

Package ‘survRatio’

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Type Package

Title Estimating, Comparing and Visualising Time to Event Data

Version 0.1

Description The 'survRatio', provides numerical and graphical summaries for time to event data. In this release functions are provided to estimate and compare estimated survivor functions, the ratio of survivor functions and the difference of survivor functions in independent and paired time to event problems. Time intervals where the survival prospects may differ are identified using pointwise confidence bands. See "Survival ratio plots with permutation envelopes in survival data problems" by Newell J, et al. (2006) <doi:10.1016/j.combiomed.2005.03.005>.

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Depends survival (>= 2.38-3), ggplot2 (> 2.1.0)

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Author Jalali Amirhossein [aut, cre] (<<https://orcid.org/0000-0001-7227-8261>>),
Roshan Davood [aut] (<<https://orcid.org/0000-0002-6553-640X>>),
Moghaddam Shirin [aut] (<<https://orcid.org/0000-0002-9965-1510>>),
Newell John [aut] (<<https://orcid.org/0000-0001-7685-6655>>)

Maintainer Jalali Amirhossein <amir.jalali@ucc.ie>

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drsurv	<i>Bootstrap pointwise confidence bands for survival ratio and survival difference</i>
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Description

Estimate the survival ratio and survival difference accompanied by their pointwise confidence bands to provide a comparison of the survival prospects ($S(t)$) for independent and paired survival problems.

Usage

```
drsurv(time, status, factor, ref = NULL, tgrid = NULL, paired = FALSE, id = NULL,
       clevel = 0.95, nboot = 1000)
```

Arguments

time	a vector of the observed survival times.
status	a binary vector indicating the censoring status (typically 0 = 'censored', 1 = 'event').
factor	a binary vector indicating the group levels.
ref	the reference level (typically a string) used as the level to compare the survival prospects with.
tgrid	a sequence of follow-up time points to calculate survival estimates for.
paired	a logical indicator whether the survival data is paired. The default is paired = FALSE.
id	a pair identifier variable which must be provided for paired survival data problems (i.e. when paired = TRUE).
clevel	the confidence level used for constructing the pointwise confidence bands. The default is clevel = 0.95.
nboot	an integer indicating the number of bootstrap replicates. The default is nboot = 1000.

Value

A list of objects including a data frame of the estimates of survival ratio and survival difference accompanied by their pointwise confidence bands. In addition, it includes the confidence level used, the factor levels, the number of bootstrap replicates, whether an independent or paired design was used and the p-value from the log-ranke test of equality for independent designs.

Author(s)

Amirhossein Jalali, Shirin Moghaddam, Davood Roshan, John Newell

References

Newell, J., Kay, J. W., & Aitchison, T. C. (2006). Survival ratio plots with permutation envelopes in survival data problems. *Computers in biology and medicine*, 36(5), 526-541.

See Also

[Surv](#), [ggsurv](#)

Examples

```
require(survival)

##### Independent survival data

data(lung)
fit1 <- drsurv(time = lung$time, status = lung$status, factor = lung$sex)
ggsurv(fit1)

##### Paired survival data
data(retinopathy)
fit2 <- drsurv(retinopathy$futime, retinopathy$status, retinopathy$trt,
  paired = TRUE, id = retinopathy$id)
head(fit2$urv)
ggsurv(fit2, statistics = "all")
```

ggsurv

Plot method for [drsurv\(\)](#) objects

Description

`ggsurv` is a generic function to plot survival functions, difference in survival functions and ratios of survivor using `ggplot2`. The function plots or all plots as generated by the `drsurv()` function.

