

Package ‘genlogis’

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Title Generalized Logistic Distribution

Version 1.0.2

Description Provides basic distribution functions for a generalized logistic distribution proposed by Rathie and Swamee (2006) <<https://www.rroij.com/open-access/on-new-generalized-logistic-distributions-and-applicationsbarreto-fhs-mota-jma-and-rathie-pn.pdf>>. It also has an interactive 'RStudio' plot for better guessing dynamically of initial values for ease of included optimization and simulating.

Depends R (>= 3.2.0), ggplot2, foreach, stats

License GPL-3

Encoding UTF-8

Imports distr, manipulate, doParallel, parallel, tcltk

SystemRequirements RStudio -
<https://posit.co/products/open-source/rstudio/>

RoxygenNote 7.3.1

URL <https://pinduzera.github.io/genlogis/>

NeedsCompilation no

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distrib	<i>The Generalized logistic distribution</i>
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Description

Density, distribution function, quantile function and random generation a generalized logistic distribution.

Usage

```
pgenlog(q, a = sqrt(2/pi), b = 0.5, p = 2, mu = 0, lower.tail = TRUE)
```

```
dgenlog(x, a = sqrt(2/pi), b = 0.5, p = 2, mu = 0)
```

```
qgenlog(k, a = sqrt(2/pi), b = 0.5, p = 2, mu = 0, lower.tail = TRUE)
```

```
rgenlog(n, a = sqrt(2/pi), b = 0.5, p = 2, mu = 0)
```

Arguments

a, b, p	parameters ≥ 0 , with restrictions.*
mu	mu parameter
lower.tail	logical; if TRUE (default), probabilities are $P[X \leq x]$ otherwise, $P[X > x]$.
x, q	vector of quantiles.
k	vector of probabilities.
n	number of observations. If length(n) > 1, the length is taken to be the number required

Details

The used distribution for this package is given by:

$$f(x) = ((a+b*(1+p)*(|x-mu|^p))*exp(-(x-mu)*(a+b*(|x-mu|^p))))/((exp(-(x-mu)*(a+b*(|x-mu|^p)))+1)^2)$$

The default values for a, b, p and mu produces a function with mean 0 and variance close to 1.

*Restrictions:

If p equals to 0, b or a must be 0 otherwise there is identifiability problem.

The distribution is not defined for a and b equal to 0 simultaneously.

Value

dgenlog gives the density, pgenlog gives the distribution function, qgenlog gives the quantile function, and rgenlog generates random deviates.

The length of the result is determined by n for rgenlog, and is the maximum of the lengths of the numerical arguments for the other functions.

References

Rathie, P. N. and Swamee, P. K (2006) *On a new invertible generalized logistic distribution approximation to normal distribution*, Technical Research Report in Statistics, 07/2006, Dept. of Statistics, Univ. of Brasilia, Brasilia, Brazil.

Examples

```
pgenlog(0.5)
curve(dgenlog(x), xlim = c(-3,3))

rgenlog(100)

qgenlog(0.95)
```

distrib_sk

The Generalized logistic distribution with skewness

Description

Density, distribution function, quantile function and random generation a generalized logistic distribution with skewness.

Usage

```
pgenlog_sk(
  q,
  a = sqrt(2/pi),
  b = 0.5,
  p = 2,
  mu = 0,
  skew = 0.5,
  lower.tail = TRUE
)

dgenlog_sk(x, a = sqrt(2/pi), b = 0.5, p = 2, mu = 0, skew = 0.5)

qgenlog_sk(
```

```

    k,
    a = sqrt(2/pi),
    b = 0.5,
    p = 2,
    mu = 0,
    skew = 0.5,
    lower.tail = TRUE
)

rgenlog_sk(n, a = sqrt(2/pi), b = 0.5, p = 2, mu = 0, skew = 0.5)

```

Arguments

a, b, p	parameters ≤ 0 , with restrictions.*
mu	mu parameter
skew	skewness parameter limited to the interval (-1, 1)
lower.tail	logical; if TRUE (default), probabilities are $P[X \leq x]$ otherwise, $P[X > x]$.
x, q	vector of quantiles.
k	vector of probabilities.
n	number of observations. If $\text{length}(n) > 1$, the length is taken to be the number required

Details

The used distribution for this package is given by:

$$f(x) = 2 * ((a + b * (1 + p) * (\text{abs}(x - \text{mu})^p)) * \exp(-(x - \text{mu}) * (a + b * (\text{abs}(x - \text{mu})^p)))) / ((\exp(-(x - \text{mu}) * (a + b * (\text{abs}(x - \text{mu})^p))))$$

The default values for a, b, p and mu produces a function with mean 0 and variance close to 1.

