

# Skew-Normal

## Parametrisation

The Skew-Normal distribution is

$$f(y) = 2 \frac{\sqrt{w\tau}}{\sqrt{2\pi}} \exp\left(-\frac{1}{2}w\tau(y-\mu)^2\right) \Phi(a a_{\max}[w\tau(y-\mu)])$$

for continuously responses  $y$  where  $\Phi(\cdot)$  is the cumulative distribution function for a standard Normal, and

$\mu$ : is the the location parameter

$\tau$ : is the inverse scale

$w$ : is a fixed weight,  $w > 0$ ,

$a$ : is the shape parameter

$a_{\max}$ : is the (fixed) maximum value of the shape paramter (added for stability reasons). Default value is 5.

## Link-function

The location parameter is linked to the linear predictor by

$$\mu = \eta$$

## Hyperparameters

The inverse scale is represented as

$$\theta_1 = \log \tau$$

and the prior is defined on  $\theta_1$ .

The shape parameter is

$$a = 2 \frac{\exp(\theta_2)}{1 + \exp(\theta_2)} - 1$$

and the prior is defined on  $\theta_2$ .

## Specification

- family = **sn**
- Required arguments:  $y$  and  $w$  (keyword **weights**). The weights has default value 1.
- Optional control arguments: **sn.shape.max**. Default value is 5.0.

## Hyperparameter spesification and default values

hyper

**theta1**

**name** log inverse scale

**short.name** iscale

**initial** 4

```

    fixed FALSE
    prior loggamma
    param 1 5e-05
  theta2
    name logit skewness
    short.name skew
    initial 4
    fixed FALSE
    prior gaussian
    param 0 10
    to.theta function(x, shape.max = 1) log((1+x/shape.max)/(1-x/shape.max))
    from.theta function(x, shape.max = 1) shape.max*(2*exp(x)/(1+exp(x))-1)

survival FALSE

discrete FALSE

link default identity

pdf sn

```

## Example

This is a simulated example requiring the package `sn`.

```

library(sn)
n = 1000
z = rnorm(n)
y = z + rsn(n, shape = 2)
formula = y ~ z
r = inla(formula, family = "sn", data = data.frame(z,y),
         control.family = list(sn.shape.max = 5.0))
summary(r)

```

## Notes

None.