

Package ‘gpciIntCensor’

August 8, 2026

Type Package

Title Generalized Process Capability Indices for Interval-Censored Data

Version 0.1.0

Description A comprehensive framework for computing, estimating, and validating Generalized Process Capability Indices (GPCIs) under interval-censored data. Supports user-supplied probability density functions (PDF/PMF), cumulative distribution functions (CDF), and survival functions (SF). Parameter estimation is performed using Maximum Likelihood Estimation for interval-censored data via the MleCensoR package. Computes classical and generalized capability indices including Cpy (Maiti et al., 2010), Spmk (Dey & Saha, 2019), CpTk (Saha et al., 2019), Cpc (Saha et al., 2022), CNpmc (Alotaibi et al., 2022), CNpmkc (Saha et al., 2024), CNpk (Saha et al., 2018), and Vannman's Cp(u,v) family. Provides parametric and non-parametric bootstrap confidence intervals at 90%, 95%, and 99% confidence levels using percentile, normal, basic, BCa, BCp, and studentized bootstrap methods. Computes standard errors, mean squared errors, and coverage probabilities for both distribution parameters and capability indices.

References:

Maiti, Saha & Nanda (2010) <doi:10.1080/16843703.2010.11673233>,
Saha, Dey & Maiti (2018) <doi:10.1080/21681015.2018.1437793>,
Dey & Saha (2019) <doi:10.1007/s41872-019-00081-4>,
Saha, Dey & Maiti (2019) <doi:10.1007/s13198-019-00789-7>,
Alotaibi, Dey & Saha (2022) <doi:10.1155/2022/3135264>,
Saha, Dey & Nadarajah (2022) <doi:10.1080/02664763.2021.1971632>,
Saha, Tripathi & Dey (2024) <doi:10.1142/S021853932450013X>.

License MIT + file LICENSE

Encoding UTF-8

RoxygenNote 7.3.3

Depends R (>= 4.0.0)

Imports stats, graphics, numDeriv, boot, MleCensoR

Suggests testthat (>= 3.0.0), knitr, rmarkdown

VignetteBuilder knitr

Config/testthat/edition 3

NeedsCompilation no
Author Shikhar Tyagi [aut, cre] (ORCID:
 <<https://orcid.org/0000-0003-1606-0844>>),
 Sumit Kumar [aut],
 Arvind Pandey [aut],
 Bhupendra Singh [aut],
 Vrijesh Tripathi [aut]
Maintainer Shikhar Tyagi <shikhar1093tyagi@gmail.com>
Repository CRAN
Date/Publication 2026-08-08 13:00:02 UTC

Contents

autoplot	2
boot_ci_censor	3
builtin_dist	4
capability_censor	5
compute_diagnostics_censor	7
compute_theoretical_moments_censor	9
define_distribution_censor	9
fit_distribution_censor	10
gpci_index	11
plot.gpcifit_censor	12
plot.gpci_ci_censor	12
plot.gpci_diagnostics_censor	13
Index	14

autoplot	<i>Autoplot Generic and Methods for Compatibility</i>
----------	---

Description

Autoplot Generic and Methods for Compatibility

Usage

```
autoplot(object, ...)  
  
## S3 method for class 'gpcifit_censor'  
autoplot(object, ...)  
  
## S3 method for class 'gpci_ci_censor'  
autoplot(object, ...)  
  
## S3 method for class 'gpci_diagnostics_censor'  
autoplot(object, ...)
```

Arguments

object Object to plot.
 ... Additional arguments.

Value

Invisible plot object.

Examples

```
dist_norm <- dist_normal()
left <- c(9.5, 10.2, 8.8, 11.1, 9.9)
right <- c(10.5, 11.2, 9.8, 12.1, 10.9)
fit <- capability_censor(left, right, dist_norm, USL = 13, LSL = 7)
autoplot(fit)
```

boot_ci_censor	<i>Compute Bootstrap Confidence Intervals for Process Capability Indices (Interval-Censored Data)</i>
----------------	---

Description

Runs parametric or non-parametric bootstrapping to compute confidence intervals for generalized process capability indices at multiple significance levels (90%, 95%, 99%) under interval-censored data.