*Restrictions:

If p equals to 0, b or a must be 0 otherwise there is identifiability problem.

The distribution is not defined for a and b equal to 0 simultaneously.

Value

dgenlog_sk gives the density, pgenlog_sk gives the distribution function, qgenlog_sk gives the quantile function, and rgenlog_sk generates random deviates.

The length of the result is determined by n for rgenlog_sk, and is the maximum of the lengths of the numerical arguments for the other functions.

References

Rathie, P. N. and Swamee, P. K (2006) *On a new invertible generalized logistic distribution approximation to normal distribution*, Technical Research Report in Statistics, 07/2006, Dept. of Statistics, Univ. of Brasilia, Brasilia, Brazil.

Azzalini, A. (1985) *A class of distributions which includes the normal ones*. Scandinavian Journal of Statistics.

Examples

```
pgenlog_sk(0.5)
curve(dgenlog_sk(x), xlim = c(-3,3))
```

```
rgenlog_sk(100)
```

```
qgenlog_sk(0.95)
```

genlog_mle

Optimization for a generalized logistic distribution

Description

Maximum likelihood estimation of parameters for a generalized logistic distribution.

Usage

```
genlog_mle(parameters, data, hessian = F, alpha = 0.05)
```

Arguments

parameters	Initial values for the parameters to be optimized over in the following order $c(a, b, p, \mu)$, μ can be omitted and will be set to 0.
data	This is the the data to be utilized for the estimation.
hessian	logical value that returns hessian, also returns the parameters estimation's confidence interval.
alpha	Type I error given to calculate confidence intervals, used when <code>hessian = T</code> .

Details

Maximum likelihood estimation of parameters for the distribution proposed in this package.

This function is an application of `constrOptim` as a particular case needed for this distribution using the method "BFGS".

For more information of the output check `help(constrOptim)`.

The used distribution for this package is given by:

$$f(x) = ((a+b*(1+p))*(abs(x-mu)^p))*exp(-(x-mu)*(a+b*(|x-mu|^p)))/((exp(-(x-mu)*(a+b*(|x-mu|^p)))+1)^2)$$

help(dgenlog) for parameters restrictions.

Value

Return a list of components as `constrOptim` (for more information, check this function) with some extras:

`par` The best set of parameters found.

`value` The value of the loglikelihood function corresponding to `par`.

`counts` A two-element integer vector giving the number of calls to the likelihood function and BFGS respectively. This excludes those calls needed to compute the Hessian, and any calls to likelihood function to compute a finite-difference approximation to the gradient.

`convergence` An integer code. 0 indicates successful completion, 1 indicates that the iteration limit `maxit` had been reached. For more errors `help(constrOptim)`.

`message` A character string giving any additional information returned by the optimizer, or NULL.

`outer.iterations` gives the number of outer iterations (calls to `optim`).

`barrier.value` giving the value of the barrier function at the optimum.

For `hessian = T` add:

`hessian` A symmetric matrix giving an estimate of the (negative) Hessian at the solution found. Note that this is the Hessian of the unconstrained problem even if the box constraints are active.

`bounds` Return the best parameters found and the upper and lower bounds for the estimation.

References

Rathie, P. N. and Swamee, P. K. (2006) *On a new invertible generalized logistic distribution approximation to normal distribution*, Technical Research Report in Statistics, 07/2006, Dept. of Statistics, Univ. of Brasilia, Brasilia, Brazil.

Byrd, R. H., Lu, P., Nocedal, J. and Zhu, C. (1995) *A limited memory algorithm for bound constrained optimization*. SIAM J. Scientific Computing, **16**, 1190-1208.

Examples

```
## Using generic parameter starting values
datas <- rgenlog(10000, 1.5,2,2, 0)
genlog_mle(c(.5,1.6, 1.5, 0),datas)

## Select parameters starting values with genlog_slider

datas <- rgenlog(10000, 1.5,2,2, 0)

if (manipulate::isAvailable()) {
  genlog_slider(datas, return_var = 'parameters') ## choose parameters
} else {
  parameters <- c(1.345, 2, 2, -0.00510)
}

genlog_mle(parameters,datas)
```

genlog_mle_sk

Optimization for a generalized logistic distribution with skewness

Description

Maximum likelihood estimation of parameters for a generalized logistic distribution with skewness.

Usage

```
genlog_mle_sk(parameters, data, hessian = F, alpha = 0.05)
```

Arguments

parameters	Initial values for the parameters to be optimized over in the following order c(a, b, p, mu, skew).
data	This is the the data to be utilized for the estimation.
hessian	logical value that returns hessian, also returns the parameters estimation's confidence interval.
alpha	Type I error given to calculate confidence intervals, used when hessian = T.

