

Package ‘SuperSurv’

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Type Package

Title A Unified Framework for Machine Learning Ensembles in Survival Analysis

Version 0.1.2

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Description Implements a Super Learner framework for right-censored survival data. The package fits convex combinations of parametric, semiparametric, and machine learning survival learners by minimizing cross-validated risk using inverse probability of censoring weighting (IPCW). It provides tools for automated hyperparameter grid search, high-dimensional variable screening, and evaluation of prediction performance using metrics such as the Brier score, Uno's C-index, and time-dependent area under the curve (AUC). Additional utilities support model interpretation for survival ensembles, including Shapley additive explanations (SHAP), and estimation of covariate-adjusted restricted mean survival time (RMST) contrasts. The methodology is related to treatment-specific survival curve estimation using machine learning described by Westling et al. (2024) <[doi:10.1080/01621459.2023.2205060](https://doi.org/10.1080/01621459.2023.2205060)>, and the unified ensemble framework described in Lyu et al. (2026) <[doi:10.64898/2026.03.11.711010](https://doi.org/10.64898/2026.03.11.711010)>.

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<code>coef.SuperSurv</code>	<i>Extract SuperSurv ensemble coefficients</i>
-----------------------------	--

Description

Returns the optimized convex-combination weights from a fitted SuperSurv object.

Usage

```
## S3 method for class 'SuperSurv'
coef(object, type = c("event", "censoring", "both"), ...)
```

Arguments

<code>object</code>	A fitted object of class "SuperSurv".
<code>type</code>	Character string specifying which weights to return. Use "event" for the event-time ensemble, "censoring" for the censoring ensemble, or "both" for both sets of weights.
<code>...</code>	Additional arguments ignored.

Value

For `type = "event"` or `type = "censoring"`, a named numeric vector of ensemble weights. For `type = "both"`, a list with elements `event` and `censoring`.

Examples

```

if (requireNamespace("glmnet", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:80, ]
  x_cols <- grep("^x", names(dat))[1:5]
  X <- dat[, x_cols, drop = FALSE]
  new.times <- seq(20, 120, by = 20)

  fit <- SuperSurv(
    time = dat$duration,
    event = dat$event,
    X = X,
    newdata = X,
    new.times = new.times,
    event.library = c("surv.coxph", "surv.ridge"),
    cens.library = c("surv.coxph"),
    control = list(saveFitLibrary = TRUE)
  )

  coef(fit)
  coef(fit, type = "both")
}

```

estimate_marginal_rmst

Estimate an Adjusted Marginal RMST Contrast

Description

Computes a covariate-adjusted marginal contrast on the restricted mean survival time (RMST) scale using standardization (g-computation) based on a fitted SuperSurv model.

Usage

```

estimate_marginal_rmst(
  fit,
  data,
  trt_col,
  times,
  tau,
  inference = FALSE,
  B = 200,
  seed = NULL,
  ci_level = 0.95
)

```

Arguments

<code>fit</code>	A fitted object of class "SuperSurv".
<code>data</code>	A data frame containing the covariates used for standardization, including the binary grouping variable specified by <code>trt_col</code> .
<code>trt_col</code>	Character string giving the name of the binary grouping variable in data. The variable is set to 1 and 0, respectively, to generate the two standardized prediction regimes.
<code>times</code>	Numeric vector of prediction time points corresponding to the evaluation grid used for survival prediction.
<code>tau</code>	Numeric scalar giving the restriction horizon for RMST. Must not exceed $\max(\text{times})$.
<code>inference</code>	Logical; if TRUE, compute perturbation-based standard errors, confidence intervals, and a Wald-type p-value. Defaults to FALSE.
<code>B</code>	Integer giving the number of perturbation replicates when <code>inference = TRUE</code> . Defaults to 200.
<code>seed</code>	Optional integer seed for reproducibility of the perturbation procedure.
<code>ci_level</code>	Numeric scalar in $(0, 1)$ specifying the confidence level for the Wald-type confidence interval. Defaults to 0.95.

Details

For a binary grouping variable `trt_col`, the function predicts counterfactual survival curves under $A = 1$ and $A = 0$ for every individual in the supplied dataset, integrates each curve up to the restriction time `tau`, and averages the resulting individual-level RMST differences. The resulting contrast is generally interpreted as an adjusted marginal contrast. When `trt_col` corresponds to a manipulable intervention and additional identification assumptions hold, the same standardized procedure may also support a causal interpretation.

If `inference = TRUE`, the function additionally performs a perturbation-based inference procedure conditional on the fitted SuperSurv model. In this implementation, the fitted learner library, hyperparameters, base learners, and ensemble weights are held fixed, and random positive weights are applied to the individual-level RMST contrasts to estimate a perturbation-based standard error, Wald-type confidence interval, and p-value.

The function uses the empirical distribution of the observed covariates in data as the standardization distribution. RMST is evaluated numerically from the predicted survival matrix using a left Riemann sum over the supplied grid `times`.

The perturbation-based inference implemented here is conditional on the fitted SuperSurv model. It does not re-tune hyperparameters, reselect the learner library, or refit the base learners under each perturbation. Instead, it perturbs the aggregation of the individual-level predicted RMST contrasts. This yields a lightweight uncertainty quantification procedure for the standardized RMST contrast given the final fitted ensemble.

Value

A list containing:

- `ATE_RMST`: The estimated adjusted marginal RMST contrast $\widehat{\Delta}_{RMST}(\tau)$.

- mean_RMST_Treated: The average predicted RMST under $A = 1$.
- mean_RMST_Control: The average predicted RMST under $A = 0$.
- tau: The restriction horizon used for integration.
- patient_rmst_treated: Vector of individual-level predicted RMST values under $A = 1$.
- patient_rmst_control: Vector of individual-level predicted RMST values under $A = 0$.
- patient_delta_rmst: Vector of individual-level predicted RMST contrasts.
- inference: Logical indicator for whether perturbation-based inference was requested.
- B: Number of perturbation replicates used when `inference = TRUE`; otherwise NULL.
- SE_RMST: Perturbation-based standard error of the RMST contrast; otherwise NULL.
- CI_RMST: Wald-type confidence interval for the RMST contrast; otherwise NULL.
- z_value: Wald-type test statistic; otherwise NULL.
- p_value: Two-sided Wald-type p-value; otherwise NULL.
- perturb_reps: Vector of perturbation replicate estimates; otherwise NULL.

Examples

```
## Not run:
data("metabric", package = "SuperSurv")
x_cols <- grep("^x", names(metabric), value = TRUE)
X <- metabric[, x_cols]
new.times <- seq(10, 150, by = 10)

fit <- SuperSurv(
  time = metabric$duration,
  event = metabric$event,
  X = X,
  newdata = X,
  new.times = new.times,
  event.library = c("surv.coxph", "surv.rfsrc"),
  cens.library = c("surv.coxph"),
  control = list(saveFitLibrary = TRUE),
  nFolds = 3
)

rmst_res <- estimate_marginal_rmst(
  fit = fit,
  data = metabric,
  trt_col = "x4",
  times = new.times,
  tau = 100,
  inference = TRUE,
  B = 200,
  seed = 123
)

rmst_res$ATE_RMST
rmst_res$SE_RMST
rmst_res$CI_RMST
```

```
format.pval(rmst_res$p_value, digits = 3, eps = 1e-16)

## End(Not run)
```

eval_brier

IPCW Brier Score and Integrated Brier Score (IBS)

Description

Calculates the Inverse Probability of Censoring Weighted (IPCW) Brier Score over a grid of times, and computes the Integrated Brier Score (IBS) using trapezoidal integration.

Usage

```
eval_brier(time, event, S_mat, times, tmin = min(times), tmax = max(times))
```

Arguments

time	Numeric vector of observed follow-up times.
event	Numeric vector of event indicators (1 = event, 0 = censored).
S_mat	A numeric matrix of predicted survival probabilities (rows = observations, columns = time points).
times	Numeric vector of evaluation times matching the columns of S_mat.
tmin	Numeric. Lower bound for IBS integration. Defaults to min(times).
tmax	Numeric. Upper bound for IBS integration. Defaults to max(times).

Value

A list containing:

- brier_scores: A numeric vector of Brier scores at each time point.
- ibs: The Integrated Brier Score over the range `{tmin}`, `{tmax}`.
- times: The time grid used.

Examples

```
data("metabric", package = "SuperSurv")
dat <- metabric[1:40, ]
x_cols <- grep("^x", names(dat))[1:3]
X <- dat[, x_cols, drop = FALSE]
newX <- X[1:10, , drop = FALSE]
times <- seq(50, 150, by = 50)

fit <- surv.coxph(
  time = dat$duration,
  event = dat$event,
```

```

X = X,
newdata = newX,
new.times = times,
obsWeights = rep(1, nrow(dat)),
id = NULL
)

eval_brier(
  time = dat$duration[1:10],
  event = dat$event[1:10],
  S_mat = fit[["pred"]],
  times = times
)

```

eval_cindex

Calculate Concordance Index (Harrell's or Uno's)

Description

Calculate Concordance Index (Harrell's or Uno's)

Usage

```
eval_cindex(time, event, S_mat, times, eval_time, method = "uno")
```

Arguments

time	Numeric vector of observed follow-up times.
event	Numeric vector of event indicators (1 = event, 0 = censored).
S_mat	A numeric matrix of predicted survival probabilities.
times	Numeric vector of evaluation times matching the columns of S_mat.
eval_time	Numeric. The specific time point at which to extract predictions.
method	Character. Either "harrell" or "uno". Defaults to "uno".

Value

A numeric value representing the chosen C-index.

Examples

```

data("metabric", package = "SuperSurv")
dat <- metabric[1:40, ]
x_cols <- grep("^x", names(dat))[1:3]
X <- dat[, x_cols, drop = FALSE]
newX <- X[1:10, , drop = FALSE]
times <- seq(50, 150, by = 50)

fit <- surv.coxph(

```

```

    time = dat$duration,
    event = dat$event,
    X = X,
    newdata = newX,
    new.times = times,
    obsWeights = rep(1, nrow(dat)),
    id = NULL
  )

eval_cindex(
  time = dat$duration[1:10],
  event = dat$event[1:10],
  S_mat = fit[["pred"]],
  times = times,
  eval_time = 100,
  method = "uno"
)

```

eval_summary

Evaluate SuperSurv predictions on test data

Description

Computes the integrated Brier score (IBS), Uno C-index, and integrated area under the curve (iAUC) for the SuperSurv ensemble and all individual base learners.

