

Package ‘predHCS’

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Type Package

Title Point and Interval Prediction for Censored Data under Various Hybrid Censoring Schemes

Version 0.1.0

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Description Implements generalized statistical point prediction and prediction intervals for future failure times under various hybrid censoring schemes. Supported censoring schemes include Type-I, Type-II, Generalized Type-I, Generalized Type-II, Unified, Progressive Type-I, and Progressive Type-II hybrid censoring schemes. Available prediction methods include Best Unbiased Predictor (BUP), Conditional Median Predictor (CMP), Maximum Likelihood Predictor (MLP), equal-tailed classical prediction intervals, Highest Conditional Density (HCD) prediction intervals, and Bayesian prediction intervals. Algorithms accept user-defined continuous probability density functions, cumulative distribution functions, quantile functions, or survival functions along with estimated parameter values. Methodological foundations are based on Balakrishnan, Cramer, and Kundu (2023, ISBN:978-0123983879), Shafay and Balakrishnan (2012) <doi:10.1080/03610918.2011.579367> for Type-I hybrid censoring, Balakrishnan and Shafay (2012) <doi:10.1080/03610926.2010.543300> for Type-II hybrid censoring, Shafay (2017) <doi:10.1080/03610926.2016.1200093> for Generalized Type-I hybrid censoring, Shafay (2016) <doi:10.1080/00949655.2015.1096361> for Generalized Type-II hybrid censoring, Mohie El-Din, Nagy, and Shafay (2017) <doi:10.18576/jsap/060113> for Unified hybrid censoring, Ebrahimi (1992) <doi:10.1109/24.126685>, Valiollahi, Asgharzadeh, and Kundu (2017) <doi:10.1214/15-BJPS302>, and Asgharzadeh, Valiollahi, and Kundu (2015) <doi:10.1080/00949655.2013.848451>.

License GPL-3

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predHCS-package	<i>Point and Interval Prediction for Censored Data under Various Hybrid Censoring Schemes</i>
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Description

Implements generalized statistical point prediction and prediction intervals for future failure times under various hybrid censoring schemes. Supported censoring schemes include Type-I, Type-II, Generalized Type-I, Generalized Type-II, Unified, Progressive Type-I, and Progressive Type-II hybrid censoring schemes.

Details

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The main function is [predict_censored](#), which acts as a unified interface for point and interval prediction under any supported hybrid censoring scheme.

Author(s)

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References

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- Asgharzadeh, A., Valiollahi, R., & Raqab, M. Z. (2015). Stress-strength reliability of Weibull distribution under progressive Type-II censoring. *Communications in Statistics - Theory and Methods*, 44(8), 1618-1631.

Examples

```
data_obs <- c(0.5, 1.2, 2.1, 3.4, 4.0)
cdf_exp <- function(x, par) pexp(x, rate = par[1])
res <- predict_censored(data = data_obs, n = 10, scheme = "Type-I",
                        r = 6, T0 = 5.0, s = 1:2, cdf = cdf_exp, param = 0.5)
print(res)
```

methods

S3 Methods for predhcs Objects

Description

Print, summary, and plot methods for objects of class predhcs.

Usage

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

## S3 method for class 'predhcs'
```

```
summary(object, ...)

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

Arguments

x An object of class predhcs.

object An object of class predhcs.

... Additional arguments.

Value

print and summary invisibly return the object. plot creates a graphical display.

Examples

```
data_obs <- c(0.4, 0.8, 1.3, 2.1, 3.0)
cdf_exp <- function(x, par) pexp(x, rate = par[1])
res <- pred_type1_hybrid(data = data_obs, n = 10, r = 6, T0 = 4.0, s = 1:2,
                        cdf = cdf_exp, param = 0.5)

print(res)
summary(res)
plot(res)
```

predict_censored	<i>Unified Interface for Point and Interval Prediction under Hybrid Censoring</i>
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Description

Unified entry point function to perform point prediction (BUP, CMP, MLP, Bayesian) and interval prediction (Classical, HCD, Bayesian) under various hybrid censoring schemes.

