

Package: lmomPi (via r-universe)

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Title (Precipitation) Frequency Analysis and Variability with
L-Moments from 'lmom'

Type Package

Description It is an extension of 'lmom' R package:

'pel...()', 'cdf...()', 'qua...()' function families are lumped
and called from one function per each family respectively in
order to create robust automatic tools to fit data with
different probability distributions and then to estimate
probability values and return periods. The implemented
functions are able to manage time series with constant and/or
missing values without stopping the execution with error
messages. The package also contains tools to calculate several
indices based on variability (e.g. 'SPI', Standardized
Precipitation Index, see
<[https://climatedataguide.ucar.edu/climate-data/
standardized-precipitation-index-spi](https://climatedataguide.ucar.edu/climate-data/standardized-precipitation-index-spi)>
and <<http://spei.csic.es/>>) for multiple time series or
spatially gridded values.

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URL <https://github.com/ecor/lmomPi>

Depends R(>= 3.0.1), lmom, stringr

Suggests SPEI

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Repository <https://ecor.r-universe.dev>

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are.lmoms.valid	<i>Validate L-moment Constraints</i>
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Description

This function checks whether a given set of L-moments satisfies theoretical and practical constraints commonly used in statistical modeling. These constraints ensure the validity of L-moment ratios and help detect potential issues in the data or its transformation (e.g., log-transformed data with non-positive values).

Usage

```
are.lmoms.valid(  
  lmom,  
  clean = TRUE,  
  return_numeric = FALSE,  
  cond3t4 = TRUE,  
  condtt3 = FALSE  
)
```

Arguments

- lmom vector of L-moments
- clean logical if it is TRUE (default) clean lmom's names
- return_numeric logical if it is TRUE L-moments corrected are returned instead of a boolean value.
- cond3t4 logical if TRUE condition on t_3 and t_4 is applied.
- condtt3 logical if TRUE condition on t and t_3 is applied (only for a distribution that takes positive values, p.24 ref).

Value

logical value indicating if all of these conditions are verified:

- $\lambda_2 > 0$ (L-scale must be positive)
- $|\tau_3| < 1$ (L-skewness must lie within $(-1, 1)$)
- $|\tau_i| < 1$ (i-th L-moment ratio must lie within $(-1, 1)$ for $i > 3$)
- λ_1 and λ_2 must be finite
- $\frac{5\tau_3^2 - 1}{4} \leq \tau_4 < 1$ is verified for theoretical consistency
- $2\tau - 1 \leq \tau_3 < 1$ is verified for theoretical consistency (only for a distribution that takes positive values, p.24 ref)

References

Hosking, J.R.M. and Wallis, J.R. (1997). *Regional Frequency Analysis: An Approach Based on L-Moments*. Cambridge University Press. doi:10.1017/CBO9780511529443

Examples

```
library(lmomPi)

data(airquality)
lmom <- samlmu(airquality$Ozone, 6)
are.lmoms.valid(lmom = lmom)

are.lmoms.valid(lmom = lmom, return_numeric=TRUE)

lmoml <- samlmu(airquality$Ozone, 6, ratio=FALSE)

are.lmoms.valid(lmom = lmoml)
are.lmoms.valid(lmom = lmoml, condtt3=TRUE)
are.lmoms.valid(lmom = lmoml, return_numeric=TRUE)
are.lmoms.valid(lmom = lmoml, return_numeric=TRUE, condtt3=TRUE)
```

cdf

Generic function for cdf . . . : probability distribution fitting with L-Moments.

Description

These functions compute value(s) of cumulated probability or SPI-like (normal standardize) index from a sample or time series of x.

Usage

```

cdf(
  para,
  x,
  probability_distribution_attrname = "probability_distrib",
  indices = NULL,
  return.as.spi = FALSE,
  spi.scale = NA,
  distrib = NA,
  ...
)

spi.cdf(x, para, ...)

cdf.spi(x, para, ...)

