Package 'gofLorenz'

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Type Package

Title Goodness-of-Fit Tests for Location-Scale Distributions via Lorenz Curve

Version 0.1.0

Description Implements goodness-of-fit test statistics and graphical methods for symmetric and asymmetric location-scale distributions under progressive Type-II censoring using the modified Lorenz curve and ratio modified sample Lorenz curve, as proposed by Lee (2024) <doi:10.3390/sym16020202>. Also provides order statistics distance test statistics based on Pakyari and Balakrishnan (2013) <doi:10.1080/00949655.2011.625424>. Supports calculation of test statistics, Monte Carlo p-values, critical values, and L-plot visual diagnostics for complete and progressively Type-II censored data.

License GPL (>= 3)

Encoding UTF-8

LazyData true

RoxygenNote 7.3.3

Depends R (>= 4.0.0)

Imports stats, graphics

Suggests testthat (>= 3.0.0), knitr, rmarkdown

VignetteBuilder knitr

NeedsCompilation no

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Contents

`breaking_strength` *Breaking Strength Data under Progressive Type-II Censoring*

Description

A dataset containing failure times of breaking strength data under progressive Type-II censoring from Nelson (1982) and King (1971), analyzed in Lee (2024) (Example 1).

Usage

```
breaking_strength
```

Format

A list with components:

x Numeric vector of 8 observed failure times.

n Total sample size (20).

m Observed failures (8).

R Progressive censoring scheme (0, 4, 1, 3, 0, 2, 0, 2).

References

Lee, K. (2024). A New Test Statistic to Assess the Goodness of Fit of Location-Scale Distribution Based on Progressive Censored Data. *Symmetry*, 16(2), 202. doi:10.3390/sym16020202

Nelson, W. (1982). *Applied Life Data Analysis*. John Wiley & Sons, New York.

King, J. R. (1971). *Probability Charts for Decision Making*. Industrial Press, New York.

Examples

```
data(breaking_strength)
gof_lorenz(
  x = breaking_strength$x,
  n = breaking_strength$n,
  m = breaking_strength$m,
  R = breaking_strength$R,
  dist = "norm",
  mc_rep = 100
)
```

`calc_lorenz_stats` *Compute Lorenz Curve Test Statistics (Lee 2024)*

Description

Computes the six Lorenz curve test statistics L+, L-, L(1), L(2), L(3), L(4) from rLC(p).

Usage

```
calc_lorenz_stats(rLC)
```

Arguments

`rLC`	Numeric vector of ratio modified Lorenz curve values.

Value

Named numeric vector of test statistics.

`calc_p` *Calculate Expected Uniform Order Statistics under Progressive Censoring*

Description

Computes the expected values p[j:m:n] of uniform order statistics under a progressive Type-II censoring scheme R.

Usage

```
calc_p(n, m, R)
```

Arguments

n	Total sample size (integer).
m	Number of observed failures (integer, m <= n).
R	Vector of length m containing the number of items removed at each failure.

Value

A numeric vector of length m containing expected values p[j:m:n].

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calc_pakyari_stats *Compute Pakyari and Balakrishnan (2013) Test Statistics*

Description

Computes the order statistics distance test statistics C+, C-, C, K, T(1), T(2) based on Pakyari & Balakrishnan (2013).

Usage

```
calc_pakyari_stats(x, n, m, R, p, dist = "norm", pfun = NULL, ...)
```

Arguments

x	Numeric vector of failure times.
n	Total sample size.
m	Failure count.
R	Censoring scheme vector.
p	Expected uniform order statistics vector.
dist	Character string specifying distribution.
pfun	Optional custom CDF function.
...	Additional arguments.

Value

Named numeric vector of test statistics.

fit_progressive_mle *Fit Location and Scale Parameters under Progressive Censoring via MLE*

Description

Fits location (alpha) and scale (beta) parameters using maximum likelihood estimation under progressive Type-II censoring.

Usage

```
fit_progressive_mle(x, R, dist = "norm", pfun = NULL, ...)
```

Arguments

x	Numeric vector of failure times.
R	Numeric vector of censoring scheme.
dist	Character string specifying distribution.
pfun	Optional custom CDF function.
...	Additional arguments.

Value

Named numeric vector c(alpha = ..., beta = ...).

get_quantile_vals *Theoretical Quantiles for Location-Scale Distributions*

Description

Obtains standard quantile values for supported location-scale distributions or a custom quantile function.

Usage

```
get_quantile_vals(p, dist = "norm", qfun = NULL, ...)
```

Arguments

p	Numeric vector of probabilities in (0, 1).
dist	Character string specifying the distribution name.
qfun	Optional custom quantile function accepting p as first argument.
...	Additional arguments passed to quantile function.