Usage

```

eval_summary(
  object,
  newdata,
  time,
  event,
  eval_times,
  risk_time = stats::median(eval_times),
  verbose = FALSE
)

```

Arguments

object	A fitted SuperSurv object.
newdata	A data.frame of test covariates.
time	Numeric vector of observed follow-up times for the test set.
event	Numeric vector of event indicators for the test set.
eval_times	Numeric vector of times at which to evaluate survival predictions.
risk_time	Numeric. The specific time horizon used when extracting risk scores for Uno C-index. Defaults to the median of eval_times.
verbose	Logical; if TRUE, progress messages are shown.

Value

An object of class "SuperSurv_eval" containing benchmark metrics for the ensemble and base learners.

Examples

```
data("metabric", package = "SuperSurv")
dat <- metabric[1:80, ]
x_cols <- grep("^x", names(dat))[1:3]

fit <- SuperSurv(
  time = dat$duration,
  event = dat$event,
  X = dat[, x_cols, drop = FALSE],
  new.times = seq(50, 200, by = 50),
  event.library = c("surv.coxph", "surv.km"),
  cens.library = c("surv.coxph", "surv.km")
)

res <- eval_summary(
  object = fit,
  newdata = dat[, x_cols, drop = FALSE],
  time = dat$duration,
  event = dat$event,
  eval_times = seq(50, 200, by = 50)
)

res
```

 eval_timeROC

Time-Dependent AUC and Integrated AUC

Description

Evaluates the cumulative/dynamic time-dependent AUC and integrated AUC (iAUC) using inverse probability of censoring weighting (IPCW).

Usage

```
eval_timeROC(time, event, S_mat, times)
```

Arguments

time	Numeric vector of observed follow-up times.
event	Numeric vector of event indicators (1 = event, 0 = censored).
S_mat	A numeric matrix of predicted survival probabilities.
times	Numeric vector of evaluation times matching the columns of S_mat.

Value

A list containing the AUC_curve at each time point, the times, and the integrated AUC iAUC.

Examples

```
data("metabric", package = "SuperSurv")
dat <- metabric[1:40, ]
x_cols <- grep("^x", names(dat))[1:3]
X <- dat[, x_cols, drop = FALSE]
newX <- X[1:10, , drop = FALSE]
times <- seq(50, 150, by = 50)

fit <- surv.coxph(
  time = dat$duration,
  event = dat$event,
  X = X,
  newdata = newX,
  new.times = times,
  obsWeights = rep(1, nrow(dat)),
  id = NULL
)

eval_timeROC(
  time = dat$duration[1:10],
  event = dat$event[1:10],
  S_mat = fit[["pred"]],
  times = times
)
```

eval_times

Access SuperSurv prediction evaluation times

Description

Returns the time grid used for the fitted SuperSurv predictions.

Usage

```
eval_times(object, ...)
```

```
## S3 method for class 'SuperSurv'
eval_times(object, ...)
```

Arguments

object A fitted object of class "SuperSurv".
... Additional arguments ignored.

Value

A numeric vector of prediction evaluation times.

event_weights	<i>Access SuperSurv ensemble weights</i>
---------------	--

Description

Extracts the fitted event or censoring ensemble weights from a SuperSurv object.

Usage

```
event_weights(object, ...)

## S3 method for class 'SuperSurv'
event_weights(object, ...)

censor_weights(object, ...)

## S3 method for class 'SuperSurv'
censor_weights(object, ...)
```

Arguments

object A fitted object of class "SuperSurv".
 ... Additional arguments ignored.

Value

A named numeric vector of ensemble weights.

Examples

```
if (requireNamespace("glmnet", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:80, ]
  x_cols <- grep("^x", names(dat))[1:5]
  X <- dat[, x_cols, drop = FALSE]
  new.times <- seq(20, 120, by = 20)

  fit <- SuperSurv(
    time = dat$duration,
    event = dat$event,
    X = X,
    newdata = X,
    new.times = new.times,
    event.library = c("surv.coxph", "surv.ridge"),
    cens.library = c("surv.coxph"),
```

```

      control = list(saveFitLibrary = TRUE)
    )

    event_weights(fit)
    censor_weights(fit)
  }

```

explain_kernel	<i>Explain Predictions with Global SHAP (Kernel SHAP)</i>
----------------	---

Description

Explain Predictions with Global SHAP (Kernel SHAP)

Usage

```

explain_kernel(
  model,
  X_explain,
  X_background,
  nsim = 20,
  only_best = FALSE,
  verbose = FALSE
)

```

Arguments

model	A fitted SuperSurv object OR a single wrapper output.
X_explain	The dataset you want to explain (e.g., X_test[1:10,]).
X_background	The reference dataset for fastshap (e.g., X_train[1:100,]).
nsim	Number of simulations. Defaults to 20.
only_best	Logical. If TRUE and model is SuperSurv, only explains the highest-weighted base learner.
verbose	Logical; if TRUE, progress messages are shown.

Value

A data.frame of class c("explain", "data.frame") containing the calculated SHAP values. The columns correspond to the covariates in X_explain.

Examples

```

if (requireNamespace("fastshap", quietly = TRUE) &&
    requireNamespace("glmnet", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:80, ]
  x_cols <- grep("^x", names(dat))[1:5]
}

```

```

X <- dat[, x_cols, drop = FALSE]
new.times <- seq(20, 120, by = 20)

fit <- SuperSurv(
  time = dat$duration,
  event = dat$event,
  X = X,
  newdata = X,
  new.times = new.times,
  event.library = c("surv.coxph", "surv.ridge"),
  cens.library = c("surv.coxph"),
  control = list(saveFitLibrary = TRUE)
)

shap_values <- explain_kernel(
  model = fit,
  X_explain = X[1:10, , drop = FALSE],
  X_background = X[11:40, , drop = FALSE],
  nsim = 5
)

dim(shap_values)
}

```

explain_survex

Create a Time-Dependent Survex Explainer

Description

Bridges a fitted SuperSurv ensemble or a single base learner to the survex package for Time-Dependent SHAP and Model Parts.

Usage

```
explain_survex(model, data, y, times, label = NULL)
```

Arguments

model	A fitted SuperSurv object OR a single wrapper output.
data	Covariate data for explanation (data.frame).
y	The survival object (Surv(time, event)).
times	The time grid for evaluation.
label	Optional character string to name the explainer.

Value

An explainer object of class `survex_explainer` created by [explain_survival](#), which can be passed to DALEX and survex functions for further model diagnostics and plotting.

Examples

```

if (requireNamespace("survex", quietly = TRUE) &&
    requireNamespace("glmnet", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:80, ]
  x_cols <- grep("^x", names(dat))[1:5]
  X <- dat[, x_cols, drop = FALSE]
  times <- seq(20, 120, by = 20)
  y <- survival::Surv(dat$duration, dat$event)

  fit <- SuperSurv(
    time = dat$duration,
    event = dat$event,
    X = X,
    newdata = X,
    new.times = times,
    event.library = c("surv.coxph", "surv.ridge"),
    cens.library = c("surv.coxph"),
    control = list(saveFitLibrary = TRUE)
  )

  explainer <- explain_survex(
    model = fit,
    data = X,
    y = y,
    times = times,
    label = "SuperSurv_demo"
  )

  class(explainer)
}

```

 learner_names

Access SuperSurv learner names

Description

Returns the fitted learner names from a SuperSurv object.

Usage

```
learner_names(object, ...)
```

```
## S3 method for class 'SuperSurv'
```

```
learner_names(object, type = c("event", "censoring", "both"), ...)
```

Arguments

object	A fitted object of class "SuperSurv".
...	Additional arguments ignored.
type	Character string specifying whether to return event learner names, censoring learner names, or both.

Value

For type = "event" or type = "censoring", a character vector of learner names. For type = "both", a list with elements event and censoring.

list_wrappers	<i>List Available Wrappers and Screeners in SuperSurv</i>
---------------	---

Description

This function prints all built-in prediction algorithms and feature screening algorithms available in the SuperSurv package.

Usage

```
list_wrappers(what = "both")
```

Arguments

what	Character string. If "both" (default), lists both prediction and screening functions. If "surv", lists only prediction models. If "screen", lists only screening algorithms. Otherwise, lists all exports.
------	--

Value

An invisible character vector containing the requested function names.

Examples

```
list_wrappers()
```

`metabric`*METABRIC Breast Cancer Dataset*

Description

A subset of the Molecular Taxonomy of Breast Cancer International Consortium (METABRIC) dataset to demonstrate the SuperSurv package. 9 Covariates: 4 gene indicators (MKI67, EGFR, PGR, and ERBB2) and 5 clinical features (age at diagnosis, and indicators for hormone treatment, radiotherapy, and chemotherapy)

Usage`metabric`**Format**

A data frame with the clinical and genomic variables:

duration Survival time.

event Event indicator (1 = event, 0 = censored).

x0 Feature x0.

x1 Feature x1.

x2 Feature x2.

x3 Feature x3.

x4 Feature x4.

x5 Feature x5.

x6 Feature x6.

x7 Feature x7.

x8 Feature x8.

`plot_beeswarm`*Beeswarm Summary Plot for SuperSurv SHAP*

Description

Beeswarm Summary Plot for SuperSurv SHAP

Usage`plot_beeswarm(shap_values, data, top_n = 10)`

Arguments

shap_values	The output from explain_kernel().
data	The covariate data used (X_explain)
top_n	Number of features to display

Value

A ggplot object visualizing the SHAP values.