```

Arguments

<code>x, para, ...</code>	L-moments and further parameters for <code>cdf...</code> and cdf
<code>probability_distribution_attrname</code>	attribute name for probability distribution
<code>indices</code>	vector of string working as factors or indices, e.g. the month names or similar. It must be of the same length of <code>x</code> or the length equal to 1 other NULL, if not used. If used, it computes cdf for each factor.
<code>return.as.spi</code>	logical parameter. Default is FALSE. If it is TRUE probability value is transformed to a normalized random variable through standard qnorm , as for Standard Precipitation Index (SPI) (https://climatedataguide.ucar.edu/climate-data/standardized-precipitation-index-spi).
<code>spi.scale</code>	integer value or NA. If it greater than 1 <code>x</code> is filtered with the sum of a generic element of <code>x</code> and the previous <code>spi.scale-1</code> ones (e.g. SPI-3, SPI-6, etc.). Default is NA (no filtering) which is equivalent to <code>spi.scale=1</code> .
<code>distrib</code>	character string indicating the probability distribution, it can be used in case <code>para</code> has no attributes. Default is NA and distribution info are all passed through <code>para</code> .

Value

A vector of cumulated probability value(s) or SPI-like Gaussianized values. It is a list of vectors in case of several probability parametric distribution functions (i.e. `para` is a list and `length(para)>1`).

See Also

[pel](#), [cdfexp](#), [cdfgam](#), [cdfgev](#), [cdfglo](#),
[cdfgpa](#), [cdfgno](#), [cdfgum](#), [cdfkap](#), [cdfln3](#), [cdfnor](#), [cdfpe3](#), [cdfwak](#), [cdfwei](#)

Examples

```
# Sample L-moments of Ozone from the airquality data
data(airquality)
lmom <- samlmu(airquality$Ozone,nmom=6)

distrib <- c("exp","gam","gev","glo","gpa","gno","gum","kap",
"ln3","nor","pe3","wak","wei")

para_list <- pel(distrib=distrib,lmom=lmom)
cdf_list <- cdf(para=para_list,x=airquality$Ozone)

cdf_gam <- cdf(para=para_list$gam,x=airquality$Ozone)
cdf_gam2 <- cdf(para=para_list$gam,x=airquality$Ozone,distrib="gam")

if (any(cdf_gam!=cdf_gam2,na.rm=TRUE)) stop("Any possible errors after 0.6.3 package updates!")

## Comparison with the SPI/SPEI algorithms: 'SPEI::spi' ('SPEI' package)

if (requireNamespace("SPEI",quietly = TRUE)) {
  library(SPEI)
  data(wichita)

  distrib_wichita <- 'pe3'
  spi.scale <- 1

  month_wichita <- sprintf("M%02d",wichita$MONTH)
  para_wichita <- pel(x=wichita$PRCP,indices=month_wichita,distrib=distrib_wichita,
    spi.scale=spi.scale,check_lmom_validity=TRUE)
  spi_wichita <- spi.cdf(x=wichita$PRCP,indices=month_wichita,para=para_wichita,
    spi.scale=spi.scale)
  spi_wichita_speipkg <- spi(data=wichita$PRCP,distrib='PearsonIII',scale=spi.scale)
  difference <- spi_wichita-spi_wichita_speipkg$fitted
}
```

pel

Generic function for [pel...](#)

Description

Generic function for [pel...](#): probability distribution fitting with L-Moments

Usage

```

pel(
  distrib = c("exp", "gam", "gev", "glo", "gpa", "gno", "gum", "kap", "ln3", "nor",
    "pe3", "wak", "wei"),
  lmom = NULL,
  probability_distribution_attrname = "probability_distrib",
  x = NULL,
  nmom = 5,
  sort.data = TRUE,
  ratios = sort.data,
  trim = 0,
  indices = NULL,
  spi.scale = NA,
  correction = NULL,
  check_lmom_validity = FALSE,
  cond3t4 = TRUE,
  ...
)

pel_x(x, ...)

pel_lmom(lmom, ...)

