Package ‘distTails’

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Title A Collection of Full Defined Distribution Tails

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Description A full definition for Weibull tails and Full-Tails Gamma and tools for fitting these distributions to empirical tails. This package build upon the paper by del Castillo, Joan & Daoudi, Jalila & Serra, Isabel. (2012) <doi:10.1017/asb.2017.9>.

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Description

This function computes the density of the full-tail gamma with the input sample data. The expression for the density used is:

\[
g(x; \alpha, \theta, \rho) = \frac{\rho^\alpha}{\sigma} \left(\frac{x}{\sigma}\right)^{\alpha-1} \exp\left(-\left(\frac{x}{\sigma} + \rho\right)\right) / \Gamma(\alpha, \rho).
\]

Usage

dFTG(x, threshold, scale, shape)

Arguments

- **x**: Sample data.
- **threshold**: Minimum value of the tail.
- **scale**: Scale parameter.
- **shape**: Shape parameter.

Value

Gives the density of the FTG. The length of the result is determined by the length of x.

References


Examples

```r
a <- 0.3
t <- 0.3
r <- 0.8
n <- 1000
sample <- rFTG(n, a, t, r)
x <- seq(min(sample), max(sample), length.out = 200)
d <- dFTG(x, a, t, r)
hist(sample, breaks = "FD", probability = TRUE)
lines(x, d, col = "red")
```
dtailw

**TailW Density function**

**Description**

This function computes the density of the tailW with the input sample data. The expression for the density used is:

\[ f(x, \alpha, \beta, \nu) = \alpha \beta (x + \nu)^{\beta - 1} \exp(-\alpha (x + \nu)^\beta + \alpha \nu^\beta) \]

**Usage**

`dtailw(x, threshold, scale, shape)`

**Arguments**

- `x`: Sample data.
- `threshold`: Minimum value of the tail.
- `scale`: Scale parameter.
- `shape`: Shape parameter.

**Value**

Gives the density of the TailW. The length of the result is determined by the length of `x`.

**Examples**

```r
# Generate random deviates from a weibull tail and plot the theoretical density.
scale <- 2
shape <- 1
threshold <- 1
x_seq <- seq(threshold, 5, length.out = 500)
theo_density <- dtailw(x_seq, threshold = threshold, scale = scale, shape = shape)
sample <- rtailw(500, threshold = threshold, scale = scale, shape = shape)
hist(sample, probability = TRUE)
lines(x = x_seq, y = theo_density, col = "red")
```

fittail

**TailW Maximum Likelihood Estimation**

**Description**

Maximum Likelihood Estimation of the tails by fitting a tailW or a FTG.

**Usage**

`fittail(sample, dist = "TailW")`
Arguments

sample  Sample data.
dist  Name of the distribution to fit.

Value

Gives a list of the estimated parameters for the function fitted. For the TailW it returns, scale and shape. For the FTG it returns the parameters scale, shape, and threshold.

Examples

scale <- 2
shape <- 1
threshold <- 1
s <- rtailw(1000, threshold = threshold, scale = scale, shape = shape)
fits <- fittail(s, dist = "TailW")
x_seq <- seq(threshold, max(s), length.out = 500)
theo_density <- dtailw(x_seq, threshold = threshold, scale = fits$scale, shape = fits$shape)
hist(s, probability = TRUE, breaks = "FD")
lines(x = x_seq, y = theo_density, col = "red")

lFTG

FTG Log-likelihood Function

Description

This function computes the loglikelihood of the full-tail gamma with the input sample data. The expression used is:

\[
l(x; \alpha, \sigma, \rho) = -n \left( \log \Gamma(\alpha, \rho) + \log(\sigma) - \alpha \log(\rho) - \frac{\alpha - 1}{n} \sum_{i=1}^{n} \log \left( 1 + \frac{x_i}{\sigma} \right) + \frac{\rho}{n} \sum_{i=1}^{n} \left( 1 + \frac{x_i}{\sigma} \right) \right)
\]

Usage

lFTG(x, threshold, scale, shape)

Arguments

x  Sample data.
threshold  Minimum value of the tail.
scale  Scale parameter.
shape  Shape parameter.

Value

Gives the log-likelihood of the FTG. The length of the result is determined by the length of x.
References


Examples

```r
lFTG(1,1,1,1)
```

**ltailw**  
*TailW Log-likelihood function*

**Description**

This function computes the log-likelihood of the tailW with the input sample data.

\[
l(x; \alpha, \beta) = n(\log(\alpha) + \log(\beta)) + (\beta - 1) \sum_{i=1}^{n} \log(x + \nu) - \alpha \sum_{i=1}^{n} ((x + \nu)^{\beta} - \nu^{\beta})
\]

**Usage**

```r
ltailw(x, threshold, scale, shape)
```

**Arguments**

- `x`  
  Sample data.

