Package 'GTDL'

January 20, 2025

Type Package

Title The Generalized Time-Dependent Logistic Family

Version 1.0.0

Date 2022-03-25

Author Jalmar Carrasco [aut, cre],
Luciano Santana [aut],
Lizandra Fabio [aut]

Maintainer Jalmar Carrasco <carrascojalmar@gmail.com>

Description Computes the probability density, survival function,
the hazard rate functions and generates random samples from the
GTDL distribution given by Mackenzie, G. (1996) <doi:10.2307/2348408>.
The likelihood estimates, the randomized quantile (Louzada, F., et al.
(2020) <doi:10.1109/ACCESS.2020.3040525>)
residuals and the normally transformed randomized survival
probability (Li,L., et al. (2021) <doi:10.1002/sim.8852>)
residuals are obtained for the GTDL model.

License GPL (>= 3)

Encoding UTF-8

LazyData TRUE

RoxygenNote 7.1.1

Imports survival,

Suggests stats,

Depends R (>= 2.10)

NeedsCompilation no

Repository CRAN

Date/Publication 2022-03-28 07:50:12 UTC

Contents

`artset1987` *Artset1987 data*

Description

Times to failure of 50 devices put on life test at time 0.

Usage

```
data(artset1987)
```

Format

This data frame contains the following columns:

- t: Times to failure

References

- Aarset, M. V. (1987). How to Identify a Bathtub Hazard Rate. IEEE Transactions on Reliability, 36, 106–108.

Examples

```
data(artset1987)
head(artset1987)
```

fGTDL *The GTDL distribution*

Description

Density function, survival function, failure function and random generation for the GTDL distribution.

Usage

```
dGTDL(t, param, log = FALSE)

hGTDL(t, param)

sGTDL(t, param)

rGTDL(n, param)
```

Arguments

t	vector of integer positive quantile.
param	parameters (alpha and gamma are scalars, lambda non-negative).
log	logical; if TRUE, probabilities p are given as log(p).
n	number of observations.

Details

- Density function

$$f(t \mid \boldsymbol{\theta}) = \lambda \left(\frac{\exp\{\alpha t + \boldsymbol{X}^\top \boldsymbol{\beta}\}}{1 + \exp\{\alpha t + \boldsymbol{X}^\top \boldsymbol{\beta}\}} \right) \times \left(\frac{1 + \exp\{\alpha t + \boldsymbol{X}^\top \boldsymbol{\beta}\}}{1 + \exp\{\boldsymbol{X}^\top \boldsymbol{\beta}\}} \right)^{-\lambda/\alpha}$$

- Survival function

$$S(t \mid \boldsymbol{\theta}) = \left(\frac{1 + \exp\{\alpha t + \boldsymbol{X}^\top \boldsymbol{\beta}\}}{1 + \exp\{\boldsymbol{X}^\top \boldsymbol{\beta}\}} \right)^{-\lambda/\alpha}$$

- Failure function

$$h(t \mid \boldsymbol{\theta}) = \lambda \left(\frac{\exp\{\alpha t + \boldsymbol{X}^\top \boldsymbol{\beta}\}}{1 + \exp\{\alpha t + \boldsymbol{X}^\top \boldsymbol{\beta}\}} \right)$$

Value

dGTDL gives the density function, hGTDL gives the failure function, sGTDL gives the survival function and rGTDL generates random samples.

Invalid arguments will return an error message.

Source

[d-p-q-r]GTDL are calculated directly from the definitions.

References

- Mackenzie, G. (1996). Regression Models for Survival Data: The Generalized Time-Dependent Logistic Family. Journal of the Royal Statistical Society. Series D (The Statistician). 45. 21-34.

Examples

```
library(GTDL)
t <- seq(0,20,by = 0.1)
lambda <- 1.00
alpha <- -0.05
gamma <- -1.00
param <- c(lambda,alpha,gamma)
y1 <- hGTDL(t,param)
y2 <- sGTDL(t,param)
y3 <- dGTDL(t,param,log = FALSE)
tt <- as.matrix(cbind(t,t,t))
yy <- as.matrix(cbind(y1,y2,y3))
matplot(tt,yy,type="l",xlab="time",ylab="",lty = 1:3,col=1:3,lwd=2)


y1 <- hGTDL(t,c(1,0.5,-1.0))
y2 <- hGTDL(t,c(1,0.25,-1.0))
y3 <- hGTDL(t,c(1,-0.25,1.0))
y4 <- hGTDL(t,c(1,-0.50,1.0))
y5 <- hGTDL(t,c(1,-0.06,-1.6))
tt <- as.matrix(cbind(t,t,t,t,t))
yy <- as.matrix(cbind(y1,y2,y3,y4,y5))
matplot(tt,yy,type="l",xlab="time",ylab="Hazard function",lty = 1:3,col=1:3,lwd=2)
```

---

mle1.GTDL *Maximum likelihood estimation*

Description

Estimate of the parameters.

