Package 'lognGPD'

June 2, 2025

Title Estimation of a Lognormal - Generalized Pareto Mixture

Version 0.1.0

Description

Estimation of a lognormal - Generalized Pareto mixture via the Expectation-Maximization algorithm. Computation of bootstrap standard errors is supported and performed via parallel computing. Functions for random number simulation and density evaluation are also available. For more details see Bee and Santi (2025) <doi:10.48550/arXiv.2505.22507>.

License MIT + file LICENSE

Encoding UTF-8

RoxygenNote 7.3.2

Depends R (>= 4.0.0)

RdMacros Rdpack

Imports evd, Rdpack, parallel, LNPar, EnvStats

URL https://github.com/marco-bee/lognGPD

BugReports https://github.com/marco-bee/lognGPD/issues

NeedsCompilation no

Author Marco Bee [aut, cre] (ORCID: <https://orcid.org/0000-0002-9579-3650>)

Maintainer Marco Bee <marco.bee@unitn.it>

Repository CRAN

Date/Publication 2025-06-02 08:50:05 UTC

Contents

dlognGPD *Density of the lognormal-GPD mixture*

Description

This function evaluates the lognormal-GPD mixture density function.

Usage

```
dlognGPD(x, p, mu, sigma, xi, beta)
```

Arguments

x	vector (nx1): points where the function is evaluated.
p	real, 0<p<1: prior probability
mu	real: log-mean of the truncated lognormal distribution.
sigma	positive real: log-standard deviation of the truncated lognormal distribution.
xi	real: shape parameter of the generalized Pareto distribution.
beta	positive real: scale parameter of the generalized Pareto distribution.

Value

ydens (n x 1) vector: numerical values of the lognormal - generalized Pareto mixture at x.

Examples

```
ydens <- dlognGPD(seq(0,20,length.out=500),.9,0,1,0.5,2)
```

dlognPareto *Density of the lognormal-Pareto spliced distribution*

Description

This function evaluates the density of the continuous and differentiable version of the truncated lognormal-Pareto spliced distribution proposed by Scollnik (2007).

Usage

```
dlognPareto(x, sigma, xmin, alpha)
```

Arguments

x	vector (nx1): points where the function is evaluated.
sigma	positive real: log-standard deviation of the truncated lognormal distribution.
xmin	positive real: scale parameter of the Pareto distribution.
alpha	positive real: shape parameterof the Pareto distribution.

Details

To get a continuous and differentiable density, it is necessary to enforce constraints that reduce the number of free parameters of the model; in particular, the mixing weight and the log-mean of the lognormal distirbution are functions of the reamining parameters. See Scollnik (2007) for details.

Value

ysim (n x 1) vector: numerical values of the truncated lognormal-Pareto spliced distribution at x.

References

Scollnik DPM (2007). "On composite lognormal-Pareto models." *Scandinavian Actuarial Journal*, **1**, 20-33.

Examples

```
ysim <- dlognPareto(seq(0,20,length.out=500),1,5,2)
```

EMBoot *Bootstrap standard errors for the MLEs of a lognormal-GPD mixture*

Description

This function draws a bootstrap sample and uses it to estimate the parameters of a lognormal-Pareto mixture distribution. Since this is typically called by LPfitEM, see the help of LPfitEM for examples.

Usage

```
EMBoot(x, x0, y, maxiter)
```

Arguments

x	list: sequence of integers 1,...,K, where K is the mumber of datasets. Set x = 1 in case of a single dataset.
x0	numerical vector (5x1): initial values of the parameters p, μ, σ, ξ, β.
y	numerical vector: observed sample.
maxiter	non-negative integer: maximum number of iterations of the EM algorithm.

Details

At each bootstrap replication, the mixture is estimated via the EM algorithm.

Value

Estimated parameters obtained from a bootstrap sample.

`EMlogngpdmix` *Mixture estimation via EM*

Description

This function estimates a static lognormal - generalized Pareto mixture by means of the EM algorithm. Optionally, bootstrap standard errors are computed via parallel computing.

Usage

```
EMlogngpdmix(x0, y, maxiter, nboot = 0)
```

Arguments

`x0`	numerical vector (5x1): initial values of the parameters p, μ, σ, ξ, β.
`y`	vector: observed data.
`maxiter`	positive integer: maximum number of iterations of the EM algorithm.
`nboot`	positive integer: number of bootstrap replications for the computation of the standard errors (defaults to 0).

Value

A list with the following elements is returned: "p" = estimated value of p, "post" = posterior probabilities of all observations, "mu" = estimated value of μ, "sigma " = estimated value of σ, "xi" = estimated value of ξ, "beta" = estimated value of β, "loglik" = maximimzed log-likelihood, "nit" = number of iterations, bootEst = matrix of parameter estimates at each bootstrap replications (only if nboot > 0). bootStd = bootstrap standard errors of each parameter (only if nboot > 0).

Examples

```
y <- rlognGPD(100,.9,0,1,0.5,2)
x0 <- c(.7,.2,1.3,.8,1.7)
res <- EMlogngpdmix(x0, y, 1000)
```

rlognGPD *Simulation of the lognormal-GPD mixture*

Description

This function simulates a lognormal-GPD mixture.

Usage

```
rlognGPD(n, p, mu, sigma, xi, beta)
```

Arguments

n	positive integer: number of observations sampled.
p	real, 0<p<1: prior probability
mu	real: log-mean of the lognormal distribution.
sigma	positive real: log-standard deviation of the lognormal distribution.
xi	real: shape parameter of the generalized Pareto distribution.
beta	positive real: scale parameter of the generalized Pareto distribution.

Value

ysim (n x 1) vector: n random numbers from the lognormal - generalized Pareto mixture.

Examples

```
ysim <- rlognGPD(100,.9,0,1,0.5,2)
```

rlognPareto *Simulation of the lognormal-Pareto spliced distribution*

Description

This function simulates the continuous and differentiable version of the truncated lognormal-Pareto spliced distribution proposed by Scollnik (2007).

Usage

```
rlognPareto(n, sigma, xmin, alphapar)
```

Arguments

n	positive integer: number of observations sampled.
sigma	positive real: log-standard deviation of the truncated lognormal distribution.
xmin	positive real: scale parameter of the Pareto distribution.
alphapar	positive real: shape parameterof the Pareto distribution.

Details

See Scollnik (2007) for details.

Value

ysim (nreps x 1) vector: nreps random numbers from the truncated lognormal-Pareto spliced distribution.

References

Scollnik DPM (2007). "On composite lognormal-Pareto models." *Scandinavian Actuarial Journal*, **1**, 20-33.

Examples

```
ysim <- rlognPareto(100,1,5,2)
```

---

weiGpdLik *Weighted GPD log-likelihood*

Description

This function evaluates the zero-mean generalized Pareto log-likelihood function computed with weighted observations.

Usage

```
weiGpdLik(x, y, post)
```

Arguments

x	numerical vector (2x1): values of the parameters ξ and β.
y	numerical vector (nx1): observed data.
post	numerical vector (nx1) with elements in (0,1): weights of the observations (in the EM algorithm, posterior probabilities).

Value

llik real: numerical value of the log-likelihood function

Examples

```
y <- rlognGPD(100,.9,0,1,0.5,2)
x0 <- c(.7,.2,1.3,.8,1.7)
res <- EMlogngpdmix(x0, y, 1000)
llik <- weiGpdLik(c(res$beta,res$xi),y,res$post)
```

Index