

Package ‘sglg’

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Type Package

Title Fitting Semi-Parametric Generalized log-Gamma Regression Models

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Description Set of tools to fit a linear multiple or semi-parametric regression models with the possibility of non-informative random right-censoring. Under this setup, the localization parameter of the response variable distribution is modeled by using linear multiple regression or semi-parametric functions, whose non-parametric components may be approximated by natural cubic spline or P-splines. The supported distribution for the model error is a generalized log-gamma distribution which includes the generalized extreme value and standard normal distributions as important special cases. Inference is based on penalized likelihood and bootstrap methods. Also, some numerical and graphical devices for diagnostic of the fitted models are offered.

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R topics documented:

bootglg	2
deBoor2	4
deviance_residuals	5
dglg	6
entropy	7
envelope.sglg	8
glg	9
gnfit	11
Gu	12
influence.sglg	13
logLik.sglg	14
lss	14
order_glg	15
pglg	16
plotnpc	17
plotsurv.sglg	18
qglg	19
quantile_residuals	20
residuals.sglg	21
rglg	22
sglg	23
shape	25
smoothp	26
ssurvglg	28
summary.sglg	30
survglg	30
survival_gg	32
Index	34

 bootglg

Bootstrap inference for a generalized log-gamma regression

Description

bootglg is used to generate parametric bootstrap inference, such as, estimated standard errors and approximate confidence intervals for a generalized log-gamma regression.

Usage

```
bootglg(formula, data, B = 500, alpha = 0.05, type = "normal", plt_den = FALSE)
```

Arguments

formula	a symbolic description of the systematic component of the model to be fitted.
data	data.frame, contains the variables in the formula object.
B	integer, represents the number of bootstrap replications. Default value is 500.
alpha	numeric, represents a confidence level for the bootstrap intervals. Default value is 0.05.
type	character, indicates the type of bootstrap confidence interval for the estimated parameters. The options are: 'normal', 't_student' or 'bootstrap_t'. These intervals used the bootstrap estimated standard error of the ML estimates of the parameters. Other kind of bootstrap intervals are the percentile-type intervals. We offer the option 'BCa'. It is a bias-corrected and accelerated percentile interval. The default value for the 'type' argument is 'normal'.
plt_den	boolean value, to request a density-type plot of the bootstrap estimates. Default value is FALSE.

Value

ml_estimates is a vector of maximum likelihood estimates associated with the coefficients of linear structure, scale, and shape parameters.

boot_mean_estimates is a vector of mean of the bootstrap estimates associated with the coefficients of linear structure, scale, and shape parameters.

boot_bias_estimates is a vector of bootstrap estimate of bias associated with the coefficients of linear structure, scale, and shape estimators.

boot_sd_estimates is a vector of bootstrap standard errors of the estimates associated with the coefficients of linear structure, scale, and shape estimators.

type indicates the type of confidence intervals.

intervals array of the confidence intervals of the coefficients of linear structure, scale, and shape.

Author(s)

Carlos Alberto Cardozo Delgado <cardozorpackages@gmail.com>

References

Cardozo C. A., Paula G. and Vanegas L. sglg: An R package to fit semi-parametric generalized log-gamma regression models. In preparation.

Efron B and Tibshirani R (1993). An introduction to the Bootstrap. Chapman & Hall, Inc.

Examples

```
#####
set.seed(1)
n <- 300
x1 <- runif(n, 0, 1)
t_beta <- 1.2
t_sigma <- 0.5
```

```

t_lambda <- 0.7
error <- rglg(n, 0, t_sigma, t_lambda)
y1 <- t_beta*x1 + error
data <- data.frame(y1, x1)
# The following examples are based on 50 bootstrap replications.
# A 90% bootstrap confidence interval with the method 'normal'.
bootglg(y1 ~ x1 - 1, data = data, type='normal', B = 50, alpha = 0.1)
# A 95% bootstrap confidence interval with the method 't_student'.
bootglg(y1 ~ x1 - 1, data = data, type='t_student', B = 50)
# A 95% bootstrap confidence interval with the method 'bootstrap_t'.
bootglg(y1 ~ x1 - 1, data = data, type='bootstrap_t', B = 50)
# A 98% bootstrap confidence interval with the method 'BCa'.
# bootglg(y1 ~ x1 - 1, data = data, type='BCa', B = 50, alpha = 0.02)
#####

```

deBoor2

Build the basis matrix and the penalty matrix of cubic B-spline basis.

Description

deBoor builds the basis matrix and penalty matrix to approximate a smooth function using cubic B-spline cubic.

Usage

```
deBoor2(t, knots)
```

Arguments

t	a vector of values.
knots	a set of internal knot.

Value

nknot number of knots.
knots set of knots.
N basis matrix.
K penalty matrix.

Author(s)

Carlos Alberto Cardozo Delgado <cardozorpackages@gmail.com>

References

Carlos Alberto Cardozo Delgado, Semi-parametric generalized log-gamma regression models. Ph. D. thesis. Sao Paulo University.

Examples

```

set.seed(1)
t_1 <- runif(120)
range(t_1)
t_2 <- t_1 + 2 #runif(120,2,3)
range(t_2)
knot <- 10
dB1 <- deBoor2(t_1,knot)
dB2 <- deBoor2(t_2,knot)
dB1$knots
dB2$knots
plot(0,0,xlim=c(-0.5,3.5))
points(dB1$knots,rep(0,length(dB1$knots)),pch=20)
delta <- dB2$knots[1] - dB1$knots[1]
points(dB2$knots-delta,rep(0,length(dB2$knots)),pch=2,col= 'blue')
dB1$K
dB2$K
zeros <- vector()
plot(t_1,dB1$N[,1],pch=20)
for(j in 1:knot){
points(t_1,dB1$N[,j],pch=20,col=j)
zeros[j] <- sum(dB1$N[,j]==0)
}
zeros/120
cond_tNN <- vector()
KnotS <- 3:50
for(j in KnotS){
dB1 <- deBoor2(t_1,j)
print(dB1$knots[2]- dB1$knots[1])
min_max <- range(eigen(t(dB1$N)%*%dB1$N)$values)
cond_tNN[j-2] <- min_max[1]/min_max[2]
}
cond_tNN
plot(KnotS,cond_tNN,pch=20,ylim=c(0,0.07))

```

deviance_residuals *Deviance Residuals for a Generalized Log-gamma Regression Model*

Description

deviance_residuals is used to generate deviance residuals for a generalized log-gamma regression model.

