

Package ‘Lmoments’

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Title L-Moments and Quantile Mixtures

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Description Contains functions to estimate
L-moments and trimmed L-moments from the data. Also
contains functions to estimate the parameters of the normal
polynomial quantile mixture and the Cauchy polynomial quantile
mixture from L-moments and trimmed L-moments.

Imports stats, Rcpp

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cauchypoly

Cauchy-polynomial quantile mixture

Description

Density, distribution function, quantile function and random generation for the Cauchy-polynomial quantile mixture.

Usage

```
dcauchypoly(x,param)
pcauchypoly(x,param)
qcauchypoly(cp,param)
rcauchypoly(n,param)
cauchypoly_pdf(x,param)
cauchypoly_cdf(x,param)
cauchypoly_inv(cp,param)
cauchypoly_rnd(n,param)
```

Arguments

x	vector of quantiles
cp	vector of probabilities
n	number of observations
param	vector of parameters

Details

The length the parameter vector specifies the order of the polynomial in the quantile mixture. If $k < \text{length}(\text{param})$ then $\text{param}[1:(k-1)]$ contains the mixture coefficients of polynomials starting from the constant and $\text{param}[k]$ is the mixture coefficient for Cauchy distribution. (Functions `cauchypoly_pdf`, `cauchypoly_cdf`, `cauchypoly_inv` and `cauchypoly_rnd` are aliases for compatibility with older versions of this package.)

Value

'dcauchypoly' gives the density, 'pcauchypoly' gives the cumulative distribution function, 'qcauchypoly' gives the quantile function, and 'rcauchypoly' generates random deviates.

Author(s)

Juha Karvanen <juha.karvanen@iki.fi>

References

Karvanen, J. 2006. Estimation of quantile mixtures via L-moments and trimmed L-moments, *Computational Statistics & Data Analysis* **51**, (2), 947–959. https://users.jyu.fi/~jutakarv/papers/Karvanen_quantile_mixtures.pdf.

See Also

[data2cauchypoly4](#) for the parameter estimation and [dnormpoly](#) for the normal-polynomial quantile mixture.

Examples

```
#Generates 500 random variables from the Cauchy-polynomial quantile mixture,
#calculates the trimmed L-moments,
#estimates parameters via trimmed L-moments and
#plots the true pdf and the estimated pdf together with the histogram of the data.
true_params <- t1lmom2cauchypoly4(c(0,1,0.075,0.343));
x <- rcauchypoly(500,true_params);
t1lmom <- t1lmoments(x);
estim_params <- t1lmom2cauchypoly4(t1lmom);
plotpoints <- seq(-10,10,by=0.01);
histpoints <- c(seq(min(x)-1,-20,length.out=50),seq(-10,10,by=0.5),seq(20,max(x)+1,length.out=50));
hist(x, breaks=histpoints, freq=FALSE, xlim=c(-10,10));
lines(plotpoints, dcauchypoly(plotpoints,estim_params), col='red');
lines(plotpoints, dcauchypoly(plotpoints,true_params), col='blue');
```

covnormpoly4

Covariance matrix of the parameters of the normal-polynomial quantile mixture

Description

Estimates covariance matrix of the four parameters of normal-polynomial quantile mixture

Usage

```
covnormpoly4(data)
```

Arguments

data vector of observations

Value

covariance matrix of the four parameters of normal-polynomial quantile mixture

Author(s)

Juha Karvanen <juha.karvanen@iki.fi>

References

Karvanen, J. 2006. Estimation of quantile mixtures via L-moments and trimmed L-moments, *Computational Statistics & Data Analysis* **51**, (2), 947–959. https://users.jyu.fi/~jutakarv/papers/Karvanen_quantile_mixtures.pdf.

