

# Gaussian model for Stochastic volatility

## Parametrization

The Gaussian likelihood for stochastic volatility models is defined as:

$$y|\dots = \sigma\epsilon$$

where

$$\epsilon \sim \mathcal{N}(0, 1)$$

## Link-function

The squared of the scale parameter  $\sigma$  is linked to the linear predictor  $\eta$  as:

$$\sigma^2 = \exp(\eta) + 1/\tau$$

where  $1/\tau$  is an possible offset in the variance.

## Hyperparameters

This likelihood has one hyperparameter

$$\theta = \log(\tau)$$

and the prior is defined on  $\theta$ .

See **Notes** for more info about the possible offset in the variance, as default  $1/\tau = 0$  and fixed.

## Specification

- family="stochvol"
- Required argument:  $y$ .

## Hyperparameter spesification and default values

**doc** The Gaussian stochvol likelihood

**hyper**

**theta**

**hyperid** 82001

**name** log precision

**short.name** prec

**output.name** Offset precision for stochvol

**output.name.intern** Log offset precision for stochvol

**initial** 500

**fixed** TRUE

**prior** loggamma

**param** 1 0.005

**to.theta** function(x) log(x)

**from.theta** function(x) exp(x)

**survival** FALSE

**discrete** FALSE

**link** default log

**pdf** stochvolgaussian

## Example

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

```
#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",
              hyper = list(prec = list(param=c(1,0.001))))
result=inla(formula,family="stochvol",data=data)
```

## Notes

The default setting treat  $\theta$  as fixed and with an initial value so that  $1/\tau = 0$ . If  $\theta$  is random, then you *must* also give it a reasonable initial value.