Package ‘extremogram’

October 8, 2016

Type Package

Title Estimation of Extreme Value Dependence for Time Series Data

Version 1.0.2

Date 2015-09-24

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Description Estimation of the sample univariate, cross and return time extremograms. The package can also adds empirical confidence bands to each of the extremogram plots via a permutation procedure under the assumption that the data are independent. Finally, the stationary bootstrap allows us to construct credible confidence bands for the extremograms.

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Imports boot(>= 1.3-11), MASS(>= 7.3-31), parallel(>= 3.1.1)

Depends R (>= 3.1.0)

NeedsCompilation no

Repository CRAN

Date/Publication 2016-10-08 08:48:07

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Description

The package estimates the sample univariate, cross and return time extremograms. It can also add empirical confidence bands to each of the extremogram plots via a permutation procedure under the assumption that the data are independent. Finally, the stationary bootstrap allows us to construct credible confidence bands for the extremograms.

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References


bootconf1  Confidence bands for the sample univariate extremogram

Description

The function estimates confidence bands for the sample univariate extremogram using the stationary bootstrap.

Usage

bootconf1(x, R, l, maxlag, quant, type, par, start = 1, cutoff = 1, alpha = 0.05)
Arguments

- **x**: Univariate time series (a vector).
- **R**: Number of bootstrap replications (an integer).
- **l**: Mean block size for stationary bootstrap or mean of the geometric distribution used to generate resampling blocks (an integer that is not longer than the length of the time series).
- **maxlag**: Number of lags to include in the extremogram (an integer).
- **quant**: Quantile of the time series to indicate an extreme event (a number between 0 and 1).
- **type**: Extremogram type (see function extremogram1).
- **par**: If par = 1, the bootstrap replication procedure will be parallelized. If par = 0, no parallelization will be used.
- **start**: The lag that the extremogram plots starts at (an integer not greater than maxlag, default is 1).
- **cutoff**: The cutoff of the y-axis on the plot (a number between 0 and 1, default is 1).
- **alpha**: Significance level for the confidence bands (a number between 0 and 1, default is 0.05).

Value

Returns a plot of the confidence bands for the sample univariate extremogram.

References


Examples

```r
# generate a GARCH(1,1) process
omega = 1
alpha = 0.1
beta = 0.6
n = 1000
quant = 0.95
type = 1
maxlag = 70
df = 3
R = 10
l = 30
par = 0
G = extremogram::garchsim(omega, alpha, beta, n, df)

extremogram1(G, quant, maxlag, type, 1, 1, 0)
bootconf1(G, R, l, maxlag, quant, type, par, 1, 1, 0.05)
```
Description

The function estimates confidence bands for the sample cross extremogram using the stationary bootstrap.

Usage

\texttt{bootconf2(x, R, l, maxlag, quant1, quant2, type, par, start = 1, cutoff = 1, alpha = 0.05)}

Arguments

- \texttt{x}: Bivariate time series (n by 2 matrix).
- \texttt{R}: Number of bootstrap replications (an integer).
- \texttt{l}: Mean block size for stationary bootstrap or mean of the geometric distribution used to generate resampling blocks (an integer that is not longer than the length of the time series).
- \texttt{maxlag}: Number of lags to include in the extremogram (an integer).
- \texttt{quant1}: Quantile of the first time series to indicate an extreme event (a number between 0 and 1).
- \texttt{quant2}: Quantile of the second series to indicate an extreme event (a number between 0 and 1).
- \texttt{type}: Extremogram type (see function \texttt{extremogram2}).
- \texttt{par}: If \texttt{par} = 1, the bootstrap replication procedure will be parallelized. If \texttt{par} = 0, no parallelization will be used.
- \texttt{start}: The lag that the extremogram plots starts at (an integer not greater than \texttt{maxlag}, default is 1).
- \texttt{cutoff}: The cutoff of the y-axis on the plot (a number between 0 and 1, default is 1).
- \texttt{alpha}: Significance level for the confidence bands (a number between 0 and 1, default is 0.05).