Value

Numeric vector of quantiles.

`gof_lorenz` *Goodness-of-Fit Tests for Location-Scale Distributions Based on Lorenz Curve*

Description

Performs goodness-of-fit tests for symmetric and asymmetric location-scale distributions under progressive Type-II censoring using the modified Lorenz curve methodology of Lee (2024) and order statistics distance methodology of Pakyari and Balakrishnan (2013).

Usage

```
gof_lorenz(
  x,
  n = NULL,
  m = NULL,
  R = NULL,
  dist = "norm",
  mc_rep = 1000,
  conf_level = 0.95,
  qfun = NULL,
  pfun = NULL,
  ...
)
```

Arguments

`x`	Numeric vector of failure times (observed progressive Type-II censored sample).
`n`	Integer specifying total sample size. Defaults to `length(x) + sum(R)`.
`m`	Integer specifying number of observed failures. Defaults to `length(x)`.
`R`	Integer vector of length m specifying progressive censoring scheme. Defaults to `rep(0, m)`.
`dist`	Character string specifying hypothesized location-scale distribution. Supported distributions: `"norm"` (default), `"gumbel"`, `"gumbel_max"`, `"exp"`, `"logistic"`, `"t"`, `"loggamma"`, `"cauchy"`.
`mc_rep`	Integer specifying Monte Carlo replicates for p-value estimation. Defaults to 1000.
`conf_level`	Numeric value specifying confidence level for critical value (default 0.95).
`qfun`	Optional custom quantile function accepting probability p as first argument.
`pfun`	Optional custom CDF function accepting standardized value z as first argument.
`...`	Additional parameters passed to quantile/CDF functions.

Value

An object of class "gof_lorenz" containing:

statistics	Named vector of test statistics.
p_values	Named vector of Monte Carlo simulated p-values.
critical_values	Named vector of critical values.
rLC	Ratio modified sample Lorenz curve values.
mLC_sample	Modified sample Lorenz curve values.
mLC_theory	Theoretical modified Lorenz curve values.
p_expected	Expected uniform order statistics p[j:m:n].
l_plot	L-plot values |1 - rLC|.
data	List containing input data x, n, m, R.
dist	Name of hypothesized distribution.
mc_rep	Number of Monte Carlo replicates.
conf_level	Confidence level.

References

Lee, K. (2024). A New Test Statistic to Assess the Goodness of Fit of Location-Scale Distribution Based on Progressive Censored Data. *Symmetry*, 16(2), 202. doi:10.3390/sym16020202

Pakyari, R., & Balakrishnan, N. (2013). Goodness-of-fit tests for progressively Type II censored data from location-scale distribution. *Journal of Statistical Computation and Simulation*, 83(1), 167-178. doi:10.1080/00949655.2011.625424

Examples

```
# Example 1 from Lee (2024): Breaking strength data
x_ex1 <- c(550, 750, 950, 1150, 1350, 1450, 1550, 1850)
R_ex1 <- c(0, 4, 1, 3, 0, 2, 0, 2)
res1 <- gof_lorenz(
  x = x_ex1, n = 20, m = 8, R = R_ex1,
  dist = "norm", mc_rep = 500
)
print(res1)
summary(res1)
plot(res1)
```

`insulating_fluid` *Log-Transformed Insulating Fluid Data under Progressive Type-II Censoring*

Description

A dataset containing log-transformed failure times of insulating fluid test data under progressive Type-II censoring from Nelson (1982), analyzed in Lee (2024) (Example 2).

Usage

```
insulating_fluid
```

Format

A list with components:

x Numeric vector of 8 log-transformed failure times.

n Total sample size (19).

m Observed failures (8).

R Progressive censoring scheme (0, 0, 3, 0, 3, 0, 0, 5).

References

Lee, K. (2024). A New Test Statistic to Assess the Goodness of Fit of Location-Scale Distribution Based on Progressive Censored Data. *Symmetry*, 16(2), 202. doi:10.3390/sym16020202

Nelson, W. (1982). *Applied Life Data Analysis*. John Wiley & Sons, New York.

Examples

```
data(insulating_fluid)
gof_lorenz(
  x = insulating_fluid$x,
  n = insulating_fluid$n,
  m = insulating_fluid$m,
  R = insulating_fluid$R,
  dist = "gumbel",
  mc_rep = 100
)
```

`lorenz_plot` *Plot Method for Lorenz Curve Goodness-of-Fit Diagnostics (L-plot)*

Description

Draws the L-plot diagnostic curve |1 - rLC(p[j:m:n])| versus p[j:m:n] for assessing goodness-of-fit to a location-scale distribution based on Lee (2024).