Examples

```

if (requireNamespace("fastshap", quietly = TRUE) &&
    requireNamespace("ggforce", quietly = TRUE) &&
    requireNamespace("glmnet", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:80, ]
  x_cols <- grep("^x", names(dat))[1:5]
  X <- dat[, x_cols, drop = FALSE]
  new.times <- seq(20, 120, by = 20)

  fit <- SuperSurv(
    time = dat$duration,
    event = dat$event,
    X = X,
    newdata = X,
    new.times = new.times,
    event.library = c("surv.coxph", "surv.ridge"),
    cens.library = c("surv.coxph"),
    control = list(saveFitLibrary = TRUE)
  )

  shap_values <- explain_kernel(
    model = fit,
    X_explain = X[1:20, , drop = FALSE],
    X_background = X[21:50, , drop = FALSE],
    nsim = 5
  )

  plot_beeswarm(
    shap_values = shap_values,
    data = X[1:20, , drop = FALSE],
    top_n = 5
  )
}

```

Description

Generates time-dependent performance curves comparing the SuperSurv ensemble against its base learners, or evaluates a single standalone learner.

Usage

```
plot_benchmark(
  object,
  newdata,
  time,
  event,
  eval_times,
  metrics = c("brier", "auc", "cindex"),
  verbose = FALSE
)
```

Arguments

object	A fitted SuperSurv object OR a fitted standalone learner.
newdata	A data.frame of test covariates.
time	Numeric vector of observed follow-up times for the test set.
event	Numeric vector of event indicators for the test set.
eval_times	Numeric vector of times at which to evaluate predictions.
metrics	Character vector specifying which plots to return. Options: "brier", "auc", "cindex". Defaults to all three.
verbose	Logical; if TRUE, progress messages are shown. Defaults to FALSE.

Value

A combined patchwork ggplot object, or a single ggplot if only one metric is selected.

Examples

```
if (requireNamespace("glmnet", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:120, ]
  x_cols <- grep("^x", names(dat))[1:5]
  X <- dat[, x_cols, drop = FALSE]
  eval_times <- seq(20, 120, by = 20)

  fit <- SuperSurv(
    time = dat$duration,
    event = dat$event,
    X = X,
    newdata = X,
    new.times = eval_times,
    event.library = c("surv.coxph", "surv.ranger"),
    cens.library = c("surv.coxph"),
```

```

    control = list(saveFitLibrary = TRUE)
  )

  plot_benchmark(
    object = fit,
    newdata = X,
    time = dat$duration,
    event = dat$event,
    eval_times = eval_times,
    metrics = c("brier")
  )
}

```

plot_calibration *Plot Survival Calibration Curve*

Description

Plot Survival Calibration Curve

Usage

```
plot_calibration(object, newdata, time, event, eval_time, bins = 5)
```

Arguments

object	A fitted SuperSurv object OR a standalone base learner.
newdata	A data.frame of test covariates.
time	Numeric vector of observed follow-up times for the test set.
event	Numeric vector of event indicators for the test set.
eval_time	Numeric. A single time point at which to assess calibration.
bins	Integer. Defaults to 5.

Value

A ggplot object.

Examples

```

if (requireNamespace("glmnet", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:120, ]
  x_cols <- grep("^x", names(dat))[1:5]
  X <- dat[, x_cols, drop = FALSE]
  eval_times <- seq(20, 120, by = 20)

  fit <- SuperSurv(
    time = dat$duration,

```

```

    event = dat$event,
    X = X,
    newdata = X,
    new.times = eval_times,
    event.library = c("surv.coxph", "surv.ridge"),
    cens.library = c("surv.coxph"),
    control = list(saveFitLibrary = TRUE)
  )

  plot_calibration(
    object = fit,
    newdata = X,
    time = dat$duration,
    event = dat$event,
    eval_time = 100,
    bins = 4
  )
}

```

plot_dependence

Plot SHAP Dependence for SuperSurv

Description

Plot SHAP Dependence for SuperSurv

Usage

```
plot_dependence(shap_values, data, feature_name, title = NULL)
```

Arguments

shap_values	The output from explain_kernel().
data	The original covariate data used for the explanation (X_explain)
feature_name	String name of the column to plot
title	Optional custom title.

Value

A ggplot object visualizing the SHAP values.

Examples

```

if (requireNamespace("fastshap", quietly = TRUE) &&
    requireNamespace("glmnet", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:80, ]
  x_cols <- grep("^x", names(dat))[1:5]
  X <- dat[, x_cols, drop = FALSE]
}

```

```

new.times <- seq(20, 120, by = 20)

fit <- SuperSurv(
  time = dat$duration,
  event = dat$event,
  X = X,
  newdata = X,
  new.times = new.times,
  event.library = c("surv.coxph", "surv.ridge"),
  cens.library = c("surv.coxph"),
  control = list(saveFitLibrary = TRUE)
)

shap_values <- explain_kernel(
  model = fit,
  X_explain = X[1:20, , drop = FALSE],
  X_background = X[21:50, , drop = FALSE],
  nsim = 5
)

plot_dependence(
  shap_values = shap_values,
  data = X[1:20, , drop = FALSE],
  feature_name = colnames(X)[1]
)
}

```

plot_global_importance

Plot Global Feature Importance for SuperSurv

Description

Plot Global Feature Importance for SuperSurv

Usage

```

plot_global_importance(
  shap_values,
  title = "SuperSurv: Ensemble Feature Importance",
  top_n = 10
)

```

Arguments

shap_values	The output from explain_kernel().
title	Plot title.
top_n	Number of features to show (default 10)

Value

A ggplot object visualizing the SHAP values.

Examples

```

if (requireNamespace("fastshap", quietly = TRUE) &&
    requireNamespace("glmnet", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:80, ]
  x_cols <- grep("^x", names(dat))[1:5]
  X <- dat[, x_cols, drop = FALSE]
  new.times <- seq(20, 120, by = 20)

  fit <- SuperSurv(
    time = dat$duration,
    event = dat$event,
    X = X,
    newdata = X,
    new.times = new.times,
    event.library = c("surv.coxph", "surv.ridge"),
    cens.library = c("surv.coxph"),
    control = list(saveFitLibrary = TRUE)
  )

  shap_values <- explain_kernel(
    model = fit,
    X_explain = X[1:10, , drop = FALSE],
    X_background = X[11:40, , drop = FALSE],
    nsim = 5
  )

  plot_global_importance(shap_values, top_n = 5)
}

```

plot_marginal_rmst_curve

Plot Adjusted Marginal RMST Contrast Over Time

Description

Generates a curve showing how the adjusted marginal restricted mean survival time (RMST) contrast evolves across a sequence of restriction times.

Usage

```

plot_marginal_rmst_curve(
  fit,
  data,
  trt_col,

```

```

    times,
    tau_seq,
    inference = FALSE,
    B = 200,
    seed = NULL,
    ci_level = 0.95
  )

```

Arguments

<code>fit</code>	A fitted SuperSurv ensemble object.
<code>data</code>	A data.frame containing the covariates and the binary grouping variable.
<code>trt_col</code>	Character string. The exact name of the binary grouping variable in data.
<code>times</code>	Numeric vector of time points matching the prediction grid.
<code>tau_seq</code>	Numeric vector. A sequence of restriction times (tau) to evaluate and plot.
<code>inference</code>	Logical; if TRUE, compute perturbation-based confidence intervals. Defaults to FALSE.
<code>B</code>	Integer. Number of perturbation replicates used when <code>inference = TRUE</code> . Defaults to 200.
<code>seed</code>	Optional integer seed for reproducibility.
<code>ci_level</code>	Numeric scalar in (0, 1) specifying the confidence level for the confidence interval. Defaults to 0.95.

Details

If `inference = TRUE`, the function additionally displays perturbation-based Wald confidence intervals at each value of tau.

Value

A ggplot object visualizing the adjusted marginal RMST contrast curve.

Examples

```

data("metabric", package = "SuperSurv")
dat <- metabric[1:80, ]
x_cols <- grep("^x", names(dat), value = TRUE)[1:5]
X <- dat[, x_cols, drop = FALSE]
new.times <- seq(20, 120, by = 20)

fit <- SuperSurv(
  time = dat$duration,
  event = dat$event,
  X = X,
  newdata = X,
  new.times = new.times,
  event.library = c("surv.coxph", "surv.glmnet"),
  cens.library = c("surv.coxph"),

```

```

    control = list(saveFitLibrary = TRUE)
  )

  tau_grid <- seq(40, 120, by = 20)
  plot_marginal_rmst_curve(
    fit = fit,
    data = dat,
    trt_col = "x4",
    times = new.times,
    tau_seq = tau_grid,
    inference = TRUE,
    B = 100,
    seed = 123
  )

```

plot_patient_waterfall

Waterfall Plot for an Individual Patient

Description

Waterfall Plot for an Individual Patient

Usage

```
plot_patient_waterfall(shap_values, patient_index = 1, top_n = 10)
```

Arguments

shap_values	The output from explain_kernel().
patient_index	The row index of the patient to explain
top_n	Number of features to show (default 10)

Value

A ggplot object visualizing the SHAP values.

Examples

```

if (requireNamespace("fastshap", quietly = TRUE) &&
    requireNamespace("glmnet", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:80, ]
  x_cols <- grep("^x", names(dat))[1:5]
  X <- dat[, x_cols, drop = FALSE]
  new.times <- seq(20, 120, by = 20)

  fit <- SuperSurv(

```

```

    time = dat$duration,
    event = dat$event,
    X = X,
    newdata = X,
    new.times = new.times,
    event.library = c("surv.coxph", "surv.ridge"),
    cens.library = c("surv.coxph"),
    control = list(saveFitLibrary = TRUE)
  )

  shap_values <- explain_kernel(
    model = fit,
    X_explain = X[1:10, , drop = FALSE],
    X_background = X[11:40, , drop = FALSE],
    nsim = 5
  )

  plot_patient_waterfall(
    shap_values = shap_values,
    patient_index = 1,
    top_n = 5
  )
}

```

plot_predict

Plot Predicted Survival Curves

Description

Plot Predicted Survival Curves

Usage

```
plot_predict(preds, eval_times, patient_idx = 1)
```

Arguments

preds	A list containing SuperSurv predictions OR a raw prediction matrix.
eval_times	Numeric vector of times at which predictions were evaluated.
patient_idx	Integer vector. Defaults to 1.