Usage

```
deviance_residuals(object, ...)
```

Arguments

object an object of the class sglg. This object is returned from the call to glg(), sglg(), survglg() or ssurvglg().

... other arguments.

Author(s)

Carlos Alberto Cardozo Delgado <cardozorpackages@gmail.com>

References

Carlos Alberto Cardozo Delgado, Semi-parametric generalized log-gamma regression models. Ph. D. thesis. Sao Paulo University.

Examples

```
# Example 1
n <- 300
error <- rglg(n,0,1,1)
y <- 0.5 + error
fit <- glg(y~1,data=as.data.frame(y))
deviance_residuals(fit)
# Example 2
n <- 300
error <- rglg(n,0,1,1)
x <- runif(n,-3,3)
y <- 0.5 + 2*x + error
fit <- glg(y~x,data=as.data.frame(y,x))
deviance_residuals(fit)
```

dglg

Density distribution function for a generalized log-gamma variable

Description

dglg is used to calculate the density distribution function of a generalized log-gamma variable at x.

Usage

```
dglg(x, location, scale, shape)
```

Arguments

x numeric, a real number.

location numeric, represent the location parameter of a generalized log-gamma distribution. Default value is 0.

scale	numeric, represent the scale parameter of a generalized log-gamma distribution. Default value is 1.
shape	numeric, represent the shape parameter of a generalized log-gamma distribution. Default value is 1.

Author(s)

Carlos Alberto Cardozo Delgado <cardozorpackages@gmail.com>

References

Carlos Alberto Cardozo Delgado, Semi-parametric generalized log-gamma regression models. Ph. D. thesis. Sao Paulo University.

Examples

```
x <- seq(-4,4,length=100)
dglg(x,location=0,scale=1,shape=1)
plot(x,dglg(x,location=0,scale=1,shape=1),type="l",xlab="x",ylab="Density")
```

entropy

Tool to calculate the entropy for a generalized log-gamma distribution.

Description

entropy is used to obtain the entropy for a generalized log-gamma distribution.

Usage

```
entropy(mu, sigma, lambda)
```

Arguments

mu	numeric, represent the location parameter of a generalized log-gamma distribution. Default value is 0.
sigma	numeric, represent the scale parameter of a generalized log-gamma distribution. Default value is 1.
lambda	numeric, represent the shape parameter of a generalized log-gamma distribution. Default value is 1.

Author(s)

Carlos Alberto Cardozo Delgado <cardozorpackages@gmail.com>

References

Carlos Alberto Cardozo Delgado, Semi-parametric generalized log-gamma regression models. Ph. D. thesis. Sao Paulo University.

Examples

```
entropy(0,1,-1) # Extreme value type I distribution, maximum case.
entropy(0,1,1) # Extreme value type I distribution, minimum case.
entropy(0,1,0.077) # Standard normal distribution.
```

```
envelope.sglg          envelope.sglg
```

Description

Build a Normal probability plot with simulated envelope for a deviance-type residuals in semiparametric or multiple linear generalized log-gamma regression models.

Usage

```
envelope.sglg(fit, Rep)
```

Arguments

`fit` an object of the class `sglg`. This object is returned from the call to `glg()`, `sglg()`.

`Rep` a positive integer. This is the number of replications on which to build the simulated envelope. Default is `Rep=50`.

Author(s)

Carlos Alberto Cardozo Delgado <cardozorpackages@gmail.com>

References

Carlos Alberto Cardozo Delgado, Semi-parametric generalized log-gamma regression models. Ph. D. thesis. Sao Paulo University.

Cardozo C.A., Paula G., and Vanegas L. (2022). Generalized log-gamma additive partial linear models with P-spline smoothing. *Statistical Papers*.

Ortega, E., Paula, G. A. and Bolfarine, H. (2008) Deviance residuals in generalized log-gamma regression models with censored observations. *Journal of Statistical Computation and Simulation*, 78, 747-764.

Examples

```
rows <- 120
columns <- 2
t_beta <- c(0.5, 2)
t_sigma <- 0.5
t_lambda <- 1
set.seed(8142031)
x1 <- rbinom(rows, 1, 0.5)
x2 <- runif(columns, 0, 1)
```



```

X <- cbind(x1,x2)
error <- rglg(rows, 0, 1, t_lambda)
y1 <- X %*%t_beta + t_sigma * error
data.example <- data.frame(y1,X)
fit <- glg(y1 ~ x1 + x2 - 1,data=data.example)
envelope.sglg(fit,Rep=50)

```

Description

glg is used to fit a multiple linear regression model suitable for analysis of data sets in which the response variable is continuous, strictly positive, and asymmetric. In this setup, the location parameter of the response variable is explicitly modeled by a linear function of the parameters.

Usage

```

glg(
  formula,
  data,
  shape = -0.75,
  Tolerance = 5e-05,
  Maxiter = 1000,
  format = "complete",
  envelope = FALSE
)

```

Arguments

formula	a symbolic description of the systematic component of the model to be fitted.
data	a data frame with the variables in the model.
shape	an optional value for the shape parameter of the error distribution of a generalized log-gamma distribution. Default value is 0.2.
Tolerance	an optional positive value, which represents the convergence criterion. Default value is 1e-04.
Maxiter	an optional positive integer giving the maximal number of iterations for the estimating process. Default value is 1e03.
format	an optional string value that indicates if you want a simple or a complete report of the estimating process. Default value is 'complete'.
envelope	an optional and internal logical value that indicates if the glg function will be employed for build an envelope plot. Default value is 'FALSE'.

