Package: distTails (via r-universe)

October 8, 2024

Title A Collection of Full Defined Distribution Tails

Version 1.0.0

Description A full definition for Weibull tails and Full-Tails Gamma
and tools for fitting these distributions to empirical tails.
This package builds upon the papers by del Castillo, Joan &
Daoudi, Jalila & Serra, Isabel. (2012) <doi:10.1017/asb.2017.9> and Vilardell, Sergi & Serra, Isabel &
Abella, Jaume & del Castillo, Joan & Cazorla, Francisco.
(2019). Software Timing Analysis for Complex Hardware with
Survivability and Risk Analysis. 227-
236. <doi:10.1109/ICCD46524.2019.00036>. This work has been supported by
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Depends R (>= 3.6.0)

URL https://github.com/SergiVilardell/distTails

License GPL-3

Encoding UTF-8

LazyData true

RoxygenNote 7.1.1

Imports ercv, gsl, MASS

Suggests knitr, rmarkdown

VignetteBuilder knitr

Repository https://sergivilardell.r-universe.dev

RemoteUrl https://github.com/sergivilardell/disttails

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`dFTG` *FTG Density Function*

Description

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

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

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

del Castillo, Joan & Daoudi, Jalila & Serra, Isabel. (2012). The full-tails gamma distribution applied to model extreme values. ASTIN Bulletin. <doi:10.1017/asb.2017.9>.

Examples

```
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.

References

Vilardell, Sergi & Serra, Isabel & Abella, Jaume & del Castillo, Joan & Cazorla, Francisco. (2019). Software Timing Analysis for Complex Hardware with Survivability and Risk Analysis. 227-236. <doi:10.1109/ICCD46524.2019.00036>.

Examples

```
# 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 fo the function fitted. For the TailW it returns, scale and shape. Fot 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

del Castillo, Joan & Daoudi, Jalila & Serra, Isabel. (2012). The full-tails gamma distribution applied to model extreme values. ASTIN Bulletin. <doi:10.1017/asb.2017.9>.

Examples

```
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

```
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.

References

Vilardell, Sergi & Serra, Isabel & Abella, Jaume & del Castillo, Joan & Cazorla, Francisco. (2019). Software Timing Analysis for Complex Hardware with Survivability and Risk Analysis. 227-236. <doi:10.1109/ICCD46524.2019.00036>.

Examples

```
ltailw(1,1,1,1)
```

pFTG *FTG Probability Function*

Description

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

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

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

del Castillo, Joan & Daoudi, Jalila & Serra, Isabel. (2012). The full-tails gamma distribution applied to model extreme values. ASTIN Bulletin. <doi:10.1017/asb.2017.9>.

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.

$$F(x, \alpha, \beta, \nu) = 1 - \exp(-\alpha(x + \nu)^{\beta} + \alpha\nu^{\beta}).$$

Usage

```
ptailw(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 TailW. The length of the result is determined by the length of x.

References

Vilardell, Sergi & Serra, Isabel & Abella, Jaume & del Castillo, Joan & Cazorla, Francisco. (2019). Software Timing Analysis for Complex Hardware with Survivability and Risk Analysis. 227-236. <doi:10.1109/ICCD46524.2019.00036>.

Examples

```
# 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

```
qFTG(p, threshold, scale, shape, 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

del Castillo, Joan & Daoudi, Jalila & Serra, Isabel. (2012). The full-tails gamma distribution applied to model extreme values. ASTIN Bulletin. <doi:10.1017/asb.2017.9>.

Examples

```
qFTG(0.5,1,1,1, c(0,10))
```

qtailw *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

```
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.

References

Vilardell, Sergi & Serra, Isabel & Abella, Jaume & del Castillo, Joan & Cazorla, Francisco. (2019). Software Timing Analysis for Complex Hardware with Survivability and Risk Analysis. 227-236. <doi:10.1109/ICCD46524.2019.00036>.

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

del Castillo, Joan & Daoudi, Jalila & Serra, Isabel. (2012). The full-tails gamma distribution applied to model extreme values. ASTIN Bulletin. <doi:10.1017/asb.2017.9>.

Examples

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

`rtailw` *TailW Random Sample Generation*

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.

References

Vilardell, Sergi & Serra, Isabel & Abella, Jaume & del Castillo, Joan & Cazorla, Francisco. (2019). Software Timing Analysis for Complex Hardware with Survivability and Risk Analysis. 227-236. <doi:10.1109/ICCD46524.2019.00036>.

Examples

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

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