Details

Maximum likelihood estimation of parameters for the distribution proposed in this package. This function is an application of `constrOptim` as a particular case needed for this distribution using the method "BFGS". For more information of the output check `help(constrOptim)`.

The used distribution for this package is given by:

$$f(x) = 2*((a+b*(1+p)*(abs(x-mu)^p))*exp(-(x-mu)*(a+b*(abs(x-mu)^p))))/((exp(-(x-mu)*(a+b*(abs(x-mu)^p)))))$$

help(dgenlog_sk) for parameters restrictions.

Value

Return a list of components as `constrOptim` (for more information, check this function) with some extras:

`par` The best set of parameters found.

`value` The value of the loglikelihood function corresponding to `par`.

`counts` A two-element integer vector giving the number of calls to the likelihood function and L-BFGS-B respectively. This excludes those calls needed to compute the Hessian, and any calls to likelihood function to compute a finite-difference approximation to the gradient.

`convergence` An integer code. 0 indicates successful completion, 1 indicates that the iteration limit `maxit` had been reached. For more errors `help(constrOptim)`.

`message` A character string giving any additional information returned by the optimizer, or NULL.

`outer.iterations` gives the number of outer iterations (calls to `optim`).

`barrier.value` giving the value of the barrier function at the optimum.

For `hessian = T` add:

`hessian` A symmetric matrix giving an estimate of the (negative) Hessian at the solution found. Note that this is the Hessian of the unconstrained problem even if the box constraints are active.

`bounds` Return the best parameters found and the upper and lower bounds for the estimation.

References

Rathie, P. N. and Swamee, P. K. (2006) *On a new invertible generalized logistic distribution approximation to normal distribution*, Technical Research Report in Statistics, 07/2006, Dept. of Statistics, Univ. of Brasilia, Brasilia, Brazil.

Azzalini, A. (1985) *A class of distributions which includes the normal ones*. Scandinavian Journal of Statistics.

Byrd, R. H., Lu, P., Nocedal, J. and Zhu, C. (1995) *A limited memory algorithm for bound constrained optimization*. SIAM J. Scientific Computing, **16**, 1190-1208.

Examples

```
## Using generic parameter starting values
datas <- rgenlog_sk(10000, 0.3,0.9,1.5, 0, 0.9)
genlog_mle_sk(c(0.3,0.9,1.5, 0, 0.9),datas)

## Select parameters starting values with genlog_slider

datas <- rgenlog(10000, 1.5,2,2, 0)

if (manipulate::isAvailable()) {
  genlog_slider(datas, return_var = 'parameters', skew = T) ## choose parameters
} else {
  parameters <- c( 1, 1.5, 1.3, 0.5, -.4)
}

genlog_mle_sk(parameters, datas)
```

genlog_simu

Simulating the Generalized logistic distribution

Description

Creating a simulation of the generalized logistic distribution maximum likelihood estimation of the parameters with parallelized processing code using the foreach package.

Usage

```
genlog_simu(real.par, init.par, sample.size = 100,
            k = 1000, seed = 555, threads = 1, progress.bar = T)
```

Arguments

real.par	the real parameters value of the distribution wich the random sample will be taken. It has to be a vector of length 4, the parameters are the values of $c(a, b, p, \mu)$ as listed in rgenlog, μ can be omitted and will be set to 0. There are no default values.
init.par	Initial values for the parameters to be optimized over in the following order $c(a, b, p, \mu)$. Can be an object returned by genlog_slider. There are no default values.
sample.size	the sample size to be taken in each k simulation.
k	the number of simulations.
seed	seed to be given to set.seed() function during the sampling process
threads	the numbers of CPU threads to be used for parallel computing. If the threads number is higher than the available the maximum allowed will be used.
progress.bar	show progress bar for each thread during simulations, default value TRUE.

Details

The used distribution for this package is given by:

$$f(x) = ((a+b*(1+p))*(abs(x-mu)^p))*exp(-(x-mu)*(a+b*(|x-mu|^p)))/((exp(-(x-mu)*(a+b*(|x-mu|^p)))+1)^2)$$

For more about the distribution use `help(dgenlog)`.

Value

It returns a `data.frame` with `k` rows (each simulation) and 7 columns with the following information:
`a`, `b`, `p` and `mu` are estimations using maximum likelihood estimation, for more info `help(genlogismle)`
`sample.size` The sample size used for each `k` simulation.
`convergence` The estimation's convergence status.

References

Rathie, P. N. and Swamee, P. K. (2006) *On a new invertible generalized logistic distribution approximation to normal distribution*, Technical Research Report in Statistics, 07/2006, Dept. of Statistics, Univ. of Brasilia, Brasilia, Brazil.

