

# Package ‘cpsurvsim’

January 20, 2020

**Type** Package

**Title** Simulating Survival Data from Change-Point Hazard Distributions

**Version** 1.2.0

**Date** 2020-01-20

**Author** Camille Hochheimer [aut, cre]

**Maintainer** Camille Hochheimer <hochheimercj@vcu.edu>

**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

**LazyData** true

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

**Suggests** rmarkdown, testthat

**RoxygenNote** 7.0.2

**VignetteBuilder** knitr

**URL** <http://github.com/camillejo/cpsurvsim>

**BugReports** <http://github.com/camillejo/cpsurvsim/issues>

**NeedsCompilation** no

**Repository** CRAN

**Date/Publication** 2020-01-20 21:00:02 UTC

## R topics documented:

cpsurvsim . . . . .	2
exp_cdfsim . . . . .	2
exp_icdf . . . . .	3
exp_memsim . . . . .	4
weib_cdfsim . . . . .	5
weib_icdf . . . . .	6
weib_memsim . . . . .	7
<b>Index</b>	<b>8</b>

---

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 $\theta$
tau	Change-point(s) $\tau$

**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 $\theta$

**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 $\theta$
tau	Change-point(s) $\tau$

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

---

**Description**

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

**Usage**

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

**Arguments**

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

**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  $\gamma$  is held constant.

**Value**

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

**Examples**

```

nochangept <- weib_cdfsims(n = 10, endtime = 20, gamma = 2,
  theta = 0.5)
onechangept <- weib_cdfsims(n = 10, endtime = 20, gamma = 2,
  theta = c(0.05, 0.01), tau = 10)
twochangepts <- 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 $\gamma$
theta	Scale parameter $\theta$

**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 $\gamma$
theta	Scale parameter $\theta$
tau	Change-point(s) $\tau$

### Details

This function simulates time-to-event data between  $K$  change-points  $\tau$  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.  $\gamma$  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