Value

mu a vector of parameter estimates associated with the location parameter.

sigma estimate of the scale parameter associated with the model.

lambda estimate of the shape parameter associated with the model.

interval estimate of a 95% confidence interval for each estimate parameters associated with the model.

Deviance the deviance associated with the model.

Author(s)

Carlos Alberto Cardozo Delgado <cardozorpackages@gmail.com>

References

Carlos Alberto Cardozo Delgado, Semi-parametric generalized log-gamma regression models. Ph. D. thesis. Sao Paulo University.

Cardozo C.A., Paula G., and Vanegas L. (2022). Generalized log-gamma additive partial linear models with P-spline smoothing. Statistical Papers.

Examples

```

set.seed(22)
rows <- 300
x1 <- rbinom(rows, 1, 0.5)
x2 <- runif(rows, 0, 1)
X <- cbind(x1,x2)
t_beta <- c(0.5, 2)
t_sigma <- 1

#####
#                               #
# Extreme value case #
#                               #
#####

t_lambda <- 1
error <- rglg(rows, 0, 1, t_lambda)
y1 <- error
y1 <- X %*%t_beta + t_sigma*error
data.example <- data.frame(y1,X)
data.example <- data.frame(y1)
fit <- glg(y1 ~ x1 + x2 - 1, data=data.example)
logLik(fit) # -449.47 # Time: 14 milliseconds
summary(fit)
deviance_residuals(fit)
#####
#                               #
# Normal case: A limit case #
#                               #

```

```
#####
# When the parameter lambda goes to zero the GLG tends to a standard normal distribution.
set.seed(8142031)
y1 <- X %>%t_beta + t_sigma * rnorm(rows)
data.example <- data.frame(y1, X)
fit0 <- glg(y1 ~ x1 + x2 - 1,data=data.example)
logLik(fit0)
fit0$AIC
fit0$mu

#####
#
# A comparison with a normal linear model #
#
#####

fit2 <- lm(y1 ~ x1 + x2 - 1,data=data.example)
logLik(fit2)
AIC(fit2)
coefficients(fit2)
```

gnfit

gnfit

Description

This function provides some useful statistics to assess the quality of fit of generalized log-gamma probabilistic model, including the statistics Cramer-von Mises and Anderson-Darling. It can also calculate other goodness of fit such as Hannan-Quin Information Criterion and Kolmogorov-Smirnov test.

Usage

```
gnfit(starts, data)
```

Arguments

starts	numeric vector. Initial parameters to maximize the likelihood function
data	numeric vector. A sample of a generalized log-gamma distribution.

Author(s)

Carlos Alberto Cardozo Delgado <cardozorpackages@gmail.com>

References

Carlos Alberto Cardozo Delgado, Semi-parametric generalized log-gamma regression models. Ph. D. thesis. Sao Paulo University.

Examples

```
## Not run:
set.seed(1)
# The size of the sample must be median or large to obtain a good estimates
n <- 100
sample <- rglg(n,location=0,scale=0.5,shape=0.75)
# This step takes a few minutes.
result <- gnfit(starts=c(0.1,0.75,1),data=sample)
result

## End(Not run)
```

Gu *Tool to build the basis matrix and the penalty matrix of natural cubic splines.*

Description

Gu builds the basis matrix and penalty matrix to approximate a smooth function using natural cubic splines based on the Gu basis form.

Usage

```
Gu(t, knot)
```

Arguments

t the covariate.
knot a integer value that represent the number of knots of the natural cubic spline.

Value

nknot number of knots.
knots set of knots.
N basis matrix.
K penalty matrix.

Author(s)

Carlos Alberto Cardozo Delgado <cardozorpackages@gmail.com>

References

Wood, S. (2006) Generalized additive models: An R introduction. Chapman and Hall.
Carlos Alberto Cardozo Delgado. Semi-parametric generalized log-gamma regression models. Ph. D. thesis. Sao Paulo University.

Examples

```
t <- runif(1000)
knot <- 6
N_gu <- Gu(t,knot)
```

influence.sglg	<i>influence</i>
----------------	------------------

Description

influence.sglg extracts from a object of class sglg the local influence measures and displays their graphs versus the index of the observations.

Usage

```
## S3 method for class 'sglg'
influence(model, ...)
```

Arguments

model	an object of the class sglg. This object is returned from the call to glg(), sglg(), survglg() or ssurvglg().
...	other arguments.

Author(s)

Carlos Alberto Cardozo Delgado <cardozorpackages@gmail.com>

References

Carlos Alberto Cardozo Delgado, Semi-parametric generalized log-gamma regression models. Ph. D. thesis. Sao Paulo University.

Cardozo C.A., Paula G., and Vanegas L. (2022). Generalized log-gamma additive partial linear models with P-spline smoothing. Statistical Papers.

Examples

```
rows <- 100
columns <- 2
t_beta <- c(0.5, 2)
t_sigma <- 1
t_lambda <- 1
set.seed(8142031)
x1 <- rbinom(rows, 1, 0.5)
x2 <- runif(columns, 0, 1)
X <- cbind(x1,x2)
error <- rglg(rows, 0, 1, t_lambda)
y1 <- X %>%t_beta + t_sigma * error
```

```
data.example <- data.frame(y1,X)
fit1 <- glg(y1 ~ x1 + x2 - 1,data=data.example)
influence(fit1)
```

logLik.sglg

Extract Log-Likelihood

Description

logLik.sglg extracts log-likelihood from a model from an object of class 'sglg'.