Examples

```
genlog_simu(real.par = c(0.3, 0.9, 1.5, 0.0), init.par = c(0.9, 0.3, 0.2, 0.0),
            sample.size = 100, k = 50, threads = 2, seed = 200)
```

genlog_simu_sk

Simulating the Generalized logistic distribution with skewness

Description

Creating a simulation of the generalized logistic distribution with skewness maximum likelihood estimation of the parameters with parallelized processing code using the `foreach` package.

Usage

```
genlog_simu_sk(real.par, init.par, sample.size = 100,
              k = 1000, seed = 555, threads = 1, progress.bar = T)
```

Arguments

`real.par` the real parameters value of the distribution with the random sample will be taken. It has to be a vector of length 5, the parameters are the values of `c(a, b, p, mu)` as listed in `rgenlog`, `mu` can be omitted and will be set to 0. There are no default values.

<code>init.par</code>	Initial values for the parameters to be optimized over in the following order $c(a, b, p, \mu, \text{skew})$. Can be an object returned by <code>genlog_slider</code> . There are no default values.
<code>sample.size</code>	the sample size to be taken in each k simulation.
<code>k</code>	the number of simulations.
<code>seed</code>	seed to be given to <code>set.seed()</code> function during the sampling process
<code>threads</code>	the numbers of CPU threads to be used for parallel computing. If the threads number is higher than the available the maximum allowed will be used.
<code>progress.bar</code>	show progress bar for each thread during simulations, default value TRUE.

Details

The used distribution for this package is given by:

$$f(x) = 2 * ((a + b * (1 + p) * (\text{abs}(x - \mu))^p) * \exp(-(x - \mu) * (a + b * (\text{abs}(x - \mu))^p))) / ((\exp(-(x - \mu) * (a + b * (\text{abs}(x - \mu))^p)))$$

Value

It returns a data.frame with k rows (each simulation) and 7 columns with the following information:
`a`, `b`, `p` and `mu` are estimations using maximum likelihood estimation, for more info `help(genlogis_mle)`
`sample.size` The sample size used for each k simulation.
`convergence` The estimation's convergence status.

References

Rathie, P. N. and Swamee, P. K. (2006) *On a new invertible generalized logistic distribution approximation to normal distribution*, Technical Research Report in Statistics, 07/2006, Dept. of Statistics, Univ. of Brasilia, Brasilia, Brazil.

Azzalini, A. (1985) *A class of distributions which includes the normal ones*. Scandinavian Journal of Statistics.

Examples

```
genlog_simu_sk(real.par = c(0.3, 0.9, 1.5, 0.0, .9), init.par = c(0.9, 0.3, 0.2, 0.0, .9),
              sample.size = 100, k = 50, threads = 2, seed = 200)
```

genlog_slider

Slider for generalized logistic

Description

Make a generalized logistic distribution slider to compare histogram with theoretical distribution

Usage

```
genlog_slider(data, return_var = NULL, mu_range = 10, skew = F)
```

Arguments

data	vector of data to compare.
return_var	a char string to name where parameters are assigned
mu_range	a number to setup the minimum and maximum range value of the mu parameter
skew	logical, if TRUE, a model with skewness should be used..

Details

There is a small gear in the top left of the graphic where you can slide the parameters @param a, b, p, mu. The used distribution for this package is given by:

$$f(x) = ((a+b*(1+p)*(abs(x-\mu)^p))*exp(-(x-\mu)*(a+b*(|x-\mu|^p))))/((exp(-(x-\mu)*(a+b*(|x-\mu|^p)))+1)^2)$$

If the density function is not printed it is not defined for these parameters.

For skew = T the model used is

The used distribution for is given by:

$$f(x) = 2*((a+b*(1+p)*(abs(x-\mu)^p))*exp(-(x-\mu)*(a+b*(abs(x-\mu)^p))))/((exp(-(x-\mu)*(a+b*(abs(x-\mu)^p))))+1)$$

#' for more information about the model (help(dgenlog_sk)) If the density function is not printed it is not defined for these parameters.

help(dgenlog) for parameters restrictions.

This function requires RStudio to run.

Value

The function plots a interactive graphic in RStudio Viewer panel.

Also, the parameters a, b, p and mu can be returned to return_var if asked in the graphic.

References

Rathie, P. N. and Swamee, P. K (2006) *On a new invertible generalized logistic distribution approximation to normal distribution*, Technical Research Report in Statistics, 07/2006, Dept. of Statistics, Univ. of Brasilia, Brasilia, Brazil.

Azzalini, A. (1985) *A class of distributions which includes the normal ones*. Scandinavian Journal of Statistics.

Examples

```
## Not run:
datas <- rgenlog(1000)
if (manipulate::isAvailable()) {
  genlog_slider(datas, return_var = 'parameters')
}

## End(Not run)
```

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