Value

Returns a plot of the confidence bands for the sample cross extremogram.

References

Examples

# generate a GARCH(1,1) process
omega = 1
alpha1 = 0.1
beta1 = 0.6
alpha2 = 0.11
beta2 = 0.78
n = 1000
quant = 0.95
type = 1
maxlag = 70
df = 3
R = 10
l = 30
par = 0
G1 = extremogram:::garchsim(omega, alpha1, beta1, n, df)
G2 = extremogram:::garchsim(omega, alpha2, beta2, n, df)
data = cbind(G1, G2)

extremogram2(data, quant, quant, maxlag, type, 1, 1, 0)
bootconf2(data, R, l, maxlag, quant, quant, type, par, 1, 1, 0.05)

bootconfr

Confidence bands for the sample return time extremogram

Description

The function estimates confidence bands for the sample return time extremogram using the stationary bootstrap.

Usage

bootconfr(x, R, l, maxlag, uplevel = 1, lowlevel = 0, type, par,
           start = 1, cutoff = 1, alpha = 0.05)

Arguments

- **x**: Univariate time series (a vector).
- **R**: Number of bootstrap replications (an integer).
- **l**: Mean block size for stationary bootstrap or mean of the geometric distribution used to generate resampling blocks (an integer that is not longer than the length of the time series).
- **maxlag**: Number of lags to include in the extremogram (an integer)
- **uplevel**: Quantile of the time series to indicate a upper tail extreme event (a number between 0 and 1, default is 1).
- **lowlevel**: Quantile of the time series to indicate a lower tail extreme event (a number between 0 and 1, default is 0).
extremogram1

- **type**: Extremogram type (see function `extremogram`).
- **par**: If par = 1, the bootstrap replication procedure will be parallelized. If par = 0, no parallelization will be used.
- **start**: The lag that the extremogram plots starts at (an integer not greater than maxlag, default is 1).
- **cutoff**: The cutoff of the y-axis on the plot (a number between 0 and 1, default is 1).
- **alpha**: Significance level for the confidence bands (a number between 0 and 1, default is 0.05).

**Value**

Returns a plot of the confidence bands for the sample return time extremogram.

**References**


**Examples**

```r
# generate a GARCH(1,1) process
omega = 1
alpha = 0.1
beta = 0.6
n = 1000
uplevel = 0.95
lowlevel = 0.05
type = 3
maxlag = 70
df = 3
R = 10
l = 30
par = 0
G = extremogram::garchsim(omega, alpha, beta, n, df)

extremogram(G, type, maxlag, uplevel, lowlevel, 1, 1)
bootconfr(G, R, l, maxlag, uplevel, lowlevel, type, par, 1, 1, 0.05)
```

---

**Description**

The function estimates the sample univariate extremogram and creates an extremogram plot.
Usage

extremogram1(x, quant, maxlag, type, ploting = 1, cutoff = 1, start = 0)

Arguments

x
Univariate time series (a vector).

quant
Quantile of the time series to indicate an extreme event (a number between 0 and 1).

maxlag
Number of lags to include in the extremogram (an integer).

type
Extremogram type. If type = 1, the upper tail extremogram is estimated. If type = 2, the lower tail extremogram is estimated.

ploting
An extremogram plot. If ploting = 1, a plot is created (default). If ploting = 0, no plot is created.

cutoff
The cutoff of the y-axis on the plot (a number between 0 and 1, default is 1).

start
The lag that the extremogram plots starts at (an integer not greater than maxlag, default is 0).

Value

Extremogram values and a plot (if requested).