Usage

```
## S3 method for class 'sglg'
logLik(object, ...)
```

Arguments

object	an object of the class sglg. This object is returned from the call to glg(), sglg(), survglg() or ssurvglg() function.
...	other arguments.

lss

Measures of location, scale and shape measures for a generalized log-gamma distribution

Description

lss is used to obtain the mean, median, mode, variance, coefficient of variation, skewness and kurtosis for a generalized log-gamma distribution.

Usage

```
lss(mu = 0, sigma = 1, lambda = 1)
```

Arguments

mu	numeric, represents the location parameter of a generalized log-gamma distribution. Default value is 0.
sigma	numeric, represents the scale parameter of a generalized log-gamma distribution. Default value is 1.
lambda	numeric, represents the shape parameter of a generalized log-gamma distribution. Default value is 1.

Author(s)

Carlos Alberto Cardozo Delgado <cardozorpackages@gmail.com>

References

Carlos Alberto Cardozo Delgado, Semi-parametric generalized log-gamma regression models. Ph. D. thesis. Sao Paulo University.

National Institute of Standards and Technology, NIST. Engineering Statistics Handbook. <https://www.itl.nist.gov/div898/handbook/>

Examples

```
lss(0,1,-1) # Extreme value type I distribution, maximum case.
lss(0,1,1)  # Extreme value type I distribution, minimum case.
lss(0,1,0.01) # Standard normal distribution.
```

order_glg	<i>Random Sampling of K-th Order Statistics from a Generalized Log-gamma Distribution</i>
-----------	---

Description

order_glg is used to obtain a random sample of the K-th order statistics from a generalized log-gamma distribution.

Usage

```
order_glg(size, mu, sigma, lambda, k, n, alpha = 0.05)
```

Arguments

size	numeric, represents the size of the sample.
mu	numeric, represents the location parameter. Default value is 0.
sigma	numeric, represents the scale parameter. Default value is 1.
lambda	numeric, represents the shape parameter. Default value is 1.
k	numeric, represents the K-th smallest value from a sample.
n	numeric, represents the size of the sample to compute the order statistic from.
alpha	numeric, (1 - alpha) represents the confidence of an interval for the population median of the distribution of the k-th order statistic. Default value is 0.05.

Value

A list with a random sample of order statistics from a generalized log-gamma distribution, the value of its joint probability density function evaluated in the random sample and a (1 - alpha) confidence interval for the population median of the distribution of the k-th order statistic.

Author(s)

Carlos Alberto Cardozo Delgado <cardozorpackages@gmail.com>.

References

Gentle, J, Computational Statistics, First Edition. Springer - Verlag, 2009.

Naradajah, S. and Rocha, R. (2016) Newdistns: An R Package for New Families of Distributions, Journal of Statistical Software.

Examples

```
# A random sample of size 10 of order statistics from a Extreme Value Distribution.
order_glg(10,0,1,1,1,50)
## Not run: # A small comparison between two random sampling methods of order statistics
# Method 1
m <- 10
output <- rep(0,m)
order_sample <- function(m,n,k){
  for(i in 1:m){
    sample <- rglg(n)
    order_sample <- sort(sample)
    output[i] <- order_sample[k]
  }
  return(output)
}
N <- 10000
n <- 200
k <- 100
system.time(order_sample(N,n,k))
sample_1 <- order_sample(N,n,k)
hist(sample_1)
summary(sample_1)
# Method 2
system.time(order_glg(N,0,1,1,k,n))
sample_2 <- order_glg(N,0,1,1,k,n)$sample
hist(sample_2)
summary(sample_2)

## End(Not run)
```

p g l g

Cumulative distribution function for a generalized log-gamma variable

Description

p g l g is used to calculate the cumulative distribution function of a generalized log-gamma variable at x .

Usage

```
pglg(x, location, scale, shape)
```

Arguments

x	numeric, a vector of real values.
location	numeric, represents the location parameter of a generalized log-gamma distribution. Default value is 0.
scale	numeric, represents the scale parameter of a generalized log-gamma distribution. Default value is 1.
shape	numeric, represents the shape parameter of a generalized log-gamma distribution. Default value is 1.

Value

A vector with the same size of x with the cumulative probability values of a generalized log-gamma distribution.

Author(s)

Carlos Alberto Cardozo Delgado <cardozorpackages@gmail.com>

References

Carlos Alberto Cardozo Delgado, Semi-parametric generalized log-gamma regression models. Ph. D. thesis. Sao Paulo University.

Examples

```
x <- runif(3,-1,1)
pglg(sort(x),location=0, scale=1, shape=1)
```

plotnpc

Plotting a natural cubic splines or P-splines.

Description

plotnpc displays a graph of a fitted nonparametric effect, either natural cubic spline or P-spline, from an object of class sglg.

Usage

```
plotnpc(fit, conf_lev)
```

Arguments

`fit` an object of the class `sglg`. This object is returned from the call to `glg()`, `sglg()`, `survglg()` or `ssurvglg()`.

`conf_lev` is the confidence level of the asymptotic confidence band. Default value is 0.05.

Author(s)

Carlos Alberto Cardozo Delgado <cardozorpackages@gmail.com>

References

Eilers P.H.C. and Marx B.D. (1996). Flexible smoothing with B-splines and penalties. *Statistical Science*. 11, 89-121.

Wood, S. (2017). *Additive generalized models: An R introduction*. Chapman and Hall.

Examples

```
set.seed(1)
n <- 300
error <- rglg(n,0,0.5,1)
t <- as.matrix((2*1:n - 1)/(2*n))
colnames(t) <- "t"
f_t <- cos(4*pi*t)
y <- 0.8 + f_t + error
colnames(y) <- "y"
data <- as.data.frame(cbind(y,1,t))
fit1 <- sglg(y ~ 1,npc=t,data=data,basis = "deBoor",alpha0=0.0001)
summary(fit1)
# The adjusted (black) non-linear component
plotnpc(fit1,conf_lev=0.02)
```

plotsurv.sglg	<i>Plot simultaneously the Kaplan-Meier and parametric estimators of the survival function.</i>
---------------	---

Description

`plotsurv.sglg` is used to plot simultaneously the Kaplan-Meier and parametric estimators of the survival function.