See Also

[Lmomcov](#) for covariance matrix of L-moments, [dnormpoly](#) for the normal-polynomial quantile mixture and [data2normpoly4](#) for the estimation of the normal-polynomial quantile mixture.

data2cauchypoly

Estimation of the Cauchy-polynomial quantile mixture

Description

Estimates the parameters of the Cauchy-polynomial quantile mixture from data or from trimmed L-moments

Usage

```
data2cauchypoly4(data)
t1lmom2cauchypoly4(t1lmom)
```

Arguments

data	vector
t1lmom	vector of trimmed L-moments

Value

vector containing the four parameters of the Cauchy-polynomial quantile mixture

Author(s)

Juha Karvanen <juha.karvanen@iki.fi>

References

Karvanen, J. 2006. Estimation of quantile mixtures via L-moments and trimmed L-moments, *Computational Statistics & Data Analysis* **51**, (2), 947–959. https://users.jyu.fi/~jutakarv/papers/Karvanen_quantile_mixtures.pdf.

See Also

[t1lmoments](#) for trimmed L-moments, [dcauchypoly](#) for the Cauchy-polynomial quantile mixture and [data2normpoly4](#) for the estimation of the normal-polynomial quantile mixture.

Examples

```
#Generates 500 random variables from the Cauchy-polynomial quantile mixture,
#calculates the trimmed L-moments,
#estimates parameters via trimmed L-moments and
#plots the true pdf and the estimated pdf together with the histogram of the data.
true_params <- t1lmom2cauchypoly4(c(0,1,0.075,0.343));
x <- rcauchypoly(500,true_params);
t1lmom <- t1lmoments(x);
estim_params <- t1lmom2cauchypoly4(t1lmom);
plotpoints <- seq(-10,10,by=0.01);
histpoints <- c(seq(min(x)-1,-20,length.out=50),seq(-10,10,by=0.5),seq(20,max(x)+1,length.out=50));
hist(x, breaks=histpoints, freq=FALSE, xlim=c(-10,10));
lines(plotpoints, dcauchypoly(plotpoints,estim_params),col='red');
lines(plotpoints, dcauchypoly(plotpoints,true_params),col='blue');
```

data2normpoly

Estimation of normal-polynomial quantile mixture

Description

Estimates the parameters of normal-polynomial quantile mixture from data or from L-moments

Usage

```
data2normpoly4(data)
lmom2normpoly4(lmom)
data2normpoly6(data)
lmom2normpoly6(lmom)
```

Arguments

data	matrix or data frame
lmom	vector or matrix of L-moments

Value

vector or matrix containing the four or six parameters of normal-polynomial quantile mixture

Author(s)

Juha Karvanen <juha.karvanen@iki.fi>

References

Karvanen, J. 2006. Estimation of quantile mixtures via L-moments and trimmed L-moments, *Computational Statistics & Data Analysis* **51**, (2), 947–959. https://users.jyu.fi/~jutakarv/papers/Karvanen_quantile_mixtures.pdf.

See Also

[dnormpoly](#) for L-moments, [dnormpoly](#) for the normal-polynomial quantile mixture and [data2cauchypoly4](#) for the estimation of Cauchy-polynomial quantile mixture.

Examples

```
#Generates a sample 500 observations from the normal-polynomial quantile mixture,
#calculates L-moments and their covariance matrix,
#estimates parameters via L-moments and
#plots the true pdf and the estimated pdf together with the histogram of the data.
true_params <- lmom2normpoly4(c(0,1,0.2,0.05));
x <- rnormpoly(500,true_params);
lmoments <- Lmoments(x);
lmomcov <- Lmomcov(x);
estim_params <- lmom2normpoly4(lmoments);
hist(x,30,freq=FALSE);
plotpoints <- seq(min(x)-1,max(x)+1,by=0.01);
lines(plotpoints, dnormpoly(plotpoints,estim_params), col='red');
lines(plotpoints, dnormpoly(plotpoints,true_params), col='blue');
```

Lmoments	<i>L-moments</i>
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Description

Calculates sample L-moments, L-coefficients and covariance matrix of L-moments.