Usage

```
lorenz_plot(
  x,
  n = NULL,
  m = NULL,
  R = NULL,
  dist = "norm",
  qfun = NULL,
  main = NULL,
  xlab = NULL,
  ylab = NULL,
  col = "blue",
  pch = 19,
  lwd = 2,
  ...
)
```

Arguments

`x`	Either an object of class `"gof_lorenz"` or a numeric vector of failure times.
`n`	Total sample size (required if x is numeric vector and n > length(x)).
`m`	Failure count (required if x is numeric vector).
`R`	Censoring scheme vector.
`dist`	Hypothesized distribution name.
`qfun`	Optional custom quantile function.
`main`	Optional plot main title.
`xlab`	Optional x-axis label.
`ylab`	Optional y-axis label.
`col`	Line and point color. Defaults to `"blue"`.
`pch`	Point symbol (default 19).
`lwd`	Line width (default 2).
`...`	Additional graphical parameters.

Value

Invisibly returns a data.frame containing p_expected, rLC, and L_plot.

References

Lee, K. (2024). A New Test Statistic to Assess the Goodness of Fit of Location-Scale Distribution Based on Progressive Censored Data. *Symmetry*, 16(2), 202. doi:10.3390/sym16020202

Examples

```
x_ex1 <- c(550, 750, 950, 1150, 1350, 1450, 1550, 1850)
R_ex1 <- c(0, 4, 1, 3, 0, 2, 0, 2)
lorenz_plot(x = x_ex1, n = 20, m = 8, R = R_ex1, dist = "norm")
```

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mLC_sample *Modified Sample Lorenz Curve*

Description

Computes the modified sample Lorenz curve mLC(p) for ordered progressive data x[1:m:n] < ... < x[m:m:n].

Usage

```
mLC_sample(x, p)
```

Arguments

x	Numeric vector of ordered failure times x[1:m:n] < ... < x[m:m:n].
p	Expected uniform order statistics vector.

Value

Numeric vector of modified sample Lorenz curve values.

mLC_theory *Theoretical Modified Lorenz Curve*

Description

Computes the theoretical modified Lorenz curve mLC_F(p) for standard location-scale distribution.

Usage

```
mLC_theory(p, dist = "norm", qfun = NULL, ...)
```

Arguments

p	Expected uniform order statistics vector.
dist	Character string specifying the distribution name.
qfun	Optional custom quantile function.
...	Additional parameters for quantile function.

Value

Numeric vector of theoretical modified Lorenz curve values.

plot.gof_lorenz *Plot Method for gof_lorenz Objects*

Description

Draws the L-plot diagnostic graph for a "gof_lorenz" object.

Usage

```
## S3 method for class 'gof_lorenz'
plot(x, ...)
```

Arguments

x	An object of class "gof_lorenz".
...	Additional graphical arguments passed to lorenz_plot.

Value

Invisibly returns the diagnostic data.frame.

print.gof_lorenz *Print Method for Lorenz Goodness-of-Fit Test Results*

Description

Prints formatted output of test statistics, p-values, and critical values.

Usage

```
## S3 method for class 'gof_lorenz'
print(x, digits = 5, ...)
```

Arguments

x	An object of class "gof_lorenz".
digits	Number of significant digits (default 5).
...	Additional arguments.

Value

Invisibly returns the input object.

rLC_calc *Ratio Modified Lorenz Curve*

Description

Computes the ratio modified Lorenz curve rLC(p) = mLC(p) / mLC_F(p).

Usage

```
rLC_calc(x, p, dist = "norm", qfun = NULL, ...)
```

Arguments

x	Numeric vector of ordered failure times.
p	Expected uniform order statistics vector.
dist	Character string specifying distribution.
qfun	Optional custom quantile function.
...	Additional arguments.

Value

Numeric vector of ratio modified Lorenz curve values rLC(p).

rprcs *Generate Random Progressive Type-II Censored Samples*

Description

Generates random progressive Type-II censored samples from standard location-scale distribution.

Usage

```
rprcs(n, m, R, dist = "norm", qfun = NULL, ...)
```

Arguments

n	Total sample size.
m	Observed failure count.
R	Censoring scheme vector.
dist	Distribution name.
qfun	Optional custom quantile function.
...	Additional arguments.

Value

Ordered numeric vector of length m containing simulated failure times.

summary.gof_lorenz *Summary Method for Lorenz Goodness-of-Fit Test Results*

Description

Summarizes goodness-of-fit test statistics and diagnostic metrics.

Usage

```
## S3 method for class 'gof_lorenz'
summary(object, ...)
```

Arguments

object	An object of class "gof_lorenz".
...	Additional arguments.

Value

Returns a summary list object.

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