

# Package ‘survParamSim’

December 8, 2020

**Type** Package

**Title** Parametric Survival Simulation with Parameter Uncertainty

**Version** 0.1.4

**Description** Perform survival simulation with parametric survival model generated from 'survreg' function in 'survival' package.

In each simulation coefficients are resampled from variance-covariance matrix of parameter estimates to capture uncertainty in model parameters.

Prediction intervals of Kaplan-Meier estimates and hazard ratio of treatment effect can be further calculated using simulated survival data.

**License** GPL-3

**Encoding** UTF-8

**LazyData** true

**Depends** R (>= 3.4.0),

**Imports** magrittr (>= 1.5), mvtnorm, rlang, purrr, forcats, dplyr, tidy, tibble, ggplot2, survival (>= 2.43), methods

**Suggests** testthat (>= 2.1.0), vdiff, knitr, rmarkdown, survminer

**RoxygenNote** 7.1.1

**Language** en-US

**URL** <https://github.com/yoshidk6/survParamSim>

**BugReports** <https://github.com/yoshidk6/survParamSim/issues>

**VignetteBuilder** knitr

**NeedsCompilation** no

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**Repository** CRAN

**Date/Publication** 2020-12-08 18:10:02 UTC

## R topics documented:

calc_hr_pi . . . . .	2
calc_km_pi . . . . .	3
extract_km_pi . . . . .	3
extract_sim . . . . .	4
plot_hr_pi . . . . .	5
plot_km_pi . . . . .	5
print.survparamsim.hrpi . . . . .	6
surv_param_sim . . . . .	6

<b>Index</b>	<b>9</b>
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calc_hr_pi	<i>Generate hazard ratio with prediction intervals from parametric bootstrap simulation</i>
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### Description

Generate hazard ratio with prediction intervals from parametric bootstrap simulation

### Usage

```
calc_hr_pi(
  sim,
  trt,
  group = NULL,
  pi.range = 0.95,
  calc.obs = TRUE,
  trt.assign = c("default", "reverse")
)
```

### Arguments

sim	A survparamsim class object generated by <a href="#">surv_param_sim</a> function.
trt	A string to specify which column define treatment status to calculate HR. The specified column should have only two levels.
group	Optional string(s) to specify grouping variable(s). You will have faceted histograms for these variables in <a href="#">plot_hr_pi</a> function.
pi.range	Prediction interval for simulated HR.
calc.obs	A logical to specify whether to calculate HR for the observed data. Need be set as FALSE if survival information in the newdata is dummy.
trt.assign	Specify which of the categories of trt need to be considered as control group.

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calc_km_pi	<i>Generate Kaplan-Meier curves with prediction intervals from parametric bootstrap simulation</i>
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**Description**

Generate Kaplan-Meier curves with prediction intervals from parametric bootstrap simulation

**Usage**

```
calc_km_pi(
  sim,
  trt = NULL,
  group = NULL,
  pi.range = 0.95,
  calc.obs = TRUE,
  simtimelast = NULL
)
```

**Arguments**

sim	A survparamsim class object generated by <code>surv_param_sim</code> function.
trt	An optional string to specify which column define treatment status. You will have survival curves with different colors in <code>plot_km_pi</code> function.
group	Optional string(s) to specify grouping variable(s). You will have faceted survival curves for these variables in <code>plot_km_pi</code> function.
pi.range	Prediction interval for simulated survival curves.
calc.obs	A logical to specify whether KM estimates will be performed for the observed data. Need be set as FALSE if survival information in the newdata is dummy.
simtimelast	An optional numeric to specify last simulation time for survival curve. If NULL (default), the last observation time in the newdata will be used.

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extract_km_pi	<i>Functions to extract prediction intervals and observed data</i>
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**Description**

Functions to extract prediction intervals and observed data

**Usage**

```
extract_km_pi(km.pi, trunc.sim.censor = TRUE)

extract_median_surv(km.pi, outtype = c("long", "wide"))

extract_hr_pi(hr.pi, outtype = c("long", "wide"))
```

**Arguments**

km.pi	A return object from <a href="#">calc_km_pi</a> function.
trunc.sim.censor	A logical specifying whether to truncate the simulated curve at the last time of ‘censor.dur’ specified in <a href="#">surv_param_sim</a> .
outtype	Specifies whether output will be in long or wide format.
hr.pi	a return object from <a href="#">calc_hr_pi</a> function.

**Details**

[extract\\_km\\_pi](#) extracts prediction intervals of simulated Kaplan-Meier curves.

[extract\\_median\\_surv](#) extracts prediction intervals of median survival times and the corresponding observed values.

[extract\\_hr\\_pi](#) extracts prediction intervals of simulated hazard ratios and the corresponding observed values.

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extract_sim	<i>Functions to extract raw simulated samples</i>
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**Description**

Functions to extract raw simulated samples

**Usage**

```
extract_sim(sim)
```

```
extract_hr(hr.pi)
```

```
extract_km_obs(km.pi)
```

**Arguments**

sim	A survparamsim class object generated by <a href="#">surv_param_sim</a> function.
hr.pi	a return object from <a href="#">calc_hr_pi</a> function.
km.pi	A return object from <a href="#">calc_km_pi</a> function.

**Details**

[extract\\_sim](#) extracts raw survival time & event status for all simulated subjects.

[extract\\_hr](#) extracts simulated HRs for all repeated simulations

[extract\\_km\\_obs](#) extracts observed Kaplan-Meier curves.