Usage

```
plotsurv.sglg(fit)
```

Arguments

`fit` an object of the class `sglg`. This object is returned from the call to `survglg()` or `ssurvglg()`.

Author(s)

Carlos Alberto Cardozo Delgado <cardozorpackages@gmail.com>

References

Carlos A. Cardozo, G. Paula and L. Vanegas. Semi-parametric accelerated failure time models with generalized log-gamma errors. In preparation.

Carlos Alberto Cardozo Delgado, Semi-parametric generalized log-gamma regression models. Ph. D. thesis. Sao Paulo University.

Examples

```
require(survival)
rows <- 240
columns <- 2
t_beta <- c(0.5, 2)
t_sigma <- 1
t_lambda <- 1
set.seed(8142031)
x1 <- rbinom(rows, 1, 0.5)
x2 <- runif(columns, 0, 1)
X <- cbind(x1,x2)
s <- t_sigma^2
a <- 1/s
t_ini1 <- exp(X %*% t_beta) * rgamma(rows, scale = s, shape = a)
cens.time <- rweibull(rows, 0.6, 14)
delta1 <- ifelse(t_ini1 > cens.time, 1, 0)
obst1 <- t_ini1
for (i in 1:rows) {
  if (delta1[i] == 1) {
    obst1[i] <- cens.time[i]
  }
}
data.example <- data.frame(obst1,delta1,X)
fit3 <- survglm(Surv(log(obst1),delta1) ~ x1 + x2 - 1, data=data.example,shape=0.9)
plotsurv.sglm(fit3)
```

qglg

Quantile function for a generalized log-gamma distribution

Description

qglg is used to calculate the quantile function of a generalized log-gamma variable at x.

Usage

```
qglg(x, location, scale, shape)
```

Arguments

x	numeric, a vector with values between 0 and 1.
location	numeric, represents the location parameter of a generalized log-gamma distribution. Default value is 0.
scale	numeric, represents the scale parameter of a generalized log-gamma distribution. Default value is 1.
shape	numeric, represents the shape parameter of a generalized log-gamma distribution. Default value is 1.

Value

A vector with the same size of x with the quantile values of a generalized log-gamma distribution.

Author(s)

Carlos Alberto Cardozo Delgado <cardozorpackages@gmail.com>

References

Carlos Alberto Cardozo Delgado, Semi-parametric generalized log-gamma regression models. Ph. D. thesis. Sao Paulo University.

Examples

```
# Calculating the quartiles of a glg(0,1,-1) distribution
x <- c(0.25, 0.5, 0.75)
qglg(x, location = 0, scale = 1, shape = -1)
```

quantile_residuals *Quantile Residuals for a Generalized Log-gamma Regression Model*

Description

quantile_residuals is used to generate quantile residuals for a generalized log-gamma regression model.

Usage

```
quantile_residuals(fit)
```

Arguments

fit is an object sglg. This object is returned from the call to glg(), sglg(), survglg() or ssurvglg().

Author(s)

Carlos Alberto Cardozo Delgado <cardozorpackages@gmail.com>

References

Carlos Alberto Cardozo Delgado, Semi-parametric generalized log-gamma regression models. Ph. D. thesis. Sao Paulo University.

Examples

```
# Example 1
n <- 400
set.seed(4)
error <- rglg(n,0,0.5,1)
y <- as.data.frame(0.5 + error)
names(y) <- "y"
fit_0 <- glg(y~1,data=y)
fit_0$mu
fit_0$sigma
fit_0$lambda
quantile_residuals(fit_0)
# Example 2
n <- 500
set.seed(6)
error <- rglg(n,0,0.5,1)
x1 <- runif(n,-2,2)
beta <- c(0.5,2)
y <- cbind(1,x1)%*%beta + error
data <- data.frame(y=y,x1=x1)
fit_1 <- glg(y~x1,data=data)
fit_1$mu
fit_1$sigma
fit_1$lambda
quantile_residuals(fit_1)
```

residuals.sglg

Extract Model Residuals

Description

residuals.sglg extracts the deviance-type residuals for a model from an object of class 'sglg'.

Usage

```
## S3 method for class 'sglg'
residuals(object, ...)
```

Arguments

object	an object of the class sglg. This object is returned from the call to glg(), sglg(), survglg() or ssurvglg() function.
...	other arguments.

rglg *Random number generation for a generalized log-gamma distribution*

Description

rglg is used to generate random numbers for a generalized log-gamma distribution.

Usage

```
rglg(n, location, scale, shape)
```

Arguments

n	numeric, size of the random sample.
location	numeric, represents the location parameter of a generalized log-gamma distribution. Default value is 0.
scale	numeric, represents the scale parameter of a generalized log-gamma distribution. Default value is 1.
shape	numeric, represents the shape parameter of a generalized log-gamma distribution. Default value is 1.

Value

A vector of size n with the generalized log-gamma random values.

Author(s)

Carlos Alberto Cardozo Delgado <cardozorpackages@gmail.com>

References

Carlos Alberto Cardozo Delgado, Semi-parametric generalized log-gamma regression models. Ph. D. thesis. Sao Paulo University.

Examples

```
u <- rglg(100, location = 0, scale = 1, shape = -1)
```

Description

sglg is used to fit a semi-parametric regression model suitable for analysis of data sets in which the response variable is continuous, strictly positive, and asymmetric. In this setup, the location parameter of the response variable is explicitly modeled by semi-parametric functions, whose non-parametric components may be approximated by natural cubic splines or cubic P-splines.