Usage

```
Lmoments(data, rmax = 4, na.rm = FALSE, returnobject = FALSE, trim = c(0, 0))
Lcoefs(data, rmax = 4, na.rm = FALSE, trim = c(0, 0))
Lmomcov(data, rmax = 4, na.rm = FALSE)
Lmoments_calc(data, rmax = 4)
Lmomcov_calc(data, rmax = 4)
shiftedlegendre(rmax)
```

Arguments

data	matrix or data frame.
rmax	maximum order of L-moments.
na.rm	a logical value indicating whether 'NA' values should be removed before the computation proceeds.
returnobject	a logical value indicating whether a list object should be returned instead of an array of L-moments.
trim	c(0, 0) for ordinary L-moments and c(1, 1) for trimmed (t = 1) L-moments

Value

Lmoments returns an array of L-moments containing a row for each variable in data, or if returnobject=TRUE, a list containing

lambdas	an array of L-moments
ratios	an array of mean, L-scale and L-moment ratios
trim	the value of the parameter 'trim'
source	a string with value "Lmoments" or "t1lmoments".

Lcoefs returns an array of L-coefficients (mean, L-scale, L-skewness, L-kurtosis, ...) containing a row for each variable in data.

Lmomcov returns the covariance matrix of L-moments or a list of covariance matrices if the input has multiple columns. The numerical accuracy of the results decreases with increasing rmax. With rmax > 5, a warning is thrown, as the numerical accuracy of the results is likely less than sqrt(.Machine\$double.eps).

shiftedlegendre returns a matrix of the coefficients of the shifted Legendre polynomials up to a given order.

Note

Functions Lmoments and Lcoefs calculate trimmed L-moments if you specify trim = c(1, 1). Lmoments_calc and Lmomcov_calc are internal C++ functions called by Lmoments and Lmomcov. The direct use of these functions is not recommended.

Author(s)

Juha Karvanen <juha.karvanen@iki.fi>, Santeri Karppinen

References

- Karvanen, J. 2006. Estimation of quantile mixtures via L-moments and trimmed L-moments, *Computational Statistics & Data Analysis* **51**, (2), 947–959. https://users.jyu.fi/~jutakarv/papers/Karvanen_quantile_mixtures.pdf.
- Elamir, E. A., Seheult, A. H. 2004. Exact variance structure of sample L-moments, *Journal of Statistical Planning and Inference* **124** (2) 337–359.
- Hosking, J. 1990. L-moments: Analysis and estimation distributions using linear combinations of order statistics, *Journal of Royal Statistical Society B* **52**, 105–124.

See Also

t1lmoments for trimmed L-moments, dnormpoly, lmom2normpoly4 and covnormpoly4 for the normal-polynomial quantile mixture and package **lmomco** for additional L-moment functions

Examples

```
#Generates a sample 500 observations from the normal-polynomial quantile mixture,
#calculates the L-moments and their covariance matrix,
#estimates parameters via L-moments and
#plots the true pdf and the estimated pdf together with the histogram of the data.
true_params <- lmom2normpoly4(c(0,1,0.2,0.05));
x <- rnormpoly(500,true_params);
lmoments <- Lmoments(x);
lmomcov <- Lmomcov(x);
estim_params <- lmom2normpoly4(lmoments);
hist(x,30,freq=FALSE)
plotpoints <- seq(min(x)-1,max(x)+1,by=0.01);
lines(plotpoints, dnormpoly(plotpoints,estim_params),col='red');
lines(plotpoints, dnormpoly(plotpoints,true_params),col='blue');
```

normpoly

Normal-polynomial quantile mixture

Description

Density, distribution function, quantile function and random generation for the normal-polynomial quantile mixture.

Usage

```
dnormpoly(x,param)
pnormpoly(x,param)
qnormpoly(cp,param)
rnormpoly(n,param)
normpoly_pdf(x,param)
normpoly_cdf(x,param)
normpoly_inv(cp,param)
normpoly_rnd(n,param)
```

Arguments

x	vector of quantiles
cp	vector of probabilities
n	number of observations
param	vector of parameters

Details

The length the parameter vector specifies the order of the polynomial in the quantile mixture. If $k < \text{length}(\text{param})$ then $\text{param}[1:(k-1)]$ contains the mixture coefficients of polynomials starting from the constant and $\text{param}[k]$ is the mixture coefficient for normal distribution. (Functions `normpoly_pdf`, `normpoly_cdf`, `normpoly_inv` and `normpoly_rnd` are aliases for compatibility with older versions of this package.)