Usage

```
boot_ci_censor(
  fit,
  B = 2000,
  alpha = c(0.1, 0.05, 0.01),
  method = c("percentile", "normal", "basic", "BCa", "BCp", "studentized"),
  type = c("parametric", "nonparametric"),
  parallel = FALSE,
  ncpus = 1
)

gpci_boot_censor(
  fit,
  B = 2000,
  alpha = c(0.1, 0.05, 0.01),
  method = c("percentile", "normal", "basic", "BCa", "BCp", "studentized"),
  type = c("parametric", "nonparametric"),
  parallel = FALSE,
  ncpus = 1
)
```

```
## S3 method for class 'gpci_ci_censor'
print(x, ...)

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

Arguments

fit	A gpcifit_censor object returned by capability_censor .
B	Number of bootstrap replicates.
alpha	Vector of significance levels (default is 0.10, 0.05, 0.01).
method	Confidence interval method ("percentile", "normal", "basic", "BCa", "BCp", "studentized").
type	Bootstrap type ("parametric" or "nonparametric").
parallel	Logical. If TRUE, parallel processing is used.
ncpus	Number of CPUs for parallel execution.
x, object	An object of class gpci_ci_censor.
...	Additional print/summary arguments.

Value

An object of class gpci_ci_censor.

Examples

```
dist_norm <- dist_normal()
left <- c(9.5, 10.2, 8.8, 11.1, 9.9)
right <- c(10.5, 11.2, 9.8, 12.1, 10.9)
fit <- capability_censor(left, right, dist_norm, USL = 13, LSL = 7)
ci <- boot_ci_censor(fit, B = 100, alpha = c(0.10, 0.05, 0.01), method = "percentile")
print(ci)
```

builtin_dist

Built-in Process Distributions for Interval-Censored Analysis

Description

Convenience constructors for standard process probability distributions.

Usage

```

dist_normal(mean = 0, sd = 1)

dist_lognormal(meanlog = 0, sdlog = 1)

dist_gamma(shape = 1, scale = 1)

dist_weibull(shape = 1, scale = 1)

dist_beta(shape1 = 1, shape2 = 1)

dist_logistic_exponential(shape = 1, scale = 1)

```

Arguments

mean, sd Mean and standard deviation parameters for normal distribution.

meanlog, sdlog Mean and standard deviation of the distribution on the log scale.

shape, scale Shape and scale parameters.

shape1, shape2 Non-negative parameters of the Beta distribution.

Value

An object of class `gpci_dist_censor`.

Examples

```

dist_n <- dist_normal(mean = 10, sd = 2)
dist_le <- dist_logistic_exponential(shape = 1.5, scale = 0.5)

```

capability_censor	<i>Compute Process Capability Indices for Interval-Censored Data</i>
-------------------	--

Description

Computes classical and generalized Process Capability Indices (PCIs) for interval-censored data.

Usage

```

capability_censor(
  data_left = NULL,
  data_right = NULL,
  distribution,
  USL,
  LSL,
  target = (USL + LSL)/2,
  indices = c("Cpy", "Cp", "Cpk", "Cpu", "Cpl", "Cpm", "Cpmk"),

```

```

    u = 1,
    v = 1,
    mode = c("moments", "quantile"),
    fit = TRUE,
    C0 = 1,
    C1 = 0,
    C2 = 1,
    tolerance_t = USL - LSL,
    P0 = 0.9973002,
    LDL = LSL,
    UDL = USL
  )

## S3 method for class 'gpcifit_censor'
print(x, ...)

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

## S3 method for class 'gpcifit_censor'
coef(object, what = c("indices", "parameters"), ...)

## S3 method for class 'gpcifit_censor'
vcov(object, ...)

## S3 method for class 'gpcifit_censor'
confint(
  object,
  parm = NULL,
  level = 0.95,
  B = 1000,
  method = "percentile",
  ...
)

```

Arguments

<code>data_left</code>	Numeric vector of left interval bounds for interval-censored data.
<code>data_right</code>	Numeric vector of right interval bounds for interval-censored data.
<code>distribution</code>	A <code>gpci_dist_censor</code> distribution object.
<code>USL</code>	Numeric value of the Upper Specification Limit.
<code>LSL</code>	Numeric value of the Lower Specification Limit.
<code>target</code>	Numeric value of process target (default is midpoint of USL and LSL).
<code>indices</code>	Character vector of capability indices to compute.
<code>u, v</code>	Parameters for Vannman's $C_p(u,v)$ family.
<code>mode</code>	Computation mode: "moments" or "quantile".

fit	Logical. If TRUE, parameters are estimated via MLE under interval censoring.
C0, C1, C2	Cost function parameters for CNpmc and CNpmkc.
tolerance_t	Tolerance parameter for CNpmc and CNpmkc.
P0	Desirable process yield for Cpy and Cpc.
LDL, UDL	Desired limits for CpTk.
x, object	An object of class gpcifit_censor.
what	Extraction target: "indices" or "parameters".
parm	Optional vector of index names.
level	Confidence level(s).
B	Number of bootstrap replicates.
method	Bootstrap CI method.
...	Additional arguments.

Value

An object of class gpcifit_censor.

Examples

