Package: Lmoments (via r-universe)

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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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License GPL-2

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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<-length(param) then param[1:(k-1)] contains the mixture coefficients of polynomials starting from the constant and 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 *L-moments*

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<-length(param) then param[1:(k-1)] contains the mixture coefficients of polynomials starting from the constant and 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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