Usage

```
sglg(
  formula,
  npc,
  basis,
  data,
  shape = 0.2,
  method,
  alpha0,
  Knot,
  Tolerance = 5e-05,
  Maxiter = 1000,
  format = "complete"
)
```

Arguments

formula	a symbolic description of the systematic component of the model to be fitted. See details for further information.
npc	a matrix with the nonparametric variables of the systematic part of the model to be fitted. Must be included the names of each variables.
basis	a name of the cubic spline basis to be used in the model. Supported basis include deBoor and Gu basis which are a B-spline basis and a natural cubic spline basis, respectively.
data	an optional data frame, list containing the variables in the model.
shape	an optional value for the shape parameter of the error distribution of a generalized log-gamma distribution. Default value is 0.2.
method	There are two possible algorithms to estimate the parameters. The default algorithm is 'FS' Fisher-Scoring, the other option is 'GSFS' an adequate combination between the block matrix version of non-linear Gauss-Seidel algorithm and Fisher-Scoring algorithm.
alpha0	is a vector of positive values for the smoothing parameters alpha. Default vector with 1 in each entry.
Knot	is a vector of the number of knots in each non-linear component of the model.

Tolerance	an optional positive value, which represents the convergence criterion. Default value is 5e-05.
Maxiter	an optional positive integer giving the maximal number of iterations for the estimating process. Default value is 1e03.
format	an optional string value that indicates if you want a simple or a complete report of the estimating process. Default value is 'complete'.

Value

mu a vector of parameter estimates associated with the location parameter.

sigma estimate of the scale parameter associated with the model.

lambda estimate of the shape parameter associated with the model.

interval estimate of a 95% confidence interval for each estimate parameters associated with the model.

Deviance the deviance associated with the model.

Author(s)

Carlos Alberto Cardozo Delgado <cardozorpackages@gmail.com>

References

Cardozo C.A., Paula G., and Vanegas L. (2022). Generalized log-gamma additive partial linear models with P-spline smoothing. Statistical Papers.

Examples

```
set.seed(1)
rows<- 300
t_beta <- c(0.5,2)
t_sigma <- 0.5
t_lambda <- 1
x1 <- runif(rows,-3,3)
x2 <- rbinom(rows,1,0.5)
X <- cbind(x1,x2)
t <- as.matrix((2*1:rows - 1)/(2*rows))
colnames(t) <- "t"
f_t <- cos(4*pi*t)
error <- rglg(rows,0,1,t_lambda)
y <- X %*%t_beta + f_t + t_sigma*error
colnames(y) <- "y"
data <- data.frame(y,X,t)
fit1 <- sglg(y ~ x1 + x2 - 1, npc = t, data = data, basis = "deBoor", alpha0 = 0.1)
logLik(fit1) # -288.1859 time: 90 milliseconds
quantile_residuals(fit1)
fit2 <- sglg(y ~ x1 + x2 - 1, npc=t, data=data, basis = "Gu", alpha0=0.005)
logLik(fit2)
#####
# An example with two non-parametric components #
```



```
#####
set.seed(2)
t_2 <- as.matrix(rnorm(rows, sd = 0.5))
colnames(t_2) <- 't_2'
f_t_2 <- exp(t_2)
error <- rglg(rows,0,1,t_lambda)
y_2 <- X %*%t_beta + f_t + f_t_2 + t_sigma*error
colnames(y_2) <- 'y_2'
data2 <- data.frame(y_2,X,t,t_2)
npcs <- cbind(t,t_2)
fit3 <- sglg(y_2 ~ x1 + x2 - 1, npc = npc, data = data2, alpha0 = c(0.45,0.65))
logLik(fit3)
#####
```

shape	<i>shape</i>
-------	--------------

Description

Tool that supports the estimation of the shape parameter in semi-parametric or multiple linear accelerated failure time model with generalized log-gamma errors under the presence of censored data. The estimation is based on the profiled likelihood function for the shape parameter of the model.

Usage

```
shape(formula, npc, data, interval, semi, step)
```

Arguments

formula	a symbolic description of the systematic component of the model to be fitted.
npc	a data frame with potential nonparametric variables of the systematic part of the model to be fitted.
data	a data frame which contains the variables in the model.
interval	an optional numerical vector of length 2. In this interval is the maximum likelihood estimate of the shape parameter of the model. By default is [0.1,1.5].
semi	a logical value. TRUE means that the model has a non-parametric component. By default is FALSE.
step	an optional positive value. This parameter represents the length of the step of the partition of the interval parameter. By default is 0.1.

Author(s)

Carlos Alberto Cardozo Delgado <cardozorpackages@gmail.com>

References

Carlos Alberto Cardozo Delgado, Semi-parametric generalized log-gamma regression models. Ph. D. thesis. Sao Paulo University.

Examples

```

rows <- 200
columns <- 2
t_beta <- c(0.5, 2)
t_sigma <- 1
t_lambda <- 1
set.seed(8142031)
x1 <- rbinom(rows, 1, 0.5)
x2 <- runif(columns, 0, 1)
X <- cbind(x1,x2)
s <- t_sigma^2
a <- 1/s
t_ini1 <- exp(X %*% t_beta) * rgamma(rows, scale = s, shape = a)
cens.time <- rweibull(rows, 0.3, 14)
delta <- ifelse(t_ini1 > cens.time, 1, 0)
obst1 = t_ini1
for (i in 1:rows) {
  if (delta[i] == 1) {
    obst1[i] = cens.time[i]
  }
}
example <- data.frame(obst1,delta,X)
lambda <- shape(Surv(log(obst1),delta) ~ x1 + x2 - 1, data=example)
lambda
# To change interval or step or both options
lambda <- shape(Surv(log(obst1),delta) ~ x1 + x2 - 1, data=example, interval=c(0.95,1.3), step=0.05)
lambda

```

smoothp

smoothp

Description

Tool that supports the selection of the smoothing parameters in semi-parametric generalized log-gamma models. The selection is based on the AIC, BIC, or Generalized Cross Validation methods.