Value

A ggplot object.

Examples

```

if (requireNamespace("glmnet", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:120, ]
  x_cols <- grep("^x", names(dat))[1:5]
  X <- dat[, x_cols, drop = FALSE]
  eval_times <- seq(20, 120, by = 20)

  fit <- SuperSurv(
    time = dat$duration,
    event = dat$event,
    X = X,
    newdata = X,
    new.times = eval_times,
    event.library = c("surv.coxph", "surv.ridge"),
    cens.library = c("surv.coxph"),
    control = list(saveFitLibrary = TRUE)
  )

  preds <- predict(fit, newdata = X, new.times = eval_times, type = "event")

  plot_predict(
    preds = preds,
    eval_times = eval_times,
    patient_idx = c(1, 2)
  )
}

```

plot_rmst_vs_obs

*Plot Predicted RMST vs. Observed Survival Times***Description**

Evaluates the calibration of the causal RMST estimator by plotting the model's predicted RMST for each patient against their actual observed follow-up time.

Usage

```
plot_rmst_vs_obs(fit, data, time_col, event_col, times, tau)
```

Arguments

fit	A fitted SuperSurv ensemble object.
data	A data.frame containing the patient covariates, times, and events.
time_col	Character string. The exact name of the observed follow-up time column in data.
event_col	Character string. The exact name of the event indicator column in data (e.g., 1 for event, 0 for censored).

times Numeric vector of time points matching the prediction grid.
 tau Numeric. A single truncation time limit up to which the RMST is calculated.

Value

A ggplot object comparing predicted RMST to observed outcomes.

Examples

```
data("metabric", package = "SuperSurv")
dat <- metabric[1:80, ]
x_cols <- grep("^x", names(dat))[1:5]
X <- dat[, x_cols, drop = FALSE]
new.times <- seq(20, 120, by = 20)

fit <- SuperSurv(
  time = dat$duration,
  event = dat$event,
  X = X,
  newdata = X,
  new.times = new.times,
  event.library = c("surv.coxph", "surv.glmnet"),
  cens.library = c("surv.coxph"),
  control = list(saveFitLibrary = TRUE)
)

plot_rmst_vs_obs(
  fit = fit,
  data = dat,
  time_col = "duration",
  event_col = "event",
  times = new.times,
  tau = 350
)
```

plot_survival_heatmap *Survival Probability Heatmap*

Description

Survival Probability Heatmap

Usage

```
plot_survival_heatmap(object, newdata, times)
```

Arguments

object A fitted SuperSurv object
 newdata Test covariates (e.g., X_te[1:50,])
 times The time grid to visualize

Value

A ggplot object visualizing the SHAP values.

Examples

```
if (requireNamespace("glmnet", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:80, ]
  x_cols <- grep("^x", names(dat))[1:5]
  X <- dat[, x_cols, drop = FALSE]
  times <- seq(20, 120, by = 20)

  fit <- SuperSurv(
    time = dat$duration,
    event = dat$event,
    X = X,
    newdata = X,
    new.times = times,
    event.library = c("surv.coxph", "surv.ridge"),
    cens.library = c("surv.coxph"),
    control = list(saveFitLibrary = TRUE)
  )

  plot_survival_heatmap(
    object = fit,
    newdata = X[1:20, , drop = FALSE],
    times = times
  )
}
```

predict.SuperSurv *Predict method for SuperSurv fits*

Description

Obtains predicted survival probabilities from a fitted SuperSurv ensemble.

Usage

```
## S3 method for class 'SuperSurv'
predict(
  object,
  newdata,
  new.times,
  type = c("both", "event", "censoring"),
  onlySL = FALSE,
  threshold = 1e-04,
  ...
)
```

Arguments

<code>object</code>	A fitted object of class <code>SuperSurv</code> .
<code>newdata</code>	A <code>data.frame</code> of new covariate values.
<code>new.times</code>	A numeric vector of times at which to predict survival.
<code>type</code>	Character string specifying the prediction output. Use "event" for the event survival matrix, "censoring" for the censoring survival matrix, or "both" for the full list of outputs.
<code>onlySL</code>	Logical. If TRUE, only uses models with weights > threshold.
<code>threshold</code>	Numeric. The weight threshold for <code>onlySL</code> .
<code>...</code>	Additional ignored arguments.

Value

If `type = "event"` or `type = "censoring"`, a numeric matrix with rows corresponding to observations and columns corresponding to `new.times`. If `type = "both"`, a list containing:

- `event.predict`: A numeric matrix of final event survival predictions.
- `event.library.predict`: A 3D numeric array of event learner predictions.
- `cens.predict`: A numeric matrix of final censoring survival predictions.
- `cens.library.predict`: A 3D numeric array of censoring learner predictions.

Examples

```
if (requireNamespace("glmnet", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:80, ]
  x_cols <- grep("^x", names(dat))[1:5]
  X <- dat[, x_cols, drop = FALSE]
  newX <- X[1:10, , drop = FALSE]
  new.times <- seq(20, 120, by = 20)

  fit <- SuperSurv(
    time = dat$duration,
    event = dat$event,
    X = X,
    newdata = X,
    new.times = new.times,
    event.library = c("surv.coxph", "surv.ridge"),
    cens.library = c("surv.coxph"),
    control = list(saveFitLibrary = TRUE)
  )

  pred_event <- predict(
    object = fit,
    newdata = newX,
    new.times = new.times,
    type = "event"
  )
}
```

```

    dim(pred_event)
  }

```

```
print.SuperSurv      Print a SuperSurv fit
```

Description

Prints a concise description of a fitted SuperSurv object.

Usage

```
## S3 method for class 'SuperSurv'
print(x, digits = max(3L, getOption("digits") - 3L), ...)
```

Arguments

`x` A fitted object of class "SuperSurv".

`digits` Number of significant digits to use for displayed weights.

`...` Additional arguments ignored.

Value

The input object `x`, invisibly.

```
screen.all           Keep All Variables Screener
```

Description

Keep All Variables Screener

Usage

```
screen.all(X, ...)
```

Arguments

`X` Training covariate data.frame.

`...` Additional ignored arguments.

Value

A logical vector of the same length as the number of columns in `X`, indicating which variables passed the screening algorithm (TRUE to keep, FALSE to drop).

Examples

```

data("metabric", package = "SuperSurv")
dat <- metabric[1:20, ]
x_cols <- grep("^x", names(dat))[1:5]
X <- dat[, x_cols, drop = FALSE]

screen.all(X)

```

screen.elasticnet *Elastic Net Screening Algorithm*

Description

This screening algorithm uses [cv.glmnet](#) to select covariates. Unlike LASSO ($\alpha = 1$), which drops correlated features, Elastic Net ($\alpha = 0.5$ by default) shrinks correlated groups of features together, making it ideal for selecting entire biological pathways.

Usage

```

screen.elasticnet(
  time,
  event,
  X,
  obsWeights = NULL,
  alpha = 0.5,
  minscreen = 2,
  nfolds = 10,
  nlambda = 100,
  ...
)

```

Arguments

time	Numeric vector of observed follow-up times.
event	Numeric vector of event indicators (1 = event, 0 = censored).
X	Training covariate data.frame or matrix.
obsWeights	Numeric vector of observation weights.
alpha	Numeric penalty exponent for <code>glmnet</code> . Defaults to 0.5 (Elastic Net).
minscreen	Integer. Minimum number of covariates to return. Defaults to 2.
nfolds	Integer. Number of folds for cross-validation. Defaults to 10.
nlambda	Integer. Number of penalty parameters to search over. Defaults to 100.
...	Additional arguments passed to <code>screen.glmnet</code> .

Value

A logical vector of the same length as the number of columns in X , indicating which variables passed the screening algorithm (TRUE to keep, FALSE to drop).

Examples

```
if (requireNamespace("glmnet", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:40, ]
  x_cols <- grep("^x", names(dat))[1:5]
  X <- dat[, x_cols, drop = FALSE]

  screen.elasticnet(
    time = dat$duration,
    event = dat$event,
    X = X,
    alpha = 0.5,
    minscreen = 2,
    nfolds = 3,
    nlambda = 20
  )
}
```

screen.glmnet

GLMNET (Lasso) Screening

Description

GLMNET (Lasso) Screening

Usage

```
screen.glmnet(
  time,
  event,
  X,
  obsWeights = NULL,
  alpha = 1,
  minscreen = 2,
  nfolds = 10,
  nlambda = 100,
  ...
)
```

Arguments

time	Observed follow-up time.
event	Observed event indicator.

X	Training covariate data.frame.
obsWeights	Observation weights.
alpha	Penalty exponent (1 = lasso).
minscreen	Minimum number of covariates to return. Defaults to 2.
nfolds	Number of CV folds.
nlambda	Number of penalty parameters.
...	Additional ignored arguments.

Value

A logical vector of the same length as the number of columns in X, indicating which variables passed the screening algorithm (TRUE to keep, FALSE to drop).

Examples

```
if (requireNamespace("glmnet", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:40, ]
  x_cols <- grep("^x", names(dat))[1:5]
  X <- dat[, x_cols, drop = FALSE]

  screen.glmnet(
    time = dat$duration,
    event = dat$event,
    X = X,
    alpha = 1,
    minscreen = 2,
    nfolds = 3,
    nlambda = 20
  )
}
```

screen.marg

Marginal Cox Regression Screening

Description

Marginal Cox Regression Screening

Usage

```
screen.marg(time, event, X, obsWeights = NULL, minscreen = 2, min.p = 0.1, ...)
```

Arguments

time	Observed follow-up time.
event	Observed event indicator.
X	Training covariate data.frame.
obsWeights	Observation weights.
minscreen	Minimum number of covariates to return. Defaults to 2.
min.p	Threshold p-value. Defaults to 0.1.
...	Additional ignored arguments.

Value

A logical vector of the same length as the number of columns in X, indicating which variables passed the screening algorithm (TRUE to keep, FALSE to drop).

