

Package ‘tvrnst’

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Type Package

Title Time-Varying Restricted Mean Survival Time from Survival Matrices

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Author Imad EL BADISY [aut, cre]

Maintainer Imad EL BADISY <elbadisyimad@gmail.com>

Description Utilities for restricted mean survival time (RMST) and time-varying restricted mean survival time quantities computed from survival curves provided on a time grid. The package is model-agnostic and accepts only a time vector and survival matrices, returning RMST-based quantities and bootstrap summaries. For restricted mean survival time methodology, see Royston and Parmar (2013) <[doi:10.1186/1471-2288-13-152](https://doi.org/10.1186/1471-2288-13-152)>.

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as_survmat	<i>Construct a survival matrix object</i>
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Description

Construct a survival matrix object

Usage

```
as_survmat(S, time, id = NULL, group = NULL)
```

Arguments

S	Numeric matrix of survival probabilities (rows = subjects, columns = time).
time	Numeric strictly increasing time grid with <code>length(time) == ncol(S)</code> .
id	Optional subject identifiers. Defaults to <code>seq_len(nrow(S))</code> .
group	Optional group labels with length <code>nrow(S)</code> .

Value

An object of class "survmat".

Examples

```
time <- c(0, 1, 2)
S <- rbind(
  c(1.0, 0.8, 0.6),
  c(1.0, 0.7, 0.5)
)
x <- as_survmat(S, time, group = c("A", "B"))
x
```

as_survprob_matrix *Coerce survival predictions to a numeric matrix*

Description

Coerce survival predictions to a numeric matrix

Usage

```
as_survprob_matrix(pred, times = NULL)
```

Arguments

pred Prediction output from a model.
times Unused placeholder for API compatibility.

Value

Numeric matrix with rows as subjects and columns as times.

Examples

```
pred <- data.frame(  
  t0 = c(1.0, 1.0),  
  t1 = c(0.8, 0.7),  
  t2 = c(0.6, 0.5)  
)  
as_survprob_matrix(pred)
```

bind_survmat *Row-bind survmat objects on a common time grid*

Description

Row-bind survmat objects on a common time grid

Usage

```
bind_survmat(...)
```

Arguments

... One or more survmat objects.

Value

A combined survmat.

Examples

```
time <- c(0, 1, 2)
xA <- as_survmat(matrix(c(1.0, 0.9, 0.7), nrow = 1), time, group = "A")
xB <- as_survmat(matrix(c(1.0, 0.8, 0.6), nrow = 1), time, group = "B")
x <- bind_survmat(xA, xB)
nobs_survmat(x)
```

bootstrap_curve

*Generic bootstrap for curve-valued estimators***Description**

Generic bootstrap for curve-valued estimators

Usage

```
bootstrap_curve(est_fun, R = 300, conf = 0.95, seed = NULL, keep_reps = FALSE)
```

Arguments

est_fun	Function of one argument <i>r</i> ; called with NULL for the point estimate and with integers 1:R for bootstrap replicates.
R	Number of replicates.
conf	Confidence level in (0, 1).
seed	Optional RNG seed.
keep_reps	If TRUE, include replicate matrix in output.

Value

A list with estimate, lo, hi, and conf.

Examples

```
vals <- c(1, 2, 4, 8)
boot <- bootstrap_curve(
  function(r) {
    if (is.null(r)) {
      mean(vals)
    } else {
      mean(sample(vals, replace = TRUE))
    }
  },
  R = 20,
  seed = 1
)
boot$estimate
```

boot_rmst_delta	<i>Bootstrap CI for dynamic RMST delta curve</i>
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Description

Bootstrap CI for dynamic RMST delta curve

Usage

```
boot_rmst_delta(xA, xB, R = 300, conf = 0.95, seed = NULL)
```

Arguments

xA	A survmat object for arm A.
xB	A survmat object for arm B.
R	Number of bootstrap replicates.
conf	Confidence level in (0, 1).
seed	Optional RNG seed.

Value

A list with point estimate and percentile confidence bands.