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plot\_hr\_pi

*Plot HR*


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**Description**

Plot HR

**Usage**

```
plot_hr_pi(hr.pi, show.obs = TRUE)
```

**Arguments**

`hr.pi` a return object from [calc\\_hr\\_pi](#) function.

`show.obs` A logical specifying whether to show observed HR on the plot. This will have no effect if `calc.obs` was set to FALSE in [calc\\_hr\\_pi](#).

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plot\_km\_pi

*Plot Kaplan-Meier curves with prediction intervals from parametric bootstrap simulation*


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**Description**

Need to think about how to apply this for subgroups

**Usage**

```
plot_km_pi(km.pi, show.obs = TRUE, trunc.sim.censor = TRUE)
```

**Arguments**

`km.pi` an output from [calc\\_km\\_pi](#) function.

`show.obs` A logical specifying whether to show observed K-M curve on the plot. This will have no effect if `calc.obs` was set to FALSE in [calc\\_km\\_pi](#).

`trunc.sim.censor` A logical specifying whether to truncate the simulated curve at the last time of `censor.dur` specified in [surv\\_param\\_sim](#).

---

```
print.survparamsim.hrpi
```

*Methods for S3 objects in the package*

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### Description

Methods for S3 objects in the package

### Usage

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

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

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

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

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

### Arguments

x	An object of the corresponding class
...	Additional arguments passed to methods.
object	An object of the corresponding class

---

```
surv_param_sim
```

*Simulation of parametric survival model*

---

### Description

The main function to generate predicted survival using a model object generated with [survreg](#) function.

**Usage**

```

surv_param_sim(
  object,
  newdata,
  n.rep = 1000,
  censor.dur = NULL,
  coef.var = TRUE,
  na.warning = TRUE
)

surv_param_sim_resample(
  object,
  newdata,
  n.rep = 1000,
  censor.dur = NULL,
  n.resample,
  strat.resample = NULL
)

```

**Arguments**

object	A survreg class object. Currently accept exponential, lognormal, weibull, loglogistic, and gaussian distributions.
newdata	A required data frame for simulation that contain covariates in the survival model. It is required even if this is the same as the one used for <code>survreg</code> function.  It also has to contain columns for survival information. These can be used in <code>plot_km_pi</code> and <code>plot_hr_pi</code> function as observed data. Survival information can be dummy data, but time need to be long enough so that simulated KM plot will be long enough for <code>plot_km_pi</code> to draw simulated survival curves.  Subjects with NA for covariates in <code>survreg</code> model will be removed from the simulation and subsequent plotting of observed data.
n.rep	An integer defining numbers of parametric bootstrap runs
censor.dur	A two elements vector specifying duration of events censoring. Censoring time will be calculated with uniform distribution between two numbers. No censoring will be applied if NULL is provided.
coef.var	Boolean specifying whether parametric bootstrap are performed on survival model coefficients, based on variance-covariance matrix. If FALSE, prediction interval only reflects inherent variability from survival events.
na.warning	Boolean specifying whether warning will be shown if newdata contain subjects with missing model variables.
n.resample	Number of subjects for resampled simulations. If <code>strat.resample</code> is provided, this needs to be a vector of the length equal to the number of categories in the stratification variable.
strat.resample	String specifying stratification variable for resampling.

## Details

`surv_param_sim` returns simulation using the provided subject in `newdata` as it is, while `surv_param_sim_resample` perform simulation based on resampled subjects from the dataset. The latter allows more flexibility in terms of simulating future trials with different number of subjects.

Currently we have not tested whether this function work for a `survreg` model with stratification variables.

## Value

A `survparamsim` object that contains the original `survreg` class object, `newdata`, and a data frame for predicted survival profiles with the following columns:

- **time**: predicted event or censor time
- **event**: event status, 0=censored, 1=event
- **rep**: ID for parametric bootstrap runs
- **subj**: ID for subjects in `newdata` (currently original ID is not retained and `subj` is sequentially assigned as `1:nrow(newdata)`)

## Examples

```
library(survival)

fit.lung <- survreg(Surv(time, status) ~ sex + ph.ecog, data = lung)

object <- fit.lung
n.rep <- 30
newdata <-
  tibble::as_tibble(dplyr::select(lung, time, status, sex, ph.ecog)) %>%
  tidyr::drop_na()
censor.dur <- c(200, 1100)

sim <- surv_param_sim(object, newdata, n.rep, censor.dur)
```



# Index

calc\_hr\_pi, 2, 4, 5  
calc\_km\_pi, 3, 4, 5

extract\_hr, 4  
extract\_hr (extract\_sim), 4  
extract\_hr\_pi, 4  
extract\_hr\_pi (extract\_km\_pi), 3  
extract\_km\_obs, 4  
extract\_km\_obs (extract\_sim), 4  
extract\_km\_pi, 3, 4  
extract\_median\_surv, 4  
extract\_median\_surv (extract\_km\_pi), 3  
extract\_sim, 4, 4

plot\_hr\_pi, 2, 5, 7  
plot\_km\_pi, 3, 5, 7  
print.survparamsim  
    (print.survparamsim.hrpi), 6  
print.survparamsim.hrpi, 6

summary.survparamsim.hrpi  
    (print.survparamsim.hrpi), 6  
summary.survparamsim.kmpi  
    (print.survparamsim.hrpi), 6  
surv\_param\_sim, 2–5, 6, 8  
surv\_param\_sim\_resample, 8  
surv\_param\_sim\_resample  
    (surv\_param\_sim), 6  
survparamsim-methods  
    (print.survparamsim.hrpi), 6  
survreg, 6, 7