Package ‘evt0’

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Type Package

Title Mean of Order P, Peaks over Random Threshold Hill and High Quantile Estimates

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Depends R (>= 1.9.0), evd, stats

Description The R package proposes extreme value index estimators for heavy tailed models by mean of order \( p \) <DOI:10.1016/j.csda.2012.07.019>, peaks over random threshold <DOI:10.57805/revstat.v4i3.37> and a bias-reduced estimator <DOI:10.1080/00949655.2010.547196>. The package also computes moment, generalised Hill <DOI:10.2307/3318416> and mixed moment estimates for the extreme value index. High quantiles and value at risk estimators based on these estimators are implemented.

License GPL (>= 2)

BugReports https://github.com/lbelzile/evt0/issues/

NeedsCompilation no

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### Description

Computes extreme value index (EVI) estimate for heavy tailed models by mean of order \( p \) (MOP) and peaks over random threshold (PORT) Hill methodologies. Besides, also computes moment, generalised Hill and mixed moment estimates for EVI. Compute high quantile or value-at-risk (VaR) based on above EVI estimates.

### Author(s)

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### DPOT

**Duration based peaks over threshold value-at-risk forecast**

### Description

This function calculate the value-at-risk (VaR) forecast for the durations-based peaks over threshold (DPOT) models.

### Usage

```r
DPOT(x, cov=0.01, c=0.75, th=0.1, nd=1000)
```

### Arguments

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>x</td>
<td>Data vector.</td>
</tr>
<tr>
<td>cov</td>
<td>Coverage value, default is cov=0.01.</td>
</tr>
<tr>
<td>c</td>
<td>Tuning parameter, default is c=0.75.</td>
</tr>
<tr>
<td>th</td>
<td>Threshold value, default is th=0.1.</td>
</tr>
<tr>
<td>nd</td>
<td>Returns days, default is nd=1000.</td>
</tr>
</tbody>
</table>
**Details**

In financial time series a relation between the excesses and the durations between excesses is usually observed. Araujo Santos and Fraga Alves (2013) propose using this dependence to improve the risk forecasts with DPOT models. The computation method in DPOT() function is based on the work from Araujo Santos and Fraga Alves (2012).

**Value**

VaR forecast and also MLE estimates of shape and time scale parameters.

**Warning**

After running the function following message appears: In \(\log(1+\gamma/y/(\alpha_1*(1/x)^c))\): NaNs produced when the gamma is negative but the optimizer continue to other iterations choosing other values until it converge.

**Author(s)**

P. Araujo Santos <paulo.santos@esg.ipsantarem.pt>, M.I. Fraga Alves <isabel.alves@fc.ul.pt>

**References**


**Examples**

```r
#Read S&P500 from data file
data(S_P500)
str(S_P500)

# One day ahead VaR forecast
DPOT(S_P500$returns, 0.01, 0.75, 0.1, 1000)
```

**mop**

*Mean of order p statistic for the extreme value index*

**Description**

This function compute mean of order p (MOP) basic statistic for the extreme value index (EVI), which is indeed a simple generalisation of the Hill estimator.

**Usage**

```r
mop(x, k, p, method = c("MOP", "RBMOP"))
```
Arguments

x  Data vector.
k  a vector of number of upper order statistics.
p  a vector of mean order.
method  Method used, ("MOP", default) and reduced-bias MOP ("RBMOP").

Details

Basic statistics for the EVI estimation, the MOP of $U_{ik}$, where $U_{ik} = \frac{X_{n-i+n}}{X_{n-k:n}}$ and $X_{i:n}$ are order statistics, is

$$A(k) = \left( \frac{1}{k} \sum_{i=1}^{k} U_{ik}^{p} \right)^{1/p},$$

for $p \neq 0$.

The new class of MOP EVI-estimators is

$$H_{p}(k) = \left(1 - A^{-p}(k)\right)^{1/p},$$

for $p \neq 0$. At $p=0$ the above MOP estimator is equal to classical Hill estimator.

Reduced bias MOP EVI-estimators is

$$RBA(k) = H_{p}(k)(1 - \frac{\beta(1 - pH_{p}(k))}{1 - \frac{n}{K}})^{1/p}. $$

Value

A matrix of EVI estimates, corresponds to k row and p columns. When Method = "RBMOP" shape and scale second order parameters estimates are also returned.