```
dist_norm <- dist_normal()
left <- c(9.5, 10.2, 8.8, 11.1, 9.9)
right <- c(10.5, 11.2, 9.8, 12.1, 10.9)
capability_censor(
  data_left = left, data_right = right,
  distribution = dist_norm,
  USL = 13, LSL = 7, target = 10,
  indices = c("Cpy", "Cp", "Cpk", "Cpm", "Cpmk"),
  mode = "moments"
)
```

compute_diagnostics_censor

*Compute Standard Errors, MSE, and Coverage Probabilities for
Interval-Censored Data*

Description

Computes standard errors, mean squared errors, and coverage probabilities for distribution parameters and process capability indices using bootstrap results.

Usage

```
compute_diagnostics_censor(
  fit,
  true_params = NULL,
  true_indices = NULL,
  B = 1000,
  alpha = c(0.1, 0.05, 0.01)
)

gpci_diagnostics_censor(
  fit,
  true_params = NULL,
  true_indices = NULL,
  B = 1000,
  alpha = c(0.1, 0.05, 0.01)
)

## S3 method for class 'gpci_diagnostics_censor'
print(x, ...)

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

Arguments

<code>fit</code>	A <code>gpcifit_censor</code> object returned by capability_censor .
<code>true_params</code>	Named list of true parameter values (if known).
<code>true_indices</code>	Named vector of true index values (if known).
<code>B</code>	Number of bootstrap replicates for SE computation.
<code>alpha</code>	Vector of significance levels for coverage probability.
<code>x, object</code>	An object of class <code>gpci_diagnostics_censor</code> .
<code>...</code>	Additional print/summary arguments.

Value

A list of class `gpci_diagnostics_censor`.

Examples

```
dist_norm <- dist_normal()
left <- c(9.5, 10.2, 8.8, 11.1, 9.9)
right <- c(10.5, 11.2, 9.8, 12.1, 10.9)
fit <- capability_censor(left, right, dist_norm, USL = 13, LSL = 7)
diagnostics <- compute_diagnostics_censor(fit, B = 100)
print(diagnostics)
```

`compute_theoretical_moments_censor`*Compute Theoretical Moments of an Interval-Censored Distribution*

Description

Computes the theoretical mean and variance of a `gpci_dist_censor` object using numerical integration.

Usage

```
compute_theoretical_moments_censor(dist)
```

Arguments

`dist` A `gpci_dist_censor` object.

Value

A list with mean and var.

Examples

```
dist_n <- dist_normal(mean = 5, sd = 1.5)
compute_theoretical_moments_censor(dist_n)
```

`define_distribution_censor`*Define a Process Distribution for Interval-Censored Data*

Description

Constructor to define a probability distribution for process capability analysis under interval-censored data.

Usage

```
define_distribution_censor(
  name,
  pdf = NULL,
  cdf = NULL,
  sf = NULL,
  quantile = NULL,
  params = list(),
  support = c(-Inf, Inf)
)
```

```

gpci_dist_censor(
  name,
  pdf = NULL,
  cdf = NULL,
  sf = NULL,
  quantile = NULL,
  params = list(),
  support = c(-Inf, Inf)
)

```

Arguments

name	Character string naming the distribution.
pdf	Function representing the probability density function (PDF/PMF).
cdf	Function representing the cumulative distribution function (CDF).
sf	Function representing the survival function (SF = 1 - CDF).
quantile	Function representing the quantile function.
params	Named list of parameters for the distribution.
support	Vector of length 2 defining lower and upper bounds of support.

Value

An object of class `gpci_dist_censor`.

Examples

```

custom_weib <- define_distribution_censor(
  name = "custom_weibull",
  sf = function(x, shape, scale) pweibull(x, shape, scale, lower.tail = FALSE),
  params = list(shape = 2, scale = 10),
  support = c(0, Inf)
)

```

`fit_distribution_censor`

Fit Distribution Parameters under Interval-Censored Data

Description

Fits the parameters of a `gpci_dist_censor` distribution to interval-censored data using Maximum Likelihood Estimation (MLE) via the `MleCensoR` package.

Usage

```

fit_distribution_censor(data_left, data_right, dist, start = NULL)

gpci_fit_censor(data_left, data_right, dist, start = NULL)

```

Arguments

data_left	Numeric vector of left interval bounds for interval-censored data.
data_right	Numeric vector of right interval bounds for interval-censored data.
dist	A gpci_dist_censor distribution object with initial parameters.
start	Optional named list of starting parameter values.

