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 $NIG(\beta, \psi)$ is a standardised NIG distribution with density

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

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

Link-function

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

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

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

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hyper

theta1

hyperid 84001 name skewness short.name skew initial 0 fixed FALSE prior gaussian param 0 10

```
to.theta function(x) x
         from.theta function(x) x
     theta2
         hyperid 84002
         name shape
         short.name shape
         initial 0
         fixed FALSE
         prior loggamma
         param 1 0.5
         to.theta function(x) log(x-1)
         from.theta function(x) 1+exp(x)
survival FALSE
discrete FALSE
link default log
\mathbf{pdf} stochvolnig
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