Author(s)

B G Manjunath <bgmanjunath@gmail.com>, Frederico Caeiro <fac@fct.unl.pt>

References


Examples

```r
# generate random samples
x = rfrechet(50000, loc = 0, scale = 1, shape = 1/0.5)

# estimate EVI
mop(x, c(1,500,5000,49999), c(-1,0,1),"RBMOP")
```
Description
This function computes asymptotic relative efficiency of mean of order p (MOP) with respect to classical Hill estimator.

Usage
mop.AREFF(x, k, p)

Arguments
x  Data vector.
k  a vector of number of upper order statistics.
p  a vector of mean order.

Details
Given two biased estimators MOP and Hill, the asymptotic root efficiency (AREFF) of MOP relatively to Hill is given in Brilhante et al. (2013). Note that highest the AREFF indicator the better is the MOP estimator.

Value
a matrix of asymptotic relative efficiency estimates, corresponds to k row and p columns.

Author(s)
B G Manjunath <bgmanjunath@gmail.com>

References

See Also
mop

Examples
# generate random samples
x = rfrechet(50000, loc = 0, scale = 1, shape = 1)

# estimate AREFF
mop.AREFF(x, c(1, 500, 5000, 49999), c(-1, 0, 0.1))
Description

This function computes estimate of high quantile or value-at-risk (VAR) using mean of order p (MOP) method.

Usage

mop.q(x, k, p, q, method = c("MOP", "RBMOP"))

Arguments

- x: Data vector.
- k: a vector of number of upper order statistics.
- p: a vector of mean order.
- q: quantile level.
- method: Method used, ("MOP", default) and reduced-bias MOP ("RBMOP").

Details

For heavy tails, Gomes et al. (2013) introduces a new class of high quantile estimators based on a class of mean of order p (MOP) extreme value index (EVI) estimators is given by

\[ Q(k) = \left( X_{n-k:n} \right) (k/nq)^{H_p(k)}, \]

where \( H_p(k) \) is MOP EVI estimator and \( X_{i:n} \) is order statistic.

Value

A matrix of EVI and VaR estimates, corresponds to k row and p columns. When Method = "RBMOP" shape and scale second order parameters estimates are also returned.

Author(s)

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References


other.EVI

See Also

mop

Examples

  # generate random samples
  x = rfrechet(50000, loc = 0, scale = 1, shape = 1/0.5)

  # estimate EVI and high quantile at level q
  mop.q(x, c(1, 500, 5000, 49999), c(-1, 0, 1), 0.5, "RBMOP")

other.EVI

Other extreme value index estimates

Description

This function computes moment (MO), generalized Hill (GH) and mixed moment (MM) estimates for extreme value index (EVI).

Usage

other.EVI(x, k, method = c("MO", "GH", "MM"))

Arguments

  x Data vector.
  k a vector of number of upper order statistics.
  method Method used, moment estimate("MO", default), generalized Hill ("GH") and mixed moment ("MM").

Details

Computation of moment and generalized Hill and mixed moment EVI estimators are based on the articles by Dekkers et al. (1989), Beirlant et al. (1996) and Fraga Alves et al. (2009), respectively.

Value

a k dimensional vector of EVI estimates.

Author(s)

B G Manjunath <bgmanjunath@gmail.com>, Frederico Caeiro <fac@fct.unl.pt>
References


Examples

```r
# generate random samples
x = rfrechet(50000, loc = 0, scale = 1, shape = 1/0.5)

# estimate EVI
other.EVI(x,c(500,5000,40000),"MO")
```

---

**other.q**

*Other methods for high quantile estimate*

**Description**

This function computes high quantile or value-at-risk (VaR) estimate based on moment (MO), generalized Hill (GH) and mixed moment (MM) extreme value index (EVI) estimates.

**Usage**

```r
other.q(x, k, q, method = c("MO", "GH", "MM"))
```

**Arguments**

- `x` : Data vector.
- `k` : a vector of number of upper order statistics.
- `q` : quantile level.
- `method` : Method used, moment estimate("MO", default), generalized Hill ("GH") and mixed moment ("MM").

