

# Package ‘lmomPi’

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**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 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. 'SPEI', 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.

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**Suggests** SPEI

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

$x$ , $para$ , ...	L-moments and further parameters for <code>cdf...</code> and <code>cdf</code>
<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 $x$ 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 <code>qnorm</code> , as for Standard Precipitation Index (SPI) ( <a href="https://climatedataguide.ucar.edu/climate-data/standardized-precipitation-index-spi">https://climatedataguide.ucar.edu/climate-data/standardized-precipitation-index-spi</a> ).
<code>spi.scale</code>	integer value or NA. If it greater than 1 $x$ is filtered with the sum of a generic element of $x$ 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)
  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...](#)*

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### 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 indicating the probability distribution to fit
lmom, ...	L-moments and further parameters for <a href="#">pel...</a>
probability_distribution_attrname	attribute name for probability distribution
x	vector containg sample. It is utilied to calculate L-moments in case lmom is set equal to NULL.
nmom, sort.data, ratios, trim	arguments for <a href="#">samllmu</a> (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 <a href="#">tapply</a> . It is used to fit different probability distribution in one sample time series (e. g. months in a 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 <- sam1mu(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      *Generic function for qua...: probabily distribution fitting with L-Moments*

---

### Description

Generic function for qua...: probabily 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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