

Package ‘cpsurvsim’

October 12, 2022

Type Package

Title Simulating Survival Data from Change-Point Hazard Distributions

Version 1.2.1

Date 2021-12-19

Author Camille Hochheimer [aut, cre]

Maintainer Camille Hochheimer <dochoch19@gmail.com>

Description Simulates time-to-event data

with type I right censoring using two methods: the inverse CDF method and our proposed memoryless method. The latter method takes advantage of the memoryless property of survival and simulates a separate distribution between change-points. We include two parametric distributions: exponential and Weibull. Inverse CDF method draws on the work of Rainer Walke (2010), <<https://www.demogr.mpg.de/papers/technicalreports/tr-2010-003.pdf>>.

Depends R (>= 3.6.0)

License GPL (>= 3)

Encoding UTF-8

Imports plyr (>= 1.8.5), stats, Hmisc (>= 4.3.0), knitr (>= 1.27)

Suggests rmarkdown, testthat

RoxygenNote 7.1.2

VignetteBuilder knitr

URL <https://github.com/camillejo/cpsurvsim>

BugReports <https://github.com/camillejo/cpsurvsim/issues>

NeedsCompilation no

Repository CRAN

Date/Publication 2022-01-14 01:22:48 UTC

R topics documented:

cpsurvsim	2
exp_cdfsim	2
exp_icdf	3
exp_memsim	4
weib_cdfsim	5
weib_icdf	6
weib_memsim	7
Index	8

cpsurvsim	<i>cpsurvsim: Simulating Survival Data from Change-Point Hazard Distributions</i>
-----------	---

Description

The `cpsurvsim` package simulates time-to-event data with type I right censoring using two methods: the inverse CDF method and a memoryless method (for more information on simulation methods, see the vignette). We include two parametric distributions: exponential and Weibull.

cpsurvsim functions

For the exponential distribution, the `exp_icdf` function simulates values from the inverse exponential distribution. `exp_cdfsim` and `exp_memsim` return time-to-event datasets simulated using the inverse CDF and memoryless methods respectively.

For the Weibull distribution, the `weib_icdf` function simulates values from the inverse Weibull distribution. `weib_cdfsim` and `weib_memsim` return time-to-event datasets simulated using the inverse CDF and memoryless methods respectively.

exp_cdfsim	<i>Inverse CDF simulation for the exponential change-point hazard distribution</i>
------------	--

Description

`exp_cdfsim` simulates time-to-event data from the exponential change-point hazard distribution by implementing the inverse CDF method.

Usage

```
exp_cdfsim(n, endtime, theta, tau = NA)
```

Arguments

n	Sample size
endtime	Maximum study time, point at which all participants are censored
theta	Scale parameter θ
tau	Change-point(s) τ

Details

This function simulates data for the exponential change-point hazard distribution with K change-points by simulating values of the exponential distribution and substituting them into the inverse hazard function. This method applies Type I right censoring at the endtime specified by the user. This function allows for up to four change-points.

Value

Dataset with n participants including a survival time and censoring indicator (0 = censored, 1 = event).

Examples

```
nochange point <- exp_cdfsim(n = 10, endtime = 20, theta = 0.05)
onechange point <- exp_cdfsim(n = 10, endtime = 20,
  theta = c(0.05, 0.01), tau = 10)
twochange points <- exp_cdfsim(n = 10, endtime = 20,
  theta = c(0.05, 0.01, 0.05), tau = c(8, 12))
```

exp_icdf

Inverse CDF for the exponential distribution

Description

exp_icdf simulates values from the inverse CDF of the exponential distribution.

Usage

```
exp_icdf(n, theta)
```

Arguments

n	Number of output exponential values
theta	Scale parameter θ

Details

This function uses the exponential distribution of the form

$$f(t) = \theta \exp(-\theta t)$$

to get the inverse CDF

$$F^{-1}(u) = (-\log(1 - u))/\theta$$

where u is a uniform random variable. It can be implemented directly and is also called by the function `exp_memsim`.

Value

Output is a value or a vector of values from the exponential distribution.

Examples

```
simdta <- exp_icdf(n = 10, theta = 0.05)
```

exp_memsim	<i>Memoryless simulation for the exponential change-point hazard distribution</i>
------------	---

Description

`exp_memsim` simulates time-to-event data from the exponential change-point hazard distribution by implementing the memoryless method.

