Package 'lmomPi'

December 5, 2022

License GPL (>= 3)

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 func-
tions 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 in-
dices based on variability (e.g. 'SPI' , Standardized
Precipitation Index, see <https://climatedataguide.ucar.edu/climate-data/
standardized-precipitation-index-spi> and <http:
//spei.csic.es/>) for multiple time series or spatially gridded values.

Version 0.6.2

Date 2022-12-04

Repository CRAN

Depends R(>= 3.0.1),lmom,stringr

Suggests rasterList,lmomRFA,SPEI

RoxygenNote 7.1.2

NeedsCompilation no

Date/Publication 2022-12-05 14:20:04 UTC

Author Emanuele Cordano [aut, cre]

Maintainer Emanuele Cordano <emanuele.cordano@gmail.com>

R topics documented:

---

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,
  ...
)

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

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

Arguments

x, para, ...	L-moments and further parameters for cdf... and [cdf](#)
probability_distribution_attrname	
	attribute name for probability distribution
indices	vector of string working as factors or indices, e g. the month names or similar. It must be of the same length of x or the length equal to 1 other NULL, if not used. If used, it computes cdf for each factor.
return.as.spi	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).
spi.scale	integer value or NA. If it 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.

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)


 library(rasterList)
 precff <- system.file("map/Mekrou_precipitation.grd", package="rasterList")
precs <- stack(precff)
 prec_point <- precs[143][,]

 ## month index
 month <- as.character(as.Date(names(prec_point),format="X%Y.%m.%d"),format="M%m")
 prec_point[(prec_point<1) & (month=="M01")] <- 0

 distrib_prec2 <- c("gam")
 para_vvv <- pel(x=prec_point,indices=month,distrib=distrib_prec2)
 cdf_      <- cdf(x=prec_point,indices=month,para=para_vvv)
spi_      <- spi.cdf(x=prec_point,indices=month,para=para_vvv)

 ####

 para_raster <- rasterList(precs,FUN=pel_x,indices=month,distrib=distrib_prec2)
 spi1_raster <- stack(RasterListApply(x=rasterList(precs),para=para_raster,
                 indices=list(month),FUN=spi.cdf))

  para_raster_spi3 <- rasterList(precs,FUN=pel_x,indices=month,distrib=distrib_prec2,
spi.scale=3)
  spi3_raster <- stack(RasterListApply(x=rasterList(precs),para=para_raster_spi3,
                 indices=list(month),spi.scale=3,FUN=spi.cdf))


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

data(wichita)

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

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

---

lmomPi-Package   *lmomPi: (Precipitation) Frequency Analysis and Variability with L-Moments from lmom*

Description

This packages contains wrapper functions of 'lmom' packages : cdf: generic distribution function; qua: generic quantile function; pel: fitting of probability distribution function through L-moments.

Details

The example functions are illustrated making use of CHIRPS rainfall meteorological data taken:

Funk, Chris, Pete Peterson, Martin Landsfeld, Diego Pedreros, James Verdin, Shraddhanand Shukla, Gregory Husak, James Rowland, Laura Harrison, Andrew Hoell and Joel Michaelsen. "The climate hazards infrared precipitation with stations - a new environmental record for monitoring extremes". Scientific Data 2, 150066. doi:10.1038/sdata.2015.66 2015 , https://chc.ucsb.edu/data/chirps.

The package-provided datasets shall be only used as example datasets.

The package also contains wrapped functions to calculate several indices based on variability (e.g. 'SPI' , Standardized Precipitation Index, see https://climatedataguide.ucar.edu/climate-data/standardized-precipitation-index-spi and http://spei.csic.es) for multiple time series or spatio-temporal gridded values. The function spi.cdf() is compared against SPEI::spi() in SPEI package (https://cran.r-project.org/package=SPEI). The differences in SPI extimation have order of magnitude averagely about 10^-8, due to the different fitting methods implemented in the two packages. (see SPEI::spi() and spi.cdf() for more details).

The development of this package has been sponsored by ACEWATER2 and "Water for Growth and Poverty Reduction in the Mekrou" projects of the Joint Research Centre of the Europan Commission (https://aquaknow.jrc.ec.europa.eu).

---

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,
  ...
)

pel_x(x, ...)

pel_lmom(lmom, ...)
```

Arguments

distrib	character string incating 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 utiled to calculete L-moments in case `lmom` is set equal to `NULL`.
nmom, sort.data, ratios, trim	
	arguments for `samlmu` (nmom=5 by default). Thay 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).

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)


library(rasterList)
precff <- system.file("map/Mekrou_precipitation.grd", package="rasterList")
precs <- stack(precff)
prec_point <- precs[143][,]
## month index
month <- as.character(as.Date(names(prec_point),format="X%Y.%m.%d"),format="M%m")
distrib_prec <- c("gam","pe3")
out_x <- pel(x=prec_point,indices=month,distrib=distrib_prec)
out_spi3_x <- pel(x=prec_point,indices=month,distrib=distrib_prec,spi.scale=3)
distrib_prec2 <- c("gam")
out_x <- pel(x=prec_point,indices=month,distrib=distrib_prec2)
out_spi3_x <- pel(x=prec_point,indices=month,distrib=distrib_prec2,spi.scale=3)


### example with PEL when x is always 0 or a fixed constant
xx <- array(0,50)
out_xx <- pel_x(x=xx,distrib=distrib_prec2)
```

---

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

Description

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

Usage

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

Arguments

f, para, ...   L-moments and further parameters for qua...

probability_distribution_attrname

                      attribute name for probability distribution

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)
```

Index