Examples

```
time <- c(0, 1, 2)
xA <- as_survmat(rbind(c(1.0, 0.9, 0.7), c(1.0, 0.8, 0.6)), time, group = c("A", "A"))
xB <- as_survmat(rbind(c(1.0, 0.95, 0.8), c(1.0, 0.85, 0.7)), time, group = c("B", "B"))
boot <- boot_rmst_delta(xA, xB, R = 10, seed = 1)
boot$estimate
```

nobs_survmat	<i>Number of rows in a survmat</i>
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Description

Number of rows in a survmat

Usage

```
nobs_survmat(x)
```

Arguments

x	A survmat object.
---	-------------------

Value

Number of subjects.

Examples

```
time <- c(0, 1, 2)
S <- rbind(
  c(1.0, 0.8, 0.6),
  c(1.0, 0.7, 0.5)
)
x <- as_survmat(S, time)
nobs_survmat(x)
```

plot_boot_curve

Plot bootstrap estimate with confidence ribbon

Description

Plot bootstrap estimate with confidence ribbon

Usage

```
plot_boot_curve(
  boot,
  grid = NULL,
  title = "Bootstrap curve",
  xlab = "t",
  ylab = "estimate",
  x_scale = 1,
  y_scale = 1,
  x_unit = NULL,
  y_unit = NULL
)
```

Arguments

boot	List returned by <code>bootstrap_curve()</code> or <code>boot_rmst_delta()</code> .
grid	Optional x-axis grid. If omitted, uses <code>boot\$time</code> .
title	Plot title.
xlab	X-axis label.
ylab	Y-axis label.
x_scale	Positive divisor applied to the x-axis values before plotting.
y_scale	Positive divisor applied to the y-axis values before plotting.
x_unit	Optional unit label appended to the x-axis title.
y_unit	Optional unit label appended to the y-axis title.

Value

A ggplot object.

Examples

```
time <- c(0, 1, 2)
xA <- as_survmat(rbind(c(1.0, 0.9, 0.7), c(1.0, 0.8, 0.6)), time, group = c("A", "A"))
xB <- as_survmat(rbind(c(1.0, 0.95, 0.8), c(1.0, 0.85, 0.7)), time, group = c("B", "B"))
boot <- boot_rmst_delta(xA, xB, R = 10, seed = 1)
plot_boot_curve(boot)
```

plot_delta_curve *Plot a delta curve*

Description

Plot a delta curve

Usage

```
plot_delta_curve(
  grid,
  delta,
  title = "Delta curve",
  xlab = "t",
  ylab = "Delta",
  x_scale = 1,
  y_scale = 1,
  x_unit = NULL,
  y_unit = NULL
)
```

Arguments

grid	X-axis grid.
delta	Y values.
title	Plot title.
xlab	X-axis label.
ylab	Y-axis label.
x_scale	Positive divisor applied to the x-axis values before plotting.
y_scale	Positive divisor applied to the y-axis values before plotting.
x_unit	Optional unit label appended to the x-axis title.
y_unit	Optional unit label appended to the y-axis title.

Value

A ggplot object.

Examples

```
time <- c(0, 1, 2)
xA <- as_survmat(rbind(c(1.0, 0.9, 0.7), c(1.0, 0.8, 0.6)), time, group = c("A", "A"))
xB <- as_survmat(rbind(c(1.0, 0.95, 0.8), c(1.0, 0.85, 0.7)), time, group = c("B", "B"))
d <- rmst_delta(xA, xB)
plot_delta_curve(d$time, d$delta)
```

plot_rmst_individual_by_group

Plot individual dynamic RMST curves by group

Description

Plot individual dynamic RMST curves by group

Usage

```
plot_rmst_individual_by_group(
  res,
  group,
  n_show_per_group = 30,
  title = "Individual dynamic RMST by group",
  x_scale = 1,
  y_scale = 1,
  x_unit = NULL,
  y_unit = NULL
)
```

Arguments

res	Result from <code>rmst_dynamic()</code> containing individual and time.
group	Group vector aligned with rows of <code>res\$individual</code> .
n_show_per_group	Maximum number of individual curves shown per group.
title	Plot title.
x_scale	Positive divisor applied to the x-axis values before plotting.
y_scale	Positive divisor applied to the y-axis values before plotting.
x_unit	Optional unit label appended to the x-axis title.
y_unit	Optional unit label appended to the y-axis title.

