

# Randomly Censored Poisson (Experimental)

## Parametrisation

The Poisson distribution is

$$\text{Prob}(y) = \frac{\lambda^y}{y!} \exp(-\lambda)$$

for responses  $y = 0, 1, 2, \dots$ , where  $\lambda$  is the expected value.

The randomly-censored Poisson allow the observations to have a known or unknown censoring: **event**= 1 its observed as is, with **event**= 0 its right censored, so the likelihood is

$$\text{Prob}(Y \geq y) = \sum_{y' \geq y} \frac{\lambda^{y'}}{y'!} \exp(-\lambda),$$

and for **event**  $\neq 0, 1$  (after rounding from double to int) then its randomly censored where

$$\text{Prob}(\text{event} = 1) = p(\cdot)$$

and

$$\text{Prob}(\text{event} = 0) = 1 - p(\cdot)$$

where  $p(\cdot)$  depends on covariates

$$\text{logit}(p(\cdot)) = \text{offset} + \sum_{i=1} \beta_i x_i$$

## Link-function

The mean  $\lambda$  is linked to the linear predictor by

$$\lambda(\eta) = E \exp(\eta)$$

where  $E > 0$  is a known constant (or  $\log(E)$  is the offset of  $\eta$ ).

## Hyperparameters

$\beta_1, \beta_2, \dots$  if in use. Maximum 10.

## Specification

- `family="rcpoisson"`
- Data are given as an `inla.mdata`-object, with format

$$\text{inla.mdata}(y, E, \text{event}, \text{offset}, x_1, x_2, \dots)$$

where maximum 10 covariates can be given. Each argument is a vector. Note that the four first columns are required, and the covariates can be omitted if there are none.

## Hyperparameter spesification and default values

`doc` Randomly censored Poisson

`hyper`

`theta1`

```

hyperid 66701
name beta1
short.name beta1
output.name beta1 rcpoisson observations
output.name.intern beta1 rcpoisson observations
initial 0
fixed FALSE
prior normal
param 0 100
to.theta function(x) x
from.theta function(x) x
theta2
hyperid 66702
name beta2
short.name beta2
output.name beta2 rcpoisson observations
output.name.intern beta2 rcpoisson observations
initial 0
fixed FALSE
prior normal
param 0 100
to.theta function(x) x
from.theta function(x) x
theta3
hyperid 66703
name beta3
short.name beta3
output.name beta3 rcpoisson observations
output.name.intern beta3 rcpoisson observations
initial 0
fixed FALSE
prior normal
param 0 100
to.theta function(x) x
from.theta function(x) x
theta4
hyperid 66704
name beta4
short.name beta4
output.name beta4 rcpoisson observations
output.name.intern beta4 rcpoisson observations
initial 0
fixed FALSE
prior normal

```

```

    param 0 100
    to.theta function(x) x
    from.theta function(x) x
theta5
    hyperid 66705
    name beta5
    short.name beta5
    output.name beta5 rcpoisson observations
    output.name.intern beta5 rcpoisson observations
    initial 0
    fixed FALSE
    prior normal
    param 0 100
    to.theta function(x) x
    from.theta function(x) x
theta6
    hyperid 66706
    name beta6
    short.name beta6
    output.name beta6 rcpoisson observations
    output.name.intern beta6 rcpoisson observations
    initial 0
    fixed FALSE
    prior normal
    param 0 100
    to.theta function(x) x
    from.theta function(x) x
theta7
    hyperid 66707
    name beta7
    short.name beta7
    output.name beta7 rcpoisson observations
    output.name.intern beta7 rcpoisson observations
    initial 0
    fixed FALSE
    prior normal
    param 0 100
    to.theta function(x) x
    from.theta function(x) x
theta8
    hyperid 66708
    name beta8
    short.name beta8
    output.name beta8 rcpoisson observations

```

```

    output.name.intern beta8 rcpoisson observations
    initial 0
    fixed FALSE
    prior normal
    param 0 100
    to.theta function(x) x
    from.theta function(x) x
theta9
    hyperid 66709
    name beta9
    short.name beta9
    output.name beta9 rcpoisson observations
    output.name.intern beta9 rcpoisson observations
    initial 0
    fixed FALSE
    prior normal
    param 0 100
    to.theta function(x) x
    from.theta function(x) x
theta10
    hyperid 66710
    name beta10
    short.name beta10
    output.name beta10 rcpoisson observations
    output.name.intern beta10 rcpoisson observations
    initial 0
    fixed FALSE
    prior normal
    param 0 100
    to.theta function(x) x
    from.theta function(x) x

status experimental

survival FALSE

discrete TRUE

link default log

pdf rcpoisson

```

## Example

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

```

n <- 30000
x <- rnorm(n)
eta <- 1 + 0.2 * x
event <- rep(1, n)
E <- runif(n)

offset <- rnorm(n, sd = 0.5)
xx <- rnorm(n)
xxx <- rnorm(n)
eta.c <- offset + 0.3 * xx + 0.5 * xxx

## need two for the censoring
y <- rpois(n, E*exp(eta))
yy <- rpois(n, E*exp(eta))

for(i in 1:n) {
  event[i] <- sample(c(1, 0, 99), 1, prob = c(0.6, 0.1, 0.3))
  if (event[i] == 1) {
    ## y[i] <- y[i]
  } else if (event[i] == 0) {
    y[i] <- min(y[i], yy[i])
  } else {
    prob <- 1/(1+exp(-eta.c[i]))
    if (runif(1) < prob) {
      ## local.event = 1
      ## y[i] <- y[i]
    } else {
      ## local.event = 0
      y[i] <- min(y[i], yy[i])
    }
  }
}

Y <- inla.mdata(y, E, event, offset, xx, xxx)
r <- inla(Y ~ 1 + x,
  data = list(Y = Y, x = x),
  family = "rcpoisson",
  control.family = list(hyper = list(beta1 = list(param = c(0, 1)),
    beta2 = list(param = c(0, 2)))),
  verbose = !TRUE)
summary(r)

```

## Notes