Package ‘gfiExtremes’

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Type Package

Title Generalized Fiducial Inference for Extremes

Version 1.0.1

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Description Fiducial framework to perform inference on the quantiles for a generalized Pareto distribution model and on the parameters of the Pareto exceedance distribution, assuming the exceedance threshold is a known or unknown parameter. Reference: Damian V. Wandler & Jan Hannig (2012) <doi:10.1007/s10687-011-0127-9>.

License GPL (>= 2)

Depends coda

Imports Rcpp (>= 1.0.5), parallel, doParallel, foreach, stats

LinkingTo Rcpp, BH, RcppArmadillo

Encoding UTF-8

RoxygenNote 7.1.1

URL https://github.com/stla/gfiExtremes

BugReports https://github.com/stla/gfiExtremes/issues

Suggests knitr, rmarkdown

VignetteBuilder knitr

SystemRequirements C++ 17

NeedsCompilation yes

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Repository CRAN

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R topics documented:

gfigpd1 *Fiducial inference for the generalized Pareto model with known threshold*

Description

Runs the MCMC sampler of the fiducial distribution for the generalized Pareto model with known threshold.

Usage

```
gfigpd1(
  X,
  beta,
  threshold,
  gamma.init = NA,
  sigma.init = NA,
  sd.gamma = NA,
  sd.sigma = NA,
  Jnumb = 50L,
  iter = 10000L,
  burnin = 2000L,
  thin = 6L,
  nchains = 4L,
  nthreads = parallel::detectCores(),
  seeds = NULL
)
```

Arguments

`X`	numeric vector of data
`beta`	vector of probabilities corresponding to the quantiles to be estimated
`threshold`	value of the known threshold, must be smaller than the maximum of `X`
`gamma.init`	starting value for `gamma` in the MCMC
`sigma.init`	starting value for `sigma` in the MCMC
`sd.gamma`	standard deviation for the proposed `gamma` in the MCMC
`sd.sigma`	standard deviation for the proposed `sigma` in the MCMC

Jnumb number of subsamples that are taken from the Jacobian

iter number of iterations per chain (burnin excluded)

burnin number of the first MCMC iterations discarded

thin thinning number for the MCMC chain. (e.g. if it is 1 no iteration is skipped)

nchains number of MCMC chains to run

nthreads number of threads to run the chains in parallel

seeds the seeds used for the MCMC sampler; one seed per chain, or NULL to use random seeds

Value

An object of class mcmc if nchains=1, otherwise an object of class mcmc.list.

References

Damian V. Wandler & Jan Hannig. *Generalized fiducial confidence intervals for extremes*. Extremes (2012) 15:67–87. <doi:10.1007/s10687-011-0127-9>

Examples

```
set.seed(666L)
X <- rgpareto(200L, mu = 10, gamma = 0.5, sigma = 1)
gf <- gfigpd1(
  X, beta = c(0.98, 0.99), threshold = 10,
  iter = 2000L, nchains = 2L, nthreads = 2L
) # note: 2*2000 iterations is not enough, I'm using these settings because
  # of CRAN constraints (elapsed time must be < 5s)
summary(gf)
qgpareto(c(0.98, 0.99), mu = 10, gamma = 0.5, sigma = 1)
rejectionRate(gf)
HPDinterval(gf)
HPDinterval(joinMCMCchains(gf))
```

gfigpd2 *Fiducial inference for the generalized Pareto model with unknown threshold*

Description

Runs the MCMC sampler of the fiducial distribution for the generalized Pareto model with unknown threshold.

Usage

```
gfigpd2(
  X,
  beta,
  threshold.init = NA,
  gamma.init = NA,
  sigma.init = NA,
  sd.gamma = NA,
  sd.sigma = NA,
  p1 = 0.9,
  p2 = 0.5,
  lambda1 = 2,
  lambda2 = 10,
  Jnumb = 50L,
  iter = 10000L,
  burnin = 2000L,
  thin = 6L,
  nchains = 4L,
  nthreads = parallel::detectCores(),
  seeds = NULL,
  allParameters = FALSE
)
```

Arguments

`X`	numeric vector of data
`beta`	vector of probabilities corresponding to the quantiles to be estimated
`threshold.init`	a guess of the unknown threshold, must be in the range of `X`
`gamma.init`	starting value for `gamma` in the MCMC
`sigma.init`	starting value for `sigma` in the MCMC
`sd.gamma`	standard deviation for the proposed `gamma` in the MCMC
`sd.sigma`	standard deviation for the proposed `sigma` in the MCMC
`p1`	probability that the MCMC will propose a new `(gamma,sigma)`; `(1-p1)` would be the probability that the MCMC chain will propose a new index for a new threshold
`p2`	probability that the new index proposed will be larger than the current index
`lambda1`	the small jump the index variable will make
`lambda2`	the large jump the index variable will make; happens 1 of every 10 iterations
`Jnumb`	number of subsamples that are taken from the Jacobian
`iter`	number of iterations per chain (burnin excluded)
`burnin`	number of the first MCMC iterations discarded
`thin`	thinning number for the MCMC chain. (e.g. if it is 1 no iteration is skipped)
`nchains`	number of MCMC chains to run

`nthreads` number of threads to run the chains in parallel

`seeds` the seeds used for the MCMC sampler; one seed per chain, or `NULL` to use random seeds

`allParameters` logical, whether to return the MCMC chains of all parameters (pretty useless) or only the ones of the quantiles

Value

An object of class `mcmc` if `nchains=1`, otherwise an object of class `mcmc.list`.

References

Damian V. Wandler & Jan Hannig. *Generalized fiducial confidence intervals for extremes*. Extremes (2012) 15:67–87. <doi:10.1007/s10687-011-0127-9>

Examples

```
set.seed(31415L)
X <- rgamma(350L, shape = 10, rate = 1)
gf <- gfigpd2(X, beta = c(0.98, 0.99), iter = 3000L, nthreads = 2L)
summary(gf)
qgamma(c(0.98, 0.99), shape = 10, rate = 1)
traceplot(gf[,"beta1"])
traceplot(gf[,"beta2"])
thresholdEstimate(gf)
rejectionRate(gf)
HPDinterval(gf)
HPDinterval(joinMCMCchains(gf))
```

GPareto *Generalized Pareto distribution*

Description

Density, distribution function, quantile function, and random generation for the generalized Pareto distribution.

Usage

```
dgpareto(x, mu, gamma, sigma, log = FALSE)

pgpareto(q, mu, gamma, sigma)

rgpareto(n, mu, gamma, sigma)

qgpareto(p, mu, gamma, sigma)
```

Arguments

`x`	numeric vector
`mu`	location parameter
`gamma`	shape parameter
`sigma`	scale parameter, strictly positive
`log`	logical, whether to return the log-density
`q`	numeric vector of quantiles
`n`	positive integer, the desired number of simulations
`p`	numeric vector of probabilities

`joinMCMCchains` *Join MCMC chains*

Description

Joins multiple MCMC chains into a single chain.

Usage

```
joinMCMCchains(gfi)
```

Arguments

`gfi`	an output of `gfigpd1` or `gfigpd2` containing more than one chain

Value

A `mcmc` object.

`thresholdEstimate` *Threshold estimate*

Description

Returns the estimate of the threshold.

Usage

```
thresholdEstimate(gfi)
```

Arguments

`gfi`	an output of `gfigpd2`

Value

The estimated threshold.

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