Value

A new gpci_dist_censor object containing fitted parameters.

Examples

```
dist_norm <- dist_normal()
left <- c(9.5, 10.2, 8.8, 11.1, 9.9)
right <- c(10.5, 11.2, 9.8, 12.1, 10.9)
fit <- fit_distribution_censor(left, right, dist_norm)
```

gpci_index

Dispatcher for Single Index Computation under Interval Censoring

Description

Dispatcher for Single Index Computation under Interval Censoring

Usage

```
gpci_index(fit, index)
```

Arguments

fit	A gpcifit_censor object.
index	Name of index to compute.

Value

Numeric value of the specified index.

Examples

```
dist_norm <- dist_normal()
left <- c(9.5, 10.2, 8.8, 11.1, 9.9)
right <- c(10.5, 11.2, 9.8, 12.1, 10.9)
fit <- capability_censor(left, right, dist_norm, USL = 13, LSL = 7)
gpci_index(fit, "Cpy")
```

plot.gpcifit_censor *Plot Method for gpcifit_censor Objects*

Description

Visualizes interval-censored observations, fitted distribution density curve, and specification limits.

Usage

```
## S3 method for class 'gpcifit_censor'
plot(x, main = "Process Capability Analysis (Interval-Censored)", ...)
```

Arguments

x	An object of class gpcifit_censor.
main	Title of the plot.
...	Additional graphical parameters.

Value

Invisible fit object x.

Examples

```
dist_norm <- dist_normal()
left <- c(9.5, 10.2, 8.8, 11.1, 9.9)
right <- c(10.5, 11.2, 9.8, 12.1, 10.9)
fit <- capability_censor(left, right, dist_norm, USL = 13, LSL = 7)
plot(fit)
```

plot.gpci_ci_censor *Plot Method for gpci_ci_censor Objects*

Description

Visualizes bootstrap confidence intervals across different significance levels.

Usage

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

Arguments

x	An object of class gpci_ci_censor.
...	Additional graphical parameters.

Value

Invisible CI object x.

Examples

```
dist_norm <- dist_normal()
left <- c(9.5, 10.2, 8.8, 11.1, 9.9)
right <- c(10.5, 11.2, 9.8, 12.1, 10.9)
fit <- capability_censor(left, right, dist_norm, USL = 13, LSL = 7)
ci <- boot_ci_censor(fit, B = 100, alpha = c(0.10, 0.05, 0.01), method = "percentile")
plot(ci)
```

plot.gpci_diagnostics_censor

Plot Method for gpci_diagnostics_censor Objects

Description

Visualizes standard errors for parameters and capability indices.

Usage

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

Arguments

x An object of class gpci_diagnostics_censor.
... Additional graphical parameters.

Value

Invisible diagnostics object x.

Examples

```
dist_norm <- dist_normal()
left <- c(9.5, 10.2, 8.8, 11.1, 9.9)
right <- c(10.5, 11.2, 9.8, 12.1, 10.9)
fit <- capability_censor(left, right, dist_norm, USL = 13, LSL = 7)
diag_obj <- compute_diagnostics_censor(fit, B = 100)
plot(diag_obj)
```

Index

autoplot, 2

boot_ci_censor, 3

builtin_dist, 4

capability_censor, 4, 5, 8

coef.gpcifit_censor
 (capability_censor), 5

compute_diagnostics_censor, 7

compute_theoretical_moments_censor, 9

confint.gpcifit_censor
 (capability_censor), 5

define_distribution_censor, 9

dist_beta (builtin_dist), 4

dist_gamma (builtin_dist), 4

dist_logistic_exponential
 (builtin_dist), 4

dist_lognormal (builtin_dist), 4

dist_normal (builtin_dist), 4

dist_weibull (builtin_dist), 4

fit_distribution_censor, 10

gpci_boot_censor (boot_ci_censor), 3

gpci_diagnostics_censor
 (compute_diagnostics_censor), 7

gpci_dist_censor
 (define_distribution_censor), 9

gpci_fit_censor
 (fit_distribution_censor), 10

gpci_index, 11

plot.gpci_ci_censor, 12

plot.gpci_diagnostics_censor, 13

plot.gpcifit_censor, 12

print.gpci_ci_censor (boot_ci_censor), 3

print.gpci_diagnostics_censor
 (compute_diagnostics_censor), 7

print.gpcifit_censor
 (capability_censor), 5

summary.gpci_ci_censor
 (boot_ci_censor), 3

summary.gpci_diagnostics_censor
 (compute_diagnostics_censor), 7

summary.gpcifit_censor
 (capability_censor), 5

vcov.gpcifit_censor
 (capability_censor), 5