References


Examples

# generate a GARCH(1,1) process
omega = 1
alpha = 0.1
beta = 0.6
n = 1000
quant = 0.95
type = 1
maxlag = 70
df = 3
G = extremogram::garchsim(omega, alpha, beta, n, df)

extremogram1(G, quant, maxlag, type, 1, 1, 0)
### extremogram2

**Sample cross extremogram**

#### Description
The function estimates the sample cross extremogram and creates an extremogram plot.

#### Usage

```r
extremogram2(a, quant1, quant2, maxlag, type, ploting = 1, cutoff = 1, start = 0)
```

#### Arguments

- `a` Bivariate time series (n by 2 matrix).
- `quant1` Quantile of the first time series to indicate an extreme event (a number between 0 and 1).
- `quant2` Quantile of the second time series to indicate an extreme event (a number between 0 and 1).
- `maxlag` Number of lags to include in the extremogram (an integer).
- `type` If type=1, the upper tail extremogram is estimated - P(Y>y,X>x). If type=2, the lower tail extremogram is estimated - P(Y<y,X<x). If type=3, the extremogram is estimated for a lower tail extreme value in the first time series and an upper tail extreme value in the second time series - P(Y<y,X<x). If type=4, the extremogram is estimated for a lower tail extreme value in the second time series and an upper tail extreme value in the first time series - P(Y<y,X>x).
- `ploting` An extremogram plot. If ploting = 1, a plot is created (default). If ploting = 0, no plot is created.
- `cutoff` The cutoff of the y-axis on the plot (a number between 0 and 1, default is 1).
- `start` The lag that the extremogram plots starts at (an integer not greater than `maxlag`, default is 0).

#### Value
Cross extremogram values and a plot (if requested).

#### References
Examples

```r
# generate a GARCH(1,1) process
omega = 1
alpha1 = 0.1
beta1 = 0.6
alpha2 = 0.11
beta2 = 0.78
n = 1000
quant = 0.95
type = 1
maxlag = 70
df = 3
G1 = extremogram:::garchsim(omega, alpha1, beta1, n, df)
G2 = extremogram:::garchsim(omega, alpha2, beta2, n, df)
data = cbind(G1, G2)

extremogramr(data, quant, quant, maxlag, type, 1, 1, 0)
```

---

**Sample return time extremogram**

**Description**

The function estimates the sample return time extremogram and creates an extremogram plot.

**Usage**

```r
extremogramr(x, type, maxlag, uplevel = 1, lowlevel = 0, histogram = 1, cutoff = 1)
```

**Arguments**

- `x` Univariate time series (a vector).
- `type` Extremogram type. If type = 1, the upper tail extremogram is estimated. If type = 2, the lower tail extremogram is estimated. If type = 3, both upper and lower tail extremogram is estimated.
- `maxlag` Number of lags to include in the extremogram (an integer).
- `uplevel` Quantile of the time series to indicate a upper tail extreme event (a number between 0 and 1, default is 1).
- `lowlevel` Quantile of the time series to indicate a lower tail extreme event (a number between 0 and 1, default is 0).
- `histogram` An extremogram plot. If histogram = 1, a plot is created (default). If histogram = 0, no plot is created.
- `cutoff` The cutoff of the y-axis on the plot (a number between 0 and 1, default is 1).
Value

Extremogram values, return time for extreme events, mean return time and a plot (if requested).

References


Examples

```r
# generate a GARCH(1,1) process
omega = 1
alpha = 0.1
beta = 0.6
n = 1000
uplevel = 0.95
lowlevel = 0.05
type = 3
maxlag = 70
df = 3
G = extremogram::garchsim(omega, alpha, beta, n, df)

extremogramr(G, type, maxlag, uplevel, lowlevel, 1, 1)
```

Description

The function estimates empirical confidence bands for the sample univariate extremogram via a permutation procedure under the assumption that the data are independent.

Usage

```r
permfn1(x, p, m, type, exttype, maxlag, start = 1, alpha = 0.05)
```

Arguments

- `x`: Univariate time series (a vector).
- `p`: Quantile of the time series to indicate an extreme event (a number between 0 and 1).
- `m`: Number of permutations (an integer).
- `type`: Type of confidence bands. If `type=1`, it adds all permutations to the sample extremogram plot. If `type=2`, it adds the alpha/2 and (1-alpha)/2 empirical confidence bands for each lag. If `type=3`, it calculates the lag 1 alpha/2 and (1-alpha)/2 empirical confidence bands lag and uses them for all of the lags.
exttype

Extremogram type (see extremogram1).

maxlag

Number of lags to include in the extremogram (an integer).

start

The lag that the extremogram plots starts at (an integer not greater than maxlag, default is 1).

alpha

Significance level for the confidence bands (a number between 0 and 1, default is 0.05).

