

# Package ‘distTails’

October 13, 2022

**Title** A Collection of Full Defined Distribution Tails

**Version** 0.1.2

**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>.

**Depends** R (>= 3.6.0)

**URL** <https://github.com/SergiVilardell/distTails>

**License** GPL-3

**Encoding** UTF-8

**LazyData** true

**RoxygenNote** 6.1.1

**Imports** ercv, gsl, MASS

**NeedsCompilation** no

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**Repository** CRAN

**Date/Publication** 2019-09-07 08:50:02 UTC

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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")
```

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dtailw	<i>TailW Density function</i>
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**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**

```
# 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")
```

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fittail	<i>TailW Maximum Likelihood Estimation</i>
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**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")
```

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 1FTG

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*FTG Log-likelihood Function*


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**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**

```
1FTG(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)
```

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<code>ltailw</code>	<i>TailW Log-likelihood function</i>
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**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**

<code>x</code>	Sample data.
<code>threshold</code>	Minimum value of the tail.
<code>scale</code>	Scale parameter.
<code>shape</code>	Shape parameter.

**Value**

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

**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)
```

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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.

### 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*

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### 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))
```

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qtailw	<i>Quantile function</i>
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**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.

**Examples**

```
qtailw(0.5, 1, 1, 1)
```

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rFTG

*FTG Random Sample Generation*

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**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**

<code>n</code>	Sample size.
<code>threshold</code>	Minimum value of the tail.
<code>scale</code>	Scale parameter.
<code>shape</code>	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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