Usage

```
smoothp(formula, npc, data, method = "PAIC", basis, interval, step)
```

Arguments

formula	a symbolic description of the systematic component of the model to be fitted.
npc	a data frame with potential nonparametric variables of the systematic part of the model to be fitted.
data	a data frame which contains the variables in the model.
method	There are three possible criteria to estimate the smoothing parameters: Penalized Akaike Criterion 'PAIC', Penalized Bayesian Criterion 'PBIC' and Generalized Cross Validation 'GCV'. The default method is 'PAIC'.

basis	a name of the cubic spline basis to be used in the model. Supported basis include deBoor and Gu basis.
interval	an optional numerical vector of length 2. In this interval is the maximum likelihood estimate of the shape parameter of the model. By default is [0.1,2].
step	an optional positive value. This parameter represents the length of the step of the partition of the interval parameter. By default is 0.2.

Author(s)

Carlos Alberto Cardozo Delgado <cardozorpackages@gmail.com>

References

Carlos Alberto Cardozo Delgado, Semi-parametric generalized log-gamma regression models. Ph.D. thesis. Sao Paulo University.

Cardozo C.A., Paula G., and Vanegas L. (2022). Generalized log-gamma additive partial linear models with P-spline smoothing. Statistical Papers.

Examples

```

set.seed(1)
rows<- 150
t_beta <- c(0.5,2)
t_sigma <- 0.5
t_lambda <- 1
x1 <- runif(rows,-3,3)
x2 <- rbinom(rows,1,0.5)
X <- cbind(x1,x2)
t <- as.matrix((2*1:rows - 1)/(2*rows))
colnames(t) <- "t"
f_t <- cos(4*pi*t)
error <- rglg(rows,0,1,t_lambda)
y <- X %*%t_beta + f_t + t_sigma*error
colnames(y) <- "y"
data <- data.frame(y,X,t)
fit1 <- sglg(y ~ x1 + x2 - 1,npc=t,data=data,basis = "deBoor",alpha0=1)
fit1$AIC
# We can get (probably) better values of alpha with the function smoothp
smoothp(y ~ x1 + x2 - 1,npc=t,data=data,basis = "deBoor")
fit2 <- sglg(y ~ x1 + x2 - 1,npc=t,data=data,basis = "Gu",alpha0=0.5)
fit2$BIC
# Again using the smooth function
smoothp(y ~ x1 + x2 - 1,npc=t,data=data,basis = "Gu",method='PBIC')
#####
# An example with two non-parametric components #
#####
set.seed(2)
t_2 <- as.matrix(rnorm(rows,sd=0.5))
colnames(t_2) <- 't_2'
f_t_2 <- exp(t_2)
error <- rglg(rows,0,1,t_lambda)

```

```

y_2 <- X %*%t_beta + f_t + f_t_2 + t_sigma*error
colnames(y_2) <- 'y_2'
data2 <- data.frame(y_2,X,t,t_2)
npcs <- cbind(t,t_2)
# Some intuition about the best alpha values
smoothp(y ~ x1 + x2 - 1,npc=npcs,data=data, method='GCV')

```

ssurvlg

Fitting semi-parametric generalized log-gamma regression models under the presence of right censored data.

Description

ssurvlg is used to fit a semi-parametric regression model in which the response variable is continuous, strictly positive, asymmetric and there are right censored observations. In this setup, the location parameter of the logarithm of the variable is explicitly modeled by semi-parametric functions, whose nonparametric components may be approximated by natural cubic splines or cubic P-splines.

Usage

```
ssurvlg(formula, npc, basis, data, shape, alpha0, Maxiter, Tolerance)
```

Arguments

formula	a symbolic description of the systematic component of the model to be fitted. See details for further information.
npc	a data frame with potential nonparametric variables of the systematic part of the model to be fitted.
basis	a name of the cubic spline basis to be used in the model. Supported basis include deBoor and Gu basis which are a B-spline basis and a natural cubic spline basis, respectively.
data	an optional data frame, list containing the variables in the model.
shape	an optional value for the shape parameter of the model.
alpha0	is a vector of initial values for the smoothing parameter alpha.
Maxiter	an optional positive integer giving the maximal number of iterations for the estimating process. Default value is 1e03.
Tolerance	an optional positive value, which represents the convergence criterion. Default value is 1e-04.

Value

mu a vector of parameter estimates associated with the location parameter.

sigma estimate of the scale parameter associated with the model.

lambda estimate of the shape parameter associated with the model.

interval estimate of a 95% confidence interval for each estimate parameters associated with the model.

Deviance the deviance associated with the model.

Author(s)

Carlos Alberto Cardozo Delgado <cardozorpackages@gmail.com>

References

Carlos A. Cardozo, G. Paula and L. Vanegas. Semi-parametric accelerated failure time models with generalized log-gamma erros: Censored case. In preparation.

Cardozo C.A., Paula G., and Vanegas L. (2022). Generalized log-gamma additive partial linear models with P-spline smoothing. Statistical Papers.