Value

'dnormpoly' gives the density, 'pnormpoly' gives the cumulative distribution function, 'qnormpoly' gives the quantile function, and 'rnormpoly' generates random deviates.

Author(s)

Juha Karvanen <juha.karvanen@iki.fi>

References

Karvanen, J. 2006. Estimation of quantile mixtures via L-moments and trimmed L-moments, *Computational Statistics & Data Analysis* **51**, (2), 947–959. https://users.jyu.fi/~jutakarv/papers/Karvanen_quantile_mixtures.pdf.

See Also

[data2normpoly4](#) for the parameter estimation and [dcauchypoly](#) for the Cauchy-polynomial quantile mixture.

Examples

```
#Generates a sample 500 observations from the normal-polynomial quantile mixture,
#calculates L-moments and their covariance matrix,
#estimates parameters via L-moments and
#plots the true pdf and the estimated pdf together with the histogram of the data.
true_params <- lmom2normpoly4(c(0,1,0.2,0.05));
x <- rnormpoly(500,true_params);
lmoments <- Lmoments(x);
lmomcov <- Lmomcov(x);
estim_params <- lmom2normpoly4(lmoments);
hist(x,30,freq=FALSE)
plotpoints <- seq(min(x)-1,max(x)+1,by=0.01);
lines(plotpoints, dnormpoly(plotpoints,estim_params),col='red');
lines(plotpoints, dnormpoly(plotpoints,true_params),col='blue');
```

t1lmoments

Trimmed L-moments

Description

Calculates sample trimmed L-moments with trimming parameter 1.

Usage

```
t1lmoments(data, rmax = 4)
t1lmoments_calc(data, rmax = 4)
```

Arguments

data	matrix or data frame.
rmax	maximum order of trimmed L-moments.

Value

array of trimmed L-moments (trimming parameter = 1) up to order 4 containing a row for each variable in data.

Note

Functions `link{Lmoments}` and `link{Lcoefs}` calculate trimmed L-moments if you specify `trim = c(1, 1)`. `t1lmoments_calc` is an internal C++ function called by `t1lmoments`. The direct use of this function is not recommended.

Author(s)

Juha Karvanen <juha.karvanen@iki.fi>, Santeri Karppinen

References

Karvanen, J. 2006. Estimation of quantile mixtures via L-moments and trimmed L-moments, *Computational Statistics & Data Analysis* **51**, (2), 947–959. https://users.jyu.fi/~jutakarv/papers/Karvanen_quantile_mixtures.pdf.

Elamir, E. A., Seheult, A. H. 2003. Trimmed L-moments, *Computational Statistics & Data Analysis* **43**, 299–314.

See Also

[Lmoments](#) for L-moments, and [dcauchypoly](#) and [t1lmom2cauchypoly4](#) for the Cauchy-polynomial quantile mixture

Examples

```
#Generates 500 random variables from the Cauchy-polynomial quantile mixture,
#calculates the trimmed L-moments,
#estimates parameters via trimmed L-moments and
#plots the true pdf and the estimated pdf together with the histogram of the data.
true_params <- t1lmom2cauchypoly4(c(0,1,0.075,0.343));
x <- rcauchypoly(500,true_params);
t1lmom <- t1lmoments(x);
estim_params <- t1lmom2cauchypoly4(t1lmom);
plotpoints <- seq(-10,10,by=0.01);
histpoints <- c(seq(min(x)-1,-20,length.out=50),seq(-10,10,by=0.5),seq(20,max(x)+1,length.out=50));
hist(x,breaks=histpoints, freq=FALSE, xlim=c(-10,10));
lines(plotpoints, dcauchypoly(plotpoints, estim_params), col='red');
lines(plotpoints, dcauchypoly(plotpoints, true_params), col='blue');
```

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