.6)
y=exp(eta/2)*rnorm(n)
time=1:n
data=list(ret=y,time=time)

#fit the model
formula=ret~f(time,model="ar1")
result=inla(formula,family="stochvol.nig",data=data)
```

Notes

None