Examples

```
require(survival)
rows <- 150
columns <- 2
t_beta <- c(0.5, 2)
t_sigma <- 0.5
t_lambda <- 1
set.seed(8142030)
x1 <- rbinom(rows, 1, 0.5)
x2 <- runif(rows, 0, 1)
X <- cbind(x1,x2)
t_knot1 <- 6
ts1 <- seq(0, 1, length = t_knot1)
t_g1 <- 0.4 * sin(pi * ts1)
BasisN <- function(n, knot) {
  N <- matrix(0, n, knot)
  m <- n/knot
  block <- rep(1,m)
  for (i in 1:knot) {
    l <- (i - 1) * m + 1
    r <- i * m
    N[l:r, i] <- block }
  return(N)
}
s_N1 <- BasisN(rows, length(ts1))
x3 <- s_N1 %*% ts1
colnames(x3) <- 'x3'
sys <- X %*% t_beta + s_N1%*%t_g1
t_ini1 <- exp(sys) * rweibull(rows,1/t_sigma,1)
```

```

cens.time <- rweibull(rows, 1.5, 14)
delta     <- ifelse(t_ini1 > cens.time, 1, 0)
obst1 = t_ini1
for(i in 1:rows) {
  if (delta[i] == 1) {
    obst1[i] = cens.time[i]
  }
}
d_example <- data.frame(obst1, delta, X, x3)
fit4 <- ssurglg(Surv(log(obst1),delta)~ x1 + x2 - 1,npc=x3,data = d_example,shape=0.9)
summary(fit4)

```

summary.sglg

summary.sglg

Description

summary.sglg extracts displays the summary of the fitted model including parameter estimates, associated (approximated) standard errors and goodness-of-fit statistics from a model from an object of class 'sglg'.

Usage

```

## S3 method for class 'sglg'
summary(object, ...)

```

Arguments

object	an object of the class sglg. This object is returned from the call to glg(), sglg(), survglg() or ssurglg() function.
...	other arguments.

survglg

Fitting linear generalized log-gamma regression models under the presence of right censored data.

Description

survglg is used to fit a multiple linear regression model in which the response variable is continuous, strictly positive, asymmetric and there are right censored observations. In this setup, the location parameter of the logarithm of the response variable is modeled by a linear model of the parameters.

Usage

```

survglg(formula, data, shape, Maxiter, Tolerance)

```

Arguments

formula	a symbolic description of the systematic component of the model to be fitted. See details for further information.
data	an optional data frame, list containing the variables in the model.
shape	an optional value for the shape parameter of the model.
Maxiter	an optional positive integer giving the maximal number of iterations for the estimating process. Default value is 1e03.
Tolerance	an optional positive value, which represents the convergence criterion. Default value is 1e-04.

Value

mu a vector of parameter estimates associated with the location parameter.

sigma estimate of the scale parameter associated with the model.

lambda estimate of the shape parameter associated with the model.

interval estimate of a 95% confidence interval for each estimate parameters associated with the model.

Deviance the deviance associated with the model.

Author(s)

Carlos Alberto Cardozo Delgado <cardozorpackages@gmail.com>

References

Carlos A. Cardozo, G. Paula and L. Vanegas. Semi-parametric accelerated failure time models with generalized log-gamma erros. In preparation.

Cardozo C.A., Paula G., and Vanegas L. (2022). Generalized log-gamma additive partial linear models with P-spline smoothing. Statistical Papers.

Examples

```
require(survival)
rows <- 240
columns <- 2
t_beta <- c(0.5, 2)
t_sigma <- 1
set.seed(8142031)
x1 <- rbinom(rows, 1, 0.5)
x2 <- runif(columns, 0, 1)
X <- cbind(x1,x2)
s <- t_sigma^2
a <- 1/s
t_ini1 <- exp(X %*% t_beta) * rgamma(rows, scale = s, shape = a)
cens.time <- rweibull(rows, 0.3, 14)
delta1 <- ifelse(t_ini1 > cens.time, 1, 0)
obst1 <- t_ini1
```

```

for (i in 1:nrow) {
  if (delta1[i] == 1) {
    obst1[i] <- cens.time[i]
  }
}
data.example <- data.frame(obst1,delta1,X)
fit3 <- survglm(Surv(log(obst1),delta1) ~ x1 + x2 - 1, data=data.example,shape=0.9)
logLik(fit3)
summary(fit3)

```

survival_gg	<i>Survival, Hazard, and Cumulative Hazard functions for a Generalized Gamma Distribution</i>
-------------	---

Description

survival_gg is used to obtain the value of survival, hazard and cumulative hazard functions of a generalized gamma distribution at a positive value.

Usage

```
survival_gg(x, mu, sigma, lambda)
```

Arguments

x	numeric, represent a vector of positive values. Default value is 1.
mu	numeric, represents the location parameter of a generalized gamma distribution. Default value is 0.
sigma	numeric, represents the scale parameter of a generalized gamma distribution. Default value is 1.
lambda	numeric, represents the shape parameter of a generalized gamma distribution. Default value is 1.

Value

A list of three vectors, survival, hazard, and cumulative hazard values of a generalized gamma distribution.

Author(s)

Carlos Alberto Cardozo Delgado <cardozorpackages@gmail.com>

References

Carlos Alberto Cardozo Delgado, Semi-parametric generalized log-gamma regression models. Ph.D. thesis. Sao Paulo University.

Jerald F. Lawless (2003). Statistical Models and Methods for Lifetime Data. Second Edition. John-Wiley & Sons

Examples

```
survival_gg(0.0001,0,1,1) # Extreme value type I distribution, maximum case.  
times <- seq(0.05,7,by=0.05)  
plot(times, survival_gg(times,0,1,1)$survival_value,type='l')  
plot(times, survival_gg(times,0,1,1)$hazard_value,type='l')  
plot(times, survival_gg(times,0,1,1)$cumulative_hazard_value,type='l')
```

Index

bootglg, 2

deBoor2, 4

deviance_residuals, 5

dglg, 6

entropy, 7

envelope.sglg, 8

glg, 9

gnfit, 11

Gu, 12

influence.sglg, 13

logLik.sglg, 14

lss, 14

order_glg, 15

pglg, 16

plotnpc, 17

plotsurv.sglg, 18

qglg, 19

quantile_residuals, 20

residuals.sglg, 21

rglg, 22

sglg, 23

shape, 25

smoothp, 26

ssurvglg, 28

summary.sglg, 30

survglg, 30

survival_gg, 32