Usage

```
mle1.GTDL(start, t, method = "BFGS")
```

Arguments

start	Initial values for the parameters to be optimized over.
t	non-negative random variable representing the failure time and leave the snapshot failure rate, or danger.
method	The method to be used.

Value

Returns a list of summary statistics of the fitted GTDL distribution.

References

- Aarset, M. V. (1987). How to Identify a Bathtub Hazard Rate. IEEE Transactions on Reliability, 36, 106–108.
- Mackenzie, G. (1996) Regression Models for Survival Data: The Generalized Time-Dependent Logistic Family. Journal of the Royal Statistical Society. Series D (The Statistician). 45. 21-34.

See Also

optim

Examples

```
# times data (from Aarset, 1987))
data(artset1987)
mod <- mle1.GTDL(c(1,-0.05,-1),t = artset1987)
```

---

mle2.GTDL *Maximum likelihood estimates of the GTDL model*

Description

Maximum likelihood estimates of the GTDL model

Usage

```
mle2.GTDL(t, start, formula, censur, method = "BFGS")
```

Arguments

t	non-negative random variable representing the failure time and leave the snapshot failure rate, or danger.
start	Initial values for the parameters to be optimized over.
formula	The structure matrix of covariates of dimension n x p.
censur	censoring status 0=censored, a=fail.
method	The method to be used.

Value

Returns a list of summary statistics of the fitted GTDL model.

References

- Mackenzie, G. (1996) Regression Models for Survival Data: The Generalized Time-Dependent Logistic Family. Journal of the Royal Statistical Society. Series D (The Statistician). (45). 21-34.

See Also

optim

Examples

```
### Example 1

require(survival)
data(lung)

lung <- lung[-14,]
lung$sex <- ifelse(lung$sex==2, 1, 0)
lung$ph.ecog[lung$ph.ecog==3]<-2
t1 <- lung$time
start1 <- c(0.03,0.05,-1,0.7,2,-0.1)
formula1 <- ~lung$sex+factor(lung$ph.ecog)+lung$age
censur1 <- ifelse(lung$status==1,0,1)
fit.model1 <- mle2.GTDL(t = t1,start = start1,
                    formula = formula1,
                    censur = censur1)
fit.model1

### Example 2

data(tumor)
t2 <- tumor$time
start2 <- c(1,-0.05,1.7)
formula2 <- ~tumor$group
censur2 <- tumor$censured
fit.model2 <- mle2.GTDL(t = t2,start = start2,
                      formula = formula2,
                      censur = censur2)
fit.model2
```

`nrsp.GTDL` *Normally-transformed randomized survival probability residuals for the GTDL model*

Description

Normally-transformed randomized survival probability residuals for the GTDL model

Usage

```
nrsp.GTDL(t, formula, pHat, censur)
```

Arguments

t	non-negative random variable representing the failure time and leave the snapshot failure rate, or danger.
formula	The structure matrix of covariates of dimension n x p.
pHat	Estimate of the parameters from the GTDL model.
censur	Censoring status 0=censored, a=fail.

Value

Normally-transformed randomized survival probability residuals

References

- Li, L., Wu, T., e Cindy, F. (2021). Model diagnostics for censored regression via randomized survival probabilities. Statistics in Medicine, 40, 1482–1497.
- de Oliveira, L. E. F., dos Santos L. S., da Silva, P. H. F., Fabio, L. C., Carrasco, J. M. F.(2022). Análise de resíduos para o modelo logístico generalizado dependente do tempo (GTDL). Submitted.