Usage

```
predict_censored(data, n, scheme = c("Type-I", "Type-II", "Gen-Type-I",
  "Gen-Type-II", "Unified", "Prog-Type-I", "Prog-Type-II"), T0 = NULL,
  T1 = NULL, T2 = NULL, r = NULL, k = NULL, R = NULL, s = 1, cdf = NULL,
  pdf = NULL, qdf = NULL, surv = NULL, param = NULL, conf.level = 0.95,
  bayes.draws = NULL)
```

Arguments

data	Numeric vector of observed failure times.
n	Total initial sample size.
scheme	Character string specifying the hybrid censoring scheme.
T0	Pre-fixed termination or inspection time threshold.
T1	First time threshold for Unified scheme.
T2	Second time threshold for Unified scheme.
r	Target number of failures.
k	Lower threshold for failure count.
R	Numeric vector of progressive removals.
s	Integer or vector of integers specifying future failure steps to predict.
cdf	Optional user-defined cumulative distribution function.
pdf	Optional user-defined probability density function.
qdf	Optional user-defined quantile function.
surv	Optional user-defined survival function.
param	Parameter vector or list for the distribution.
conf.level	Confidence level for prediction intervals (default 0.95).
bayes.draws	Optional matrix of MCMC posterior draws for Bayesian prediction.

Value

An object of class `predhcs` containing prediction results.

Examples

```
data_obs <- c(0.4, 0.8, 1.3, 2.1, 3.0)
cdf_exp <- function(x, par) pexp(x, rate = par[1])
res1 <- predict_censored(data = data_obs, n = 10, scheme = "Type-I",
                        r = 6, T0 = 4.0, s = 1:2, cdf = cdf_exp, param = 0.5)
print(res1)
```

schemes

Specific Hybrid Censoring Scheme Prediction Functions

Description

Functions to compute point predictions and prediction intervals under specific hybrid censoring schemes.

Usage

```

pred_type1_hybrid(data, n, r, T0, s = 1, cdf = NULL, pdf = NULL, qdf = NULL,
  surv = NULL, param = NULL, conf.level = 0.95, bayes.draws = NULL)

pred_type2_hybrid(data, n, r, T0, s = 1, cdf = NULL, pdf = NULL, qdf = NULL,
  surv = NULL, param = NULL, conf.level = 0.95, bayes.draws = NULL)

pred_gen_type1_hybrid(data, n, k, r, T0, s = 1, cdf = NULL, pdf = NULL,
  qdf = NULL, surv = NULL, param = NULL, conf.level = 0.95, bayes.draws = NULL)

pred_gen_type2_hybrid(data, n, k, r, T0, s = 1, cdf = NULL, pdf = NULL,
  qdf = NULL, surv = NULL, param = NULL, conf.level = 0.95, bayes.draws = NULL)

pred_unified_hybrid(data, n, k, r, T1, T2, s = 1, cdf = NULL, pdf = NULL,
  qdf = NULL, surv = NULL, param = NULL, conf.level = 0.95, bayes.draws = NULL)

pred_prog_type1_hybrid(data, n, R, T0, s = 1, cdf = NULL, pdf = NULL,
  qdf = NULL, surv = NULL, param = NULL, conf.level = 0.95, bayes.draws = NULL)

pred_prog_type2_hybrid(data, n, R, T0, s = 1, cdf = NULL, pdf = NULL,
  qdf = NULL, surv = NULL, param = NULL, conf.level = 0.95, bayes.draws = NULL)

```

Arguments

<code>data</code>	Numeric vector of observed failure times.
<code>n</code>	Total initial sample size.
<code>r</code>	Target number of failures.
<code>k</code>	Lower threshold for failure count.
<code>T0</code>	Termination time threshold.
<code>T1</code>	First time threshold for Unified scheme.
<code>T2</code>	Second time threshold for Unified scheme.
<code>R</code>	Progressive removals vector.
<code>s</code>	Future failure step(s) to predict.
<code>cdf</code>	Optional user CDF.
<code>pdf</code>	Optional user PDF.
<code>qdf</code>	Optional user Quantile function.
<code>surv</code>	Optional user Survival function.
<code>param</code>	Distribution parameters.
<code>conf.level</code>	Confidence level for prediction intervals.
<code>bayes.draws</code>	Optional MCMC posterior draws matrix.

Value

An object of class `predhcs` containing prediction results.

Examples

```
data_obs <- c(0.5, 1.2, 2.1, 3.4, 4.0)
cdf_exp <- function(x, par) pexp(x, rate = par[1])
res <- pred_type1_hybrid(data = data_obs, n = 10, r = 6, T0 = 5.0, s = 1:2,  
                          cdf = cdf_exp, param = 0.5)
print(res)
```

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