Value

The empirical confidence bands are added to the sample univariate extremogram plot.

References


Examples

# generate a GARCH(1,1) process
omega  = 1
alpha  = 0.1
beta   = 0.6
n      = 1000
quant  = 0.95
exttype = 1
maxlag = 70
df     = 3
type   = 3
m      = 10
G = extremogram::garchsim(omega, alpha, beta, n, df)

extremogram1(G, quant, maxlag, exttype, 1, 1, 0)
permfn1(G, quant, m, type, exttype, maxlag, 1, 0.05)
Arguments

- **x**: Bivariate time series (n by 2 matrix).
- **p1**: Quantile of the first time series to indicate an extreme event (a number between 0 and 1).
- **p2**: Quantile of the second time series to indicate an extreme event (a number between 0 and 1).
- **m**: Number of permutations (an integer).
- **type**: Type of confidence bands. If type=1, it adds all permutations to the sample extremogram plot. If type=2, it adds the alpha/2 and (1-alpha)/2 empirical confidence bands for each lag. If type=3, it calculates the lag 1 alpha/2 and (1-alpha)/2 empirical confidence bands lag and uses them for all of the lags.
- **exttype**: Extremogram type (see extremogram2).
- **maxlag**: Number of lags to include in the extremogram (an integer).
- **start**: The lag that the extremogram plots starts at (an integer not greater than maxlag, default is 1).
- **alpha**: Significance level for the confidence bands (a number between 0 and 1, default is 0.05).

Value

The empirical confidence bands are added to the sample cross extremogram plot.

References


Examples

```r
# generate a GARCH(1,1) process
omega = 1
alpha1 = 0.1
beta1 = 0.6
alpha2 = 0.11
beta2 = 0.78
n = 1000
quant = 0.95
exttype = 1
maxlag = 70
df = 3
type = 3
m = 10
G1 = extremogram::garchsim(omega, alpha1, beta1, n, df)
G2 = extremogram::garchsim(omega, alpha2, beta2, n, df)
data = cbind(G1, G2)
```
**Description**

The function estimates empirical confidence bands for the sample return time extremogram via a permutation procedure under the assumption that the data are independent.

**Usage**

permfnr(x, m, type, exttype, maxlag, uplevel = 1, lowlevel = 0, start = 1, alpha = 0.05)

**Arguments**

- **x**: Univariate time series (a vector).
- **m**: Number of permutations (an integer).
- **type**: Type of confidence bands. If type=1, it adds all permutations to the sample extremogram plot. If type=2, it adds the alpha/2 and (1-alpha)/2 empirical confidence bands for each lag. If type=3, it calculates the lag 1 alpha/2 and (1-alpha)/2 empirical confidence bands lag and uses them for all of the lags.
- **exttype**: Extremogram type (see extremogram).
- **maxlag**: Number of lags to include in the extremogram (an integer).
- **uplevel**: Quantile of the time series to indicate a upper tail extreme event (a number between 0 and 1, default is 1).
- **lowlevel**: Quantile of the time series to indicate a lower tail extreme event (a number between 0 and 1, default is 0).
- **start**: The lag that the extremogram plots starts at (an integer not greater than maxlag, default is 1).
- **alpha**: Significance level for the confidence bands (a number between 0 and 1, default is 0.05).

**References**

Examples

# generate a GARCH(1,1) process
omega = 1
alpha = 0.1
beta = 0.6
n = 1000
uplevel = 0.95
lowlevel = 0.05
exttype = 3
maxlag = 70
type = 3
m = 10
df = 3
G = extremogram::garchsim(omega, alpha, beta, n, df)

extremogramr(G, type, maxlag, uplevel, lowlevel, 1, 1)
permfnr(G, m, type, exttype, maxlag, uplevel, lowlevel, 1, 0.05)
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