

# CBinomial

## Parametrisation

The clustered/clumped-Binomial distribution arrives from a transformation of Binomial observations. Let  $z$  be Binomial distributed

$$\text{Prob}(z) = \binom{n}{z} p^z (1-p)^{n-z}$$

for  $z = 0, 1, 2, \dots, n$ , where

$n$ : number of trials.

$p$ : probability of success in each trial.

Then the CBinomial distribution is the distribution for  $y$ , where

$$y = \begin{cases} 0 & z = 0 \\ 1 & z > 0 \end{cases}$$

It then follows that  $\text{Prob}(y = 0) = (1-p)^n$  and  $\text{Prob}(y = 1) = 1 - (1-p)^n$ , i.e.  $y$  is Binomial distributed with size 1 and probability for success  $1 - (1-p)^n$ .

## Link-function

The probability  $p$  is linked to the linear predictor by

$$p(\eta) = \frac{\exp(\eta)}{1 + \exp(\eta)}$$

## Hyperparameters

None.

## Specification

- family = `binomial`
- Required arguments:  $y$  and  $n$  (keyword `Ntrials`)

## Example

In the following example we estimate the parameters in a simulated example with CBinomial responses.

```
n=100
a = -1
b = 1
z = rnorm(n)
eta = a + b*z
Ntrials = sample(c(1,5,10,15), size=n, replace=TRUE)
prob = exp(eta)/(1 + exp(eta))
yy = rbinom(n, size=Ntrials, prob = prob)
y = as.numeric(yy != 0)

data = list(y=y,z=z)
formula = y ~ 1+z
result = inla(formula, family = "cbinomial", data = data, Ntrials=Ntrials)
summary(result)
```

## Notes

None.