Examples

```
### Example 1

require(survival)
data(lung)
lung <- lung[-14,]
lung$sex <- ifelse(lung$sex==2, 1, 0)
lung$ph.ecog[lung$ph.ecog==3]<-2
t1 <- lung$time
formula1 <- ~lung$sex+factor(lung$ph.ecog)+lung$age
censur1 <- ifelse(lung$status==1,0,1)
start1 <- c(0.03,0.05,-1,0.7,2,-0.1)
fit.model1 <- mle2.GTDL(t = t1,start = start1,
           formula = formula1,
           censur = censur1)
r1 <- nrsp.GTDL(t = t1,formula = formula1 ,pHat = fit.model1$Coefficients[,1],
             censur = censur1)
r1

### Example 2

data(tumor)
```

```
t2 <- tumor$time
formula2 <- ~tumor$group
censur2 <- tumor$censured
start2 <- c(1,-0.05,1.7)
fit.model2 <- mle2.GTDL(t = t2,start = start2,
                        formula = formula2,
                        censur = censur2)
r2 <- nrsp.GTDL(t = t2,formula = formula2, pHat = fit.model2$Coefficients[,1],
            censur = censur2)
r2
```

`random.quantile.GTDL` *Randomized quantile residuals for the GTDL model*

Description

Randomized quantile residuals for the GTDL model

Usage

```
random.quantile.GTDL(t, formula, pHat, censur)
```

Arguments

`t`	non-negative random variable representing the failure time and leave the snapshot failure rate, or danger.
`formula`	The structure matrix of covariates of dimension n x p.
`pHat`	Estimate of the parameters from the GTDL model.
`censur`	censoring status 0=censored, a=fail.

Details

The randomized quantile residual (Dunn and Smyth, 1996), which follow a standard normal distribution is used to assess departures from the GTDL model.

Value

Randomized quantile residuals

References

- Dunn, P. K. e Smyth, G. K. (1996). Randomized quantile residuals. Journal of Computational and Graphical Statistics, 5, 236–244.
- Louzada, F., Cuminato, J. A., Rodriguez, O. M. H., Tomazella, V. L. D., Milani, E. A., Ferreira, P. H., Ramos, P. L., Bochio, G., Perissini, I. C., Junior, O. A. G., Mota, A. L., Alegr´ıa, L. F. A., Colombo, D., Oliveira, P. G. O., Santos, H. F. L., e Magalh~aes, M. V. C. (2020). Incorporation of frailties into a non-proportional hazard regression model and its diagnostics for reliability modeling of downhole safety valves. IEEE Access, 8, 219757 – 219774.

- de Oliveira, L. E. F., dos Santos L. S., da Silva, P. H. F., Fabio, L. C., Carrasco, J. M. F.(2022). Análise de resíduos para o modelo logístico generalizado dependente do tempo (GTDL). Submitted.

Examples

```
### Example 1

require(survival)
data(lung)
lung <- lung[-14,]
lung$sex <- ifelse(lung$sex==2, 1, 0)
lung$ph.ecog[lung$ph.ecog==3]<-2
t1 <- lung$time
formula1 <- ~lung$sex+factor(lung$ph.ecog)+lung$age
censur1 <- ifelse(lung$status==1,0,1)
start1 <- c(0.03,0.05,-1,0.7,2,-0.1)
fit.model1 <- mle2.GTDL(t = t1,start = start1,
           formula = formula1,
           censur = censur1)
r1 <- random.quantile.GTDL(t = t1,formula = formula1 ,pHat = fit.model1$Coefficients[,1],
             censur = censur1)
r1

### Example 2

data(tumor)
t2 <- tumor$time
formula2 <- ~tumor$group
censur2 <- tumor$censured
start2 <- c(1,-0.05,1.7)
fit.model2 <- mle2.GTDL(t = t2,start = start2,
                        formula = formula2,
                        censur = censur2)
r2 <- random.quantile.GTDL(t = t2,formula = formula2, pHat = fit.model2$Coefficients[,1],
            censur = censur2)
r2
```

`tumor` *Tumor data*

Description

Times (in days) of patients in ovarian cancer study

Usage

```
data(tumor)
```

Format

This data frame contains the following columns:

- time: survival time in days
- censured: censored = 0, dead = 1
- group: large tumor = 0, small tumor = 1

References

- Colosimo, E. A and Giolo, S. R. Análise de Sobrevivência Aplicada. Edgard Blucher: São Paulo. 2006.

Examples

```
data(tumor)
head(tumor)
```

Index