Package 'TLCAR'

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Type Package

Title Computation of Topp-Leone Cauchy Rayleigh (TLCAR) distribution's properties

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Description
Provides a comprehensive suite of statistical tools for analyzing, simulating, and computing properties of the Topp-Leone Cauchy Rayleigh (TLCAR) distribution, a versatile distribution amalgamating features of the Topp-Leone, Cauchy, and Rayleigh distributions, ideal for modeling intricate, heterogeneous data across scientific domains. See Atchadé, M.N., Bogninou, M.J., and Djibril, A.M. (2023) <doi:10.1007/s44199-023-00066-4> and Atchadé, M.N., Bogninou, M.J., and Djibril, A.M. (2024) <doi:10.1007/s44199-023-00069-1> for further insights.

Depends R (>= 3.6.0),stats,dplyr,ggplot2

Suggests knitr,rmarkdown,testthat (>= 3.0.0)

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LazyData true

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VignetteBuilder knitr

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R topics documented:

`ConductorFailureTimes` *Dataset: ConductorFailureTimes*

Description

This dataset contains failure times measured in hours from an accelerated life test with 59 conductors.

Usage

```
data(ConductorFailureTimes)
```

Format

A numeric vector of failure times.

Details

This dataset contains failure times (measured in hours) obtained from an accelerated life test involving 59 conductors. The data are presented as a numeric vector.

References

Nasiri, B., et al. (2010). "Bayesian analysis of the accelerated life model with Type-II censoring." Journal of Statistical Planning and Inference, 140(6), 1565-1572.

Schafft, H. A., et al. (1987). "Reproducibility of the accelerated test for electric cable insulation." IEEE Transactions on Electrical Insulation, 22(5), 739-746.

cTLCAR *Cumulative Distribution Function (CDF) for the TLCAR Distribution*

Description

Calculate the cumulative distribution at a given value using the TLCAR distribution.

Usage

```
cTLCAR(x, alpha, a, b, theta, m)
```

Arguments

x	Value at which to calculate the CDF.
alpha	Parameter representing the distribution of the Topp-Leone component.
a	Parameter representing the scale (a) of the Cauchy component.
b	Parameter representing the position (b) of the Cauchy component.
theta	Parameter representing the scale of the Rayleigh component.
m	Additional parameter.

Details

The cumulative distribution function (CDF) for the TLCAR distribution is defined as follows:

$$F(x) = \left[1 - \left(\frac{1}{2} - \frac{1}{\pi}\arctan\frac{x\left(1 - e^{-\frac{x^2}{2\theta^2}} + m\right) - b}{a}\right)^2\right]^{\alpha}$$

Value

Cumulative distribution at the given value.

Examples

```
cTLCAR(x = 1, alpha = 1, a = 1, b = 0, theta = 2, m = 0.5)
```

dTLCAR *Probability Density Function (PDF) for the TLCAR Distribution*

Description

Calculate the probability density at a given value using the TLCAR distribution.

Usage

```
dTLCAR(x, alpha, a, b, theta, m)
```

Arguments

x	Value at which to calculate the PDF.
alpha	Parameter representing the distribution of the Topp-Leone component.
a	Parameter representing the scale (a) of the Cauchy component.
b	Parameter representing the position (b) of the Cauchy component.
theta	Parameter representing the scale of the Rayleigh component.
m	Additional parameter.

Details

The probability density function (PDF) for the TLCAR distribution is defined as follows:

$$f(x) = \frac{2\alpha}{\pi a}\left[\frac{1+\left(\frac{x^2}{\theta^2}-1\right)e^{-\frac{x^2}{2\theta^2}}+m}{1+\left(\frac{x\left(1-e^{-\frac{x^2}{2\theta^2}}+m\right)-b}{a}\right)^2}\right]\left[\frac{1}{2}-\frac{1}{\pi}\arctan\frac{x\left(1-e^{-\frac{x^2}{2\theta^2}}+m\right)-b}{a}\right]\left[1-\left(\frac{1}{2}-\frac{1}{\pi}\arctan\frac{x\left(1-e^{-\frac{x^2}{2}}\right.\right.\right.$$

Value

Probability density at the given value.