Examples

```
data("metabric", package = "SuperSurv")
dat <- metabric[1:40, ]
x_cols <- grep("^x", names(dat))[1:5]
X <- dat[, x_cols, drop = FALSE]

screen.marg(
  time = dat$duration,
  event = dat$event,
  X = X,
  minscreen = 2,
  min.p = 0.2
)
```

screen.rfsrc

Random Survival Forest Screening Algorithm

Description

This screening algorithm uses the randomForestSRC package to select covariates based on their Variable Importance (VIMP). It grows a fast forest and retains features with a VIMP greater than zero.

Usage

```
screen.rfsrc(
  time,
  event,
  X,
  obsWeights = NULL,
  minscreen = 2,
```

```

    ntree = 100,
    ...
  )

```

Arguments

time	Numeric vector of observed follow-up times.
event	Numeric vector of event indicators (1 = event, 0 = censored).
X	Training covariate data.frame or matrix.
obsWeights	Numeric vector of observation weights.
minscreen	Integer. Minimum number of covariates to return. Defaults to 2.
ntree	Integer. Number of trees to grow. Defaults to 100 for fast screening.
...	Additional arguments passed to <code>rfsrc</code> .

Value

A logical vector of the same length as the number of columns in X , indicating which variables passed the screening algorithm (TRUE to keep, FALSE to drop).

Examples

```

if (requireNamespace("randomForestSRC", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:40, ]
  x_cols <- grep("^x", names(dat))[1:5]
  X <- dat[, x_cols, drop = FALSE]

  screen.rfsrc(
    time = dat$duration,
    event = dat$event,
    X = X,
    minscreens = 2,
    ntree = 10
  )
}

```

screen.var

High Variance Screening Algorithm (Unsupervised)

Description

An unsupervised screening algorithm that filters out low-variance features. This is particularly useful for high-dimensional genomic or transcriptomic data where many features remain relatively constant across all observations.

Usage

```
screen.var(
  time,
  event,
  X,
  obsWeights = NULL,
  keep_fraction = 0.5,
  minscreen = 2,
  ...
)
```

Arguments

time	Numeric vector of observed follow-up times (Ignored internally).
event	Numeric vector of event indicators (Ignored internally).
X	Training covariate data.frame or matrix.
obsWeights	Numeric vector of observation weights (Ignored internally).
keep_fraction	Numeric value between 0 and 1. The fraction of highest-variance features to retain. Defaults to 0.5 (keeps the top 50%).
minscreen	Integer. Minimum number of covariates to return. Defaults to 2.
...	Additional ignored arguments.

Value

A logical vector of the same length as the number of columns in X, indicating which variables passed the screening algorithm (TRUE to keep, FALSE to drop).

Examples

```
data("metabric", package = "SuperSurv")
dat <- metabric[1:40, ]
x_cols <- grep("^x", names(dat))[1:6]
X <- dat[, x_cols, drop = FALSE]

screen.var(
  time = dat$duration,
  event = dat$event,
  X = X,
  keep_fraction = 0.5,
  minscreen = 2
)
```

selected_variables	<i>Access variables selected by SuperSurv screeners</i>
--------------------	---

Description

Returns the variables retained by a screening step for one or more fitted event or censoring learners.

Usage

```
selected_variables(object, ...)

## S3 method for class 'SuperSurv'
selected_variables(object, type = c("event", "censoring"), learner = NULL, ...)
```

Arguments

object	A fitted object of class "SuperSurv".
...	Additional arguments ignored.
type	Character string specifying whether to inspect event or censoring learners.
learner	Optional learner index or learner name. If omitted, selected variables are returned for every learner of the requested type.

Value

A named list of character vectors, or a single character vector when learner has length one.

summary.SuperSurv	<i>Summarize a SuperSurv fit</i>
-------------------	----------------------------------

Description

Summarizes the fitted event and censoring ensembles, including learner names, ensemble weights, cross-validated risks, error flags, prediction dimensions, and recorded timing information.

Usage

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

## S3 method for class 'summary.SuperSurv'
print(x, digits = max(3L, getOption("digits") - 3L), ...)
```

Arguments

object	A fitted object of class "SuperSurv".
...	Additional arguments ignored.
x	A summary object produced by <code>summary.SuperSurv()</code> .
digits	Number of significant digits to use for displayed weights and risks.

Value

An object of class "summary.SuperSurv", a list containing the matched call, selection mode, event and censoring learner summaries, prediction dimensions, and timing information.

 SuperSurv

Super Learner for conditional survival functions

Description

Orchestrates the cross-validation, metalearner optimization, and prediction for an ensemble of survival base learners.

Usage

```
SuperSurv(
  time,
  event,
  X,
  newdata = NULL,
  new.times,
  event.library,
  cens.library,
  id = NULL,
  verbose = FALSE,
  control = list(),
  cvControl = list(),
  obsWeights = NULL,
  metalearner = "brier",
  selection = "ensemble",
  nFolds = 10,
  parallel = FALSE
)
```

Arguments

time	Observed follow-up time.
event	Observed event indicator.
X	Training covariate data.frame.

<code>newdata</code>	Test covariate data.frame for prediction (defaults to X).
<code>new.times</code>	Times at which to obtain predicted survivals.
<code>event.library</code>	Character vector of prediction algorithms for the event.
<code>cens.library</code>	Character vector of prediction algorithms for censoring.
<code>id</code>	Cluster identification variable.
<code>verbose</code>	Logical. If TRUE, prints progress messages.
<code>control</code>	List of control parameters for the Super Learner.
<code>cvControl</code>	List of control parameters for cross-validation.
<code>obsWeights</code>	Observation weights.
<code>metalearner</code>	Character string specifying the optimizer (e.g., "brier" or "logloss").
<code>selection</code>	Character. Specifies how the meta-learner combines the base models. Use "ensemble" (default) to calculate a weighted average (convex combination) of the base learners. Use "best" to act as a Discrete Super Learner, which assigns a weight of 1.0 to the single model with the lowest cross-validated risk.
<code>nFolds</code>	Number of cross-validation folds (default: 10).
<code>parallel</code>	Logical. If TRUE, uses <code>future.apply</code> for parallel execution.

Details

Extending the learner library. Custom base learners can be added by defining a wrapper function and passing its name in `event.library` or `cens.library`. A learner wrapper should accept `time`, `event`, `X`, `newdata`, `new.times`, `obsWeights`, `id`, and `...`, and should return a list with `pred`, a numeric survival-probability matrix with `nrow(newdata)` rows and `length(new.times)` columns, and `fit`, the fitted object used for future prediction. If saved fits are needed, give `fit` a class and provide a corresponding `predict.<class>()` method that returns the same matrix shape.

Screening methods can also be supplied by name. A screener should accept the training inputs and return a logical vector aligned with the columns of `X`. See `vignette("extending-supersurv", package = "SuperSurv")` for a practical custom learner and screener example.

Value

A list of class `SuperSurv` containing:

- `call`: The matched function call.
- `event.predict`: Matrix of in-sample cross-validated survival predictions.
- `cens.predict`: Matrix of in-sample cross-validated censoring predictions.
- `eval.times`: Numeric vector of prediction evaluation times.
- `event.coef`: Numeric vector of optimized ensemble weights for the event.
- `cens.coef`: Numeric vector of optimized ensemble weights for censoring.
- `event.library.predict`: 3D array of cross-validated predictions from individual event learners.
- `event.libraryNames`: Data frame detailing the algorithms and screeners used.
- `event.fitLibrary`: List of the fitted base learner models (if `saveFitLibrary = TRUE`).
- `times`: The time grid used for evaluation.

Examples

```
if (requireNamespace("glmnet", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:80, ]
  x_cols <- grep("^x", names(dat))[1:5]
  X <- dat[, x_cols, drop = FALSE]
  new.times <- seq(20, 120, by = 20)

  fit <- SuperSurv(
    time = dat$duration,
    event = dat$event,
    X = X,
    newdata = X,
    new.times = new.times,
    event.library = c("surv.coxph", "surv.ridge"),
    cens.library = c("surv.coxph"),
    control = list(saveFitLibrary = TRUE)
  )

  fit
  event_weights(fit)
}
```

`surv.aorsf`*Wrapper for AORSF (Oblique Random Survival Forest)*

Description

Final Production Wrapper for AORSF (Tunable & Robust).

Usage

```
surv.aorsf(
  time,
  event,
  X,
  newdata,
  new.times,
  obsWeights,
  id,
  n_tree = 500,
  leaf_min_events = 5,
  mtry = NULL,
  ...
)
```

Arguments

time	Observed follow-up time; i.e. minimum of the event and censoring times.
event	Observed event indicator; i.e, whether the follow-up time corresponds to an event or censoring.
X	Training covariate data.frame.
newdata	Test covariate data.frame to use for prediction. Should have the same variable names and structure as X.
new.times	Times at which to obtain the predicted survivals.
obsWeights	Observation weights.
id	Optional cluster/individual ID indicator.
n_tree	Number of trees to grow (default: 500).
leaf_min_events	Minimum number of events in a leaf node (default: 5).
mtry	Number of predictors evaluated at each node.
...	Additional arguments passed to <i>orsf</i> .

Value

A list containing:

- `fit`: The fitted model object (e.g., the raw `coxph` or `xgb.Booster` object). If the model fails to fit, this may be an object of class `try-error`.
- `pred`: A numeric matrix of cross-validated survival predictions evaluated at the specified `new.times` grid.

Examples

```
if (requireNamespace("aorsf", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:30, ]
  x_cols <- grep("^x", names(dat))[1:3]
  X <- dat[, x_cols, drop = FALSE]
  newX <- X[1:5, , drop = FALSE]
  times <- seq(50, 150, by = 50)

  fit <- surv.aorsf(
    time = dat$duration,
    event = dat$event,
    X = X,
    newdata = newX,
    new.times = times,
    obsWeights = rep(1, nrow(dat)),
    id = NULL,
    n_tree = 10,
    leaf_min_events = 2
  )

  dim(fit[["pred"]])
}
```

surv.bart

*Wrapper for BART (Bayesian Additive Regression Trees)***Description**

Final Production Wrapper for BART (Tunable & Robust). Uses the `mc.surv.bart` function. Automatically reshapes the flat output vector into a survival matrix and interpolates the predictions to the requested `new.times`.

Usage