**Details**

The computation of estimate of high quantile or VaR is based on moment, generalized Hill and mixed moment EVI estimators and the computation of EVI estimators are related to the work by Dekkers et al. (1989), Beirlant et al. (1996) and Fraga Alves et al. (2009).

**Value**

a k dimensional vector of EVI and high quantile estimates.
Author(s)

B G Manjunath <bgmanjunath@gmail.com>

References


See Also

other.EVI

Examples

```r
# generate random samples
x = rfrechet(50000, loc = 0, scale = 1, shape = 1/0.5)

# estimate EVI and high quantile at level q
other.q(x, c(500, 5000, 40000), 0.5, "MO")
```

Description

This function computes peaks over random threshold (PORT) high quantile or value-at-risk (VaR) based on moment (MO), generalized Hill (GH) and mixed moment (MM) extreme value index (EVI) estimates.

Usage

```r
otherPORT.q(x, k, q1, q2, method = c("MO", "GH", "MM"))
```

Arguments

- `x`: Data vector.
- `k`: a vector of number of upper order statistics.
- `q1`: quantile for PORT.
- `q2`: quantile level.
- `method`: Method used, moment estimate("MO", default), generalized Hill ("GH") and mixed moment ("MM").
Details

The computation of high quantile estimate is based on the method by Weissman (1978) and the EVI estimators are given in Dekkers et al. (1989), Beirlant et al. (1996) and Fraga Alves et al. (2009).

Value

a k dimensional vector of PORT EVI and high quantile estimates.

Author(s)

B G Manjunath <bgmanjunath@gmail.com>

References


See Also

other.EVI

Examples

# generate random samples
x = rfrechet(50000, loc = 0, scale = 1, shape = 1/0.5)

# estimate PORT EVI and high quantile at level q2
otherPORT.q(x,c(500,5000),0.1,0.5,"MO")

---

PORT.Hill

*Peaks over random threshold Hill estimate*

Description

This function performs peaks over random threshold (PORT) Hill methodology for estimating extreme value index (EVI) for heavy tailed models.
PORT.Hill

Usage

PORT.Hill(x, k, q, method = c("PMOP", "PRBMOP"))

Arguments

x  Data vector.

k  a vector of number of upper order statistics.

q  quantile for PORT.

method  Method used, ("PMOP", default) and reduced-bias PMOP ("PRBMOP").

Details

The computation of PORT Hill estimator is based on the work by Araujo Santos et al. (2006). Reduced biased PORT Hill computation is based on quasi-PORT methodology, see Gomes et al.

Value

a k dimensional vector of PORT Hill estimates. When Method = "RBMOH" shape and scale second order parameters estimates are also returned.

Author(s)

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References


Examples

# generate random samples
x = rfrechet(50000, loc = 0, scale = 1, shape = 1/0.5)

# estimate PORT Hill
PORT.Hill(x,c(1,500,5000),0.1,"PRBMOP")
PORT.q

Peaks over random threshold high quantile estimate

Description

This function computes high quantile or value-at-risk (VaR) estimate based on peaks over random threshold (PORT) Hill extreme value index (EVI) estimate.

Usage

PORT.q(x, k, q1, q2, method = c("PMOP", "PRBMOP"))

Arguments

x
Data vector.

k
a vector of number of upper order statistics.

q1
quantile for PORT.

q2
quantile level.

method
Method used, ("PMOP", default) and reduced-bias PMOP ("PRBMOP").

Details

The computation of the high quantile estimate is based on the work by Gomes et al. (2006).

Value

a k dimensional vector of PORT Hill and high quantile estimates. When Method = "RBMO" shape and scale second order parameters estimates are also returned.

Author(s)

B G Manjunath <bgmanjunath@gmail.com>

References


See Also

PORT.Hill
Examples

# generate random samples
x = rfrechet(50000, loc = 0, scale = 1, shape = 1/0.5)

# estimate PORT Hill and quantile at level q2
PORT.q(x,c(1,500,5000),0.1,0.5,"PRBMOP")

---

Description


Usage

data(S_P500)

Format

A data frame with 6984 observations on the following variable.

returns a numeric vector

Details


Examples

data(S_P500)
str(S_P500)
plot(S_P500$returns)
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