- `threshold`  
  Minimum value of the tail.

- `scale`  
  Scale parameter.

- `shape`  
  Shape parameter.

**Value**

Gives the log-likelihood of the TailW. The length of the result is determined by the length of `x`.

**Examples**

```r
ltailw(1,1,1,1)
```
Description

This function computes the probability of the full-tail gamma with the input sample data. The expression for the probability used is:

$$G(x; \alpha, \theta, \rho) = 1 - \frac{\Gamma(\alpha, \rho \left(1 + \frac{x}{\sigma}\right))}{\Gamma(\alpha, \rho)}.$$  

Usage

`pFTG(x, threshold, scale, shape)`

Arguments

- `x`: Sample data.
- `threshold`: Minimum value of the tail.
- `scale`: Scale parameter.
- `shape`: Shape parameter.

Value

Gives the distribution function of the FTG. The length of the result is determined by the length of `x`.

References


Examples

`pFTG(1,1,1,1)`
**ptailw**

*TailW Probability Function*

**Description**

This function computes the cumulative density function of the tailW with the input sample data.

\[ F(x, \alpha, \beta, \nu) = 1 - \exp(-\alpha(x + \nu)^2 + \alpha \nu^2). \]

**Usage**

\[ \text{ptailw}(x, \text{threshold}, \text{scale}, \text{shape}) \]

**Arguments**

- \(x\) Sample data.
- \(\text{threshold}\) Minimum value of the tail.
- \(\text{scale}\) Scale parameter.
- \(\text{shape}\) Shape parameter.

**Value**

Gives the distribution function of the TailW. The length of the result is determined by the length of \(x\).

**Examples**

```r
# Using the probability function to show the fitting.
samp <- rtailw(1000, 1, 2, 3)
emp_cdf <- ecdf(samp)(samp)
pars <- fittail(samp, dist = "TailW")
x_seq <- seq(min(samp), max(samp), length.out = 250)
p <- ptailw(x_seq, threshold = 1, scale = pars$scale, shape = pars$shape)
plot(samp, 1-emp_cdf, log = "y")
lines(x_seq, 1-p, col = "red")
```

**qFTG**

*FTG Quantile function*

**Description**

This function computes the quantiles of the full-tail gamma with the input sample data.

**Usage**

\[ \text{qFTG}(p, \text{threshold}, \text{scale}, \text{shape}, \text{interval}) \]
Arguments

\( p \)  
Probability.

threshold  
Minimum value of the tail.

scale  
Scale parameter.

shape  
Shape parameter.

interval  
a vector containing the end-points of the interval to be searched for the minimum.

Value

Gives the quantiles of the FTG. The length of the result is determined by the length of x.

References


Examples

\( q_{\text{FTG}}(0.5,1,1,1, c(0,10)) \)

---

\texttt{qtailw}   \quad \textit{Quantile function}

Description

This function computes the quantile function of the tailW.

\[
Q(p, \alpha, \beta, \nu) = \left( \frac{-\log(1 - p)}{\alpha} + \nu^\beta \right)^{1/\beta}
\]

Usage

\texttt{qtailw}(p, threshold, scale, shape)

Arguments

\( p \)  
Probability.

threshold  
Minimum value of the tail.

scale  
Scale parameter.

shape  
Shape parameter.

Value

Gives the quantiles of the TailW. The length of the result is determined by the length of x.
rFTG

Examples

qtailw(0.5, 1, 1, 1)

rFTG FTG Random Sample Generation

Description

This function computes n random variates from full-tail gamma with a rejection method.

Usage

rFTG(n, threshold, scale, shape)

Arguments

n Sample size.
threshold Minimum value of the tail.
scale Scale parameter.
shape Shape parameter.

Value

Gives random deviates of the FTG. The length of the result is determined by n.

References


Examples

x <- rFTG(100, 1, 1, 1)
hist(x, breaks = "FD")
Description

This function generates random deviates for the tailW distribution.

Usage

rtailw(n, threshold, scale, shape)

Arguments

n    Sample size.
threshold    Minimum value of the tail.
scale    Scale parameter.
shape    Shape parameter.

Value

Gives random deviates of the TailW. The length of the result is determined by n.

Examples

x <- rtailw(1000, 1, 2, 3)
hist(x, breaks = "FD")
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