Value

A ggplot object.

Examples

```
time <- c(0, 1, 2)
S <- rbind(
  c(1.0, 0.9, 0.7),
  c(1.0, 0.8, 0.6),
  c(1.0, 0.95, 0.8),
  c(1.0, 0.85, 0.7)
)
grp <- c("A", "A", "B", "B")
x <- as_survmat(S, time, group = grp)
res <- rmst_dynamic(x)
plot_rmst_individual_by_group(res, grp, n_show_per_group = 2)
```

plot_rmst_two_arms *Plot mean RMST curves for two arms*

Description

Plot mean RMST curves for two arms

Usage

```
plot_rmst_two_arms(
  xA,
  xB,
  labels = c("Arm A", "Arm B"),
  title = NULL,
  xlab = "Time (tau)",
  ylab = "RMST(tau)",
  curve_colors = c("#1B6CA8", "#D95F02"),
  x_scale = 1,
  y_scale = 1,
  x_unit = NULL,
  y_unit = NULL
)
```

Arguments

xA	A survmat object for arm A.
xB	A survmat object for arm B.
labels	Two legend labels.
title	Plot title. Use NULL to omit it.

xlab	X-axis label.
ylab	Y-axis label.
curve_colors	Colors for the two curves.
x_scale	Positive divisor applied to the x-axis values before plotting.
y_scale	Positive divisor applied to the y-axis values before plotting.
x_unit	Optional unit label appended to the x-axis title.
y_unit	Optional unit label appended to the y-axis title.

Value

A ggplot object.

Examples

```
time <- c(0, 1, 2)
xA <- as_survmat(rbind(c(1.0, 0.9, 0.7), c(1.0, 0.8, 0.6)), time, group = c("A", "A"))
xB <- as_survmat(rbind(c(1.0, 0.95, 0.8), c(1.0, 0.85, 0.7)), time, group = c("B", "B"))
plot_rmst_two_arms(xA, xB, labels = c("Control", "Treatment"))
```

rmst_delta

Dynamic RMST difference between two arms

Description

Computes $\Delta(\tau) = \text{RMST}_B(\tau) - \text{RMST}_A(\tau)$.

Usage

```
rmst_delta(xA, xB, tau = NULL)
```

Arguments

xA	A survmat object for arm A.
xB	A survmat object for arm B.
tau	Optional numeric horizons for interpolation.

Value

A list with RMST curves for both arms and the delta curve.

Examples

```
time <- c(0, 1, 2)
xA <- as_survmat(rbind(c(1.0, 0.9, 0.7), c(1.0, 0.8, 0.6)), time, group = c("A", "A"))
xB <- as_survmat(rbind(c(1.0, 0.95, 0.8), c(1.0, 0.85, 0.7)), time, group = c("B", "B"))
rmst_delta(xA, xB, tau = 1.5)$at_tau
```

rmst_dynamic	<i>Dynamic RMST trajectories</i>
--------------	----------------------------------

Description

Computes $RMST_i(\tau) = \int_0^\tau S_i(u) du$ over the provided grid.

Usage

```
rmst_dynamic(x, tau = NULL, by = x$group)
```

Arguments

x	A survmat object.
tau	Optional numeric horizons for interpolation.
by	Optional grouping variable. Defaults to x\$group.

Value

A list with individual and mean RMST curves.

Examples

```
time <- c(0, 1, 2)
S <- rbind(
  c(1.0, 0.8, 0.6),
  c(1.0, 0.7, 0.5)
)
x <- as_survmat(S, time, group = c("A", "A"))
res <- rmst_dynamic(x, tau = c(0.5, 1.5))
res$mean
res$at_tau
```

tvrmt	<i>tvrmt: Matrix-first dynamic restricted mean survival time utilities</i>
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Description

Tools for dynamic restricted mean survival time estimation, restricted mean survival time contrasts, bootstrap uncertainty, and plotting from survival probability matrices evaluated on a common time grid.

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