```
surv.bart(
  time,
  event,
  X,
  newdata = NULL,
  new.times,
  obsWeights = NULL,
  id = NULL,
  ntree = 10,
  ndpost = 30,
  nskip = 10,
  ...
)
```

Arguments

<code>time</code>	Observed follow-up time.
<code>event</code>	Observed event indicator.
<code>X</code>	Training covariate data.frame.
<code>newdata</code>	Test covariate data.frame to use for prediction.
<code>new.times</code>	Times at which to obtain predicted survivals.
<code>obsWeights</code>	Observation weights (Note: BART does not natively support weights).
<code>id</code>	Optional cluster/individual ID indicator.
<code>ntree</code>	Number of trees (default: 50).
<code>ndpost</code>	Number of posterior draws (default: 1000).
<code>nskip</code>	Number of burn-in draws (default: 250).
<code>...</code>	Additional arguments passed to <code>mc.surv.bart</code> .

Value

A list containing:

- `fit`: The fitted model object (e.g., the raw `coxph` or `xgb.Booster` object). If the model fails to fit, this may be an object of class `try-error`.

- `pred`: A numeric matrix of cross-validated survival predictions evaluated at the specified `new.times` grid.

Examples

```
## Not run:
if (.Platform$OS.type != "windows" &&
    requireNamespace("BART", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:20, ]
  x_cols <- grep("^x", names(dat))[1:3]
  X <- dat[, x_cols, drop = FALSE]
  newX <- X[1:5, , drop = FALSE]
  times <- seq(50, 150, by = 50)

  fit <- surv.bart(
    time = dat$duration,
    event = dat$event,
    X = X,
    newdata = newX,
    new.times = times,
    ntree = 3,
    ndpost = 5,
    nskip = 5
  )

  dim(fit[["pred"]])
}

## End(Not run)
```

surv.coxboost

Wrapper function for Component-Wise Boosting (CoxBoost)

Description

Final Production Wrapper for CoxBoost (Tunable & Robust). Estimates a Cox model via component-wise likelihood based boosting.

Usage

```
surv.coxboost(
  time,
  event,
  X,
  newdata,
  new.times,
  obsWeights,
  id,
```

```

    stepno = 100,
    penalty = 100,
    ...
  )

```

Arguments

time	Observed follow-up time.
event	Observed event indicator.
X	Training covariate data.frame.
newdata	Test covariate data.frame to use for prediction.
new.times	Times at which to obtain the predicted survivals.
obsWeights	Observation weights (Note: CoxBoost does not natively support weights, so these are ignored).
id	Optional cluster/individual ID indicator.
stepno	Number of boosting steps (default: 100).
penalty	Penalty value for the update (default: 100).
...	Additional arguments passed to CoxBoost .

Value

A list containing:

- fit: The fitted model object (e.g., the raw coxph or xgb.Booster object). If the model fails to fit, this may be an object of class try-error.
- pred: A numeric matrix of cross-validated survival predictions evaluated at the specified new.times grid.

Examples

```

if (requireNamespace("CoxBoost", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:30, ]
  x_cols <- grep("^x", names(dat))[1:3]
  X <- dat[, x_cols, drop = FALSE]
  newX <- X[1:5, , drop = FALSE]
  times <- seq(50, 150, by = 50)

  fit <- surv.coxboost(
    time = dat$duration,
    event = dat$event,
    X = X,
    newdata = newX,
    new.times = times,
    obsWeights = rep(1, nrow(dat)),
    id = NULL,
    stepno = 10,
    penalty = 50
  )
}

```

```

    )
    dim(fit[["pred"]])
  }

```

surv.coxph

Wrapper for standard Cox Proportional Hazards

Description

Final Production Wrapper for CoxPH. Uses partial maximum likelihood and the Breslow estimator.

Usage

```
surv.coxph(time, event, X, newdata, new.times, obsWeights, id, ...)
```

Arguments

time	Observed follow-up time.
event	Observed event indicator.
X	Training covariate data.frame.
newdata	Test covariate data.frame to use for prediction.
new.times	Times at which to obtain predicted survivals.
obsWeights	Observation weights.
id	Optional cluster/individual ID indicator.
...	Additional arguments passed to <code>coxph</code> .

Value

A list containing:

- `fit`: The fitted model object (e.g., the raw `coxph` or `xgb.Booster` object). If the model fails to fit, this may be an object of class `try-error`.
- `pred`: A numeric matrix of cross-validated survival predictions evaluated at the specified `new.times` grid.

Examples

```

data("metabric", package = "SuperSurv")
dat <- metabric[1:30, ]
x_cols <- grep("^x", names(dat))[1:3]
X <- dat[, x_cols, drop = FALSE]
newX <- X[1:5, , drop = FALSE]
times <- seq(50, 150, by = 50)

fit <- surv.coxph(

```

```

    time = dat$duration,
    event = dat$event,
    X = X,
    newdata = newX,
    new.times = times,
    obsWeights = rep(1, nrow(dat)),
    id = NULL
  )

  dim(fit[["pred"]])

```

surv.exponential *Parametric Survival Prediction Wrapper (Exponential)*

Description

Parametric Survival Prediction Wrapper (Exponential)

Usage

```
surv.exponential(time, event, X, newdata, new.times, obsWeights, id, ...)
```

Arguments

time	Observed follow-up time.
event	Observed event indicator.
X	Training covariate data.frame.
newdata	Test covariate data.frame to use for prediction.
new.times	Times at which to obtain the predicted survivals.
obsWeights	Observation weights.
id	Cluster identification variable.
...	Additional ignored arguments.

Value

A list containing the fitted model and predictions.

Examples

```

data("metabric", package = "SuperSurv")
dat <- metabric[1:30, ]
x_cols <- grep("^x", names(dat))[1:3]
X <- dat[, x_cols, drop = FALSE]
newX <- X[1:5, , drop = FALSE]
times <- seq(50, 150, by = 50)

fit <- surv.exponential(

```

```

time = dat$duration,
event = dat$event,
X = X,
newdata = newX,
new.times = times,
obsWeights = rep(1, nrow(dat)),
id = NULL
)

dim(fit[["pred"]])

```

surv.gam

Wrapper for Generalized Additive Cox Regression (GAM)

Description

Final Production Wrapper for GAM (Tunable & Robust). Uses [gam](#) to fit an additive combination of smooth and linear functions.

Usage

```
surv.gam(time, event, X, newdata, new.times, obsWeights, id, cts.num = 5, ...)
```

Arguments

time	Observed follow-up time.
event	Observed event indicator.
X	Training covariate data.frame.
newdata	Test covariate data.frame to use for prediction.
new.times	Times at which to obtain predicted survivals.
obsWeights	Observation weights (Note: Ignored, as mgcv uses weights for the event indicator).
id	Optional cluster/individual ID indicator.
cts.num	Cutoff of unique values at which a numeric covariate receives a smooth term (s).
...	Additional arguments passed to gam .

Value

A list containing:

- fit: The fitted model object (e.g., the raw coxph or xgb.Booster object). If the model fails to fit, this may be an object of class try-error.
- pred: A numeric matrix of cross-validated survival predictions evaluated at the specified new.times grid.

Examples

```

if (requireNamespace("mgcv", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:30, ]
  x_cols <- grep("^x", names(dat))[1:3]
  X <- dat[, x_cols, drop = FALSE]
  newX <- X[1:5, , drop = FALSE]
  times <- seq(50, 150, by = 50)

  fit <- surv.gam(
    time = dat$duration,
    event = dat$event,
    X = X,
    newdata = newX,
    new.times = times,
    obsWeights = rep(1, nrow(dat)),
    id = NULL,
    cts.num = 5
  )

  dim(fit[["pred"]])
}

```

surv.gbm

*Wrapper function for Gradient Boosting (GBM) prediction algorithm***Description**

Final Production Wrapper for GBM (Tunable & Robust). Estimates a Cox proportional hazards model via gradient boosting. Uses the Breslow estimator with a step-function approach for the baseline hazard. Includes internal safeguards against C++ crashes and small cross-validation folds.

Usage

```

surv.gbm(
  time,
  event,
  X,
  newdata,
  new.times,
  obsWeights,
  id,
  n.trees = 1000,
  interaction.depth = 2,
  shrinkage = 0.01,
  cv.folds = 5,
  n.minobsinnode = 10,
  ...
)

```

Arguments

time	Observed follow-up time.
event	Observed event indicator.
X	Training covariate data.frame.
newdata	Test covariate data.frame to use for prediction.
new.times	Times at which to obtain the predicted survivals.
obsWeights	Observation weights.
id	Optional cluster/individual ID indicator.
n.trees	Integer specifying the total number of trees to fit (default: 1000).
interaction.depth	Maximum depth of variable interactions (default: 2).
shrinkage	A shrinkage parameter applied to each tree (default: 0.01).
cv.folds	Number of cross-validation folds to perform internally for optimal tree selection (default: 5).
n.minobsinnode	Minimum number of observations in the trees terminal nodes (default: 10).
...	Additional arguments passed to gbm .

Value

A list containing:

- fit: The fitted model object (e.g., the raw coxph or xgb.Booster object). If the model fails to fit, this may be an object of class try-error.
- pred: A numeric matrix of cross-validated survival predictions evaluated at the specified new.times grid.

Examples

```
if (requireNamespace("gbm", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:30, ]
  x_cols <- grep("^x", names(dat))[1:3]
  X <- dat[, x_cols, drop = FALSE]
  newX <- X[1:5, , drop = FALSE]
  times <- seq(50, 150, by = 50)

  fit <- surv.gbm(
    time = dat$duration,
    event = dat$event,
    X = X,
    newdata = newX,
    new.times = times,
    obsWeights = rep(1, nrow(dat)),
    id = NULL,
    n.trees = 20,
    interaction.depth = 1,
```