```

Arguments

distrib	character string indicating the probability distribution to fit
lmom, ...	L-moments and further parameters for pel...
probability_distribution_attrname	attribute name for probability distribution
x	vector containg sample. It is utilied to calculete L-moments in case lmom is set equal to NULL.
nmom, sort.data, ratios, trim	arguments for samlm (nmom=5 by default). They are utilized if argument lmom is NULL.
indices	optional index or tag character vector of the same length of x used as INDEX for tapply . It is used to fit different probability distribution in one sample time series (e. g. months in an year).
spi.scale	integer value or NA. If it is greater than 1, x is filtered with the sum of a generic element of x and the previous spi.scale-1 ones (e.g. SPI-3,SPI-6, etc.). Default is NA (no filtering) which is equivalent to spi.scale=1.
correction	numeric value correction for the 3rd (and higher) L-moment estimation. Default is NULL , generally it is not used. It is used and suggested to be 10^{-10} in case of a massive function use with lmom=NULL (e.g. raster cell or zonal statistics).
check_lmom_validity	logical. Default is FALSE. If it is TRUE, L-moments are checked through are.lmoms.valid
cond3t4	argument for are.lmoms.valid in case are.lmoms.valid==TRUE

Details

`pel_x` and `pel_lmom` are wrapper functions of `pel` whose first argument is `x` or `lmom` respectively.

Value

A numeric vector containing the parameters of the selected probability distribution. It is a list in case of selection of several probability distributions (i.e. `length(distrib)>1`).

See Also

`pel...`, `pelexp`, `pelgam`, `pelgev`, `pelglo`, `pelgpa`,
`pelgno`, `pelgum`, `pelkap`, `pelln3`, `pelnor`,
`pelpe3`, `pelwak`, `pelwei`,
`cdf`, `qua`

Examples

```
# Sample L-moments of Ozone from the airquality data
data(airquality)
lmom <- samlmu(airquality$Ozone, nmom=6)
distrib <- "gev"
# Fit a GEV distribution
out_gev <- pel(distrib=distrib, lmom=lmom)

distrib <- c("exp", "gam", "gev", "glo", "gpa", "gno", "gum", "kap", "ln3",
"nor", "pe3", "wak", "wei")

out_list <- pel(distrib=distrib, lmom=lmom)
```

qua	<i>Generic function for qua...: probability distribution fitting with L-Moments</i>
-----	---

Description

Generic function for qua...: probability distribution fitting with L-Moments

Usage

```
qua(
  para,
  f,
  probability_distribution_attrname = "probability_distrib",
  distrib = NA,
  ...
)
```

Arguments

`f, para, ...` L-moments and further parameters for `qua...`
`probability_distribution_attrname`
 attribute name for probability distribution
`distrib` character string indicating the probability distribution, it can be used in case `para` has no attributes. Default is NA and distribution info are all passed through `para`.

Value

A vector of quantiles. It is a list of vectors of quantiles in case of several probability parametric distribution functions (i.e. `para` is a list and `length(para)>1`).

See Also

[pel](#), [quaexp](#), [quagam](#), [quagev](#), [quaglo](#), [quagpa](#), [quagno](#), [quagum](#),
[quakap](#), [qualn3](#), [quanor](#), [quape3](#), [quawak](#), [quawei](#)

Examples

```
# Sample L-moments of Ozone from the airquality data
data(airquality)
lmom <- samlmu(airquality$Ozone, nmom=6)

distrib <- c("exp", "gam", "gev", "glo", "gpa", "gno", "gum", "kap", "ln3", "nor",
  "pe3", "wak", "wei")

para_list <- pel(distrib=distrib, lmom=lmom)
f <- (1:10)/10
qua_list <- qua(para=para_list, f=f)

qua_gam <- qua(para=para_list$gam, f=f)
qua_gam2 <- qua(para=as.vector(para_list$gam), f=f, distrib="gam")

if (any(qua_gam!=qua_gam2, na.rm=TRUE)) stop("Any possible errors after 0.6.3 package updates!")
```

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