Usage

```
ggsurv(fit,
  statistics = c("surv", "diff", "ratio", "all"),
  palette = NULL,
  xlab = NULL, ylab = NULL,
  theme = NULL,
  table = FALSE,
  p.value = FALSE,
  flag = NULL,
  flag.col = NULL,
  break.times.by = NULL)
```

Arguments

fit	a <code>drsurv()</code> object.
statistics	<p>the statistics of interest to be plotted. The default is <code>statistics = "ratio"</code>.</p> <ul style="list-style-type: none"> • If <code>statistics = "surv"</code>, the Kaplan Meier estimated survivor function with confidence intervals will be plotted. • If <code>statistics = "diff"</code>, the difference in survival functions with the associated bootstrap pointwise confidence bands will be plotted. • If <code>statistics = "ratio"</code>, the ratio of survival functions with the associated bootstrap pointwise confidence bands will be plotted. • If <code>statistics = "all"</code> is selected, all of the survival, difference and ratio functions will be plotted in a single labelled graphic.
palette	<p>the color palette to be used for coloring or filling the survival, difference and ratio curves.</p> <ul style="list-style-type: none"> • If <code>statistics = "surv"</code>, the palette should consist of two colors that correspond to the levels of the factor variable in the <code>drsurv()</code> object. The default is <code>palette = c("red", "blue")</code>. • If <code>statistics = "diff"</code>, the palette should consist of one color. The default is <code>palette = "black"</code>. • If <code>statistics = "ratio"</code>, the palette should consist of one color. The default is <code>palette = "black"</code>. • If <code>statistics = "all"</code>, the palette should consist of four colors where the first two colors correspond to the levels of the factor variable in the <code>drsurv()</code> object. The third color indicates the color for the difference plot and the fourth color indicates the color for the ratio plot. The defaults are <code>palette = c("red", "blue", "black", "black")</code>.
xlab	a character specifying the x axis label. The default is <code>xlab = "Follow up times"</code> .
ylab	<p>a character specifying y axis label.</p> <ul style="list-style-type: none"> • If <code>statistics = "surv"</code>, the <code>ylab</code> should consist of only one character indicating the y axis label for the Kaplan Meier plot. The default is <code>ylab = "Estimated Survival Probability"</code>. • If <code>statistics = "diff"</code>, the <code>ylab</code> should consist of only one character indicating the y axis label for the Survival Difference plot. The default is <code>ylab = "Estimated Survival Difference"</code>. • If <code>statistics = "ratio"</code>, the <code>ylab</code> should consist of only one character indicating the y axis label for the Survival Ratio plot. The default is <code>ylab = "Estimated Survival Ratio"</code>. • If <code>statistics = "all"</code>, the <code>ylab</code> should consist of three characters indicating the y axis labels for the survival, difference and ratio plots, respectively. The default is <code>ylab = c("Estimated Survival Probability", "Estimated Survival Difference", "Estimated Survival Ratio")</code>.
theme	ggplot2 themes. Allowed values include ggplot2 official themes: <code>"bw"</code> for <code>theme_bw()</code> , <code>"classic"</code> for <code>theme_classic()</code> , <code>"dark"</code> for <code>theme_dark()</code> , <code>"gray"</code> for <code>theme_gray()</code> , <code>"light"</code> for <code>theme_light()</code> , <code>"linedraw"</code> for <code>theme_linedraw()</code> , <code>"minimal"</code> for <code>theme_minimal()</code> . The default is <code>theme = "minimal"</code> .

<code>table</code>	Allowed values include TRUE or FALSE specifying whether to display the table of the number of subjects at risk over time. Default is <code>table = FALSE</code> .
<code>p.value</code>	Allowed values include TRUE or FALSE specifying whether to display the p-value for the log-ranke test of equality for independent designs. Default is <code>p.value = FALSE</code> .
<code>flag</code>	Allowed values include TRUE or FALSE specifying whether or not to show regions where survival is different from 1 for the ratio and 0 for the difference. Default is <code>flag = TRUE</code> .
<code>flag.col</code>	the color palette to be used for coloring the time regions where survival is identified as being different when <code>flag = TRUE</code> . The default is <code>flag.col = c("green", "red")</code> where "green" indicates survival times where the (pointwise) confidence intervals contained 1 for the ratio or 0 for the difference while "red" indicates survival times where the (pointwise) confidence intervals did not contain 1 for the ratio or 0 for the difference.
<code>break.times.by</code>	numeric value controlling the time axis breaks. Default value is NULL.

