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 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
        output.name.intern skewness_param_intern for stochvol-nig
        output.name skewness parameter for stochvol-nig
        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
        output.name shape parameter for stochvol-nig
        output.name.intern shape_param_intern for stochvol-nig
        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

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