```

      shrinkage = 0.05,
      cv.folds = 0,
      n.minobsinnode = 3
    )

    dim(fit[["pred"]])
  }

```

surv.glmnet

Wrapper function for Penalized Cox Regression (GLMNET)

Description

Final Production Wrapper for GLMNET (Tunable & Robust). Estimates a penalized Cox model (Lasso, Ridge, or Elastic Net) with automatic lambda selection. Uses the Breslow estimator with a step-function approach for the baseline hazard.

Usage

```

surv.glmnet(
  time,
  event,
  X,
  newdata,
  new.times,
  obsWeights,
  id,
  alpha = 1,
  nfolds = 10,
  ...
)

```

Arguments

time	Observed follow-up time.
event	Observed event indicator.
X	Training covariate data.frame.
newdata	Test covariate data.frame to use for prediction.
new.times	Times at which to obtain the predicted survivals.
obsWeights	Observation weights.
id	Optional cluster/individual ID indicator.
alpha	The elasticnet mixing parameter (0 = Ridge, 1 = Lasso). Default is 1.
nfolds	Number of folds for internal cross-validation to select lambda. Default is 10.
...	Additional arguments passed to cv.glmnet .

Value

A list containing:

- `fit`: The fitted model object (e.g., the raw `coxph` or `xgb.Booster` object). If the model fails to fit, this may be an object of class `try-error`.
- `pred`: A numeric matrix of cross-validated survival predictions evaluated at the specified `new.times` grid.

Examples

```
if (requireNamespace("glmnet", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:30, ]
  x_cols <- grep("^x", names(dat))[1:3]
  X <- dat[, x_cols, drop = FALSE]
  newX <- X[1:5, , drop = FALSE]
  times <- seq(50, 150, by = 50)

  fit <- surv.glmnet(
    time = dat$duration,
    event = dat$event,
    X = X,
    newdata = newX,
    new.times = times,
    obsWeights = rep(1, nrow(dat)),
    id = NULL,
    alpha = 1,
    nfolds = 3
  )

  dim(fit[["pred"]])
}
```

surv.km

Kaplan-Meier Prediction Algorithm

Description

This prediction algorithm ignores all covariates and computes the marginal Kaplan-Meier survival estimator using the [survfit](#) function.

Usage

```
surv.km(time, event, X, newdata, new.times, obsWeights, id, ...)
```

Arguments

time	Numeric vector of observed follow-up times.
event	Numeric vector of event indicators (1 = event, 0 = censored).
X	Training covariate data.frame (Ignored by KM).
newdata	Test covariate data.frame to use for prediction.
new.times	Numeric vector of times at which to predict survival.
obsWeights	Numeric vector of observation weights.
id	Optional vector indicating subject/cluster identities.
...	Additional ignored arguments.

Value

A list containing:

- fit: A list containing the fitted `survfit` object.
- pred: A numeric matrix of cross-validated survival predictions evaluated at `new.times`.

Examples

```
data("metabric", package = "SuperSurv")
dat <- metabric[1:30, ]
x_cols <- grep("^x", names(dat))[1:3]
X <- dat[, x_cols, drop = FALSE]
newX <- X[1:5, , drop = FALSE]
times <- seq(50, 150, by = 50)

fit <- surv.km(
  time = dat$duration,
  event = dat$event,
  X = X,
  newdata = newX,
  new.times = times,
  obsWeights = rep(1, nrow(dat)),
  id = NULL
)

dim(fit[["pred"]])
```

surv.loglogistic

Parametric Survival Prediction Wrapper (Log-Logistic)

Description

Parametric Survival Prediction Wrapper (Log-Logistic)

Usage

```
surv.loglogistic(time, event, X, newdata, new.times, obsWeights, id, ...)
```

Arguments

time	Observed follow-up time.
event	Observed event indicator.
X	Training covariate data.frame.
newdata	Test covariate data.frame to use for prediction.
new.times	Times at which to obtain the predicted survivals.
obsWeights	Observation weights.
id	Cluster identification variable.
...	Additional ignored arguments.

Value

A list containing the fitted model and predictions.

Examples

```
data("metabric", package = "SuperSurv")
dat <- metabric[1:30, ]
x_cols <- grep("^x", names(dat))[1:3]
X <- dat[, x_cols, drop = FALSE]
newX <- X[1:5, , drop = FALSE]
times <- seq(50, 150, by = 50)

fit <- surv.loglogistic(
  time = dat$duration,
  event = dat$event,
  X = X,
  newdata = newX,
  new.times = times,
  obsWeights = rep(1, nrow(dat)),
  id = NULL
)

dim(fit[["pred"]])
```

surv.lognormal

Parametric Survival Prediction Wrapper (Log-Normal)

Description

Parametric Survival Prediction Wrapper (Log-Normal)

Usage

```
surv.lognormal(time, event, X, newdata, new.times, obsWeights, id, ...)
```

Arguments

time	Observed follow-up time.
event	Observed event indicator.
X	Training covariate data.frame.
newdata	Test covariate data.frame to use for prediction.
new.times	Times at which to obtain the predicted survivals.
obsWeights	Observation weights.
id	Cluster identification variable.
...	Additional ignored arguments.

Value

A list containing the fitted model and predictions.

Examples

```
data("metabric", package = "SuperSurv")
dat <- metabric[1:30, ]
x_cols <- grep("^x", names(dat))[1:3]
X <- dat[, x_cols, drop = FALSE]
newX <- X[1:5, , drop = FALSE]
times <- seq(50, 150, by = 50)

fit <- surv.lognormal(
  time = dat$duration,
  event = dat$event,
  X = X,
  newdata = newX,
  new.times = times,
  obsWeights = rep(1, nrow(dat)),
  id = NULL
)

dim(fit[["pred"]])
```

surv.parametric

Universal Parametric Survival Wrapper

Description

Final Production Wrapper for AFT Models (Weibull, Exponential, LogNormal, LogLogistic). Replaces individual wrappers with one robust, vectorized function.

Usage

```
surv.parametric(
  time,
  event,
  X,
  newdata,
  new.times,
  obsWeights,
  id,
  dist = "weibull",
  ...
)
```

Arguments

<code>time</code>	Observed follow-up time.
<code>event</code>	Observed event indicator.
<code>X</code>	Training covariate data.frame.
<code>newdata</code>	Test covariate data.frame to use for prediction.
<code>new.times</code>	Times at which to obtain predicted survivals.
<code>obsWeights</code>	Observation weights.
<code>id</code>	Optional cluster/individual ID indicator.
<code>dist</code>	Distribution for the AFT model (default: "weibull").
<code>...</code>	Additional arguments passed to survreg .

Value

A list containing:

- `fit`: The fitted model object (e.g., the raw `coxph` or `xgb.Booster` object). If the model fails to fit, this may be an object of class `try-error`.
- `pred`: A numeric matrix of cross-validated survival predictions evaluated at the specified `new.times` grid.

Examples

```
data("metabric", package = "SuperSurv")
dat <- metabric[1:30, ]
x_cols <- grep("^x", names(dat))[1:3]
X <- dat[, x_cols, drop = FALSE]
newX <- X[1:5, , drop = FALSE]
times <- seq(50, 150, by = 50)

fit <- surv.parametric(
  time = dat$duration,
  event = dat$event,
  X = X,
```

```

newdata = newX,
new.times = times,
obsWeights = rep(1, nrow(dat)),
id = NULL,
dist = "weibull"
)

dim(fit[["pred"]])

```

surv.ranger

Wrapper function for Ranger Random Survival Forest

Description

Final Production Wrapper for Ranger (Tunable & Fast). Uses the [ranger](#) C++ implementation to estimate survival curves.

Usage

```

surv.ranger(
  time,
  event,
  X,
  newdata,
  new.times,
  obsWeights,
  id,
  num.trees = 500,
  mtry = NULL,
  min.node.size = NULL,
  ...
)

```

Arguments

time	Observed follow-up time.
event	Observed event indicator.
X	Training covariate data.frame.
newdata	Test covariate data.frame to use for prediction.
new.times	Times at which to obtain predicted survivals.
obsWeights	Observation weights.
id	Optional cluster/individual ID indicator.
num.trees	Number of trees (default: 500).
mtry	Number of variables to split at each node. Defaults to \sqrt{p} .
min.node.size	Minimum node size (default: 15 for survival).
...	Additional arguments passed to ranger .

Value

A list containing:

- `fit`: The fitted model object (e.g., the raw `coxph` or `xgb.Booster` object). If the model fails to fit, this may be an object of class `try-error`.
- `pred`: A numeric matrix of cross-validated survival predictions evaluated at the specified `new.times` grid.

Examples

```
if (requireNamespace("ranger", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:30, ]
  x_cols <- grep("^x", names(dat))[1:3]
  X <- dat[, x_cols, drop = FALSE]
  newX <- X[1:5, , drop = FALSE]
  times <- seq(50, 150, by = 50)

  fit <- surv.ranger(
    time = dat$duration,
    event = dat$event,
    X = X,
    newdata = newX,
    new.times = times,
    obsWeights = rep(1, nrow(dat)),
    id = NULL,
    num.trees = 10,
    min.node.size = 3
  )

  dim(fit[["pred"]])
}
```

surv.rfsrc

Wrapper function for Random Survival Forests (RFSRC)

Description

Final Production Wrapper for RFSRC (Tunable & Robust). Estimates a survival random forest using [rfsrc](#).

Usage

```
surv.rfsrc(
  time,
  event,
  X,
  newdata = NULL,
```

```

    new.times,
    obsWeights = NULL,
    id = NULL,
    ntree = 1000,
    nodesize = 15,
    mtry = NULL,
    ...
  )

```

Arguments

time	Observed follow-up time.
event	Observed event indicator.
X	Training covariate data.frame.
newdata	Test covariate data.frame to use for prediction.
new.times	Times at which to obtain the predicted survivals.
obsWeights	Observation weights.
id	Currently ignored.
ntree	Number of trees to grow (default: 1000).
nodesize	Minimum number of deaths in terminal nodes (default: 15).
mtry	Number of variables randomly selected as candidates for splitting a node.
...	Additional arguments passed to rfsrc .

Value

A list containing:

- `fit`: The fitted model object (e.g., the raw `coxph` or `xgb.Booster` object). If the model fails to fit, this may be an object of class `try-error`.
- `pred`: A numeric matrix of cross-validated survival predictions evaluated at the specified `new.times` grid.

Examples