Usage

```
exp_memsim(n, endtime, theta, tau = NA)
```

Arguments

n	Sample size
endtime	Maximum study time, point at which all participants are censored
theta	Scale parameter θ
tau	Change-point(s) τ

Details

This function simulates time-to-event data between K change-points from independent exponential distributions using the inverse CDF implemented in `exp_icdf`. This method applies Type I right censoring at the endtime specified by the user.

Value

Dataset with n participants including a survival time and censoring indicator (0 = censored, 1 = event).

Examples

```
nochangept <- exp_memsim( n = 10, endtime = 20, theta = 0.05)
onechangept <- exp_memsim(n = 10, endtime = 20,
  theta = c(0.05, 0.01), tau = 10)
twochangepts <- exp_memsim(n = 10, endtime = 20,
  theta = c(0.05, 0.01, 0.05), tau = c(8, 12))
```

weib_cdfsims	<i>Inverse CDF simulation for the Weibull change-point hazard distribution</i>
--------------	--

Description

weib_cdfsims simulates time-to-event data from the Weibull change-point hazard distribution by implementing the inverse CDF method.

Usage

```
weib_cdfsims(n, endtime, gamma, theta, tau = NA)
```

Arguments

n	Sample size
endtime	Maximum study time, point at which all participants are censored
gamma	Shape parameter γ
theta	Scale parameter θ
tau	Change-point(s) τ

Details

This function simulates data from the Weibull change-point hazard distribution with K change-points by simulating values of the exponential distribution and substituting them into the inverse hazard function. This method applies Type I right censoring at the endtime specified by the user. This function allows for up to four change-points and γ is held constant.

Value

Dataset with n participants including a survival time and censoring indicator (0 = censored, 1 = event).

Examples

```

nochangeoint <- weib_cdfsims(n = 10, endtime = 20, gamma = 2,
  theta = 0.5)
onechangeoint <- weib_cdfsims(n = 10, endtime = 20, gamma = 2,
  theta = c(0.05, 0.01), tau = 10)
twochangeoints <- weib_cdfsims(n = 10, endtime = 20, gamma = 2,
  theta = c(0.05, 0.01, 0.05), tau = c(8, 12))

```

weib_icdf

*Inverse CDF value generation for the Weibull distribution***Description**

weib_icdf returns a value from the Weibull distribution by using the inverse CDF.

Usage

```
weib_icdf(n, gamma, theta)
```

Arguments

n	Number of output Weibull values
gamma	Shape parameter γ
theta	Scale parameter θ

Details

This function uses the Weibull density of the form

$$f(t) = \theta t^{\gamma-1} \exp(-\theta/\gamma t^{\gamma})$$

to get the inverse CDF

$$F^{-1}(u) = (-\gamma/\theta \log(1-u))^{1/\gamma}$$

where u is a uniform random variable. It can be implemented directly and is also called by the function [weib_memsim](#).

Value

Output is a value or vector of values from the Weibull distribution.

Examples

```
simdta <- weib_icdf(n = 10, theta = 0.05, gamma = 2)
```

weib_memsim	<i>Memoryless simulation for the Weibull change-point hazard distribution</i>
-------------	---

Description

weib_memsim simulates time-to-event data from the Weibull change-point hazard distribution by implementing the memoryless method.

Usage

```
weib_memsim(n, endtime, gamma, theta, tau = NA)
```

Arguments

n	Sample size
endtime	Maximum study time, point at which all participants are censored
gamma	Shape parameter γ
theta	Scale parameter θ
tau	Change-point(s) τ

Details

This function simulates time-to-event data between K change-points τ from independent Weibull distributions using the inverse Weibull CDF implemented in [weib_icdf](#). This method applies Type I right censoring at the endtime specified by the user. γ is held constant.

Value

Dataset with n participants including a survival time and censoring indicator (0 = censored, 1 = event).

Examples

```
nochangept <- weib_memsim(n = 10, endtime = 20, gamma = 2,
  theta = 0.05)
onechangept <- weib_memsim(n = 10, endtime = 20, gamma = 2,
  theta = c(0.05, 0.01), tau = 10)
twochangepts <- weib_memsim(n = 10, endtime = 20, gamma = 2,
  theta = c(0.05, 0.01, 0.05), tau = c(8, 12))
```

Index

`cpsurvsim`, 2

`exp_cdfsim`, 2, 2

`exp_icdf`, 2, 3

`exp_memsim`, 2, 4, 4

`weib_cdfsim`, 2, 5

`weib_icdf`, 2, 6, 7

`weib_memsim`, 2, 6, 7