Value

Returns an object of class `ggsurv` and `ggplot2` that displays either one (or all) of the Kaplan Meier estimated survivor function, the ratio of survivor functions or the difference of survivor functions as a single graphic using `ggplot2`.

Note

The `ggsurv()` object is a flexible `ggplot2` object that can be further modified and customised using `ggplot` commands when the arguments `table = FALSE` and `statistics` is not all. See the example provided below.

Author(s)

Davood Roshan, Amirhossein Jalali, Shirin Moghaddam, John Newell

References

<https://github.com/michaelway/ggkm>

See Also

[drsurv](#)

Examples

```
# Fit the drsurv model
#++++++
require(survival)
lung$sex <- as.factor(lung$sex)
levels(lung$sex) <- c("Male", "Female")
fit <- drsurv(time = lung$time, status = lung$status, factor = lung$sex, ref = "Female")
```

```

# Visualise the drsurv model output
#++++++

# Basic survival curves
ggsurv(fit, statistics = "surv")

# Customized survival curves
ggsurv(fit, statistics = "surv",
       palette = c("Orange", "purple"),
       xlab = "Time (days)", ylab = "Estimated Survival Probability",
       theme = "classic",
       table = TRUE,
       p.value = TRUE,
       break.times.by = 200)

# Survival difference curve
ggsurv(fit, statistics = "diff")

# Survival difference curve without the point wise significant different times flag
ggsurv(fit, statistics = "diff", flag = FALSE)

# Customized survival difference curve
ggsurv(fit, statistics = "diff",
       palette = c("gray"),
       xlab = "Time (days)", ylab = "Estimated Survival Difference",
       theme = "classic",
       flag = TRUE,
       flag.col = c("darkseagreen", "red4"),
       break.times.by = 200)

# Survival ratio curve
ggsurv(fit, statistics = "ratio")

# Customized survival ratio curve with further ggplot2 objects
ggsurv(fit, statistics = "ratio") +
  ggtitle("Overall survival from lung cancer") +
  theme(legend.position="bottom",
        legend.background = element_rect(fill="lightblue", linetype="solid")
  )

# Displaying all the survival, difference and ratio curves in one graphic
## For better visualisation, user may need to increase the ratio of "Plots" panel
## in Rstudio working environment.
ggsurv(fit, statistics = "all")

# Customized all in one curves
ggsurv(fit, statistics = "all",
       palette = c("Orange", "purple", "dimgray", "dimgray"),
       xlab = "Time (days)",
       ylab = c("Estimated Survivor Function", "Estimated Survival Difference"),

```

```
    "Estimated Survival Ratio"),
    theme = "light",
    table = TRUE, ## table will be only shown for the survival plot.
    p.value = TRUE, ## p.value will be only displayed for the survival plot.
    flag = TRUE,
    flag.col = c("limegreen", "darkred"),
    break.times.by = 150)

# personalized all in one curves
survp <- ggsurv(fit, statistics = "surv",
               p.value = TRUE,
               table = TRUE)

diffp <- ggsurv(fit, statistics = "diff")

ratiop <- ggsurv(fit, statistics = "ratio")

## changing the labels
ggpubr::ggarrange(survp,
                  ggpubr::ggarrange(diffp, ratiop, ncol = 2, labels = c("(ii)", "(iii)")),
                  nrow = 2,
                  labels = "(i)",
                  heights = c(1.3,1) # first row's height is 1.3 times bigger than 2nd row's height.
)

## changing the alignment and save it locally

#png("all_in_one.png", height = 1000, res=100)
#ggpubr::ggarrange(ratiop, diffp, survp,
#                  # nrow = 3,
#                  # labels = c("(i)", "(ii)", "(iii)"),
#                  # heights = c(1,1,1.5) # 1st and 2nd rows' heights are equal while
#                  # the 3rd row's height is 1.5 times bigger than the first #two rows.
#)
#dev.off()

## get the directory where the plot is saved
getwd()

### See ?ggpubr::ggarrange for more customizations.
```

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