```

if (requireNamespace("randomForestSRC", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:30, ]
  x_cols <- grep("^x", names(dat))[1:3]
  X <- dat[, x_cols, drop = FALSE]
  newX <- X[1:5, , drop = FALSE]
  times <- seq(50, 150, by = 50)

  fit <- surv.rfsrc(
    time = dat$duration,
    event = dat$event,
    X = X,
    newdata = newX,

```

```

    new.times = times,
    ntree = 10,
    nodesize = 3
  )

  dim(fit[["pred"]])
}

```

surv.ridge

Wrapper for Ridge Regression (Penalized Cox)

Description

Final Production Wrapper for Ridge Regression (Tunable & Robust). Estimates a penalized Cox model using a pure Ridge penalty ($\alpha = 0$).

Usage

```

surv.ridge(
  time,
  event,
  X,
  newdata,
  new.times,
  obsWeights = NULL,
  id = NULL,
  nfolds = 10,
  ...
)

```

Arguments

time	Observed follow-up time.
event	Observed event indicator.
X	Training covariate data.frame.
newdata	Test covariate data.frame to use for prediction.
new.times	Times at which to obtain the predicted survivals.
obsWeights	Observation weights.
id	Optional cluster/individual ID indicator.
nfolds	Number of folds for internal cross-validation to select lambda. Default is 10.
...	Additional arguments passed to cv.glmnet .

Value

A list containing:

- `fit`: The fitted model object (e.g., the raw `coxph` or `xgb.Booster` object). If the model fails to fit, this may be an object of class `try-error`.
- `pred`: A numeric matrix of cross-validated survival predictions evaluated at the specified `new.times` grid.

Examples

```
if (requireNamespace("glmnet", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:30, ]
  x_cols <- grep("^x", names(dat))[1:3]
  X <- dat[, x_cols, drop = FALSE]
  newX <- X[1:5, , drop = FALSE]
  times <- seq(50, 150, by = 50)

  fit <- surv.ridge(
    time = dat$duration,
    event = dat$event,
    X = X,
    newdata = newX,
    new.times = times,
    nfolds = 3
  )

  dim(fit[["pred"]])
}
```

 surv.rpart

Wrapper for Survival Regression Trees (rpart)

Description

Final Production Wrapper for single decision trees. Uses `rpart` with `method="exp"` and calculates survival probabilities using the Breslow estimator.

Usage

```
surv.rpart(
  time,
  event,
  X,
  newdata,
  new.times,
  obsWeights,
  id,
```

```

    cp = 0.01,
    minsplit = 20,
    maxdepth = 30,
    ...
)

```

Arguments

time	Observed follow-up time.
event	Observed event indicator.
X	Training covariate data.frame.
newdata	Test covariate data.frame to use for prediction.
new.times	Times at which to obtain predicted survivals.
obsWeights	Observation weights.
id	Optional cluster/individual ID indicator.
cp	Complexity parameter (default: 0.01).
minsplit	Minimum number of observations to attempt a split (default: 20).
maxdepth	Maximum depth of any node of the final tree (default: 30).
...	Additional arguments passed to rpart.control .

Value

A list containing:

- `fit`: The fitted model object (e.g., the raw `coxph` or `xgb.Booster` object). If the model fails to fit, this may be an object of class `try-error`.
- `pred`: A numeric matrix of cross-validated survival predictions evaluated at the specified `new.times` grid.

Examples

```

if (requireNamespace("rpart", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:30, ]
  x_cols <- grep("^x", names(dat))[1:3]
  X <- dat[, x_cols, drop = FALSE]
  newX <- X[1:5, , drop = FALSE]
  times <- seq(50, 150, by = 50)

  fit <- surv.rpart(
    time = dat$duration,
    event = dat$event,
    X = X,
    newdata = newX,
    new.times = times,
    obsWeights = rep(1, nrow(dat)),
    id = NULL,

```

```

      cp = 0.01,
      minsplit = 5,
      maxdepth = 3
    )

    dim(fit[["pred"]])
  }

```

surv.svm

Wrapper for Survival Support Vector Machine (survivalsvm)

Description

Final Production Wrapper for SVM (Tunable & Robust). Estimates a survival SVM and calibrates the raw utility scores into survival probabilities using a univariate Cox proportional hazards model.

Usage

```

surv.svm(
  time,
  event,
  X,
  newdata,
  new.times,
  obsWeights,
  id,
  gamma.mu = 0.1,
  type = "vanbelle2",
  kernel = "lin_kernel",
  opt.meth = "quadprog",
  ...
)

```

Arguments

time	Observed follow-up time.
event	Observed event indicator.
X	Training covariate data.frame.
newdata	Test covariate data.frame to use for prediction.
new.times	Times at which to obtain the predicted survivals.
obsWeights	Observation weights.
id	Optional cluster/individual ID indicator.
gamma.mu	Regularization parameter for the SVM (default: 0.1).
type	Type of SVM implementation (default: "vanbelle2").
kernel	Kernel type for the SVM (default: "lin_kernel").
opt.meth	Optimization method (default: "quadprog").
...	Additional arguments passed to survivalsvm .

Value

A list containing:

- `fit`: The fitted model object (e.g., the raw `coxph` or `xgb.Booster` object). If the model fails to fit, this may be an object of class `try-error`.
- `pred`: A numeric matrix of cross-validated survival predictions evaluated at the specified `new.times` grid.

Examples

```
if (requireNamespace("survivalsvm", quietly = TRUE) &&
    requireNamespace("quadprog", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:25, ]
  x_cols <- grep("^x", names(dat))[1:3]
  X <- dat[, x_cols, drop = FALSE]
  newX <- X[1:5, , drop = FALSE]
  times <- seq(50, 150, by = 50)

  fit <- surv.svm(
    time = dat$duration,
    event = dat$event,
    X = X,
    newdata = newX,
    new.times = times
  )

  dim(fit[["pred"]])
}
```

surv.weibull

Parametric Survival Prediction Wrapper (Weibull)

Description

Parametric Survival Prediction Wrapper (Weibull)

Usage

```
surv.weibull(time, event, X, newdata, new.times, obsWeights, id, ...)
```

Arguments

<code>time</code>	Observed follow-up time.
<code>event</code>	Observed event indicator.
<code>X</code>	Training covariate data.frame.
<code>newdata</code>	Test covariate data.frame to use for prediction.

<code>new.times</code>	Times at which to obtain the predicted survivals.
<code>obsWeights</code>	Observation weights.
<code>id</code>	Cluster identification variable.
<code>...</code>	Additional ignored arguments.

Value

A list containing the fitted model and predictions.

Examples

```
data("metabric", package = "SuperSurv")
dat <- metabric[1:30, ]
x_cols <- grep("^x", names(dat))[1:3]
X <- dat[, x_cols, drop = FALSE]
newX <- X[1:5, , drop = FALSE]
times <- seq(50, 150, by = 50)

fit <- surv.weibull(
  time = dat$duration,
  event = dat$event,
  X = X,
  newdata = newX,
  new.times = times,
  obsWeights = rep(1, nrow(dat)),
  id = NULL
)

dim(fit[["pred"]])
```

surv.xgboost

Wrapper for XGBoost (Robust CV-Tuned + Safe Prediction)

Description

Estimates a Cox proportional hazards model via XGBoost. Incorporates safe Breslow hazard calculation and matrix alignment to prevent C++ crashes.

Usage

```
surv.xgboost(
  time,
  event,
  X,
  newdata = NULL,
  new.times,
  obsWeights,
  id,
```

```

nrounds = 1000,
early_stopping_rounds = 10,
eta = 0.05,
max_depth = 2,
min_child_weight = 5,
lambda = 10,
subsample = 0.7,
...
)

```

Arguments

time	Observed follow-up time.
event	Observed event indicator.
X	Training covariate data.frame.
newdata	Test covariate data.frame to use for prediction.
new.times	Times at which to obtain the predicted survivals.
obsWeights	Observation weights.
id	Optional cluster/individual ID indicator.
nrounds	Max number of boosting iterations (default: 1000).
early_stopping_rounds	Rounds with no improvement to trigger early stopping (default: 10).
eta	Learning rate (default: 0.05).
max_depth	Maximum tree depth (default: 2).
min_child_weight	Minimum sum of instance weight in a child (default: 5).
lambda	L2 regularization term on weights (default: 10).
subsample	Subsample ratio of the training instances (default: 0.7).
...	Additional arguments passed to xgb.train .

Value

A list containing:

- `fit`: The fitted model object (e.g., the raw `coxph` or `xgb.Booster` object). If the model fails to fit, this may be an object of class `try-error`.
- `pred`: A numeric matrix of cross-validated survival predictions evaluated at the specified `new.times` grid.

Examples

```

if (requireNamespace("xgboost", quietly = TRUE)) {
  data("metabric", package = "SuperSurv")
  dat <- metabric[1:30, ]
  x_cols <- grep("^x", names(dat))[1:3]
}

```

```
X <- dat[, x_cols, drop = FALSE]
newX <- X[1:5, , drop = FALSE]
times <- seq(50, 150, by = 50)

fit <- surv.xgboost(
  time = dat$duration,
  event = dat$event,
  X = X,
  newdata = newX,
  new.times = times,
  obsWeights = rep(1, nrow(dat)),
  id = NULL,
  nrounds = 5,
  early_stopping_rounds = 2,
  max_depth = 1
)

dim(fit[["pred"]])
}
```

training_variables *Access SuperSurv training variable names*

Description

Returns the covariate names used to fit a SuperSurv object.

Usage

```
training_variables(object, ...)
```

```
## S3 method for class 'SuperSurv'
training_variables(object, ...)
```

Arguments

object A fitted object of class "SuperSurv".
... Additional arguments ignored.

Value

A character vector of training variable names.

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