Examples

```
dTLCAR(x = 1, alpha = 1, a = 1, b = 0, theta = 2, m = 0.5)
```

fTLCAR *Estimate parameters for the TLCAR distribution using maximum likelihood.*

Description

This function estimates the parameters of the TLCAR distribution while respecting the constraints on the parameters.

Usage

```
fTLCAR(data)
```

Arguments

data	Numeric vector of data values.

Value

Numeric vector of estimated parameters.

Examples

```
data(ConductorFailureTimes)
estimated_params <- fTLCAR(ConductorFailureTimes)
```

ploTLCAR *Graphical Plot of the TLCAR Distribution*

Description

Generate a graphical plot of the probability density function (PDF) or cumulative distribution function (CDF) for the TLCAR distribution.

Usage

```
ploTLCAR(x, alpha, a, b, theta, m, type = "pdf")
```

Arguments

x	The range of values to plot the distribution.
alpha	Parameter representing the distribution of the Topp-Leone component.
a	Parameter representing the scale (a) of the Cauchy component.
b	Parameter representing the position (b) of the Cauchy component.
theta	Parameter representing the scale of the Rayleigh component.
m	Additional parameter.
type	The type of plot to generate: "pdf" for PDF plot, "cdf" for CDF plot.

Value

A graphical plot of the TLCAR distribution.

Examples

```
ploTLCAR(x = seq(0, 10, by = 0.1), alpha = 0.5, a = 1, b = 0, theta = 2, m = 1, type = "pdf")
```

---

qTLCAR *Quantile function for TLCAR distribution*

Description

Calculate the quantile value for a given probability using the TLCAR distribution.

Usage

```
qTLCAR(p, alpha, a, b, theta, m)
```

Arguments

p	Probability value (between 0 and 1).
alpha	Parameter representing the distribution of the Topp-Leone component.
a	Parameter representing the scale (a) of the Cauchy component.
b	Parameter representing the position (b) of the Cauchy component.
theta	Parameter representing the scale of the Rayleigh component.
m	Additional parameter.

Value

Numeric value representing the quantile.

Examples

```
qTLCAR(p = 0.5, alpha = 1, a = 1, b = 0, theta = 3, m = 1)
```

rTLCAR *Generate a random sample from the TLCAR distribution*

Description

Generate a random sample from the TLCAR distribution using the quantile function.

Usage

```
rTLCAR(n, alpha, a, b, theta, m)
```

Arguments

n	Number of observations in the sample.
alpha	Parameter representing the distribution of the Topp-Leone component.
a	Parameter representing the scale (a) of the Cauchy component.
b	Parameter representing the position (b) of the Cauchy component.
theta	Parameter representing the scale of the Rayleigh component.
m	Additional parameter.

Value

Random sample from the TLCAR distribution.

Examples

```
# Generate a random sample with 100 observations using estimated parameters
sample <- rTLCAR(n = 100, alpha = 1, a = 1, b = 0, theta = 3, m = 1)
```

sTLCAR *Estimate parameters with constraints and plot histogram with estimated density*

Description

This function estimates the parameters of the TLCAR distribution while respecting the constraints on the parameters. It plots the histogram of the data along with the estimated density curve.

Usage

```
sTLCAR(data)
```

Arguments

data	Numeric vector of data values.

Value

Numeric vector of estimated parameters.

Examples

```
data(ConductorFailureTimes)
sTLCAR(ConductorFailureTimes)
```

---

temp_var *Temporary Variable Calculation*

Description

This function calculates a temporary variable used in the TLCAR distribution density function.

Usage

```
temp_var(x, theta, a, b, m)
```

Arguments

x	Numeric vector of values at which to calculate the temporary variable.
theta	Parameter representing the scale of the Rayleigh component.
a	Parameter representing the scale (a) of the Cauchy component.
b	Parameter representing the position (b) of the Cauchy component.
m	Additional parameter.

Value

Numeric vector of calculated temporary variable values

Tree_diameters *Dataset: Tree_diameters*

Description

This dataset contains tree diameter measurements (in cm) for Teak trees in the Agrimey sector in Benin.

Usage

```
data(Tree_diameters)
```

Format

A numeric vector of tree diameter measurements (in cm).

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