Tweedie

Parametrisation

The Tweedie distribution[1] is a compond Poisson-Gamma model, where

$$Y = \sum_{i=1}^{N} X_i,$$

and $\{X_i\}$ are iid Gamma variables with parameter (α, γ) so that the mean of X_i is $\alpha\gamma$ and variance $\alpha\gamma^2$, and N is (independent) Poisson with mean λ. Since N can be 0 with a positive probability, then the Tweedie distribution have a singleton in zero and is continuous for $y > 0$.

We will use the following reparametersation

$$\mu = \lambda\alpha\gamma, \qquad p = \frac{\alpha+2}{\alpha+1}, \qquad \frac{\phi}{w} = \frac{\lambda^{1-p}(\alpha\gamma)^{2-p}}{2-p}$$

where $w > 0$ is a fixed scaling, so the mean of Y is $\mu > 0$, variance is $\frac{\phi}{w}\mu^p$ where $1 < p < 2$, and ϕ is a dispersion parameter.

Link-function

The linkfunction is given as

$$\log(\mu) = \eta$$

where η is the linear predictor.

Hyperparameters

The hyperparameters are $\theta = (\theta_1, \theta_2)$, where

$$p = 1 + \frac{\exp(\theta_1)}{1 + \exp(\theta_1)}, \qquad 1 < p < 2.$$

and

$$\phi = \exp(\theta_2), \qquad \phi > 0$$

The priors are given on (θ_1, θ_2).

Specification

- family = `tweedie`
- Required arguments: y (and optional w through option `scale`)

Hyperparameter spesification and default values

doc Tweedie distribution

hyper

    theta1

        hyperid 102101

        name p

---

[1] This documentation follows the notation in *Likelihood-based and Bayesian methods for Tweedie compound Poisson linear mixed models, by Yanwei Zhang, Stat Comput (2013) 23:743–757, DOI 10.1007/s11222-012-9343-7*

short.name p

initial 0

fixed FALSE

prior normal

param 0 100

to.theta function(x, interval = c(1.0, 2.0)) log(-(interval[1] - x) / (interval[2] -

from.theta function(x, interval = c(1.0, 2.0)) interval[1] + (interval[2] - interval|

theta2

hyperid 102201

name dispersion

short.name phi

initial -4

fixed FALSE

prior loggamma

param 100 100

to.theta function(x) log(x)

from.theta function(x) exp(x)

status experimental

survival FALSE

discrete FALSE

link default log

pdf tweedie

Example

In the following example we estimate the parameters in a simulated example.

```
library(tweedie)
library(INLA)

n <- 300
x <- rnorm(n, sd = 0.2)
eta <- 1 + x
mu <- exp(eta)

p <- 1.32
phi <- 2.0
y <- numeric(n)
for(i in 1:n) {
    y[i] <- rtweedie(1, xi = p, mu = mu[i], phi = phi)
}

r <- inla(y ~ 1 + x,
          data = data.frame(y, x),
          ## offset = rep(log(mean(y)), n),
          family = "tweedie",
```

```
          control.family = list(hyper =  list(
                                theta1 = list(initial = 0),
                                theta2 = list(initial = -4,
                                              prior = "loggamma",
                                              param = c(100, 100)))),
          ## control.fixed = list(prec = 0, prec.intercept = 1),
          ## control.inla = list(cmin = 0, b.strategy = "skip"),
          ## inla.mode = "experimental",
          num.threads = "4:1",
          verbose = T)
summary(r)
```

Notes

This distribution is experimental, and changes will occur.